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Solid biofuels — Fuel specifications and classes —

Part 1:
General requirements

Biocombustibles solides — Classes et spécifications des combustibles —

Partie 1: Exigences générales

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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 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.

This second edition cancels and replaces the first edition ISO 17225-1:2014, which has been technically revised. The main changes compared to the previous edition are as follows:

— particle size distribution for wood chips and hog fuel updated

— Table 15 for undensified thermally treated biomass deleted

A list of all parts in the ISO 17225 series can be found on the ISO website.

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 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.

The ISO 17225 series is made for all stakeholders.

Solid biomass covers organic, non-fossil material of biological origin which may be used as fuel for heat and electrical generation.

Figure 1 describes the bioenergy utilization chain from sources of biomass, to biofuel production to final use of bioenergy. Although biomass can be used for energy generation it has many other primary uses (non-fuels) as a raw material for construction, furniture, packaging, paper products, etc.

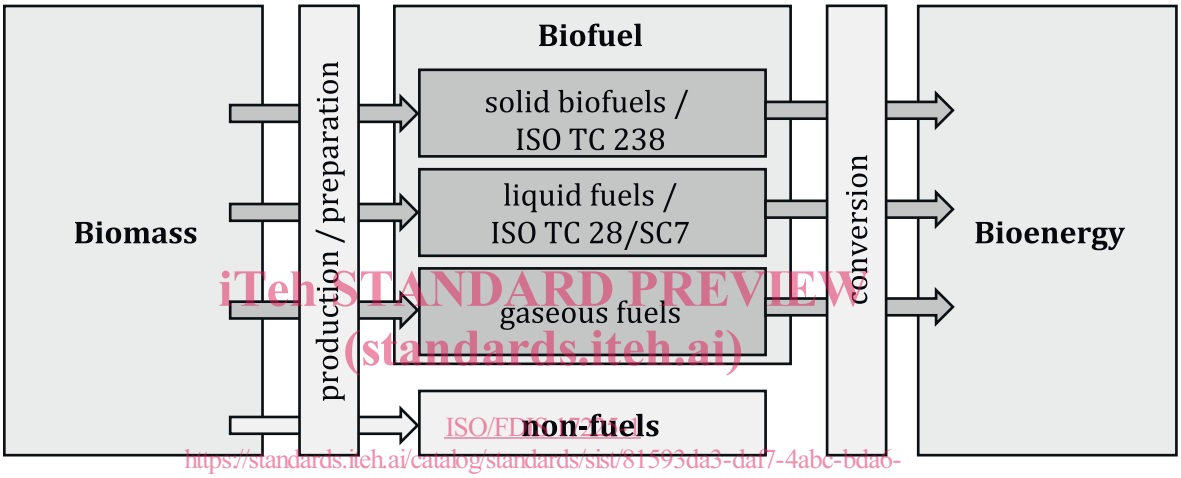

Figure 1 — ISO TC 238 within the biomass — Biofuel — Bioenergy field

The classifications given in this document are provided with the objective of using biomass as a solid biofuel and therefore do not deal with all other uses.

Although the product standards starting from Part 2 of the ISO 17225 series 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.

In the product standards, graded means that solid biofuel is used either in commercial applications, such as in households and small commercial and public sector buildings or industrial applications, which demand the use of fuels with specified quality (properties) expressed by quality classes like A1, A2 or B.

Solid biofuels — Fuel specifications and classes —

Part 1: General requirements

1 Scope

This document determines the fuel quality classes and specifications for solid biofuels of raw and processed materials originating from

a) forestry and arboriculture;

b) agriculture and horticulture;

c) aquaculture.

Chemically treated material may not include halogenated organic compounds or heavy metals at levels higher than those in typical virgin material values (see Annex B) or higher than typical values of the country of origin.

NOTE Raw and processed material includes woody, herbaceous, fruit, aquatic biomass and biodegradable waste originating from above sectors.

