International Standard

ISO 17827-2

Second edition
2024-05

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

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

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

Partie 2: Méthode au tamis vibrant d'ouverture de maille inférieure ou égale à 3,15 mm

Reference number
ISO 17827-2:2024(en)

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Published in Switzerland

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Foreword

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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 17827-2:2016), which has been technically revised.

The main changes are as follows:

— several sieves were removed from the set; the remaining sieves have apertures of 3,15 mm, 2,0 mm, 1,0 mm, 0,5 mm and 0,1 mm;

— table of results has been modified and adapted;

— references have been updated;

— an introduction has been added;

— Annex A and Annex B have been deleted;

— 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

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

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

1 Scope

This document specifies a method for the determination of the size distribution of particulate biofuels by the vibrating screen method. The method described is meant for particulate biofuels only, namely, materials that either have been reduced in size, such as most wood fuels, or are physically in a particulate form. This document applies to particulate uncompressed fuels with a nominal top size of 3,15 mm and below (e.g. sawdust).

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 14780, *Solid biofuels — Sample preparation*

ISO 16559, *Solid biofuels — Vocabulary*

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

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 laboratory sample is subjected to sieving through vibrating sieves, sorting the particles in decreasing size classes by mechanical means.

NOTE Manual sieving is excluded because small sieve holes can easily be clogged by particles.

5 Apparatus

5.1 Sieves

For the test, an appropriate number of either circular or rectangular sieves with a minimum effective sieve area of 250 cm^2 is required. Depending on the aperture size, different sieves shall be used. All sieves with an aperture size smaller than 3,15 mm must have an aperture geometry in accordance with ISO 3310-1 (metal wire cloth), all sieves with an aperture size of 3,15 mm or above must have round perforated holes in metal plate in accordance with ISO 3310-2 (perforated metal plate). The frame of the sieves shall have a height that enables the sieves to contain the samples 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 with the size specification for the actual laboratory sample material in accordance with ISO 17225-1. For sawdust and similar fine grade materials, the following set of sieves is recommended:

— 3,15 mm round holes;

— 2,0 mm metal wire cloth;

— 1,0 mm metal wire cloth;

— 0,5 mm metal wire cloth;

— 0,1 mm metal wire cloth.

NOTE If further classification of particles is required, other sieves can be used.

5.2 Collecting pan

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

5.3 Weighing containers

The weighing of the sieved particle fractions can be performed either by weighing the remaining material directly on the tarred weighed sieves or by collecting and weighing the material in weighing containers. For this purpose, an adequate number of weighing containers is required.

5.4 Brush

For cleaning the sieves, a brush is required.

5.5 Mechanical sieving equipment

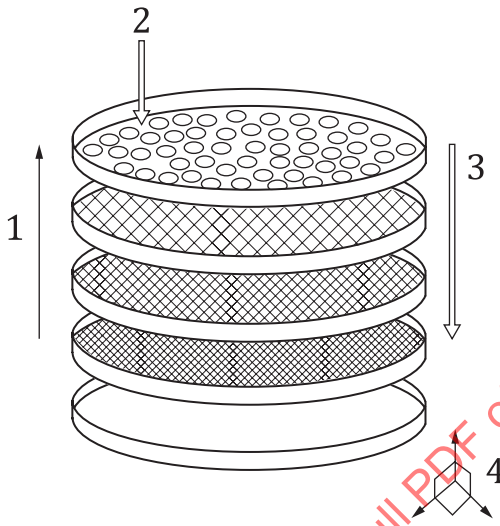
The mechanical device (sieving machine) shall apply a vibration on the sieves. Some sieving machines have adjustable parameters. The results of the sieving can differ depending on how adjustable parameters are

controlled. It is therefore important for comparative purposes to report how adjustable parameters have been used 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 vibrating at an amplitude that is too low might lead to incomplete particle segregation. The minimum amplitude can be determined by pre-tests.

NOTE 2 This sieving machine differs from that used in ISO 17827-1 in that it has a three-dimensional movement.



Key

1 increasing hole diameter
2 material addition
3 material flow direction
4 vibration direction

Figure 1 — Principle of the sieving operation

5.6 Balance

The balance shall be capable of reading to the nearest 0,01 g.

