



International
Standard

ISO 17827-1

**Solid biofuels — Determination
of particle size distribution for
uncompressed fuels —**

**Part 1:
Oscillating screen method using
sieves with apertures of 3,15 mm
and above**

*Biocombustibles solides — Détermination de la distribution
granulométrique des combustibles non comprimés —*

*Partie 1: Méthode au tamis oscillant d'ouverture de maille égale
ou supérieure à 3,15 mm*

**Second edition
2024-05**

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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 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).

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This document was prepared by Technical Committee ISO/TC 238, *Solid biofuels*, in collaboration with the European Committee for Standardization (CEN) Technical Committee CEN/TC 335, *Solid biofuels*, in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

This second edition cancels and replaces the first edition (ISO 17827-1:2016), which has been technically revised.

The main changes are as follows:

- 8-mm-sieve has been removed from the set of sieves;
- the required minimum sieving time can now optionally be chosen based on pre-tests;
- table of results has been completely modified;
- calculation of median value (Annex) has been deleted;
- precision requirements have been deleted;
- references have been updated.
- an introduction has been added;
- editorial changes have been made.

A list of all parts in the ISO 17827 series can be found on the ISO website.

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

Particle size and size distribution of uncompressed solid biofuels significantly influence the transport, handling and combustion properties of solid fuels. Depending on the type of fuel feeding and the type and size of a conversion plant, fuels of different particle sizes are suitable. Of particular interest are also the fines fraction and oversized particles. An increased content of fine particles can lead to clogging in feed systems and unsteady combustion. Oversized particles can block conveying systems or cause bridging problems in silos and can reduce the bulk density of the fuel. Very fine particles can have negative health effects and are relevant for explosion protection reasons ($< 0,5$ mm).

The ISO 17827 series, describing the determination of particle size distribution, consists of the following parts under the general title Solid biofuels — Determination of particle size distribution for uncompressed fuels:

Part 1: Oscillating screen method using sieves with apertures of 3,15 mm and above

Part 2: Vibrating screen method using sieves with apertures of 3,15 mm and below

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Solid biofuels — Determination of particle size distribution for uncompressed fuels —

Part 1:

Oscillating screen method using sieves with apertures of 3,15 mm and above

1 Scope

This document specifies a method for the determination of the size distribution of particulate biofuels by the horizontally oscillating screen method. It applies to particulate uncompressed fuels with a nominal top size of 3,15 mm and above, e.g. wood chips, hog fuel, olive stones.

The method is intended to characterize material up to a particle size class (P) of P63. For larger P-classes and PL-classes, the characterization is mainly done by hand sorting.

NOTE The definitions and specifications of P- and PL-classes are given in ISO 17225-1, ISO 17225-4 and ISO 17225-9.

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

ISO 14780, *Solid biofuels — Sample preparation*

ISO 16559, *Solid biofuels — Vocabulary*

ISO 17225-1, *Solid biofuels — Fuel specifications and classes — Part 1: General requirements*

ISO 17225-4, *Solid biofuels — Fuel specifications and classes — Part 4: Graded wood chips*

ISO 17225-9, *Solid biofuels — Fuel specifications and classes — Part 9: Graded hog fuel and wood chips for industrial use*

ISO 18134-1, *Solid biofuels — Determination of moisture content — Part 1: Reference method*

ISO 18134-2, *Solid biofuels — Determination of moisture content — Part 2: Simplified method*

ISO 18135, *Solid Biofuels — Sampling*

ISO 21945, *Solid biofuels — Simplified sampling method for small scale applications*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 16559 and the following 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/>

3.1 sieve fraction

mass fraction of test portion or sub-portion collected on a sieve after particle separation through the sieving process.

4 Principle

A test portion is subjected to sieving through horizontally oscillating sieves, sorting the particles in decreasing size classes by mechanical means.

5 Apparatus

5.1 Sieves

An appropriate number of sieves with a minimum effective sieve area of 1 200 cm² (e.g. 400 mm diameter) is required for the test.

The sieves shall have round perforated holes in metal plate in accordance with ISO 3310-2. The frame of the sieves shall have a height that will enable the sieves to contain the sample and allows a free movement of the sample during the sieving process.

