INTERNATIONAL STANDARD

ISO 17225-6

First edition
2014-05-01

Solid biofuels — Fuel specifications and classes —

Part 6: Graded non-woody pellets

Biocombustibles solides — Classes et spécifications des combustibles —

Partie 6: Classes de granulés d'origine agricole

Reference number
ISO 17225-6:2014(E)

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Published in Switzerland

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

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).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

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 17225 consists of the following parts, under the general title *Solid biofuels — Fuel specifications and classes*:

- *Part 1: General requirements*
- *Part 2: Graded wood pellets*
- *Part 3: Graded wood briquettes*
- *Part 4: Graded wood chips*
- *Part 5: Graded firewood*
- *Part 6: Graded non-woody pellets*
- *Part 7: Graded non-woody briquettes*

Introduction

The objective of the ISO 17225 series is to provide unambiguous and clear classification principles for solid biofuels and to serve as a tool to enable efficient trading of biofuels and to enable good understanding between seller and buyer as well as a tool for communication with equipment manufacturers. It will also facilitate authority permission procedures and reporting.

This part of ISO 17225 supports the use of graded non-woody pellets for residential, small commercial and public buildings as well as industrial energy generation applications, which require classified pellet quality.

The residential, small commercial and public building applications require higher quality fuel for the following reasons:

- Small-scale equipment does not usually have advanced controls and flue gas cleaning
- Appliances are not generally managed by professional heating engineers
- Appliances are often located in residential and populated districts

Non-woody pellets have high ash, chlorine, nitrogen and sulfur content and major element contents, so non-woody pellets are recommended to be used in appliances, which are specially designed or adjusted for this kind of pellet.

NOTE 1 Pellets produced according to this part of ISO 17225 may be used in pellet burners tested according to EN 15270[1] and pellet boilers or integrated-pellet burner systems tested according to EN 303–5[2].

NOTE 2 When using non-woody materials for combustion special attention should be paid to the risk of corrosion in small and medium scale boilers and flue gas systems. Be aware that herbaceous or fruit biomass may influence the fuel ash composition differently depending on growth and soil conditions. The content of chlorine, phosphate and potassium in the material may form chlorides and phosphates and other chemical compounds resulting in high hydrochloric emissions and chemically active ash with low melting temperature causing corrosion.

NOTE 3 In general non-woody biomass materials have higher content of ash forming elements and produces ashes with lower melting temperature compared to most woody biomass. This may result in fouling, slagging and corrosion inside boilers. These problems are especially related to materials that contain high content of potassium (K) and silicate (Si) and low content of calcium (Ca).

NOTE 4 For individual contracts ISO 17225-1 can be used.

Although these product standards may be obtained separately, they require a general understanding of the standards based on and supporting ISO 17225-1. It is recommended to obtain and use ISO 17225-1 in conjunction with these standards

Solid biofuels — Fuel specifications and classes —

Part 6: Graded non-woody pellets

1 Scope

This part of ISO 17225 determines the fuel quality classes and specifications of graded non-woody pellets. This part of ISO 17225 covers only non-woody pellets produced from the following raw material (see ISO 17225-1, Table 1):

– 2 Herbaceous biomass

NOTE 1 *Herbaceous biomass* is from plants that have a non-woody stem and which die back at the end of the growing season. It includes grains or seeds crops from food production or processing industry and their by-products such as cereals.

– 3 Fruit biomass

– 4 Aquatic biomass

– 5 Biomass blends and mixtures

NOTE 2 Group 5 *Blends and mixtures* include blends and mixtures from the main origin-based solid biofuel groups woody, herbaceous biomass, fruit biomass and aquatic biomass.

Blends are intentionally mixed biofuels, whereas mixtures are unintentionally mixed biofuels. The origin of the blend and mixture is to be described using ISO 17225-1, Table 1.

If solid biofuel blend or mixture contains chemically treated material it shall be stated.

NOTE 3 Thermally treated biomass pellets (e.g. torrefied pellets) are not included in the scope of this part of ISO 17225. Torrefaction is a mild pre-treatment of biomass at a temperature between 200 °C to 300 °C.

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.

NOTE ISO standards describing methods for analysis of fuel properties listed in the Bibliography, will become normative references when they are published.

