SLOVENSKI STANDARD
SIST EN 13384-1:2003/A1:2006

01-januar-2006

Dimniki ï Raļ unske metode termodinamike in dinamike fluidov ï 1. del: Dimniki za eno ogrevalno napravo

Chimneys - Thermal and fluid dynamic calculation methods - Part 1: Chimneys serving one appliance

Abgasanlagen - Wärme- und strömungstechnische Berechnungsverfahren - Teil 1: Abgasanlagen mit einer Feuerstätte

Conduits de fumée - Méthode de calcul thermo-aéraulique - Partie 1: Conduits de fumée ne desservant qu'un seul appareil

Ta slovenski standard je istoveten z: EN 13384-1:2002/A1:2005

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91.060.40	Dimniki, jaški, kanali	Chimneys, shafts, ducts

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English Version

Chimneys - Thermal and fluid dynamic calculation methods - Part 1: Chimneys serving one appliance

Conduits de fumée - Méthode de calcul thermo-aéraulique - Partie 1: Conduits de fumée ne desservant qu'un seul appareil

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This amendment A1 modifies the European Standard EN 13384-1:2002; it was approved by CEN on 19 September 2005.

CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for inclusion of this amendment into the relevant national standard without any alteration. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CEN member.

This amendment exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the Central Secretariat has the same status as the official versions.

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

Management Centre: rue de Stassart, 36 B-1050 Brussels

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Foreword

This European Standard (EN 13384-1:2002/A1:2005) has been prepared by Technical Committee CEN/TC 166 “Chimneys”, the secretariat of which is held by UNI.

This Amendment to the European Standard EN 13384-1:2002 shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by April 2006, and conflicting national standards shall be withdrawn at the latest by April 2006.

The following Amendment to EN 13384-1 is an additional specific calculation method for balanced flue chimneys

- In the Foreword:

Change in the 5th paragraph: … consists of three (instead two) parts:

Add part 13384-3:

Part 3: Methods for the development of diagrams and tables for chimneys serving one heating appliance

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

1 Scope

Add at the end of the 3rd paragraph:

Part 3 describes methods for the development of diagrams and tables for chimneys serving one heating appliance.

2 Normative references

Delete: "pr" at EN 1856-1 *(only in the English version)*

3 Terms and definitions

Delete in the first sentence: "1999" at EN 1443. (only in the English version)

Add new definitions:

3.24
air-flue gas system
system of concentric or non-concentric ducts for transport of combustion air from the open air to the heating appliance and products of combustion from the heating appliance to the open air

3.25
air-supply duct
component or components parallel to the chimney (separate or concentric) that conveys combustion air from the outside atmosphere to the inlet of the connecting air supply pipe

3.26
balanced flue chimney
chimney where the point of air entry to the air supply duct is adjacent to the point of discharge of combustion products from the flue, the inlet and outlet being so positioned that wind effects are substantially balanced

3.27
chimney segment
a calculation part of a chimney

3.28
condensate mass flow ($\Delta\dot{m}_D$)
mass of water vapour of the flue gas condensed in the heating appliance, connecting flue pipe or the chimney per time unit

3.29
connecting air supply pipe
component or components connecting the air supply duct outlet with the room-sealed heating appliance combustion air inlet

3.30
condensation factor (f_K)
proportion of the theoretical maximum condensation mass flow usable in the calculation

4 Symbols, terminology and units

Add new symbols:

q_C heat transfer from the flue to the outer surface, in K

σ_{Rad} black body radiation number, in W/(m^2·K^4)

New title for Clause 5:

5 Calculation method for non-balanced flue chimneys

5.1 General principles

Third indent:

Delete the first word "chimney".

5.2.2 Überdruckabgasanlagen (only in the German version)

In der Legende ist die 1. Zeile auszutauschen gegen:

P_{WO} der zur Verfügung stehende Förderdruck der Feuerstätte, in Pa

5.4 Calculation procedure

To the first paragraph add the following sentence:

For new built chimneys, a pre-estimated value for the flue size should be used.

*In the third paragraph "5.5.2" shall be replaced by "5.5.**3**":*

At the end of 5.4 add the following note:

NOTE The temperature requirement need not be met for the following conditions provided that it is accepted that in case the requirement for temperature is not fulfilled no guarantee can be given that no moisture appears.

