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Solid biofuels — Determination of fines content in pellets

Biocombustibles solides — Détermination de la teneur en fines des granulés

Reference number
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Contents

Page

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 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.

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).

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

This document specifies a method for manual determination of the fines content in pellets. The fines content is defined as the percentage in mass of material below 3,15 mm in size (measured with a round hole perforated metal plate sieve according to ISO 3310-2). The fines content is an important parameter since excessive amounts of fines in consignments of pellets can cause problems either in transportation systems or during combustion, or both. It also can cause health problems if the dust is inhaled and it increases the risk of dust explosions. Many of these problems are connected to the tendency of stratification of fines caused by any movement of the pellets.

Annex A describes a procedure for determining the amount of coarse pellet fines (3,15 mm ≤ CPF < 5,6 mm). The determination of the amounts of smaller fines particles, for example the fractions < 1 mm and < 0,5 mm, is given in Annex B.

NOTE 1 The upper limit of 5,6 mm for CPF was chosen because a sieve with an aperture diameter of 5,6 mm is the standard commercial sieve with the next-smallest aperture diameter after 6 mm, which corresponds to the diameter of the standard pellet size. When conducting the procedure for CPF as outlined in Annex A, additional CPF are created as a result of the sieving procedure. Test results are therefore indicative and best used for comparative purposes rather than treated as CPF originally present in the sample.

NOTE 2 This document will replace ISO 18846.

Solid biofuels — Determination of fines content in pellets

1 Scope

This document specifies a method for determining the amount of material passing through a sieve with 3,15-mm-diameter round holes. It is intended for use in all applications (e.g. laboratories, production sites, field locations) where the measurement of fines is required.

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 16559, *Solid biofuels — Vocabulary*

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
coarse pellet fines
CPF
particles with a size ranging from ≥ 3,15 mm to < 5,6 mm resulting from breakage of pellets during production or handling

Note 1 to entry: The fraction of CPF contains all particles which pass through a sieve with 5,6-mm-diameter round holes and which are retained on a sieve with 3,15-mm-diameter round holes (see ISO 3310-2).

4 Principle

A test portion is subjected to manual screening by means of a sieve with 3,15-mm-diameter round holes while utilizing specific test conditions (e.g. a template is used to guide the movement of the sieve, rotational speed is specified, the number of rotations is dependent on the nature of the material being tested) and the mass of the material passing through the sieve is determined as a mass percentage of the total mass of the test portion.

5 Apparatus

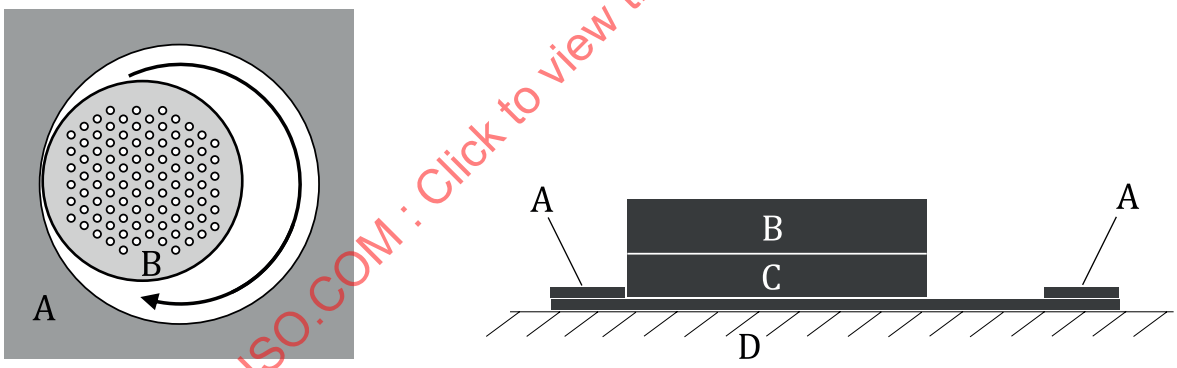
5.1 Sieve template, as illustrated in Figure 1, consisting of a (14 ± 2) mm-thick wooden board with a hole cut in the centre to receive the sieve with collecting pan, all mounted on a base panel with the same size dimensions. The sieve template is for guiding the sieve during the screening process to ensure consistent motion of the sieve. The inner circle should have a smooth surface to enable smooth circular movements of the sieve with the collecting pan within the template. The template diameter is based on a factor of 1,4 multiplied by the sieve diameter.