The number of sieves and the aperture sizes of the sieves shall be chosen in accordance with the size specification for the actual test sample material. For test samples, which shall be assessed according to the requirements in ISO 17225-1, ISO 17225-4 and ISO 17225-9, the following set of sieve aperture sizes is needed: 3,15 mm; 16 mm; 31,5 mm; 45 mm; 63 mm. For further size classification of the fraction passing through the 3,15 mm sieve, see ISO 17827-2.

5.2 Collecting pan

A collecting pan of adequate size is required for collection of material passing through all sieves.

5.3 Weighing containers

The weighing of the sieved particle fractions may be performed either by weighing the remaining material directly on the tared weighed sieves or by collecting and weighing the material in weighing containers.

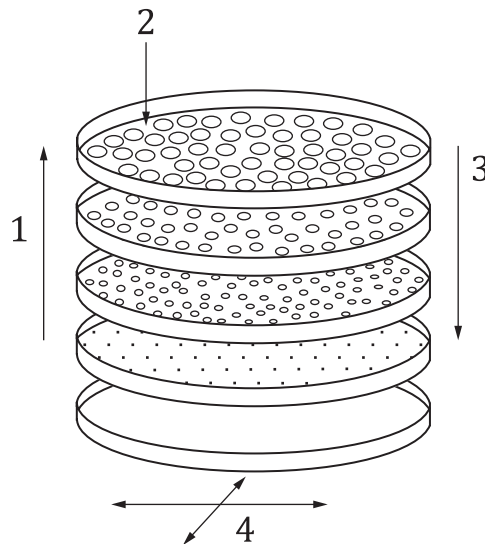
5.4 Mechanical sieving equipment

The sieving operation shall be horizontally oscillating (two-dimensional) using an appropriate stroke-frequency depending on the type of material being analysed. Some sieving machines have adjustable parameters. The results of the sieving can differ depending on how adjustable parameters are controlled. It is therefore important for comparative purposes to report how the adjustable parameters are set in terms of frequency, amplitude, duration, etc. If machines have adjustable dimensionless settings, an estimate of the adjustable degree shall be recorded to the best of the ability of the operator.

For a principle drawing of the sieving operation, see [Figure 1](#).

NOTE 1 Be aware that oscillating at too low of a frequency can lead to incomplete particle segregation. The minimum frequency can be determined by conducting pre-tests.

NOTE 2 Results from using equipment applying three-dimensional movement can differ from results obtained with an apparatus as described above. Especially for irregular particles like wood chips or hog fuel, a significantly higher amount of particles can be found in smaller sieving fractions than from sieving with two-dimensional movements.

**Key**

- 1 increasing hole diameter
- 2 material addition
- 3 material flow direction
- 4 oscillating direction

Figure 1 — Principle of the sieving operation

5.5 Balance

It shall be capable of reading to the nearest 0,1 g.

6 Sample preparation

6.1 Sample size

A test sample shall be obtained in accordance with ISO 18135 or ISO 21945 and a test portion of minimum eight litres shall be extracted using volume reduction methods in accordance with ISO 14780. For solid biofuels where 100 % of the particles will pass through a sieve with 45 mm aperture, a minimum sample size of four litres may be used.

The test sample shall include sufficient material for determination of size distribution and moisture content.

Depending on the size of the sieves, the test portion may need to be divided into several sub-portions, which are processed in sequential sieving operations. This is to ensure that the filling height on the upper sieve shall never exceed 5 cm. This procedure of sequential processing also applies if test portions larger than eight litres are processed.

6.2 Moisture conditioning

The test portion shall be sieved at moisture content below 20 % in mass (wet basis). This prevents small particles from sticking together. If necessary, the test sample shall be pre-dried in accordance with ISO 14780.

NOTE By pre-drying, as described in ISO 14780, the test sample is brought into equilibrium with the humidity of the surrounding atmosphere.

Determine the moisture content of the material after pre-drying on a separate test portion in accordance with the procedure given in ISO 18134-1 or ISO 18134-2. The moisture content shall be determined and reported concurrently with the determined particle size distribution.

