BRITISH STANDARD

BS EN
13403:2003

# Ventilation for buildings — Non-metallic ducts — Ductwork made from insulation ductboards

The European Standard EN 13403:2003 has the status of a British Standard

ICS 91.140.30

# National foreword

This British Standard is the official English language version of EN 13403:2003.

The UK participation in its preparation was entrusted to Technical Committee RHE/2, Air distribution and air diffusion, which has the responsibility to:

— aid enquirers to understand the text;

— present to the responsible international/European committee any enquiries on the interpretation, or proposals for change, and keep the UK interests informed;

— monitor related international and European developments and promulgate them in the UK.

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

**Cross-references**

The British Standards which implement international or European publications referred to in this document may be found in the *BSI Catalogue* under the section entitled "International Standards Correspondence Index", or by using the "Search" facility of the *BSI Electronic Catalogue* or of British Standards Online.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

**Compliance with a British Standard does not of itself confer immunity from legal obligations.**

This British Standard was published under the authority of the Standards Policy and Strategy Committee on 6 May 2003

**Summary of pages**

This document comprises a front cover, an inside front cover, the EN title page, pages 2 to 17 and a back cover.

The BSI copyright date displayed in this document indicates when the document was last issued.

**Amendments issued since publication**

| Amd. No. | Date | Comments |
|---|---|---|
| | | |
| | | |
| | | |
| | | |



ISBN 0 580 41783 2

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

# EN 13403

April 2003

ICS 91.140.30

English version

# Ventilation for buildings - Non-metallic ducts - Ductwork made from insulation ductboards

Ventilation des bâtiments - Conduits non métalliques - Réseau de conduits en panneaux isolants de conduits

Lüftung von Gebäuden - Nichtmetallische Luftleitungen - Luftleitungen aus Dämmplatten

This European Standard was approved by CEN on 17 January 2003.

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

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

CEN members are the national standards bodies of Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Luxembourg, Malta, Netherlands, Norway, Portugal, Slovakia, Spain, Sweden, Switzerland and United Kingdom.

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

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



Ref. No. EN 13403:2003 E

# Contents

# Foreword

This document (EN 13403:2003) has been prepared by Technical Committee CEN/TC 156, "Ventilation for buildings" the secretariat of which is held by BSI.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by October 2003, and conflicting national standards shall be withdrawn at the latest by October 2003.

This standard is a part of a series of standards for ductwork used in ventilation and air conditioning of buildings for human occupancy.

The position of this standard in the field of mechanical building services is shown in Figure 1.