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*

ISO 16948, *Solid biofuels — Determination of total content of carbon, hydrogen and nitrogen*

ISO 16967, *Solid biofuels — Determination of major elements — Al, Ca, Fe, Mg, P, K, Si, Na and Ti*

ISO 16968, *Solid biofuels — Determination of minor elements*

ISO 16993, *Solid biofuels — Conversion of analytical results from one basis to another*

ISO 16994, *Solid biofuels — Determination of total content of sulfur and chlorine*

ISO 17827-1, *Solid biofuels — Determination of particle size distribution for uncompressed fuels — Part 1: Oscillating screen method using sieves with apertures of 3,15 mm and above*

ISO 17827-2, *Solid biofuels — Determination of particle size distribution for uncompressed fuels — Part 2: Vibrating screen method using sieves with aperture of 3,15 mm and below*

ISO 17828, *Solid biofuels — Determination of bulk density*

ISO 17829, *Solid Biofuels — Determination of length and diameter of pellets*

ISO 17830, *Solid biofuels — Particle size distribution of disintegrated pellets*

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

ISO 17831-2, *Solid biofuels — Determination of mechanical durability of pellets and briquettes — Part 2: Briquettes*

ISO 18122, *Solid biofuels — Determination of ash content*

ISO 18123, *Solid biofuels — Determination of the content of volatile matter*

ISO 18125, *Solid biofuels — Determination of calorific value*

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

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

ISO 18135, *Solid Biofuels — Sampling*

ISO 18847, *Solid biofuels — Determination of particle density of pellets and briquettes*

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

Note 1 to entry: Examples of chemical treatments are listed in informative Annex C.

3.2
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.

4 Symbols and abbreviated terms

The symbols and abbreviated terms used in this document conform with the SI system of units as far as possible,

A	Designation for ash content on dry basis A_d [% in mass]
ar	as received
BD	Designation for bulk density as received [kg/m^3 (loose volume)]

C	Designation for fixed carbon on dry basis C_f [% in mass]
CPF	Designation for amount of coarse pellet fines as reived [% in mass, particles ≥ 3,15 mm and < 5,6 mm]
D	Designation for diameter as received, *D* [mm]
DE	Designation for particle density as received [g/cm^3]
DT	Designation for deformation temperature of the fuel ash [°C]
DU	Designation for mechanical durability as received [% in mass]
d	dry (dry basis)
daf	dry, ash-free
E	Designation for energy density as received, E_{ar} [MJ/m^3 or kWh/m^3 loose or stacked volume] (amount of energy/volume unit)
F	Designation for amount of fines (< 3,15 mm) as determined [% in mass]
Fs	Designation for amount if small fines (< 1 mm) as determined (% in mass)
FT	Designation for flow temperature of the fuel ash [°C]
HT	Designation for hemisphere temperature of the fuel ash [°C]
L	Designation for length as received, *L* [mm]
M	Designation for moisture content as received, M_{ar} [% in mass]
P	Designation for particle size distribution on analysis moisture basis
Q	Designation for net calorific value as received, $q_{p,net,ar}$ [MJ/kg or kWh/kg] at constant pressure
$q_{V,gr,d}$	Gross calorific value at constant volume on dry basis [MJ/kg or kWh/kg]
$q_{p,net,d}$	Net calorific value at constant pressure on dry basis [MJ/kg or kWh/kg]
SST	Designation for shrinkage starting temperature of the fuel ash [°C]
s	Designation for small-scale and commercial use in particle size distribution
U	Designation for moisture content as received on dry basis U_{ar} [% in mass]
VM	Designation for volatile matter on dry basis [% in mass]

NOTE 1 Fixed carbon (%) is calculated by the following: 100 – (moisture [% in mass] + ash [% in mass] + volatile matter [% in mass]). All percentages are on the same moisture basis.

