
**Adhesives — Floor covering adhesives
and products for flooring installation
— Assessment and classification of
low volatile organic compound (VOC)
products**

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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 61, *Plastics*, Subcommittee SC 11 *Products*.

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.

Introduction

Safety in use is an important criterion when selecting adhesives and installation materials. This applies both to the user of the installation materials and to the residential user of the floor or flooring over its entire service life. Volatile solvents with boiling points of less than 200 °C, which occur in relatively high concentrations at the workplace during application, should not be used with respect to occupational safety. Even those products that are referred to as "solvent-free" by the manufacturers and labelled accordingly can, if they contain higher-boiling solvents and/or plasticisers, release volatile ingredients into the indoor air over long periods of time (e.g. weeks, months and years), which is not compatible with today's requirements for indoor air quality. In addition, products used in residential areas should not release long-term emissions of volatile and very volatile organic compounds (VOC, VVOC) that can be detected in the indoor air over weeks, months and sometimes years in relatively low but nevertheless health-relevant concentrations.

This document specifies an easy reference method for testing the emission (release) of substances from floor covering adhesives and products for flooring installation into indoor air, expressed as emission classes based on toluene equivalents. This method uses a test chamber to determine the emissions under conditions, which are kept constant during the test. These conditions are selected so, that the test results can be expressed in terms of concentrations of substances in the air of the reference room. The reference room dimensions, associated product loading factors, as well as climate and ventilation conditions are selected according to existing standards for determining product emissions to represent the general indoor environment.

This test setup determines a material characteristic of the floor covering adhesives and products for flooring installation and is limited to this.

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Adhesives — Floor covering adhesives and products for flooring installation — Assessment and classification of low volatile organic compound (VOC) products

1 Scope

This document specifies a reference method for the determination of volatile organic compound (VOC) emissions into indoor air from floor covering adhesives and products used for flooring installation. This method is applicable to determine volatile organic compounds, semi-volatile organic compounds, and volatile aldehydes. It is based on the use of a test chamber and subsequent analysis of an air sample for organic compounds by GC-MS respectively HPLC.

The main purpose of the test procedure is to obtain relevant performance data for the classification of flooring adhesives and products used for the installation of floor coverings with respect to low VOC emissions during the use phase of the flooring.

NOTE 1 This document describes the overall procedure and makes use of existing standards mainly by normative reference, complemented when necessary with additional or modified normative requirements.

NOTE 2 No conclusions about occupational health and safety can be drawn from the testing and/or the classification of products according to this standard.

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 3251, *Paints, varnishes and plastics — Determination of non-volatile matter content*

ISO 16000-3, *Indoor air — Part 3: Determination of formaldehyde and other carbonyl compounds in indoor and test chamber air — Active sampling method*

ISO 16000-6, *Indoor air — Part 6: Determination of organic compounds (VVOC, VOC, SVOC) in indoor and test chamber air by active sampling on sorbent tubes, thermal desorption and gas chromatography using MS or MS FID*

ISO 16000-9, *Indoor air — Part 9: Determination of the emission of volatile organic compounds from building products and furnishing — Emission test chamber method*

ISO 16000-11, *Indoor air — Part 11: Determination of the emission of volatile organic compounds from building products and furnishing — Sampling, storage of samples and preparation of test specimens*

ISO 22631:2019, *Adhesives — Test methods for adhesives for floor and wall coverings — Peel test*

EN 16516, *Construction products: Assessment of release of dangerous substances Determination of emissions into indoor air*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in EN 16516 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/>

4 Symbols and abbreviated terms

For the purpose of this document, the following abbreviated terms apply.

GC	Gas chromatography
HPLC	High performance liquid chromatography
MS	Mass spectrometry
SVOC	Semi-volatile organic compound
TIC	Total ion current chromatogram
TSVOC	Total semi-volatile organic compound
TVOC	Total volatile organic compound
VOC	Volatile organic compound

5 Emission scenario and reference room

5.1 Emission scenario

Regarding the determination of emission into indoor air, the emission scenario specifies the climate and ventilation conditions of the air surrounding the product in the reference room. The actual condition(s) of use in reality can be different. It is also not possible to evaluate emissions under all possible use scenarios. Therefore, this document refers to defined conditions of EN 16516 that are agreed to be representative of use of the product in “normal” indoor environments, such that all construction products can be evaluated under comparable conditions.

These defined conditions assume a standardised installation of the product in the reference room with standardised dimensions, climate and ventilation.

5.2 Reference room and loading factor

In this document, only the reference room and set of conditions as defined in EN 16516 are used as conventional references for any specification of emission rates and any calculation of the related concentrations of emitted compounds in indoor air. This is valid for the dimensions, the ventilation, the climate conditions and the loading factors in the reference room.