The conditions are:

- where the heating appliance is replaced by an appliance that has an output of < 30 kW, and,

- that the flue gas loss of the heating appliance is at least 8 %, and

- that the heating appliance has a draught diverter which provides adequate ventilation in the chimney during standby periods or periods of low output. This may be achieved by over-sizing the heating appliance output.

5.5 Flue gas data characterizing the heating appliance

Delete in the head line the text "for nominal heat output".

5.7.1.3 Ambient air temperature

Delete in the second indent the brackets "(including relined chimneys)".

Delete the third indent (data for "chimneys with ventilated air gaps ventilated in the opposite direction as the flue gas").

5.10.1.2 Positive pressure at the flue gas inlet into the positive pressure chimney (P_{ZO})

The second paragraph and Equation (30) shall be replaced as follows:

The positive pressure at the flue gas inlet into the chimney P_{ZO} shall be calculated using the following equation:

$$P_{ZO} = P_R - P_H + P_L \qquad \text{in Pa} \qquad (30)$$

5.10.1.1 Unterdruck an der Abgaseinführung in die Unterdruck-Abgasanlage (P_Z) *(only in the German version)*

Der letzte Satz der Legende ist zu ändern in:

P_R der ~~Wind~~... <u>Wider</u>standsdruck für den senkrechten Abschnitt der Abgasanlage, in Pa.

5.10.3.3 Rohreibungszahl des Abgaswegs (ψ) *(only in the German version)*

Der letzte Satz ist zu ändern in:

Liegen kein Werte vor, können typische mittlere Rauigkeits~~bei~~ werte für verschiedene Werkstoffe der Tabelle B.4 entnommen werden.

5.10.4 Wind velocity pressure (P_L)

Amend second sentence to:

The chimney outlet is considered to be in an adverse pressure zone if the chimney outlet position is less than 0,4 m above the ridge and the distance of a horizontal line from the intersection with the roof, or the projection of the ridge above the roof, to the chimney outlet is less than 2,3 m, and the chimney outlet is situated:

Add new Clauses 7 and 8:

7 Calculation method for balanced flue chimneys

7.1 General principles

The calculation of inside dimensions (cross section) of negative pressure chimneys is based on the following three criteria:

— the draught at the flue gas inlet into the chimney shall be equal to or greater than the draught required at the flue gas inlet into the chimney;

— the draught at the flue gas inlet to the chimney shall be equal to or greater than the effective pressure resistance at the outlet of the air supply duct;

— the temperature of the inner wall at the outlet of the chimney shall be equal to or greater than the temperature limit.

The calculation of inside dimensions (cross section) of positive pressure is based on the following three criteria:

— the comparison between the positive pressure at the flue gas inlet into the chimney shall be equal to or less than the maximum differential pressure at the flue gas inlet into the chimney;

— the positive pressure in the connecting flue pipe and in the chimney shall not be higher than the difference between the excess pressure for which both are designated and the pressure of the surrounding supply air;

— the temperature of the inner wall at the outlet of the chimney shall be equal to or greater than the temperature limit.

In order to verify the criteria, two sets of external conditions are used:

— the calculation of the pressure (draught) is made with conditions for which the capacity of the chimney is minimal (i.e. high outside temperature); and also

— the calculation of the inner wall temperature with conditions for which the inside temperature of the chimney is minimal (i.e. low outside temperature).

For the calculation, a balanced flue chimney and its air supply duct shall be divided into *Nseg* chimney segments of equal lengths each with a maximum length of 0,5 m. When the thermal resistance between the chimney (flue duct) and the air supply duct is higher than 0,65 m^2K/W then they need not to be divided into segments (*Nseg* =1).

The connecting flue pipe and the connecting air supply pipe shall be divided into *NsegV* connecting flue pipe segments of equal lengths each with a maximum length of 0,5 m. When the thermal resistance between the connecting flue pipe and the connecting air supply pipe is higher than 0,65 m^2·K/W then the configuration need not to be divided into segments (*NsegV* =1).

