SLOVENSKI STANDARD
SIST EN ISO 18125:2017

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Nadomešča:
SIST EN 14918:2010

Trdna biogoriva - Določevanje kalorične vrednosti (ISO 18125:2017)

Solid biofuels - Determination of calorific value (ISO 18125:2017)

Biogene Festbrennstoffe - Bestimmung des Heizwertes (ISO 18125:2017)

Biocombustibles solides - Détermination du pouvoir calorifique (ISO 18125:2017)

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75.160.40	Biogoriva	Biofuels

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English Version

Solid biofuels - Determination of calorific value (ISO 18125:2017)

Biocombustibles solides - Détermination du pouvoir calorifique (ISO 18125:2017)

Biogene Festbrennstoffe - Bestimmung des Heizwertes (ISO 18125:2017)

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EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

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European foreword

This document (EN ISO 18125:2017) has been prepared by Technical Committee ISO/TC 238 "Solid biofuels" in collaboration with Technical Committee CEN/TC 335 “Solid biofuels” the secretariat of which is held by SIS.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by November 2017, and conflicting national standards shall be withdrawn at the latest by November 2017.

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Endorsement notice

The text of ISO 18125:2017 has been approved by CEN as EN ISO 18125:2017 without any modification.

INTERNATIONAL STANDARD

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Solid biofuels — Determination of calorific value

Biocombustibles solides — Détermination du pouvoir calorifique

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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).

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For an explanation on 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 the following URL: www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 238, *Solid biofuels*.

Solid biofuels — Determination of calorific value

1 Scope

This document specifies a method for the determination of the gross calorific value of a solid biofuel at constant volume and at the reference temperature 25 °C in a bomb calorimeter calibrated by combustion of certified benzoic acid.

The result obtained is the gross calorific value of the analysis sample at constant volume with all the water of the combustion products as liquid water. In practice, biofuels are burned at constant (atmospheric) pressure and the water is either not condensed (removed as vapour with the flue gases) or condensed. Under both conditions, the operative heat of combustion to be used is the net calorific value of the fuel at constant pressure. The net calorific value at constant volume may also be used; formulae are given for calculating both values.

General principles and procedures for the calibrations and the biofuel experiments are presented in the main text, whereas those pertaining to the use of a particular type of calorimetric instrument are described in Annexes A to C. Annex D contains checklists for performing calibration and fuel experiments using specified types of calorimeters. Annex E gives examples to illustrate some of the calculations.

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 651, *Solid-stem calorimeter thermometers*

ISO 652, *Enclosed-scale calorimeter thermometers*

ISO 1770, *Solid-stem general purpose thermometers*

ISO 1771, *Enclosed-scale general purpose thermometers*

ISO 14780, *Solid biofuels — Sample preparation*

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

ISO 18134-3, *Solid biofuels — Determination of moisture content — Oven dry method — Part 3: Moisture in general analysis sample*

ISO 18135, *Solid biofuels — Sampling*

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 terminological databases for use in standardization at the following addresses:

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

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

3.1
gross calorific value at constant volume
absolute value of the specific energy of combustion, in joules, for unit mass of a solid biofuel burned in oxygen in a calorimetric bomb under the conditions specified

Note 1 to entry: The products of combustion are assumed to consist of gaseous oxygen, nitrogen, carbon dioxide and sulphur dioxide, of liquid water (in equilibrium with its vapour) saturated with carbon dioxide under the conditions of the bomb reaction, and of solid ash, all at the *reference temperature* (3.4).

3.2
net calorific value at constant volume
absolute value of the specific energy of combustion, in joules, for unit mass of the biofuel burned in oxygen under conditions of constant volume and such that all the water of the reaction products remains as water vapour (in a hypothetical state at 0,1 MPa), the other products being as for the gross calorific value, all at the *reference temperature* (3.4)

3.3
net calorific value at constant pressure
absolute value of the specific heat (enthalpy) of combustion, in joules, for unit mass of the biofuel burned in oxygen at constant pressure under such conditions that all the water of the reaction products remains as water vapour (at 0,1 MPa), the other products being as for the gross calorific value, all at the *reference temperature* (3.4)

3.4
reference temperature
international reference temperature for thermochemistry of 25 °C is adopted as the reference temperature for calorific values

Note 1 to entry: See 8.7.

