Chimneys — Requirements and test methods for metal chimneys and material independent air supply ducts for roomsealed heating applications —

Part 1: Vertical air/flue terminals for C6-type appliances

The European Standard EN 14989-1:2007 has the status of a British Standard

ICS 91.060.40

British Standards

National foreword

This British Standard is the UK implementation of EN 14989-1:2007.

The UK participation in its preparation was entrusted by Technical Committee B/506, Chimneys, to Subcommittee B/506/5, Chimneys and their components having inner linings of metal.

A list of organizations represented on this committee can be obtained on request to its secretary.

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This British Standard was published under the authority of the Standards Policy and Strategy Committee on 28 September 2007

ISBN 978 0 580 54462 0

Amendments issued since publication

Amd. No.	Date	Comments

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN 14989-1

February 2007

ICS 91.060.40

English Version

Chimneys - Requirements and test methods for metal chimneys and material independent air supply ducts for roomsealed heating applications - Part 1: Vertical air/flue terminals for C6-type appliances

Conduits de fumée - Exigences et méthodes d'essais pour conduits de fumées métalliques et conduits d'alimentation en air pour tous matériaux pour des appareils de chauffages étanches - Partie 1 : Terminaux verticaux air/fumée pour appareils de type C6

Abgasanlagen - Anforderungen und Prüfverfahren für Metall-Abgasanlagen und materialunabhängige Luftleitungen für raumluftunabhängige Anlagen - Teil 1: Senkrecht angeordnete luft/Abgas-Aufsätze für Abgasanlagen mit Gasgeräten des Typs C6

This European Standard was approved by CEN on 7 January 2007.

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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

Ref. No. EN 14989-1:2007: E

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Foreword

This document (EN 14989-1:2007) has been prepared by Technical Committee CEN/TC 166 “Chimneys”, the secretariat of which is held by UNI.

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of an identical text or by endorsement, at the latest by August 2007, and conflicting national standards shall be withdrawn at the latest by November 2008.

This document has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association, and supports essential requirements of EU Directive(s).

For relationship with EU Directive(s), see informative Annex ZA, which is an integral part of this document.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: 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 United Kingdom.

Introduction

This standard covers vertical air/flue terminals with metal flue ducts for chimneys for roomsealed heating applications meaning the combination of flue duct and air supply duct needed for the correct functioning of a C_6 roomsealed appliance.

The current requirements and test methods apply to balanced flue type applications. Requirements and test methods for other roomsealed applications will follow in separate documents.

A standard covering the design, installation and commissioning of room sealed heating applications is in the current CEN/TC 166 work program, which includes this Part 1: Vertical Terminals for C_6-type appliances, and Part 2: Flue and air supply ducts for individual roomsealed appliances.

1 Scope

This standard specifies the requirements and test methods for positive pressure air/flue terminals with metal flue ducts for C_{62}- and C_{63}-type gas appliances, which convey air for combustion, and the products of combustion from appliances to the outside atmosphere.

It also specifies the requirements for marking, manufacturer's instructions, product information and evaluation of conformity.

NOTE The classification of gas appliances is according to CEN/TR 1749.

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.

EN 573-3, *Aluminium and aluminium alloys - Chemical composition and form of wrought products - Part 3: Chemical composition*

EN 1443:2003, *Chimneys - General requirements*

EN 1856-1:2003, *Chimneys - Requirements for metal chimneys - Part 1: System chimney products*

EN 1856-2:2004, *Chimneys - Requirements for metal chimneys - Part 2: Metal liners and connecting flue pipes*

EN 1859:2000, *Chimneys - Metal chimneys - Test methods*

EN 10088-1, *Stainless steels - Part 1: List of stainless steels*

EN 14241-1, *Chimneys - Elastomeric seals and elastomeric sealants - Material requirements and test methods - Part 1: Seals in flue liners*

EN 14471, *Chimneys - System chimneys with plastic flue liners - Requirements and test methods*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in EN 1443:2003, EN 1859:2000, EN 1856-1:2003, EN 1856-2:2004 and the following apply.

3.1
air/flue terminal
terminal unit consisting of a flue duct, which may be provided with a cover, and an air supply duct for the connection of a roomsealed appliance

3.2
air supply duct
independent duct in a building, or a structural part of an air/flue terminal, conveying combustion air to a roomsealed appliance

3.3
concentric air/flue configuration
configuration in which the chimney flue is fully surrounded by the air supply duct

3.4
flow resistance
difference between the static pressures in the flue connection and the air supply duct connection under dynamic conditions

3.5
friction length
imaginary dimension for the flow resistance of the air/flue terminal expressed in metres of duct length

3.6
nominal diameter of the flue of the terminal (D_n)
whole number representing the diameter of the flue of the terminal, expressed in millimetres

3.7
nominal flow rate
amount of air which flows at the nominal velocity through a duct with nominal diameter

3.8
nominal velocity
velocity in a duct which characterises the velocity used in the test

NOTE The actual test velocity may differ from the nominal velocity, because the actual inside diameter differs from the nominal diameter.

3.9
push-in spigot
part of a pipe or fitting which is pushed into the socket of another pipe or fitting, thus resulting in a connection

3.10
re-circulation percentage
ratio between the amount of flue gases leaking through the flue opening into the air supply duct opening of the terminal and the total amount of flue gases produced

3.11
room-sealed appliance
appliance in which the combustion circuit (air supply, combustion chamber, heat exchanger and evacuation of the products of combustion) is sealed with respect to the room in which the appliance is installed

3.12
separate air/flue configuration
configuration in which the air supply duct and the chimney flue are separate (non-concentric)

3.13
socket
part of a pipe or fitting which is pushed over the push-in spigot of another pipe or fitting, thus resulting in a connection

3.14
terminal adapter
part of the terminal used to connect the terminal to the air supply duct and the flue. It may include the transition from parallel to concentric configuration

3.15
wind pressure angle
angle from which the wind (generated in the wind tunnel) hits the air/flue terminal

3.16
wind effect pressure
additional pressure difference between the inlet and the outlet of the terminal due to the wind

3.17
balanced flue chimney system
system where the air entry to the combustion air supply duct is adjacent to the discharge of combustion products from the flue, the inlet and outlet being so positioned that wind effects are substantially balanced

4 Symbols

α_a	coefficient of heat transfer between the supply air and the outer surface of the flue duct	in	$\frac{W}{m^2 \cdot K}$
α_{aB}	coefficient of heat transfer between the outside of the air supply duct and the ambient air	in	$\frac{W}{m^2 \cdot K}$
α_i	coefficient of heat transfer between the air and the inner surface of the flue duct	in	$\frac{W}{m^2 \cdot K}$
α_{iB}	coefficient of heat transfer between the supply air and the inner surface of the air supply duct	in	$\frac{W}{m^2 \cdot K}$
η_A	dynamic viscosity of air for T_m	in	$\frac{N \cdot s}{m^2}$
η_B	dynamic viscosity of air for T_{mB}	in	$\frac{N \cdot s}{m^2}$
λ_A	thermal conductivity of air for T_m	in	$\frac{W}{m \cdot K}$
λ_B	thermal conductivity of air for T_{mB}	in	$\frac{W}{m \cdot K}$
$\left(\frac{1}{\Lambda}\right)$	thermal resistance of the flue duct	in	$\frac{m^2 \cdot K}{W}$
$\left(\frac{1}{\Lambda}\right)_B$	thermal resistance of the air supply duct	in	$\frac{m^2 \cdot K}{W}$
ρ	density of air at 20 °C = 1,2	in	$\frac{kg}{m^3}$
ρ_a	density of air	in	$\frac{kg}{m^3}$
ρ_e	density of air for T_e	in	$\frac{kg}{m^3}$
ρ_m	density of air for T_m	in	$\frac{kg}{m^3}$
ρ_{mB}	density of air for T_{mB}	in	$\frac{kg}{m^3}$
ψ	coefficient of friction of the flue	-	
ψ_B	the higher of the value of the coefficient of friction of the inside of the air supply duct and the outside of the flue duct	-	

ψ_{smooth}	coefficient of friction of the flue for hydraulically smooth flow	-	
$\psi_{smoothB}$	coefficient of friction of the air supply for hydraulically smooth flow	-	
ζ	coefficient of flow resistance, friction factor	-	
ζ_A	declared coefficient of flow resistance of the air supply duct of the terminal	-	
ζ_F	declared coefficient of flow resistance of the flue duct of the terminal	-	
A_B	cross-sectional area of the air supply passage	in	m²
c_p	specific heat capacity of air for T_m	in	$\frac{J}{kg \cdot K}$
c_{pB}	specific heat capacity of air for T_{mB}	in	$\frac{J}{kg \cdot K}$
d_1	external diameter of the push-in spigot of the flue duct	in	mm
d_2	internal diameter of the socket of the flue duct	in	mm
D_1	external diameter of the push-in spigot of the air supply	in	mm
D_2	internal diameter of the duct socket of the air supply duct	in	mm
D_h	hydraulic diameter of the flue	in	m
D_{ha}	hydraulic diameter of the outside of the flue duct	in	m
D_{haB}	hydraulic diameter of the outside of the air supply duct	in	m
D_{hB}	hydraulic diameter of the air supply passage	in	m
D_{hiB}	hydraulic diameter of the inside of the air supply duct	in	m
D_n	declared nominal diameter of the terminal	in	mm
k_b	coefficient of heat transmission between the flue and the air supply passage at temperature equilibrium	in	$\frac{W}{m^2 \cdot K}$
k_{Bb}	coefficient of heat transmission between the supply air and the ambient air at temperature equilibrium	in	$\frac{W}{m^2 \cdot K}$
L	length of the test segment	in	m
L_0	Available insertion length	in	mm
Nu	Nusselt number for the flue	-	
Nu_a	Nusselt number for the outside of the flue duct	-	
Nu_B	Nusselt number for a reference pipe flow	-	
Nu_{iB}	Nusselt number for the inside of the air supply duct	-	
Δp	Static pressure difference, measured friction	in	Pa
P_A	static pressure above ambient pressure directly downstream of the air supply duct of the terminal	in	Pa
P_F	static pressure above ambient pressure directly upstream of the flue duct of the terminal	in	Pa
P_L	wind effect pressure	in	Pa
Pr	Prandtl number of the flue duct	-	
Pr_B	Prandtl number of the supply air duct	-	
r	mean value of roughness of the inner wall of the flue duct	in	m
r_B	the higher of the value of the mean value of roughness of the inside of the air supply duct and the outside of the flue duct	in	m

Re	Reynolds number of the flue	-	
Re_B	Reynolds number of the air supply passage	-	
S_A	cross sectional area of the duct at the measurement position directly downstream of the air supply duct of the terminal	in	mm^2
S_F	cross sectional area of the duct at the measurement position directly upstream of the flue duct of the terminal	in	mm^2
S_{rad}	correction factor for radiation from the outer surface of the flue duct to the inner surface of the air supply duct	-	
T_e	air temperature at the flue inlet	in	°C
T_{eB}	air temperature at the air supply inlet	in	°C
T_{mB}	mean temperature in the air supply	in	°C
T_o	air temperature at the flue outlet	in	°C
T_{oB}	air temperature at air supply outlet	in	°C
T_u	ambient air temperature	in	°C
U	circumference of the inside of the flue	in	m
U_a	circumference of the outside of the flue duct	in	m
U_{iB}	circumference of the inside of the air supply duct	in	m
$\dot{V}$	test flow rate	in	$\frac{m^3}{s}$
w_A	velocity at the static pressure measurement position directly downstream of the air supply duct of the terminal, in m/s.	in	$\frac{m}{s}$
w_F	velocity at the static pressure measurement position directly upstream of the flue duct of the terminal, in m/s.	in	$\frac{m}{s}$
w_n	velocity of the flow inside the terminal under nominal operating conditions	in	$\frac{m}{s}$
w_{mB}	average velocity of the supply air	in	$\frac{m}{s}$
w_w	Wind speed	in	$\frac{m}{s}$
x	centre to centre distance of the air supply duct and the flue duct for separate air/flue configuration	in	mm

5 Manufacturer's declaration for type test

The manufacturer shall provide the relevant information from product documentation and instructions and in addition shall declare:

a) the manufacturing drawings including declared internal diameter and tolerances of manufacture;

b) materials from which the air/flue terminal is made (according to EN 10088-1 and EN 573-3 for metal);

c) the minimum thicknesses after manufacture; and

d) the nominal diameter (D_n);

e) the nominal length (L_n)

6 Dimensions and tolerances

The thickness of material of the flue and air supply ducts shall be not less than that declared by the manufacturer.

The declared internal diameter and length of the air/flue terminal shall not vary by more than ± 5 mm from the nominal diameter (D_n) and nominal length (L_n). The measured internal diameter of the air/flue terminal shall be not less than the manufacturer's declared diameter.

NOTE Annex A gives examples of typical dimensions for air flue terminals.

7 Performance requirements

7.1 Mechanical resistance and stability

7.1.1 Vertical load on the air/flue terminal

When tested according to the test method described in 12.1.1, the flue/air terminal shall be able to withstand an evenly applied force of 7 N/mm x D_n to a maximum of 750 N without showing any permanent deformations.