NOTE 2 1 MJ/kg equals 1 GJ/t or 0,277 8 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 %

NOTE 3 Designation symbols are used in combination with a number to specify property levels in Tables 3 to 15. For designation of chemical properties, chemical symbols such as S (sulfur), Cl (chlorine), and N (nitrogen) are used and the property class is added at the end of the symbol.

5 Principle

Solid biofuels are specified by:

a) origin and source, Clause 6;

b) major traded forms and properties, Clause 7.

For specification of origin and source, see Table 1. For major traded forms, see Table 2.

For specification of properties see Tables 3 to 15. The major traded forms of solid biofuels are covered by Tables 3 to 14. Table 15 is a general master table to be used for a specification of solid biofuels not covered by Tables 3 to 14.

Tables 3 to 15 list the normative properties, which shall be specified and informative properties, which are voluntary. Normative properties vary depending on both origin and traded form.

EXAMPLE OF SPECIFICATION

Origin: Logging residues (1.1.4)

Traded form: Wood chips

Properties: Dimensions P45, Fines F05, Moisture M40, Ash A1.5

In the case of wood chips and hog fuel (Table 5) the properties of dimensions, fines, moisture and ash are normative in the specification. Other properties are informative.

Product standards for graded solid biofuels are given in other parts of this ISO series.

6 Classification of origin and sources of solid biofuels

6.1 General

The classification is based on the biofuel origin and source. In the hierarchical classification system (Table 1) the main origin-based solid biofuel groups are:

a) woody biomass;

b) herbaceous biomass;

c) fruit biomass;

d) aquatic biomass;

e) blends and mixtures.

Woody biomass is biomass from trees, bushes and shrubs.

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 and their by-products.

Fruit biomass is biomass from those parts of a plant which are from or hold seeds.

Aquatic biomass is from so called hydrophytic plants or hydrophytes, which are plants that have adapted to living in or on aquatic environments.

If appropriate, also the actual species (e.g. spruce, wheat) of biomass should be stated.

The term “Blends and mixtures” in Table 1 refers to material of various origin within the given box in the classification table and appears on all four classification levels. Blends are intentionally mixed

biofuels, whereas mixtures are unintentionally mixed biofuels. The origin of the blend and mixture shall be described using Table 1.

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

The second level of classification in Table 1 describes fuels from different sources within the main groups, primarily stating whether the biomass is a virgin material, a by-product or a residue from the industry.

Groups in Table 1 are further divided into third and fourth level sub-groups. The purpose of Table 1 is to allow the possibility to differentiate and specify biofuel material based on origin with as much detail as needed. With the help of typical values from informative Annex B information on physical and chemical properties can be deduced.

Examples for classification according to Table 1:

a) Whole trees without roots from birch (1.1.1.1);

b) Blend (1.1.1.5) of broad-leaf and coniferous whole trees without roots (1.1.1.1, 1.1.1.2);

c) Oil palm stem (1.1.3.3);

d) Logging residues (1.1.4);

e) Oil palm branches (1.1.4.1);

f) Logging residues from spruce stands (1.1.4.2);

g) Sawdust from broad-leaf (1.2.1.1);

h) Plywood from coniferous (1.2.2.1);

i) Plywood residues (1.2.2.1);

j) Grinding dust from furniture industry (1.2.2.1);

k) Lignin (1.2.2.4);

l) Unpainted and untreated construction wood (1.3.1.1);

m) Pallets (1.3.1.1 or 1.3.2.1);

n) Demolition wood (1.3.2.1)

o) Straw from wheat, barley, oat, rye (2.1.1.2);

p) Rice husk (2.1.1.4);

q) Reed canary grass (2.1.2.1);

r) Bamboo (2.1.2.5);

s) Grains or seeds crops from food processing industry (2.2.1.1);

t) Palm kernel or palm shell (3.1.2.3);

u) Oil palm fruit bunch (3.2.1.2);

v) Olive residues from olive pressing (3.2.2.4);

w) Kelp (4.3.2.4, Latin name to be stated);

x) Blend (5.1); 80 % in mass sawdust from coniferous (1.2.1.2) and 20 % in mass reed canary grass (2.1.2.1);

y) Mixture (1.1.1.5); whole trees without roots from birch (1.1.1.1), whole trees without roots from spruce (1.1.1.2);

z) Blend (1.2.3); 99 % in mass sawdust (1.2.1), 1 % in mass glued wood (glue content of whole mass 0,1 % in mass) (1.2.2).