Note 2 to entry: The temperature dependence of the calorific value of biofuels is small [less than 1 J/(g × K)].

3.5
effective heat capacity of the calorimeter
amount of energy required to cause unit change in temperature of the calorimeter

3.6
corrected temperature rise
change in calorimeter temperature caused solely by the processes taking place within the combustion bomb

Note 1 to entry: The corrected temperature rise is the total observed temperature rise corrected for heat exchange, stirring power, etc. (8.6).

Note 2 to entry: The change in temperature may be expressed in terms of other units: resistance of a platinum or thermistor thermometer, frequency of a quartz crystal resonator, etc., provided that a functional relationship is established between this quantity and a change in temperature. The *effective heat capacity of the calorimeter* (3.5) may be expressed in units of energy per such an arbitrary unit. Criteria for the required linearity and closeness in conditions between calibrations and fuel experiments are given in 9.3.

Note 3 to entry: A list of the symbols used and their definitions is given in Annex F.

4 Principle

4.1 Gross calorific value

A weighed portion of the analysis sample of the solid biofuel is burned in high-pressure oxygen in a bomb calorimeter under specified conditions. The effective heat capacity of the calorimeter is determined in calibration experiments by combustion of certified benzoic acid under similar conditions, accounted for in the certificate. The corrected temperature rise is established from observations of temperature

before, during and after the combustion reaction takes place. The duration and frequency of the temperature observations depend on the type of calorimeter used. Water is added to the bomb initially to give a saturated vapour phase prior to combustion (see 8.2.1 and 9.2.2), thereby allowing all the water formed, from the hydrogen and moisture in the sample, to be regarded as liquid water.

The gross calorific value is calculated from the corrected temperature rise and the effective heat capacity of the calorimeter, with allowances made for contributions from ignition energy, combustion of the fuse(s) and for thermal effects from side reactions such as the formation of nitric acid. Furthermore, a correction is applied to account for the difference in energy between the aqueous sulphuric acid formed in the bomb reaction and gaseous sulphur dioxide, i.e. the required reaction product of sulphur in the biofuel. The corresponding energy effect between aqueous and gaseous hydrochloric acid can be neglected due to the usually low value for the correction regarding solid biofuels.

4.2 Net calorific value

The net calorific value at constant volume and the net calorific value at constant pressure of the biofuel are obtained by calculation from the gross calorific value at constant volume determined on the analysis sample. The calculation of the net calorific value at constant volume requires information about the moisture and hydrogen contents of the analysis sample. In principle, the calculation of the net calorific value at constant pressure also requires information about the oxygen and nitrogen contents of the analysis sample.

5 Reagents

5.1 Oxygen, at a pressure high enough to fill the bomb to 3 MPa, pure with an assay of at least a volume fraction of 99,5 %, and free from combustible matter.

Oxygen made by the electrolytic process may contain up to a volume fraction of 4 % of hydrogen.

5.2 Fuse.

5.2.1 Ignition wire, of nickel-chromium 0,16 mm to 0,20 mm in diameter, platinum 0,05 mm to 0,10 mm in diameter, or another suitable conducting wire with well-characterized thermal behaviour during combustion.

5.2.2 Cotton fuse, of white cellulose cotton, or equivalent, if required (see 8.2.1).

5.3 Combustion aids of known gross calorific value, composition and purity, like benzoic acid, n-dodecane, paraffin oil, combustion bags or capsules may be used.

5.4 Standard volumetric solutions and indicators, only for use when analysis of final bomb solutions is required.

5.4.1 Barium hydroxide solution, $c[Ba(OH)_2]$ = 0,05 mol/l.

5.4.2 Sodium carbonate solution, $c(Na_2C0_3)$ = 0,05 mol/l.

5.4.3 Sodium hydroxide solution, $c(NaOH)$ = 0,1 mol/l.

5.4.4 Hydrochloric acid solution, $c(HCl)$ = 0,1 mol/l.

5.4.5 Screened methyl orange indicator, 1 g/l solution.

Dissolve 0,25 g of methyl orange and 0,15 g of xylene cyanol FF in 50 ml of a volume fraction of 95 % ethanol and dilute to 250 ml with water.