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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

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

Reference number
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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 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).

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For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT) see the following URL: Foreword - Supplementary information.

The committee responsible for this document is ISO/TC 238, *Solid biofuels*.

ISO 17827 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*

NOTE ISO 17827–2 can also be used for round hole sieves with apertures of 4,0 mm and 5,6 mm.

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 part of ISO 17827 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, etc. The method is intended to characterize material up to a particle size class of P63. For larger P-classes, the characterization is mainly done by hand sorting.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. 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 16559, *Solid biofuels — Terminology, definitions and descriptions*

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

ISO 17827–2[1)], *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*

ISO 18134–1, *Solid biofuels — Determination of moisture content — Oven dry method — Part 1: Total moisture — Reference method*

ISO 18134–2, *Solid biofuels — Determination of moisture content — Oven dry method — Part 2: Total moisture — Simplified method*

EN 14778, *Solid biofuels — Sampling*

EN 14780, *Solid biofuels — Sample preparation*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 16559 and the following apply.

3.1
median value of the size distribution
median value [d50] that separates a distribution into two equal parts

Note 1 to entry: Graphically, the median value is the intercept point of the cumulative size distribution curve with the 50 % horizontal line.

1) To be published.

3.2
sieve fraction
material collected on a sieve

4 Principle

A laboratory sample 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 either circular or rectangular sieves with a minimum effective sieve area of 1 200 cm^2 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 (see also ISO 17225-1).

NOTE 1 For laboratory samples with a nominal top size of less than 10 mm, an effective sieve area of less than 1 200 cm^2 is adequate.

NOTE 2 For laboratory samples such as wood chips, the following set of sieves may be selected: 3,15 mm; 8,0 mm; 16 mm; 31,5 mm; 45 mm; 63 mm. If no particles are caught by the larger sieves, these can be omitted from the set. For further size distribution determination of the fraction passing through the 3,15 mm sieve, see ISO 17827-2.

NOTE 3 Sieve sizes above 63 mm are not useful since the oscillation might not force the particles to orientate perpendicular to the plane of the sieves. Furthermore, the distance to the sieve below will have to be longer than the usual 80 mm in order to allow the long and slim particles to pass through the holes.

For checking compliance with particle size specification in ISO 17225-1, only those sieve sizes which have limit values are required.

5.2 Collecting pan, a collecting pan of adequate size is required for collection of material passing through the sieves.

5.3 Weighing containers, an adequate number of weighing containers are required.

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.

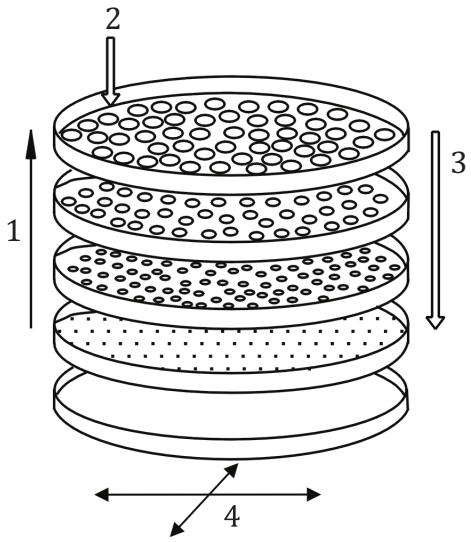
5.4 Mechanical sieving equipment

The sieving operation shall be horizontally oscillating (one or two dimensional) using an appropriate stroke-frequency depending on the type of material being analyzed. Some sieving machines have adjustable parameters. The results of the sieving may 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 which are created by using equipment applying three dimensional movement might differ from results obtained with an apparatus as described above.



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

6 Sample preparation

6.1 Sample size

A laboratory sample shall be obtained in accordance with EN 14778 and a test sample of minimum eight litres shall be extracted using volume reduction methods in accordance with EN 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 can be used.

