IEC 62321-2

Edition 2.0 2021-08

INTERNATIONAL STANDARD

NORME INTERNATIONALE

colour inside

HORIZONTAL PUBLICATION
PUBLICATION HORIZONTALE

Determination of certain substances in electrotechnical products – Part 2: Disassembly, disjointment and mechanical sample preparation

Détermination de certaines substances dans les produits électrotechniques – Partie 2: Démontage, défabrication et préparation mécanique de l'échantillon

IEC 62321-2:2021-08(en-fr)

IEC Central Office
3, rue de Varembé
CH-1211 Geneva 20
Switzerland

Tel.: +41 22 919 02 11
info@iec.ch
www.iec.ch

About the IEC
The International Electrotechnical Commission (IEC) is the leading global organization that prepares and publishes International Standards for all electrical, electronic and related technologies.

About IEC publications
The technical content of IEC publications is kept under constant review by the IEC. Please make sure that you have the latest edition, a corrigendum or an amendment might have been published.

IEC publications search - webstore.iec.ch/advsearchform
The advanced search enables to find IEC publications by a variety of criteria (reference number, text, technical committee, …). It also gives information on projects, replaced and withdrawn publications.

IEC Just Published - webstore.iec.ch/justpublished
Stay up to date on all new IEC publications. Just Published details all new publications released. Available online and once a month by email.

IEC Customer Service Centre - webstore.iec.ch/csc
If you wish to give us your feedback on this publication or need further assistance, please contact the Customer Service Centre: sales@iec.ch.

IEC online collection - oc.iec.ch
Discover our powerful search engine and read freely all the publications previews. With a subscription you will always have access to up to date content tailored to your needs.

Electropedia - www.electropedia.org
The world's leading online dictionary on electrotechnology, containing more than 22 000 terminological entries in English and French, with equivalent terms in 18 additional languages. Also known as the International Electrotechnical Vocabulary (IEV) online.

A propos de l'IEC
La Commission Electrotechnique Internationale (IEC) est la première organisation mondiale qui élabore et publie des Normes internationales pour tout ce qui a trait à l'électricité, à l'électronique et aux technologies apparentées.

A propos des publications IEC
Le contenu technique des publications IEC est constamment revu. Veuillez vous assurer que vous possédez l'édition la plus récente, un corrigendum ou amendement peut avoir été publié.

Recherche de publications IEC - webstore.iec.ch/advsearchform
La recherche avancée permet de trouver des publications IEC en utilisant différents critères (numéro de référence, texte, comité d'études, …). Elle donne aussi des informations sur les projets et les publications remplacées ou retirées.

IEC Just Published - webstore.iec.ch/justpublished
Restez informé sur les nouvelles publications IEC. Just Published détaille les nouvelles publications parues. Disponible en ligne et une fois par mois par email.

Service Clients - webstore.iec.ch/csc
Si vous désirez nous donner des commentaires sur cette publication ou si vous avez des questions contactez-nous: sales@iec.ch.

IEC online collection - oc.iec.ch
Découvrez notre puissant moteur de recherche et consultez gratuitement tous les aperçus des publications. Avec un abonnement, vous aurez toujours accès à un contenu à jour adapté à vos besoins.

Electropedia - www.electropedia.org
Le premier dictionnaire d'électrotechnologie en ligne au monde, avec plus de 22 000 articles terminologiques en anglais et en français, ainsi que les termes équivalents dans 16 langues additionnelles. Egalement appelé Vocabulaire Electrotechnique International (IEV) en ligne.

