BRITISH STANDARD

BS EN 13030:2001

Ventilation for buildings — Terminals — Performance testing of louvres subjected to simulated rain

The European Standard EN 13030:2001 has the status of a British Standard

ICS 91.140.30

National foreword

This British Standard is the official English language version of EN 13030:2001.

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 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 Standards Catalogue under the section entitled "International Standards Correspondence Index", or by using the "Find" facility of the BSI Standards Electronic Catalogue.

A British Standard does not purport to include all the necessary provisions of a contract. Users of British Standards are responsible for their correct application.

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

This British Standard, having been prepared under the direction of the Engineering Sector Policy and Strategy Committee, was published under the authority of the Standards Policy and Strategy Committee on 30 November 2001

Summary of pages

This document comprises a front cover, an inside front cover, the EN title page, pages 2 to 31 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 38739 9

EUROPEAN STANDARD
NORME EUROPÉENNE
EUROPÄISCHE NORM

EN 13030

October 2001

ICS 91.140.30

English version

Ventilation for buildings - Terminals - Performance testing of louvres subjected to simulated rain

Ventilation des bâtiments - Bouches d'air - Essai de performance des grilles d'air extérieur soumises à une pluie simulée

Lüftung von Gebäuden - Endgeräte - Leistungsprüfung von Wetterschutzblenden bei Beanspruchung durch Beregnung

This European Standard was approved by CEN on 18 August 2001.

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, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, 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 13030:2001 E

Contents

Foreword

This European Standard 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 April 2002, and conflicting national standards shall be withdrawn at the latest by April 2002.

The annexes A, B and C are normative. Annex D is informative.

Warning

Attention is drawn to the possible risks associated with legionella, if recirculated water is used or biofilms are allowed to develop within the facility during weather louvre testing, in order that appropriate precautions are taken to safeguard the health of those involved.

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, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom.

1 Scope

This European Standard specifies a method for measuring the water rejection performance of louvres subject to simulated rain and wind pressures, both with and without air flow through the louvre under test. For the purpose of tests in this standard, a 1000 mm × 1000 mm section of weather louvre or the nearest possible blade increment is considered.

Weather louvres are designed to restrict the passage of water during rainfall while allowing the passage of air into or from an air distribution system or part of a building. They are used in a wide range of applications, where there may be differences in wind speed and direction, levels of local turbulence, rate and droplet size, distribution of rainfall and surface water flow from the surrounding structure. It is impractical to consider a standard test procedure simulating the whole range of likely conditions, but this standard provides for heavy rainfall directed on to the louvre surface, with simulated wind pressures. This provides a common basis on which to compare the water rejection performance of weather louvres of different designs. This standard is not intended for the evaluation of weather performance of pressure relief dampers.

The purpose of tests incorporated in this European Standard is as follows:

a) Weather tests

To establish the weather louvre effectiveness when subjected to wind pressure at various air flow rates.

b) Discharge and Entry loss coefficient/Pressure requirements

To establish the air pressure loss through the weather louvre at various air flow rates and by calculation the Discharge and Entry Loss Coefficient.

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 the 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 24185, *Measurement of liquid flow in closed conduits — Weighing method (ISO 4185:1980)*

CR 12792, *Ventilation for buildings — Symbols and Terminology*

EN ISO 5167-1, *Measurement of fluid flow by means of pressure differential devices — Part 1 orifice plates, nozzles and venturi tubes inserted into circular section conduits running full (ISO 5167-1:1991)*

ISO 5221, *Air distribution and air diffusion — Rules to methods of measuring air flow rate in an air handling duct*

ISO 5801, *Industrial fans — Performance testing using standardized airways*

3 Terms and definitions

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

3.1
weather louvre
device intended to allow the passage of supply or exhaust air while minimising the ingress of rain; louvres can have either fixed or adjustable blades

3.2
insertion loss
difference in simulated rain penetration between the test specimen (weather louvre) and the calibration plate at the same test conditions

3.3
weather louvre core area
product of the minimum height *H* and minimum width *W* of the front opening in the weather louvre assembly with the louvre blades removed (see Figure C.5)

3.4
louvre calibration plate
plate having an opening of the same geometric shape and dimensions as the core area of the test specimen

3.5
discharge or entry loss coefficient of a louvre
actual air flow rate divided by the theoretical air flow rate at a given pressure difference across the louvre. For louvres tested with air flow in the reverse direction then the coefficient of discharge becomes the coefficient of entry

3.6
theoretical air flow
product of the louvre core area and the air velocity calculated using the pressure difference across the louvre as the velocity pressure, assuming C_D or $C_E = 1$

3.7
weather louvre effectiveness
quotient resulting from the value of the insertion loss of the louvre assembly at any air velocity divided by the amount of water penetration of the calibration plate at that velocity

4 Symbols and subscripts

4.1 Symbols

Symbol	Quantity	Unit
A	Louvre core area/area of the hole in calibration plate	m^2
C_D	Discharge Loss Coefficient	
C_E	Entry Loss Coefficient	
p_{sa}	Absolute static pressure	Pa
p_a	Atmospheric pressure	Pa
p_d	Dynamic (velocity) pressure $½ \rho \cdot v^2$	Pa
p_{ta}	Stagnation or absolute total pressure	Pa
p_s	Static gauge pressure (p_{sa} - p_a)	Pa
p_t	Total pressure (p_{ta} - p_a)	Pa
Δp	Flow meter pressure difference	Pa
Δp_t	Conventional total pressure differential for an air density of 1,2 $kg.m^{-3}$ at the inlet to the louvre or valve under test	Pa
q_v	Volume flow rate of air at the flow meter	$m^3 s^{-1}$
q_s	Water supply rate to the nozzles	$l h^{-1}$
q_u	Water rejection rate collected upstream of the test louvre	$l h^{-1}$
q_d	Water penetration rate collected downstream of the test louvre	$l h^{-1}$
v_w	Wind velocity	$m s^{-1}$
v_c	Core velocity	$m s^{-1}$
ε	Effectiveness	%
ρ	Air density	$kg m^{-3}$
θ	Temperature	°C

