

Solid recovered fuels - Sample preparation (ISO 21646:2022)

This document is a preview generated by EVS



## EESTI STANDARDI EESSÕNA

## NATIONAL FOREWORD

See Eesti standard EVS-EN ISO 21646:2022 sisaldab Euroopa standardi EN ISO 21646:2022 ingliskeelset teksti.	This Estonian standard EVS-EN ISO 21646:2022 consists of the English text of the European standard EN ISO 21646:2022.
Standard on jõustunud sellekohase teate avaldamisega EVS Teatajas	This standard has been endorsed with a notification published in the official bulletin of the Estonian Centre for Standardisation and Accreditation.
Euroopa standardimisorganisatsioonid on teinud Euroopa standardi rahvuslikele liikmetele kättesaadavaks 18.05.2022.	Date of Availability of the European standard is 18.05.2022.
Standard on kättesaadav Eesti Standardimis-ja Akrediteerimiskeskusest.	The standard is available from the Estonian Centre for Standardisation and Accreditation.

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 75.160.10

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)

EUROPEAN STANDARD

EN ISO 21646

NORME EUROPÉENNE

EUROPÄISCHE NORM

May 2022

ICS 75.160.10

Supersedes EN 15443:2011, EN 15413:2011

English Version

## Solid recovered fuels - Sample preparation (ISO 21646:2022)

Combustibles solides de récupération - Préparation des échantillons (ISO 21646:2022)

Feste Sekundärbrennstoffe - Probenvorbereitung (ISO 21646:2022)

This European Standard was approved by CEN on 25 March 2022.

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, Turkey 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 21646:2022) has been prepared by Technical Committee ISO/TC 300 "Solid recovered materials, including solid recovered fuels" in collaboration with Technical Committee CEN/TC 343 "Solid recovered materials, including solid recovered fuels" the secretariat of which is held by SFS.

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 November 2022, and conflicting national standards shall be withdrawn at the latest by November 2022.

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.

This document supersedes EN 15443:2011 and EN 15413:2011.

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, Turkey and the United Kingdom.

## Endorsement notice

The text of ISO 21646:2022 has been approved by CEN as EN ISO 21646:2022 without any modification.

# Contents

Page

Foreword.....	v
Introduction.....	vi
<b>1 Scope.....</b>	<b>1</b>
<b>2 Normative references.....</b>	<b>1</b>
<b>3 Terms and definitions.....</b>	<b>1</b>
<b>4 Symbols.....</b>	<b>4</b>
<b>5 Safety remarks.....</b>	<b>4</b>
<b>6 Principles of correct sample preparation.....</b>	<b>4</b>
<b>7 Quality control and sources of error.....</b>	<b>6</b>
<b>8 Apparatus.....</b>	<b>7</b>
8.1 Selection of equipment.....	7
8.2 Apparatus for sample division.....	8
8.2.1 Scoops and shovels (sampling tools).....	8
8.2.2 Riffle boxes.....	9
8.2.3 Rotary sample dividers.....	10
8.3 Apparatus for particle size reduction.....	11
8.3.1 Shredder.....	11
8.3.2 Coarse cutting mill.....	11
8.3.3 Cutting mill.....	11
8.4 Sieves.....	11
8.5 Balance.....	11
<b>9 Sample preparation procedure.....</b>	<b>12</b>
9.1 General.....	12
9.2 Step 1: Collecting the relevant information of the material for sample preparation.....	12
9.3 Step 2: Making a sample preparation plan.....	12
9.3.1 General.....	12
9.3.2 Sample division.....	12
9.3.3 Particle size reduction of a sample.....	12
9.3.4 Retaining the minimum (sub-)sample mass.....	15
9.4 Step 3: Performing the sample preparation plan.....	16
<b>10 Methods for homogenization and sample division.....</b>	<b>16</b>
10.1 General.....	16
10.2 Homogenization.....	16
10.3 Sample division methods.....	16
10.3.1 General.....	16
10.3.2 Riffing.....	16
10.3.3 Strip division.....	17
10.3.4 Long strip.....	18
10.3.5 Manual increment division.....	18
10.3.6 Rotary sample divider.....	19
10.3.7 Fractional shovelling.....	19
10.3.8 Quartering.....	20
<b>11 Methods for mass and particle size reduction of laboratory samples and general analysis samples.....</b>	<b>21</b>
11.1 General.....	21
11.2 Initial sample division.....	21
11.3 Initial mass determination.....	21
11.4 Pre-drying.....	21
11.5 Particle size reduction to < 30 mm.....	22
11.6 Sample division of < 30 mm material.....	23