ISO 16559, *Solid biofuels — Terminology, definitions and descriptions*[1)]

ISO 16948, *Solid biofuels — Determination of total content of carbon, hydrogen and nitrogen*[2)]

ISO 16968, *Solid biofuels — Determination of minor elements*[3)]

ISO 16994, *Solid biofuels — Determination of total content of sulfur and chlorine*[4)]

1) To be published.

2) To be published.

3) To be published.

4) To be published.

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

ISO 17828, *Solid biofuels — Determination of bulk density*[5)]

ISO 17829, *Solid Biofuels — Determination of length and diameter of pellets*[6)]

ISO 17831-1, *Solid biofuels — Determination of mechanical durability of pellets and briquettes — Part 1: Pellets*[7)]

ISO 18122, *Solid biofuels — Determination of ash content*[8)]

ISO 18134-1, *Solid biofuels — Determination of moisture content — Oven dry method — Part 1: Total moisture — Reference method*[9)]

ISO 18134-2, *Solid biofuels — Determination of moisture content — Oven dry method — Part 2: Total moisture — Simplified method*[10)]

3 Terms and definitions

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

3.1
non-woody pellet
densified biofuel made from grinded or milled biomass with or without additives and unitized as cylinders, usually diameter < 25 mm, random length and typically 3,15 mm to 40 mm with broken ends, obtain by mechanical compression

Note 1 to entry: The raw material for non-woody pellets can be herbaceous biomass, fruit biomass, aquatic biomass or biomass blends and mixtures. These blends and mixtures can also include woody biomass. They are usually manufactured in a die with total moisture content usually less than 15 % of their mass.

3.2
additive
material which has been intentionally introduced into the fuel feed stock to improve quality of fuel (e.g. combustion properties), to reduce emissions or to make production more efficient

Note 1 to entry: Trace amounts of e.g. grease or other lubricants that are introduced into the fuel processing stream as part of normal mill operations are not considered as additives.

3.3
chemical treatment
any treatment with chemicals other than air, water or heat

Note 1 to entry: Examples of chemical treatment are listed in informative Annex C of ISO 17225-1.

3.4
commercial application
facility that utilize solid biofuel burning appliances or equipment that have similar fuel requirements as residential appliances

Note 1 to entry: Commercial applications should not be confused with industrial applications, which can utilize a much wider array of materials and have vastly different fuel requirements.

5) To be published.

6) To be published.

7) To be published.

8) To be published.

9) To be published.

10) To be published.

4 Symbols and abbreviated terms

The symbols and abbreviated terms used in this part of ISO 17225 comply with the SI system of units as far as possible.

d	dry (dry basis)
ar	as received
w-%	weight-percentage
A	Designation for ash content on dry basis, A_d [w-%]
BD	Designation for bulk density as received [kg/m^3]
D	Designation for diameter as received, D [mm]
DU	Designation for mechanical durability as received [w-%]
F	Designation for amount of fines as received [w-%, particles less than 3,15 mm]
L	Designation for length as received, L [mm]
M	Designation for moisture content as received on wet basis, M_{ar} [w-%]
Q	Designation for net calorific value as received, $q_{p,net,ar}$ [MJ/kg or kWh/kg or MWh/t] at constant pressure

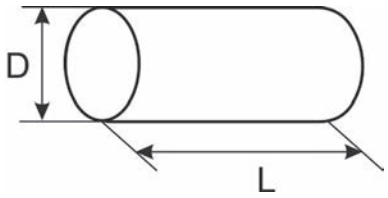
NOTE 1 1 MJ/kg equals 0,2778 kWh/kg (1 kWh/kg equals 1 MWh/t and 1 MWh/t is 3,6 MJ/kg). 1 g/cm^3 equals 1 kg/dm^3. 1 mg/kg equals 0,000 1 % or 1 ppm.

NOTE 2 Designation symbols are used in combination with a number to specify property levels in Tables 1 and 2. For designation of chemical properties, chemical symbols like S (sulfur), Cl (chlorine), N (nitrogen) are used and the property class is added at the end of the symbol.

