SLOVENSKI STANDARD
SIST-TS CEN/TS 15883:2009

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Stanovanjski aparati na trdna goriva - Emisijska preskusna metoda

Residential solid fuel burning appliances - Emission test methods

Häusliche Feuerstätten für feste Brennstoffe - Emissionsprüfverfahren

Appareils résidentiels à combustibles solides - Méthodes d'essai des émissions

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TECHNICAL SPECIFICATION

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CEN/TS 15883

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English Version

Residential solid fuel burning appliances - Emission test methods

Appareils résidentiels à combustibles solides - Méthodes d'essai des émissions

Häusliche Feuerstätten für feste Brennstoffe - Emissionsprüfverfahren

This Technical Specification (CEN/TS) was approved by CEN on 28 March 2009 for provisional application.

The period of validity of this CEN/TS is limited initially to three years. After two years the members of CEN will be requested to submit their comments, particularly on the question whether the CEN/TS can be converted into a European Standard.

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EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
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Foreword

This document (CEN/TS 15883:2009) has been prepared by Technical Committee CEN/TC 295 “Residential solid fuel burning appliances”, the secretariat of which is held by BSI.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN [and/or CENELEC] shall not be held responsible for identifying any or all such patent rights.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to announce this Technical Specification: Austria, Belgium, Bulgaria, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland and the United Kingdom.

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Introduction

All the standards of CEN/TC 295 deal with the field of residential heating and cooking appliances burning solid fuels covering the standardization of appliance construction, safety and commissioning requirements and performance requirements (e.g. heat outputs, efficiency and emissions) together with supporting test methods.

This European Technical Specification (TS) deals with methods for the measurements of NO_x, and OGC/total hydrocarbons emissions and particulate and dust produced by the above mentioned heating and cooking appliances.

For the nitrogen oxides this European Technical Specification describes the 'Chemiluminescence method' and the 'Non-dispersive infrared (NDIR) method'. Besides these two techniques, there are also the 'Non-dispersive ultraviolet (NDUV) method' and the 'Non-extractive (in situ) method' which are described in detail in ISO 10849:1996.

For the total hydrocarbon contents the method is described but the TS does not give any information regarding separate constituents due to the measurements being expressed as equivalents of a reference substance. In this method the measurement is continuous.

Finally, for the measurements of particulate and dust, this European Technical Specification reports, in the Annex, three official methods that coincide respectively with the combined Austrian and German method, the Norwegian method and the UK method currently in force in these countries.

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1 Scope

This European Technical Specification is applicable to residential heating and cooking appliances burning solid fuels and details methods for the measurements of NO_x, and OGC/total hydrocarbons emissions and particulate and dust produced by these appliances and is to be used in conjunction with the test methods given in the European Standards covering these appliances.

This European Technical Specification covers the NO_x, and OGC/total hydrocarbons emission test methods, however it does not cover input data and detailed calculation procedures.

For the particulate and dust emissions test methods, the national documents of those countries that have a test method are reference methods which are summarised in Informative Annex A, whilst those countries that do not have a specific test method, could choose one of these methods listed in the annex.

2 Normative references

The following referenced documents are indispensable for the application 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.

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EN 12815:2001, *Residential cookers fired by solid fuel — Requirements and test methods*

EN 13229:2001, *Inset appliances including open fires fired by solid fuels — Requirements and test methods*

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EN 13240:2001, *Roomheaters fired by solid fuel – Requirements and test methods*

ISO 10849:1996, *Stationary source emissions — Determination of the mass concentration of nitrogen oxides — Performance characteristics of automated measuring systems*

3 Terms and definitions

3.1 Definitions

For the purposes of this Technical Specification, the following definitions apply.

3.1.1
absorption
incorporation of a substance into the body of a liquid or solid

3.1.2
calibration
set of operations that establish the relationship between values of quantities indicated by a measuring instrument or measuring system, or values represented by a material measure or a reference material, and the corresponding values realized by standards

3.1.3
dew point
temperature at, or below which, the condensation from the gas phase will occur

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3.1.4
dust
particles of various shape, structure and density scattered in the gaseous phase of the flue gas

3.1.5
gas sample
portion of gaseous material on which observations can be made in order to provide data on the gaseous material from which it has been removed

NOTE A sample is taken as being representative of the gaseous material if the same observations are supplied on any other samples taken from this gaseous material to furnish the same data within preset intervals.

