INTERNATIONAL STANDARD

ISO 3182

First edition
2022-05

Light measuring system for smoke emission testing

Système de mesure de la lumière pour les essais d'émission de fumée

Reference number
ISO 3182:2022(E)

COPYRIGHT PROTECTED DOCUMENT

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

Contents

Page

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 documents 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).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

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 92, *Fire safety*, Subcommittee SC 1, *Fire initiation and growth*.

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.

Light measuring system for smoke emission testing

1 Scope

This document specifies a measuring system that enables the determination of the transmittance and the optical density of smoke emission tests under laboratory conditions. This document also provides the calibration method for the system.

This document is an English-language version of DIN 50055, with minor editorial modifications.

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 13943, *Fire safety — Vocabulary*

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
smoke emission test
test for determining smoke emission levels of substances subject to thermal decomposition

Note 1 to entry: This test requires a decomposition system, a measuring room or duct, and a light measuring system.

3.2
light-measuring system
system for the measurement of light, implemented using a device that measures the attenuation of light caused by smoke and comprising a light source, light receiver, power supply and voltage or current-measuring device

3.3
transmittance
τ
quotient of transmitted radiant flux, Φ_t, and incident radiant flux, Φ_m

Note 1 to entry: Transmittance is calculated using Formula (1):

$$\tau = \frac{\Phi_t}{\Phi_m} \tag{1}$$

3.4
light attenuation
S
loss in light power of the measuring beam caused by absorption and scatter

Note 1 to entry: The light attenuation value is expressed as a percentage and is calculated using Formula (2):

$$S = 100\,(1 - \tau(\lambda)) \tag{2}$$

3.5
optical density
D
common logarithm of the inversely proportional transmittance

Note 1 to entry: This is based on DIN 5036-1 and is calculated using Formula (3):

$$D(\lambda) = \lg \frac{1}{\tau(\lambda)} \tag{3}$$

4 Devices

4.1 Design and main connection settings

The light-measuring system consists of a light source, a lens system to create an almost parallel light beam as described in Table 1, a light receiver, a power supply and electronics. A schematic of such a system is provided in Figure 1. When the optional grey filter depicted in Figure 2 is used, it is necessary to choose a shorter measuring path than the one indicated in Figure 1. Attach the measuring light source and the light receiver to a sufficiently rigid and temperature-resistant frame in a manner that allows for adjusting and centring of the light beam (optical bench or similar setup). The frame is not described in this document. A frame suitable for the smoke emission test in question should be chosen.

4.2 Light source

The light source is comprised of an electrical lamp and a lens system that can generate an almost parallel light beam with a diameter of 25 mm (emission diameter) (see Figure 2 and Table 1). It uses a gas-filled tungsten incandescent lamp at the correlated colour temperature of (2 900 ± 100) K at the applied voltage.

The light source includes a movable aperture that allows the reduction of the illuminance at the light receiver for different measuring distances. A neutral density filter can be inserted between the lenses and apertures to reduce the illuminance at the light receiver for shorter measuring distances.

4.3 Light receiver

The light receiver comprises an achromatic lens system with a focal length of approximately 80 mm and a silicon photo element measuring at least 7 mm^2, which includes a spectral filter set for adjusting to human eye sensitivity at photopic vision.

NOTE See also DIN 5031-3.

The photo element should be temperature-compensated.

A frosted cased glass is positioned in front of the spectral filter set, which serves the purpose of diffusing light entering the focal plane of the lens.

The light receiver shall have a linear measuring range of 500 to 2 500 cd/m^2 (luminance at the reception surface).

4.4 Power supply

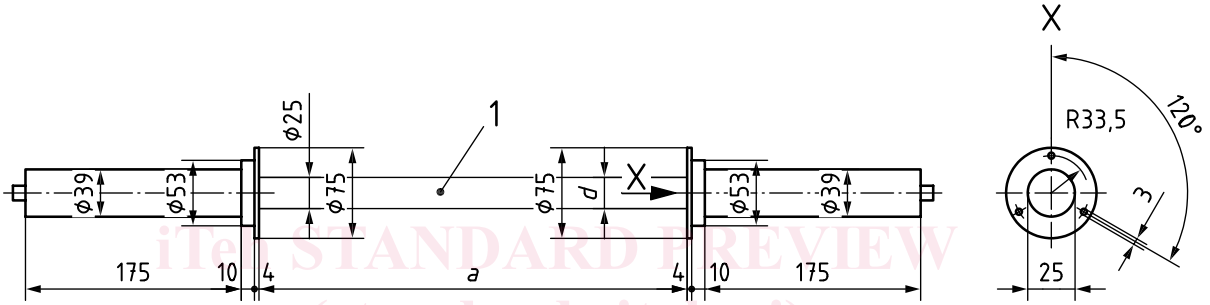
The lamp shall be supplied with stabilized direct current, stable within ±0,5 % (including temperature, short-term and long-term stability).