IEC 62321-2

Edition 2.0 2021-08

INTERNATIONAL STANDARD

NORME INTERNATIONALE

colour inside

HORIZONTAL PUBLICATION
PUBLICATION HORIZONTALE

Determination of certain substances in electrotechnical products – Part 2: Disassembly, disjointment and mechanical sample preparation

Détermination de certaines substances dans les produits électrotechniques – Partie 2: Démontage, défabrication et préparation mécanique de l'échantillon

INTERNATIONAL ELECTROTECHNICAL COMMISSION

COMMISSION ELECTROTECHNIQUE INTERNATIONALE

ICS 13.020.01; 43.040.10

ISBN 978-2-8322-9926-5

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

INTERNATIONAL ELECTROTECHNICAL COMMISSION

_____

DETERMINATION OF CERTAIN SUBSTANCES IN ELECTROTECHNICAL PRODUCTS –

Part 2: Disassembly, disjointment and mechanical sample preparation

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 62321-2 has been prepared by IEC technical committee 111: Environmental standardization for electrical and electronic products and systems. It is an International Standard.

This second edition cancels and replaces the first edition published in 2013. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

a) Reference to the IEC 62321 series instead of to a list of individual parts of the IEC 62321 series.
b) Update of the flow chart in Figure 1. Restructure of Clause 4 and update of examples in Annex A.

c) Adjustment of the risk levels of certain parts and materials to reflect the recent technology development and material change. Update of Table B.1 to include the risk levels of phthalates. Creation of Table B.2 for other substances (e.g. HBCDD, PAH) in polymeric materials.

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

FDIS	Report on voting
111/619/FDIS	111/628/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.

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 www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/standardsdev/publications.

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.

IMPORTANT – The "colour inside" logo on the cover page of this document indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.

INTRODUCTION

The widespread use of electrotechnical products has drawn increased attention to their impact on the environment. In many countries this has resulted in the adaptation of regulations affecting wastes, substances and energy use of electrotechnical products.

The use of certain substances in electrotechnical products is a source of either concern or importance in current and proposed regional legislations.

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 in electrotechnical products on a consistent global basis. This document, as an important part of the IEC 62321 series, covers strategies of sampling along with the mechanical preparation.

WARNING – Persons using this document should be familiar with normal laboratory practice. 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.

DETERMINATION OF CERTAIN SUBSTANCES IN ELECTROTECHNICAL PRODUCTS –

Part 2: Disassembly, disjointment and mechanical sample preparation

1 Scope

This part of IEC 62321 provides strategies of sampling along with the mechanical preparation of samples from electrotechnical products. These samples can be used for analytical testing to determine the levels of certain substances as described in the test methods in other parts of the IEC 62321 series. Restrictions for substances will vary between geographic regions and can be updated on a regular basis. This document describes a generic process for obtaining and preparing samples prior to the determination of any substance of concern.

This document does not provide:

– full guidance on each and every product that could be classified as electrotechnical product. Since there is a huge variety of electrotechnical parts, with various structures and compositions, along with the continuous innovations in the industry, it is unrealistic to attempt to provide procedures for the disjointment of every type of part;

– guidance regarding other routes to gather additional information on certain substances in a product, although the information collected has relevance to the sampling strategies in this document;

– safe disassembly and mechanical disjointment instructions related to electrotechnical products (e.g. mercury-containing switches) and the recycling industry (e.g. how to handle CRTs or the safe removal of batteries). See IEC 62554 [1][1] for the disjointment and mechanical sample preparation of mercury-containing fluorescent lamps;

– sampling procedures for packaging and packaging materials;

– analytical procedures to measure the levels of certain substances. This is covered by other standards (e.g. other parts of the IEC 62321 series), which are referred to as "test standards" in this document;

– guidelines for assessment of compliance.

This document has the status of a horizontal standard in accordance with IEC Guide 108 [2].

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.

IEC 62321 (all parts), *Determination of certain substances in electrotechnical products*

1 Numbers in square brackets refer to the bibliography.

3 Terms, definitions and abbreviated terms

3.1 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 62321-1 and the following apply.

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

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

3.1.1
composite testing
testing of two or more materials as a single sample that could be mechanically disjointed if necessary

3.1.2
certain substance
substance subject to test methods developed or under development in IEC 62321 (all parts), such as cadmium, lead, mercury, hexavalent chromium, polybrominated biphenyl, polybrominated diphenyl ether, phthalates

Note 1 to entry: IEC 62321-1 includes test methods for the evaluation of each of the substances identified in the definition above.