4.2 Subscripts

1	outlet of the weather louvre under test
m	measuring point at the air flow meter
n	value at selected point of air flow rate/static pressure curve
o	measured value with calibration plate
corr nom	(used to show correct values against references values)

5 Instrumentation

5.1 Air flow rate measurement

5.1.1 The air flow rate shall be measured using instruments and techniques in accordance with ISO 5221, EN ISO 5167-1 and ISO 5801.

5.1.2 Air flow meters shall have ranges and accuracies as specified in Table 1.

Table 1 — Range and accuracy of air flow meters

Range $m^3 s^{-1}$	**Error limit** %
0,07 to 7	± 2,5
0,007 to 0,07	± 5,0

NOTE Flow meters can be calibrated in situ by means of pitot static tube traverse techniques described in ISO 3966.

5.1.3 Flow meters shall be checked at intervals as appropriate but not exceeding 12 months. This check can take the form of one of the following:

a) a dimensional check for all flow meters not requiring calibration;

b) a check calibration over their full range using the original method employed for initial calibration or meters calibrated in situ;

c) a check against a flow meter which meets the flow meter specification ISO 5221.

5.2 Wind Velocity Measurement

The wind velocity shall be measured using a pitot tube, vane anemometer or other similar style instrument for which the measuring error does not exceed 2,0 %

5.3 Pressure Measurement

5.3.1 Pressure in the duct shall be measured by means of a liquid-filled calibrated pressure gauge, or any other device conforming to 5.3.2.

5.3.2 The maximum scale interval shall not be greater than the values given in Table 2 for the appropriate range of pressure gauges.

Table 2 — Range and maximum scale interval for pressure measurement

Range Pa	**Max. scale interval** Pa
≤ 25	1,0
> 25 to ≤ 250	2,5
> 250 to ≤ 500	5,0
> 500	25,0

5.3.3 For air flow measurements, the minimum pressure differential shall be:

a) 25 Pa with an inclined tube pressure gauge or micro-pressure gauge;

b) 500 Pa with a vertical tube pressure gauge.

5.3.4 Calibration standards shall be as follows:

a) for instruments with the range ≤ 25 Pa, a pressure gauge with an error limit of ± 0,5 Pa;

b) for instruments with the range > 25 ≤ 500 Pa, a pressure gauge with an error limit of ± 2,5 Pa (vertical pressure gauge).

5.4 Temperature measurement

Measurement of temperature shall be by means of mercury-in-glass thermometers, resistance thermometers, or thermo-couples. Instruments shall be graduated to give readings in intervals not greater than 0,5 K and calibrated up to the nearest 0,25 K.

5.5 Water flow meters

5.5.1 The measurement error of water flow meters shall not exceed 0,5 % of the indicated flow rate.

5.5.2 Water flow meters shall be calibrated against a known weight of water flowing for a measurement time period as specified in EN 24185.

5.6 Timers

The error limit for timers for determining water flow rates shall not exceed 0,2 s.

5.7 Rain gauge

The error limit for rain gauges shall not exceed 2 % of the indicated reading.

6 Test apparatus

6.1 General

A diagram of the test apparatus is shown in Figure C.1 and the requirements for the various elements described in 6.2 to 6.8.

6.2 Wind simulation equipment

An external fan shall be fitted to direct the air perpendicular to the weather louvre test plane, as illustrated in Figure C.2.

The air outlet of the fan and any silencing or straightening section shall not be less than 1 m diameter.

The fan shall be capable of producing an air velocity of 13 $m \cdot s^{-1}$ at a distance 1 m in front of the test plane of the weather louvre.

An air straightener section shall be assembled to the outlet of the fan to avoid swirling air currents.

A suitable air straightener is illustrated in Figure C.2. Other air straighteners (such as are described in ISO 5801 for fan tests) can also be used.

6.3 Weather section

The weather louvre or calibration plate to be tested shall be mounted and fixed in the centre of a 3 m × 3 m square wall at the rear of the weather section (see Figure C.2).

The weather louvre or the calibration plate as appropriate shall be tightly sealed to the wall, as recommended by the manufacturer.

The outside face of the weather louvre shall be facing the wind and rain simulation equipment.

6.4 Rain simulation equipment

The simulated rain shall be produced by at least 4 nozzles in an array close to the discharge of the wind effect fan to suit the spread of rain required. A suitable spray can be achieved by using the nozzles and control system as shown in Figures C.2 and C.4 and annex A.

The rain simulation equipment shall satisfy the following requirements with the calibration plate mounted in the test opening.

a) The equipment shall be capable of producing a simulated rain penetration through the calibration plate of 75 $l \cdot h^{-1}$ (+ 10 % / 0 %) per square metre of opening;

b) The simulated rainfall rate measured using the rain gauge in the positions shown in Figure C.5 shall not deviate from the mean value by more than 15 %;

c) The water penetration through the calibration plate measured in the collection section shall be at least 80 % of the total water collected in both the weather section at the base, in front of the calibration plate, and the collection duct.

6.5 Collection duct

The collection duct (see Figure C.3) shall be sealed against the back of the weather section.