7.1.2 Wind load

When the air/flue terminal is tested according to the test method described in 12.1.2, the air/flue terminal shall withstand a minimum load of 1,5 kN/m^2 of the projected outer surface area.

This requirement shall be declared fulfilled for a terminal of height less than 0,8 m above the roof, and more than 0,4 m below the roof.

7.2 Hygiene, health and environment

7.2.1 Gas tightness of the flue

When an air/flue terminal is tested according to the test method described in 12.1.3 with a positive pressure of 200 Pa in the flue, the leakage rate shall not exceed 0,006 l s^{-1} m^{-2} of surface area of the flue before and after the thermal performance test.

7.2.2 Gas tightness of the air supply duct

When an air/flue terminal is tested according to the test method described in 12.1.4 with a positive pressure of 40 Pa in the air supply duct section, the leakage shall not exceed 0,28 l s^{-1} m^{-2} of surface of the air supply duct before and after the thermal performance test.

7.3 Safety in use

7.3.1 Thermal performance

7.3.1.1 Gas tightness

The air/flue terminal shall meet the gas tightness requirements of 7.2 before performing the test described in 12.2.4.1 and after performing the test described in 12.2.4.3.

7.3.1.2 Heat stress

7.3.1.2.1 Distance to adjacent combustible surfaces

When the air/flue terminal is tested in accordance with 12.2.4.1, the maximum temperature of the test walls adjacent to the air flue terminal shall not be greater than 85 °C related to an ambient temperature of 20 °C.

This requirement shall be declared fulfilled for a concentric air/flue terminal designated T200 or below with a zero distance to combustible materials.

NOTE For a concentric terminal having a separate connecting spigot, the manufacturer should give instructions on how the terminal is to be installed regarding the distance to combustible material.

7.3.1.2.2 Temperature cycling test

When the air/flue terminal and its components is tested in accordance with 12.2.4.3 no part of the terminal or its components shall show any permanent deformation, blisters or cracks which could affect its performance.

7.3.2 Thermal resistance

7.3.2.1 Air/flue terminal with separate air/flue configuration

The thermal resistance value of the air/flue terminal section declared by the manufacturer shall be verified either by testing according to the test method of EN 1859 or by calculation using either the simplified calculation or the finite difference equation of EN 1859:2000 (Annexes F and G). When the value for the thermal resistance is calculated, the thermal conductivity value shall be based on the mean temperature of the insulation depending on the nominal temperature of Table 1.

7.3.2.2 Air/flue terminal with concentric air/flue configuration

The thermal resistance value of the air/flue terminal section declared by the manufacturer shall be verified by testing according to 12.2.4.4.

7.3.3 Rainwater ingress

7.3.3.1 Flue

When a terminal designated D according to 10.4 is tested for rain ingress according to the test method described in 12.3, the volume of the water collected in the flue shall not exceed 0,05 mm^3/s per millimetre of the nominal size.

7.3.3.2 Air supply duct

When a terminal is tested for rain ingress according to the test method described in 12.3, the volume of the water collected in the air supply duct shall not exceed 0,05 mm^3/s per millimetre of nominal size.

7.3.3.3 Insulation

When a section of the air flue terminal containing insulation is tested for rain ingress according to the test method described in 12.3 the increase of mass shall not exceed 1% of the mass of the insulation of the section.

7.3.4 Aerodynamic properties of the terminal

7.3.4.1 Coefficient of flow resistance of the air supply duct of the terminal

When a terminal is tested according to the test method described in 12.4 under the conditions specified in 12.4.2.1, the declared coefficient of flow resistance of the air supply duct ζ_A shall fulfil the following condition:

$$\zeta_A \geq \frac{-2}{\rho_a w_n^2}\left(P_A + \frac{1}{2}\rho_a w_A^2\right) \tag{1}$$

with

ζ_A	declared coefficient of flow resistance of the air supply duct of the terminal
ρ_a	density of air, in kg/m^3
w_n	velocity of the flow inside the terminal under nominal operating conditions, in m/s
P_A	static pressure above ambient pressure directly downstream of the air supply duct of the terminal, in Pa
w_A	velocity at the static pressure measurement position directly downstream of the air supply duct of the terminal, in m/s

7.3.4.2 Coefficient of flow resistance of the flue duct of the terminal

When a terminal is tested according to the test method described in 12.4 under the conditions specified in 12.4.2.2 the declared coefficient of flow resistance of the flue duct ζ_F shall fulfil the condition:

$$\zeta_F \geq \frac{2}{\rho_a w_n^2}\left(P_F + \tfrac{1}{2}\rho_a w_F^2\right) \tag{2}$$

with

ζ_F	declared coefficient of flow resistance of the flue duct of the terminal
ρ_a	density of air, in kg/m^3
w_n	velocity of the flow inside the terminal under nominal operating conditions, in m/s
P_F	static pressure above ambient pressure directly upstream of the flue duct of the terminal, in Pa
w_F	velocity at the static pressure measurement position directly upstream of the flue duct of the terminal, in m/s

7.3.4.3 Wind effect on the terminal

When a terminal is tested according to the test method described in 12.4 under the conditions specified in 12.4.2.3, the wind effect pressure P_L for each condition shall be determined using the following formula

$$P_L = P_F - P_A - \tfrac{1}{2}\rho_a w_n^2(\zeta_F + \zeta_A) \tag{3}$$

with

P_L wind effect pressure, in Pa

P_A static pressure above ambient pressure directly downstream of the air supply duct of the terminal, in Pa

P_F static pressure above ambient pressure directly upstream of the flue duct of the terminal, in Pa

ρ_a density of air, in kg/m^3

w_n velocity of the flow inside the terminal under nominal operating conditions, in m/s

ζ_A declared coefficient of flow resistance of the air supply duct of the terminal

ζ_F declared coefficient of flow resistance of the flue duct of the terminal

For all conditions, P_L < 20 Pa.

For P_F and P_A determined under the conditions w_w = 12 m/s and w_n = 1 m/s, $P_F > P_A$ - 50 Pa.

For P_F and P_A determined under the conditions w_w = 12 m/s and no flow inside the terminal (w_n = 0 m/s):

— in the case where the terminal is designated FL1 (see 10.7.3), $P_F < P_A$ +5 Pa;

— in the case where the terminal is designated FL2 (see 10.7.3), $P_F < P_A$;

7.3.4.4 Recirculation of flue gases

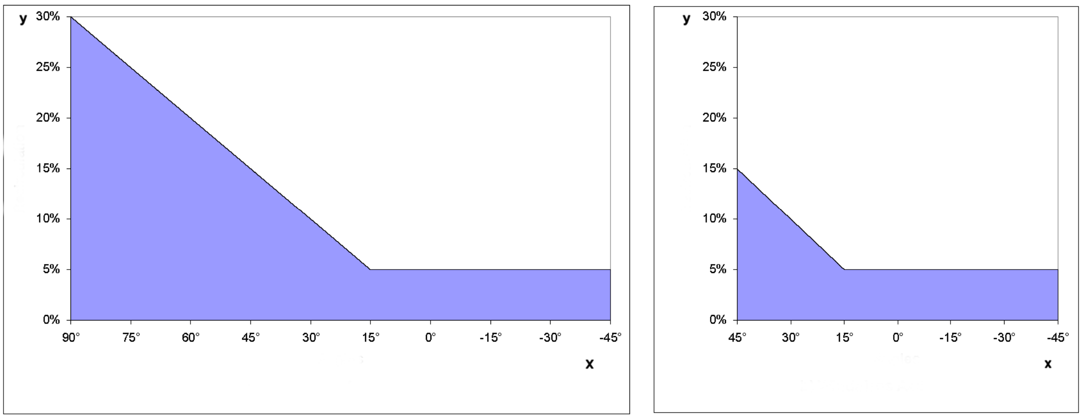
When the air/flue terminal is tested according to the test method in 12.4.2.4 any recirculation of flue gases in the flue terminal as a result of wind effects shall not exceed:

— a maximum of 5% at wind pressure angles ranging from -45° to +15°;

— 5 % at +15°, increasing linearly to 30 % at +90° at wind pressure angles ranging from +15° to +90° for type A90 (see 10.7);

— 5 % at +15°, increasing linearly to 15 % at +45° at wind pressure angles ranging from +15° to +45° for type A45 (see 10.7).

This recirculation requirement is schematically represented in Figure 1.



a) Windclass A90 b) Windclass A45

Key

x angles
y recirculation

Figure 1 — Graphical representation of recirculation requirement

NOTE The rational supporting the performance graph of Figure 1 a) and b) is based on an acceptance that it is the equivalent of a maximum of 10 % recirculation when fitted to a boiler under operating conditions, as required in EN 483.

7.3.5 Resistance to ice formation

When an air/flue terminal is declared ice free, when tested in accordance with 12.5 it shall satisfy the following requirements:

— the increase in weight of the tested flue terminal shall not exceed 0,5 g for each mm of the nominal diameter of the flue;

— the dimension of any ice formation, measured in any direction on or in the terminal, shall not exceed 10 mm.

7.3.6 Resistance to penetration by foreign objects

When the air/flue terminal is tested according to 12.6 the opening in the external surface of the terminal shall not permit the entry of a (16 ± 0,1) mm diameter metal ball applied with a force of 5 N ± 0,1 N.

7.3.7 Materials

7.3.7.1 Flue duct and metal air/flue terminal parts in contact with combustion products

Flue ducts and metal air/flue terminal parts for vertical air/flue terminals in contact with combustion products shall be in accordance with EN 1856-1.

7.3.7.2 Air supply duct and other parts not in contact with combustion products

The casing, if any, of the air/flue terminal shall consist of materials - protected or not - which are to be regarded as fit for the purpose.

E.g.:

- plastic;
- aluminium;
- steel galvanized according to the Sendzimir process with a minimum zinc layer weight of 275 g/m^2;
- stainless steel.

7.3.7.3 Additional information on plastics and elastomers

Attention shall be paid to the resistance to sunlight where appropriate, in particular UV radiation, as well as to flame extinction and flame sustainability.

Plastics and elastomeric components used in the air/flue terminal shall:

a) Not show any deformation, permanent or temporary, when the air/flue terminal is tested in accordance with 12.7, that will affect the performance of the air/flue terminal, and

b) Meet the requirements laid down in EN 14471 and EN 14241-1 when assessed using the test methods described in those standards at the temperatures obtained in 12.2.4.2

7.3.7.4 Freeze thaw resistance

Metal terminal products are considered deemed to satisfy freeze thaw resistance. Plastic components satisfying the requirement 7.3.7.3.a), are also considered deemed to satisfy the freeze thaw resistance.

8 Product information

8.1 Manufacturer's instructions

The manufacturer's instructions shall be available in the language of the country in which the product is placed on the market.

8.2 Minimum information to be included in the manufacturer's instructions

The manufacturer shall include in his documentation and instructions the following minimum information:

- manufacturer identification;
- product designation (according to 10.1), with explanation, e.g. metal vertical air/flue terminal for use with C_{62} and C_{63} gas appliances, and resistance to fire external to external class EI;

NOTE 1 Resistance to fire external to external is zero for this product.

NOTE 2 For resistance to fire classification see EN 13501-2.

- nominal diameters of the flue duct and air duct;

— actual diameters and lengths of the spigots with tolerances;

— weight;

— typical installation drawing, including relevant dimensions and details of how the terminal is supported;

— identification of flue and air supply ducts;

— minimum distance to combustible materials;

— that the product shall be installed in accordance with local rules in force;

— thermal resistance;

— coefficient of flow resistance for the air supply ζ_A;

— coefficient of flow resistance for the flue duct ζ_F;

— minimum/maximum height above roof.

And where appropriate:

— compatibility with the spigot sizes shown in Annex B;

— storage instructions;

— method of installation of any seals required;

— specific methods or tools for cleaning.

NOTE 3 The normal method of cleaning is by the use of a brush which should not be made from black steel.

8.3 Sampling points

Where appropriate an adapter with a flue gas and air supply sampling point shall be provided with the terminal.

9 Marking

NOTE For CE marking and CE labelling purposes the provisions of ZA.3 apply.

9.1 Air/flue terminal

The air/flue terminal shall be marked with the following information:

a) product designation in accordance with Clause 10;

b) Additional characteristics:

— Wind class (see 10.7.1): e.g A90

— Ice/rain class (see 10.7.2): e.g. K1.

— Pilot flame class (see 10.7.3): e.g. FL1

c) name or trade mark of the manufacturer;

d) manufacturing batch or product reference of manufacturer;

e) for separate air/flue configurations, identification of the flue and air supply ducts.

9.2 Packaging

Each package within a consignment shall be legibly marked with the following information:

a) product designation in accordance with Clause 10;

b) name or trade mark of the manufacturer;

c) nominal diameters of the flue duct and air duct.

10 Designation

10.1 General

An air/flue terminal shall be designated in accordance with the following designation system.

Example:

Terminal EN XXXX – T120 – P1 – D – Vm-L40045 – O50

- Product description (Terminal)
- Standard number (EN XXXX)
- Temperature class (see 10.2) (T120)
- Pressure class (see 10.3) (P1)
- Condensate resistance class (W: wet or D: dry) (see 10.4) (D)
- Corrosion resistance class (Vm)
- Flue duct material specification (see 10.5) (L40045)
- Sootfire resistance and distance to combustible material (in mm) (see 10.6) (O50)

10.2 Temperature classes and test temperature

The temperature class for the terminal nominal working temperature and the test temperature for the temperature class are defined in Table 1.

