
Polimerni materiali - Nastajanje dima - Določanje optične gostote s preskusom v enojni preskusni komori (ISO 5659:2026)

Plastics - Smoke generation - Determination of optical density by a single-chamber test (ISO 5659:2026)

Kunststoffe -Rauchentwicklung -Bestimmung der optischen Dichte durch Einkammerprüfung (ISO 5659:2026)

Plastiques - Production de fumée - Détermination de la densité optique par un essai en enceinte unique (ISO 5659:2026)

Ta slovenski standard je istoveten z: EN ISO 5659:2026

ICS:

13.220.40	Sposobnost vžiga in obnašanje materialov in proizvodov pri gorenju	Ignitability and burning behaviour of materials and products
83.080.01	Polimerni materiali na splošno	Plastics in general

SIST EN ISO 5659:2026**en,fr,de**

Sample Document

get full document from standards.iteh.ai

EUROPEAN STANDARD

EN ISO 5659

NORME EUROPÉENNE

EUROPÄISCHE NORM

February 2026

ICS 13.220.40; 83.080.01

Supersedes EN ISO 5659-2:2017

English Version

Plastics - Smoke generation - Determination of optical density by a single-chamber test (ISO 5659:2026)

Plastiques - Production de fumée - Détermination de la densité optique par un essai en enceinte unique (ISO 5659:2026)

Kunststoffe - Rauchentwicklung - Bestimmung der optischen Dichte durch Einkammerprüfung (ISO 5659:2026)

This European Standard was approved by CEN on 13 January 2026.

CEN 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 CEN 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 CEN member into its own language and notified to the CEN-CENELEC Management Centre has the same status as the official versions.

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



EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

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

© 2026 CEN All rights of exploitation in any form and by any means reserved worldwide for CEN national Members.

Ref. No. EN ISO 5659:2026 E

Contents	Page
European foreword.....	3

Sample Document

get full document from standards.iteh.ai

European foreword

This document (EN ISO 5659:2026) has been prepared by Technical Committee ISO/TC 61 "Plastics" in collaboration with Technical Committee CEN/TC 249 "Plastics" the secretariat of which is held by SIS.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by August 2026, and conflicting national standards shall be withdrawn at the latest by August 2026.

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

This document supersedes EN ISO 5659-2:2017.

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

According to the CEN-CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Republic of North Macedonia, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Türkiye and the United Kingdom.

Endorsement notice

The text of ISO 5659:2026 has been approved by CEN as EN ISO 5659:2026 without any modification.

Sample Document

get full document from standards.iteh.ai



**International
Standard**

ISO 5659

**Plastics — Smoke generation —
Determination of optical density by
a single-chamber test**

*Plastiques — Production de fumée — Détermination de la densité
optique par un essai en enceinte unique*

**First edition
2026-01**

Sample Document

get full document from standards.iteh.ai

Sample Document

get full document from standards.iteh.ai



COPYRIGHT PROTECTED DOCUMENT

© ISO 2026

All rights reserved. Unless otherwise specified, or required in the context of its implementation, no part of this publication may be reproduced or utilized otherwise in any form or by any means, electronic or mechanical, including photocopying, or posting on the internet or an intranet, without prior written permission. Permission can be requested from either ISO at the address below or ISO's member body in the country of the requester.

ISO copyright office
CP 401 • Ch. de Blandonnet 8
CH-1214 Vernier, Geneva
Phone: +41 22 749 01 11
Email: copyright@iso.org
Website: www.iso.org

Published in Switzerland

© ISO 2026 – All rights reserved

ISO 5659:2026(en)

Contents

	Page
Foreword	v
Introduction	vi
1 Scope	1
2 Normative references	1
3 Terms and definitions	1
4 Principles of the test	3
5 Suitability of a material or product for testing	3
5.1 Material or product geometry.....	3
5.2 Surface characteristics.....	3
5.3 Asymmetrical products.....	3
6 Specimen construction and preparation	4
6.1 Number of specimens.....	4
6.2 Size of specimens.....	4
6.3 Specimen preparation.....	4
6.4 Conditioning.....	5
6.5 Wrapping of specimens.....	5
6.6 Dimensionally unstable materials.....	5
7 Apparatus and ancillary equipment	6
7.1 General.....	6
7.2 Test chamber.....	6
7.2.1 Construction.....	6
7.2.2 Chamber pressure control facilities.....	7
7.2.3 Chamber wall temperature.....	10
7.3 Specimen support and heating arrangements.....	11
7.3.1 Radiator cone.....	11
7.3.2 Framework for support of the radiator cone, specimen holder and heat flux meter.....	11
7.3.3 Radiation shield.....	14
7.3.4 Heat flux meter.....	14
7.3.5 Specimen holder.....	14
7.3.6 Pilot burner.....	15
7.4 Gas supply.....	15
7.5 Photometric system.....	16
7.5.1 General.....	16
7.5.2 Light source.....	16
7.5.3 Photo detector.....	16
7.5.4 Additional equipment.....	18
7.6 Chamber leakage.....	18
7.7 Cleaning materials.....	19
7.8 Ancillary equipment.....	19
7.8.1 Balance (optional).....	19
7.8.2 Timing device.....	19
7.8.3 Linear measuring devices.....	19
7.8.4 Auxiliary heater.....	19
7.8.5 Protective equipment.....	19
7.8.6 Recorder.....	19
7.8.7 Water-circulating device.....	19
7.8.8 Oxygen meter (optional).....	19
8 Test environment	20
9 Setting-up and calibration procedures	20
9.1 General.....	20

