

### SLOVENSKI STANDARD SIST EN IEC 62321-12:2025

01-maj-2025

Določevanje posameznih snovi v elektrotehničnih izdelkih - 12. del: Sočasno določevanje polibromiranih bifenilov, polibromiranih difenil etrov in ftalatov v polimerih s plinsko kromatografijo-masno spektrometrijo

Determination of certain substances in electrotechnical products - Part 12: Simultaneous determination - Polybrominated biphenyls, polybrominated diphenyl ethers and phthalates in polymers by gas chromatography-mass spectrometry

Verfahren zur Bestimmung von bestimmten Substanzen in Produkten der Elektrotechnik - Teil 12: Gleichzeitige Bestimmung - Polybromierte Biphenyle, polybromierte Diphenylether und Phthalate in Polymeren durch Gaschromatographie-Massenspektrometrie

Détermination de crtaines substances dans les produits électroniques - Partie 12: Détermination simultanmée - Biphéyles polybromés, diphényléthers polybromés et phtalates dans les polymères par chromatographie en phase gazeuse-spectronmétrie de masse

Ta slovenski standard je istoveten z: EN IEC 62321-12:2023

ICS:

29.020 Elektrotehnika na splošno Electrical engineering in

general

31.020 Elektronske komponente na Electronic components in

splošno general

71.040.50 Fizikalnokemijske analitske Physicochemical methods of

metode analysis

SIST EN IEC 62321-12:2025

en

# iTeh Standards (https://standards.iteh.ai) Document Preview

SIST EN IEC 62321-12:2025

### EUROPEAN STANDARD NORME EUROPÉENNE EUROPÄISCHE NORM

**EN IEC 62321-12** 

April 2023

ICS 13.020.01; 29.100.01; 01.110

### **English Version**

Determination of certain substances in electrotechnical products
- Part 12: Simultaneous determination - Polybrominated biphenyls, polybrominated diphenyl ethers and phthalates in polymers by gas chromatography-mass spectrometry (IEC 62321-12:2023)

Détermination de crtaines substances dans les produits électroniques - Partie 12: Détermination simultanée -Biphényles polybromés, diphényléthers polybromés et phtalates dans les polymères par chromatographie en phase gazeuse-spectrométrie de masse (IEC 62321-12:2023) Verfahren zur Bestimmung von bestimmten Substanzen in Produkten der Elektrotechnik - Teil 12: Gleichzeitige Bestimmung - Polybromierte Biphenyle, polybromierte Diphenylether und Phthalate in Polymeren durch Gaschromatographie-Massenspektrometrie (IEC 62321-12:2023)

This European Standard was approved by CENELEC on 2023-04-14. CENELEC 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 CENELEC 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 CENELEC member into its own language and notified to the CEN-CENELEC Management Centre has the same status as the official versions.

CENELEC members are the national electrotechnical committees of Austria, Belgium, Bulgaria, Croatia, Cyprus, the Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the

Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Norway, Poland, Portugal, Republic of North Macedonia, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Türkiye and the United Kingdom.



European Committee for Electrotechnical Standardization Comité Européen de Normalisation Electrotechnique Europäisches Komitee für Elektrotechnische Normung

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

### EN IEC 62321-12:2023 (E)

### **European foreword**

The text of document 111/689/FDIS, future edition 1 of IEC 62321-12, prepared by IEC/TC 111 "Environmental standardization for electrical and electronic products and systems" was submitted to the IEC-CENELEC parallel vote and approved by CENELEC as EN IEC 62321-12:2023.

The following dates are fixed:

- latest date by which the document has to be implemented at national (dop) 2024-01-14 level by publication of an identical national standard or by endorsement
- latest date by which the national standards conflicting with the (dow) 2026-04-14 document have to be withdrawn

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CENELEC 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 committee. A complete listing of these bodies can be found on the CENELEC website.

#### **Endorsement notice**

The text of the International Standard IEC 62321-12:2023 was approved by CENELEC as a European Standard without any modification.

In the official version, for Bibliography, the following notes have to be added for the standard indicated:

IEC 62321-6:2015 NOTE Approved as EN 62321-6:2015 (not modified)

IEC 62321-8:2017 NOTE Approved as EN 62321-8:2017 (not modified)

EN IEC 62321-12:2023 (E)

# Annex ZA (normative)

# Normative references to international publications with their corresponding European publications

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.