3.1.3
disassembly
process whereby an item is taken apart in such a way that it could subsequently be reassembled and made operational

3.1.4
disjointment
process whereby materials are separated by mechanical means such that the item cannot subsequently be reassembled to make it operational

3.1.5
homogeneous material
one material of uniform composition throughout or a material, consisting of a combination of materials, that cannot be disjointed or separated into different materials by mechanical actions such as unscrewing, cutting, crushing, grinding and abrasive processes

[SOURCE: EU RoHS DIRECTIVE 2011/65/EU [3]]

3.1.6
sampling
process of obtaining a sample of an electrotechnical product intended for the analysis for the presence of certain substance(s)

3.2 Abbreviated terms

AC	alternating current
BGA	ball grid array
CRT	cathode ray tube (television)
DVD	digital versatile disc
IC	integrated circuit
ICP-MS	inductively coupled plasma mass spectrometry

ICP-AES	inductively coupled plasma atomic emission spectroscopy
JEDEC	Joint Electronic Devices Engineering Council
LCD	liquid crystal display
LED	light-emitting diode
LOT	line output transformer
MDL	method detection limit
OEM	original equipment manufacturer
OLED	organic light-emitting diode
PBB	polybrominated biphenyl
PBDE	polybrominated diphenyl ethers
PCB	printed circuit board
PCBA	printed circuit board assembly
PDA	personal digital assistant
SCART	Syndicat francais des constructeurs d'appareils radio et television
SIM	subscriber identity module
SMD	surface mounted device
TFT	thin film transistor
TV	television
USB	universal serial bus
XRF	X-ray fluorescence

4 Introduction to sampling

4.1 Introductory remarks

Testing of certain substances in products is performed for different reasons including:

– commercial release of a product (e.g. in fulfillment of a contractual agreement between an OEM and a part manufacturer);
– assessment of conformity with regulatory limits;
– forensics, in case non-conformity is questioned (why the product does not satisfy contractual or legal requirements, when did this happen, and how many products are affected?).

Appropriate sampling is crucial when analysing electrotechnical products for the presence of certain substances. The strategy and process of sampling are often as important as the analytical test itself. Hence an effective sampling strategy requires a clear understanding of the electrotechnical product, reasons for the analysis and the requirements to be met.

4.2 Requirements for certain substances

While many regulators, industries and other stakeholders have their own, often non-uniform requirements for certain substances, it is not the intention of this document to discuss fully these differences. However, awareness of different requirements for certain substances is an important step in the sampling strategy. Subclause 4.2 highlights the differences in requirements concerning certain substances.

– Geographical differences: not all geographies (e.g. country or region) impose a restriction to the same substances. For example, some regions have chosen to restrict the use of only a few specific PBDE compounds, while others have a broader restriction regarding this class of flame-retardants. When sampling a product or part, it is critical to keep in mind what the differences are in the applicable legal requirements across geographies.

– Allowable limits: the typical allowable levels of certain substances in many legislations are below 1 000 mg/kg. Some certain substances have their limits set to even lower levels, like 100 mg/kg. For some material types, limits for certain substances may be above 1 000 mg/kg, for example lead in copper and aluminum alloys.

– Applicability of the allowable level: the manner in which the allowable level of certain substances is applied to an electrotechnical product determines the sampling strategy and how the test results are interpreted. Many regulators apply their allowable limits to homogeneous materials. However, the interpretation of homogeneous material is not consistent across the different regions.

– Applicable exemptions: some types of electrotechnical products are exempt from certain substances requirements. These exemptions may be based on different rationales including the scope of the restrictions (e.g. for military purposes), the application of the material (e.g. high melting temperature solder), (maximum) amount of a certain substance in the product, or the electrical properties of the product.