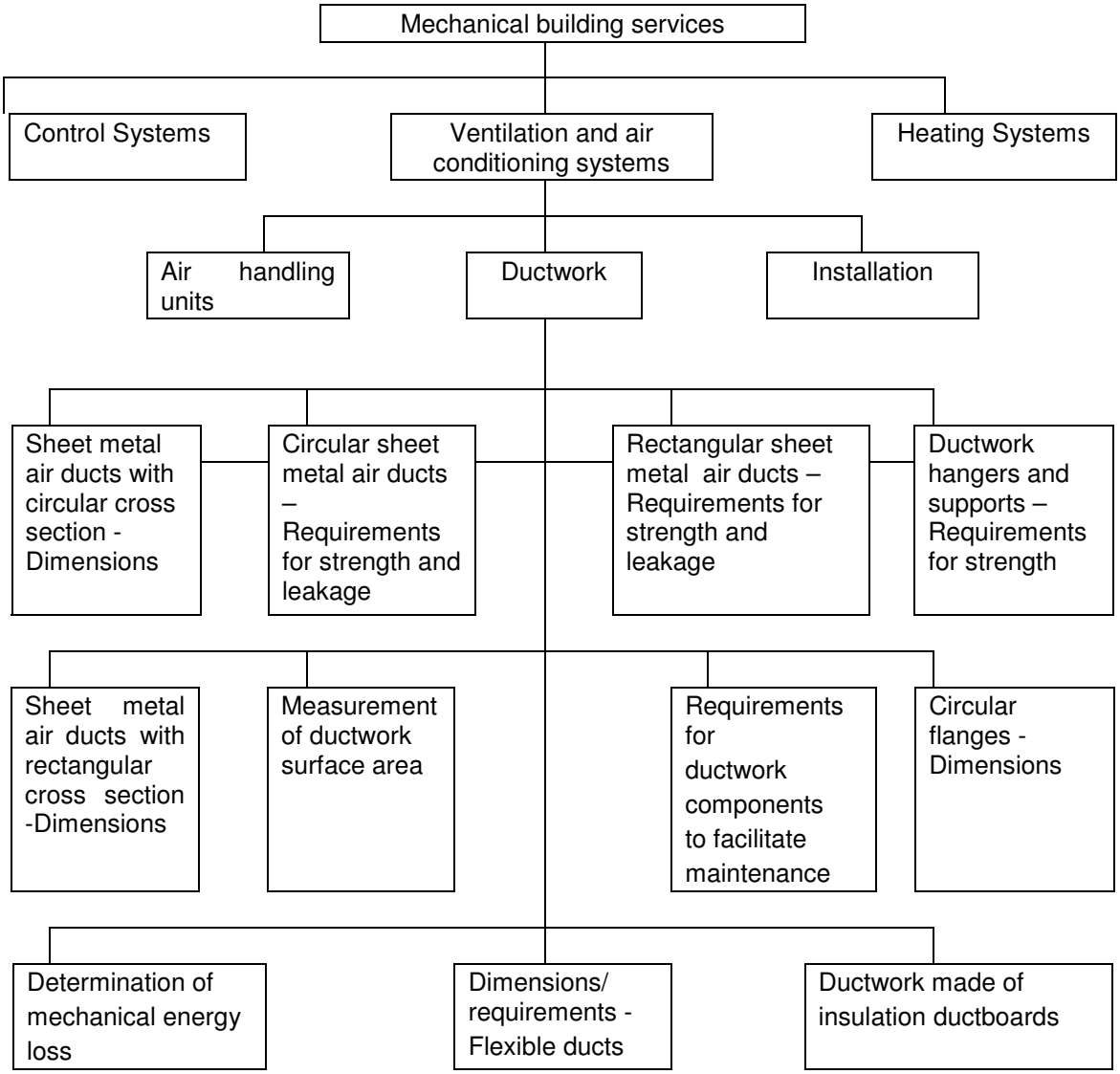



**Figure 1 Position of EN 13403 in the field of mechanical building services**

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

## 1 Scope

This European Standard contains the basic requirements and characteristics for ductwork made of insulation ductboards, and used in ventilation and air conditioning systems of buildings, subject to human occupancy.

## 2 Normative references

This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text, and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies (including amendments).

| | |
|---|---|
| EN 822 | *Thermal insulating products for building applications – Determination of length and width.* |
| EN 823 | *Thermal insulating products for building applications – Determination of thickness.* |
| EN 12086 | *Thermal insulating products for building applications - Determination of water vapour transmission properties.* |
| ENV 12097 | *Ventilation for buildings - Ductwork - Requirements for ductwork components to facilitate maintenance of ductwork systems.* |
| EN 12236 | *Ventilation for buildings – Ductwork hangers and supports – Requirements for strength.* |
| EN 12667 | *Thermal performance of building materials and products - Determination of thermal resistance by means of guarded hot plate and heat flow meter methods - Products of high and medium thermal resistance.* |
| EN 12939 | *Thermal performance of building materials and products - Determination of thermal resistance by means of guarded hot plate and heat flow meter methods - Thick products of high and medium thermal resistance.* |
| EN 13162 | *Thermal insulation products for buildings - Factory made mineral wool (MW) products - Specification.* |
| EN 13165 | *Thermal insulation products for buildings - Factory made rigid polyurethane foam (PUR) products - Specification.* |
| EN 13166 | *Thermal insulation products for buildings - Factory made products of phenolic foam (PF) - Specification.* |
| EN 13501-1 | *Fire classification of construction products and building elements - Part 1: Classification using test data from reaction to fire tests.* |
| EN ISO 11654:1997 | *Acoustics - Sound absorbers for use in buildings - Rating of sound absorption (ISO 11654:1997).* |
| CR 12792:1997 | *Ventilation for buildings - Symbols and terminology.* |

# 3 Terms and definitions, symbols and abbreviations

## 3.1 Terms and definitions

For the purposes of this European Standard, the terms and definitions given in CR 12792:1997 and the following apply.

**3.1.1**
**ductboard**
rigid board composed of insulation material body with both sides faced: the outer facing comprising a duct vapour barrier, which makes the duct tight

NOTE Ductboards are fabricated into rectangular or multisided duct sections.

## 3.2 Symbols and abbreviations

The symbols and abbreviations are given in Table 1.