The diameter of the sieve and the template, the target size of the sub-portion used for a single screening operation and the rotational speed are given in Table 1.

Table 1 — Diameter of sieve and the template, size of the sub-portion and rotational speed

Sieve diameter mm		Inner diameter of template mm	Mass of sub-portion for a single sieving procedure		Approximate rotational speed r/min
			Recommended g	Range g	
400	Recommended sieve diameter	560	500	300 to 600	80
300	Alternative sieve diameters	420	280	170 to 340	95
450		630	630	380 to 760	77

The template shall be secured to the workplace (table) by, for example, clamps.



a) Top view **b) Cross-section**

Key

A template, with a wooden base
B sieve
C collecting pan
D workplace, table

Figure 1 — Sieving apparatus with template

To facilitate operation, a lubricant may be used to improve the sliding properties of the collection pan in the template, such as graphite powder or silicon lubricant. Additionally, roller tables may be used.

5.2 Circular sieve with 3,15-mm-diameter round holes, and aperture geometry in accordance with ISO 3310-2. A sieve with a diameter of 400 mm is recommended. Other sieve diameters within the range of 300 mm to 450 mm may be used, but it is important to make sure the sieving criteria is adjusted for the specific sieve to be used (see Table 1). The frame of the sieve shall have a height which allows for free movement of the sample without losing material during the sieving process.

5.3 Sieve with 5,6-mm-diameter round holes. If coarse pellet fines (3,15 mm ≤ CPF < 5,6 mm) are determined in accordance with Annex A, the circular sieve shall have round holes with a diameter of 5,6 mm and aperture geometry in accordance with ISO 3310-2. All other requirements are given in 5.2.

5.4 Sieves, with metal wire cloth having aperture sizes smaller than 3,15 mm. If fines fractions smaller than 3,15 mm, for example < 1 mm or < 0,5 mm, are determined in accordance with Annex B, the circular or rectangle sieves shall have an aperture geometry in accordance with ISO 3310-1 and shall have a minimum effective sieve area of 250 cm^2.

5.5 Collecting pan, for collection of material passing through the sieve, with the same diameter as the sieve.

5.6 Weighing container(s), of adequate size for weighing of the fractions. The collecting pan may also be used as a weighing container.

5.7 Balance, with suitable capacity to weigh the total mass of the sample plus any container used to hold the sample, capable of reading to the nearest 0,1 g.

5.8 Metronome or stopwatch, for confirmation of the rotational speed when performing the sieving procedure.

NOTE Use of a simple metronome, such as a mobile phone app, has been shown to be a convenient method for speed control.

6 Sample preparation

6.1 Sample size reduction

The laboratory sample used for the determination of the fines content shall be obtained in accordance with ISO 18135 or ISO 21945. The sampling strategy shall be such that special provisions are taken regarding the tendency for stratification of the fines in a consignment of pellets. For example, the entire quantity of pellets in a bag shall be taken as the laboratory sample. Due to the special provisions necessary regarding sampling for fines determination, the combined (raw) sample can end up being very large. The combined sample may be divided into one or more smaller test portions using appropriate methods of subdivision as outlined in ISO 14780 (e.g. a riffle box). For the test portion used for the determination of fines content, the minimum mass given in 6.2 shall be considered.

NOTE In bulk handling of large volumes of pellets there is often a risk of stratification of materials in storage bins. There is also the risk of incremental variations of fines in volumes of pellets due to batch-wise operation during transportation by rail carriages, trucks and ocean-going vessels.

6.2 Size of the test portion

The size of the test portion shall be selected in relation to pellet diameter as given in Table 2.

Table 2 — Minimum mass of test portion depending on the pellet diameter

Pellet diameter mm	Minimum size of a test portion kg
6 to 8	3
> 8 (up to 25)	5

7 Procedure

7.1 Preparing of the sieving equipment

The template shall be placed on a table or work bench as shown in Figure 1. It shall be fixed, for example with clamps, to ensure regular circular movements of the combination of sieve and collecting pan.

The sieve is placed on top of the collecting pan and together they are placed inside the template against the edge.

This sieving procedure is based on the use of a 400-mm-diameter sieve and a template of 560 mm inner diameter. When using a sieve with another size, the appropriate template shall be used.