7.2 Pressure requirements

The relationships (1) and (59), for negative pressure chimneys or (3), (60) and (61) for positive pressure chimneys shall be verified for all relevant operating conditions.

$$P_Z \geq P_{RB} + P_{HB} \quad \text{in Pa} \quad (59)$$

$$P_{ZO} \leq P_{Zexcess} - (P_{RB} + P_{HB}) \quad \text{in Pa} \quad (60)$$

$$P_{ZO} + P_{FV} \leq P_{ZVexcess} - P_B \quad \text{in Pa} \quad (61)$$

where

P_Z	is the draught at the flue gas inlet into the chimney, in Pa;
P_{ZO}	is the positive pressure at the flue gas inlet into the chimney, in Pa;
P_{RB}	is the pressure resistance of the air supply duct, in Pa;
P_{HB}	is the theoretical draught available due to chimney effect of the air supply duct, in Pa;
P_{FV}	is the effective pressure resistance of the connecting flue pipe, in Pa;
$P_{Zexcess}$	is the maximum allowed pressure from the designation of the chimney, in Pa;
$P_{ZVexcess}$	is the maximum allowed pressure from the designation of the connecting flue pipe, in Pa.

The pressure resistance for the air supply P_B shall be calculated using the following equation:

$$P_B = P_{RB} + P_{HB} + P_{RBV} + P_{HBV} \quad \text{in Pa} \quad (62)$$

where

P_B	is the effective pressure resistance of air supply, in Pa;
P_{RB}	is the pressure resistance of the air supply duct, in Pa;
P_{HB}	is the theoretical draught available due to chimney effect of the air supply duct, in Pa;

P_{RBV} is the pressure resistance of the connecting air supply pipe, in Pa;

P_{HBV} is the theoretical draught available due to chimney effect of the connecting air supply pipe, in Pa.

7.3 Temperature requirements

The relationships (6) and (7) shall be verified.

7.4 Calculation procedure

For the calculation of the pressure and temperature values for the relationships of Equations (1), (3), (6), (59), (60), and (61) the values of the flue gas data, characterised according to 5.5, shall be obtained for the appliance. The data specified in 7.6 shall be obtained for the chimney, the connecting flue pipe, the air supply duct and the connecting air supply pipe. For new built chimneys a pre-estimated value for the flue size should be used.

7.7 to 7.11 provide calculations needed to finalise the chimney thermal and fluid dynamic calculations. In 7.7 the equations provide the calculation of the basic data which are needed for further calculation.

The equations for the calculations of the relevant temperatures are compiled in 5.5.3 and 7.8. The equations for the density of the flue gas and its velocity are compiled in 7.9.

The procedure in 7.10 and 7.11 shall be used to validate the pressure requirement. The procedure in 7.12 shall be used to validate the temperature requirement.

The validation for pressure and temperature requirement shall be conducted twice:

— for the nominal heat output of the heating appliance and

— for the lowest value of the heat output range which is indicated by the manufacturer of the heating appliance.

7.5 Flue gas data characterizing the heating appliance

The flue gas data characterizing the heating appliance shall be calculated in accordance with 5.5.

7.6 Characteristic data for the calculation

The characteristic data shall be calculated in accordance with 5.6.

The mean value for roughness of the air supply duct r_B and the connecting air supply pipe r_{BV} should be obtained from the product manufacturer. The mean values of roughness of materials normally used are listed in Table B.4.

The thermal resistance of the air supply duct $(1/\Lambda)_B$ and the connecting air supply pipe $(1/\Lambda)_{BV}$ can be determined as described in 5.6.3 for chimneys. In Equation (10) D_h is the hydraulic diameter of the inside of the air supply duct D_{hiB} or of the connecting air supply pipe D_{hiBV}.

7.7 Basic values for the calculation

7.7.1 Air temperatures

7.7.1.1 General

A differentiation shall be made between the external air temperature and the ambient air temperatures for chimneys which pass through heated areas.

7.7.1.2 External air temperature (T_L)

To check that the pressure requirement has been met, the external air temperature T_L for heating systems is normally calculated using 288,15 K (t_L = 15 °C). To check that the temperature requirement has been met the following values for external air temperature T_L shall be used:

$T_L = 258{,}15$ K ($t_L = -15$ °C) for chimneys operating under wet conditions;

$T_L = 273{,}15$ K ($t_L = 0$ °C) for chimneys operating under dry conditions.

Other values for T_L may be used based on national accepted data.