**Table 1 Symbols and abbreviations**

| Symbol | Description | Unit |
|---|---|---|
| MW | Mineral wool | --- |
| PF | Phenolic foam | |
| PIR | Polyisocianurate | --- |
| PUR | Polyurethane and Polyisocianurate | --- |
| $e$ | Thickness | mm |
| $f_{max}$ | Air leakage factor | $l/(sm^2)$ |
| $E$ | Young's modulus | $N/mm^2$ |
| $I$ | Moment of inertia | $mm^4$ |
| $I_u$ | Moment of inertia referred to 1 mm width. | $mm^4$ |
| $EI$ | Flexural rigidity | $N\ mm^2$ |
| $EI_u$ | Flexural rigidity referred to 1 mm width. | $Nmm^2$ |
| $P_S$ | Pressure | Pa |
| $R$ | Thermal resistance | $(m^2\ K)/W$ |
| Zv | Water vapour resistance | $m^2.h.Pa/mg$ |
| | Specific mass | $kg/m^3$ |
| | Acoustical absorption | --- |
| $f$ | Frequency | Hz |
| | Thermal conductivity | W/(m K) |

# 4 Requirements

## 4.1 Erosion and emission of particles

When tested in accordance with 7.2, at 2,5 times the maximum air speed recommended by the manufacturer of the ductboard, material from the inside surface of the ductwork shall not break away, flake off, or show evidence of delamination or erosion.

Emission of particles shall be less than 60 g/m$^3$ for particles bigger than 0,5 m, and no more than 4 g/m$^3$ for particles bigger than 5,0 m.

## 4.2 Resistance against pressure (without reinforcements)

When tested in accordance with 7.3, air ducts and connector sections with joints, assembled in accordance with the manufacturer's instructions, shall withstand without rupture an internal air pressure of 2,5 times the manufacturer's rated positive pressure, but not less than 200 Pa.

For this test rupture is considered as evidenced by breaks, tears, rips or other openings greater than 4 mm.

NOTE Plastic deformation is not considered to be a rupture

Any joining material shall remain intact to the extent that materials such as tapes do not become displaced more than a total for both edges of 4 mm from their initial position. There shall not be evidence of other damage, which would cause the sample to become unusable.

## 4.3 Air leakage factor and air tightness class

The air leakage factor is given in Table 2 and the air leakage rates in Table 3 when tested in accordance with prEN 1507.

**Table 2 – Air tightness classification and air leakage factor**

| **Air Tightness class** | **Air leakage factor** ($f_{max}$) l/(sm$^2$) |
|---|---|
| A | 0,027 Ps $^{0,65}$ |
| B | 0,009 Ps $^{0,65}$ |
| C | 0,003 Ps $^{0,65}$ |

**Table 3 Air leakage rates**

| **Static pressure differential** Pa | **Maximum leakage,** l/(s×m$^2$) (surface area) | | |
|---|---|---|---|
| | **Ductwork class** | | |
| | **Class A** | **Class B** | **Class C** |
| 400 | 1,32 | 0,44 | 0,14 |
| 800 | - | 0,69 | 0,23 |
| 1000 | - | 0,80 | 0,27 |
| 1200 | - | 0,90 | 0,30 |
| 1500 | - | 1,1 | 0,36 |

## 4.4 Bulging and/or caving, air leakage

No wall of the duct shall bulge and/or cave by more than 3 % of its width or 30 mm, whichever is the greater value.

The maximum air leakage is defined at the relevant test pressure given in Table 3 based on relevant parts of the test method described in prEN 1507.

## 4.5 Supports and hangers

The ductwork shall fulfil the requirements specified in EN 12236.

## 4.6 Facilities for cleaning

The ductwork shall conform to the requirements specified in ENV 12097. Different cleaning systems can be used such as contact sucking, air pressure cleaning, or brushing and air pressure cleaning.

When brushing is used brushes shall be non metallic (acrylic, nylon, etc.)

The ductboard shall resist the cleaning operations equivalent to a life span of 20 years of use (one cleaning operation per year) without any damage. When tested in accordance with 7.2, after 20 cleaning simulations have been performed, material from the inside surface of the ductwork shall not break away, flake off, or show evidence of delamination or erosion.

Emission of particles shall be less than 60 $g/m^3$ for particles bigger than 0,5 m and no more than 4 $g/m^3$ for particles bigger than 5 m.

## 4.7 Requirements for ductboards

### 4.7.1 Health and safety

The insulation materials used in the ductboards shall not be listed in the Directive 67/548/EEC Annex 1.

MW products covered by this standard, shall be classified as non carcinogenic fulfilling the requirements specified in Article 1 of Directive 97/69/EC.