Table 1 — Temperature classes and test temperatures

Temperature class	Nominal working Temperature (T) ºC	Flue gas test Temperature (T_e) ºC
T 080	≤ 80	100
T 100	≤ 100	120
T 120	≤ 120	150
T 140	≤ 140	170
T 160	≤ 160	190
T 200	≤ 200	250
T 250	≤ 250	300
T 300	≤ 300	350
T 400	≤ 400	500
T 450	≤ 450	550
T 600	≤ 600	700

10.3 Pressure class

Terminals conforming to this standard shall be designated according to only one pressure class P1 (see 7.2.1).

10.4 Condensate resistance class

Terminals shall be designated either:

— W for terminals operating under wet operating conditions; or

— D for terminals operating under dry conditions.

10.5 Corrosion resistance

10.5.1 Corrosion resistance

Corrosion resistance shall be designated either on the basis of:

a) material type (according to Table 2) and thickness of the flue duct; or

b) on the basis of the results of at least one of the three test methods described in normative Annex A of EN 1856-1:2003.

Products which have a declaration on the basis of material type and thickness shall be designated Vm.

Products passing the test described in A.1 of EN 1856-1:2003 shall be designated V1.

The product designation shall, in any case, include the flue duct material specification, according to 10.5.2.

NOTE The link between Vm, and V1, and the allowed use is dependent on individual member states regulations where they exist.

10.5.2 Flue duct material specification for terminals

The complete material specification of the flue duct shall be formed by the letter L followed by five digits. The first two digits shall represent the material type as in Table 2 and the last three digits shall represent the material thickness in multiples of the unit 0,01 mm.

Example: L 40045 represents a liner made of 1.4401 stainless steel with a thickness of 0,45 mm.

Table 2 — Flue duct material specification (according to EN 10088-1 and EN 573-3)

Material type	Material No.	Symbol
10	EN AW – 4047A	EN AW Al Si 12A CU <0,1%, Zn<0,15% (cast aluminium)
11	EN AW – 1200	EN AW-AL 99,0
20	1.4301	X5CrNi 18-10
30	1.4307	X2CrNi 18-9
40	1.4401	X5CrNiMo 17-12-2
50	1.4404[a]	X2CrNiMo 17-12-2
60	1.4432	X2CrNiMo 17-12-3
70	1.4539	X1NiCrMoCu 25-20-5
99	To be declared by the manufacturer	To be declared by the manufacturer

[a] Equivalent for material Nº 1.4404 = 1.4571(symbol X6CrNiMoTi 17-12-2)

10.6 Resistance to fire (internal to external): Soot fire resistance and distance to combustible material

Terminals according to this standard are designated non-soot fire resistant. The terminal shall be designated O followed by the separation distance to combustible material xx in mm (see 7.3.1.2.1).

10.7 Additional characteristics

10.7.1 Wind class

Terminals shall be designated either A90 or A45.

10.7.2 Ice/rain class

A terminal shall be designated ice/rain class K according to Table 3.

Table 3 — Ice/rain class

Ice/rain	K1	K2	K3	K4
Ice free	yes	no	yes	no
Rain Protected	yes	yes	no	no

10.7.3 Pilot flame class

Terminals shall be designated either:

FL1 – For $P_F < P_A$ +5 Pa

FL2 – For $P_F < P_A$

NOTE 1 For some boiler and terminal combinations practical experience has shown that after a period of use, when the boiler extinguishes, initially it is possible for counter flow to occur in the terminal.

This counter flow can transport vaporised condensate from the flue or the warm heat exchanger back into the appliance where it may condense on the first cold part(s) that it meets which may cause corrosion problems.

The possibility of counter flow is avoided when $P_F < P_A$.

NOTE 2 It is recommended that a boiler with a pilot flame is matched with a terminal designated FL2.

11 Evaluation of conformity

11.1 General

The compliance of a terminal with the requirements of this standard and with the stated values (including classes) shall be demonstrated by:

— initial type testing;

— factory production control by the manufacturer, including product assessment.

11.2 Type testing

11.2.1 General

Initial type testing shall be performed to show conformity with this standard. Tests previously performed in accordance with the provisions of this standard [same product, same characteristic(s), test method, sampling procedure, system of attestation of conformity, etc.] may be taken into account. In addition, initial type testing shall be performed at the beginning of the production of a new terminal or at the beginning of a new method of production (where this may affect the stated properties).

Where characteristics are determined on the basis of conformity with other product standards (for insulation material, metals including coatings, seals and sealants), these characteristics do not need to be reassessed provided that the designer ensures the validity of the results. Products CE marked in accordance with appropriate harmonised European specifications may be presumed to have the performances stated of them, although this does not replace the responsibility of the manufacturer to ensure that the terminal as a whole is correctly designed and its component products have the necessary performance values.

— All characteristics defined in Clauses 5, 6 and 7 shall be subject to initial type testing.

11.2.2 Further type testing

Whenever a change occurs in the product design, the raw material or supplier of the components, or the production process, which would change the tolerances or requirements of Clauses 5 and 6 for one or more of the characteristics, the type tests shall be repeated for the appropriate characteristic(s).

11.2.3 Sampling for type testing

The size of products to be tested shall be according to Annex C.

The results of all type tests shall be recorded and held by the manufacturer, until superseded.

11.3 Factory production control (FPC)

11.3.1 General

NOTE 1 A FPC system conforming with the following requirements of the relevant part(s) or EN ISO 9001, and made specific to the requirements of this standard, is considered to satisfy these requirements.

— The manufacturer shall establish, document and maintain a FPC system to ensure that the manufactured products conform to the stated performance characteristics. The FPC system shall consist of procedures, regular inspections and tests and/or assessments and the use of the results to e.g. control raw and other incoming materials or components, equipment, the production process and the product.

— The manufacturer is responsible for organising the effective implementation of the factory production control system. Tasks and responsibilities in the production control organisation should be documented and this documentation should be kept up to-date. In each factory the manufacturer may delegate the action to a person having the necessary authority to:

a) identify procedures to demonstrate conformity of the product at appropriate stages;

b) identify and record any instance of non-conformity;

c) identify procedures to correct instances of non conformity.

— The manufacturer shall draw up and keep up-to-date documents defining the factory production control which he applies. The manufacturer's documentation and procedures shall be appropriate to the product and manufacturing process. All FPC systems shall achieve an appropriate level of confidence in the conformity of the product. This involves:

d) the preparation of documented procedures and instructions relating to factory production control operations, in accordance with the requirements of the reference technical specification;

e) the effective implementation of these procedures and instructions;

f) the recording of these operations and their results;

g) the use of these results to correct any deviations, repair the effects of such deviations, treat any resulting instances of non-conformity and, if necessary, revise the FPC to rectify the cause of non-conformity.

— The production control operations shall include some or all of the following operations:

h) the specification and verification of raw materials and constituents;

i) the controls and tests to be carried out during manufacture according to a frequency laid down;

j) the verifications and tests to be carried out on finished products according to a frequency which may be laid down in the technical specifications and adapted to the product and its conditions of manufacture.

NOTE 2 Depending on the specific case, it may be necessary to carry out i) the operations referred to under i) and j), ii) only the operations under i) or iii) only those under j).

The operations under b) center as much on the intermediate states of the product as on manufacturing machines and their adjustment, and equipment, etc. These controls and tests and their frequency are chosen based on product type and composition, the manufacturing process and its complexity, the sensitivity of product features to variations in manufacturing parameters, etc.

The manufacturer shall have or have available the installations, equipment and personnel which enable him to carry out the necessary verifications and tests. He may, as may his agent, meet this requirement by concluding a sub-contracting agreement with one or more organizations or persons having the necessary skills and equipment.

The manufacturer has responsibility to calibrate or verify and maintain the control, measuring or test equipment in good operating condition, whether or not it belongs to him, with a view to demonstrating conformity of the product with its technical specification. The equipment shall be used in conformity with the specification or the test reference system to which the specification refers.

If necessary, monitoring of the conformity of intermediate states of the product shall be carried out at the main stages of its production.

This monitoring of conformity focuses where necessary on the product throughout the process of manufacture, so that only products having passed the scheduled intermediate controls and tests are dispatched.

The results of inspections, tests or assessments requiring action shall be recorded, as any action taken. The action to be taken when control values or criteria are not met shall be recorded.

11.3.2 Equipment

All weighing, measuring and testing equipment shall be calibrated and regularly inspected according to documented procedures, frequencies and criteria.

11.3.3 Raw materials and components

The specifications of all incoming raw materials and components shall be documented, as the inspection scheme for ensuring their conformity.

11.3.4 Product testing and evaluation

The manufacturer shall establish procedures to ensure that the stated values of the characteristics of the components are maintained. An example of sampling for FPC is given in Annex B. The characteristics of the components to be included are given in Annex D.

11.3.5 Non conforming products

Non conforming products should be handled according to Annex B.

12 Test methods

12.1 Mechanical resistance and stability

12.1.1 Vertical load on the air/flue terminal

12.1.1.1 Test assembly

The terminal shall be mounted in a simulated roof assembly supported according to the manufacturers instructions with adapters where appropriate.

12.1.1.2 Procedure

A vertical load of (7 ± 0,1) N/mm x D_n (nominal diameter) shall be applied to a maximum of 750 N to the top of the unit, distributed as evenly as possible. Maintain this load for (5 ± 1) min.

Inspect the assembly for any permanent deformations or other visible damage.

NOTE A method for applying an evenly distributed load is done by covering the terminal with a bag of sand sufficient to take up the shape of the terminal and allow the rest of the load to be applied by means of additional weight.

12.1.1.3 Test results

Any permanent deformation or other defects shall be recorded.

12.1.2 Wind load

12.1.2.1 Test assembly

The terminal shall be mounted in a simulated roof assembly supported according to the manufacturer's instructions with adapters where appropriate.

12.1.2.2 Procedure

An evenly distributed test load laterally shall be applied and increased uniformly up to (1,5 ± 2,5%) kN/m^2 of projected surface area of the largest diameter of that part of the terminal above the roof. Inspect the assembly.

NOTE A method for applying an evenly distributed load is done by placing a 180 mm wide leather collar halfway between the roof intersection and the top of the terminal above the roof around the section (including air supply duct and flue cover). The collar should span the casing across an angle of 180°.

12.1.2.3 Test results

Record whether the test sample has withstood the load.

12.1.3 Gas tightness of the flue

12.1.3.1 Test assembly

A positive pressure air supply and a flow meter with a maximum measuring error of 2 % of the value measured shall be connected to the flue of the flue terminal. Connect a manometer (pressure meter) to the flue of the test assembly.

12.1.3.2 Procedure

Seal one end of the flue. Connect a positive pressure air supply, flow meter and manometer to the other end of the flue with appropriate air-tight seals.

Deliver air from the positive pressure air supply to the flue at a rate necessary to achieve and maintain a constant pressure of (200 ± 2%) Pa.

Measure the flow rate into the flue section of the flue terminal, at the required test pressure.

12.1.3.3 Test result

The air flow rate shall be recorded.

12.1.4 Gas tightness of the air supply duct

12.1.4.1 Test assembly

A positive pressure air supply and a flow meter with a maximum measuring error of 2 % of the value measured shall be connected to the air supply duct of the flue terminal. Connect a manometer (pressure meter) to the air supply duct of the test assembly.

12.1.4.2 Procedure

Seal both ends of the flue duct.

Seal the end of the air supply duct at the flue cover.

Deliver air from the positive pressure air supply to the air supply duct at a rate necessary to achieve and maintain a constant pressure of (40 ± 2%) Pa.

Measure the flow rate into the air supply duct of the flue terminal, at the required test pressure.

12.1.4.3 Test results

The air flow rate shall be recorded.

12.2 Safety in use

12.2.1 Test environment

The minimum distance between the test assembly and building structures (i.e. walls etc.) shall be 1,0 m.

The ambient air temperature in the test room shall not vary during tests by more than 5 °C and shall remain in the temperature range of 15 °C up to 30 °C.

The test room shall consist of a ventilated space not subject to air movement greater than 0,5 m/s measured at the ambient thermocouple positions.

The ambient air temperature and velocity shall be measured at a position:

— 0,3 m ± 0,1 m below the floor;

— 1,5 m ± 0,5 m from any walls of test sample;

— at least 1,0 m from any other structures.

The ambient air temperature shall be measured with an accuracy of ± 0,5 °C.

The velocity of the ambient air shall be measured with an accuracy of ± 0,1 m/s.

12.2.2 Test assembly

The test assembly shall comprise a heat generator for the production of hot air, and test walls to form a corner as shown in Figure 2. The walls shall consist of a framework constructed from timber with nominal dimension 38 mm x 89 mm, faced on each side with nominal 12 mm thick plywood to give a total nominal wall thickness of 114 mm. Timbers shall have a dimensional tolerance of ± 1 mm. The voids shall be insulated with mineral fibre insulation having a thermal conductivity of 0,035 W/m·K ± 0,002 W/mK at 20 °C with a minimum density of 70 kg/m^3. The walls shall extend 1 200 mm ± 12 mm.