As this document deals with floor covering adhesives and products for flooring installation, the flooring scenario with a loading factor of $0,4 \text{ m}^2/\text{m}^3$ shall be applicable.

6 Test chamber conditions

A ventilated test chamber shall be used for generating emissions from the test specimen under constant controlled conditions.

Generation of emissions from a test specimen in a test chamber shall be performed as specified in ISO 16000-9, with additional requirements as specified in EN 16516 regarding dimension of the test specimen, loading factor, ventilation, air velocity, cleanliness of test chamber, testing climate, storage of test specimen and placement of test specimen in the test chamber.

The volume of the test chamber shall be larger than 100 l.

Testing duration is 28 days with sampling after 3 days and 28 days as specified in [Clause 9](#). The test specimen shall remain in the test chamber during the whole testing period.

7 Product sampling and transport to the laboratory

The objective of sampling is to obtain a sample that is sufficiently representative of the construction product being assessed.

Product sampling, packaging and transport to the laboratory shall be performed as described in EN 16516 including size of sample, sampling techniques, packaging and transport, sample description, dispatch of product samples and time schedule.

Samples of solid products (non-reactive or non-physically drying, e.g. film adhesives, underlays, ...) delivered for emissions testing shall be tested within 8 weeks after production. Products for wet application received in a closed container (can or cartridge) shall be tested not later than 4 months after production. This applies as well to powdery products that are meant to be mixed with a liquid component or water. The content is mixed uniformly by the test laboratory prior to testing, and a retained sample is taken out.

8 Handling of product samples in the laboratory

8.1 General

Storage of sample in the testing laboratory shall follow ISO 16000-11 and the additional requirements as specified in EN 16516.

8.2 Preparation of test specimen

Preparation of test specimens shall follow ISO 16000-11, additional requirements shall be as specified in EN 16516 as well as additional requirements specified in [8.3](#) to [8.7](#).

Test specimens shall be transferred into the test chambers immediately after sample preparation without pre-conditioning.

8.3 Preparation of water-based primers

If the solid content is not reported by the manufacturer, it shall be determined by drying a separate part of the sample at 105 °C until constant weight, as described in ISO 3251.

Use water which is free of VOC to adjust the sample to 10 % solids content on the basis of the reported (alternatively, the measured) solids content of the original sample and homogenise. Pour as much of the (possibly diluted) sample into a pre-weighted glass dish such that it is loaded with $(100 \pm 5) \text{ g/m}^2$. If the solids content of the product is lower than 10 % then add more into the dish until a loading of $(10 \pm 1) \text{ g/m}^2$ solids is reached. Wet the bottom evenly by swinging the dish. Transfer the test specimen into the test chamber immediately after preparation. After testing is completed the test specimen is weighed back to ensure that the dried film weighs $(10 \pm 1) \text{ g/m}^2$.

8.4 Preparation of non-water-based primers

In case of multi component primers, mix the components as specified by manufacturer.

Test an undiluted sample with an amount of $(100 \pm 5) \text{ g/m}^2$ as described in [8.2](#). There is no need to weigh the sample back after testing is completed.

8.5 Preparation of flooring adhesives

In case of multi component adhesives, mix the components as specified by manufacturer.

Transfer the sample in excess onto a pre-weighed glass plate and spread it with a notched trowel of dimensions given in [Table 1](#), in accordance with ISO 22631:2019, Figure 1. Hold the trowel with a 60° angle to the horizontal glass plate. This shall be carried out in such a way that the sample is uniformly structured across the whole area.

Table 1 — Dimensions of notched trowel

Dimension		Tolerance
Notch depth	2,0 mm	±0,1 mm
Notch width	2,4 mm	±0,1 mm
Notch distance	2,6 mm	±0,1 mm
Notch angle	55°	±0,5°

If the procedure described in this subclause cannot be applied to products with low viscosity, make a full coverage application in glass dishes with a flat bottom and a rim.

Weigh the plate or dish back and record the weight of the specimen. The sample shall weigh (300 ± 10) g/m². The preparation shall not take more than 3 min.

Transfer the test specimen into the test chamber immediately after preparation.

8.6 Preparation of levelling compounds

Mix the sample uniformly according to the instructions given by the manufacturer using water that is free of VOC or with a supplied liquid component. Let the mixture stand for about 5 minutes and mix thoroughly once again. Prepare products with a shorter processing time (e.g. rapid setting cements) as specified by the manufacturer.

Apply an even layer onto a glass plate in 3 mm thickness and smooth the surface with a straight trowel.