4.3 Complexity of electrotechnical products and related challenges

The complexity of electrotechnical products impacts the sampling and can have a bearing on the practical execution of sampling and analysis. The following elements are identified as relevant to sampling and testing:

a) Miniaturization: miniaturization is one of the key trends in the electrotechnical industry. It implies that more functionality is provided within a smaller volume. An increased number of parts and diversity of materials are used per cm^2 of printed circuit board (PCB) every year. Taking samples for measurement from these small amounts of material is difficult. For example, the size of surface mounted devices (SMDs) is too small for regular tools to further disjoint or separate and the quantity of the remaining sample is often too small after disjointment to satisfy the requirements of adequate analysis.

b) Number of homogeneous materials: many parts have complex structures and are constructed of multiple layers of different materials. Typically a single electronic part has between 10 and 20 materials, whereas many electrotechnical products or assemblies contain hundreds or thousands of parts. This means one electrotechnical product can have between 1 000 and 10 000 homogeneous materials. Often, homogeneous materials adhere too tightly together for a clean separation in a practical manner. Experience shows that the composition often changes due to molecular diffusion between materials (e.g. the composition of a plating is affected by a base material containing lead). Similarly, present-day electrotechnical products are made of many parts. A typical TV or laptop computer, for example, contains thousands of parts. Hence the design database for an OEM may include several tens of thousands of parts. In Annex E this point is further illustrated in the disassembly of a mobile phone.

c) Oxidation states of certain substances may not be stable over time. For example, the concentration of hexavalent chromium in corrosion protection layers can change significantly with time and storage conditions.

d) Visually undetectable substances: another complicating factor in sampling and testing is that often certain substances are not visible without supplemental action or optical enhancement. A part containing a certain substance may look and perform in an identical manner to one that does not contain it. While there are sometimes visible indications of the presence of certain substances (e.g. a yellow coating on steel products suggests the presence of hexavalent chromium), visual detection is not practical.

e) Batch-to-batch variations: most product manufacturers use commodity parts that may come from multiple suppliers simultaneously, for example cables, resistors and capacitors. Commodity parts are mixed during production because technically they are fully interchangeable, as long as they fit the umbrella specification. However, in most cases they are not chemically identical. Furthermore, experience shows that the materials can be changed by commodity part suppliers (e.g. in times of shortage) which leads to a change in the chemical composition of that part. Notification of these changes is not always provided if the part still meets its technical specification.

f) Depth of the supply chain: producing electronic parts often involves a complex supply chain. Relatively simple products, such as an external cable, can utilize supply chains at least seven tiers deep. The supply chain for a more complex part such as an LCD screen, is considerably deeper.

These characteristics of the electrotechnical industry show that the management of certain substances, along with sampling and testing, is not straightforward. The size and number of parts, and complexity of the supply chain make it challenging to fully grasp the locations of certain substances in an electrotechnical product. The prospect of implementing homogeneous material level sampling and testing at the upper tiers of the supply chain (towards finished products) is not practical for complex products.

4.4 Sampling procedure

The sampling strategy describes the process to be followed to determine the sample. This is then followed by the actual preparation of the samples and is finalized with the testing. While different approaches for sampling and testing are likely to apply to different electrotechnical products, it is possible to describe a generic process that will be applicable in the majority of cases. This is illustrated by the iterative process shown in Figure 1.

