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Edition 3.2 2019-11
CONSOLIDATED VERSION

INTERNATIONAL STANDARD

NORME INTERNATIONALE

colour inside

Measurement of smoke density of cables burning under defined conditions – Part 1: Test apparatus

Mesure de la densité de fumées dégagées par des câbles brûlant dans des conditions définies – Partie 1: Appareillage d'essai

IEC 61034-1:2005-04+AMD1:2013-06+AMD2:2019-11 CSV(en-fr)

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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MEASUREMENT OF SMOKE DENSITY OF CABLES BURNING UNDER DEFINED CONDITIONS –

Part 1: Test apparatus

FOREWORD

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This consolidated version of the official IEC Standard and its amendments has been prepared for user convenience.

IEC 61034-1 edition 3.2 contains the third edition (2005-04) [documents 20/754/FDIS and 20/766/RVD], its amendment 1 (2013-06) [documents 20/1428/FDIS and 20/1443/RVD] and its amendment 2 (2019-11) [documents 20/1885/FDIS and 20/1893/RVD].

In this Redline version, a vertical line in the margin shows where the technical content is modified by amendments 1 and 2. Additions are in green text, deletions are in strikethrough red text. A separate Final version with all changes accepted is available in this publication.

International Standard IEC 61034-1 has been prepared by IEC technical committee 20: Electric cables.

The principal changes with respect to the previous edition are as follows:

a) closer definition of the draught screen and the chamber orifices;
b) closer definition of the support for the cable(s) under test;
c) removal of minor differences with equivalent CENELEC work to allow parallel voting with that body.

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

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

IEC 61034 consists of the following parts, under the general title *Measurement of smoke density of cables burning under defined conditions*,

Part 1: Test apparatus

Part 2: Test procedure and requirements

The committee has decided that the contents of the base publication and its amendments 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- withdrawn,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.

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INTRODUCTION

The measurement of smoke density is an important aspect in the evaluation of the burning performance of cables as it is related to the evacuation of persons and accessibility for firefighting.

IEC 61034 is published in two parts, which together specify a method of test for measurement of smoke density of cables burning under defined conditions. Users of this test are reminded that the configurations of cable in the test (i.e. as test pieces or bundles of test pieces) may not represent actual installation conditions.

This Part 1 gives details of the test apparatus and verification procedure to be used for the measurement of smoke density of the products of combustion of cables burnt under defined conditions. It includes details of a test enclosure of 27m^3 volume, a photometric system for light measurement, the fire source, smoke mixing method and a qualification procedure. Annex A gives guidance on various aspects of the test apparatus which may be useful when first constructing the test enclosure.

Part 2 gives the test procedure, together with an informative annex giving recommended requirements for compliance where no specified requirement is given in the particular cable standard or specification.

MEASUREMENT OF SMOKE DENSITY OF CABLES BURNING UNDER DEFINED CONDITIONS –

Part 1: Test apparatus

1 Scope

This part of IEC 61034 provides details of the test apparatus to be used for measuring smoke emission when electric or optical fibre cables are burnt under defined conditions, for example, a few cables burnt horizontally. The light transmittance (l_t) under flaming combustion and smouldering conditions can be used as a means of comparing different cables or complying with specific requirements.

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

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

IEC Guide 104~~:1997~~, *The preparation of safety publications and the use of basic safety publications and group safety publications*

ISO/IEC 13943:2000, *Fire safety – Vocabulary*

3 Terms and definitions

For the purposes of this document, the terms and definitions in IEC 60695-4 apply, or if a term is not defined in IEC 60695-4 then the definition in ISO/IEC 13943 applies.

4 Details of test enclosure

The equipment shall comprise a cubic enclosure with inside dimensions of 3 000 mm ± 30 mm and constructed of a suitable material fixed on to a steel angle frame. One side shall have a door, with a glass inspection window. Transparent sealed windows (minimum size 100 mm × 100 mm) shall be provided on two opposite sides to permit the transmission of a beam of light from the horizontal photometric system. The distance from the floor to the centre of these windows shall be 2 150 mm ± 100 mm (see Figure 1 for plan view).

