

Additive manufacturing - Environment, health and safety - Test method for the hazardous substances emitted from material extrusion type 3D printers in the non-industrial places (ISO/ASTM 52933:2024)

## EESTI STANDARDI EESSÕNA

## NATIONAL FOREWORD

<p>See Eesti standard EVS-EN ISO/ASTM 52933:2024 sisaldab Euroopa standardi EN ISO/ASTM 52933:2024 ingliskeelset teksti.</p> <p>Standard on jõustunud sellekohase teate avaldamisega EVS Teatajas.</p> <p>Euroopa standardimisorganisatsioonid on teinud Euroopa standardi rahvuslikele liikmetele kättesaadavaks 27.03.2024.</p> <p>Standard on kättesaadav Eesti Standardimis-ja Akrediteerimiskeskusest.</p>	<p>This Estonian standard EVS-EN ISO/ASTM 52933:2024 consists of the English text of the European standard EN ISO/ASTM 52933:2024.</p> <p>This standard has been endorsed with a notification published in the official bulletin of the Estonian Centre for Standardisation and Accreditation.</p> <p>Date of Availability of the European standard is 27.03.2024.</p> <p>The standard is available from the Estonian Centre for Standardisation and Accreditation.</p>
---	---

Tagasisidet standardi sisu kohta on võimalik edastada, kasutades EVS-i veebilehel asuvat tagasiside vormi või saates e-kirja meiliaadressile [standardiosakond@evs.ee](mailto:standardiosakond@evs.ee).

ICS 13.040.30, 13.100, 25.030

Standardite reprodutseerimise ja levitamise õigus kuulub Eesti Standardimis- ja Akrediteerimiskeskusele. Andmete paljundamine, taastekitamine, kopeerimine, salvestamine elektroonsesse süsteemi või edastamine ükskõik millises vormis või millisel teel ilma Eesti Standardimis-ja Akrediteerimiskeskuse kirjaliku loata on keelatud.

Kui Teil on küsimusi standardite autorikaitse kohta, võtke palun ühendust Eesti Standardimis-ja Akrediteerimiskeskusega: Koduleht [www.evs.ee](http://www.evs.ee); telefon 605 5050; e-post [info@evs.ee](mailto:info@evs.ee)

The right to reproduce and distribute standards belongs to the Estonian Centre for Standardisation and Accreditation. No part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying, without a written permission from the Estonian Centre for Standardisation and Accreditation.

If you have any questions about copyright, please contact Estonian Centre for Standardisation and Accreditation: Homepage [www.evs.ee](http://www.evs.ee); phone +372 605 5050; e-mail [info@evs.ee](mailto:info@evs.ee)

English Version

Additive manufacturing - Environment, health and safety -  
Test method for the hazardous substances emitted from  
material extrusion type 3D printers in the non-industrial  
places (ISO/ASTM 52933:2024)

Fabrication additive - Environnement, santé et sécurité  
- Méthode d'essai pour les substances dangereuses  
émises par les imprimantes 3D de type à extrusion de  
matière dans les lieux non industriels (ISO/ASTM  
52933:2024)

Additive Fertigung - Umwelt, Gesundheit und  
Sicherheit - Prüfverfahren für die gefährlichen Stoffe,  
die von 3D-Druckern mit Materialeextrusion in nicht-  
industriellen Bereichen emittiert werden (ISO/ASTM  
52933:2024)

This European Standard was approved by CEN on 20 March 2024.

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

## European foreword

This document (EN ISO/ASTM 52933:2024) has been prepared by Technical Committee ISO/TC 261 "Additive manufacturing" in collaboration with Technical Committee CEN/TC 438 "Additive Manufacturing" the secretariat of which is held by AFNOR.

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 September 2024, and conflicting national standards shall be withdrawn at the latest by September 2024.

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.

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/ASTM 52933:2024 has been approved by CEN as EN ISO/ASTM 52933:2024 without any modification.

Contents

Page

**Foreword**.....iv

**Introduction**.....v

**1 Scope**.....1

**2 Normative references**.....1

**3 Terms and definitions**.....2

**4 Hazardous substance targets and major factors**.....3

**5 Relevant test standards**.....3

**6 Sampling conditions**.....4

    6.1 Sampling location.....4

    6.2 Sampling planning.....4

**7 Measurement methods**.....6

    7.1 Active and time-integrated methods.....6

        7.1.1 Purpose.....6

        7.1.2 VOCs analysis.....6

        7.1.3 Aldehyde method.....9

    7.2 Real-time method.....11

        7.2.1 Purpose.....11

        7.2.2 Sampling.....11

        7.2.3 Determination of particles concentration.....11

**8 Test report**.....13

**Annex A (informative) Considerations for reducing the emission of hazardous substances**.....15

**Annex B (informative) Checklist for reduction of hazardous substances**.....22

**Bibliography**.....23

## 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](http://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/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](http://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](http://www.iso.org/iso/foreword.html).