7.2 Sieving

Weigh the test portion to the nearest 0,1 g and record the mass.

Place a first sub-portion on the sieve. The target mass of the sub-portion is 500 g but it is also permitted to use a mass within the range given in Table 1. If a sieve with another diameter is being used, see Table 1 for the size of sub-portions.

Sieve the sub-portion using circular rotations within the template at a rate of approximately 80 rotations per minute (r/min). At this speed (10 ± ¼) rotations will take approximately 7,5 s and (20 ± ¼) rotations will take approximately 15 s. Technicians performing the test procedure the first time should adjust their rotational speed in pre-tests using a stopwatch or a metronome. Rotational speed can also be checked from time to time using the stopwatch or the metronome. For other sieve sizes, an appropriate rotational speed shall be used; values for sieves with a diameter of 300 mm and of 450 mm are given in Table 1. In all cases, the rotational speed should be sufficient to maintain most of the pellets in motion. Sieve rotations can be either clockwise or anticlockwise.

Empirical data for the sieving speed using sieves with a diameter of 400 mm and of 300 mm are given in Annex D.

The total number of rotations will depend on the nature of the material being sieved and is given in Table 3. The number of rotations will remain the same regardless of the sieve diameter being used.

Table 3 — Number of rotations for sieving procedure

Pellets to be sieved	Number of rotations
Pellets made for residential or commercial use where compliance limits for fines content is 1,0 % in mass or less	10 ± ¼
Pellets made for commercial or industrial use where compliance limits for fines content is > 1 % in mass	20 ± ¼

After completing the sieving of the sub-portion, transfer the coarse material retained on the sieve to another container. The fines fraction can be left inside the collecting pan or, if desired, can be transferred to a weighing container. Place the sieve back on the collecting pan, place both the collecting pan and the sieve back into the template against the edge and place the next sub-portion on the sieve. Repeat this sieving process until all sub-portions have been screened for fines.

Once the whole test-portion has been sieved, weigh the cumulated fines fraction (either in the tared weighed collecting pan or in a separate weighing container) to the nearest 0,1 g. For quality control, also weigh the cumulated coarse material that was retained on the sieve.

NOTE 1 The maximum mass of 600 g of a sub-portion allows the subsequent use of the sub-portion for the determination of durability according to ISO 17831-1.

NOTE 2 Sieving of pellets with low durability leads to formation of fines due to abrasion during sieving. The tendency of an over-estimation of the fines content increases with decreasing mechanical durability of the pellets.

8 Calculations

8.1 Proportion of fines

Calculate the percentage in mass of fines by dividing the mass of the cumulated fines fraction by the mass of the test portion used for the sieving procedure and multiply by 100.

The result shall be given to the nearest 0,1 % in mass for reporting.

8.2 Quality control

Calculate the difference between the mass of the test portion and the total mass of the cumulated fines fraction and the cumulated coarse material that was retained on the sieve and express the difference in per cent of the mass of the test portion. If the difference is larger than 2 % in mass, the causes for the deviation shall be investigated and the determination shall be repeated with a new test portion. If the difference after repeated determination still exceeds 2 % of the mass of the test portion, the size of the test portion and the difference in percentage mass shall be reported together with the fines content as per 8.1.

If the amount of CPF is determined according to Annex A from the sample used in 7.2, then the mass of cumulated CPF and the mass of cumulated coarse material that was retained on the sieve with 5,6-mm-diameter round holes can be calculated as a sum and used instead of cumulated coarse material retained on the sieve during the initial screening.

9 Performance characteristics

The achievable performance of the method is given in Annex C, showing the results obtained by an international laboratory comparison study carried out on two industrial samples of 6-mm-diameter pellets with different amounts of added fines and different mechanical durability.

Additional information about the recovery of fines, CPF and fines smaller than 3,15 mm depending on the number of rotational movements are given in Annex D.