The collection duct shall have a water droplet elimination section at the downstream end to prevent carry over of airborne water droplets from the collection duct (see annex B).

The collection duct shall have an airtight connection to the air flow measuring plenum.

6.6 Water collection

6.6.1 Water collection at the collection duct

Water shall be collected at the drain from the collection duct in order to measure the penetration for the test period (see Figure C.3).

6.6.2 Water collection in front of the louvre

Water shall be collected in the weather section at the base in front of the weather louvre or calibration plate in order to measure the water rejection during the test period (see Figure C.2).

6.7 Aerodynamic measurement section

6.7.1 Air flow rate measurement

The air flow rate shall be measured using an inlet cone or similar device positioned at the end of the discharge end of the section (see Figure C.6). Uniform flow approaching the conical inlet shall be obtained by fitting resistance screens.

The required uniformity is considered to be achieved if the maximum air velocity in plane A nowhere exceeds 1,25 times the average velocity in plane A (see Figure C.6).

Three uniform wire mesh or perforated plate screens adequately supported and sealed to the chamber spaced 100 mm apart and with 60 %, 50 % and 45 % free area successively in the direction of flow may be expected to secure the required flow uniformity.

Other air flow rate meters conforming to 5.1 may be used.

6.7.2 Pressure loss measurement

This test is performed with the collection duct removed and the test louvre fitted to the entry of the aerodynamic measurement section. The pressure loss across the weather louvre shall be measured using static pressure measurement points positioned 100 mm behind the weather louvre on the sides of the aerodynamic test section (see Figure C.6). There shall be no obstructions within 2 m of the face of the louvre.

6.8 Mechanical ventilation section

The mechanical ventilation section shall consist of a ventilation fan that shall be capable of producing an air flow rate through the weather louvre under test over the range of 0,5 $m^3 \cdot s^{-1}$ to 3,5 $m^3 \cdot s^{-1}$ (see Figure C.6).

6.9 Test specimen and calibration plate

6.9.1 The louvre to be tested shall be as near to, but not exceeding, the nominal dimensions of 1000 × 1000 mm as possible using standard blade pitches and without the use of cover plate or infills.

6.9.2 If the manufacturer's range does not extend up to 1000 mm × 1000 mm then the maximum size unit shall be tested.

6.9.3 For the purpose of calibration tests a calibration plate shall be fabricated which will fit over the test plane and have an opening of the same dimensions as the core area of the weather louvre to be tested.

This plate shall be used in the determination of the rain penetration insertion loss of the louvre.

7 Test methods

7.1 Water penetration test

7.1.1 Mounting and sealing

The weather louvre to be tested shall be as detailed in 6.9 and shall be mounted and sealed to the 3 m × 3 m wall at the rear of the weather section as recommended by the manufacturer, to prevent any ingress of water other than through the weather louvre blades.

7.1.2 Test requirements

The weather louvre shall be tested at a minimum of 8 different core velocities ranging from 0 $m \cdot s^{-1}$ to 3,5 $m \cdot s^{-1}$ in increments of 0,5 $m \cdot s^{-1}$. The set values shall not deviate from the nominal values by more than ± 0,1 $m \cdot s^{-1}$. All tests shall be at a constant simulated heavy rainfall rate of 75 $l \cdot h^{-1} \cdot m^{-2}$ (75 $mm \cdot h^{-1}$).

All tests shall be carried out at a simulated wind speed of 13 $m \cdot s^{-1}$ measured by means of a velocity meter (i.e., vane anemometer or pitot tube) on the centre line of the fan and 1 m in front of the face of the louvre. The velocity meter shall be removed before the rain simulation nozzles are turned on.

The water flow rates shall be measured with a flow meter and set to the desired rates for each test. Water shall be collected from in front and behind the weather louvre.

7.1.3 Tolerances

For any of the series of tests, the following shall be held constant within the tolerances given below.

Water supply rate (see fig C.4)	± 2 %
Water collection rate	± 10 %
Ventilation air flow rate	± 5 %
Wind velocity	± 10 %

7.1.4 Test intervals

Test values shall be noted at not more than 10 min intervals and the test period shall be complete when a minimum of four consecutive readings of values within the steady state tolerance have been noted. The minimum test period shall be 30 min.

NOTE Wind velocity will be measured only before and after testing.

7.1.5 Calibration plate test

The test of the calibration plate shall be implemented as follows:

a) Mount the calibration plate in the test position;

b) Mount the spray nozzles as illustrated on Figure C.2;

c) Adjust the ventilation air flow rate q_v to zero and set the wind velocity at 13 $m \cdot s^{-1}$;

d) Set up the rain pattern as described in 6.4;

e) Adjust the water supply rate q_s so that the penetration rate q_{do} lies between 75 $l \cdot h^{-1}$ per m^2 (+ 10 % - 0 %) of the calibration plate;

f) For the test period the following values shall be measured and recorded:-

1) the water supply rate	q_{so} in $l \cdot h^{-1}$
2) the water rejection rate	q_{uo} in $l \cdot h^{-1}$
3) the water penetration rate	q_{do} in $l \cdot h^{-1}$
4) volume flow rate through the calibration plate (except for no air flow test)	q_{vo} in $m^3 \cdot s^{-1}$
5) wind velocity (at the start and end of test period)	v_w in $m \cdot s^{-1}$

g) Adjust the volume flow rate of air q_v through the calibration plate to the next value in the test schedule as in 7.1.2 and repeat e) and f).

h) When tests have been made at all of the values of q_{vo} the test results shall be summarised and the water penetration rate corrected by calculation if the water supply rate has varied from the nominal value of q_{so}.

i) The nominal water supply rate, which will achieve the simulated rain penetration of 75 $mm^3.h^{-1}$ through the calibration plate shall be used in the louvre tests which can be at slightly different core velocities.
The values of $q_{s\ nom}$ at other core velocities should be estimated using graphical or computer curve fit routines provided that the estimated $q_{s\ corr}$ does not vary from test value $q_{s\ nom}$ achieved on the calibration plate tests by more than ± 2 %.

