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Solid biofuels — Simplified sampling method for small scale applications

Biocombustibles solides — Méthode d'échantillonnage simplifiée pour les applications à petite échelle

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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).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

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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*.

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

The objective of this document is to provide unambiguous and clear principles for sampling of solid biofuels from small scale applications and storages. It is to serve as a tool to enable efficient trading of biofuels and to enable good understanding between seller and buyer. It is also a tool for communication with equipment manufacturers. It will also facilitate the development of sampling plans and reporting.

This document is intended for all stakeholders.

Priority in this document is to take a number of increments which is possible to handle at small applications under practical aspects. In ISO 18135 the priority is to obtain a sample with a defined precision and to calculate the minimum number of increments on basis of the corresponding precision data.

Solid biofuels — Simplified sampling method for small scale applications

1 Scope

This document describes simplified methods for taking samples of solid biofuels in small scale applications and storages including preparation of sampling plans and reports. The main focus is on storages with a size of ≤100 t. This document is applicable to the following solid biofuels:

1) fine (up to about 10 mm nominal top size) and regularly-shaped particulate materials that can be sampled using a scoop or pipe, e.g. sawdust, olive stones and wood pellets;

2) coarse or irregularly-shaped particulate materials (up to 200 mm nominal top size) that can be sampled using a fork or shovel, e.g. wood chips, hog fuel and nut shells;

3) large pieces (above 200 mm nominal top size) which are picked manually (e.g. firewood and briquettes).

This document can also be used for other solid biofuels not listed above if the procedures described in this document are applicable. This document specifies methods to be used, for example, when a sample is to be tested for moisture content, ash content, calorific value, bulk density, mechanical durability, particle size distribution, ash melting behaviour and chemical composition.

Additionally, it describes a method for the reduction of sample size and defines requirements on handling and storage of samples.

NOTE 1 If higher precision of analytical results is needed or when in doubt if this document is applicable ISO 18135 can be used. Using the number of increments given in this document the resulting precision for analytical results can be estimated with the formulas given in ISO 18135.

NOTE 2 Pellets can generate CO and CO_2 off gasses by nature. If pellets are sampled, check for CO and CO_2 and O_2 levels prior and during the sample taking process in a confined space like a container, silo or shed and have another person standby at the entrance.

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 14780, *Solid biofuels — Sample preparation*

ISO 16559, *Solid biofuels — Terminology, definitions and descriptions*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at http://www.electropedia.org/

3.1
combined sample
sample consisting of all the increments taken from a *lot* or *sub-lot*

Note 1 to entry: The *increments* may be reduced by division before being added to the combined *sample.*

[SOURCE: ISO 16559:2014, 4.52]

3.2
increment
portion of fuel extracted in a single operation of the *sampling* device

[SOURCE: ISO 16559:2014, 4.122]

3.3
laboratory sample
combined *sample* or a sub-sample of a combined sample for use in a laboratory

[SOURCE: ISO 16559:2014, 4.124]

3.4
lot
defined quantity of fuel for which the quality is to be determined

[SOURCE: ISO 16559:2014, 4.128, modified — Note 1 to entry has been removed.]

3.5
nominal top size
aperture size of the smallest sieve through which at least 95 % by mass of the material passes during the determination of particle size distribution

Note 1 to entry: For selection of sieves types and aperture sizes see ISO 17827-1 and ISO 17827-2.

Note 2 to entry: For pellets the diameter is used.

[SOURCE: ISO 16559:2014, 4.137, modified — Note 1 and 2 to entry have been added for additional information, the word "smallest" has been added and the words "of solid fuels" have been deleted.]

3.6
sample
quantity of material, representative of a larger quantity for which the quality is to be determined

[SOURCE: ISO 16559:2014, 4.170, modified — "(all increments)" has been removed from the definition, Note 1 to entry has been removed.]

3.7
sub-lot
part of a *lot* for which a test result is required

EXAMPLE Material in a transport unit or on a particular stockpile.

[SOURCE: ISO 16559:2014, 4.197, modified — Example has been added.]