### 4.7.2 Microbial growth

Materials used shall not facilitate (or being nutrient to) microbial growth following test method 7.4. All types of materials used as insulation ductboards shall withstand the test requirements specified in 7.4, after first having been exposed to 20 cleaning simulations.

### 4.7.3 Board stiffness

The minimum rigidity for different classes, as specified in Table 4, shall be determined in accordance with the test method specified in 7.1. The classes are referred to a width of 1 mm.

**Table 4 Classification for board stiffness**

| Stiffness class | Flexural rigidity *[EI]* N $mm^2$ |
|---|---|
| R 1 | 55,000 |
| R 2 | 90,000 |
| R 3 | 160,000 |
| R4 | 200,000 |
| R 5 | 300,000 |

#### 4.7.4 Water vapour resistance

The water vapour resistance shall not be less than 140 $m^2 \cdot h \cdot Pa/mg$ for the outer facing to avoid condensation inside the ducts.

The water vapour resistance shall be determined in accordance with EN 12086.

#### 4.7.5 Dimensional tolerances

The tolerance on the length and width of the ductboards, when tested in accordance with EN 822, shall not exceed the following:

- Length: 2 %.
- Width: 1,5 %.

The upper and lower deviations of the thickness of the ductboard, when tested in accordance with EN 823 under a load of 50 Pa, shall not exceed + 2,0 mm - 1,5 mm.

#### 4.7.6 Dimensional stability under combined temperature and humidity (optional)

The dimensional changes in length, width and thickness shall be less than 0,5 % when conditioned for 48 hours at 70 °C and 90% relative humidity and tested in accordance with CEN/TC 88 N 478.

#### 4.7.7 Weighted acoustical absorption

The weighted acoustical absorption $_w$, determined according to EN ISO 11654, shall be not less than the values given in Table 5.

**Table 5 Weighted acoustical absorption $_w$ (see Table B.1 of EN ISO 11654:1997)**

| Class | Acoustic absorption $_w$ |
|---|---|
| A | 0,9; 0,95; 1,00 |
| B | 0,80; 0,85 |
| C | 0,60; 0,65; 0,70; 0,75 |
| D | 0,30; 0,35; 0,40; 0,45; 0,50; 0,55 |
| E | 0,25; 0,20; 0,15 |
| Without classification | 0,10; 0,05; 0,00 |

#### 4.7.8 Thermal properties

Thermal resistance (*R*) and thermal conductivity ( ) shall be based upon measurements carried out in accordance with EN 12667 or EN 12939 and determined by following the specific insulation product standard (EN 13162 for MW, EN 13165 for PUR and EN 13166 for PF).

#### 4.7.9 Reaction to Fire

Reaction to fire classification (Euroclasses) shall be determined in accordance with EN 13501-1. In the absence of a complete set of European Standards for reaction to fire, existing national regulations for fire safety apply.

## 5 Application restrictions

The manufacturers of ductwork made of insulation ductboards shall recommend cleaning methods that are compatible with fulfilling the requirements given in 4.6.

Ducts manufactured from Mineral Wool (MW) to EN 13162, Poliurethane/Polyisocianurate (PUR) to EN 13165 or Phenolic foam (PF) to EN 13166 shall not be used for the following applications:

- transport of solid particles or corrosive gases;
- outdoor use without additional protection;
- buried below ground without additional protection;
- smoke extraction from kitchens, laboratories, etc.;
- where air speed in the duct is higher than the determined according to the test described in 7.2;
- where internal air pressure is higher than the determined according to the test described in 7.3;
- where the minimum air temperature is less than - 30 ºC;
- where, under extreme temperature conditions, measures have to be taken to prevent external or internal condensation, e.g. by using a ductboard of a sufficient thermal resistance and/or by application of water vapour barrier;
- at higher levels of relative humidity than those specified by the manufacturer of the ductboard.

For MW ducts the following restrictions also apply:

- ducts shall not be used in vertical air ducts systems higher than 10 m., without additional support;
- the maximum air temperature inside the duct shall not exceed 90 ºC and outside the duct shall not exceed 60 ºC.

For PIR; PUR; and PF ducts only, the maximum air temperature inside the duct shall not exceed 65 ºC.

## 6 Test conditions

Before testing, the supplier has to specify the following data for the ductwork to be tested (if applicable):

a) recommended maximal air speed;

b) recommended maximum positive pressure;

c) air tightness class;

d) mechanical energy loss (optional);

e) board stiffness class;

f) water absorption class;

g) acoustical absorption class;

h) thermal conductivity and/or thermal resistance.