ISO 5659:2026(en)

9.2	Alignment of photometric system.....	20
9.2.1	General.....	20
9.2.2	Beam collimation.....	20
9.2.3	Beam focusing.....	20
9.3	Selection of compensating filter(s).....	21
9.4	Linearity check.....	21
9.5	Calibration of range-extension filter.....	21
9.6	Chamber leakage rate test.....	22
9.7	Burner calibration.....	22
9.8	Radiator cone calibration.....	22
9.9	Cleaning.....	23
9.10	Frequency of checking and calibrating procedure.....	23
10	Test procedure.....	24
10.1	General.....	24
10.2	Preparation of test chamber.....	24
10.3	Tests with pilot flame.....	24
10.4	Preparation of the photometric system.....	24
10.5	Loading the specimen.....	25
10.6	Recording of light transmission.....	25
10.7	Observations.....	25
10.8	Termination of test.....	25
10.9	Testing in different modes.....	26
11	Expression of results.....	26
11.1	Specific optical density, D_s	26
11.2	Clear-beam correction factor, D_c	27
12	Precision.....	27
13	Test report.....	27
Annex A (normative)	Calibration of heat flux meter.....	29
Annex B (informative)	Variability in the specific optical density of smoke measured in the single-chamber test.....	30
Annex C (informative)	Determination of mass optical density.....	32
Annex D (informative)	Precision data from tests on intumescent materials.....	37
Annex E (informative)	Guidance on optical density testing.....	39
Annex F (informative)	Specific sample preparation.....	46
Annex G (informative)	Background to standard reference materials.....	49
Bibliography		50

ISO 5659:2026(en)

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO document should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

ISO draws attention to the possibility that the implementation of this document may involve the use of (a) patent(s). ISO 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, ISO 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 www.iso.org/patents. ISO shall not be held responsible for identifying any or all such patent rights.

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 61, *Plastics*, Subcommittee SC 4, *Burning behaviour*, in collaboration with the European Committee for Standardization (CEN) Technical Committee CEN/TC 249, *Plastics*, in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

This first edition of ISO 5659 cancels and replaces ISO 5659-2:2017, which has been technically revised.

The main changes are as follows:

- [Annex G](#) has been added as background information.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

ISO 5659:2026(en)

Introduction

Fire is a complex phenomenon; its development and effects depend upon a number of interrelated factors. The behaviour of materials and products depends upon the characteristics of the fire, the method of use of the materials and the environment in which they are exposed to (see also ISO/TS 3814^[1] and ISO 13943).

A test such as is specified in this document deals only with a simple representation of a particular aspect of the potential fire situation, typified by a radiant heat source, and it cannot alone provide any direct guidance on behaviour or safety in fire. A test of this type may, however, be used for comparative purposes or to ensure the existence of a certain quality of performance (in this case, smoke production) considered to have a bearing on fire behaviour generally. It would be wrong to attach any other meaning to results from this test.

The term “smoke” is defined in ISO 13943 as a visible suspension of solid and/or liquid particles in gases resulting from incomplete combustion. It is one of the first response characteristics to be manifested and should almost always be taken into account in any assessment of fire hazard as it represents one of the greatest threats to occupants of a building or other enclosure, such as a ship or train, on fire.

The responsibility for the preparation of ISO 5659 was transferred during 1987 from ISO/TC 92 to ISO/TC 61 on the understanding that the scope and applicability of the standard for the testing of materials should not be restricted to plastics but should also be relevant to other materials where possible, including building materials. See [Annex G](#) for further information.

Sample Document

get full document from standards.iteh.ai

Plastics — Smoke generation — Determination of optical density by a single-chamber test

1 Scope

This document specifies a method of measuring smoke production from the exposed surface of specimens of materials or composites. It is applicable to specimens that have an essentially flat surface and do not exceed 25 mm in thickness when placed in a horizontal orientation and subjected to specified levels of thermal irradiance in a closed cabinet with or without the application of a pilot flame. This method of test is applicable to all plastics.

It is intended that the values of optical density determined by this test be taken as specific to the specimen or assembly material in the form and thickness tested and are not to be considered inherent, fundamental properties.