3.8
sub-sample
portion of a *sample*

[SOURCE: ISO 16559:2014, 4.198]

4 Symbols and abbreviated terms

d_{95} is the nominal top size of the biofuel [mm];

m is the mass of the lot or sublot [kg or t];

V_{incr} is the minimum volume of an increment [l];

V_{req} is the volume required for the foreseen analyses [l];

W is the width of a sampling tool [mm].

5 Principle

The main principle of sampling is to obtain (a) representative sample(s) from the whole lot concerned. Every particle in the lot or sub-lot to be represented by the sample should have an equal probability of being included in the sample. In order to do so a sampling plan is needed. Figure 1 shows the main steps of a sampling procedure.

Under certain circumstances (e.g. certain construction types of built in storages, silos or containers) representative sampling might not be possible.

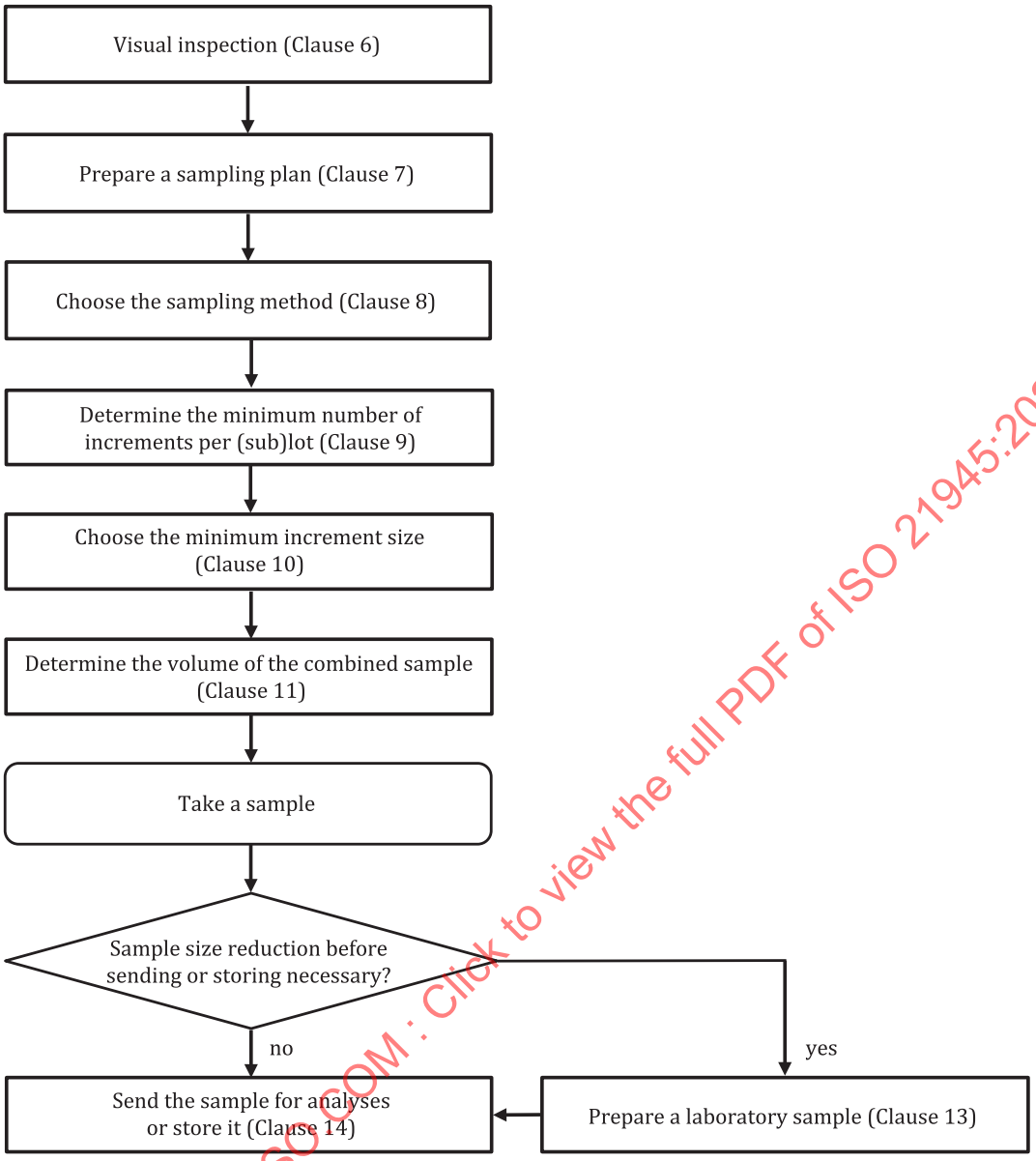


Figure 1 — Procedure for sampling

6 Visual inspection

Visual inspection shall be used for the choice or verification of the classification of the solid biofuels. Based on the sampling plan, verification or selection of the sampling equipment and the sampling method shall also be made by visual inspection. If the lot/sub-lot consists of substantially inhomogeneous material or if it contains impurities (such as soil or pieces of metal) this shall be stated in the sampling report. If the biofuel type or the quality of it is diverging strongly from the one expected, the sampler shall report without any delay to the appropriate party for further instructions.

If the particle size distribution should be analysed the visible surface of the complete lot should be inspected for the longest particle — in addition to the sampling and testing — and its length shall be noted in the sampling report.

NOTE 1 It is advisable to take photographs of deviations noted during visual inspection.

NOTE 2 For documentation of oversized particles photographs are useful. Therefore, it is advisable to include a folding rule or any other scale into the photograph to enable the estimation of the particles size.

7 Preparing sampling plan and report

The sampler shall prepare the sampling plan. The sampling plan may be prepared either by using a copy of the form presented in Annex A or by preparing his own forms or documents containing the appropriate items selected from those shown in Annex A.

Once completed, this form becomes a sampling report.

The sampling plan shall include the key elements:

a) a reference to this document (ISO 21945:2020);

b) the unique identification code of the sample;

c) the name and contact data of the sampler;

d) the date and time of sampling;

e) information required in order to identify the origin of the sample (e.g. supplier(s), location of storage, customer, trade name);

f) the type of lot or sub-lot (e.g. pile, silo, cargo hold, storage, lorry);

g) sampling from stationary or moving material;