If individual values of $q_{s\ nom}$ vary from the curve fit by more than 2 % then more tests should be carried out on the calibration plate at suitable core velocity increments between the first test series velocities.

$q_{s\ corr}$ = $q_{s\ nom}$ adjusted to suit the test core velocity.'

The nominal water supply rate $q_{s\ nom}$ is the supply rate to the nozzles that will produce a penetration of 75 $l{\cdot}h^{-1}{\cdot}m^{-2}$ through the calibration plate at the test air flow rate.

$$q_{snom} = 75 \cdot q_{so} \cdot q_{do}^{-1} \cdot A$$

7.1.6 Weather louvre test

The test of the weather louvre shall be implemented as follows:

a) Install the weather louvre in the test opening, and for adjustable blade units set angle to manufacturers requirements;

b) Install the spray nozzles as illustrated on Figure C.2;

c) Adjust the volume flow rate of air q_v to zero and the wind speed to 13 $m{\cdot}s^{-1}$;

d) The rain pattern shall be as established during the testing of the calibration plate;

e) Adjust the water supply rate as close as possible to $q_{s\ nom}$ as established during the testing of the calibration plate;

f) During the test period the following values shall be measured and recorded:

1) the water supply rate	q_s in $l{\cdot}h^{-1}$
2) the water rejection rate	q_u in $l{\cdot}h^{-1}$
3) the water penetration rate	q_d in $l{\cdot}h^{-1}$
5) air flow rate through weather louvre (except for no air flow test)	q_v in $m^3{\cdot}s^{-1}$

g) Adjust the air flow rate q_v through the weather louvre to the next value in the test schedule and repeat e) and f).

NOTE Volume flow rates of air should be as established during calibration plate test to within ± 5 %

h) When tests have been made at all of the values of q_v, the test results shall be summarised and the penetration rate corrected by calculation if the water supply rate has varied from the nominal value of $q_{s\ nom}$.

The corrected water penetration rate $q_{d\ corr}$ is the water penetration rate that would be achieved if the water supply rate were to be equal to the corrected water supply rate.

$q_{s\ corr}$ at the test ventilation air flow rate.

$$q_{d\ corr} = q_{s\ corr}\, q_d\, q_s^{-1}$$

7.1.7 Test report

The test report shall include the following:

a) A graph of the test results of the rain penetration through the calibration plate by plotting the nominal water supply rate $q_{s\ nom}$ and the measured water penetration rate collected downstream with the calibration plate q_{do} against the core velocity v_c.

i.e. $q_{s\ nom}$ (vs) v_c and q_{do} (vs) v_c

b) A graph of the test results of the rain penetration through the weather louvre by plotting the nominal water supply rate $q_{s\ nom}$ and the corrected water penetration rate $q_{d\ corr}$ against the core velocity v_c .

i.e. $q_{s\ nom}$ (vs) v_c and $q_{d\ corr}$ (vs) v_c

c) A graph of the effectiveness of the weather louvre at different velocities by plotting the velocity calculated from $q_v.A^{-1}$ against the effectiveness ε calculated from.

$$\varepsilon = [75 \cdot A - q_{d\ corr}].\ 100\ [75 \cdot A]^{-1}$$

at each of the test air flow rates

d) For adjustable blade louvres repeat (b) and (c) above for each blade angle tested.

NOTE 75×A is the product of the required calibration plate water penetration rate (75 $l \cdot h^{-1} \cdot m^{-2}$) and the area of the hole in the calibration plate (A).

7.2 Discharge and entry loss coefficient/pressure loss

7.2.1 To derive the pressure loss and discharge or entry loss coefficient of the weather louvre, where appropriate for each blade angle, five different air flow rates q_v shall be measured at the air flow rate meter. The lowest flow rate in the range shall be such that it produces a pressure difference greater than 10 Pa, and the highest shall be 3,5 $m^3 \cdot s^{-1}$.

7.2.2 If there are significant differences in the air temperature and static pressure between the flow meter and the weather louvre under test so that the air density ratio $\rho_m \cdot \rho_1^{-1}$ is less than 0,98 or greater than 1,02, then the following correction shall be applied:

$$q_{v1} = \frac{q_v \cdot \rho_m}{\rho_1}$$

where $\rho_m = 3{,}47 \times 10^{-3}\ \{(p_{su} + p_a) \cdot (\theta_u + 273)^{-1}\}$

and $\rho_1 = 3{,}47 \times 10^{-3}\ \{(p_{s1} + p_a) \cdot (\theta_1 + 273)^{-1}\}$

Otherwise q_{v1} can be taken as equal to q_v

7.2.3 Having measured values of p_{s1} and also determined corresponding values of q_{v1} in accordance with 7.2.2, the function p_{s1} shall be plotted against $(q_{v1})^2$ on linear graph paper.

i.e. $p_{s1} = f\ (q_{v1})^2$

By graphical or calculation methods the best straight line through the plotted points and passing through zero shall be determined (see Figure C.7a). If isolated points fall outside the 5 % pressure difference band about the best mean line, repeat the tests at the relevant flow rates to check validity of test data.