5 Specification of graded non-woody pellets

Specification of non-woody pellets produced from other herbaceous, fruit, aquatic biomass and blends and mixtures are stated in accordance with Table 1 and Figure 1. Specifications of the non-woody pellets from cereal straw, Miscanthus and reed canary grasses are stated in accordance with Table 2 and Figure 1. Sampling and analysis of the properties shall be carried out in accordance with the methods mentioned in the normative references.

Chemical treatment before harvesting of biomass does not need to be stated. Where any operator in the fuel supply chain has reason to suspect serious contamination of land (e.g. coal slag heaps) or if planting has been used specifically for the sequestration of chemicals or growing biomass is fertilised by sewage sludge (originating from waste water treatment or chemical process), fuel analysis should be carried out to identify chemical impurities such as halogenated organic compounds or heavy metals. In case of raw materials belonging to 2.2.2 and 3.2.2 (chemically treated herbaceous and fruit biomass according to ISO 17225-1, Table 1) the actual origin of the raw material shall be clearly described.



Key

D diameter

L length

Figure 1 — Dimension of pellets

If data for chemical or physical properties are available, further analysis may not be required.

To ensure resources are used appropriately and the declaration is accurate, use the most appropriate measure below:

1) using previous measured values or obtained by experience of same raw material;

2) calculation of properties, e.g. by using typical values and considering generally accepted and documented specific values;

3) carrying out of analysis:

   a) with simplified methods if available;

   b) with reference methods.

The responsibility of the producer or supplier to provide correct and accurate information is exactly the same whether laboratory analysis is performed or not. Typical values do not negate the producer or supplier from providing accurate and reliable information.

NOTE It is important to carry out laboratory analysis, if the raw material basis is changed.

To ensure the end-user receives pellets with a low level of fines, the amount of fines shall be stated when leaving the final point of loading for delivery to the end-user (see Table 1 and Table 2). Between factory gates and the end-user, distributors should take appropriate measures to maintain this low level of fines.

To ensure that pellets maintain their quality, the handling and storage (including the equipments) shall be appropriate at different stages of supply or delivery chain ending to the end-user storage.

NOTE The fines requirement has been included to ensure small-scale users are protected from handling and combustion issues while operating their combustion plant/appliance.

The quality shall be given either in the product declaration or by a corresponding label on the package.

Table 1 — Specification of pellets produced from herbaceous biomass, fruit biomass, aquatic biomass and blends and mixtures

	Property class, Analysis method	**units**	**A**	**B**
Normative	**Origin and source** [a], ISO 17225-1, Table 1		2 Herbaceous biomass 3 Fruit biomass 4 Aquatic biomass 5 Blends and mixtures	2 Herbaceous biomass 3 Fruit biomass 4 Aquatic biomass 5 Blends and mixtures
	Diameter, *D* [b] and **Length *L*** [c], ISO 17829 According to Figure 1	mm	D06 to D25, *D* ± 1; 3,15 < L ≤ 40 (from D06 to D10) 3,15 < L ≤ 50 (from D12 to D25)	D06 to D25, *D* ± 1; 3,15 < L ≤ 40 (from D06 to D10) 3,15 < L ≤ 50 (from D12 to D25)
	Moisture, M, ISO 18134-1, ISO 18134-2	w-% as received, wet basis	M12 ≤ 12	M15 ≤ 15
	Ash, A, ISO 18122	w-% dry	A6.0 ≤ 6	A10 ≤ 10
	Mechanical durability, DU, ISO 17831-1	w-% as received	DU97.5 ≥ 97,5	DU96.0 ≥ 96,0
	Fines, F [d], ISO 18846	w-% as received	F2.0 ≤ 2,0	F3.0 ≤ 3,0
	Additives [e]	w-% as received	≤ 5 Type and amount to be stated	≤ 5 Type and amount to be stated
	Net calorific value, Q, ISO 18125	MJ/kg or kWh/kg as received	Q14.5 ≥ 14,5 or Q4.0 ≥ 4,0	Q14.5 ≥ 14,5 or Q4.0 ≥ 4,0
	Bulk density, BD, ISO 17828	kg/m^3 as received	BD600 ≥ 600	BD600 ≥ 600
	Nitrogen, N, ISO 16948	w-% dry	N1.5 ≤ 1,5	N_2.0 ≤ 2,0
	Sulfur, S, ISO 16994	w-% dry	S0.20 ≤ 0,20	S0.30 ≤ 0,30
	Chlorine, Cl, ISO 16994	w-% dry	Cl0.10 ≤ 0,10	Cl0.30 ≤ 0,30
	Arsenic, As, ISO 16968	mg/kg dry	≤ 1	≤ 1
	Cadmium, Cd, ISO 16968	mg/kg dry	≤ 0,5	≤ 0,5
	Chromium, Cr, ISO 16968	mg/kg dry	≤ 50	≤ 50
	Copper, Cu, ISO 16968	mg/kg dry	≤ 20	≤ 20
	Lead, Pb, ISO 16968	mg/kg dry	≤ 10	≤ 10
	Mercury, Hg, ISO 16968	mg/kg dry	≤ 0,1	≤ 0,1
	Nickel, Ni, ISO 16968	mg/kg dry	≤ 10	≤ 10
	Zinc, Zn, ISO 16968	mg/kg dry	≤ 100	≤ 100
Informative	**Ash melting behaviour** [f], CEN/TS 15370–1 [3]	°C	Should be stated	Should be stated