h) the identification code of the lot or the sub-lot;

i) the mass or volume of the sub-lot or the lot;

j) the traded form of the biofuel (wood pellet, briquette, chips, etc.);

k) the number of increments;

l) the required volume of sample;

m) the volume of sample sent to the laboratory and number of packages if applicable;

n) the question, if the combined sample has been divided before sending to the laboratory;

o) the type of packaging of the sample sent to the laboratory (e.g. airtight container, plastic bag).

Also consider including the following items:

p) in case of sampling stationary material: location (centre, bottom, etc.) from where the sample was obtained (optional: mark sampling locations in a sketch);

q) storage information of the lot (e.g. how to reach the material, weather conditions, storage inside or outside, covered or uncovered);

r) the sampling technique, e.g. shovelling, sampling pipe, stopped belt, etc.;

s) existence of material of other origin in the same storage or pile (incl. estimated amount if possible), e.g. residues of a former lot of pellets in a pellet storage;

t) the approximate nominal top size (visual assessment);

u) any other details (e.g. visual inspection remarks).

8 Methods for sampling

8.1 General

It is difficult to take samples in a way that satisfies the principle of correct sampling, stating that all individual parts of the lot shall have an equal probability of becoming part of the final sample. The chance that this can be achieved when the material is stationary (for example in a silo, or stockpile, or in a lorry) is low. It is easier when the material is moving (for example, on a conveyor belt, or being loaded into or unloaded from transport equipment). Hence sampling from moving materials is to be preferred wherever possible, care shall be taken that fuel parameters (physical properties) to be analysed are not affected.

The following general aspects of sampling shall be considered:

a) Sampling equipment shall be properly cleaned and maintained. The equipment shall be controlled after every sampling to avoid contamination of following samples.

b) The integrity of the sampled material shall be ensured, e.g. avoiding loss or gain of moisture, formation of fines etc. E.g. working quickly and storing the sample in an airtight container, e.g. plastic bag or bucket during sampling could help avoiding loss or gain of moisture.

c) All increments belonging to one combined sample shall be:

   1) extracted in a uniform way,

   2) of equal weight or volume,

   3) transferred to the sampling bucket without any contamination or loss of material.

d) If an increment or combined sample mass (volume) is too large to be handled or transported, the mass shall be reduced in accordance with the methods described in ISO 14780.

e) All personnel performing sampling shall be properly instructed or trained in the specific use of the device and method.

f) All aspects of health and safety shall be considered.