# 7 Test methods

## 7.1 Board stiffness

### 7.1.1 General

The stiffness of a board of thickness *e* is defined as the flexural rigidity, which is the product of Young's modulus of elasticity *E* and the moment of inertia *I* calculated with respect to the width *a* at the central axis of the board (see Figure 2).

The moment of inertia is given by the formula $I = \frac{a \times e^3}{12}$ and in this case it is referred to a unit width of 1 mm (a =1), therefore $I_u = \frac{e^3}{12}$

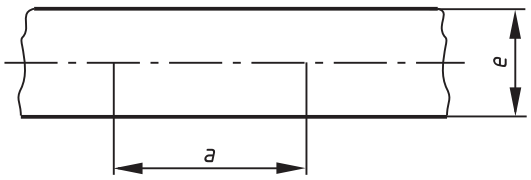



**Figure 2 Moment of inertia**

The flexural rigidity shall be determined by one of the methods specified in 7.1.2 or 7.1.3.

### 7.1.2 Full size specimen under own load

The production line specimen shall be placed on a horizontal surface leaving a length of 1,0 m unsupported to deflect under its own load as shown in Figure 3. The deflection shall be measured, and the flexural rigidity established using the formula:

$$EI_u = \frac{\times v^4}{8 \times d}$$

where *p* is the material load per unit length in N/mm;

*v* is the unsupported length equal to 1000 mm;

and *d* is the deflection in mm.

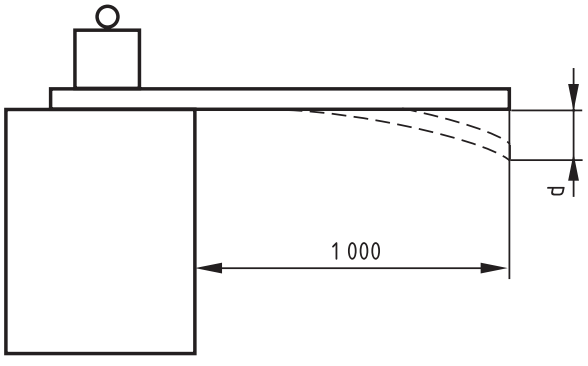



**Figure 3 – Full size specimen under own load**

A mean value shall be obtained from two measurements, the second measurement being taken with the duct board turned upside down.

### 7.1.3 Specimen with preload

This is the preferred method in the case of rigid boards that are not totally flat or display hysteresis. The specimen with dimensions in the range of 1,200 mm x 200 mm shall be placed on a horizontal surface leaving a length of 750 mm unsupported as shown in Figure 4. At a point 700 mm from the end of the supporting surface, a weight $W$ shall be applied slowly and removed several times, until the distances to a reference plane, with the weight, $d_1$ and without the weight, $d_2$ are constant. The deflection $d$ shall be calculated as the difference between $d_1$ and $d_2$.

The weigh $W$ is chosen to result in a deflection $d$ in the range 10 mm to 20 mm. For guidance the expected value of the function $EI_U$ is given in Table 6:

**Table 6 – Guidance values for $EI_u$**

| Expected $Ei_u$ (Nmm$^2$) | W (N) |
|---|---|
| 55,000 | 1,1 |
| 90,000 | 1,8 |
| 160,000 | 3,2 |
| 200,000 | 4,0 |
| 300,000 | 6,0 |
| Note Sample size: 1200 x 200 x thickness. | |

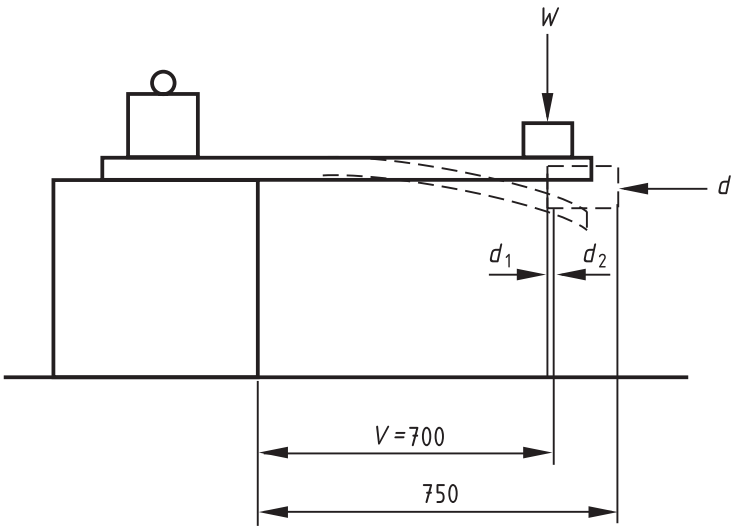



**Figure 4 – Specimen with preload**

$EI_u$ shall be calculated using the following equation:

$$EI_u = \frac{W / A \times V^3}{3 \times d}$$

where $EI_u$ is the flexural rigidity for 1mm wide in Nmm$^2$

$W$ is the weight applied in N

$A$ is the sample width and equal to 200 mm

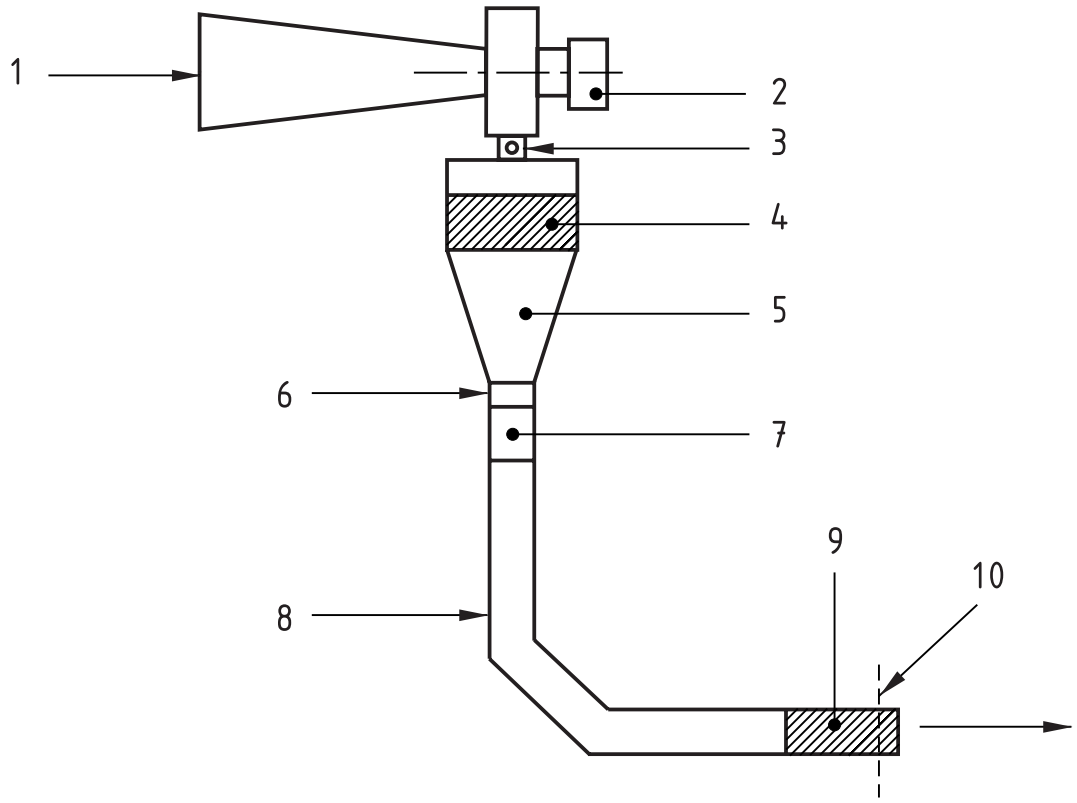
$d$ is the deflection under load in mm

and $V$ is the distance between the support surface and the point where the load is applied and equal to 700 mm

## 7.2 Determination of particle emission

### 7.2.1 General

The air is passed through typical rectangular sections at a speed of two and a half times the manufacturer's recommended maximum air speed, but the lowest test speed should be not less than 12 m/s. The sample or samples selected are to be arranged in an L-shaped assembly shown in Figure 5. The 90-degree bend is to be made with an elbow as used for normal installations. The entire assembly shall have similar cross sections. Connection to the outlet of the fan shall provide a uniform air entry to the test sample by means of a transformation piece of any acceptable material. Air ducts and connector sections with joints, assembled in accordance with the manufacturer's instructions, shall withstand without rupture.