10 Test report

The test report shall include at least the following information:

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

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

c) a reference to this document, i.e. ISO 5370:2023;

d) the mass of the test portion (as per 7.2);

e) the result of the test on an as-received basis as indicated in 8.1;

f) the difference between the mass of the test portion and the total mass of all fractions, in per cent of the mass of the test portion if the difference exceeds a mass fraction of 2 %;

g) any unusual features noted during the determination, which can affect the result;

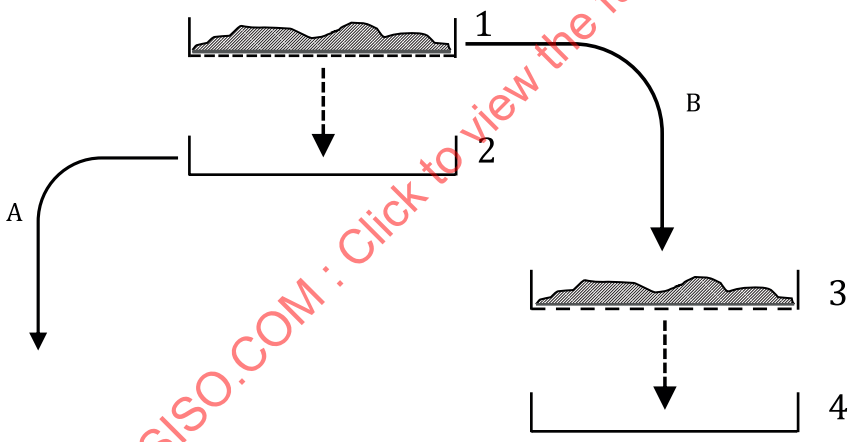
h) any deviation from this document, or operations regarded as optional.

Annex A
(informative)

Determination of coarse pellet fines (CPF)

A.1 Procedure for the determination of CPF

When the analysis of coarse pellet fines (3,15 mm ≤ CPF < 5,6 mm) is desired the pellets are screened using the principles outlined in this document with a sieve with 5,6-mm-diameter round holes having an aperture geometry in accordance with ISO 3310-2. A 400-mm-diameter test sieve is recommended. Other sieve sizes with a minimum diameter of 300 mm may be use but it is important to make sure the sieving criteria is adjusted for the specific sieve size used as referenced in this document. For example, template size and rotational speed need to be adjusted as well as the maximum amount of material that can be placed on the sieve. It should be noted that sieving pellets in this fashion causes significant amounts of new fines and CPF to be created. It is therefore important to note that the determination of CPF needs to be conducted after the fines content has been determined and that test results are considered indicative and best used for comparative purposes rather than treated as CPF originally present in the sample. The determination of the amount of CPF should be conducted in conjunction with the fines determination using the following procedure (see also Figure A.1).



Key

1 3,15 mm sieve
2 collecting pan; fines < 3,15 mm
3 5,6 mm sieve
4 collecting pan; coarse pellet fines (3,15 mm ≤ CPF < 5,6 mm)
A determination of fractions < 3,15 mm
B determining CPF

Figure A.1 — Sieving scheme for the determination of CPF

Upon completion of sieving the test portion for fines, the material retained on the sieve with 3,15-mm-diameter round holes can be further screened using the sieve with 5,6-mm-diameter round holes. This can be done by sieving the cumulated coarse fraction incrementally in the same fashion as when screening on the sieve with 3,15-mm-diameter round holes or by screening each of the sub-portions immediately after it has been screened with the sieve with 3,15-mm-diameter round holes. Sieving the cumulated coarse fraction will be necessary if only one collection pan is available. In such cases it should be noted that every transfer of pellets should be performed with great care. Unnecessary movement of the pellets can lead to increased amounts of fines and CPF.

For each screening, mount the sieve with 5,6-mm-diameter round holes on a collecting pan. Place the sieve with the collecting pan inside the template against the edge and then add a sub-portion to the sieve.

Screen the sub-portion using (10 ± ¼) circular rotations within the template at a rate of approximately 80 r/min. At this rate, screening should be complete within approximately 7,5 s. The rotational speed should be sufficient to maintain most of the pellets in motion. For the determination of CPF, (10 ± ¼) rotations are used for all samples independent of the amount of fines.

After completing the sieving of the sub-portion, transfer the pellets retained on the sieve to another container. The CPF can be left inside the collecting pan or, if desired, can be transferred to a weighing container. Repeat the sieving process until all sub-portions have been screened.

Once all sub-portions have been sieved, weigh the cumulated CPF (either in the tared weighed collecting pan or in a separate weighing container) to the nearest 0,1 g. For quality control (8.2), also weigh the cumulated remaining pellets (≥ 5,6 mm) after sieving to the nearest 0,1 g.