If groups of points fall outside the ± 5 % band indicating the test results do not follow a linear relationship between q_{v1} and p_{s1} instead draw the best line (curve) through the points and zero (see Figure C.7b). If the p_{s1} points fall within ± 5 % of the line (curve) then the curve can be used for calculation in 7.2.4. If outside ± 5 % of the curve then only individual test points for p_{s1} can be used in 7.2.4 and the situation made clear in reporting the test results.

7.2.4 The discharge loss coefficient C_D shall be calculated for each ventilation air flow rate used in the test. This also applies to the entry loss coefficient C_E.

$$C_D = \frac{Actual \quad Flow}{Theoretical \quad Flow}$$

$$= q_{vn}.\{A\ (2.p_{sn}\ .\rho_{1n}{}^{-1})^{1/2}\}^{-1}$$

where ρ_{1n} = 1,2 or corrected density in accordance with 7.2.2, and Theoretical Flow is defined as the flow with a loss coefficient $\xi = 1$

8 Classification of weather louvres

8.1 General

Weather louvres shall be classified by their ability to reject simulated rain as specified in 8.2 and 8.3.

8.2 Penetration classification

Table 3 shows different classes based on the maximum simulated rain penetration per square metre of louvre. The effectiveness is determined in accordance with 7.1.7 c).

Water penetration rating at a given louvre face velocity is determined by the water penetration while the louvre is subjected to a 13 $m \cdot s^{-1}$ simulated wind velocity and a simulated rain fall at the nominal rate.

These classes apply at various core velocities.

Table 3 — Penetration classes

Class	Effectiveness ε	Maximum allowed penetration of simulated rain $l \cdot h^{-1} \cdot m^{-2}$
A	1 to 0,99	0,75
B	0,989 to 0,95	3,75
C	0,949 to 0,80	15,00
D	Below 0,8	Greater than 15,00

8.3 Discharge and Entry loss coefficient

The discharge loss coefficient C_D, given in Table 4, shall be determined in accordance with 7.2.4. This also applies to the entry loss coefficient C_E.

Table 4 — Discharge loss coefficient classification

Class	Discharge loss coefficient
1	0,4 to 1,0
2	0,3 to 0,399
3	0,2 to 0,299
4	0,199 and below
NOTE The above classes also apply to entry loss coefficient.	

8.4 Classification nomenclature

The water penetration class letter should precede the coefficient of discharge class letter followed by the limiting core velocity. A single louvre design can be classified at flow rates as follows:

A	2	up to	1 $m \cdot s^{-1}$
B	2	up to	2 $m \cdot s^{-1}$
C	2	up to	3 $m \cdot s^{-1}$

It should be stated if the classification is related to inlet or discharge operation.

The classification applies to a specific weather louvre design irrespective of size.

Annex A
(normative)

Simulated rain spray nozzles

The general arrangement for the simulated rain spray nozzles shall be as indicated in Figures C.2 and C.4.

The required overall effect is to cover the area of the louvre and calibration plate in a uniform manner.

In order to achieve a satisfactory trajectory, water flow rate and droplet size from the nozzles it is necessary to spray water from the nozzles in short bursts with only one of the 4 nozzles spraying at any instant.

This is achieved by connecting each nozzle array to an electrically or mechanically operated timer valve as shown in Figure C.4.

The total flow rate to the nozzle array shall be maintained constant and the water flow sufficient to ensure that the droplet size is significant.

The nozzles used shall be of the wide spray type featuring a solid cone-shaped spray pattern with a square impact area, and a spray angle of 93° to 115° with a capacity of 3,7 $l \cdot min^{-1}$ at 0,3 bar pressure.

Annex B
(normative)

Water eliminator performance test

B.1 General

The following installation and procedures shall be used to check the effectiveness of the water eliminators in the water collection duct as shown in Figures C.1 and C.3.

The test shall be carried out for the extremes of the louvre test conditions as follows:

simulated wind velocity = 13 $m \cdot s^{-1}$ ventilation rate = 3,5 $m^3 \cdot s^{-1}$

simulated wind velocity = 13 $m \cdot s^{-1}$ no ventilation rate

B.2 Installation

The nozzles shall be supplied with water by means of a pump drawing water from a small sump tank, and the sump tank shall have a sight glass for gauging the water content. The drain from the collection duct shall feed to the sump tank.

B.3 Procedure

The procedure for the water eliminator performance test is as follows:

a) install the array of spray nozzles in the collection duct;

b) fill the sump tank with water and start the pump and set the water flow rate to 75 $l \cdot h^{-1}$ (+ 10 % / 0 %);

c) allow sufficient time for the surfaces of the collection tank to become wetted (approximately one hour);

d) after the surfaces of the collection duct have been wetted, the sump tank shall be filled to a mark on the sight glass;

e) as the water level in the sump drops due to water loss, refill the tank with measured amounts;