**Key**

1 Sucking box
2 Sucking fan
3 Control valve
4 Absolute filters
5 Blowing plenum
6 Flexible connexion
7 Connexion duct
8 Ducts to be tested of length 4 m
9 Measuring duct of length 2 m
10 Measuring section

**Figure 5 – Typical construction for particle emission**

The air speed shall be measured by a pitot tube, or direct reading velometer, positioned in the centre of the outlet end of the assembly. The fan shall displace air from a room with a temperature range between 15 ºC and 38 ºC.

To regulate and control the air speed, the fan can be controlled by a variable speed motor or a control valve located between the fan and the inlet of the test assembly. The internal section to be used is 300 mm 300 mm.

### 7.2.2 Particle accounting

The particle accounting shall be made with an optical laser counter with a range between 0,2 m and 5,0 m with 6 different groups (channels) as given in Table 7.

**Table 7 – Laser counter range**

| Channel | Range |
|---|---|
| 1 | 0,2 – 0,3 m |
| 2 | 0,3 – 0,5 m |
| 3 | 0,5 – 1,0 m |
| 4 | 1,0 – 2,0 m |
| 5 | 2,0 – 5,0 m |
| 6 | > 5,0 m |

The extracted flow shall be between 25 l/min and 30 l/min [typically 28 l/min] and the extraction time can be programmed as needed

#### 7.2.3 Results

The erosion test shall take 5 h, after a 1 h purge at a speed of 12 m/s, at a speed of two and a half times the manufacturer's recommended maximum air speed noting that the lowest test speed should be not less than 12 m/s,

Between both periods of time the test is stopped during 15 min.

The average particle concentration is calculated from the extracted air volume and the measurement of the particle's mass using the following formula:

$$C = \frac{M}{Q_v \times t}$$

where $C$ is the particle concentration in g/m$^3$;

$M$ is the particles' mass in g;

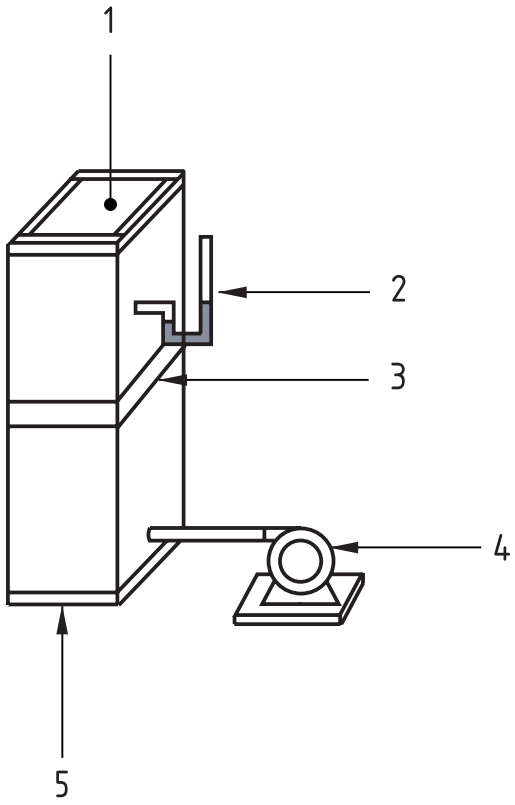
$t$ is the extraction time in s;

and $Q_v$ is the extraction flow rate in m$^3$/s.

The maximum particle concentration to be attained shall be no more than 60 g/m$^3$ for particles bigger than 0,5 m, and no more than 4,0 g/m$^3$ for particles bigger than 5,0 m. The material from the inside surface of the ductwork shall not break away, flake off, or show evidence of delamination or erosion.

### 7.3 Pressure test

The pressure test determines the fitness for purpose of the ductboard assembly. An air duct and connector section shall be prepared in accordance with Figure 6. Each end of the sample to be tested shall be sealed airtight by any means consistent with the use of the material under test.




**Key**

1 Sealed section [Top]
2 Pressure gauge
3 Joint
4 Compressor
5 Sealed section [Bottom]

**Figure 6 - Typical construction for pressure test**

Two typical rectangular section ducts shall be constructed with a length equal to the nominal ductboard width and assembled with a peripheral joint. The internal section to be used is 300 mm 300 mm.

The joint shall be made following the manufacturer's instructions ensuring that any adhesives or cements are allowed to cure for a period of at least 24 h. Samples used in the construction shall not be exposed to relative humidity greater than 70 % during the 24 h period prior to the test.

A pressure tap consisting of pipe or tubing shall be sealed into one end of the test sample and connected to a manometer whit a resolution of 10 Pa or less. The manometer shall be checked for zero reading at the beginning and end of each test.