8.2 Methods for sampling stationary material

8.2.1 Sampling from small packages (≤50 kg)

When sampling a lot consisting of individual packages, a primary increment consists of an entire or partial package. Packages (e.g. pellet bags) shall be chosen at random from the entire lot, making sure all packages have an equal probability of being selected. The number of selected packages shall be chosen from Table 1 (see Clause 9). Since the segregation of fines is not a problem as for stationary bulk material, the minimum number of increments specified for sampling moving material shall be chosen. In this case one package corresponds to one increment regardless of taking the whole package or a part of it as increment.

If the packages are transported on a conveyor (e.g. after bagging at the bagging line), a lot can be defined as a certain time frame, a certain number of packages or similar. Increments shall be chosen either systematically, randomly from defined strata, or completely at random, from the entire lot.

If the packages are stored, it is important to ensure that packages are chosen at random from the entire lot. It is recommended not to extract all increments from one pallet but from three pallets minimum.

In case it is necessary to minimize the number of opened pallets or when access to all pallets is difficult or impossible the possible consequences of not respecting the principle of correct sampling shall be stated in the sampling report.

If only a part of a package is taken as an increment, it shall be taken by using a scoop, in case of loose material (e.g. pellets), or by hand, in case of piece goods (e.g. briquettes). If the amount of fines or the share of overlong particles are to be analysed the package shall be emptied completely. Sample division is then to be performed according to Clause 13.

8.2.2 Sampling from transport containers and lorries

It is always recommended if possible, to sample when the biofuel is in motion, e.g. during loading or unloading.

It shall always be stated in the sampling report when a sampling device cannot reach the bottom of the container.

8.2.3 Sampling from small built-in storages

In general, it is difficult to take increments from all parts of a built-in storage or silo. The increments shall be extracted from different parts of the storage if possible, chosen according to the principle as given in Figure 2.

When sampling the storage, special care shall be taken to encompass the possible segregation of the material in the room, e.g. extract increments that cover the entire direction of segregation by selecting increments at different depths. For free-flowing materials, e.g. grain like material, dry olive kernels, pellets, etc. pipes or drills are recommended to be used. An example of a pipe (see Figure 5) and handling instructions are given in 12.7. An example of a drill (see Figure 6) and handling instructions are given in 12.8.

It is always recommended if possible, to sample when the biofuel is in motion, e.g. during loading or unloading.

It may be needed to take a sample from a storage that was not completely empty before refilling or from which a relevant share has been removed already. In this case some parameters cannot be measured representatively for the whole lot because of segregation of fine materials.

It shall always be stated in the sampling report when a sampling device cannot reach the complete area of the storage or its bottom, with the risk of underrepresenting a certain particle size fraction etc.

Using the fuel conveyor system (feeding screw and/or suction system) for sampling, the whole storage shall be emptied. This method should not be used if the storage contains fuel from more than one lot. Increments shall be taken from the whole content of the storage. This is to avoid sampling of any segregated material. Samples received by this method should not be used for mechanical parameters due to the mechanical stress from emptying the storage.

8.2.4 Sampling from stockpiles and stacked material

8.2.4.1 General

Stockpiles shall preferentially be sampled during build-up or reclaiming as this ensures accessibility to all parts of the lot which in turn minimizes the effect of segregating materials. Only relatively small stockpiles may be sampled while stationary using a wheel loader.

A scoop, shovel, fork, auger, grab or pipe shall be used to extract increments.

Sampling from an orderly stack shall be done by hand (i.e. firewood and bagged pellets). Provisions for personal safety shall be taken when sampling from large stacks.

8.2.4.2 Sampling from stockpiles during build up or reclaiming

Increments shall be extracted either from the working face of the stockpile, or from the bucket of a wheel loader or grab or from a single, discrete load delivered to the stockpile before being pushed into

the main stockpile. If a conveyor is used in stacking or reclaiming, or elsewhere in the material handling process, this is the optimal sampling point, and the methods for sampling moving material shall be used (see 8.3).