3.1.6
line
gas-tight system of tubing equipped with accessories such a valves, manometers, etc. enabling gas to be transported from one point to another

3.1.7
measured value
estimated value of the air quality characteristics derived from an output signal; this usually involves calculations related to the calibration process and conversion to required quantities

3.1.8
nominal heat output
declared heat output of an appliance achieved under defined test conditions when burning the specified test fuel in accordance with the European standard relevant to that appliance

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3.1.9
reference material
material or substance one or more of whose property values is sufficiently homogeneous and well established to be used for the calibration of an apparatus, the assessment of measurement method, or for assigning values to materials

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3.1.10
resolution
smallest difference between indications, for an identifiable component, of a recording or display device that can be meaningfully distinguished

3.1.11
sample line
line provided to remove a representative sample of a gas to be analysed and to transport it from the sample point to the analyzer

4 Emission test methods: measurements of total hydrocarbons (THC)

NOTE These methods are intended to determine the total hydrocarbon content in the flue gases from appliances burning solid fuels. The method uses an instrument equipped with a flame ionisation detector (FID). The measurement is continuous. The result obtained is expressed as equivalents of a reference substance, usually methane or propane. The measurement concerns only the total hydrocarbon content and does not give any information of separate constituents. The sampling point should be as described for the measurement section detailed in the test methods appropriate to the appliance as given in the European Standard covering the requirement and testing of these residential heating and cooking appliances burning solid fuels.

4.1 General procedure

The measurement is extractive and continuous, i.e. a sample of test gas flow is continuously extracted and is analyzed in a free-standing instrument. The sampling point shall be as described in the test methods detailed in the European Standard appropriate to the appliance being tested. If there is a damper or any other device which favours the lack of homogeneity in the flow, the measuring point

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shall be moved to a position where the flow is homogenous. The measuring system shall be heated to 195 °C.

4.2 Equipment

The measuring system consists of the following components.

a) *Instrument with flame ionisation detector, FID*. Measuring range, usually between 0 -10 and 0 - 100 000 ppm. The instrument shall be equipped with a heated filter.

b) *Gas probe with a cleaning filter for particulates*. The probe shall consist of a suitable material, such as corrosion resistant steel. The filter shall be heated so that condensation is avoided. This requires a temperature in the filter of 195 °C.

c) *Sample line*. The sample line shall be heated to the same temperature as the filter. The inner line shall be of PTFE and be exchangeable. The sample line shall be as short as possible.

4.3 Calculation of organic gaseous compounds (OGC)

4.3.1 This method describes how to calculate the content of organic gaseous compounds expressed in mg/Nm^3 (dry) (at normal condition[1)]) and based upon an oxygen content of 13 % in the exit flue gases. The calculation of total hydrocarbons (THC) content is based on a continuous measurement as described in 4.1.

4.3.2 Calculation assumptions

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In order to undertake the calculations given in 4.3.3 the following data shall be available:

a) total hydrocarbon content in methane or propane equivalents, mean value;

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b) $O_{2,m}$, $CO_{2,m}$, CO_m content, mean values;

c) carbon, hydrogen and moisture content of the test fuel (C, H and W);

d) carbon content of the residue crossing the grate referred to the quantity of the test fuel fired (C_r).

4.3.3 Calculations of organic gaseous compounds

If the OGC content is required in methane equivalents it is determined as follows:

$$C_{OGC} = \frac{(THC \times 12)}{22,36} \times \frac{(21 - 13)}{(21 - O_{2,m})} \times \frac{G_W}{G_D} \quad (1)$$

Alternatively, if the OGC content is required in propane equivalents it is determined as follows:

$$C_{OGC} = \frac{(THC \times 36)}{21,93} \times \frac{(21 - 13)}{(21 - O_{2,m})} \times \frac{G_W}{G_D} \quad (2)$$

where

C_{OGC} is the calculated content of organic gaseous compound expressed in mg/Nm^3 dry flue gas at 13 % O_2;

1) Referred to 273 K and 1013 mbar.

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THC is the measured total hydrocarbon content in the wet flue gas either in ppm methane equivalents or propane equivalents;

$O_{2,m}$ is the measured content of oxygen in dry flue gas expressed in % as mean value;

G_w is the actual specific wet flue gas volume expressed in Nm^3/kg fuel;

G_D is the actual specific dry flue gas volume expressed in Nm^3 /kg fuel.

The actual specific flue gas volume in wet condition is to be calculated as:

$$G_W = \frac{(C - C_r)}{(0{,}536 \times (CO_{2,m} + CO_m))} + 1{,}24 \times \frac{(9 \times H + W)}{100} \quad (3)$$

where

G_w is the specific flue gas volume in wet conditions in Nm^3/kg fuel;

C is the carbon content of the test fuel in % of mass;

C_r is the carbon content of the residue referred to the quantity of the test fuel fired in % of mass;

$CO_{2,m}$ is the measured mean content of carbon dioxide in the dry flue gas in %;

CO_m is the measured mean content of carbon monoxide in the dry flue gas in %;

H is the hydrogen content of the test fuel in % of mass;

W is the moisture content of the test fuel in % of mass.

The actual specific dry flue gas volume, G_D, is calculated as:

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$$G_D = \frac{(C - C_r)}{0{,}536 \times (C_{2,m} + CO)} \quad (4)$$

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where

G_D is the specific flue gas volume in wet conditions in Nm^3/kg fuel;

C is the carbon content of the test fuel in % of mass;

C_r is the carbon content of the residue referred to the quantity of the test fuel fired in % of mass;

$CO_{2,m}$ is the measured mean content of carbon dioxide in the dry flue gas in %;

CO_m is the measured mean content of carbon monoxide in the dry flue gas in %;

4.4 Uncertainty of measurement

The uncertainty of the measurement for total hydrocarbon is maximum ± 10 % of the measured value. The total uncertainty of the calculated OGC value, according to this instruction, is ± 15 % of the calculated value.