An air supply tap consisting of pipe or tubing shall be sealed into the same or the other end of the sample and connected to a source capable of maintaining the specified air pressure in the sample.

The manufacturer's rated pressure shall gradually be reached in not less than 45 s and not more than 60 s from the initial application of the test pressure. This pressure shall be held for 1 min and then increased to 2,5 times the manufacturer's rated pressure in not less than 45 s and nor more than 60 s. The air pressure in the test assembly is to be maintained at the designated value for a period of 1 h. Air ducts and connector sections with joints, assembled in accordance with the manufacturer's instructions, shall withstand this test pressure without rupture.

## 7.4 Microbial growth

Materials for air ducts and connectors, including any tapes, fabrics, cements, or other materials to be used in installation, shall not be nutrient or residence for mould mycelia and spores from bread. These criteria are valid before and after 20 cleaning simulations have been performed.

Three samples representing typical wall areas of the assembled air ducts or connectors shall be prepared, each sample being an square of 100 mm 100 mm including any joining material used in the installation of duct systems.

Mould mycelia and bread spores shall be applied to the samples and then they are placed in a dark and closed room with an atmosphere saturated with water vapour and stable temperature of 21 ºC.

The samples shall remain in this atmosphere until the extent of growth has been demonstrated or until the mould and spores have disintegrated, but never less than 60 days.

The samples shall be examined visually for extent of mould growth and for any indication of deterioration in wall structure. The mould shall not spread beyond the inoculated area, and no significant growth of mould shall be observed.

As an alternate, instead of bread mould, Chaetomium Globosium can be used.

## 8 Marking, labelling and packaging

Products complying with the requirements stated in this standard shall be clearly marked, either on the product or a label with the following information:

a) name or identifying mark of the manufacturer and plant;

b) product identity (trade name);

c) designation code of the insulation product as given in the respective CEN standard;

d) year of manufacture (the last two digits);

e) lot or shift or time of manufacture;

f) dimensions and number of pieces in the package.

# Bibliography

[1] CETIAT; *Test methods on emission of particles. Glass wool ducts*.

[2] UL181; *Standard for factory made air ducts and connectors*.

[3] UNE 100–105-84; *Conductos de fibra de vidrio para transporte de aire. (Glass wool made ducts for air transport)*.

[4] prEN ISO 9229; *Thermal insulation - Definitions of terms (ISO/DIS 9229:1997).*

[5] prEN 1507; *Ventilation for buildings - Sheet metal air ducts with rectangular section - Requirements for strength and leakage.*

# BSI — British Standards Institution

BSI is the independent national body responsible for preparing British Standards. It presents the UK view on standards in Europe and at the international level. It is incorporated by Royal Charter.

**Revisions**

British Standards are updated by amendment or revision. Users of British Standards should make sure that they possess the latest amendments or editions.

It is the constant aim of BSI to improve the quality of our products and services. We would be grateful if anyone finding an inaccuracy or ambiguity while using this British Standard would inform the Secretary of the technical committee responsible, the identity of which can be found on the inside front cover. Tel: +44 (0)20 8996 9000. Fax: +44 (0)20 8996 7400.

BSI offers members an individual updating service called PLUS which ensures that subscribers automatically receive the latest editions of standards.

**Buying standards**

Orders for all BSI, international and foreign standards publications should be addressed to Customer Services. Tel: +44 (0)20 8996 9001. Fax: +44 (0)20 8996 7001. Email: orders@bsi-global.com. Standards are also available from the BSI website at http://www.bsi-global.com.

In response to orders for international standards, it is BSI policy to supply the BSI implementation of those that have been published as British Standards, unless otherwise requested.

**Information on standards**

BSI provides a wide range of information on national, European and international standards through its Library and its Technical Help to Exporters Service. Various BSI electronic information services are also available which give details on all its products and services. Contact the Information Centre. Tel: +44 (0)20 8996 7111. Fax: +44 (0)20 8996 7048. Email: info@bsi-global.com.

Subscribing members of BSI are kept up to date with standards developments and receive substantial discounts on the purchase price of standards. For details of these and other benefits contact Membership Administration. Tel: +44 (0)20 8996 7002. Fax: +44 (0)20 8996 7001. Email: membership@bsi-global.com.

Information regarding online access to British Standards via British Standards Online can be found at http://www.bsi-global.com/bsonline.

Further information about BSI is available on the BSI website at http://www.bsi-global.com.

**Copyright**



BSI
389 Chiswick High Road
London
W4 4AL