Table 1 — Classification of origin and sources of solid biofuels

1. Woody biomass	1.1 Forest, plantation and other virgin wood	1.1.1 Whole trees without roots	1.1.1.1 Broad-leaf 1.1.1.2 Coniferous 1.1.1.3 Short rotation coppice 1.1.1.4 Bushes 1.1.1.5 Blends and mixtures
		1.1.2 Whole trees with roots	1.1.2.1 Broad-leaf 1.1.2.2 Coniferous 1.1.2.3 Short rotation coppice 1.1.2.4 Bushes 1.1.2.5 Blends and mixtures
		1.1.3 Stemwood	1.1.3.1 Broad-leaf with bark 1.1.3.2 Coniferous with bark 1.1.3.3 Broad-leaf without bark 1.1.3.4 Coniferous without bark 1.1.3.5 Blends and mixtures
		1.1.4 Logging residues	1.1.4.1 Fresh/Green, Broad-leaf (including leaves) 1.1.4.2 Fresh/Green, Coniferous (including needles) 1.1.4.3 Stored, Broad-leaf 1.1.4.4 Stored, Coniferous 1.1.4.5 Blends and mixtures
		1.1.5 Stumps/roots	1.1.5.1 Broad-leaf 1.1.5.2 Coniferous 1.1.5.3 Short rotation coppice 1.1.5.4 Bushes 1.1.5.5 Blends and mixtures
		1.1.6 Bark (from forestry operations)	
		1.1.7 Segregated wood from gardens, parks, roadside maintenance, vineyards, fruit orchards and driftwood from freshwater	
		1.1.8 Blends and mixtures	

Table 1 *(continued)*

	1.2 By-products and residues from wood processing industry	1.2.1 Chemically untreated wood by-products and residues	1.2.1.1 Broad-leaf with bark 1.2.1.2 Coniferous with bark 1.2.1.3 Broad-leaf without bark 1.2.1.4 Coniferous without bark 1.2.1.5 Bark (from industry operations)
		1.2.2 Chemically treated wood by-products, residues, fibres and wood constituents	1.2.2.1 Without bark 1.2.2.2 With bark 1.2.2.3 Bark (from industry operations) 1.2.2.4 Fibres and wood constituents
		1.2.3 Blends and mixtures	
	1.3 Used wood	1.3.1 Chemically untreated used wood	1.3.1.1 Without bark 1.3.1.2 With bark 1.3.1.3 Bark
		1.3.2 Chemically treated used wood	1.3.2.1 Without bark 1.3.2.2 With bark 1.3.2.3 Bark
		1.3.3 Blends and mixtures	
	1.4 Blends and mixtures		
2. Herbaceous biomass	2.1 Herbaceous biomass from agriculture and horticulture	2.1.1 Cereal crops	2.1.1.1 Whole plant 2.1.1.2 Straw parts 2.1.1.3 Grains or seeds 2.1.1.4 Husks or shells 2.1.1.5 Blends and mixtures
		2.1.2 Grasses	2.1.2.1 Whole plant 2.1.2.2 Straw parts 2.1.2.3 Seeds 2.1.2.4 Shells 2.1.2.5 Bamboo 2.1.2.6 Blends and mixtures
		2.1.3 Oil seed crops	2.1.3.1 Whole plant 2.1.3.2 Stalks and leaves 2.1.3.3 Seeds 2.1.3.4 Husks or shells 2.1.3.5 Blends and mixtures