Fix the edges of the loaded surface using an emission free rim of sufficient height that is made of, for example, glass or stainless steel. Transfer the test specimen with the rim into the test chamber immediately after preparation.

8.7 Preparation of (dry) film adhesives (tapes) and underlays for flooring

The sample is unpacked in the testing laboratory immediately prior to testing. The material to be tested is taken out of the middle of the package. For products on a roll, at least 2 m shall be unrolled. The test specimen is either cut or put together to the proper size for testing. The backside is fixed tightly onto an inert plate with its full surface. All open edges of products more than 1 mm thick can be sealed with an inert material, e.g. a non-emitting tape or aluminium foil. Materials used for sealing of back and edges shall be shown to be emission-free according to EN 16516. Testing without such sealing is possible as well. Remove the protective foil from products with a self-adhesive upper side.

9 Determination of vapour-phase organic compounds in test chamber air

9.1 General

A measured volume of air from the emission test chamber is drawn at a controlled flow rate through the samplers at specified times during the emission test. Vapour-phase organic chemicals present in the chamber air are selectively trapped on the samplers as the air passes through. The type of air sampler differs depending on the compounds described in the following sections.

Air sampling for emissions is performed 3 days $[(72 \pm 1) \text{ h}]$ after transfer of the test specimen into the test chamber. Start time and end time of air sampling shall be within the specified interval of $\pm 1 \text{ h}$.

The test specimen shall remain in the test chamber until finalizing all later air sampling.

Air sampling for long-term emissions test is performed 28 days $[(672 \pm 4) \text{ h}]$ after transfer of test specimen into the test chamber. Start time and end time of air sampling shall be within the specified interval of $\pm 4 \text{ h}$.

Alternatively, conformance can be shown, if all criteria (28 days limit values) are respected already at an earlier point of time, but not earlier than after 10 days, under the condition that the emissions did not increase, compared to the emissions after 3 days.

9.2 Determination of VOCs and SVOCs in test chamber air

Volatile organic compounds (VOC) and semi volatile organic compounds (SVOC) shall be determined in test chamber air according to ISO 16000-6 with further requirements as specified in EN 16516 as toluene equivalents, including sampling on Tenax® TA tubes¹⁾ followed by GC/MS analysis.

Determining VOCs using toluene equivalent is semi-quantitative since individual compounds in the mixture may have response factors, which differ widely from the toluene response factor (see EN 16516:2017, 8.2.5.5, NOTE 4).

Analytical system, sampling of test chamber air, tube conditioning, handling of blank tubes, calibration, identification, quantification, analysis and calculation of TVOC and TSVOC shall follow EN 16516.

9.3 Determination of formaldehyde and acetaldehyde in test chamber air

Formaldehyde and acetaldehyde shall be determined in test chamber air in accordance with ISO 16000-3, with further requirements specified in EN 16516, including sampling on DNPH tubes followed by HPLC analysis.

Analytical system, sampling of test chamber air, handling of blank tubes, calibration, identification, quantification and analysis shall be in accordance with EN 16516.

9.4 Determination of carcinogenic substances of category 1 in test chamber air

Carcinogenic substances of cat. 1A and 1B (Globally Harmonized System of Classification and Labelling of Chemicals – GHS, see Reference [1]) are monitored within the frame of the emissions test specified in 9.2 without additional sampling or analysis. An analytical quantification limit of $1 \mu\text{g}/\text{m}^3$ for each carcinogenic substance shall be targeted, as far as technically feasible.

A list of volatile 1A and 1B carcinogens is given in EN 16516:2017, Annex H. This list was read from Regulation EU 1272/2008 (Annex VI, Part 3), see Reference [2].

10 Expression of results

TVOC shall be calculated by summing up the reference room concentrations of every individual compound (target and non-target, identified and unidentified) eluting between n-hexane and n-hexadecane inclusively using the specified column, and calculated using the TIC response factor for toluene after subtracting the blank values and after excluding compounds calculated to be below $5 \mu\text{g}/\text{m}^3$ using the TIC response factor for toluene.

TSVOC shall be calculated by summing up the reference room concentrations of every individual compound (target and non-target, identified and unidentified) eluting after n-hexadecane and up to and including n-docosane using the specified column, and calculated using the TIC response factor for toluene after subtracting the blank values and after excluding compounds calculated to be below $5 \mu\text{g}/\text{m}^3$ using the TIC response factor for toluene.

The compliance with the emission class criteria given in Table 2 is evaluated.

1) Tenax® TA is an example of a suitable product available commercially. This information is given for the convenience of users of this document and does not constitute an endorsement by ISO of this product.