Construct flooring framework of nominal dimension 50 mm x 100 mm timbers. Forming an opening that enables the test sample to be erected so that all parts of the test structure are at the manufacturer's specified clearance x mm from the test sample (see Figure 2) covered with one thickness of nominal dimension 20 mm boarding for the top and one thickness of nominal dimension 12 mm plywood for the underside, and the spaces between the timbers filled with nominal 100 mm thick mineral wool insulation with a thermal conductivity of 0,035 W/mK ± 0,002 W/mK at 10 °C, with a minimum density of 70 kg/ m^3.

For measuring the surface temperature at the test assembly use a device with an accuracy of ± 1 °C.

The thermocouples shall be located on the test assembly as follows, see Figure 2:

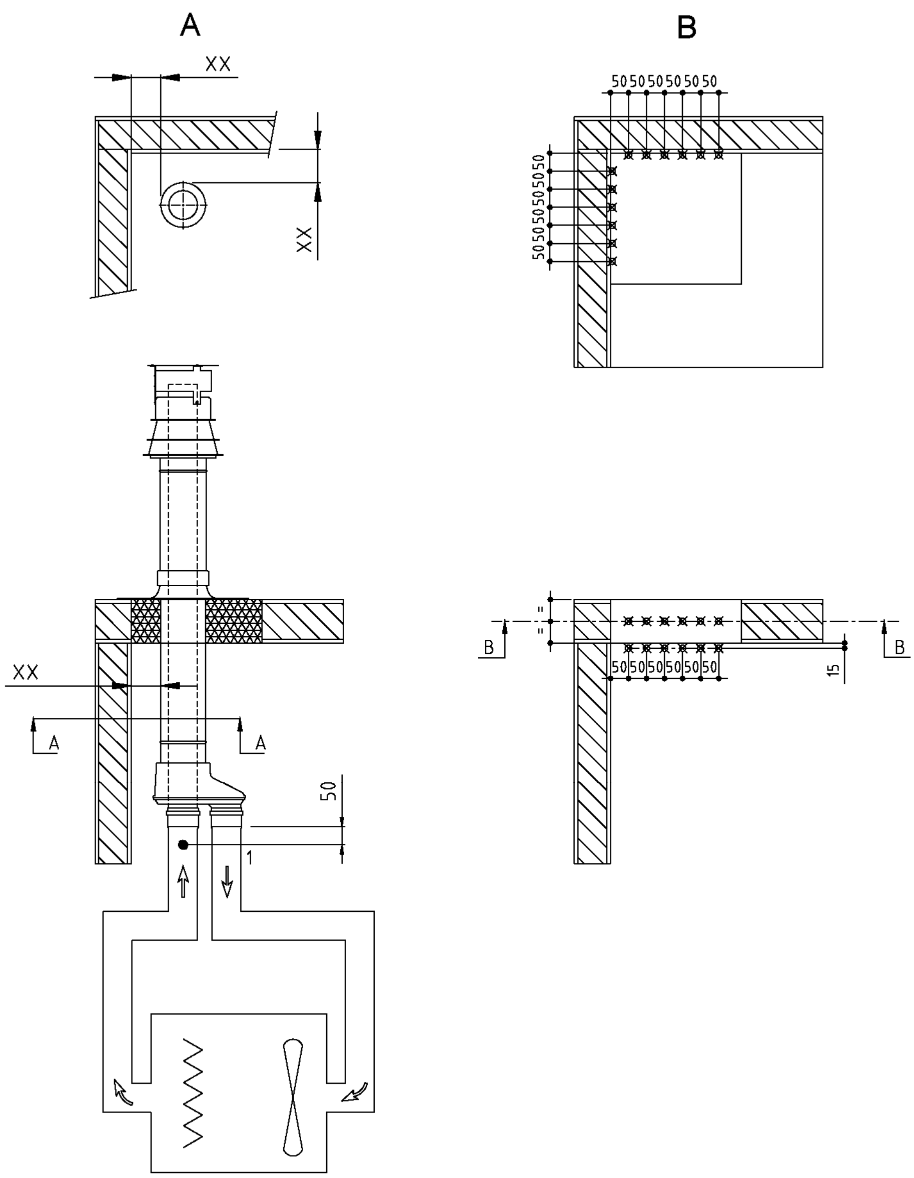
a) Wood joists on surfaces adjacent to the test sample:

One row of six thermocouples at least sufficient to go beyond the centre line located on both joists in line with the walls, spaced at a regular distance of 50 mm ± 2,0 mm beginning 50 mm ± 2,0 mm from the corner.

b) Wall panels:

15 mm below the underside of the floor located on both walls one row of six thermocouples spaced at a

regular distance of 50 mm ± 2,0 mm beginning 50 mm ± 2,0 mm from the corner.



key

A section A-A

B section B-B

1 sample point 1

xx distance to combustible materials

Figure 2 — Test assembly for testing the thermal performance

12.2.3 Hot gas generator

The test apparatus shall consist of a hot gas generator, producing the hot gas as given in Table 4 at the rate and temperature according to the designation and flue diameter. The overall temperature distribution factor (OTDF), see Annex E, shall not be greater than 1,05 at the measuring point at the entry of the test sample. When the hot gas is generated by the combustion of fuel, no flame shall enter the test sample. This is fulfilled when the hot gas has a CO/CO_2 ratio not greater than 0,01.

Alternatively, a test apparatus consisting of a fan and an electric heater, producing the hot gas as given in Table 2 at the rate and temperature according to the designation and flue diameter may be used up to a designated temperature of 250 °C.

For measuring the hot gas temperature use a device with an accuracy of ± 2 °C for hot gas temperatures less than or equal to 250 °C, of ± 5 °C for hot gas temperatures less than or equal to 600 °C and ± 0,75 % for hot gas temperatures greater than 600 °C at a position (50 ± 2) mm before the inlet to the test chimney and at a point in the cross section coincident with the highest temperature position.

The method is described in Annex E.

NOTE In order to prove the integrity of measurements the hot gas temperature may be measured by one thermocouple located in the centre of the flue, at each level. The temperature of flue gases within the sample may be measured at each level by means of a thermocouple rake inserted vertically into the centre of the flue.

12.2.4 Procedure

12.2.4.1 Preliminary

Fit the terminal in accordance with the manufacturer's instructions to the test assembly and as described in Figure 2 and in 12.2.2. The fan and heat input to the heat generator are adjusted such that hot air enters the terminal at a temperature equal to the test temperature of the terminal as given in Table 1, with a flow rate ± 0,2 m/s as given in Table 4. The following tests are carried out.

Table 4 — Hot gas velocity as a function of test temperature *T* and diameter of the test sample

	Hot gas velocity in m/s at a test temperature *T* of											
D mm	100 °C	120 °C	150 °C	170 °C	190 °C	250 °C	300 °C	350 °C	500 °C	550 °C	700 °C	1 000 °C
100	2,2	2,4	2,6	2,8	3,0	3,3	3,6	3,9	4,7	5,0	5,6	6,7
120	2,4	2,6	2,8	3,0	3,2	3,6	3,9	4,2	5,0	5,3	5,9	7,1
160	2,6	2,8	3,1	3,3	3,5	3,9	4,2	4,5	5,4	5,6	6,3	7,6
200	2,8	3,0	3,2	3,4	3,6	4,1	4,4	4,7	5,6	5,9	6,6	7,9

12.2.4.2 Distance to adjacent surfaces

The clearance distance (see Figure 2) is adjusted to equal the minimum distance from combustible surfaces quoted in the manufacturer's instructions. Temperature measurements shall be taken on the inside face of the wood surface. The test is continued until equilibrium is reached and the highest temperature recorded. The requirements of 7.3.1.2.1 shall be met.

12.2.4.3 Temperature of additional materials and components

Use a thermocouple embedded into the surface of all plastic and elastomeric components, or other suitable means, to measure the temperatures.

Using the test assembly described in 12.2.2, the procedure described in 12.2.4 and with the clearance distances adjusted to equal the minimum distance to combustible surfaces quoted in the manufacturer's instructions run the test procedure until equilibrium is reached.

For each plastic and elastomeric component in the air/flue terminal record the highest temperature measured.

These are the temperatures to be used in 7.3.7.3 b).

12.2.4.4 Temperature cycling test

After carrying out the tests described in 12.2.4.1 and 12.2.4.2 generate hot gas with the volume flow and test temperature specified in Table 1 and Table 4 appropriate to the product designation and diameter. Regulate the rate of rise of the hot gas temperature to achieve the specified gas temperature (T_e) in time (T_e x 60/50) s ± 30 s.

Introduce hot gas to achieve the volume flow and test temperature specified in Table 1 and Table 4 for the product designation and diameter. Maintain this condition for 10 min, then shut off the hot gas generator and allow to cool for 10 min. Repeat this cycle 11 times.

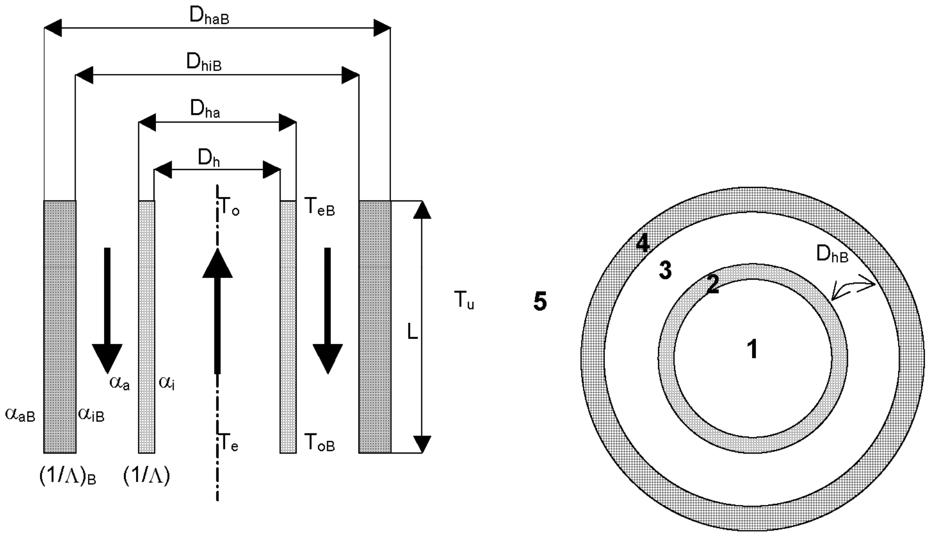
The terminal is allowed to cool down to ambient temperature, removed from the test assembly and inspected for deformation, cracks and/or blistering. The requirements of 7.3.1.2.2 shall be met.

12.2.4.5 Thermal resistance

12.2.4.5.1 Procedure

Fit the terminal in accordance with the manufacturer instructions to the test assembly, Figure 2. The fan and heat input to the heat generator are adjusted, and measured at sample point 1 such that hot air enters the terminal at a temperature equal to the test temperature as given in Table 1, with a flow rate as given in Table 4.

The temperature of the air entering the air duct of the terminal, measured at measuring point T_{eB} Figure 3, will be adjusted to be (20 ± 5) °C. The temperatures at the air supply inlet T_{eB}, air supply outlet T_{oB}, flue inlet T_e and flue outlet T_o of the terminal, as well as the ambient air temperature T_u shall be recorded and used for the calculation of the thermal resistance.