The walls of the enclosure shall include orifices at ground level (i.e. not greater than 100 mm above the level of the chamber floor) for the passage of cables, etc., and to permit the enclosure to be at atmospheric pressure.

No orifice shall be directly behind the fire source or on the same wall. A minimum of two orifices shall be provided and the total area of the orifices open during the test shall be 50 cm^2 ± 10 cm^2.

NOTE 1 Two orifices, each with an area of 25 cm^2 ± 5 cm^2, and located on two opposite walls, one under the light source and one under the receiver have been found to be suitable.

The ambient temperature outside the enclosure shall be 20 °C ± 10 °C and the enclosure shall not be directly exposed to sunlight or extreme climatic changes.

NOTE 2 It should normally be possible to extract fumes from the enclosure after each test through a duct complete with valve which should be closed during the test. The duct may include a fan to increase the rate of extraction. It is recommended that the door of the enclosure be opened to assist the extraction process.

A draught screen, 1 500 mm ± 50 mm long and 1 000 mm ± 50 mm high, shall be placed in the enclosure, at the position shown in Figure 1. It shall abut on the back wall (with a maximum gap of 10 mm) at a point 750 mm ± 25 mm from the side wall, and shall be curved to intersect the centre line of the enclosure at a point 1 400 mm ± 25 mm from the point of abutment.

5 Photometric system

5.1 The photometric system is illustrated in Figure 2. The light source and the receiver shall be placed opposite each other externally, in the centre of ~~both~~ windows in ~~the~~ two opposite walls of the cube ~~without making physical contact~~, as shown in Figures 1 and 2. The light beam shall traverse the cube through the glass windows in the side walls.

5.2 The light source shall be a halogen lamp with a tungsten filament with a clear quartz bulb having the following characteristics:

nominal power:	100 W;
nominal voltage:	12 V d.c.;
nominal luminous flux:	2 000 lm to 3 000 lm;
nominal colour temperature:	2 800 K to 3 200 K.

The bulb shall be supplied with a voltage of 12,0 V ± 0,1 V (mean value). During the test, the voltage shall be stabilized to a range of ± 0,01 V (see A.2c) for additional guidance.) The lamp shall be mounted in a housing and the beam adjusted by a lens system to give an evenly illuminated circular area of 1,5 m ± 0,1 m diameter on the interior of the opposite wall.

5.3 The receptor photocell shall be of the selenium or silicon type with a spectral response matching the International Commission on Illumination (CIE) photopic observer (equivalent to the human eye). The photocell shall be mounted at the end of 150 mm ± 10 mm tube with a dust protection window at the other end. The inside of the tube shall be matt black to prevent reflections. The photocell shall be connected to a potentiometric recorder to produce a linear proportional output. The cell shall be resistance-loaded to operate in its linear range and the input impedance of the recorder shall be at least 10^4 times greater than the load resistance of the cell which shall not exceed 100 Ω.

5.4 The photometric system shall be energized before the blank test. When stability has been attained, the zero and full scale reading of the recorder shall be adjusted for light on the detector corresponding to 0 % (absence of light) and 100 % luminous transmission.

NOTE 1 Periodically, for example at the beginning of a test series, the performance of the photocell should be verified by placing standard neutral density filters in the light beam. It is essential that these filters cover the entire optical port of the photocell and the values of transmittance measured by the photocell give a value of parameter ~~A~~ A_m (defined in 10.5) within ± 5 % of the calibrated value of the filter. The filters should also permit the verification of the linearity of response of the detector which should be proportional to the transmittance of light in the range used.

NOTE 2 Most neutral density filters are designated according to a parameter defined as absorbance which is the same as the parameter A defined in 10.5 which may be used to convert measured transmittance.

