BS EN 15415-1:2011

BSI Standards Publication

Solid recovered fuels — Determination of particle size distribution

Part 1: Screen method for small dimension particles

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National foreword

This British Standard is the UK implementation of EN 15415-1:2011. It supersedes DD CEN/TS 15415:2006 which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee PTI/17, Solid biofuels.

A list of organizations represented on this committee can be obtained on request to its secretary.

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English Version

Solid recovered fuels - Determination of particle size distribution - Part 1: Screen method for small dimension particles

Combustibles solides de récupération - Détermination de la distribution granulométrique - Partie 1: Méthode de criblage pour des particules de petites dimensions

Feste Sekundärbrennstoffe - Bestimmung der Partikelgrößenverteilung - Teil 1: Siebverfahren für kleine Partikel

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Foreword

This document (EN 15415-1:2011) has been prepared by Technical Committee CEN/TC 343 “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of an identical text or by endorsement, at the latest by March 2012, and conflicting national standards shall be withdrawn at the latest by March 2012.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN [and/or CENELEC] shall not be held responsible for identifying any or all such patent rights.

This document supersedes CEN/TS 15415:2006.

EN 15415, *Solid recovered fuels — Determination of particle size distribution*, consists of the following parts:

— *Part 1: Screen method for small dimension particles;*

— *Part 2: Maximum projected length method (manual) for large dimension particles* (draft standard);

— *Part 3: Method by image analysis for large dimension particles* (draft standard).

This document differs from CEN/TS 15415:2006 mainly as follows:

a) large pieces with irregular shape definitely excluded from the scope;

b) whole document editorially revised.

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, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland and the United Kingdom.

1 Scope

This European Standard specifies the determination of particle size distribution of solid recovered fuels by a machine or manual sieving method. It applies to particulate agglomerated and non-agglomerated fuels, such as fluff, pellets, briquettes, pulverised solid recovered fuels.

This sieving method is not applicable to large pieces with irregular shape such as the pieces of shredded tyres or of demolition wood. In the case, of large pieces of irregular shape, prEN 15415-2 and prEN 15415-3 are applicable.

NOTE 1 For fine particles < 1 mm (e.g. sludges), the use of other methods could give more representative results as e.g. an analysis with the laser diffraction method in accordance with ISO 13320.

NOTE 2 This European Standard is based on EN 15149-1 applicable to particle sizes less than 3,15 mm.

2 Normative references

The following referenced documents are indispensable for the application 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.

EN 15357:2011, *Solid recovered fuels — Terminology, definitions and descriptions*

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

EN 15442, *Solid recovered fuels — Methods for sampling*

EN 15443, *Solid recovered fuels — Methods for the preparation of the laboratory sample*

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*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in EN 15357:2011 apply.

4 Principle

A sample is subjected to sieving through horizontally oscillating sieves, sorting the particles in decreasing size classes either manually or by machine sieving. For particles less than 25 mm, only machine sieving is used, for particles greater than 25 mm, manual or machine sieving is applied.

5 Apparatus

5.1 Sieve

5.1.1 General

The sieve (e.g. the geometry of the apertures, the thickness of the sieve, hole distances) shall be in accordance with ISO 3310-1 and ISO 3310-2. The geometry of the apertures shall be either circular or square and shall be reported.

NOTE For terms regarding sieves and test sieving, see ISO 2395.

For a correct comparison of different sieve analysis, it is necessary to use the same type of sieve with the same geometry of the apertures for each analysis.

The frame of the sieve shall have a height that enables the sieve to contain the sample and allows for free movement of the sample during the sieving process.

5.1.2 Minimum sieve area

An appropriate number of either circular or rectangular certified test sieves is required for the test. For particles greater than 10 mm, an effective sieve area of 0,12 m^2 shall be observed. An effective sieve area of less than 0,12 m^2 and greater than 0,025 m^2 is adequate for materials with a nominal top size of less than 10 mm.

The geometry of the apertures, the thickness of the sieves, the hole distances and the diameter of the holes shall be in accordance with ISO 3310-1 and ISO 3310-2.

5.1.3 Number and size of the sieves

The number of sieves and the aperture sizes of the sieves shall be chosen according to the size specification of the sample material.

NOTE 1 For solid recovered fuels > 3,15 mm, it is recommended to use sieves with hole diameters of 3,15 mm, 6,3 mm, 12,5 mm, 25 mm, 50 mm, 100 mm and 125 mm, and for solid recovered fuels < 3,15 mm, it is recommended to use sieves with hole diameters of 200 µm, 400 µm, 800 µm, 1,6 mm and 3,15 mm.

NOTE 2 In order to obtain a complete characterisation of the size range of a sample, the number of sieves should be such that no more than 25 % of the gross sample mass will be retained on any given sieve. On the biggest and the smallest sieves no more than 5 % of the gross sample mass should be retained.

NOTE 3 For further resolution in the size distribution and for avoiding any overloading of one fraction, the addition of sieves in accordance with ISO 565 (sieve mesh scale R 20) to the sieve set is also recommended.