[a] To be stated the 4-digit classification (Table 1 ISO 17225-1). Blends and mixtures can include also woody biomass. If composition of blend is known, the w-% can be used to specify blends. *Example 1*: 80 w-% 2.1.1.2 Straw, 20 w-% 2.1.2.2 Grasses, straw plant. In the case of mixture, the main component should be stated first. *Example 2:* 2.1.1.2 Straw, 2.1.2.2 Grasses, straw plant.

[b] Selected size (e.g. D06, D08, D10, D12 or D25) of pellets to be stated

[c] Amount of pellets longer than 40 mm can be 1 w-% (from D06 to D10). Maximum length shall be ≤ 45 mm for pellets from D06 to D10. Pellets are longer than 3,15 mm, if they stay on a round hole-sieve of 3,15 mm.

[d] At factory gate in bulk transport (at the time of loading) and in small (up to 20 kg)and large sacks (at time of packing or when delivering to end-user).

[e] Type of additives to aid production, delivery or combustion (e.g. pressing aids, slagging inhibitors or any other additives like starch, corn flour, potato flour, vegetable oil, lignin).

[f] It is recommended that all characteristic temperatures (shrinkage starting temperature (SST), deformation temperature (DT), hemi-sphere temperature (HT) and flow temperature (FT)) in oxidizing conditions should be stated.

Table 2 — Specification of pellets produced from cereal straw, miscanthus and reed canary grass