The committee responsible for this document is ISO/TC 261, *Additive manufacturing*, in cooperation with ASTM Committee F42, *Additive Manufacturing Technologies*, on the basis of a partnership agreement between ISO and ASTM International with the aim to create a common set of ISO/ASTM standards on Additive Manufacturing, in collaboration with the European Committee for Standardization (CEN) Technical Committee CEN/TC 438, *Additive manufacturing*, in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

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](http://www.iso.org/members.html).

## Introduction

This document refers to the assessment of hazardous substances emitted during operation of material extrusion type AM machines, commonly known as “3D printers” installed in schools or public places for educational and hands-on purposes, and basic countermeasures for reducing the substances.

This document provides the necessary information and test procedures to reflect the characteristics of the AM process based on the previous international standards related to indoor air quality and to assess hazardous substances in the non-industrial places.

Operator, supervisor, and manager who are working at the non-industrial places will be able to use this document to measure and diagnose air quality. This document also includes appendices to help them try to reduce the hazardous substances emitted into the non-industrial spaces.

# Additive manufacturing — Environment, health and safety — Test method for the hazardous substances emitted from material extrusion type 3D printers in the non-industrial places

## 1 Scope

This document specifies a test method for measuring hazardous substances emitted during the operation of material extrusion type AM machines commonly used in the non-industrial places and includes non-normative suggestions for ways to reduce them.

This document specifies some of the main hazardous substances emitted from this type of machine during operation for currently commonly used materials, it describes the additional information and the associated test method for measuring hazardous substances, and includes considerations for reducing the hazardous substances and basic countermeasures.

This document specifies how to measure concentrations of hazardous substances generated in the non-industrial places (school, public place and so on) in which this type of machines are installed, and to maintain an acceptable work environment by managing field facilities, machines, filaments, and additive manufactured products for the reduction of hazardous substances.

However, this document does not cover all gas-phase chemical emissions. Only a range of Volatile Organic Compounds (VOCs) from n-hexane to n-hexadecane, including aldehydes are included. Considerations for reducing chemical emissions and for improving the work environment are given in [Annexes A](#) and [B](#).

## 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 16000-2, *Indoor air — Part 2: Sampling strategy for formaldehyde*

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

ISO 16000-4, *Indoor air — Part 4: Determination of formaldehyde — Diffusive sampling method*

ISO 16000-5, *Indoor air — Part 5: Sampling strategy for volatile organic compounds (VOCs)*

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 16017-1, *Indoor, ambient and workplace air — Sampling and analysis of volatile organic compounds by sorbent tube/thermal desorption/capillary gas chromatography — Part 1: Pumped sampling*

ISO 16017-2, *Indoor, ambient and workplace air — Sampling and analysis of volatile organic compounds by sorbent tube/thermal desorption/capillary gas chromatography — Part 2: Diffusive sampling*

ISO 16200-1, *Workplace air quality — Sampling and analysis of volatile organic compounds by solvent desorption/gas chromatography — Part 1: Pumped sampling method*

ISO 16200-2, *Workplace air quality — Sampling and analysis of volatile organic compounds by solvent desorption/gas chromatography — Part 2: Diffusive sampling method*



ISO/TR 27628, *Workplace atmospheres — Ultrafine, nanoparticle and nano-structured aerosols — Inhalation exposure characterization and assessment*

ISO 28439, *Workplace atmospheres — Characterization of ultrafine aerosols/nanoaerosols — Determination of the size distribution and number concentration using differential electrical mobility analysing systems*

ISO/ASTM 52900, *Additive manufacturing — General principles — Fundamentals and vocabulary*

### 3 Terms and definitions

For the purposes of this document, the terms and definitions from ISO/ASTM 52900 and the following are applied.

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 volatile organic compound VOC

organic compound that is emitted from the test specimen and all those detected in the chamber outlet air

Note 1 to entry: Due to practical reasons to be taken into account for test chambers, this definition differs from that defined in ISO 16000-6:2004. In ISO 16000-6, the definition is based on the boiling point range (50 °C to 100 °C) to (240 °C to 260 °C).

Note 2 to entry: The emission test method described in ISO 16000-9 is optimum for the range of compounds specified by the definition of total volatile organic compounds (TVOC).

[SOURCE: ISO 16000-9:2006, 3.15]

#### 3.2 aldehydes

organic compounds containing formyl families

Note 1 to entry: Formaldehyde, acetaldehyde and vanillin are members of aldehyde families.

[SOURCE: ISO 21366:2019, 3.8]

#### 3.3 ultrafine particles UFP

particles with a particle diameter less or equal 0,1 µm

[SOURCE: ISO/IEC 28360-1:2021, 4.36]

#### 3.4 breakthrough volume

volume of test atmosphere that can be passed through a sorbent tube before the concentration of eluting vapour reaches a predefined limit value of the applied test concentration

Note 1 to entry: For hazardous substances in air, 5 % of the applied test concentration is a generally applied limit value.

[SOURCE: ISO 16017-1:2000, 3.1, modified — The definition was slightly reworded.]

#### 3.5 active sampling

active sampling method in which sampling for collecting chemical substances is performed within an hour