A.2 Calculation of the proportion of CPF

Calculate the percentage in mass of CPF by dividing the mass of the cumulated CPF by the mass of the test portion used for the sieving procedure (7.2) and multiply by 100.

A.3 Quality control

Calculate the difference between the mass of the test portion and the sum of total mass of the cumulated fines fraction, the cumulated coarse fines fraction and the cumulated coarse material retained on the sieve with 5,6-mm-diameter round holes and express the difference in per cent of the mass of the test portion. If the difference is larger than 2 % in mass, the causes for the deviation shall be investigated and the determination shall be repeated. If the difference after repeated determination still exceeds 2 % of the mass of the test portion, the deviation in percentage mass fraction from the test portion shall be reported together with the CPF content.

A.4 Performance data for determination of fractioned pellet

Within the research project "Development and validation of a reference method to determine the amount of fines in quantities of pellets", conducted at the University of Applied Sciences and Arts Göttingen (HAWK), the recovery of amounts of CPF in different types and origins of pellets were determined. The tests were carried out using three samples: wood pellets of class A1 according to ISO 17225-2 with a mechanical durability of 98,7 %, straw pellets with a mechanical durability of 97,4 % and sunflower husk pellets with a durability of 95,9 %.

Test samples were prepared by sieving an amount of pellets (10 rotations) with a sieve with 3,15-mm-diameter round holes. Defined amounts of different pellet fines fractions (< 0,5 mm; 0,5 mm to 1,0 mm; 1,0 mm to 3,15 mm; 3,15 mm to 5,6 mm) were added to get samples with defined compositions as given in Table A.1, Table A.2 and Table A.3.

The composition of fines was as follows:

< 0,5 mm	25 % in mass
≥ 0,5 mm < 1,0 mm	35 % in mass
≥ 1,0 mm < 3,15 mm	30 % in mass
≥ 3,15 mm < 5,6 mm	10 % in mass

The sieved pellets comprised a small amount of CPF, which was not quantified. The added fines were produced from the pellets to be tested by disintegration with water, drying and sieving the material with the appropriate sieves.

Sieving with a total of 80 circular movements was performed in intervals of 10 circular movements each. After each interval, the CPF content was weighed and the test was continued with the same sample. The recovery of the CPF fraction was calculated in relation to the amount of coarse fines added. All data are mean values from three replications.

Table A.1 — Recovery of coarse pellet fines (CPF) from wood pellet (A1, DU 98,7 %)[a]

Type of pellets	Sample composition (Pellets; added fines; added CPF)		CPF[b] No. of rotations 10	20	30	40	50	60	70	80
Wood pellets, A1, DU 98,7 %	495 g; 4,5 g (0,9 %); 0,5 g (0,1 %)	Mean CPF (g)	3,58	4,28	4,57	4,81	5,02	5,20	5,27	5,30
		RSD[c] (g)	1,91	2,13	2,16	2,30	2,28	2,33	2,43	2,40
		Recovery of CPF[d] (%)	717	856	915	962	1 003	1 041	1 053	1 061
	475 g; 22,5 g (4,5 %); 2,5 g (0,5 %)	Mean CPF (g)	4,77	5,64	5,95	6,22	6,50	6,57	6,65	6,75
		RSD[c] (g)	2,36	2,92	3,16	3,18	3,43	3,46	3,49	3,52
		Recovery of CPF[d] (%)	191	226	238	249	260	263	266	270
	400 g; 90,0 g (18,0 %); 10,0 g (2,0 %)	Mean CPF (g)	6,80	7,15	7,28	7,42	7,58	7,68	7,67	7,78
		RSD[c] (g)	0,93	1,05	1,02	1,19	1,18	1,20	1,13	1,08
		Recovery of CPF[d] (%)	68,0	71,5	72,8	74,2	75,8	76,8	76,7	77,8
	500 g; 0 g; 0 g	Mean CPF (g)	4,70	5,75	6,21	6,49	6,68	6,80	6,89	7,04
		RSD[c] (g)	2,10	2,37	2,60	2,60	2,57	2,71	2,77	2,77
	500 g; 0 g; 0 g	Mean CPF (g)	0,66	0,82	0,85	0,91	1,06	1,06	1,10	1,15
		RSD[c] (g)	0,08	0,18	0,13	0,13	0,17	0,13	0,12	0,14

[a] Diameter of sieve: 400 mm; size of template (inner diameter): 560 mm; total sample mass: 500 g.