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

Depending on the size of the sieves, the test sample may need to be divided into several test 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 samples larger than eight litres are processed.

6.2 Moisture conditioning

The laboratory sample shall be sieved at moisture content below 20 w-% wet basis, thus preventing the particles from sticking together or losing moisture during the sieving process. If necessary, the laboratory sample shall be pre-dried. Drying shall be done in accordance with EN 14780.

NOTE By pre-drying, as described in EN 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 sample 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 sample 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. A duration of 15 min is recommended for the sieving operation to make sure the particle segregation is as complete as possible.

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

NOTE 2 Be aware that an excessive sieving time, which is significantly longer than the required sieving time, can cause abrasion and a higher portion of the fine fraction.

NOTE 3 Avoid loosing particles from the screens. This can be done by proper sealing between the trays and by the use of a top cover.

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 cases, these particles shall remain part of the fraction where they are retained. Only particles with a maximum dimension of 100 mm or more shall be sorted by hand and weighed regardless on which sieve they land.

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 equal to Table 1. If a particle gets stuck in the 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).

If required, the cross sectional area of oversize particles is measured by placing the particle orthogonally behind a transparent template with cm^2 squares and estimating the maximum cross sectional area of the particle with the help of the cm^2 pattern.

NOTE 4 In many cases, it is useful to identify the longest particle (maximum dimension) and the particle with the largest cross sectional area. If required, record it in a scheme equal to Table 1. The information on the longest particle might be required for computing the median particle size or for illustrating the results in a cumulative size distribution curve.

If particle size determination of the particles passing through the 3,15 mm sieve is required, 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 sample has been divided into two or more test 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 sample is divided into two test portions. Table 1 provides guidance for how a table can be structured but has to be adjusted for the number of test portions to be analyzed.

The obtained mass for each test portion shall be summed up vertically in column 1 and 2, respectively (or additional columns as applicable), and recorded in g.

The total mass of each sieve fraction shall be summed up horizontally in column 3 and recorded to the nearest 0,1 g and expressed in column 4 as percent of the sum of all mass fractions. The cumulative w-% passing through is summed up in column 5. Annex A provides research data for comparison.

The moisture content of the test sample shall be recorded in the lower section of Table 1 and expressed as w-%.

The difference between the mass of the test sample 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 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.

If an assessment of the performance characteristics is required (see Clause 9), the sieving operation shall be repeated using another test sample of the laboratory sample material. If sufficient sample material is not available, the fractions from the first determination may be re-mixed and used for the second determination. The results of the first and second determinations should then meet repeatability requirements as defined in 9.1.

Table 1 — Results of the particle size distribution analysis

		(1)	(2)	(3)	(4)	(5)
Sieve name	Fraction, in mm (to be specified)	Mass of fraction in test portion 1, in g	Mass of fraction in test portion 2, in g *(add more columns if necessary)*	Total mass fraction, column (1) + (2) or more, in g	Percentage mass fraction, based on the total mass of all fractions in column 3	Cumulative w-% passing through (summing up the mass fraction percentages in column 4)
Hand sorting (...mm)						
Hand sorting (...mm)						
1st sieve (....mm)						
2nd sieve (.... mm)						
3rd sieve (....mm)						
4th sieve (.....mm)						
5th sieve (.... mm)						
6th sieve (.... mm)						
Collecting pan	Below:					
Total mass of all fractions	All				100%	

Other recordings:

Mass of the test sample, in g	
Fractions of oversize hand-sorted particles in percent per size class, in mm	
Overall length of longest particle, in mm (if applicable)	
Result of the largest cross sectional area determination (if applicable), in cm^2	
Difference between the mass of the test sample and the total mass of all sieve fractions (column 3), in percent of the mass of the test sample	
Moisture content of the sieved sample, in w-%.	

9 Performance characteristics

9.1 Repeatability

The results of duplicate determinations of the individual mass fractions, performed within a short period of time in the same laboratory, by the same operator, using the same apparatus on two representative