7 Procedure

The test portion to be used for sieving shall be weighed to the nearest 0,1 g.

Assemble and operate the mechanical shaking device with the appropriate sieves with decreasing aperture, ending with the collecting pan at the bottom. Spread the material in an even layer on the top sieve and start the sieving operation. The required minimum sieving time shall be determined based on pre-tests. The sieving operation shall be continued until the mass changes between two sequential sieves do not exceed a maximum of 0,3 % of the sample mass under test per 1 min time of sieving operation. As an alternative to the pre-test, a 15 min duration of the sieving operation is recommended.

NOTE 1 Be aware that an excessive sieving time can cause abrasion and a higher portion of the fine fraction.

NOTE 2 Avoid losing particles from the screens. This can be done by proper sealing between the trays and by use of a top cover.

Particles with a length of 100 mm or more shall be sorted by hand and weighed regardless on which sieve they had landed.

Weigh the material retained on each sieve and in the collecting pan to an accuracy of 0,1 g and record each mass in a scheme comparable to [Table 1](#). If a particle gets stuck in a hole of a sieve, it shall be removed and added to the mass of the fraction retained on that sieve (as if it did not pass the hole).

NOTE 3 In many cases it is useful to identify the longest particle. If required, record it in a scheme equal to [Table 1](#).

If it is required to determine the size distribution of the particles passing through the 3,15 mm sieve, proceed as described in ISO 17827-2.

8 Calculation

The results of the particle size determination shall be expressed as percentages of the total mass of all fractions. If the test portion has been divided into two or more sub-portions, the mass of the respective fractions shall be added up before calculating the overall percentage of each size class. This procedure is illustrated in [Table 1](#), assuming that the test portion is divided into up to three sub-portions.

The total mass of each sieve fraction shall be summed up horizontally and the total mass of all fractions shall be summed up vertically in column B and recorded to the nearest 0,1 g and expressed in column C as percent of the sum of all mass fractions.

The moisture content of the test sample after pre-drying shall be recorded in the upper section of [Table 1](#) and expressed as % in mass.

The difference between the mass of the test portion and the sum of the mass of all sieve fractions as indicated in [Table 1](#) shall be less than 2 %. Larger differences can occur due to lost or retained particles or due to changes in moisture content. In these cases, the causes for the deviation shall be investigated and corrected before the measurement is repeated. If this is not practical or the result still deviates by more than 2 %, then it shall be noted in the test report.

Table 1 — Example of reporting results of the particle size distribution analysis

Date of test:							
Analyst:							
Sample ID:							
Mass of test portion (g):							
Overall length of longest particle (mm):							
Moisture content of the sample (% in mass):							
		A0	A1	A2	A3	B	C
Sieve aperture size (mm)	Particle size fraction (mm)	Mass of empty sieves and collecting pan (g)	Mass of fraction in			Total mass of fraction, (columns A1+A2+A3)	Percentage of mass fraction, (based on the total mass of all fractions in column B)
			sub-portion 1 (g)	sub-portion 2 (g)	sub-portion 3 (g)		
Collecting pan	< 3,15						
3,15	≥ 3,15 to < 16						
16	≥ 16 to < 31,5						
31,5	≥ 31,5 to < 45						
45	≥ 45 to < 63						
63	≥ 63 to < 100						
Hand sorting	>100						
Total mass of all fractions	All						
Difference between mass of test portion and total mass of all sieve fractions					(g)		
					(%)		

NOTE Further technical assistance on applying the method described in this document is given in ISO/TS 17595¹⁾.

9 Performance characteristics

Because of the varying nature of the solid biofuels covered by this document, it is not possible to give a precision statement (repeatability or reproducibility) for this test method.

10 Test report

The test report shall include at least the following information:

- identification of the laboratory performing the test and the date of the test;
- identification of product (or sample) tested;
- a reference to this document, i.e. ISO 17827-1:2024;
- recording of all adjustable machine settings;
- results of the test as demonstrated in [Table 1](#) and the moisture content that the sample was sieved at;
- if the difference in mass of the test portion and the sum of all fractions of all sub portions exceeds 2 %, this shall be stated;
- any unusual features noted during the determination, which could affect the result;

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