11.7	Particle size reduction of < 30 mm material to < 1 mm.....	23
11.8	Sample division of < 1 mm material.....	24
11.9	Particle size reduction of < 1 mm material to < 0,25 mm.....	24
<b>12</b>	<b>Handling considerations of the general analysis sample and the test portion.....</b>	<b>25</b>
12.1	Key concepts.....	25
12.2	Sequence of preparation procedures.....	26
<b>13</b>	<b>Storage, preservation and labelling of samples.....</b>	<b>26</b>
<b>14</b>	<b>Sample preparation report.....</b>	<b>26</b>
<b>15</b>	<b>Precision.....</b>	<b>27</b>
<b>Annex A</b>	<b>(normative) Determination of the shape factor.....</b>	<b>28</b>
<b>Annex B</b>	<b>(normative) Determination of the changing shape factor.....</b>	<b>29</b>
<b>Annex C</b>	<b>(informative) Examples of sample preparation procedures.....</b>	<b>31</b>
<b>Annex D</b>	<b>(normative) Guidelines for choosing sample preparation procedures.....</b>	<b>35</b>
<b>Annex E</b>	<b>(informative) Relationship between minimum amount of sample and particle size – Formula for the estimation of the minimum amount of sample.....</b>	<b>44</b>
<b>Annex F</b>	<b>(normative) Sample preparation equipment.....</b>	<b>47</b>
<b>Annex G</b>	<b>(normative) Characteristics of the laboratory sample for chemical analysis of solid recovered fuel.....</b>	<b>48</b>
<b>Annex H</b>	<b>(informative) Data on the precision of sample preparation.....</b>	<b>50</b>
<b>Annex I</b>	<b>(informative) Results of ruggedness testing.....</b>	<b>53</b>
<b>Bibliography</b>	<b>.....</b>	<b>61</b>

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

This document was prepared by Technical Committee ISO/TC 300, *Solid recovered materials, including solid recovered fuels*, in collaboration with the European Committee for Standardization (CEN) Technical Committee CEN/TC 343, *Solid recovered materials, including solid recovered fuels*, 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

Solid recovered fuels are a major source of renewable energy. International Standards facilitate the production, trade and use of solid recovered fuels. For sampling and sample preparation of solid recovered fuels, ISO 21645 and this document, respectively, can be used (in conjunction) by different types of organizations, including but not limited to:

- solid recovered fuel production and trading companies;
- energy companies;
- regulatory bodies;
- conformity assessment bodies;
- laboratories.

The sample preparation technique adopted depends on a combination of different characteristics of the material and circumstances encountered at the sampling location. The determining factors are:

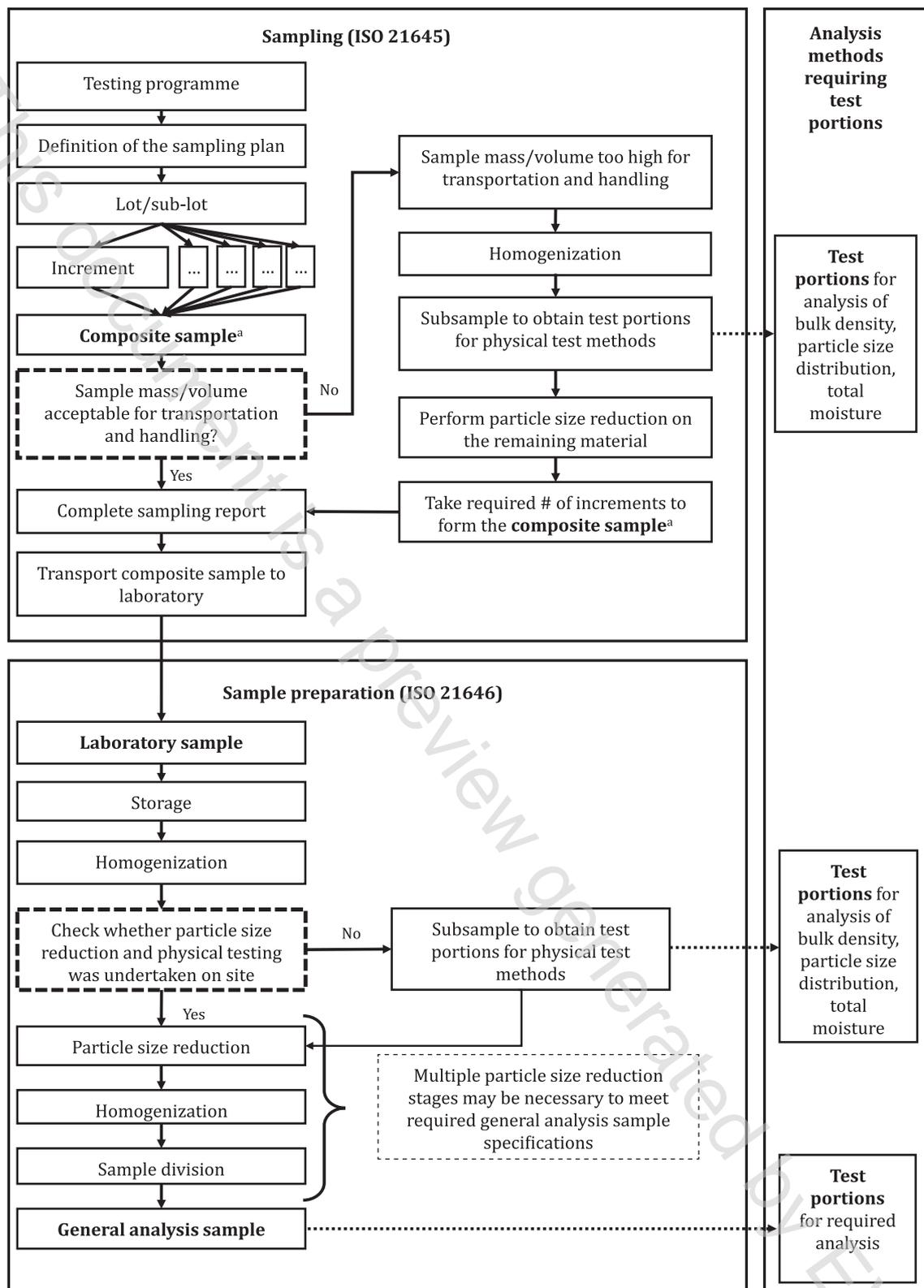
- the type of solid recovered fuel;
- the physical behaviour of the specific solid recovered fuel;
- the (expected) degree of heterogeneity (e.g. monostreams, mixed fuels, blended fuels).