The test is intended primarily for use in research and development and fire safety engineering in buildings, trains, ships, etc. and not as a basis for ratings for building codes or other purposes. No basis is provided for predicting the density of smoke that can be generated by the materials upon exposure to heat and flame under other (actual) exposure conditions. This test procedure excludes the effect of irritants on the eye.

NOTE This test procedure addresses the loss of visibility due to smoke density, which generally is not related to irritancy potency (see [Annex E](#)).

It is emphasized that smoke production from a material varies according to the irradiance level to which the specimen is exposed. The results yielded from the method specified in this document are based on exposure to the specific irradiance levels of 25 kW/m² and 50 kW/m².

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.

ISO 291, *Plastics — Standard atmospheres for conditioning and testing*

ISO 13943, *Fire safety — Vocabulary*

ISO 14934-3, *Fire tests — Calibration and use of heat flux meters — Part 3: Secondary calibration method*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 13943 and the following apply.

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

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

3.1 assembly

fabrication of *materials* (3.6) and/or *composites* (3.2)

Note 1 to entry: Sandwich panels are an example of an assembly.

ISO 5659:2026(en)

Note 2 to entry: The assembly can include an air gap.

3.2

composite

combination of *materials* (3.6) which are generally recognized in building construction as discrete entities

Note 1 to entry: Coated or laminated materials are examples of composites.

3.3

essentially flat surface

surface which does not deviate from a plane by more than 1 mm

3.4

exposed surface

surface of the *product* (3.9) subjected to the heating conditions of the test

3.5

irradiance

radiant flux incident on an infinitesimal element of the surface containing the point divided by the area of that element

3.6

material

basic single substance or uniformly dispersed mixture

Note 1 to entry: Metal, stone, timber, concrete, mineral fibre and polymers are examples.

3.7

mass optical density

MOD

measure of the degree of opacity of smoke in terms of the mass loss of the *material* (3.6)

3.8

optical density of smoke

D

measure of the degree of opacity of smoke, taken as the negative common logarithm of the relative transmission of light

3.9

product

material (3.6), *composite* (3.2) or *assembly* (3.1) about which information is required

3.10

specific optical density

D_s

optical density multiplied by a factor which is calculated by dividing the volume of the test chamber by the *product* (3.9) of the exposed area of the *specimen* (3.11) and the path length of the light beam

Note 1 to entry: See 11.1.1.

3.11

specimen

representative piece of the product to be tested together with any substrate or surface coating

Note 1 to entry: The specimen can include an air gap.

3.12

intumescent material

material (3.6), that expands in excess of normal thermal expansion under the action of heat normally generated by the fire

Note 1 to entry: Generally, a material developing an expanded structure of thickness >10 mm during the test, with the cone heater 25 mm from the specimen, is considered as intumescent material.

ISO 5659:2026(en)

Note 2 to entry: Definition adapted from ISO 10294-5[2].

4 Principles of the test

Specimens of the product are mounted horizontally within a chamber and exposed to thermal radiation on their upper surfaces at selected levels of constant irradiance up to 50 kW/m².

The smoke evolved is collected in the chamber, which also contains photometric equipment. The attenuation of a light beam passing through the smoke is measured. The results are reported in terms of specific optical density.

5 Suitability of a material or product for testing

5.1 Material or product geometry

5.1.1 The method is applicable to essentially flat materials, products, composites or assemblies not exceeding 25 mm in thickness.

5.1.2 The method is sensitive to small variations in geometry, surface orientation, thickness (either overall or of the individual layers), mass and composition of the material, and so the results obtained by this method only apply to the thickness of the material or product as tested.

5.1.3 It is not possible to calculate the specific optical density of one thickness of a material or product from the specific optical density of another thickness of the material or product.

5.2 Surface characteristics

A material or product having one of the following properties is suitable for testing:

- a) an essentially flat exposed surface;
- b) a surface irregularity which is evenly distributed over the exposed surface provided that
 - 1) at least 50 % of the surface of a representative 100 mm² area lies within a depth of 10 mm from a plane taken across the highest points on the exposed surface, or
 - 2) for surfaces containing cracks, fissures, or holes not exceeding 8 mm in width or 10 mm in depth, the total area of such cracks, fissures, or holes at the surface does not exceed 30 % of a representative 100 mm² area of the exposed surface.

When an exposed surface does not meet the requirements of either [5.2 a\)](#) or [5.2 b\)](#), the material or product shall be tested in a modified form complying as close as possible with the requirements given in [5.2](#). The test report shall state that the material or product has been tested in a modified form and clearly describe the modification.

5.3 Asymmetrical products

It is possible that a product submitted to this test will have faces which differ or contain laminations of different materials arranged in a different order in relation to the two faces. If either of the faces can be exposed in use within a room, cavity, or void, both faces shall be tested.