Key

1 flue (with flue gas)

2 flue duct

3 air supply passage (with supply air),

4 air supply duct

5 ambient air

Figure 3 - Definition of the symbols used for the calculation of the thermal resistance of concentric terminals

12.2.4.5.2 Calculations

12.2.4.5.2.1 Calculation of the thermal resistance of the flue duct

For the calculation of the thermal resistance of the flue duct (between the flue gas and the air supply) for concentric terminals the following formula shall be used:

$$\left(\frac{1}{\Lambda}\right) = \frac{1}{k_b} - \frac{1}{\alpha_i} - \frac{D_\mathrm{h}}{D_\mathrm{ha} \cdot \alpha_\mathrm{a} \cdot S_\mathrm{rad}} \text{ in } \frac{\mathrm{m^2K}}{\mathrm{W}} \tag{4}$$

Where:

$\left(\frac{1}{\Lambda}\right)$	thermal resistance of the flue duct	in $\frac{\mathrm{m^2} \cdot K}{\mathrm{W}}$
k_b	coefficient of heat transmission between the flue and the air supply passage at temperature equilibrium	in $\frac{\mathrm{W}}{\mathrm{m^2 \cdot K}}$
α_i	coefficient of heat transfer between the air and the inner surface of the flue duct	in $\frac{\mathrm{W}}{\mathrm{m^2 \cdot K}}$
α_a	coefficient of heat transfer between the supply air and the outer surface of the flue duct	in $\frac{\mathrm{W}}{\mathrm{m^2 \cdot K}}$
D_h	hydraulic diameter of the flue	in m

D_{ha}	hydraulic diameter of the outside of the flue duct	in m
S_{rad}	correction factor for radiation from the outer surface of the flue duct to the inner surface of the air supply duct	-

For the calculation of the coefficient of heat transmission between the flue and the air supply passage at equilibrium temperature k_b the following equations shall be used:

$$k_b = \frac{\dot{V} \cdot \rho_e \cdot c_p \cdot (T_e - T_o)}{U \cdot L \cdot (T_m - T_{mB})} \text{ in } \frac{\text{W}}{\text{m}^2\text{K}} \tag{5}$$

With

$$T_m = \frac{T_e + T_o}{2} \text{ in °C} \tag{6}$$

$$T_{mB} = \frac{T_{eB} + T_{oB}}{2} \text{ in °c} \tag{7}$$

Where:

$\dot{V}$	test flow rate	in	$\frac{\text{m}^3}{s}$
ρ_e	density of air for T_e	in	$\frac{\text{kg}}{m^3}$
c_p	specific heat capacity of air for T_m	in	$\frac{\text{J}}{\text{k}g \cdot \text{K}}$
T_e	air temperature at the flue inlet	in	°C
T_o	air temperature at the flue outlet	in	°C
U	circumference of the inside of the flue	in	m
L	length of the test segment	in	m
T_m	mean temperature in the flue	in	°C
T_{mB}	mean temperature in the air supply	in	°C
T_{eB}	air temperature at the air supply inlet	in	°C
T_{oB}	air temperature at air supply outlet	in	°C

For the calculation of the coefficient of heat transfer between the flue gas and the inner surface of the flue duct α_i the following equations shall be used:

$$\alpha_\text{i} = \frac{\lambda_A \cdot \text{Nu}}{D_\text{h}} \text{ in } \frac{\text{W}}{\text{m}^2\text{K}} \tag{8}$$

with

$$\text{Nu} = \left(\frac{\psi}{\psi_\text{smooth}}\right)^{0,67} \cdot 0{,}0214 \cdot \left(\text{Re}^{0,8} - 100\right) \cdot \text{Pr}^{0,4} \cdot \left(1 + \frac{D_\text{h}}{L}\right)^{0,67} \tag{9}$$

with

$$\frac{1}{\sqrt{\psi}} = -2 \cdot \log\left(\frac{2}{\mathrm{Re} \cdot \sqrt{\psi}} + \frac{r}{3{,}71 \cdot D_h}\right) \tag{10}$$

$$\frac{1}{\sqrt{\psi_{smooth}}} = -2 \cdot \log\left(\frac{2}{\mathrm{Re} \cdot \sqrt{\psi_{smooth}}}\right) \tag{11}$$

$$\mathrm{Re} = \frac{w_m \cdot D_h \cdot \rho_m}{\eta_\mathrm{A}} \tag{12}$$

and

$$\mathrm{Pr} = \frac{\eta_A \cdot c_p}{\lambda_A} \tag{13}$$

Where:

α_i	coefficient of heat transfer between the flue gas and the inner surface of the flue duct	in	$\frac{\mathrm{W}}{\mathrm{m}^2 \cdot \mathrm{K}}$
λ_A	thermal conductivity of air for T_m	in	$\frac{\mathrm{W}}{\mathrm{m} \cdot \mathrm{K}}$
Nu	Nusselt number for the flue	-	
D_h	hydraulic diameter of the flue	in	m
ψ	coefficient of friction of the flue	-	
ψ_{smooth}	coefficient of friction of the flue for hydraulically smooth flow	-	
Re	Reynolds number of the flue	-	
Pr	Prandtl number of the flue	-	
L	length of the test segment	in	m
r	mean value of roughness of the inner wall of the flue duct	in	m
w_m	average velocity of the air in the flue	in	$\frac{\mathrm{m}}{\mathrm{s}}$
ρ_m	density of air for T_m	in	$\frac{\mathrm{kg}}{\mathrm{m}^3}$
η_A	dynamic viscosity of air for T_m	in	$\frac{\mathrm{N} \cdot \mathrm{s}}{\mathrm{m}^2}$

For the calculation of the coefficient of heat transfer between the supply air and the outer surface of the flue α_a the following equations shall be used:

$$\alpha_\mathrm{a} = \frac{\lambda_\mathrm{B} \cdot \mathrm{Nu_a}}{D_\mathrm{hB}} \text{ in } \frac{\mathrm{W}}{\mathrm{m^2K}} \tag{14}$$

with

$$D_{hB} = \frac{4 \cdot A_B}{U_a + U_{iB}} \text{ in m} \tag{15}$$

$$Nu_a = 0{,}86 \cdot \left(\frac{D_{hB}}{D_{ha}}\right)^{0{,}16} \cdot Nu_B \tag{16}$$

and

$$Nu_B = \left(\frac{\psi_B}{\psi_{smoothB}}\right)^{0{,}67} \cdot 0{,}0214 \cdot \left(Re_B^{\ 0{,}8} - 100\right) \cdot Pr_B^{\ 0{,}4} \cdot \left(1 + \frac{D_{hB}}{L}\right)^{0{,}67} \tag{17}$$

with

$$\frac{1}{\sqrt{\psi_B}} = -2 \cdot \log\left(\frac{2}{Re_B \cdot \sqrt{\psi_B}} + \frac{r_B}{3{,}71 \cdot D_{hB}}\right) \tag{18}$$

$$\frac{1}{\sqrt{\psi_{smoothB}}} = -2 \cdot \log\left(\frac{2}{Re_B \cdot \sqrt{\psi_{smoothB}}}\right) \tag{19}$$

$$Re_B = \frac{w_{mB} \cdot D_{hB} \cdot \rho_{mB}}{\eta_{AB}} \tag{20}$$

and

$$Pr_B = \frac{\eta_B \cdot c_{pB}}{\lambda_B} \tag{21}$$

Where:

α_a	coefficient of heat transfer between the supply air and the outer surface of the flue duct	in	$\frac{W}{m^2 \cdot K}$
λ_B	thermal conductivity of air for T_{mB}	in	$\frac{W}{m \cdot K}$
Nu_a	Nusselt number for the outside of the flue duct	-	
D_{hB}	hydraulic diameter of the air supply passage	in	m
A_B	cross-sectional area of the air supply passage	in	m²
U_{iB}	circumference of the inside of the air supply duct	in	m
U_a	circumference of the outside of the flue duct	in	m
D_{ha}	hydraulic diameter of the outside of the flue duct	in	m
Nu_B	Nusselt number for a reference pipe flow	-	
ψ_B	the higher of the value of the coefficient of friction of the inside of the air supply duct and the outside of the flue duct	-	
$\psi_{smoothB}$	coefficient of friction of the air supply for hydraulically smooth	-	

	flow		
Re_B	Reynolds number of the air supply passage	-	
Pr_B	Prandtl number of the supply air	-	
L	length of the test segment	in	m
r_B	The higher of the value of the mean value of roughness of the inside of the air supply duct and the outside of the flue duct	in	m
w_{mB}	average velocity of the supply air	in	$\frac{m}{s}$
ρ_{mB}	density of air for T_{mB}	in	$\frac{kg}{m^3}$
η_B	dynamic viscosity of air for T_{mB}	in	$\frac{N \cdot s}{m^2}$
c_{pB}	specific heat capacity of air for T_{mB}	in	$\frac{J}{kg \cdot K}$

In order to account for the effects of radiation from the outer surface of the flue duct to the inner surface of the air supply duct the calculation of the coefficient of heat transmission k,j includes a correction factor for radiation Srad, for which the value 2 shall be taken.

12.2.4.5.2.2 Calculation of the thermal resistance of the air supply duct

For the calculation of thermal resistance of the air supply duct (between the supply air and the ambient air) the following formula shall be used:

$$\left(\frac{1}{\Lambda}\right)_B = \frac{1}{k_{Bb}} - \frac{1}{\alpha_{iB}} - \frac{D_{hiB}}{D_{haB} \cdot \alpha_{aB}} \text{ in } \frac{m^2K}{W} \quad (22)$$

Where:

$\left(\frac{1}{\Lambda}\right)_B$	thermal resistance of the air supply duct	in	$\frac{m^2 \cdot K}{W}$
k_{Bb}	coefficient of heat transmission between the supply air and the ambient air at temperature equilibrium	in	$\frac{W}{m^2 \cdot K}$
α_{iB}	coefficient of heat transfer between the supply air and the inner surface of the air supply duct	in	$\frac{W}{m^2 \cdot K}$
D_{haB}	hydraulic diameter of the outside of the air supply duct	in	m
D_{hiB}	hydraulic diameter of the inside of the air supply duct	in	m
α_{aB}	coefficient of heat transfer between the outside of the air supply duct and the ambient air	in	$\frac{W}{m^2 \cdot K}$

For the calculation of the coefficient of heat transmission between the supply air and the ambient air at equilibrium temperature k_{Bb} the following formula shall be used:

$$k_{Bb} = \frac{\dot{V} \cdot \rho_e \left[c_p \cdot (T_e - T_o) - c_{pB} \cdot (T_{oB} - T_{eB})\right]}{U_{iB} \cdot L \cdot (T_{mB} - T_u)} in \frac{W}{m^2K} \text{ in } \frac{W}{m^2K} \quad (23)$$

with T_{mB} according to formula (7).

Where:

$\dot{V}$	test flow rate	in	$\frac{m^3}{s}$
ρ_e	density of air for T_e	in	$\frac{kg}{m^3}$
c_p	specific heat capacity of air for t_m	in	$\frac{J}{kg \cdot K}$
T_e	air temperature at the flue inlet	in	°C
T_o	air temperature at the flue outlet	in	°C
c_{pB}	specific heat capacity of air for t_{mB}	in	$\frac{J}{kg \cdot K}$
T_{eB}	air temperature at the air supply inlet	in	°C
T_{oB}	air temperature at air supply outlet	in	°C
U_{iB}	circumference of the inside of the air supply	in	m
L	length of the test segment	in	m
T_{mB}	mean temperature in the air supply	in	°C
T_u	ambient air temperature	in	°C

For the calculation of α_{iB} the following formula shall be used:

$$\alpha_{iB} = \frac{\lambda_B \cdot Nu_{iB}}{D_{hB}} \text{ in } \frac{W}{m^2 \cdot K} \tag{24}$$

with

$$Nu_{iB} = \left[1 - 0,14 \cdot \left(\frac{D_{ha}}{D_{hiB}} \right)^{0,6} \right] \cdot Nu_B \tag{25}$$

and D_{hB} according to formula (15) and Nu_B according to formula (17)

Where:

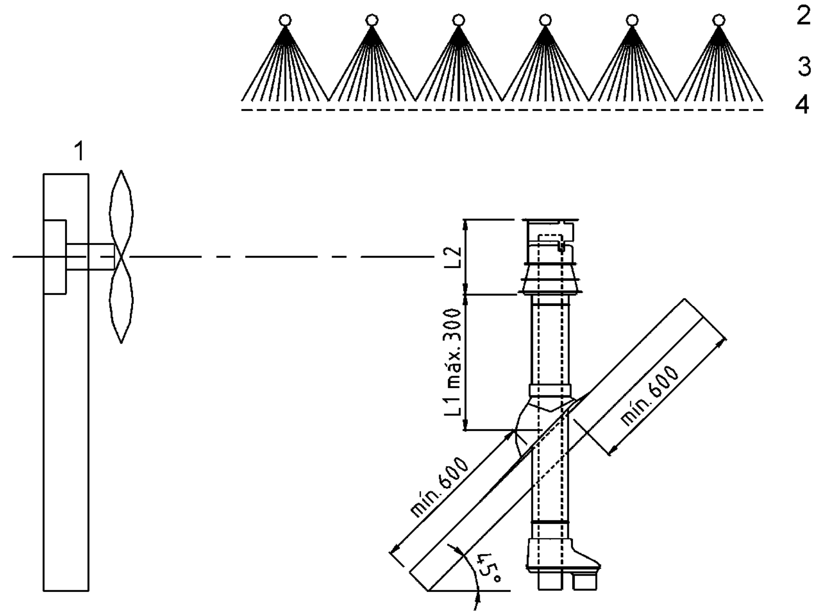
λ_B	thermal conductivity of air for t_{mB}	in	$\frac{W}{m \cdot K}$
Nu_{iB}	Nusselt number for the inside of the air supply duct	-	
Nu_B	Nusselt number for a reference pipe flow	-	
D_{hB}	hydraulic diameter of the air supply passage	in	m
D_{hiB}	hydraulic diameter of the inside of the air supply duct	in	m
D_{ha}	hydraulic diameter of the outside of the flue duct	in	m

12.3 Rainwater ingress

12.3.1 Test assembly

The rainmaking installation is made up of parallel pipes in a horizontal plane. The tubes have small spray holes (placed vertically downwards).

These spray holes are evenly distributed across the area above the wire mesh. The water from the spray holes shall be distributed through a web of fine 1,3 mm ± 0,1 mm wide wire mesh, after which the water will fall in the form of raindrops. A typical arrangement is shown in Figure 4.



Key

1 wind generator

2 pipes with spray hole

3 rainwater

4 mesh screen

Figure 4 — Rainwater ingress test assembly

The rain intensity shall be (1,6 ± 0,2) mm/min and shall be measured. During calibration is found an area in front of the wind generator where with and without wind the rain intensity is (1,6 ± 0,2) mm/min. The largest area of the top of the terminal shall not be more than 20 % of the area found by calibration.

The wind generator supplies a horizontal airflow at a velocity of 12 m/s ± 0,5 m/s. The outlet of the wind generator should be square or circular. For a terminal with a length L_1 between the bottom of the air inlet and the roof of more than 300 mm, the minimum dimensions of the height and the width or the diameter can be calculated by L_2 + 300 mm.