Table 1 *(continued)*

		2.1.4 Root crops	2.1.4.1 Whole plant 2.1.4.2 Stalks and leaves 2.1.4.3 Root 2.1.4.4 Blends and mixtures
		2.1.5 Legume crops	2.1.5.1 Whole plant 2.1.5.2 Stalks and leaves 2.1.5.3 Fruit 2.1.5.4 Pods 2.1.5.5 Blends and mixtures
		2.1.6 Flowers	2.1.6.1 Whole plant 2.1.6.2 Stalks and leaves 2.1.6.3 Seeds 2.1.6.4 Blends and mixtures
		2.1.7 Segregated herbaceous biomass from gardens, parks, roadside maintenance, vineyards and fruit orchards	
		2.1.8 Blends and mixtures	
	2.2 By-products and residues from food and herbaceous processing industry	2.2.1 Chemically untreated herbaceous residues	2.2.1.1 Cereal crops and grasses 2.2.1.2 Oil seed crops 2.2.1.3 Root crops 2.2.1.4 Legume crops 2.2.1.5 Flowers 2.2.1.6 Blends and mixtures
		2.2.2 Chemically treated herbaceous residues	2.2.2.1 Cereal crops and grasses 2.2.2.2 Oil seed crops 2.2.2.3 Root crops 2.2.2.4 Legume crops 2.2.2.5 Flowers 2.2.2.6 Blends and mixtures
		2.2.3 Blends and mixtures	
	2.3 Blends and mixtures		

Table 1 *(continued)*

3. Fruit biomass	3.1 Orchard and horticulture fruit	3.1.1 Berries	3.1.1.1 Whole berries
			3.1.1.2 Flesh
			3.1.1.3 Seeds
			3.1.1.4 Blends and mixtures
		3.1.2 Stone/kernel fruits	3.1.2.1 Whole fruit
			3.1.2.2 Flesh
			3.1.2.3 Stone/kernel/fruit fibre
			3.1.2.4 Blends and mixtures
		3.1.3 Nuts and acorns	3.1.3.1 Whole nuts
			3.1.3.2 Shells/husks
			3.1.3.3 Kernels
			3.1.3.4 Blends and mixtures
		3.1.4 Blends and mixtures	
	3.2 By-products and residues from food and fruit processing industry	3.2.1 Chemically untreated fruit residues	3.2.1.1 Berries
			3.2.1.2 Stone/kernel fruits/fruit fibre
			3.2.1.3 Nuts and acorns
			3.2.1.4 Crude olive cake
			3.2.1.5 Blends and mixtures
		3.2.2 Chemically treated fruit residues	3.2.2.1 Berries
			3.2.2.2 Stone/kernel fruits
			3.2.2.3 Nuts and acorns
			3.2.2.4 Exhausted olive cake
			3.2.2.5 Blends and mixtures
		3.2.3 Blends and mixtures	
	3.3 Blends and mixtures		
4. Aquatic biomass	4.1 Algae	4.1.1 Micro algae (Latin name to be stated)	
		4.1.2 Macro algae (Latin name to be stated)	
			4.1.2.1 Green sea weed (Latin name to be stated)
			4.1.2.2 Brown sea weed (Latin name to be sated)
			4.1.2.3 Red sea weed (Latin name to be stated)
		4.1.3 Blends and mixtures	
	4.2 Water hyacinth		
	4.3 Lake and sea grass	4.3.1 Lake grass (Latin name to be stated)	
		4.3.2 Sea grass (Latin name to be stated)	
		4.3.3 Blends and mixtures	
	4.4 Reeds	4.4.1 Common reed	
		4.4.2 Other reed	
		4.4.3 Blends and mixtures	
	4.5 Blends and mixtures		
5 Blends and mixtures	5.1 Blends		
	5.2 Mixtures		

NOTE 1 If appropriate, also the actual species (e.g. spruce, wheat) of biomass can be stated according to EN 13556, *Round and sawn timber — Nomenclature of timbers used in Europe* [1].