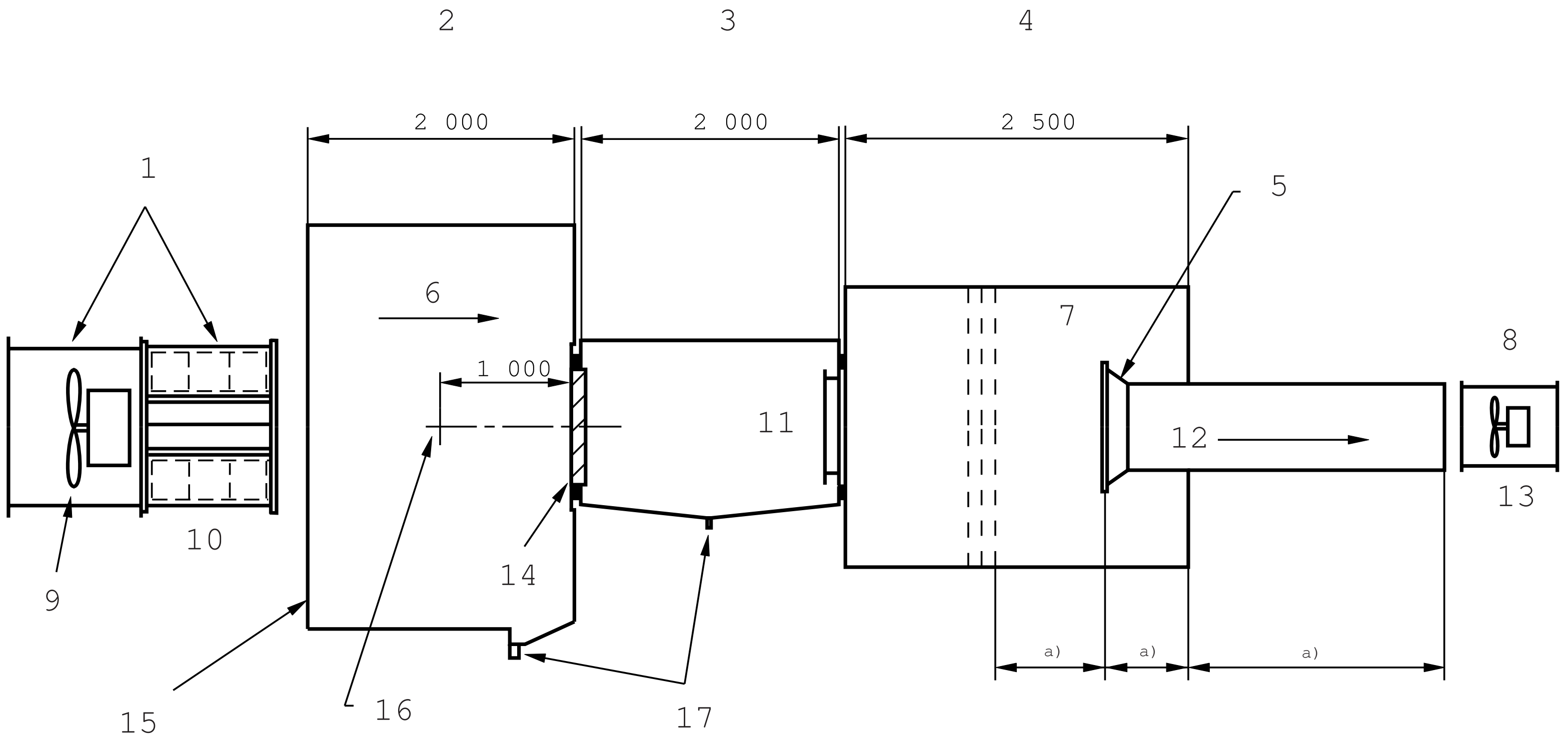
f) continue the test for a period of two hours;

g) calculate the total amount of water used to refill the tank.

The rate of water loss (the amount of water used to refill the tank) shall be less than 3 % of the hourly water flow rate through the nozzle.