6 Standard fire source

The standard fire source shall be 1,00 l ± 0,01 l of alcohol having the following composition by volume:

ethanol:	90 % ± 1 %

methanol: 4 % ± 1 %

water: 6 % ± 1 %.

When a denaturing agent is added to the alcohol, it shall have no effect on the smoke emission of any cable under test.

The alcohol shall be contained in a tray made from galvanized or stainless steel with jointed sealed edges, a trapezoidal trunk section and the following interior dimensions (see Figure 3):

bottom ~~base~~: (210 ± 2) mm × (110 ± 2) mm;

top ~~base~~: (240 ± 2) mm × (140 ± 2) mm;

height: (80 ± 2) mm;

thickness of tray: (1,0 ± 0,1) mm.

The tray shall be supported at a height of 100 mm ± 10 mm from the floor on an open sided framework to permit air circulation around and beneath the tray.

7 Smoke mixing

In order to ensure uniform distribution of the smoke, a table-type fan shall be placed on the floor of the cube as shown in Figure 1, the fan axis being between 200 mm and 300 mm from the floor and the distance from the wall being 500 mm ± 50 mm. The fan shall have a blade sweep of 300 mm ± 60 mm and a flow rate of 7 m^3/min to 15 m^3/min. Air shall then be blown horizontally by the fan during the tests but the ignition source shall be protected by the screen as shown.

NOTE Suitable fans may be found by reference to IEC 60879: 1986.

8 Blank test

8.1 Purpose

The purpose of the blank test is to condition the interior of the cube to the specified temperature range, when necessary, prior to carrying out tests.

8.2 Procedure

8.2.1 Burn approximately 1 l of alcohol as detailed in Clause 6, in order to preheat the test enclosure.

8.2.2 Purge the inside of the cube of all combustion products by operating the extraction system.

9 Qualification of test apparatus

In order to ensure that the combination of the test cube and the optical system produce results consistent with other test cubes when identical cables are burnt under the same conditions, the test apparatus shall be subject to qualification. Qualification shall be achieved by carrying out the qualification burning test (see Clause 10). The test apparatus shall meet the stated requirements.

10 Qualification burning test

10.1 Purpose

The purpose of the qualification burning test is to verify that the smoke produced in the cube gives A_C values within the limits quoted in 10.6 for both of the alcohol/ toluene fire sources described in 10.3.

10.2 Preparation of cube

Clean the windows of the photometric system to regain 100 % transmission after stabilization of the voltage.

Immediately before commencing the test, the temperature inside the cube shall be within the range 25 °C ± 5 °C when measured at the internal door surface at a height of 1,5 m to 2,0 m and a minimum of 0,2 m from the walls. If necessary, carry out ~~a~~ the blank test in accordance with Clause 8 in order to condition the interior of the cube to the specific temperature range.

10.3 Qualification fire sources

Two mixtures, a) and b), of PA (pro analysis) toluene and alcohol (as defined in Clause 6) shall be made up ~~in the following proportions by volume~~ as follows:

~~a) 4 parts toluene to 96 parts alcohol,~~

~~b) 10 parts toluene to 90 parts alcohol,~~

~~using a pipette and volumetric flask for accuracy of measurement.~~

The two mixtures shall be prepared by measuring the required quantity of toluene, 40 ml for a) or 100 ml for b), into a 1,0 l volumetric flask using a pipette and adding alcohol up to the 1,0 l calibration mark.

NOTE 1 PA toluene has a purity greater than 99,5 %.

The mixtures shall be contained in a tray as described in Clause 6.

NOTE 2 The type of material of the tray (galvanized steel or stainless steel) in combination with the condition of the tray can have an impact on the results of the qualification burning test. Experience has shown that galvanized steel results in higher values of the standard parameter A_C and stainless steel in lower values. Ageing of the galvanized tray results in lower values of the standard parameter A_C.