5 Emissions test methods: measurement of nitrogen oxides

NOTE The methods detailed in 5.2.1 to 5.2.3 are intended to determine the content of nitrogen oxides (NO) in flue gases from small combustion appliances. The methods are continuous. The result obtained is expressed as equivalents of nitrogen dioxide (NO_2). The sampling point should be as described for the measurement section detailed in the test methods as appropriate to the appliance as given in the European Standard covering the requirement and testing of these residential heating and cooking appliances burning solid fuels.

5.1 General procedure

The measurement is extractive and continuous, i.e. the test gas flow is extracted from the measuring point by the suction pyrometer and is analysed by an arrangement of a complete measuring system

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as shown in Figure 1A or Figure 1B. This system is suitable for use with all the analysers described in 5.2. The sampling point and the suction pyrometer shall be as described in the test methods detailed in the European Standard appropriate to the appliance being tested.

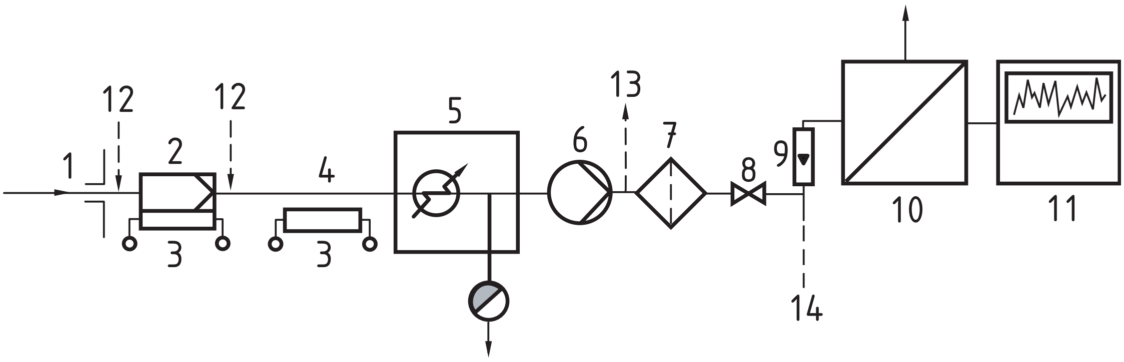

Figure 1a — NO measuring device

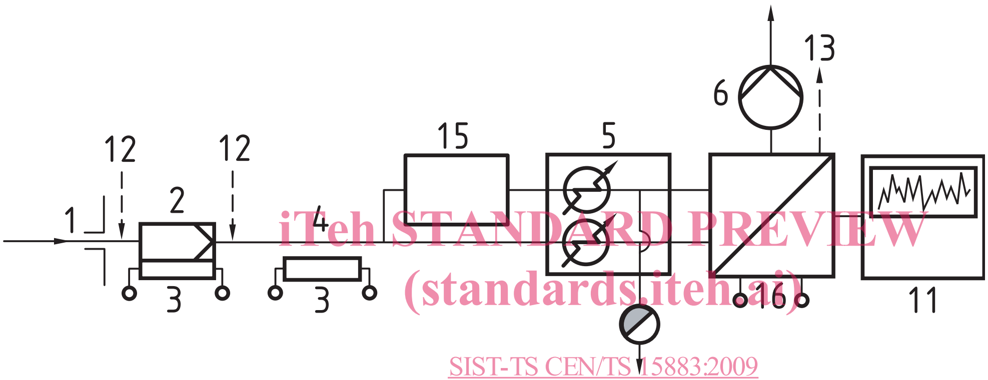

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Figure 1b — NO/NO$_x$ measuring device

Key

1 Gas sampling
2 Particulate filter
3 Heating
4 Sampling line (heated if necessary)
5 Sample cooler with condensate separator
6 Sample pump
7 Filter
8 Needle valve
9 Flow meter
10 NO-analyser
11 Recorder
12 Inlet for zero and calibration gas (preferably in front of the filter) to check the complete system
13 Bypass for excess gas
14 inlet for zero and span gas to check the analyser
15 Converter
16 NO/NOx analyser

Figures 1A and 1B — Examples of the installation of the measuring devices

5.2 Measuring principles of analysers

NOTE The examples detailed in 5.2.1 to 5.2.3 describe typical principles found in existing analysers.

5.2.1 Chemiluminescence method

If NO reacts with ozone (O_3), NO_2 is formed. Part of the NO_2 is in a photochemical reaction state. When returning to the basic state, these NO_2 molecules can radiate light in the wavelength range of 590 nm to 3 000 nm. The intensity of this light depends on the NO content and is influenced by the pressure and presence of other gases.