[b] After separation of the fines (< 3,15 mm) according to the standard procedure (see 7.2) the pellets were sieved with a sieve with 5,6-mm-diameter round holes in intervals of (10 ± ¼) rotations as described in this annex.

[c] Relative standard deviation.

[d] Recovery of the amount of added CPF.

NOTE DU = mechanical durability.

Table A.2 — Recovery of coarse pellet fines (CPF) from straw pellet (DU 97,4 %)[a]

Type of pellets	Sample composition (Pellets; added fines; added CPF)		CPF[b] No. of rotations							
			10	20	30	40	50	60	70	80
Straw pellets, DU 97,4 %	495 g; 4,5 g (0,9 %); 0,5 g (0,1 %)	Mean CPF (g)	1,57	1,60	1,65	1,68	1,71	1,80	1,83	1,82
		RSD[c] (g)	0,71	0,72	0,74	0,72	0,77	0,78	0,75	0,78
		Recovery of CPF[d] (%)	315	321	329	335	341	359	366	364
	475 g; 22,5 g (4,5 %); 2,5 g (0,5 %)	Mean CPF (g)	2,61	2,76	2,85	2,89	2,96	3,01	3,02	3,04
		RSD[c] (g)	1,43	1,43	1,48	1,46	1,51	1,49	1,51	1,50
		Recovery of CPF[d] (%)	104	110	114	116	118	120	121	121
	400 g; 90,0 g (18,0 %) 10,0 g (2,0 %)	Mean CPF (g)	7,50	7,58	7,62	7,65	7,67	7,75	7,82	7,86
		RSD[c] (g)	1,02	1,04	1,04	1,06	1,06	1,06	1,04	1,07
		Recovery of CPF[d] (%)	75,0	75,8	76,2	76,5	76,7	77,5	78,2	78,6
	500 g; 0 g; 0 g	Mean CPF (g)	1,79	1,88	2,01	2,11	2,17	2,19	2,31	2,37
		RSD[c] (g)	1,58	1,68	1,65	1,58	1,64	1,61	1,65	1,67
	500 g; 0 g; 0 g	Mean CPF (g)	0,21	0,31	0,37	0,43	0,48	0,53	0,58	0,62
		RSD[c] (g)	0,04	0,04	0,03	0,11	0,09	0,10	0,12	0,12

[a] Diameter of sieve: 400 mm; size of template (inner diameter): 560 mm; total sample mass: 500 g.

[b] After separation of the fines (< 3,15 mm) according to the standard procedure (see 7.2) the pellets were sieved with a sieve with 5,6-mm-diameter round holes (10 ± ¼) rotations as described in this annex.

[c] Relative standard deviation.

[d] Recovery of the amount of added CPF.

NOTE DU = mechanical durability.

Table A.3 — Recovery of coarse pellet fines (CPF) from sun flower husk pellet (DU 95,9 %)[a]

Type of pellets	Sample composition (Pellets; added fines; added CPF)		CPF[b] No. of rotations 10	20	30	40	50	60	70	80
Sunflower-husk pellets, DU 95,9 %	495 g; 4,5 g (0,9 %); 0,5 g (0,1 %)	Mean CPF (g)	11,18	11,66	11,95	12,07	12,13	12,25	12,29	12,36
		RSD[c] (g)	3,63	4,00	4,15	4,17	4,18	4,13	4,12	4,15
		Recovery of CPF[d] (%)	2 237	2 331	2 391	2 415	2 426	2 451	2 458	2 473
	475 g; 22,5 g (4,5 %); 2,5 g (0,5 %)	Mean CPF (g)	7,25	7,53	7,71	7,74	7,84	7,95	7,98	8,01
		RSD[c] (g)	1,82	2,05	2,08	2,05	2,20	2,21	2,21	2,20
		Recovery of CPF[d] (%)	290	301	308	309	314	318	319	321
	400 g; 90,0 g (18,0 %); 10,0 g (2,0 %)	Mean CPF (g)	17,49	17,97	18,21	18,29	18,41	18,49	18,55	18,60
		RSD[c] (g)	6,88	6,78	6,73	6,77	6,70	6,64	6,72	6,65
		Recovery of CPF[d] (%)	175	180	182	183	184	185	185	186
	500 g; 0 g; 0 g	Mean CPF (g)	3,10	3,46	3,79	6,97	4,15	4,24	4,44	4,55
		RSD[c] (g)	1,31	1,44	1,50	4,05	1,49	1,53	1,50	1,52
	500 g; 0 g; 0 g	Mean CPF (g)	1,07	1,34	1,56	1,69	4,92	2,05	2,17	2,23
		RSD[c] (g)	0,34	0,45	0,53	0,65	5,06	0,79	0,78	0,77

[a] Diameter of sieve: 400 mm; size of template (inner diameter): 360 mm; total sample mass: 500 g.