For a terminal with a length L_1 between the bottom of the air inlet and the roof of 300 mm or less, the minimum dimensions of the height and the width or the diameter can be calculated by $L_1 + L_2$ + 150 mm. Nevertheless the dimensions of the outlet of a square wind generator will be at least 900 mm x 900 mm and the diameter of a round wind generator will be at least 600 mm.

A roof plane is needed if the length $L_1 \leq 300$ mm. The roof plane shall be a square with a minimum size of the diameter of the terminal + 1 200 mm. The roof plane has to be covered by roofing tiles.

The tolerance of the measurements of the lengths and diameters shall be ± 2 mm.

12.3.2 Procedure

Before commencing the rain ingress tests, the test assembly has to be calibrated. For this calibration, 5 buckets of a diameter of 150 mm, one on each corner of a rectangular area and one in the middle, shall be positioned at a level corresponding to the level of the centre between the flue gas outlet and the air inlet. Make sure that the largest area of the top of the terminal is less than 20 % of the area within the line circumscribing the buckets. Start the calibration test during 10 min without wind and determine if the rain intensity is 1,6 mm/min ± 0,2 mm/min by weighing the 5 buckets. Repeat the calibration test with a horizontal airflow of 12 m/s.

Mount the terminal in the roof plane if required, in accordance with the manufacturer's installation instructions. Place the roof plane (if required) with the air flue terminal under the rain system and in front of the wind generator in accordance with Figure 4 and in such a way that the centres of the inlet and the outlet openings are in line with the centre of the wind generator outlet opening.

Prior to the final tests, the air flue terminal is exposed in a vertical position for 20 min to the rain at a horizontal airflow of 12 m/s ± 0,5 m/s.

Now expose the roof terminal at a horizontal airflow of 12 m/s ± 0,5 m/s for 20 min to the rain under the following tests:

a) vertical;

b) turned 10° into the wind;

c) turned 10° away from the wind;

and determine the ingress of rainwater after each test.

For class **D**, no more than 0,05 mm^3/s of rainwater per mm of the nominal diameter of the flue shall enter the flue outlet or the air inlet, during each test period.

For class **W**, no more than 0,05 mm^3/s of rainwater per mm of the nominal diameter of the flue shall enter the air inlet, during each test period.

12.4 Aerodynamic behaviour of air/flue terminal

12.4.1 Test assembly

12.4.1.1 Air/flue terminal assembly

Depending on the design, the air/flue terminal is connected to a parallel or concentric air supply duct and flue with the same nominal diameter.

This air/flue supply duct and flue shall have a straight length of at least 1 000 mm.

No bends or other fittings shall be placed between the air/flue terminal and the air supply duct and flue.

Pressure test points are fitted in the air supply duct and flue at a distance of 500 mm ± 20 mm from the connection nozzles of the air/flue terminal.

Flow rate is created in the air supply duct and flue by means of a fan.

The air supply duct and flue are connected to each other through the fan.

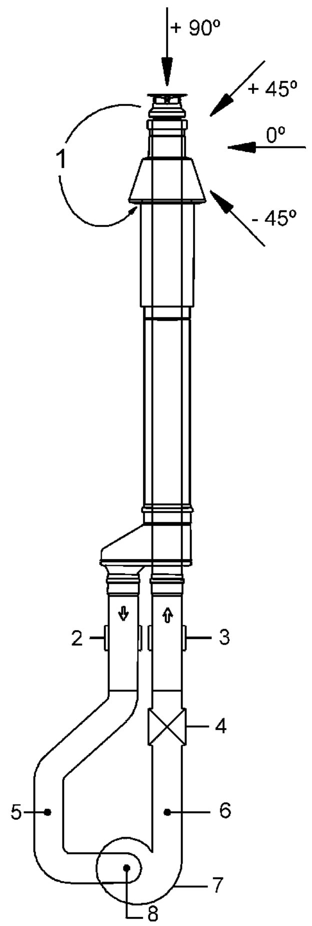
The air transport in the air supply duct shall be equal to the air transport in the flue.

The flow rate through the air/flue terminal is measured to an accuracy of ± 2,5% using for example an orifice plate measuring arrangement.

The pressure differential (flow resistance P_t) between the air supply duct and flue is measured to an accuracy of ± 0,2 Pa using at least 3 openings with a 1 mm diameter evenly distributed around the circumference of each duct, in a plane perpendicular to the central line. These openings shall be free of burrs on the inside of the duct.

It shall be possible to turn the combination of air/flue terminal and air supply duct and flue in front of the wind system in such a way that wind pressure angles relative to the air/flue terminal ranging from a downward wind (+90°) to an upward wind (-45°) can be set in maximum steps of 7,5°.

Figure 5 shows the set-up diagram for the wind testing installation.



Key

1 external recirculation

2 static pressure air supply duct P_A

3 static pressure flue duct P_F

4 orifice plate measuring arrangement

5 CO_2 sampling

6 CO_2 sampling

7 fan

8 CO_2 injection

Figure 5 — Test assembly for aerodynamic behaviour of air/flue terminals

12.4.1.2 Wind generator assembly

The wind is generated by a unit which produces an air flow at a constant velocity, adjustable between 0,5 m/s and 12 m/s with an accuracy equal to ± 0,25 m/s.

The air flow at the point of measurement of the air/flue terminal (in a plane perpendicular to the wind direction) shall not show a standard deviation greater than 0,25 m/s at all wind speeds set. Both the average wind speed and the standard deviation are determined at the point of measurement in a plane whose dimensions are 90 % of the height and width of the wind tunnel outlet. In this plane there shall be 9 x 9 = 81 measurement points, evenly distributed.

The degree of turbulence of the air flow at the point of measurement shall not exceed 5 %.

During the test, the largest projected area of the air/flue terminal in the air flow shall not be more than 20 % of the area of the wind tunnel outlet.

Suspend the terminal horizontally in front of the wind tunnel.

The centre of the air/flue terminal shall be placed in the centre line of the wind tunnel during the test.

If the air/flue terminal is not rotation-symmetric, determine experimentally the most unfavourable position with regard to its aerodynamic behaviour. Undertake the aerodynamic behaviour tests in this position.

12.4.1.3 Terminal test flow rates

The terminal test flow rates $\dot{V}$ shall be specified using the concept of nominal velocity w_n. The relation between the terminal test flow rate $\dot{V}$ and the nominal velocity w_n depends also on the nominal diameter of the terminal D_n and is defined by the following formula:

$$\dot{V} = 9 \cdot 10^{-4} \cdot \pi \cdot D_n^2 \cdot w_n \quad (26)$$

with

$\dot{V}$ test flow rate, in m³/h

D_n declared nominal diameter of the terminal, in mm

w_n velocity of the flow inside the terminal under nominal operating conditions, in m/s

NOTE Table 5 can be used to determine the test flow rates for some frequently occurring nominal diameters.

Table 5 — Test flow rates $\dot{V}$ in m³/h for some frequently occurring nominal diameters and the test nominal velocities

D_n (in mm)	w_n = 1 m/s	w_n = 2 m/s	w_n = 3 m/s
50	7,07	14,14	21,20
60	10,18	20,35	30,53
70	13,85	27,70	41,56
80	18,10	36,19	54,28
90	22,90	45,80	68,70
100	28,27	56,54	84,81
110	34,21	68,41	102,62
130	47,78	95,55	143,33
150	63,61	127,22	190,82
180	91,61	183,22	274,83
200	113,10	226,19	339,29
The test flow rates shall be maintained within ± 2,5 %			

12.4.2 Test procedure

12.4.2.1 Measurements for the determination of the coefficient of flow resistance of the air supply duct without wind

Apply a test flow rate corresponding to w_n = 2 m/s (see 12.4.1.3) to the terminal at a temperature T_e = 20 °C ± 5 K. Measure the pressure differentials between the pressure measurement position directly downstream of the air supply duct of the terminal with the ambient air (P_A), using the ambient air pressure as reference pressure (see Figure 4).

Determine the flow velocities w_A and w_F at the pressure measurement points. The flow velocities are determined using the following formulas:

$$w_A = w_n \frac{\frac{1}{4}\pi D_n^2}{s_A} \tag{27}$$

with

- w_A velocity at the static pressure measurement position directly downstream of the air supply duct of the terminal, in m/s
- w_n velocity of the flow inside the terminal under nominal operating conditions, in m/s
- D_n declared nominal diameter of the terminal, in mm
- s_A cross sectional area of the duct at the measurement position directly downstream of the air supply duct of the terminal, in mm^2

and

$$w_F = w_n \frac{\frac{1}{4}\pi D_n^2}{s_F} \tag{28}$$

with

- w_F velocity at the static pressure measurement position directly upstream of the flue duct of the terminal, in m/s
- w_n velocity of the flow inside the terminal under nominal operating conditions, in m/s
- D_n declared nominal diameter of the terminal, in mm
- s_F cross sectional area of the duct at the measurement position directly upstream of the flue duct of the terminal, in mm^2

12.4.2.2 Measurements for the determination of the coefficient of flow resistance of the flue duct without wind

Apply a test flow rate corresponding to w_n = 2 m/s (see 12.4.1.3) to the terminal at a temperature T_e = 20 °C ± 5 K. Measure the pressure differential between the pressure measurement position directly upstream of the flue duct and the ambient air (using the ambient air as reference pressure). This is the static pressure directly upstream of the flue duct of the terminal P_F.

12.4.2.3 Measurements for the coefficient of flow resistance of the terminal with wind

Subject the terminal to the following set of conditions:

1) test flow rate $\dot{V}$ corresponding to w_n = 1 m/s, 2 m/s and 3 m/s;

2) wind velocity w_w = 9 m/s ± 0,25 m/s and 12 m/s ± 0,25 m/s;

3) wind angles ranging from -45° to +90° for type A90 and –45° to + 45° for type A45 in maximum steps of 7,5°.

Additionally subject the terminal to the following set of conditions:

1) test flow rate $\dot{V}$ of zero flow (w_n = 0 m/s);

2) wind velocity w_w = 12 m/s ± 0,25 m/s;

3) wind angles ranging from -45° to +90° for type A90 and –45° to + 45° for type A45 in maximum steps of 7,5°.

NOTE The condition of w_n = 0 m/s can best be realised by closing the terminal at the position of the pressure measurement points. Usually just leaving the fan without power will not stop the flow completely.

All measurements shall be taken at an ambient temperature of T_u = 20 °C ± 5 K.

For all combinations of conditions the pressure differentials between the pressure measurement position directly upstream of the flue duct of the terminal shall be measured with the ambient air (P_F) and between the pressure measurement position directly downstream of the air supply duct of the terminal with the ambient air (P_A), using the ambient air pressure as reference pressure.

12.4.2.4 Recirculation of flue gases

Subject the air/flue terminal to the following conditions:

1) test flow rate $\dot{V}$ corresponding to w_n = 2 m/s;

2) Wind velocities of 0,5 m/s, 1 m/s, 2 m/s and 3 m/s. The tolerances on this wind velocities is ± 0,25 m/s;

3) Wind pressure angles ranging from -45° to +90° for type A90 and –45° to + 45° for type A45, in maximum steps of 7,5°.

Determine the recirculation R for each of the above conditions by injecting CO_2 in front of the fan which provides the air transport via the air/flue terminal (it is assumed that the CO_2 injected is completely mixed in the fan with the supplied air).

The recirculation R is defined as follows:

$$R = \frac{C_{total} - C_{basis}}{C_{total} - C_0} \cdot 100\% \qquad (29)$$

where

R recirculation

C_{total} measured CO_2 concentration at sample point 6 Figure 5, with recirculation

C_{basis} measured CO_2 concentration at sample point 6 Figure 5, without recirculation

C_0 background CO_2 concentration in room

The accuracy of the measurement shall be such that *R* can be determined with a relative accuracy of 2 %.

In selecting the wind pressure angles step by step, a waiting time shall be applied such that a state of equilibrium is reached each time for C_{total}.

12.4.3 Results

All appropriate values shall be recorded.

12.5 Icing test

12.5.1 Test assembly

12.5.1.1 General

The test assembly shall consist of:

A cooling chamber large enough to contain the terminal and capable of maintaining a temperature of –15ºC ± 3 K with the heat load from the heat generator and the steam generator entering the room (see Figure 6).

The heat generator, used for test 12.2.3 may be used.

A steam generator suitable for injecting steam into the flue in order to maintain a relative humidity of 100 % within the flue duct of the terminal.