When sampling the working face of the pile, consider the possible (rolling) segregation on the surface. Ensure that a manual auger, shovel or scoop is inserted at right angles to the surface, and that insertion of the auger is spread evenly over the entire surface of the pile. No portion of the increment should be lost during extraction of the scoop from the surface. Owing to the difficulty of insertion, an auger shall be used only for fuels on which a full column of fuel can be extracted so that a representative increment is taken.

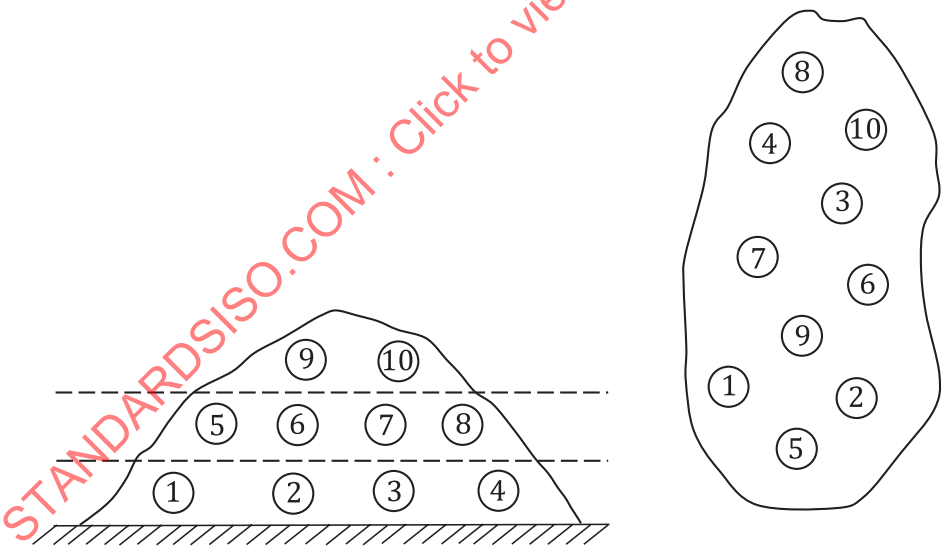
If sampling is performed from selected wheel loader buckets or grabs, take the increments according to the method described in 8.3.4.

8.2.4.3 Sampling from stationary stockpiles and stacks

When sampling from a stockpile it shall be decided at which height the increments shall be taken, therefore the sampler shall visually divide the heap into three horizontal layers and take a number of increments from each layer in proportion to the volume contained in each layer. The positions around the circumference of the heap from which the increments are taken shall be equally spaced. A wheel loader may be used to dig into the heap to reach the sampling points. Collecting samples from the absolute bottom and edges of the pile should amongst others be avoided, to avoid impurities. Figure 2 shows a possible arrangement of the sampling points on a heap.

When sampling material from a stack (firewood, briquettes, pellets bags), the increments shall be chosen according to the same principles as for stockpiles [Figure 2 a)].

NOTE To take an increment from the lower part of a stack it could be necessary to reclaim a part of the stack.



a) Cross section **b) View from above**

Figure 2 — View on a small stockpile with an example of sampling points

If there is any reason to suspect that the material in the stockpile is segregated, then the material shall be moved (e.g. into a new stock pile) and the increments shall be taken during the reclaiming or build up as described in 8.2.4.2.

8.3 Methods for sampling moving material

8.3.1 General

The lot or sub-lot shall be defined as all the material in a container (ship hold, wagon, etc.) that the sample is to represent, or in the case of continuous production or conveying, all the material passing the sampling point during a specified time interval. Preferable an interval can also be defined in terms of mass or volume.

Increments shall be distributed over the entire lot according to one of two scenarios:

1) Systematic increment extraction: Increments are taken at fixed time, mass or volume intervals evenly spread over the entire lot.

2) Stratified random increment extraction: The lot is divided into equal strata (time, weight or volume) and an increment is taken from each at random. This approach is preferred when periodicities or cycles are expected in the process, to avoid taking increments at a frequency (or multiple thereof) coinciding with the frequency of the cycle.