NOTE 1 Where an International Publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

NOTE 2 Up-to-date information on the latest versions of the European Standards listed in this annex is available here: www.cencenelec.eu.

| <u>Publication</u> | <u>Year</u> | <u>Title</u>   | EN/HD      | <u>Year</u> |
|--------------------|-------------|--|------------|-------------|
| IEC 62321-1        | 2013        | Determination of certain substances in electrotechnical products - Part 1: Introduction and overview                                   | EN 62321-1 | 2013        |
| IEC 62321-2        | -<br>(ht    | Determination of certain substances in electrotechnical products - Part 2: Disassembly, disjointment and mechanical sample preparation |            | -           |

**Document Preview** 

SIST EN IEC 62321-12:2025

# iTeh Standards (https://standards.iteh.ai) Document Preview

SIST EN IEC 62321-12:2025



### IEC 62321-12

Edition 1.0 2023-03

# INTERNATIONAL STANDARD

# NORME INTERNATIONALE

HORIZONTAL PUBLICATION

**PUBLICATION HORIZONTALE** 

Determination of certain substances in electrotechnical products – Part 12: Simultaneous determination – Polybrominated biphenyls, polybrominated diphenyl ethers and phthalates in polymers by gas chromatography-mass spectrometry

Détermination de certaines substances dans les produits électrotechniques – Partie 12: Détermination simultanée – Biphényles polybromés, diphényléthers polybromés et phtalates dans les polymères par chromatographie en phase gazeuse-spectrométrie de masse

INTERNATIONAL ELECTROTECHNICAL COMMISSION

COMMISSION ELECTROTECHNIQUE INTERNATIONALE

ICS 01.110; 13.020.01; 29.100.01

ISBN 978-2-8322-6539-0

Warning! Make sure that you obtained this publication from an authorized distributor.

Attention! Veuillez vous assurer que vous avez obtenu cette publication via un distributeur agréé.