Annex C
(normative)
Diagrams of apparatus and typical graphs

All dimensions in mm



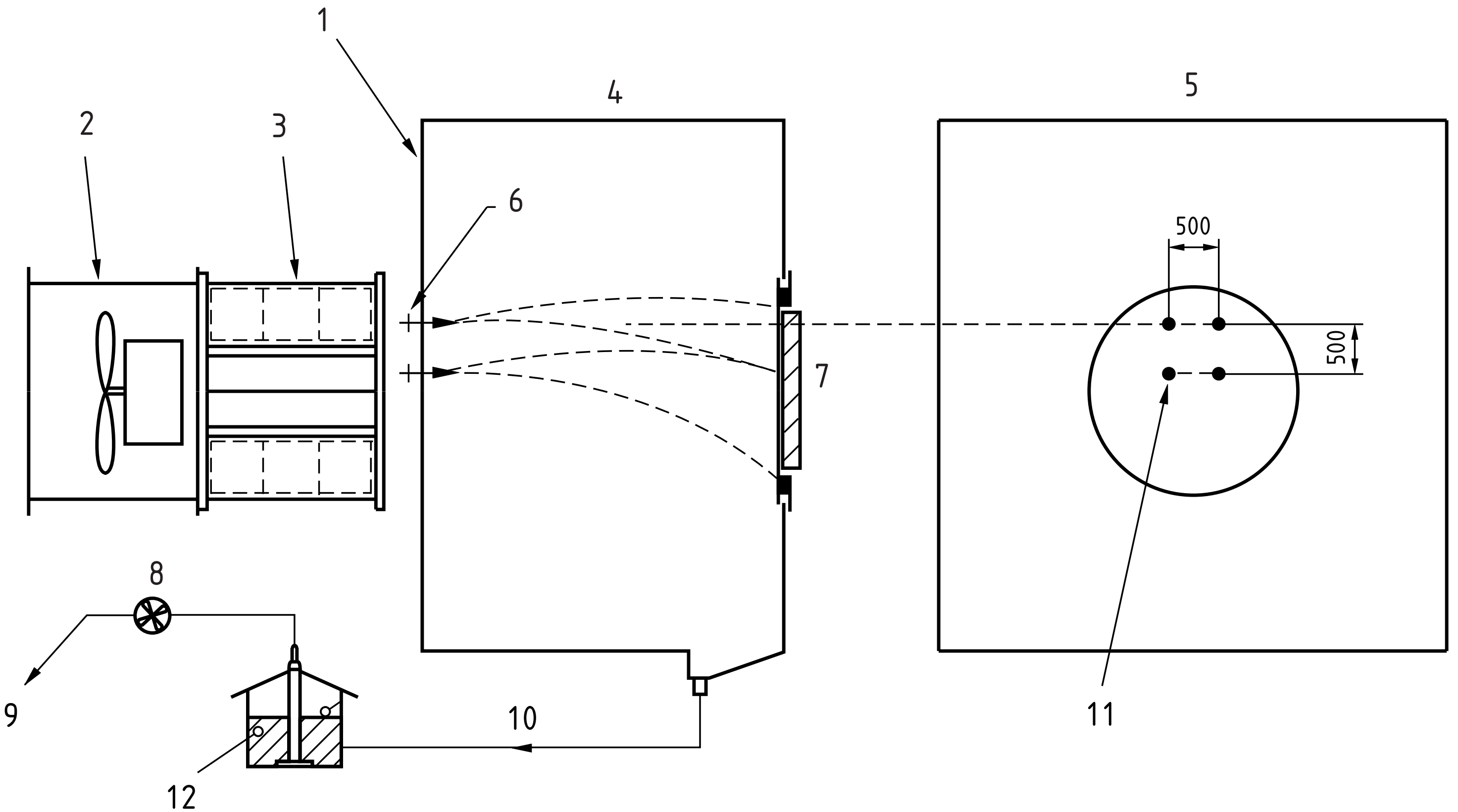
Key

1 Wind simulation equipment
2 Weather section 3 000 x 3 000 x 2 000
3 Collection duct 1 250 x 1 250 x 2 000
4 Aerodynamic measurement section
5 Inlet cone or alternative measuring station
6 Wind direction
7 Resistance screens
8 Mechanical ventilation section
9 Fan
10 Air straighteners
11 Water eliminator
12 Ventilation air
13 Ventilation fan
14 Louvre under test
15 Open face to weather section
16 Wind speed measuring device position
17 Drain connections

[a] Dimensions determined from ISO 5221

Figure C.1 — Aerodynamic weather louvre test apparatus

All dimensions in mm

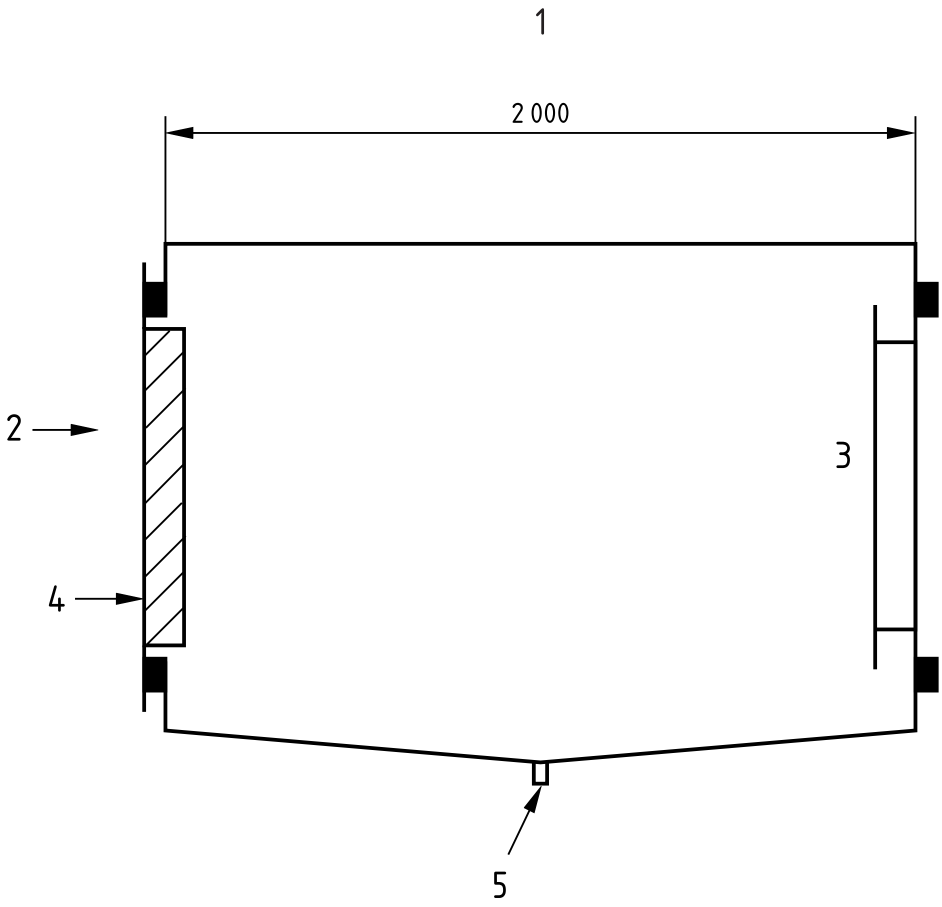


Key

1	Open face to weather section	7	Louvre under test
2	Wind simulation fan	8	Water flow turbine
3	Air straighteners	9	To drain
4	Weather section	10	Water rejected by louvre
5	Nozzle position for wind tests	11	Array to be adjusted to achieve penetration rate through the calibration plate
6	Rain simulation nozzles	12	Float level switches

