

**KORSTNAD. TERMO- JA HÜDRODÜNAAMIKA
ARVUTUSMEETODID. OSA 2: KORSTNAD MITME
KÜTTESEADME TEENINDAMISEKS**

Chimneys - Thermal and fluid dynamic calculation
methods - Part 2: Chimneys serving more than one
heating appliance

EESTI STANDARDI EESSÕNA

NATIONAL FOREWORD

See Eesti standard EVS-EN 13384-2:2015 sisaldab Euroopa standardi EN 13384-2:2015 ingliskeelset teksti.	This Estonian standard EVS-EN 13384-2:2015 consists of the English text of the European standard EN 13384-2:2015.
Standard on jõustunud sellekohase teate avaldamisega EVS Teatajas.	This standard has been endorsed with a notification published in the official bulletin of the Estonian Centre for Standardisation.
Euroopa standardimisorganisatsioonid on teinud Euroopa standardi rahvuslikele liikmetele kättesaadavaks 01.04.2015.	Date of Availability of the European standard is 01.04.2015.
Standard on kättesaadav Eesti Standardikeskusest.	The standard is available from the Estonian Centre for Standardisation.

Tagasisidet standardi sisu kohta on võimalik edastada, kasutades EVS-i veebilehel asuvat tagasiside vormi või saates e-kirja meiliaadressile standardiosakond@evs.ee.

ICS 91.060.40

Standardite reprodutseerimise ja levitamise õigus kuulub Eesti Standardikeskusele

Andmete paljundamine, taastekitamine, kopeerimine, salvestamine elektroonsesse süsteemi või edastamine ükskõik millises vormis või millisel teel ilma Eesti Standardikeskuse kirjaliku loata on keelatud.

Kui Teil on küsimusi standardite autorikaitse kohta, võtke palun ühendust Eesti Standardikeskusega:

Aru 10, 10317 Tallinn, Eesti; koduleht www.evs.ee; telefon 605 5050; e-post info@evs.ee

The right to reproduce and distribute standards belongs to the Estonian Centre for Standardisation

No part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying, without a written permission from the Estonian Centre for Standardisation.

If you have any questions about copyright, please contact Estonian Centre for Standardisation:

Aru 10, 10317 Tallinn, Estonia; homepage www.evs.ee; phone +372 605 5050; e-mail info@evs.ee

English Version

**Chimneys - Thermal and fluid dynamic calculation methods -
Part 2: Chimneys serving more than one heating appliance**

Conduits de fumée - Méthodes de calcul thermo-aéraulique
- Partie 2: Conduits de fumée desservant plus d'un appareil
de chauffage

Abgasanlagen - Wärme- und strömungstechnische
Berechnungsverfahren - Teil 2: Abgasanlagen mit mehreren
Feuerstätten

This European Standard was approved by CEN on 24 January 2015.

CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the CEN-CENELEC Management Centre or to any CEN member.

This European Standard 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 CEN-CENELEC Management Centre has the same status as the official versions.

CEN members are the national standards bodies of Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and United Kingdom.



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

CEN-CENELEC Management Centre: Avenue Marnix 17, B-1000 Brussels

Contents

Page

Foreword.....	5
Introduction	6
1 Scope	7
2 Normative references	7
3 Terms and definitions	8
4 General symbols and abbreviations	9
5 Calculation method.....	9
5.1 General principles.....	9
5.2 Pressure equilibrium condition	11
5.2.1 Negative pressure chimneys	11
5.2.2 Positive pressure chimneys	12
5.3 Mass flow requirement.....	13
5.4 Pressure requirements.....	13
5.4.1 Negative pressure chimneys	13
5.4.2 Positive pressure chimneys	14
5.5 Temperature requirement	15
5.6 Calculation procedure	15
6 Flue gas data characterising the heating appliance	18
7 Data for chimney and connecting flue pipes	19
8 Basic data for the calculation.....	20
8.1 General.....	20
8.2 Air temperatures	20
8.2.1 External air temperature (T_L)	20
8.2.2 Ambient air temperature (T_u)	20
8.3 External air pressure (p_L)	20
8.4 Gas constant	20
8.4.1 Gas constant of the air (R_L).....	20
8.4.2 Gas constant of flue gas (R)	20
8.5 Density of air (ρ_L)	20
8.6 Specific heat capacity of the flue gas (c_p)	20
8.7 Water vapour content ($\sigma(\text{H}_2\text{O})_j$) and condensing temperature (T_{sp})	20
8.8 Correction factor for temperature instability (S_H)	21
8.9 Flow safety coefficient (S_E)	21
8.10 External coefficient of heat transfer	21
9 Determination of temperatures	21
10 Mixing calculations.....	23
10.1 General.....	23
10.2 Flue gas mass flow (\dot{m}_j)	23
10.3 Flue gas temperature at the inlet of the chimney segment ($T_{e,j}$).....	23
10.4 CO ₂ -content of the flue gas in the chimney segment ($\sigma(\text{CO}_2)_j$)	23
10.5 H ₂ O-content of the flue gas ($\sigma(\text{H}_2\text{O})_j$).....	24
10.6 Gas constant of the flue gas (R_j)	24
10.7 Flue gas data	24
10.7.1 Specific heat capacity ($c_{pV,j}$), ($c_{p,j}$)	24