### CONTENTS

| FOREWORD  | 4                   |
|---|---------------------|
| INTRODUCTION  | 6                   |
| 1 Scope   | 7                   |
| 2 Normative references  | 7                   |
| 3 Terms, definitions and abbreviated terms  | 7                   |
| 3.1 Terms and definitions   | 7                   |
| 3.2 Abbreviated terms   | 8                   |
| 4 Principle   | 9                   |
| 5 Reagents and materials  | 9                   |
| 6 Equipment, apparatus and tools  | 10                  |
| 7 Sampling  | 10                  |
| 8 Procedure   | 10                  |
| 8.1 General instructions for the analysis   | 10                  |
| 8.2 Sample preparation  | 11                  |
| 8.2.1 Stock solution  | 11                  |
| 8.2.2 Extraction  |                     |
| 8.2.3 Addition of the internal standard (IS)  |                     |
| 8.3 Instrumental parameters   |                     |
| 8.4 Calibrants  |                     |
| of Calibratian https://standards.itah.gi)   | 4.4                 |
| 8.5 Calibration   |                     |
| <ul> <li>8.5 Calibration</li></ul>  | 14<br>DE (10<br>and |
| <ul> <li>8.5.1 General</li></ul>  | 14 DE (10 and15     |
| 8.5.1 General   | 14 DE (10 and1515   |
| <ul> <li>8.5.1 General</li></ul>  |                     |
| <ul> <li>8.5.1 General</li></ul>  |                     |
| <ul> <li>8.5.1 General</li> <li>8.5.2 Mixing stock solutions for PBB (10 μg/ml for each congener), PBE μg/ml for each congener), phthalate (10 μg/ml for each analyte) a surrogate standard (10 μg/ml)</li> <li>8.5.3 Internal standard solution (100 μg/ml of CB209, anthracene-d<sub>10</sub>)</li> <li>8.5.4 Standard solutions</li> <li>9 Calculation of analyte concentration</li> </ul>   |                     |
| <ul> <li>8.5.1 General</li> <li>8.5.2 Mixing stock solutions for PBB (10 μg/ml for each congener), PBE μg/ml for each congener), phthalate (10 μg/ml for each analyte) a surrogate standard (10 μg/ml)</li> <li>8.5.3 Internal standard solution (100 μg/ml of CB209, anthracene-d<sub>10</sub>)</li> <li>8.5.4 Standard solutions</li> <li>9 Calculation of analyte concentration</li> <li>9.1 General</li> </ul>  |                     |
| <ul> <li>8.5.1 General</li> <li>8.5.2 Mixing stock solutions for PBB (10 μg/ml for each congener), PBE μg/ml for each congener), phthalate (10 μg/ml for each analyte) a surrogate standard (10 μg/ml)</li> <li>8.5.3 Internal standard solution (100 μg/ml of CB209, anthracene-d<sub>10</sub>)</li> <li>8.5.4 Standard solutions</li> <li>9 Calculation of analyte concentration</li> <li>9.1 General</li> <li>9.2 Calculation</li> </ul>   |                     |
| <ul> <li>8.5.1 General</li> <li>8.5.2 Mixing stock solutions for PBB (10 μg/ml for each congener), PBE μg/ml for each congener), phthalate (10 μg/ml for each analyte) a surrogate standard (10 μg/ml)</li> <li>8.5.3 Internal standard solution (100 μg/ml of CB209, anthracene-d<sub>10</sub>)</li> <li>8.5.4 Standard solutions</li> <li>9 Calculation of analyte concentration</li> <li>9.1 General</li> <li>9.2 Calculation</li> <li>10 Precision</li> </ul>   |                     |
| 8.5.1 General  8.5.2 Mixing stock solutions for PBB (10 μg/ml for each congener), PBE μg/ml for each congener), phthalate (10 μg/ml for each analyte) a surrogate standard (10 μg/ml).  8.5.3 Internal standard solution (100 μg/ml of CB209, anthracene-d <sub>10</sub> )  8.5.4 Standard solutions.  9 Calculation of analyte concentration  9.1 General.  9.2 Calculation.  10 Precision  11 Quality assurance and control  11.1 Resolution  11.2 Performance  |                     |
| <ul> <li>8.5.1 General</li></ul>  |                     |
| 8.5.1 General  8.5.2 Mixing stock solutions for PBB (10 µg/ml for each congener), PBI µg/ml for each congener), phthalate (10 µg/ml for each analyte) a surrogate standard (10 µg/ml)  8.5.3 Internal standard solution (100 µg/ml of CB209, anthracene-d <sub>10</sub> )  8.5.4 Standard solutions  9 Calculation of analyte concentration  9.1 General  |                     |
| <ul> <li>8.5.1 General</li></ul>  |                     |
| 8.5.1 General  8.5.2 Mixing stock solutions for PBB (10 µg/ml for each congener), PBI µg/ml for each congener), phthalate (10 µg/ml for each analyte) a surrogate standard (10 µg/ml)  8.5.3 Internal standard solution (100 µg/ml of CB209, anthracene-d <sub>10</sub> )  8.5.4 Standard solutions  9 Calculation of analyte concentration  9.1 General  |                     |
| 8.5.1 General  8.5.2 Mixing stock solutions for PBB (10 μg/ml for each congener), PBI μg/ml for each congener), phthalate (10 μg/ml for each analyte) a surrogate standard (10 μg/ml).  8.5.3 Internal standard solution (100 μg/ml of CB209, anthracene-d <sub>10</sub> )  8.5.4 Standard solutions.  9 Calculation of analyte concentration  9.1 General  |                     |
| <ul> <li>8.5.1 General</li> <li>8.5.2 Mixing stock solutions for PBB (10 μg/ml for each congener), PBE μg/ml for each congener), phthalate (10 μg/ml for each analyte) a surrogate standard (10 μg/ml)</li> <li>8.5.3 Internal standard solution (100 μg/ml of CB209, anthracene-d<sub>10</sub>)</li> <li>8.5.4 Standard solutions</li> <li>9 Calculation of analyte concentration</li> <li>9.1 General</li> <li>9.2 Calculation</li> <li>10 Precision</li> <li>11 Quality assurance and control</li> <li>11.1 Resolution</li> <li>11.2 Performance</li> <li>11.3 Limit of detection (LOD) or method detection limit (MDL) and limit of quantification (LOQ)</li> <li>12 Test report</li> <li>Annex A (informative) Example of extraction efficiency in different cycles</li> </ul> |                     |
| 8.5.1 General  8.5.2 Mixing stock solutions for PBB (10 μg/ml for each congener), PBE μg/ml for each congener), phthalate (10 μg/ml for each analyte) a surrogate standard (10 μg/ml)  8.5.3 Internal standard solution (100 μg/ml of CB209, anthracene-d <sub>10</sub> )  8.5.4 Standard solutions  9 Calculation of analyte concentration  9.1 General  9.2 Calculation  10 Precision  11 Quality assurance and control  11.1 Resolution  11.2 Performance  11.3 Limit of detection (LOD) or method detection limit (MDL) and limit of quantification (LOQ)  12 Test report  Annex A (informative) Example of extraction efficiency in different cycles  Annex B (informative) Examples of chromatograms  |                     |