6 Sample preparation

6.1 Sample size

The laboratory sample shall be obtained in accordance with ISO 18135 or ISO 21945 and a test portion of minimum 50 g shall be extracted using volume reduction methods in accordance with ISO 14780. To prevent overloading of the sieves, the height of the layer of material on the upper sieve shall never exceed 2 cm. If the material height does exceed 2 cm, then the test portion shall be divided into sub portions, which are processed in sequential sieving operations. The results of the separate determinations of the sub portions shall be combined in accordance with Clause 8.

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

6.2 Moisture conditioning

The test portion shall be sieved at a moisture content below 20 % in mass (wet basis), thus preventing the particles from sticking together or losing significant amount of moisture during the sieving process. If necessary, the test sample shall be pre-dried. Drying is done in accordance with ISO 14780.

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

Determine the moisture content of the material to be sieved on a separate test portion by following the procedure given in ISO 18134-1 or ISO 18134-2. The moisture content shall be determined and reported concurrently with the particle size distribution determination.

7 Procedure

The test portion to be used for sieving shall be weighed to the nearest 0,01 g.

Assemble and operate the mechanical shaking device with the appropriate sieves with decreasing aperture, ending with the collecting pan at the bottom. If the size of the test portion is significantly larger than the minimum 50 g given in 6.1, the test portion shall be divided into two or more sub portions, which are to be processed subsequently.

Spread the material in an even layer on the top sieve and start the sieving operation. As a pre-test, a 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 30 min duration of the sieving operation is recommended.

The required minimum sieving time shall be determined for each equipment and type of fuel in separate pre-tests. Avoid losing any particles when determining individual weight differences during such pre-tests.

NOTE 1 If shorter sieving time is applied for the purpose of decreasing the abrasion, the results could be affected by machine characteristics.

During the sieving operation, particles can stick on the edge of the sieves due to static electricity generated during the shaking of the material. Any tendency of such a problem should be observed during pre-testing and remediated by means of earthing the sieves using copper wires or braids.

NOTE 2 Be aware that an excessive sieving time might cause abrasion and a higher portion of fine fraction.

If it is observed that the sample under test is not evenly distributed on each of the sieves, the sieve stack shall be rotated approximately 180° after approximately half of the sieve time has elapsed and complete the sieving operation.

In size classification by sieving, thin particles, which are longer than the diameter of a hole in the sieve, can pass through the sieve and mix with the particles in the smaller size fractions. In such case, these particles shall remain part of the fraction where they are retained.

Weigh the material in each sieve and in the collecting pan to an accuracy of 0,01 g and record each mass in a scheme equal 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).

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 the test portion is divided in two sub portions. The table provides guidance for how a table can be structured but has to be adjusted for the number of sub portions to be analysed.

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 0,01 g and expressed in column C as

percent of the sum of all mass fractions. The cumulative percentage in mass passing through is summed up in column D.

The moisture content of the test sample 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 in column B of Table 1 shall be less than 2 % in mass. 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 should be investigated and the measurement 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):							
Moisture content of the sample (% in mass):							
		A0	A1	A2	B	C	D
Sieve aperture size (mm)	Particle size fraction (mm)	Mass of empty sieves and collecting pan (g)	Mass of fraction in sub-portion 1 (g)	Mass of fraction in sub-portion 2 (g) (add more columns if necessary)	Total mass of fraction, (columns A1+A2 or more)	Percentage of mass fraction, (based on the total mass of all fractions in column B)	Cumulative percent in mass passing through (summing up the mass fraction percentages in column C)
Collecting pan	< 0,1						
0,1	≥ 0,1 to < 0,5						
0,5	≥ 0,5 to < 1,0						
1,0	≥ 1,0 to < 2,0						
2,0	≥ 2,0 to < 3,15						
3,15	≥ 3,15						
Total mass of all fractions	All		—	—			
Difference between mass of test portion and total mass of all sieve fractions					(g) (%)		

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:

a) an identification of the laboratory performing the test and the date of the test;

b) an identification of product (or sample) tested;

c) a reference to this document, i.e. ISO 17827-2:2024;