10.4 Test procedure

Burn 1 l ± 0,01 l of the test solutions specified in 10.3. Record the minimum of the measured transmittance level I_t during the test.

10.5 Calculation

Calculate the measured parameter (A_m) as follows:

$$\sim\sim A_m = \lg_{10} \frac{I_0}{I_t}\sim\sim \quad A_m = \lg_{10} \frac{I_0}{I_{t(min)}}$$

"where I_0 is the initial transmittance level of incident light and $I_{t(min)}$ is the minimum of the measured transmittance level during the qualification test."

Calculate the standard parameter (A_c):

$$A_C = \frac{A_m}{\%\ \text{toluene}} \times \frac{\text{Volume of cube (m}^3\text{)}}{\text{Optical light path (m)}}$$

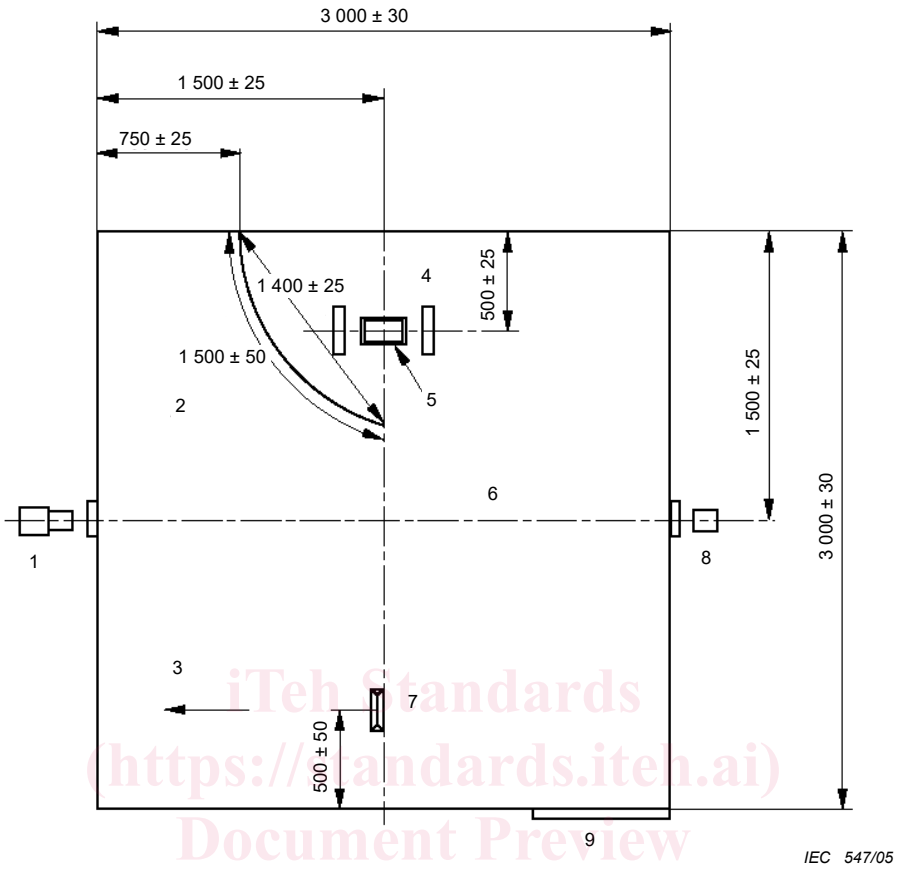
10.6 Requirements

The calculated values of A_C shall fall between the following limits:

4 % toluene: 0,18 m² to 0,26 m²;

10 % toluene: 0,80 m² to 1,20 m².

Dimensions in millimetres



Key

1 light source
2 draught screen (height 1 000 ± 50)
3 direction of air flow from fan
4 cable support
5 alcohol tray
6 optical path height 2 150 ± 100
7 fan flow 7 m^3/min to 15 m^3/min
8 photocell
9 door

Figure 1 – Plan view of test chamber