7.7.1.3 Ambient air temperature (T_u)

To check that the pressure requirement has been met the ambient air temperature T_u = T_L shall be used. To check that the temperature requirement has been met, the following values for ambient air temperatures T_u shall be used:

$T_{uo} = T_L$ ($t_{uo} = t_L$)

$T_{ub} = 288{,}15$ K ($t_{ub} = 15$ °C)

$T_{uh} = 293{,}15$ K ($t_{uh} = 20$ °C)

$T_{ul} = T_{uo}$ ($t_{ul} = t_{uo}$)

$T_{uu} = 273{,}15$ K ($t_{uu} = 0$ °C)

Other values for T_{uo} may be used based on national accepted data.

where

T_{uo} is the ambient air temperature at the chimney outlet, in K;

T_{ub} is the ambient air temperature for boiler room, in K;

T_{uh} is the ambient air temperature for heated areas, in K;

T_{ul} is the ambient air temperature for areas external to the building, in K;

T_{uu} is the ambient air temperature for unheated areas inside the building, in K.

7.7.2 Other basic values

Other basic values shall be calculated in accordance with 5.7.2 to 5.7.6 and 5.7.8.

7.8 Determination of the temperatures

7.8.1 Non-concentric (separate) ducts

When the thermal resistance between the flue duct and the air supply duct is higher than 0,65 $m^2 \cdot K/W$ the determination of the temperatures of the flue gas for separate ducts shall be calculated according to Clause 5. The temperature of the supply air within the air ducts shall be taken equal to the external air temperature.

Otherwise the determination of the temperatures shall be undertaken in a similar way as described in 7.8.2 or 7.8.3.

7.8.2 Concentric ducts – calculation based on a correction factor for heat radiation

7.8.2.1 General

For concentric ducts, also the values to satisfy the pressure requirements shall be used for calculating for temperature equilibrium.

For the calculation of the temperature values in a concentric duct an iterative procedure is necessary. It is recommended to start the calculation at the first connecting flue pipe segment *j* = 1 using a pre-estimated value for the temperature of the supply air at the outlet of the concentric connecting air supply pipe $T_{\mathrm{oBV},1}$. Then $T_{\mathrm{oBV},1}$ shall be searched iteratively using the equations in 7.8.2 until the following conditions are fulfilled:

$$\left|T_{\mathrm{eB},Nseg} - T_{\mathrm{L}}\right| \leq \varepsilon \qquad \text{in K} \qquad (63)$$

where

$T_{\mathrm{oBV},1}$	is the temperature of the supply air at the outlet of the connecting air supply pipe segment 1, in K;
$T_{\mathrm{eB},Nseg}$	is the temperature of the supply air at the inlet of the chimney segment $Nseg$, in K;
T_{L}	is the temperature of the external air, in K;
T_{uo}	is the ambient air temperature at the chimney outlet, in K;
$Nseg$	is the number of chimney segments used in the calculation;
ε	is the maximal convergence error in K and shall be taken as ≤ 1 K.

7.8.2.2 Temperatures in the connecting flue pipe and connecting air supply pipe segments

When the thermal resistance between the connecting flue pipe and the connecting air supply pipe is higher than 0,65 $m^2 \cdot K/W$ then the temperatures in the connecting flue pipe and the connecting air supply pipe shall be calculated in accordance to Clause 5. Then the temperature of the supply air at the beginning of the connecting air supply pipe segment *j* = *NsegV* $T_{\mathrm{eB,NsegV}}$ has to be pre-estimated instead of the temperature at the end of the connecting air supply pipe segment *j* = 1 $T_{\mathrm{oB},1}$ (see 7.8.2.1).

Otherwise the determination of the temperatures in the connecting flue pipe and in the connecting air supply pipe shall be undertaken as follows:

The flue gas temperature at the connecting flue pipe inlet, that means the beginning of the first connecting flue pipe segment *j* = 1 $T_{\mathrm{eV},1}$ is:

$$T_{\mathrm{eV},1} = T_{\mathrm{W}} \qquad \text{in K} \qquad (64)$$

The flue gas temperature at the beginning of the connecting flue pipe segments *j* > 1 $T_{\mathrm{e},j}$ is:

$$T_{\mathrm{eV},j} = T_{\mathrm{oV},j-1} \qquad \text{in K} \qquad (65)$$

where

$T_{\mathrm{eV},j}$	is the temperature of the flue gas at the beginning of the connecting flue pipe segment *j*, in K;
T_{W}	is the temperature of the flue gas at the outlet of the appliance, in K;
$T_{\mathrm{oV},j}$	is the temperature of the flue gas at the end of the connecting flue pipe segment *j*, in K.

The temperature of the supply air at the end of the connecting air supply segment *j* = 1 $T_{\mathrm{oB},1}$ has to be pre-estimated (see 7.8.2.1).