4.5 Voltage or current-measuring device

The voltage or current-measuring device contains a gain adjustment such that the initial measurement (blank measurement) corresponds to a transmittance value of 100 % (or 1), and the measurement of the smoke will show the transmittance value, or the device can provide a voltage output for external capture of measured values, allowing calculation of the transmittance. The expanded uncertainty (k = 2) of the transmittance must not exceed 1,5 %.

To help simplify the evaluation of measuring results, the voltage or current measuring device can also provide an output for external capture of the optical density.

Dimensions in millimetres

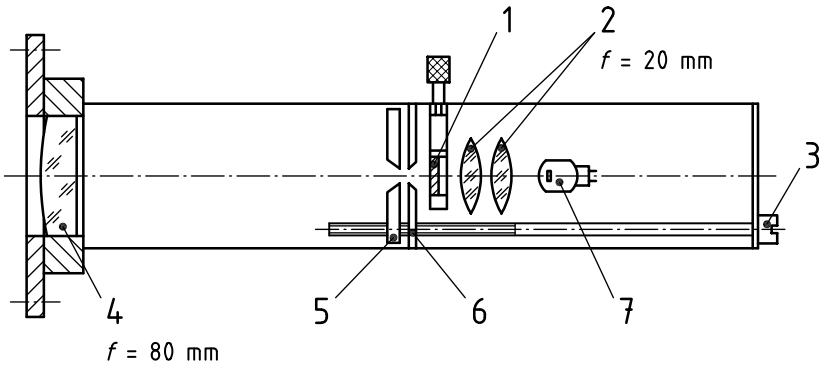


Key

1 light beam

NOTE See Table 1 for the definition of measurement "a".

Figure 1 — Schematic diagram of the light-measuring system

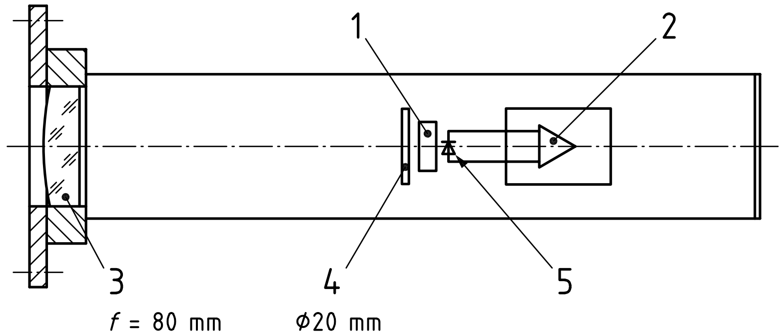


Key

1 optional insertable grey filter
2 lenses
3 aperture setting
4 achromatic lens
5 movable aperture
6 fixed aperture
7 lamp movable along the axis
f focal length of the achromatic lens

Figure 2 — Schematic diagram of the light source

Dimensions in millimetres



Key

1 filter for adjusting to eye sensitivity
2 amplifier
3 achromatic lens
4 frosted cased glass
5 si photodiode
f focal length of the achromatic lens

Figure 3 — Schematic diagram of the light receiver

Table 1 — Diameter of the light beam as function of distance from the light source

Distance from the light source, *a* (mm)	**Diameter, *d*, of the light beam at the distance "*a*"** (mm)
0	25
1 200	37

When using a control unit and display, electronic components may be implemented to control the attenuation of the amplifier such that the response times for the 95 % measurement value setting (T 95) conform to the time constants shown in Table 2.

Table 2 — Time constant at each attenuation level

Attenuation level	Time constant (±10 %) s
0	0,75
1	1,60
2	2,50
3	4,00
4	6,00
5	8,00

5 Calibration

5.1 Setting the illumination level

After turning on the device and adjusting/centring the light beam, ensure the light beam is centred on the light receiver and adjust the beam as explained in 5.2.

5.2 Checking the light measuring system

Check the light measuring system using at least three neutral density filters made of glass with optical density of 0,1 ,0,3 and 1,0, for example. Place the filters (vertically) into the light beam. Compare the

measured optical density with the calibration value of the filter. If the optical density deviates by more than 5 % or 0,01 (whichever represents a wider tolerance) from the calibration value, then corrective action is required (for example, check the alignment and setup of the system, replace the light source, replace the light receiver or replace the optical filters).

Bibliography

[1] ISO 11664-2, *Colorimetry — Part 2: CIE standard illuminants*

[2] ISO/CIE 19476, *Characterization of the performance of illuminance meters and luminance meters*

[3] CIE S 017/E, *ILV: International Lighting Vocabulary, 2nd Edition*

[4] DIN 5031-3, *Optical radiation physics and illuminating engineering; quantities, symbols and units of illuminating engineering*

[5] DIN 5033-7, *Colorimetry - Part 7: Measuring conditions for object colours*

[6] DIN 5036-1, *Radiometric and photometric properties of materials; definitions characteristics*

[7] DIN 50055, *Light measuring system for testing smoke development*