	Property class, Analysis method	**units**	**Cereal Straw pellets**	**Miscanthus pellets** (*Miscanthus Giganteus*)	**Reed canary grass pellets** (*Phalaris arundinacea L.*)
Normative	**Origin and source**, ISO 17225-1, Table 1		2.1.1.2 Straw parts	2.1.2.1 Grasses, Whole plant	2.1.2.1 Grasses, Whole plant
	Diameter, *D* [a] and **length *L***, [b] ISO 17829 According to Figure 1	mm	D06 to D25, *D* ± 1; 3,15 < L ≤ 40 (from D06 to D10) 3,15 < L ≤ 50 (from D12 to D25)	D06 to D25, *D* ± 1; 3,15 < L ≤ 40 (from D06 to D10) 3,15 < L ≤ 50 (from D12 to D25)	D06 to D25, *D* ± 1; 3,15 < L ≤ 40 (from D06 to D10) 3,15 < L ≤ 50 (from D12 to D25)
	Moisture, M, ISO 18134-1, ISO 18134-2	w-% as received, wet basis	M10 ≤ 10	M10 ≤ 10	M12 ≤ 12
	Ash, A[c], ISO 18122	w-% dry	A6.0 ≤ 6 A6.0+ > 6 [d]	A4.0 ≤ 4 A4.0+ > 4 [d]	A8.0 ≤ 8 A8.0 + > 8 [d]
	Mechanical durability, DU, ISO 17831-1	w-% as received	DU97.5 ≥ 97,5	DU97.5 ≥ 97,5	DU96.5 ≥ 96,5
	Fines, F [d], ISO 18846	w-% as received	F1.0 ≤ 1,0	F1.0 ≤ 1,0	F1.0 ≤ 1,0
	Additives [f]	w-%, dry	Type and amount to be stated	Type and amount to be stated	Type and amount to be stated
	Net calorific value, Q, ISO 18125	as received, MJ/kg or kWh/kg	Minimum value to be stated	Minimum value to be stated	Q14.5 ≥ 14,5 Q4.0 ≥ 4,0
	Bulk density, BD, ISO 17828	kg/m^3 as received	BD600 ≥ 600	BD580 ≥ 580	BD550 ≥ 550
	Nitrogen, N, ISO 16948	w-% dry	N0.7 ≤ 0,7	N0.5 ≤ 0,5	N 2.0 ≤ 2,0
	Sulfur, S, ISO 16994	w-% dry	S0.10 ≤ 0,10	S0.05 ≤ 0,05	S0.20 ≤ 0,20
	Chlorine, Cl, ISO 16994	w-% dry	Cl0.10 ≤ 0,10	Cl0.08 ≤ 0,08	Cl0.10 ≤ 0,10
	Arsenic, As, ISO 16968	mg/kg dry	≤ 1	≤ 1	≤ 1
	Cadmium, Cd, ISO 16968	mg/kg dry	≤ 0,5	≤ 0,5	≤ 0,5
	Chromium, Cr, ISO 16968	mg/kg dry	≤ 50	≤ 50	≤ 50
	Copper, Cu, ISO 16968	mg/kg dry	≤ 20	≤ 20	≤ 20
	Lead, Pb, ISO 16968	mg/kg dry	≤ 10	≤ 10	≤ 10
	Mercury, Hg, ISO 16968	mg/kg dry	≤ 0,1	≤ 0,1	≤ 0,1
	Nickel, Ni, ISO 16968	mg/kg dry	≤ 10	≤ 10	≤ 10
	Zinc, Zn, ISO 16968	mg/kg dry	≤ 100	≤ 100	≤ 100
Informative	**Ash melting behaviour** [g], CEN/TS 15370–1 [3]	°C	Should be stated	Should be stated	Should be stated

[a] Selected size (e.g. D06, D08, D10, D12 or D25) of pellets to be stated

[b] Amount of pellets longer than 40 mm can be 1 w-% (for D06 to D10). Maximum length shall be ≤ 45 mm for pellets for D06 to D10. Pellets are longer than 3,15 mm, if they stay on a round hole-sieve of 3,15 mm.

[c] Actual ash property class shall be stated.

[d] Value to be stated.

[e] At factory gate in bulk transport (at the time of loading) and in small (up to 20 kg)and large sacks (at time of packing or when delivering to end-user).

[f] Type of additives to aid production, delivery or combustion (e.g. pressing aids, slagging inhibitors or any other additives like starch, corn flour, potato flour, vegetable oil, lignin).

[g] It is recommended that all characteristic temperatures (shrinkage starting temperature (SST), deformation temperature (DT), hemisphere temperature (HT) and flow temperature (FT)) in oxidizing conditions should be stated.

Bibliography

[1] EN 15270:2007, *Pellet burners for small heating boilers — Definitions, requirements, testing, marking*

[2] EN 303-5:2012, *Heating boilers. Part 5: Heating boilers for solid fuels, manually and automatically stoked, nominal heat output of up to 500 kW. Terminology, requirements, testing and marking*

[3] CEN/TS 15370-1:2006, *Solid Biofuels — Determination of ash melting behaviour — Part 1: Characteristic temperatures method*

[4] ISO 14780, *Solid biofuels — Sample preparation*[11)]

[5] ISO 18135, *Solid biofuels — Sampling*[12)]

[6] ISO 18125, *Solid Biofuels — Determination of calorific value*[13)]

[7] ISO 18846, *Solid biofuels — Determination of fines content in quantities of pellets — Manual sieve method using 3,15 mm sieve aperture*[14)]

11) Under development.

12) Under development.

13) Under preparation.

14) Under preparation.

ICS 27.190;75.160.10

Price based on 7 pages