12.5.1.2 Procedure

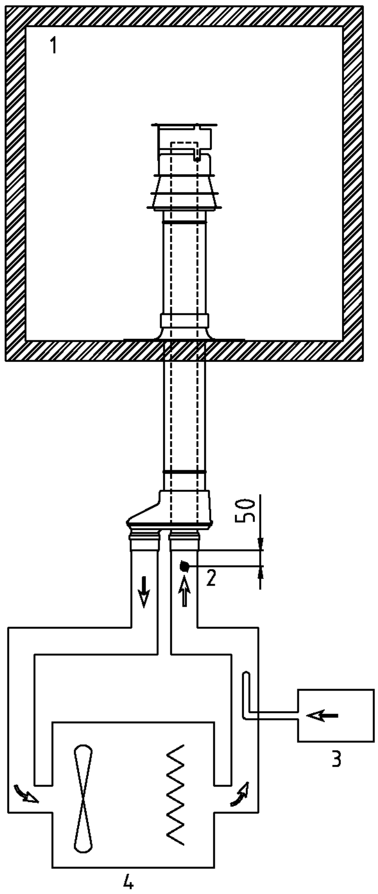
Weigh the air/flue terminal and mount it vertically in the test cooling chamber in accordance with the manufacturer’s instructions. Connect the terminal to the heat generator and adjust the fan and heat input to the heat generator such that hot air enters flue inlet at a temperature of 60°C ± 5K and with a flow rate of 2 m/s ± 0,2 m/s.

Inject sufficient steam into the flue to ensure a relative humidity of 100 % within the air/flue terminal

The hot air and steam injection are simultaneously cycled 3 min on and 7 min off for a period of 4 h.

12.5.1.3 Results

At the end of the test, before the ice starts to melt, measure the increase in weight of the air/flue terminal and the dimensions of any ice formation in any direction on or inside the terminal.



Key

1 cooling chamber

2 measuring point

3 steam generator

4 hot gas generator

Figure 6 — Icing test assembly

12.6 Resistance to penetration by foreign objects

12.6.1 Test assembly

A 16 mm ball shall be provided.

12.6.2 Procedure

A 16 mm ± 0,1 mm metal ball is applied to any opening in the terminal above the roof with a force of 5 N ± 0,1 N.

12.6.3 Results

The results shall be recorded.

12.7 Low temperature test

Allow the terminal to reach ambient temperature and remove any obvious deposits of water. Place the terminal in the cooling chamber without connecting it to the hot gas generator and reduce its temperature to –15°C ± 3 K for a period of 4 h. Allow the terminal to return to ambient temperature.

NOTE This test procedure is considered fulfilled if the icing test has been undertaken.

Inspect the terminal for any deformation, permanent or temporary, that will affect the performance of the air/flue terminal.

Annex A
(informative)

Typical dimensions

A.1 General

The push-in spigots of the air/flue terminal shall be capable of being pushed into the socket of the ducts or fittings, resulting in a connection with the system to:

— transport the flue gases from a gas appliance to the air/flue terminal;

— supply the combustion air to the gas appliance.

This connection may be made either separate or concentric.

A.2 Dimensions of the push-in spigots for a separate connection

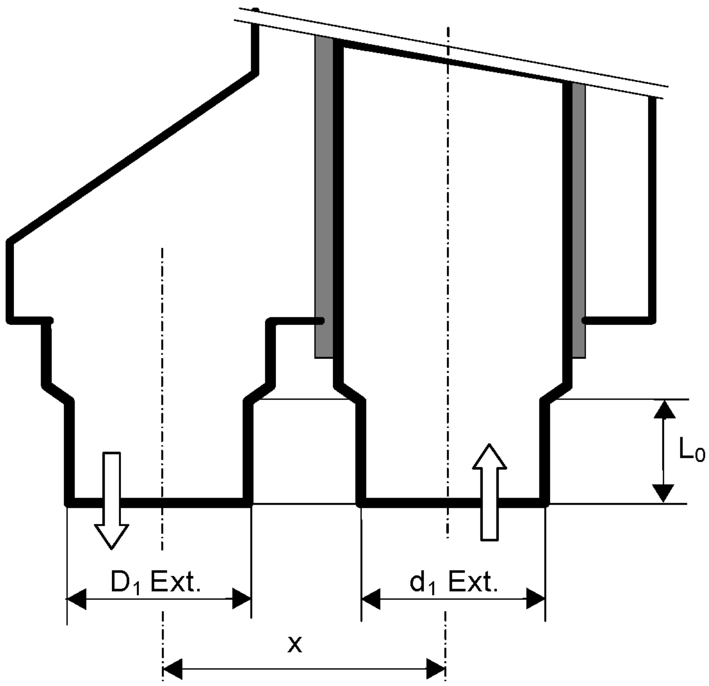


Figure A.1 — Push-in spigots for separate connection

Table A.1 — Dimensions of push-in spigots for separate connection

Dimensions in millimetres

D_n	$d_1\,^{+0,3}_{-0,7}$	$D_1\,^{+0,3}_{-0,7}$	x	L_0
50	50	50	90	≥48
60	60	60	100	≥48
70	70	70	110	≥48
80	80	80	120	≥48
90	90	90	130	≥48
100	100	100	140	≥48
110	110	110	150	≥48
130	130	130	170	≥48
150	150	150	190	≥48

Where:

D_n	nominal diameter of the flue	in	mm
d_1	external diameter of the push-in spigot of the flue duct	in	mm
D_1	external diameter of the push-in spigot of the air supply	in	mm
x	centre-to-centre distance of air supply duct and flue	in	mm
L_0	Minimum insertion length	in	mm

A.3 Dimensions of the push-in spigots for a concentric connection

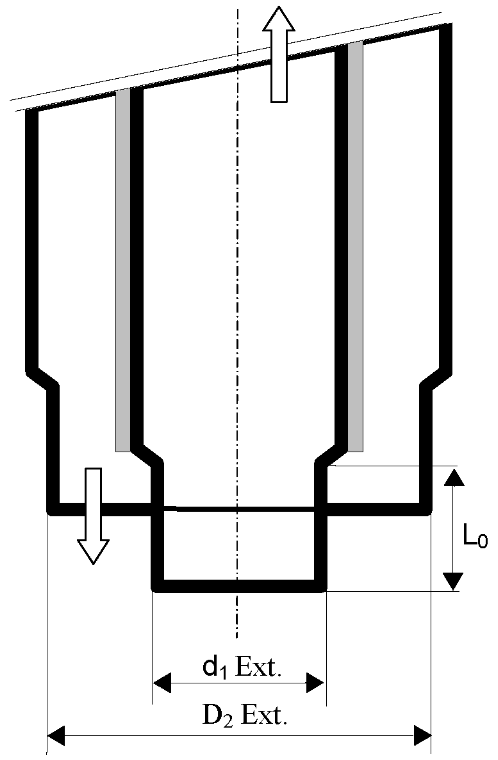


Figure A.2 — Push-in spigots for concentric connection

Table A.2 — Dimensions of the push-in spigots for concentric connection

Dimensions in millimetres

D_n	$d_1 {}^{+0,5}_{-0,5}$	$D_1 {}^{+0,5}_{-1,0}$	L_0
50	50	80	≥48
		90	≥48
60	60	90	≥48
		100	≥48
70	70	110	≥48
		125	≥48
80	80	125	≥48
		150	≥48
90	90	125	≥48
		150	≥48
100	100	150	≥48
		190	≥48
110	110	190	≥48
		210	≥48
130	130	200	≥48
		230	≥48
150	150	230	≥48
		250	≥48

Where:

D_n nominal diameter of the flue in mm

d_1 external diameter of the push-in spigot of the flue duct in mm

D_1 external diameter of the push-in spigot of the air supply in mm

L_0 minimum insertion length in mm

Annex B
(informative)

Sampling for factory production control

B.1 Sampling plans

B.1.1 General

Sampling plans should be selected from the tables published in ISO 2859-1.

B.1.2 Acceptable quality level (AQL)

The AQL should be decided in relation to the nature of the inspection feature being controlled. For defects classed as MAJOR, the sampling plan should be based on an AQL of 4,0. The classification of defects should be the responsibility of the manufacturer.

B.1.3 The inspection level

The inspection level defines the relationship between the batch size and the sample size, all incoming goods should be subjected to inspection level II.

B.1.4 Normal, tightened or reduced inspection

Normal inspection should be used initially on all incoming materials, after which, the following rules apply:

a) When ten successive batches have been accepted on original there can be a switch to reduced inspection. This should remain in operation until one batch is rejected, at which point revert back to normal inspection.

b) When two out of any five successive batches have been rejected on original inspection, there can be a switch to tightened inspection. This should remain in operation until five successive batches have been accepted, at which point revert back to normal inspection.

B.1.5 Single, double, multiple or sequential sampling

Unless otherwise specified, all incoming material should be subjected to single sampling plans.

B.1.6 Batch quantity

Once the first four variables have been decided, the sampling plan tables should indicate the amount of samples to be inspected for any given batch quantity.

All information regarding levels of inspection should be indicated where appropriate on the inspection records.

B.2 Inspection levels and procedures

B.2.1 Incoming material

Sample inspected to ISO 2859-1 using an AQL = 2,5, general inspection level II, single sampling plan for normal inspection incorporating the switching rules to tightened or reduced inspection if necessary. All mill certification is checked against the relevant technical specification. For large batches the special inspection level should be S-1.

B.2.2 In-process inspection

a) All dimensional aspects

An inspection of the product should be carried out following any change in manufacturing procedure.

A first inspection is implemented and verified by either the setter or supervisor at each machine operation and from then on the operators will carry out each required dimensional check at a rate of four per batch - unrecorded, using go-no go gauges.

b) Joint leakage tests – 1 per week

B.2.3 Finished goods checks

a) End of manufacturing process - Prior to packaging, each unit is visually inspected.

Annex C
(normative)

Choice of size for type test and sampling

C.1 General

All diameters within a range of products of the same design and designation shall be deemed to meet the requirements met by the tested samples.

C.2 Mechanical resistance and stability

Mechanical resistance and stability shall be undertaken on the smallest, largest and one diameter in between. In some cases, this may depend on the manufacturer instructions (e.g. same bracket spacing for different diameters).

C.3 Gas tightness

Gas tightness shall be undertaken on the largest diameter up to and including 200 mm before and after thermal performance.

An additional gas tightness test shall be done on the smallest of the manufacturer's product range, but not subjected to thermal performance.

C.4 Thermal performance and thermal resistance

Thermal performance shall be undertaken on the largest diameter up to and including 200 mm.

C.5 Rainwater ingress

Rainwater ingress shall be undertaken on the largest diameter up to and including 200 mm.

C.6 Aerodynamic properties

Aerodynamic properties are geometry/diameter related. Undertake test on the smallest and largest and at least one other size in between to establish if a scaling factor is possible. Otherwise test all sizes.

C.7 Resistance to ice formation

Resistance to ice formation shall be undertaken on the smallest diameter.

C.8 Resistance to penetration by foreign objects

Resistance to penetration by foreign objects shall be undertaken on the smallest, largest and one diameter in between.

C.9 Additional information on plastics and elastomers

Additional checks on plastics and elastomers shall be undertaken on the largest diameter up to and including 200 mm.

Annex D
(normative)

Factory production control

The following characteristics shall be included in the factory production control scheme.

D.1 Insulation material (where appropriate)

a) Specification of insulation material.

b) Density value - for thermal conductivity and factory production control purposes.

Supplier's declaration for material type and properties is accepted, provided that the supplier has an appropriate quality assurance system.

D.2 Metals, including coatings

a) Type – composition.

b) Thickness.

c) Finish.

Supplier's declaration for material type and properties is allowed, provided that the supplier has an appropriate quality assurance system.

D.3 Supports

a) Material type.

b) Structural section.

c) Additional components - nuts, bolts, fixings.

Supplier's declaration for material type and properties is allowed, provided that the supplier has an appropriate quality assurance system.

D.4 Seals and sealants

a) Type - Including identification or composition, when the conformity certificate is not available.

b) Dimensions

Supplier's declaration for material type and properties is allowed, provided that the supplier has an appropriate quality assurance system.

D.5 Manufacturing checks

D.5.1 Dimensions

Dimensions of critical parts shall be confirmed during the manufacturing and/or on completion:

a) material thickness;

b) diameter - may be checked through the sheet size during manufacture;

c) length;

d) coupler characteristic (e.g. joint fit).

D.5.2 Other checks

These checks are to be carried out during the manufacturing process:

a) leakage (negative and, if appropriate, positive pressure).

b) Mass if product contains insulation.

Annex E
(normative)

Method of measuring the hot gas temperature

Use a calibrated thermocouple. Its position is determined by a temperature traverse during the first thermal cycle as follows:

- Set the hot gas thermocouple in the centre of the flue pipe through one of two apertures provided at right angles to each other at a level (50 ± 2) mm from the entry to the test chimney.
- Fire the hot gas generator at the volume flow specified in Table 1 and regulate it to produce the nominated hot gas temperature.
- After firing for not less than 10 min, take ten equally spaced temperature measurements along two traverses at right angles across the flue pipe cross section.
- Determine the location of the highest temperature of these two traverses and position the thermocouple there for the test.
- Seal the redundant aperture.
- Re-adjust the hot gas generator to obtain the nominated hot gas temperature.
- Alternatively, a thermocouple grid may be used to determine the OTDF (Overall Temperature Distribution Factor).