8.3.2 Manual sampling from falling streams

Usually manual sampling is only suited for low mass flows. For higher mass flows mechanical equipment is recommended for safety reasons.

Sampling shall be carried out using a sampling bucket (see Figure 3) or other suitable equipment that is passed through the stream of falling material so that it cuts the whole cross section of the falling stream. The sampling bucket or other sampling equipment shall be large enough so that the container does not become full during sampling of the increment.

The sampling bucket or other sampling equipment shall be filled up to a minimum defined height when collecting an increment.

Sampling from falling streams can also be done by taking the increments from a variety of points representing the whole cross section of the falling stream of material. In these cases, careful attention shall be put on possible segregation of fuel flow.

If it is not possible to take the increment covering the entire cross section of the stream, it shall be clearly stated in the sampling report.

NOTE Keeping the sampling tool unnecessarily long in the falling stream can lead to segregation of the sample.

8.3.3 Manual sampling from conveyor belts

Samples shall be taken with a scoop across the direction of the mass flow. The samples shall be taken covering the whole width of the belt and in through the full depth of the material on the belt.

NOTE Keeping the scoop unnecessarily long in the production stream can lead to segregation of the sample.

8.3.4 Manual sampling from grabs and wheel loader buckets

A number of grab loads or wheel loader buckets shall be selected for sampling during the discharge of the lot or sub-lot.

Either take all of a selected grab load, a wheel loader bucket or a compartment of the drag conveyor as an increment, or take a smaller representative increment by:

a) Emptying the entire contents onto a clean, hard surface, and take an increment from the tipped material according to the method described in 8.2.4.2 (stockpiles, during build up/reclaiming).

b) Taking an increment out of the bucket, drag conveyor etc. by digging into the material as many times as feasible, and at different depths, to form a combined increment.

9 Minimum number of increments

The minimum number of increments to be taken from a lot or sub-lot to generate a sample is shown in Table 1.

Table 1 — Minimum number of increments to be sampled from a sub-lot or lot

Mass of sub-lot or lot, m	$m \leq 30$ t	30 t < $m \leq 100$ t
Sampling from moving material	5	10
Sampling from stationary material	10	15

When sampling small packages (≤50 kg), e.g. pellet bags, the number of increments specified for sampling moving material shall be chosen.

If it is not possible to take the required number of increments, it shall be stated in the sampling report.

10 Minimum size of increment

The minimum size (volume) of increments (V_{incr}) from bulk material is derived from Table 2. If the material which is to be sampled is not listed in Table 2 choose the minimum volume of the material in the list which is most similar in size and shape.

Table 2 — Required increment volumes

Material	**Minimum increment volume** l
Pellets, diameter: 6 mm	0,3
Pellets, diameter: 8 mm	0,5
Saw dust	0,3
Shavings	2
Small wood chips (P16, P31)	2
Wood chips	3
Hog fuel ($d_{95} \leq 100$ mm)	5

For large pieces (e.g. briquettes, fire wood, pellet bags), one increment correlates to one piece.

When sampling pellets from pellet bags the minimum volume per increment (see Table 2) shall be taken from every chosen bag.

The sampler shall choose and record the appropriate sampling tool. Take care, that increments are large enough to get a combined sample with a volume suitable for the analyses required. If the size of the combined sample is insufficient for the required analyses the number of increments could be enlarged instead of the increment size.

11 Determination of the volume of the combined sample

The sampler shall consider what tests are to be done and calculate the required volume needed for the required determinations (V_{req}). In particular, the calculation shall take into account the need in some test methods for duplicate test portions, and for extra material to be available in case dubious results are obtained. Information about the volume needed for particular analyses shall be provided by the laboratory carrying out the analyses. The volume for performing typical analyses for the most common solid biofuels may be found in Table 3.

One of the following options shall be used to get the combined sample:

a) All the increments are placed directly into one container to form a combined sample, which is sent to the laboratory. In this case the combined sample is also the laboratory sample.

b) The increments are mixed together to form a combined sample, which is divided and prepared as described in Clause 13.

c) Each increment is placed in a separate container and sent to the laboratory. The laboratory combines the increments to form the laboratory sample.