In laboratory practice, different analytical procedures often need to be applied to the laboratory sample that has been taken according to the sampling plan. For this purpose, sub-sampling is applied in a way that the different test portions are representative of the laboratory sample with respect to the compounds of interest and the specific analytical procedures. The representativeness of the laboratory sample and of the test portions is of major importance to guarantee the quality and accuracy of analytical results. The representativeness of the laboratory sample is specified by the sampling plan.

This document is largely based on the work done by CEN/TC 343, *Solid recovered fuels*, and CEN/TC 292, *Characterization of waste* (now integrated in CEN/TC 444, *Environmental characterization of solid matrices*), and in particular EN 15002, which was developed for the majority of waste samples. Most of its concepts and specifications are also applicable to solid recovered fuel samples. However, the foundations of EN 15002 are not completely applicable to solid recovered fuel, as the nature of this material is substantially different and can lead to misrepresentation of the fuel quality.

The main characteristic that makes solid recovered fuel samples significantly different from other kinds of waste is that very often solid recovered fuels are solid, but neither 'granular' nor monolithic. It often happens that solid recovered fuel samples are fibrous-like materials, so that the statistical formula for sampling as defined in EN 15002 is not applicable. One additional term in the statistical formula is needed, namely the 'shape factor' ( $f$ ).

This document is part of the testing programme for solid recovered fuels. This programme consists of various steps leading to the analysis sample for fuel quality testing as outlined in [Figure 1](#).



<sup>a</sup> ISO 21645:2021, B.2, steps 5) and 6).

**Figure 1 — Links between the essential elements of a testing programme**

# Solid recovered fuels — Sample preparation

## 1 Scope

This document specifies methods for sample preparation to ensure representativeness of the samples throughout the preparation procedures to produce general analysis samples. Suitable test portions can be taken from the laboratory or general analysis samples and used for analysis according to the specific requirements defined in the corresponding analytical procedures.

This document specifies the correct sample preparation sequence to be applied to:

- a) the composite sample, in order to produce a laboratory sample (taking into account large pieces of solid recovered fuel);
- b) each sub-sampling step throughout the testing programme;
- c) the laboratory sample, in order to obtain suitable test portions;
- d) ensure the representativeness of the test portions that have been taken according to the sample preparation plan, prior to physical analysis, chemical analysis or both (e.g. extractions, digestion, analytical determinations).

The methods specified in this document can be used for sample preparation, for example, when the samples are to be tested for bulk density, biomass content determination, mechanical durability, particle size distribution, moisture content, ash content, ash melting behaviour, calorific value, chemical composition, impurities and self-heating properties. The methods are not intended to be applied to the very large samples required for the testing of bridging properties.

## 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 3310-1, *Test sieves — Technical requirements and testing — Part 1: Test sieves of metal wire cloth*

ISO 3310-2, *Test sieves — Technical requirements and testing — Part 2: Test sieves of perforated metal plate*

ISO 21637:2020, *Solid recovered fuels — Vocabulary*

ISO 21660-3, *Solid recovered fuels — Determination of moisture content using the oven dry method — Part 3: Moisture in general analysis sample*

CEN/TS 15414-1, *Solid recovered fuels — Determination of moisture content using the oven dry method — Part 1: Determination of total moisture by a reference method*

CEN/TS 15414-2, *Solid recovered fuels — Determination of moisture content using the oven dry method — Part 2: Determination of total moisture by a simplified method*

## 3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 21637 and the following apply.