10.7.2	Thermal conductivity of the flue gas ($\lambda_{AV,j}$), ($\lambda_{A,j}$)	24
10.7.3	Dynamic viscosity ($\eta_{AV,j}$), ($\eta_{A,j}$)	25
10.7.4	Condensing temperature (T_{SP})	25
11	Density and velocity of the flue gas	25
12	Determination of the pressures	26
12.1	Pressures at each inlet of the chimney segments	26
12.1.1	Draught	26
12.1.2	Positive pressure	26
12.1.3	Draught due to chimney effect in the chimney segment ($P_{H,j}$)	27
12.1.4	Pressure resistance in the chimney segment ($P_{R,j}$)	27
12.2	Minimum draught required at the flue gas inlet into the chimney and maximum allowed draught (P_{Ze} and P_{Zemax}) and maximum and minimum differential pressure at the flue gas inlet into the chimney (P_{ZOe} and P_{ZOemin})	29
12.2.1	Minimum required and maximum allowed draught	29
12.2.2	Maximum available and minimum allowed differential pressure	29
12.2.3	Calculated pressure resistance of the connecting flue pipe ($P_{V,j}$)	30
12.2.4	Calculated pressure resistance of the air supply ($P_{Bc,j}$)	32
13	Inner wall temperature	33
14	Cascade installations	33
14.1	Principle of the calculation method	33
14.2	Pressure equilibrium condition	34
14.2.1	Negative pressure cascade installation	34
14.2.2	Positive pressure cascade installation	35
14.3	Mass flow requirement	36
14.4	Pressure requirements	36
14.4.1	Negative pressure chimneys	36
14.4.2	Positive pressure chimneys	37
14.5	Temperature requirement	38
14.6	Calculation procedure	38
14.7	Pressures at the outlet of the connecting flue pipe and pressures at the inlet of the collector segment	38
14.7.1	Pressure at the flue gas inlet into the collector segment ($P_{ZC,j,l}$ or $P_{ZOC,j,l}$)	38
14.7.2	Pressures required or available at the outlet of the connecting flue pipe ($P_{ZeC,j,l}$, $P_{ZOeC,j,l}$)	42
14.8	Inner wall temperature ($T_{iobC,j,l}$)	44
15	Balanced flue chimney	44
15.1	Principle of the calculation method	44
15.2	Pressure equilibrium condition	44
15.3	Mass flow requirement	45
15.4	Pressure requirements	45
15.4.1	Negative pressure chimneys	45
15.4.2	Positive pressure chimneys	45
15.5	Temperature requirements	47
15.6	Calculation procedure for balanced flue chimneys	47
15.7	Mass flow of the supply air	49
15.8	Determination of the temperatures in balanced flue chimneys	50
15.8.1	Separate ducts	50
15.8.2	Concentric ducts	50
15.8.3	Concentric connection pipes	58
15.9	Pressures of the air supply ducts	64
15.9.1	Draught due to chimney effect of the air supply duct of chimney segment j	64
15.9.2	Draught due to chimney effect of the air supply duct of connection pipes	64
15.9.3	Pressure resistance of the air supply duct of the chimney segment j ($P_{RB,j}$)	64
15.9.4	Pressure resistance of the air supply duct of the connection pipe j ($P_{RBV,j}$)	66
15.10	Density and velocity of the supply air	68

15.10.1	Density and velocity of the supply air in the air supply duct averaged over the length of the chimney segment	68
15.10.2	Density and velocity of the supply air averaged over the length of the connection pipes	68
16	Consideration of chimney fans	69
16.1	General.....	69
16.2	Inline fans	70
16.3	Exhaust fans.....	71
Annex A	(informative) Recommendations	72
A.1	General.....	72
A.2	Recommendations for the chimney and heating appliances.....	72
A.3	Recommendations for connecting flue pipes.....	72
Annex B	(informative) Characteristics for the heating appliance	73

Foreword

This document (EN 13384-2:2015) has been prepared by Technical Committee CEN/TC 166 “Chimneys”, the secretariat of which is held by ASI.

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 October 2015, and conflicting national standards shall be withdrawn at the latest by October 2015.

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.

This document supersedes EN 13384-2:2003+A1:2009.