5.2 Collecting pan

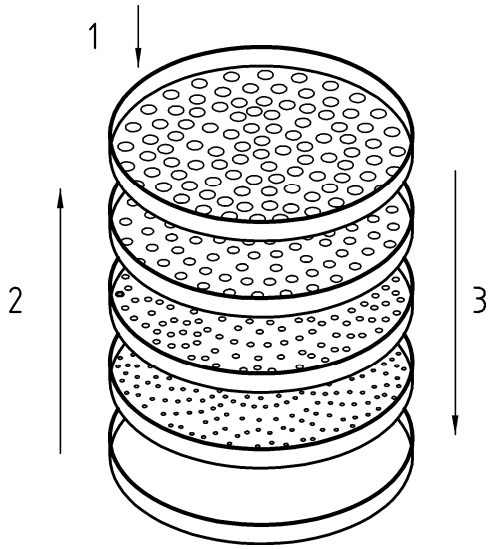
An adequate number of collecting pans is required for weighing the size classes.

5.3 Flat brush

A flat brush is required for cleaning the sieves, especially in case of fine grade solid recovered fuels.

5.4 Mechanical oscillating equipment

If a mechanical device is used, the shaking operation shall be horizontally oscillating (one or two dimensional), using an appropriate stroke-frequency according to the type of material. The principle of a mechanical oscillator is shown in Figure 1.



Key

1 material addition
2 increasing hole diameters
3 material flow direction

Figure 1 — Principle of a mechanical oscillator

5.5 Balance

A balance capable of measuring the mass of the sample to be sieved to the nearest 0,1 g shall be used.

6 Sampling and sample preparation

The sample shall be taken in accordance with EN 15442 and prepared in accordance with EN 15443.

The minimum mass of the test sample shall be:

— 1 kg for fine grade solid recovered fuels with a nominal top size, d_{95}, less than 25 mm;

— 2 kg for solid recovered fuels with a nominal top size, d_{95}, from 25 mm to 150 mm;

— 5 kg for solid recovered fuels with a nominal top size, d_{95}, greater than 150 mm.

Sieve the sample raw or air-dried. If the moisture content of the sample is greater than 20 %, air-drying is recommended for preventing the particles from sticking together or losing moisture during the sieving process. Air-drying shall be performed in accordance with CEN/TS 15414-2.

Determine the moisture content of the material to be sieved on a separate sub-sample following the procedure given in CEN/TS 15414-2. The moisture content shall be determined and reported concurrently with the particle size distribution determination.

NOTE Air-drying as specified in CEN/TS 15414-2 is performed by bringing the sample into equilibrium with the humidity of the surrounding atmosphere.

7 Procedure

7.1 General

Depending on the size of the sieves, the test sample shall be divided into several sub-samples to avoid overloaded sieves. The sub-samples shall be processed in sequential sieving operations.

NOTE 1 Generally, it is recommended to perform a pre-test, especially if there is no experience with the type of fuel. The required minimum sieving time should be determined for each equipment and type of fuel in a pre-test.

NOTE 2 Losing any particles when determining individual mass differences during a pre-test should be avoided.

Continue the sieving operation until the mass changes between two sequential sieves do not exceed a maximum of 0,3 % of the total sample mass per one minute time of sieving operation.

NOTE 3 Attention should be paid to the fact that an excessive sieving time which is significantly longer than the minimum sieving time can cause a modification of the particle size distribution (e.g. abrasion causes a higher portion of the fine fraction).

7.2 Manual sieving

Place the sieve over a collecting pan starting with the sieve with the largest aperture size. Weigh the sample to the nearest 0,1 g. Spread the sample (sub-sample) in an even layer and start sieving. When shaking, apply a vertical as well as horizontal action in order to allow all small particles to pass through the openings until no more material will pass.

Collect the particles passing through the sieve in the collecting pan. Spread the contents in the collecting pan in an even layer on the subsequent sieve and repeat the operation. Weigh the retained net material on each sieve and in the collecting pan to the nearest 0,1 g after sieving with the sieve with the smallest aperture size. In the case that a particle sticks in a sieving hole, it shall be removed and added to the fraction which has remained on the sieve (as if it did not pass the hole).

All particles greater than 100 mm (maximum dimension) shall be manually classified into one or more fractions regardless from which sieve or collecting pan they are collected. In this case, the size is defined as maximum length of the particle.

Record the mass of each fraction in a scheme, see Table 1[1)] for an example.

1) The user of Table 1 is allowed to copy it.