[b] After separation of the fines (< 3,15 mm) according to the standard procedure (see 7.2) the pellets were sieved with a sieve with 5,6-mm-diameter round holes (10 ± ¼) rotations as described in this Annex.

[c] Relative standard deviation.

[d] Recovery of the amount of added CPF.

NOTE DU = mechanical durability.

Possible explanations for the large deviation in recovery of CPF from the desired result of about 100 % are as follows:

— The bigger holes of the sieve with 5,6-mm-diameter holes compared to the sieve with 3,15-mm-diameter holes allow a tilting of the pellets. This can cause the generation of new CPF by breaking off edges of the pellets.

— In cases of recovery rates of less than 100 % of CPF the first step of determination of fines (< 3,15 mm) can cause some crushing of the added CPF.

Annex B
(informative)

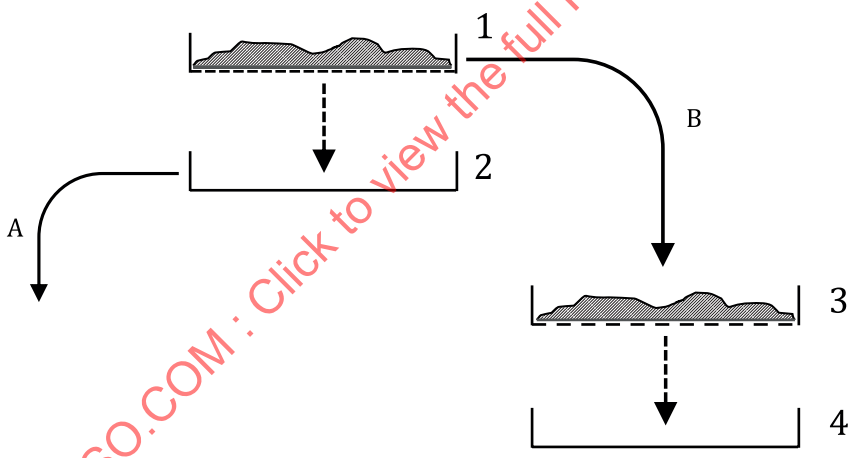
Determination of fractions of fines smaller than 3,15 mm

B.1 Procedure for the determination of fractions of fines smaller than 3,15 mm

For some applications the determination of particles smaller than 3,15 mm can be necessary, for example to assess explosion characteristics or health-related concerns. For explosion protection, the fraction < 0,5 mm often has to be determined.

The determination of particle fractions < 3,15 mm should be conducted using the cumulated fines fraction as referenced in 8.1 (see Figure B.1) and according to ISO 17827-2, using vibratory screening apparatus.

Considering the maximum sieve load for the sieving procedure according to ISO 17827-2, it can be necessary to divide the cumulated fines fraction into sub-portions. The sieving procedure should be performed with all of them.



Key

1 3,15 mm sieve
2 collecting pan; fines < 3,15 mm
3 5,6 mm sieve
4 collecting pan; coarse pellet fines (3,15 mm ≤ CPF < 5,6 mm)
A determination of fractions < 3,15 mm
B determining CPF (see Annex A)

Figure B.1 — Sieving scheme for the determination of fines fractions smaller than 3,15 mm

B.2 Calculation of the proportions of fines smaller than 3,15 mm

Calculate the percentage in mass of the desired fines fraction by dividing the cumulated amount of mass of fines passing the desired sieve size by the mass of the original test portion as referenced in 8.1 and multiply by 100.

Be aware that using more than one sieve means that the determined fraction has an upper limit and a lower limit. For example, using a sieve with a mesh size of 1 mm combined with a sieve with a mesh size

of 0,5 mm, results in the fractions 0,5 mm ≤ m < 1,0 mm and 0 mm < m < 0,5 mm. Results shall be stated with both limits.

In the test report the results for all determined fractions should be given.