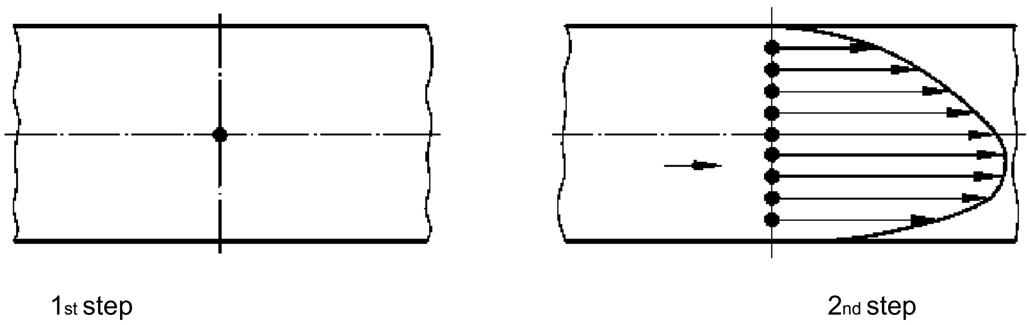


Figure E.1 — Place for the measuring point for the hot gas

Annex ZA
(informative)

Clauses of this European Standard addressing the provisions of the EU Construction Products Directive

ZA.1 Scope and relevant characteristics

This European Standard has been prepared under a mandate M/105 "Chimneys, flues and specific products" as amended given to CEN by the European Commission and the European Free Trade Association.

The clauses of this European Standard shown in this annex meet the requirements of the mandate given under the EU Construction Products Directive (89/106/EEC).

Compliance with these clauses confers a presumption of fitness of the vertical air/flue terminals for C_6-type appliances comprising a flue duct, which may be provided with a cover, and an air supply duct for the connection of a roomsealed appliance covered by this annex for the intended uses indicated herein; reference shall be made to the information accompanying the CE marking.

WARNING: Other requirements and other EU Directives, not affecting the fitness for intended uses, can be applicable to the vertical air/flue terminals metal liners, connecting flue pipes and fittings falling within the scope of this standard.

NOTE 1 In addition to any specific clauses relating to dangerous substances contained in this standard, there may be other requirements applicable to the products falling within its scope (e.g. transposed European legislation and national laws, regulations and administrative provisions). In order to meet the provisions of the EU Construction Products Directive, these requirements need also to be complied with, when and where they apply.

NOTE 2 An informative database of European and national provisions on dangerous substances is available at the Construction web site on EUROPA, accessed through http://europa.eu.int/comm/enterprise/construction/internal/dangsub/dangmain.htm

This annex establishes the conditions for the CE marking the vertical air/flue terminals for C_6-type appliances intended for the uses indicated in Table ZA.1 and shows the relevant clauses applicable.

This annex has the same scope as Clause 1 of this standard and is defined by Table ZA.1.

Table ZA.1 — Scope and relevant requirement clauses

Product: Positive pressure air/flue terminals with metal flue duct for C_{62}- and C_{63}-type gas appliances as covered in Clause 1 of this standard. Intended use: convey air for combustion, and the products of combustion from appliances to the outside atmosphere.			
Essential Characteristics	**Requirement clauses in this European Standard(s)**	**Levels and/or classes**	**Notes**
Compressive strength	7.1.1 Vertical load on the air/flue terminal	None	Pass/fail criteria
Resistance to fire	7.3.1.2.1 Distance to adjacent combustible surfaces	O (xx)	Declared class and distance to adjacent combustible material xx, in mm.
Gas tightness /leakage	7.2.1 Gas tightness of the flue 7.2.2 Gas tightness of the air supply duct	None None	Pressure class (this reflects a gas tightness determined by a threshold leakage rate appropriate to the pressure class)
Flow resistance	7.3.4.1 Coefficient of flow resistance of the air supply duct of the terminal 7.3.4.2 Coefficient of flow resistance of the flue duct of the terminal	None None	Declared value of coefficient Declared value of coefficient
Thermal resistance	7.3.2.1 Air/flue terminal with separate air/flue configuration 7.3.2.2 Air/flue terminal with concentric air/flue configuration	None None	Declared value Declared value
Thermal shock	7.3.1.2.2 Temperature cycling test	None	Pass fail criteria No part of the terminal or its components shall show any permanent deformation, blisters or cracks which could affect its performance
Flexural tensile strength	7.1 Mechanical resistance and stability 7.1.2 Wind load	None	Pass fail criteria
Durability against chemicals	7.3.7 Materials	None	Manufacturer's declared material and thickness and pass fail criteria according to EN 14471 and EN 14241-1 as appropriate
Durability against corrosion	7.3.7 Materials	None	Manufacturer's declared material and thickness and pass fail criteria according to EN 14471 and EN 14241-1 as appropriate.
Freeze thaw	7.3.7.4 Freeze thaw resistance	None	Product declaration for metal components and pass fail criteria for plastic components

The requirement on a certain characteristic is not applicable in those Member States (MS) where there are no regulatory requirements on that characteristic for the intended use of the product. In this case, manufacturers placing their products on the market of these MS's are not obliged to determine nor declare the performance of their products with regard to this characteristic and the option “No performance determined” (NPD) in the information accompanying the CE marking (see ZA.3) may be used. The NPD option may not be used, however, where the characteristic is subject to a threshold level.

ZA.2 Procedure for attestation of conformity of the vertical air/flue terminals for C6-type appliances

ZA.2.1 System of attestation of conformity

The system(s) of attestation of conformity of positive pressure air/flue terminals with metal flue duct for C_{62}- and C_{63}-type gas appliances indicated in Table ZA.1 in accordance with the Decision of the Commission 95/467/EC of 27-09-95 amended by the Decision 01/596/EC and as given in Annex III of the mandate for “Chimneys, flues and specific products", is shown in Table ZA.2 for the indicated intended use(s) and relevant level(s) or class(es).

Table ZA.2 — System(s) of attestation of conformity

Product(s)	Intended use(s)	Level(s) or class(es)	Attestation of conformity system(s)
Positive pressure air/flue terminals with metal flue duct for C_{62}- and C_{63}-type gas appliances	Convey air for combustion, and the products of combustion from appliances to the outside atmosphere	None	2+
System 2+: See Directive 89/106/EEC (CPD) Annex III.2.(ii), First possibility, including certification of the factory production control by an approved body on the basis of initial inspection of factory and of factory production control as well as of continuous surveillance, assessment and approval of factory production control.			

The attestation of conformity of positive pressure air/flue terminals with metal flue duct for C62- and C63-type gas in Table ZA.1 shall be based on the evaluation of conformity procedures indicated in Table ZA.3 resulting from application of the clauses of this or other European Standard indicated therein.

Table ZA.3 — Assignment of evaluation of conformity tasks for positive pressure air/flue terminals with metal flue duct for C_{62}- and C_{63}-type gas appliances under system 2+

<table>
<tr><th colspan="3">Tasks</th><th>Content of the task</th><th>Evaluation of conformity clauses to apply</th></tr>
<tr><td rowspan="5">Tasks under the responsibility of the manufacturer</td><td colspan="2">Factory production control (F.P.C)</td><td>Parameters related to all relevant characteristics of Table ZA.1</td><td>11.3</td></tr>
<tr><td colspan="2">Initial type testing by a manufacturer</td><td>Those characteristics of Table ZA.1</td><td>11.2.2, 11.2.3</td></tr>
<tr><td colspan="2">Testing of samples taken at the factory</td><td>All relevant characteristics of Table ZA.1</td><td>11.2.3</td></tr>
<tr><td rowspan="2">Certification of F.P.C by the FPC certification body on the basis of</td><td>Initial inspection of factory and of F.P.C.</td><td>Parameters related to relevant characteristics of Table ZA.1</td><td>11.3</td></tr>
<tr><td>Continuous surveillance, assessment and approval of F.P.C.</td><td>Parameters related to relevant characteristics of Table ZA.1</td><td>11.3</td></tr>
</table>

ZA.2.2 EC Declaration of conformity

When compliance with the conditions of this annex is achieved, and once the notified body has drawn up the certificate mentioned below, the manufacturer or his agent established in the EEA shall prepare and retain a declaration of conformity, which entitles the manufacturer to affix the CE marking. This declaration shall include:

— name and address of the manufacturer, or his authorised representative established in the EEA, and the place of production;

NOTE 1 The manufacturer may also be the person responsible for placing the product onto the EEA market, if he takes responsibility for CE marking.

— description of the product (type, identification, use, etc.), and a copy of the information accompanying the CE marking;

NOTE 2 Where some of the information required for the Declaration is already given in the CE marking information, it does not need to be repeated.

— provisions to which the product conforms (e.g. Annex ZA of this standard), and a reference to the ITT report(s) and factory production control records (if appropriate),

— particular conditions applicable to the use of the product (e.g. provisions for use under certain conditions, etc.);

— the number of the accompanying factory production control certificate, and FPC records, where applicable,

— name and address of the notified laboratory(ies) [if some characteristics are tested by such a lab],

— name of, and position held by, the person empowered to sign the declaration on behalf of the manufacturer or his authorised representative.

The declaration shall be accompanied by a factory production control certificate, drawn up by the notified body, which shall contain, in addition to the information above, the following:

- name and address of the notified body;
- the number of the factory production control certificate;
- conditions and period of validity of the certificate, where applicable;
- name of, and position held by, the person empowered to sign the certificate.

The above mentioned declarations shall be presented in the official language or languages of the Member State in which the product is to be used.

ZA.3 CE marking and labelling

The manufacturer or his authorised representative established within the EEA is responsible for the affixing of the CE marking. The CE marking symbol to affix shall be in accordance with Directive 93/68/EC and shall be shown on the positive pressure air/flue terminals with metal flue duct for C_{62}- and C_{63}-type gas appliances (or when not possible it may be on the accompanying label, the packaging or on the accompanying commercial documents e.g. a delivery note), together with the identification number of the notified body (where relevant), the name or identifying mark of the manufacturer, the number of the relevant standard and the relevant designation on the product or the packaging. Additionally, the CE marking symbol and all the elements listed below shall be on the accompanying documents (e.g. a delivery note). The following information shall accompany the CE marking symbol:

- identification number of the certification body;
- name or identifying mark and registered address of the manufacturer (see Note 1 in ZA.2.2);
- last two digits of the year in which the marking is affixed;
- number of the EC factory production control certificate;
- reference to this European Standard;
- description of the product: generic name, material, dimensions, etc. and intended use;
- information on the relevant essential characteristics listed in Table ZA.1 which are to be declared presented as:
  - declared values and, where relevant, level or class (including “pass” for pass/fail requirements, where necessary) to declare for each essential characteristic as indicated in "Notes" in Table ZA.1;
  - “No performance determined” for characteristics where this is relevant.
  - as an alternative, a standard designation which shows some or all of the relevant characteristics (where the designation covers only some characteristics, it will need to be supplemented with declared values for other characteristics as above).

The “no performance determined” (NPD) option may not be used where the characteristic is subject to a threshold level. Otherwise, the NPD option may be used when and where the characteristic, for a given intended use, is not subject to regulatory requirements in the Member State of destination.

Figure ZA.1 gives an example of the information to be given on the product, label, packaging and/or commercial documents.

CE 01234	*CE conformity marking, consisting of the "CE"-symbol given in Directive 93/68/EEC.* *Identification number of the certification body*
AnyCo Ltd, PO Box 21, B-1050 **06** 01234-CPD-00234	*Name or identifying mark and registered address of the producer* *Last two digits of the year in which the marking was affixed* *Certificate number (where relevant)*
EN 14989-1 **Positive pressure air/flue terminal with metal flue duct for C_{62}- and C_{63}-type gas appliances** ***T120- P1- D-Vm-L40045- O50*** **Compressive strength:** Pass **Flow resistance:** **Coefficient of flow resistance** **Air supply duct:** 2,5 **Flue duct:** 1,5 **Thermal resistance:** 0 m^2K/W **Thermal shock :** Pass **Flexural strength:** **Wind loading:** Pass **Freeze thaw:** Pass	*No. of European Standard* *Description of product* *and appropriate designation according to Clause 10* *Information on mandated characteristics not included in the designation or threshold values to be given (see Table ZA. 1)*

Figure ZA.1 - Example CE marking information

In addition to any specific information relating to dangerous substances shown above, the product should also be accompanied, when and where required and in the appropriate form, by documentation listing any other legislation on dangerous substances for which compliance is claimed, together with any information required by that legislation.

NOTE 1 European legislation without national derogations need not be mentioned.

NOTE 2 Affixing the CE marking symbol means, if a product is subject to more than one directive, that it complies with all applicable directives.

Bibliography

[1] EN 483, Gas-fired central heating boilers - Type C boilers of nominal heat input not exceeding 70 KW.

[2] EN 26, Gas-fired instantaneous water heaters for sanitary uses production, fitted with atmospheric burners (Including Corrigendum 1998).

[3] CEN/TR 1749, European scheme for the classification of gas appliances according to the method of evacuation of the combustion products (types).

[4] EN 563, Safety of machinery - Temperatures of touchable surfaces - Ergonomics data to establish temperature limit values for hot surfaces.

[5] EN 13216-1, Chimneys – Test methods for system chimneys - Part 1: General test methods.

[6] EN 13384-1, Chimneys - Thermal and fluid dynamic calculation methods - Part 1: Chimneys serving one appliance.

[7] EN ISO 9001, Quality management systems - Requirements (ISO 9001:2000).

[8] EN 13501-2, Fire classification of construction products and building elements - Part 2: Classification using data from fire resistance tests, excluding ventilation services.

[9] ISO 2859-1, Sampling procedures for inspection by attributes - Part 1: Sampling schemes indexed by acceptance quality limit (AQL) for lot-by-lot inspection

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