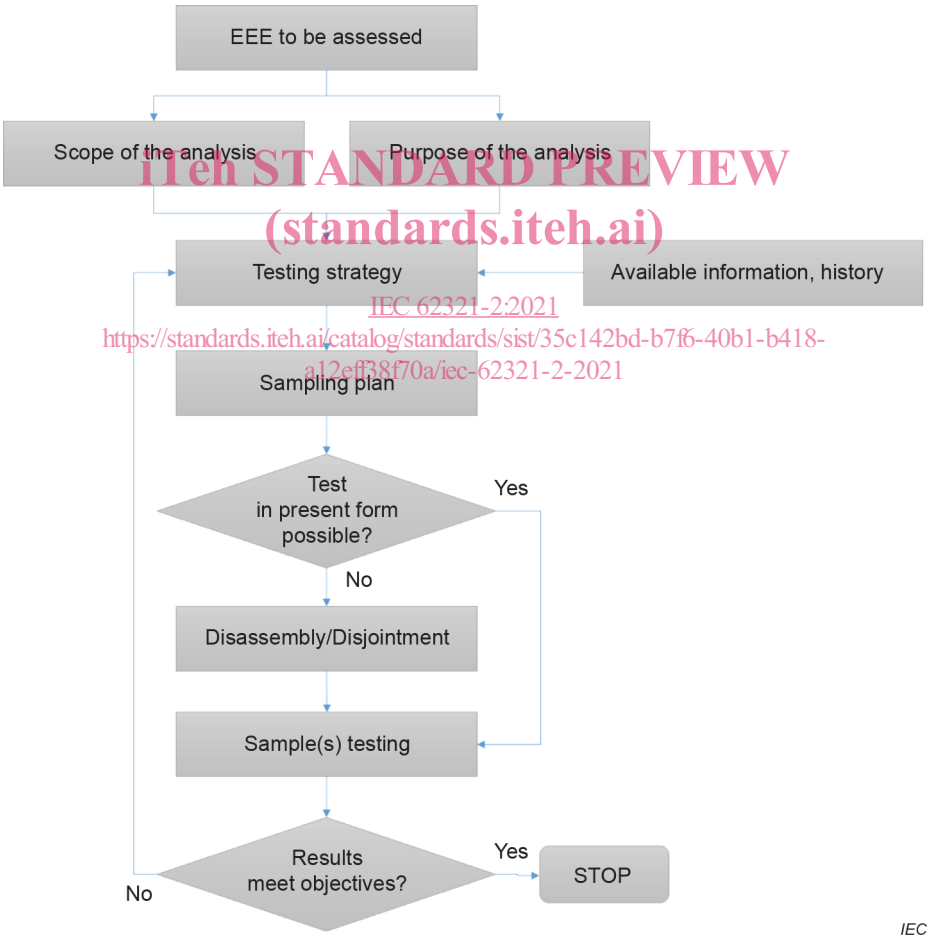

Figure 1 – Generic iterative procedure for sampling strategy

The process depicted in Figure 1 contains two iterative loops. The first is in relation to the disassembly and disjoinment loop that is described further in Clause 5, including as follows

- 1st iteration: partial disassembly (see 5.3);
- 2nd iteration: complete disassembly (see 5.4);
- 3rd iteration: partial disjointment (see 5.5);
- 4th to nth iteration: complete disjointment (see 5.6).

The other iterative loop refers to whether the objectives of the assessment have been met, which is out of the scope of this document.

4.5 Scope of the analysis

The development of the sampling strategy for a particular electrotechnical product or part starts with the definition of the scope of the analysis. It also includes what can be excluded, based on knowledge found elsewhere. Some basic questions to be considered in this phase include (not intended to be exhaustive):

– Which geographies are covered with the test?
– If not all, which of the certain substances are tested (e.g. either because they are restricted by regulations within the region under scope or because of customer requirements)?
– What are the allowable limits for these certain substances in the applicable geographies?
– What is the complexity of the product or part and is it practical to consider sampling and testing at the homogeneous material level?
– Are there applicable exemptions applying to one or more of the certain substances to be tested?
– Is a bill of materials available for the product?
– Are specifications and drawings of the product or part available?
– What is the depth of the supply chain for the parts and materials in this product?
– Are material declarations for this product available?
– Is there any previous experience evaluating this product or similar products that could be helpful?
– Is there any risk for the certain substances to be found in the materials used in the product/part?
– Was any screening (e.g. X-ray fluorescence) previously performed on this product or similar products that could be helpful?
– Is there any information regarding the manufacturing process of parts or materials (metal making or IC production) used in this product or similar products that could be helpful?
– Are there any perceived process controls present at the part or material suppliers (e.g. level of trust in the manufacturer)?
– Is there any history of concern with the part or material supplier?

The answers to these and perhaps other, more specific questions will influence the sampling strategy.