Table 3 — Sample volume required for analysis of selected solid biofuels

Solid biofuel	Required volume for analysis[a,b]		
	without bulk density and mechanical durability or particle size distribution	incl. mechanical durability or particle size distribution	incl. mechanical durability or particle size distribution and bulk density
Pellets	1 l	4 l[c]	12 l[c]
Saw dust	2 l	3 l	9 l
Wood chips, P16, P31, P45S	8 l	24 l	73 l[g]
Other wood chips, shavings	20 l	24 l	73 l[g]
Firewood[d]	10 pieces, min. 1 kg	20 pieces[e], min. 2 kg	60 l, min. 20 pieces
Briquettes[d]	10 pieces, min. 1 kg	depending to the briquette size[f]	depending to the briquette size[f]

[a] Analysis of the sample according to ISO 17225 (all parts). Calculation of the sampling volume for the parameter of size distribution is not required for pellets.

[b] Sample volume calculated on the basis of a single determination of the moisture content (and determination of the content according to the procedure in ISO 18134-1 or ISO 18134-2).

[c] For determination of fines additional 8 l to 10 l of sample are required.

[d] According to ISO 14780 a minimum number of pieces is required, due to the large size differences of firewood, additionally a minimum weight is given.

[e] For determination of particle diameter 20 pieces should be used.

[f] For necessary sample size to determine the mechanical durability see ISO 17831-2.

[g] Material used for the bulk density determination provided to be used for the particle size distribution determination.

12 Equipment for manual sampling

12.1 General

The equipment shall enable the sampler to take unbiased increments to provide a representative sample.

The volume of the sampling device shall conform with the required minimum increment volume (V_{incr}) as described in Clause 10. The opening of the sampling device shall be wide enough for normal oversized material particles to enter the sampling device. For sampling of pellets, the opening shall be minimum 70 mm.

Sampling tools shall be robust, and be able to withstand physical force, wear and prolonged use without compromising functionality.

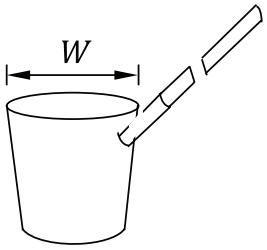
All moving parts should be accessible to inspection and maintenance.

The choice of sampling tool shall enable the sampler to extract the biofuel safely.

While using shovel, scoop or fork, one hand can be used to push sample material onto and to keep it on the device.

12.2 Sampling bucket for falling-stream

The sampling bucket should have a circular opening at the top as shown in Figure 3. Alternatively, it could have a square or rectangular opening. The dimensions of the top opening of the sampling bucket shall be large enough so that the container cuts the whole cross section of the stream to be sampled. The height of the sampling bucket shall be large enough to ensure that the container is filled at most up to the brim during sampling of the increment. The sampling bucket shall be provided with a handle or some other means of support (for instance mounted on rails) that enables the sampler to pass the container safely through the whole cross section of the falling stream of the biofuel to be sampled.



Key

W width of the sampling bucket

Figure 3 — Example of a sampling bucket

NOTE 1 For biofuel with large particle size, or high material flows, sampling buckets can become too big and heavy for manual sampling and mechanical sampling is recommended.

NOTE 2 A sampling bucket as illustrated in Figure 3 is commercially available as slurry scoop.

12.3 Scoops

A scoop may be designed as illustrated in Figure 4 a), complying with the general requirements for equipment design.

a) Scoops **b) Shovel** **c) Fork**

Key

W width of the scoop

NOTE 1 A scoop is best for sampling from a stationary pile.

NOTE 2 A fork is best for sampling loose hay and straw.

Figure 4 — Examples of scoops, a shovel and a fork

12.4 Shovels

A shovel may be designed as illustrated in Figure 4 b), conforming to the general requirements for equipment design.

12.5 Forks

When using a fork, see Figure 4 c), the smaller particles of the material being sampled will fall between the tines of the fork. The sampler shall check that the fork to be used for sampling a material has tines sufficiently close together to minimize the number of particles falling between them. Any material losses will affect the quality of the sample and may lead to a biased result.