According to EN 13384-2:2003+A1:2009 the following fundamental changes are given:

- editorial mistakes have been corrected;
- mistakes in formulas have been corrected;
- characteristic values for heating appliances for solid fuel and for liquid fuels in Annex B have been adapted to actual data;
- for the mixture of fuels a clarification about the rise of the dew point has been added;
- for non-concentric ducts the calculation of the mean temperature of the air supply has been amended;
- the process for iteration for appliances with low impact of the pressure to the flue gas mass flow (e.g. CHP with combustion engine) has been simplified;
- for chimney fans a calculation procedure has been added;

This standard is one of a series of standards prepared by CEN/TC 166 comprising product standards and execution standards for chimneys.

National installation rules are not regarded in the standard.

This document has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association.

This European Standard “Chimneys — Thermal and fluid dynamic calculation methods” consists of three Parts:

- Part 1: Chimneys serving one heating appliance
- Part 2: Chimneys serving more than one heating appliance
- 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 organisations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

Introduction

The calculation described in this standard is complex and is intended to be solved by using a computer programme. The general principles of this calculation method of EN 13384-1 also apply to this standard.

This standard is in support of the execution standards for a chimney installation serving more than one heating appliance.

The execution standard identifies limitations and safety considerations associated with the design, installation, commissioning and maintenance of a chimney serving more than one heating appliance (not dealt within the calculation method).

1 Scope

This part of EN 13384 specifies methods for calculation of the thermal and fluid dynamic characteristics of chimneys serving more than one heating appliance.

This part of EN 13384 covers both the cases, either

- a) where the chimney is connected with more than one connecting flue pipe from individual or several appliances in a multi-inlet arrangement; or
- b) where the chimney is connected with an individual connecting flue pipe connecting more than one appliance in a cascade arrangement.

The case of multiple inlet cascade arrangement is covered by the case a).

This part of EN 13384 deals with chimneys operating under negative pressure conditions (there can be positive pressure condition in the connecting flue pipe) and with chimneys operating under positive pressure conditions and is valid for chimneys serving heating appliances for liquid, gaseous and solid fuels.

This part of EN 13384 does not apply to:

- chimneys with different thermal resistance or different cross-section in the various chimney segments. This part does not apply to calculate energy gain;
- chimneys with open fire places, e.g. open fire chimneys or chimney inlets which are normally intended to operate open to the room;
- chimneys which serve different kinds of heating appliances regarding natural draught, fan assisted, forced draught or combustion engine. Fan assisted appliances with draught diverter between the fan and the chimney are considered as natural draught appliances;
- chimneys with multiple inlets from more than 5 storeys. (This does not apply to balanced flue chimney.);
- chimneys serving heating appliances with open air supply through ventilation openings or air ducts, which are not installed in the same air supply pressure region (e.g. same side of building).

For positive pressure chimneys this part only applies if any heating appliance which is out of action can be positively isolated to prevent flue gas back flow.

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.

EN 1443:2003, *Chimneys - General requirements*

EN 13384-1:2015, *Chimneys - Thermal and fluid dynamic calculation methods - Part 1: Chimneys serving one appliance*

EN 15287-1:2007+A1:2010, *Chimneys - Design, installation and commissioning of chimneys - Part 1: Chimneys for non-roomsealed heating appliances*

EN 15287-2:2008, *Chimneys - Design, installation and commissioning of chimneys - Part 2: Chimneys for roomsealed appliances*

prEN 16475-2, *Chimneys - Accessories - Part 2: Chimney fans - Requirements and test methods*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in EN 1443:2003, EN 13384-1:2015, EN 15287-1:2007+A1:2010, EN 15287-2:2008 and the following apply.

3.1
chimney segment
part of a chimney between two consecutive flue gas connections or between the last flue gas connection and the chimney outlet

3.2
collector segment
part of a connecting flue pipe between two consecutive flue gas connections or between the last flue gas connection and the chimney inlet

3.3
flue gas mass flow
 \dot{m}
mass of the flue gas leaving the heating appliance through the connecting flue pipe per unit of time

Note 1 to entry: In case of a chimney serving more than one heating appliance, the air being transported through an appliance which is out of action is also given the term flue gas mass flow.

3.3.1
declared flue gas mass flow
 $\dot{m}_{w,j}$
flue gas mass flow given by the manufacturer of the heating appliance j with respect to the heat output used in the calculation

3.3.2
calculated flue gas mass flow
 $\dot{m}_{wc,j}$
flue gas mass flow calculated with respect to calculated draught and the working conditions of the heating appliance j

3.4
calculated flue gas temperature
 $T_{wc,j}$
flue gas temperature at the outlet of the heating appliance j depending on the calculated flue gas mass flow

3.5
calculated draught of the flue gas of the heating appliance
 $P_{wc,j}$
draught at the flue gas outlet of the heating appliance j depending on the calculated flue gas mass flow

3.6
flue damper
device to close or partially close the flue