For quality control, the amounts of fines fractions determined according to ISO 17827-2 should be added up. The sum should not deviate by more than 0,2 % in mass from the amount of fines calculated in 8.1.

Annex C
(informative)

Performance data

An interlaboratory test was carried out in Austria, Bulgaria, Canada, Denmark, Estonia, France, Germany, Italy, Latvia, Russia, Spain, Sweden, the United Kingdom and the USA. In total, 17 laboratories participated in this test and delivered results. All participating laboratories conducted the test on two different samples, which were provided in duplicate. The samples were wood pellets with a diameter of 6 mm produced from 100 % European spruce by Austrian pellet producers.

— Sample A was a certified ENplus®[1)] sample (quality A1) with a mechanical durability of 99,2 %.

— Sample B was a pellet sample of industrial quality with a mechanical durability of 90,0 %.

Both samples were carefully sieved with a sieve with 3,15-mm-diameter round holes to remove all fines and were then filled into 5 l buckets. In a second step, a defined amount of fines was added, consisting of two fractions:

— fines content < 3,15 mm and ≥ 1 mm;

— fines content with a particle size < 500 µm.

Final composition of the samples:

— Sample A: pellets with a total fines content of 0,4 % in mass from which 0,3 % in mass fines had a particle size of < 3,15 mm and ≥ 1 mm and 0,1 % in mass fines had a particle size of < 500 µm.

— Sample B: pellets with a total fines content of 2,5 % from which 2,0 % fines had a particle size of < 3,15 mm and ≥ 1 mm and 0,5 % fines had a particle size of < 500 µm.

The performance data according to ISO 5725-2 are presented in Table C.1, Table C.2, Table C.3, Table C.4 and Table C.5.

NOTE 1 See Table C.1 for a definition of the symbols used in Tables C.1 to C.5.

NOTE 2 A guideline can be found in ISO 16993:2016, Annex C on how to use these validation parameters.

1) This trademark is provided for reasons of public interest or public safety. This information is given for the convenience of users of this document and does not constitute an endorsement by ISO.

Table C.1 — Performance data for the determination of the fines content < 3,15 mm

Sample	n	l	o %	X %	s_R %	CV_R %	s_r %	CV_r %
Sample A (DU 99,2 %)	14	28	18	0,39	0,02	4,2	0,01	2,9
Sample B (DU 90,0 %)	16	32	6	2,82	0,09	3,1	0,03	1,1

Key

m amount of particles
n number of laboratories after outlier elimination
l number of outlier free individual analytical values
o percentage of outlier values from replicate determination
X overall mean
s_R reproducibility standard deviation
CV_R coefficient of variation, reproducibility
s_r repeatability standard deviation
CV_r coefficient of variation, repeatability
DU mechanical durability

Table C.2 — Performance data for the determination of coarse pellet fines (CPF): 3,15 mm ≤ CPF < 5,6 mm

Sample	n	l	o %	X %	s_R %	CV_R %	s_r %	CV_r %
Sample A (DU 99,2 %)	13	26	13	0,17	0,03	17,9	0,03	17,8
Sample B (DU 90,0 %)	14	28	7	1,04	0,21	20,5	0,10	9,8

Table C.3 — Performance data for the determination of fines fraction 1,0 mm ≤ m < 3,15 mm

Sample	n	l	o %	X %	s_R %	CV_R %	s_r %	CV_r %
Sample A (DU 99,2 %)	15	30	12	0,16	0,01	8,0	0,01	8,0
Sample B (DU 90,0 %)	16	32	6	1,33	0,06	4,5	0,03	2,0

Table C.4 — Performance data for the determination of fines fraction 0,5 mm ≤ m < 1,0 mm

Sample	n	l	o %	X %	s_R %	CV_R %	s_r %	CV_r %
Sample A (DU 99,2 %)	16	32	6	0,13	0,01	9,8	0,01	7,2
Sample B (DU 90,0 %)	16	32	6	0,83	0,06	7,4	0,03	3,7

Table C.5 — Performance data for the determination of fines fraction < 0,5 mm

Sample	n	l	o %	X %	s_R %	CV_R %	s_r %	CV_r %
Sample A (DU 99,2 %)	16	32	6	0,09	0,01	12,0	0,01	5,3
Sample B (DU 90,0 %)	16	32	6	0,65	0,03	5,4	0,02	2,6