12.6 Sample extraction using hands

In case the sample can't be taken using the equipment described in 12.2 to 12.5 (e.g. when sampling hog fuel with extremely long particles), sampling may be done by hand. Special attention shall be put on representative sampling; especially the loss of fine particles shall be avoided.

The sampling method shall be adapted to the type of material the sample has to be taken from. E.g. hog fuel could be moved by both hands into a bucket which is held at the brim of the load of a wheel loader, a heap or a stockpile.

12.7 Pipes (spears)

The sampling pipe shall not be used if the sample will be assigned to assess the amount of overlong particles. The holes in the sampling pipe should be positioned as illustrated in Figure 5, and the pipe shall be constructed so that the holes open one after the other starting with the hole closest to the tip of the pipe. A sampling pipe is suitable only for sampling free flowing granular and uniform materials. The length of the pipe shall be sufficient to reach all the way into the container or heap. The opening of the holes in the pipe shall be wide enough in one direction for normal oversized particles (e.g. maximum size of classified material) to enter the sampling device. The equipment is not suitable for material with normal overlong particles exceeding the maximum size of the holes of the spear. The dimensions of the holes in the pipe shall be at least 70 × 20 mm. The volume of the pipe shall ensure to take an increment of a sufficiently high volume according to Clause 10.

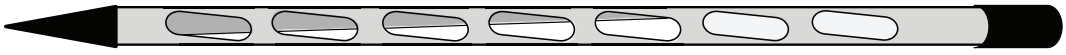


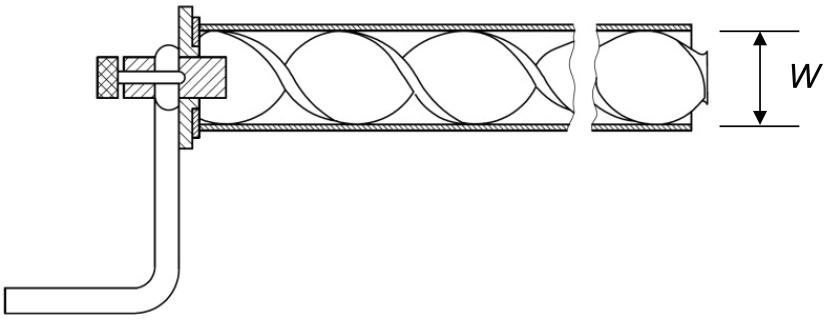
Figure 5 — Example of a pipe (spear)

When using a sampling pipe insert it into the material at an angle between 30° and 90°. Insert the pipe completely before opening the sampling holes. Shaking the pipe may help to fill it. Take care when removing the increment from the pipe to collect all the fine particles.

12.8 Drills (augers)

A drill should be used only in situations when no other sampling tools work. A drill, see Figure 6, may be manually or mechanically driven. For baled materials the drill may be driven by a brace or an electrical

motor. The centre should be encapsulated to prevent gaining or losing material that does not belong to the increment.



Key

W width of the drill opening

Figure 6 — Example of a drill

13 Reduction of sample size

Sample size reduction shall be done if the size of the combined sample exceeds the size of the sample which has to be sent to the laboratory.

The method of coning and quartering may be used for bulk materials that may be manually worked with a shovel. It is suitable for producing sub-samples of these materials down to approximately 1 kg. For the purpose of homogenization, place the whole combined sample on a clean, hard surface. Shovel the sample into a conical pile, placing each shovel full on top of the preceding one in such a way that the biofuel runs down all sides of the cone and is evenly distributed and different particle sizes become well mixed. Repeat this process. Flatten the cone by inserting the shovel repeatedly and vertically into the peak of the cone to form a flat heap that has a uniform thickness and diameter and is no higher than the blade of the shovel. Quarter the flat heap along two diagonals at right angles by inserting the shovel vertically into the heap (see Figure 7). A sheet-metal cross may be used for this operation if available. Discard one pair of opposite quarters. Repeat the coning and quartering process until a sub-sample of the required size is obtained. Care should be taken to keep all particles belonging to the quarters to be sampled especially with materials and particles that tend to roll off the pile and cause segregation.