| extractantsextraction efficiency using detection response of the analyt            |                |
|--|----------------|
| Figure C.1 – Total ion current chromatogram of each analyte (1,5 μg/ml, splitless) |                |
| Figure C.2 – SIM ion chromatogram of PBBs, PBDEs and phthalate (1,5 splitless)     |                |
| Figure D.1 – 2-Bromobiphenyl (Mono-BB)   | 27             |
| Figure D.2 – 4-Bromodiphenyl ether (Mono-BDE)                                      | 27             |
| Figure D.3 – 2,5-Dibromobiphenyl (Di-BB)   | 28             |
| Figure D.4 – Di-isobutyl phthalate (DIBP)  | 28             |
| Figure D.5 – Di-n-butyl phthalate (DBP)  | 28             |
| Figure D.6 – 4,4'-Dibromobiphenyl ether (Di-BDE)                                   | 29             |
| Figure D.7 – 2,4,6-Tribromobiphenyl (Tri-BB)                                       | 29             |
| Figure D.8 – 3,3',4-Tribromobiphenyl ether (Tri-BDE)                               | 29             |
| Figure D.9 – 2,2',5,5'-Tetrabromobiphenyl (Tetra-BB)                               | 30             |
| Figure D.10 – Butyl benzyl phthalate (BBP)   | 30             |
| Figure D.11 – 2,2',4,5',6-Pentabromobiphenyl (Penta-BB)                            | 30             |
| Figure D.12 – Di-(2-ethylhexyl) phthalate (DEHP)                                   | 31             |
| Figure D.13 – 3,3',4,4'-Tetrabromobiphenyl ether (Tetra-BDE)                       | 31             |
| Figure D.14 – 2,2',4,4',6,6'-Hexabromobiphenyl (Hexa-BB)                           | 31             |
| Figure D.15 – 2,2',4,4',6-Pentabromobiphenyl ether (Penta-BDE)                     | 32             |
| Figure D.16 – 2,2',4,4',5,6'-Hexabromodiphenyl ether (Hexa-BDE)                    | 32             |
| Figure D.17 – 2,2',3,4,4',5, <mark>5'-Heptabromobiphenyl (Hepta-BB)</mark>         | 32             |
| Figure D.18 – 2,2',3,4,4',5,6-Heptabromodiphenyl ether (Hepta-BDE)                 | 33             |
| Figure D.19 – 2,2',3,4,4',5,5',6'-Octabromodiphenyl ether (Octa-BDE)               | 33             |
| Figure D.20 – Octabromobiphenyl, technology (hepta + octa + nona) (Oct             | ta-BB)33 -12-2 |
| Figure D.21 – 2,2',3,3',4,4',5,5',6-Nonabromobiphenyl (Nona-BB)                    | 34             |
| Figure D.22 – 2,2',3,3',4,4',5,5',6-Nonabromodiphenyl ether (Nona-BDE)             | 34             |
| Figure D.23 – Decabromobiphenyl (Deca-BB)  | 34             |
| Figure D.24 – Decabromodiphenyl ether (Deca-BDE)                                   | 35             |
| Table 1 – Matrix spiking solution  | 11             |
| Table 2 – Reference for the quantification of PBBs                                 | 13             |
| Table 3 –Reference for the quantification of PBDEs                                 | 13             |
| Table 4 – Reference for the quantification of each phthalate                       | 13             |
| Table 5 – Example of commercially available reference solutions                    | 14             |
| Table 6 – Examples of calibration ranges of PBBs, PBDEs and phthalates             | s15            |
| Table 7 – IIS12 repeatability and reproducibility                                  | 19             |
| Table 8 – Example calculation  | 20             |
| Table 9 – IIS12 mean, recovery and relative standard deviation                     | 21             |
| Table B.1. Extraction efficiency of the analytes in different cycles               | 25             |