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

Sieve name	**Fraction**	(1) **Mass of fraction in sub-sample 1**	(2) **Mass of fraction in sub-sample 2**	(3) **Mass of fraction in sub-sample 3** (*add more columns if necessary*)	(4) **Total mass of fractions in columns (1), (2) and (3) (or more)**	(5) **Percentage of fraction (by mass) (based on total mass of test portion in column (4))**
	mm	g	g	g	g	%
Manual sorting	> 125					
Manual sorting	100 to 125					
1st sieve (50 mm)	50 to 100					
2nd sieve (25 mm)	25 to 50					
3rd sieve (12,5 mm)	12,5 to 25					
4th sieve (6,3 mm)	6,3 to 12,5					
5th sieve (3,15 mm)	3,15 to 6,3					
Collecting pan	< 3,15					
Total mass of all fractions	All					100

Other recordings:

Total mass of test portion, in grams	
Number of overlong (> 125 mm)	
Number of overlong (100 mm to 125 mm)	
Length of longest particle overall, in millimetres (if required)	
Difference between the total mass of test portion and the total mass of all fractions (column 4), in percent of the total test portion	
Moisture content of the sample, in percent Raw or air-dried sieving	
Manual or machine sieving Metal wire cloth or perforated metal plate	
Trade form (e.g. fluff, pellets, briquettes)	

NOTE 1 For smaller sieves, it can be convenient to combine two or more sieves in the same sieving operation.

Ensure that the sieves (particularly the lower sieves) do not clog because of a too great mass on the upper sieve. If a sieve is mostly or entirely clogged, decrease the mass of the sub-samples such that there is no clogging on any sieves and repeat the test.

NOTE 2 In many cases, it is useful to identify the greatest particle (maximum dimension) and record it in a scheme according to Table 1. The information on the longest particle can be required for computing the median particle size or for illustrating the results in a cumulative size distribution curve.

When classifying size by sieving, some of the thin particles longer than the hole diameter will pass through the sieve and mix with the particles in the smaller size fractions. Most of these particles remain in that fraction. Only particles greater than 100 mm (maximum dimension) shall be manually sorted as specified above.

7.3 Mechanical sieving

Assemble and operate the mechanical shaking device with the appropriate sieve sizes with decreasing aperture size ending with the collecting pan. Weigh the sample to the nearest 0,1 g. Spread the sample (sub-sample) in an even layer on the top sieve and start the sieving operation.

Weigh the retained net material on each sieve and in the collecting pan to the nearest of 0,1 g. In the case that a particle sticks in a sieving hole, it shall be removed and added to the fraction, which has remained on the sieve (as if it did not pass the hole).

All particles greater than 100 mm (maximum dimension) shall be manually classified into one or more fractions regardless of which sieve or collecting pan they are collected in. In this case, the size is defined as maximum length of the particle.

Record the mass of each fraction in a scheme according to Table 1.

Ensure that the sieves (particularly the lower sieves) do not clog because of a too great mass on the upper sieve. If a sieve is mostly or entirely clogged, decrease the mass of the sub-samples such that there is no clogging on any sieves and repeat the test.

When classifying size by sieving, some of the thin particles longer than the hole diameter will pass through the sieve and mix with the particles in the smaller size fractions. Most of these particles will remain in that fraction. Only particles greater than 100 mm (maximum dimension) shall be manually sorted as specified above.

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

NOTE 2 During the sieving operation, particularly fine particles can stick to the edge of the sieves due to static electricity. Since this problem is mostly connected to the intensity of the mechanical shaking operation, it should be taken into consideration in a separate pre-test for each equipment and solid recovered fuel sample materials. Grounding the sieves using a copper wire can reduce the problem with static electricity.

8 Calculation of results

The results shall be expressed as a percentage of the total mass of all fractions. If more than one sample (sub-sample) is processed, the mass of the respective fractions shall be added up before calculating the overall percentage of each class. An example of this procedure is shown in Table 1.

The difference between the total mass of test portion and the total mass of all fractions shall be less than 2 %. Larger differences can occur due to lost or retained particles or due to changes in moisture content. In this case, the causes for the deviation shall be investigated and the measurement repeated. In case this is impossible or the result still deviates more than accepted, this shall be reported.

9 Precision

Because of the varying nature of solid recovered fuels covered by this document, it is not possible at the present time 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) name of the testing establishment;

b) date of the test;

c) a reference to this European Standard, i.e. EN 15415-1;

d) identification of the product or sample tested;

e) test results as shown in Table 1;

f) if the difference of 2 % between the total mass of test portion and the total mass of all fractions, in percent, of the total test portion according to Table 1, column (4), has been exceeded, it shall be clearly stated and, if necessary, founded why the test has not been repeated;

g) any deviation from this European Standard;

h) any unusual features observed during the determination which may affect the result and details of any operations not included in this European Standard or regarded as optional.

Bibliography

[1] EN 15149-1, *Solid biofuels — Determination of particle size distribution — Part 1: Oscillating screen method using sieve apertures of 1 mm and above*

[2] prEN 15415-2, *Solid recovered fuels — Determination of particle size distribution — Part 2: Maximum projected length method (manual) for large dimension particles*

[3] prEN 15415-3, *Solid recovered fuels — Determination of particle size distribution — Part 3: Method by image analysis for large dimension particles*

[4] ISO 565, *Test sieves — Metal wire cloth, perforated metal plate and electroformed sheet — Nominal sizes of openings*

[5] ISO 2395, *Test sieves and test sieving — Vocabulary*

[6] ISO 13320:2009, *Particle size analysis — Laser diffraction methods*

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