### INTERNATIONAL ELECTROTECHNICAL COMMISSION

# DETERMINATION OF CERTAIN SUBSTANCES IN ELECTROTECHNICAL PRODUCTS –

# Part 12: Simultaneous determination – Polybrominated biphenyls, polybrominated diphenyl ethers and phthalates in polymers by gas chromatography-mass spectrometry

#### **FOREWORD**

- 1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
- 2) The formal decisions or agreements of IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested IEC National Committees.
- 3) IEC Publications have the form of recommendations for international use and are accepted by IEC National Committees in that sense. While all reasonable efforts are made to ensure that the technical content of IEC Publications is accurate, IEC cannot be held responsible for the way in which they are used or for any misinterpretation by any end user.
- 4) In order to promote international uniformity, IEC National Committees undertake to apply IEC Publications transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC Publication and the corresponding national or regional publication shall be clearly indicated in the latter.
- 5) IEC itself does not provide any attestation of conformity. Independent certification bodies provide conformity assessment services and, in some areas, access to IEC marks of conformity. IEC is not responsible for any services carried out by independent certification bodies.
  - 6) All users should ensure that they have the latest edition of this publication.
  - 7) No liability shall attach to IEC or its directors, employees, servants or agents including individual experts and members of its technical committees and IEC National Committees for any personal injury, property damage or other damage of any nature whatsoever, whether direct or indirect, or for costs (including legal fees) and expenses arising out of the publication, use of, or reliance upon, this IEC Publication or any other IEC Publications.
  - 8) Attention is drawn to the Normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.
  - 9) Attention is drawn to the possibility that some of the elements of this IEC Publication may be the subject of patent rights. IEC shall not be held responsible for identifying any or all such patent rights.

IEC 62321-12 has been prepared by IEC technical committee 111: Environmental standardization for electrical and electronic products and systems. It is an International Standard.

The text of this International Standard is based on the following documents:

| Draft        | Report on voting |
|--------------|------------------|
| 111/689/FDIS | 111/696/RVD      |

Full information on the voting for its approval can be found in the report on voting indicated in the above table.

The language used for the development of this International Standard is English.

IEC 62321-12:2023 © IEC 2023

- 5 -

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at <a href="https://www.iec.ch/members\_experts/refdocs">www.iec.ch/members\_experts/refdocs</a>. The main document types developed by IEC are described in greater detail at <a href="https://www.iec.ch/standardsdev/publications">www.iec.ch/standardsdev/publications</a>.

A list of all parts in the IEC 62321 series, published under the general title *Determination of certain substances in electrotechnical products*, can be found on the IEC website.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under webstore.iec.ch in the data related to the specific document. At this date, the document will be

- · reconfirmed,
- · withdrawn,
- · replaced by a revised edition, or
- amended.

### iTeh Standards (https://standards.iteh.ai) Document Preview

SIST EN IEC 62321-12:2025

#### •

### INTRODUCTION

**-** 6 **-**

The widespread use of electrotechnical products has drawn increased attention to their impact on the environment. In many countries around the world it has been a contributing factor in adapting regulations that affect wastes, substances and energy use of electrotechnical products.

The use of certain substances (e.g. lead (Pb), cadmium (Cd), polybrominated diphenyl ethers (PBDEs) and specific phthalates) in electrotechnical products is a source of concern in current and proposed regional legislation.

The purpose of the IEC 62321 series is therefore to provide test methods that will allow the electrotechnical industry to determine the levels of certain substances of concern in electrotechnical products on a consistent global basis.

This first edition of IEC 62321-12 introduces a new part in the IEC 62321 series.

WARNING – Persons using this document should be familiar with normal laboratory practices. This document does not purport to address all of the safety problems, if any, associated with its use. It is the responsibility of the user to establish appropriate safety and health practices and to ensure compliance with any national regulatory conditions.

## iTeh Standards (https://standards.iteh.ai) Document Preview

SIST EN IEC 62321-12:2025