Figure C.2 — Weather simulation section of louvre test apparatus

All dimensions in mm



Key

1 Collection duct size 1 250 x 1 250 x 2 000

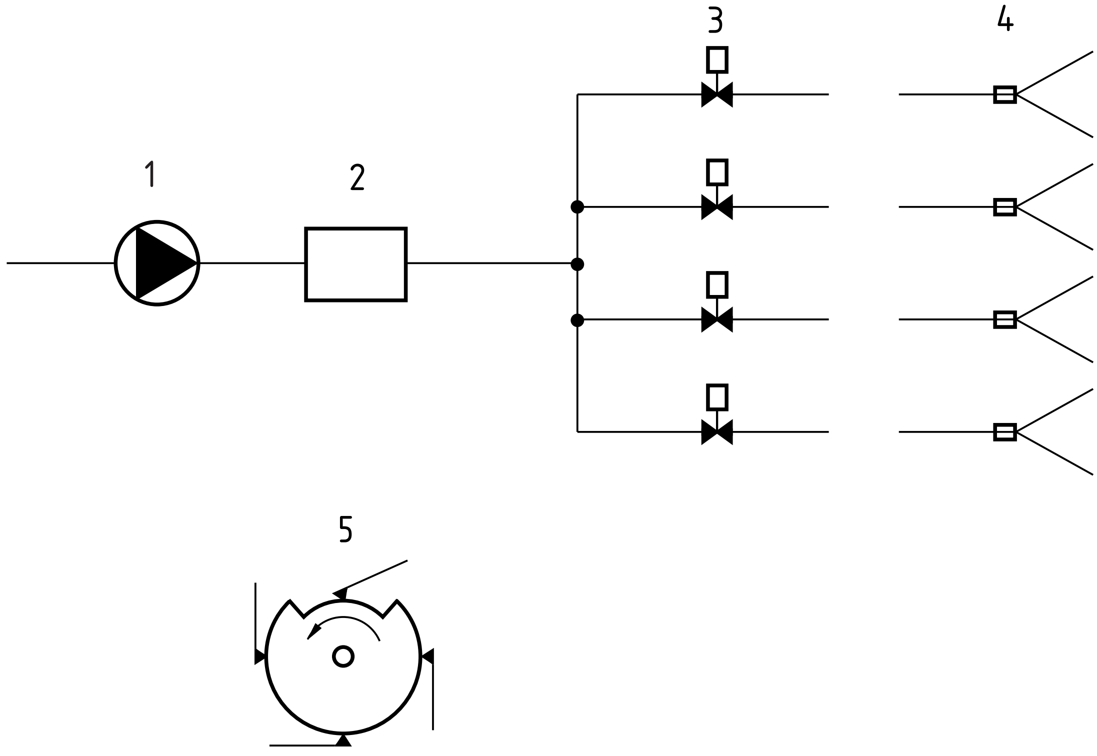
2 Wind direction

3 Water eliminator

4 Louvre under test

5 Drain connection

Figure C.3 — Detail of collection duct



Key

1 Pump

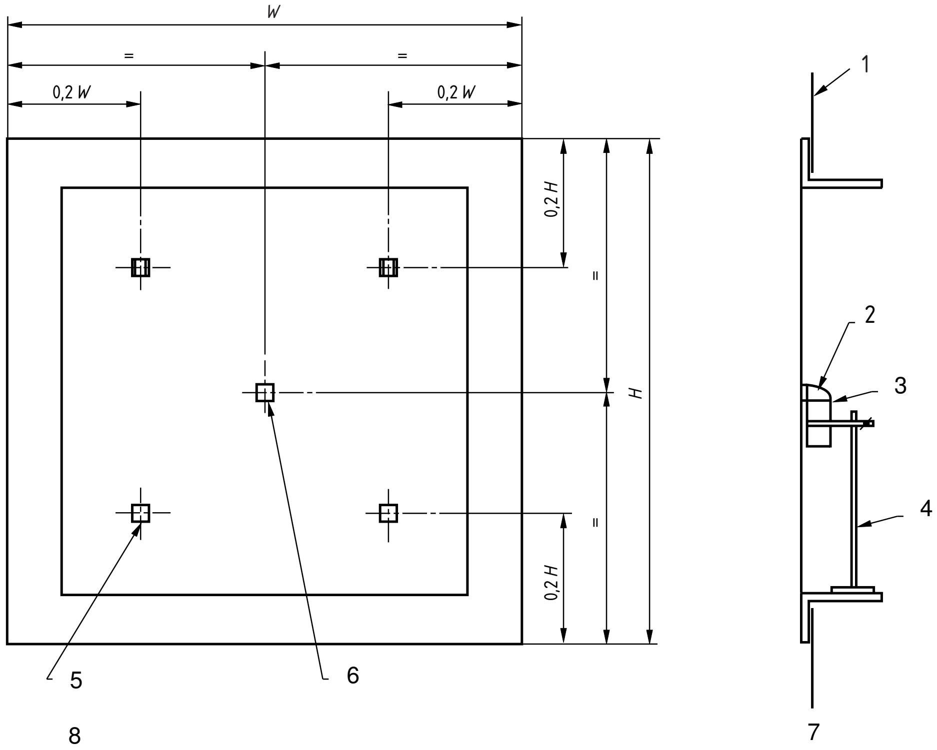
2 Flow meter

3 Solenoid valves

4 Nozzles

5 Rotary solenoid control switch

Figure C.4 – Schematic diagram of nozzle control system



Key

1 Rear wall of weather section

2 Elbow entry as rain gauge entry

3 Rain gauge position

4 Support for rain gauge

5 4 Peripheral readings to check coverage

6 Main rainfall reading taken at the centre of the calibration plate opening

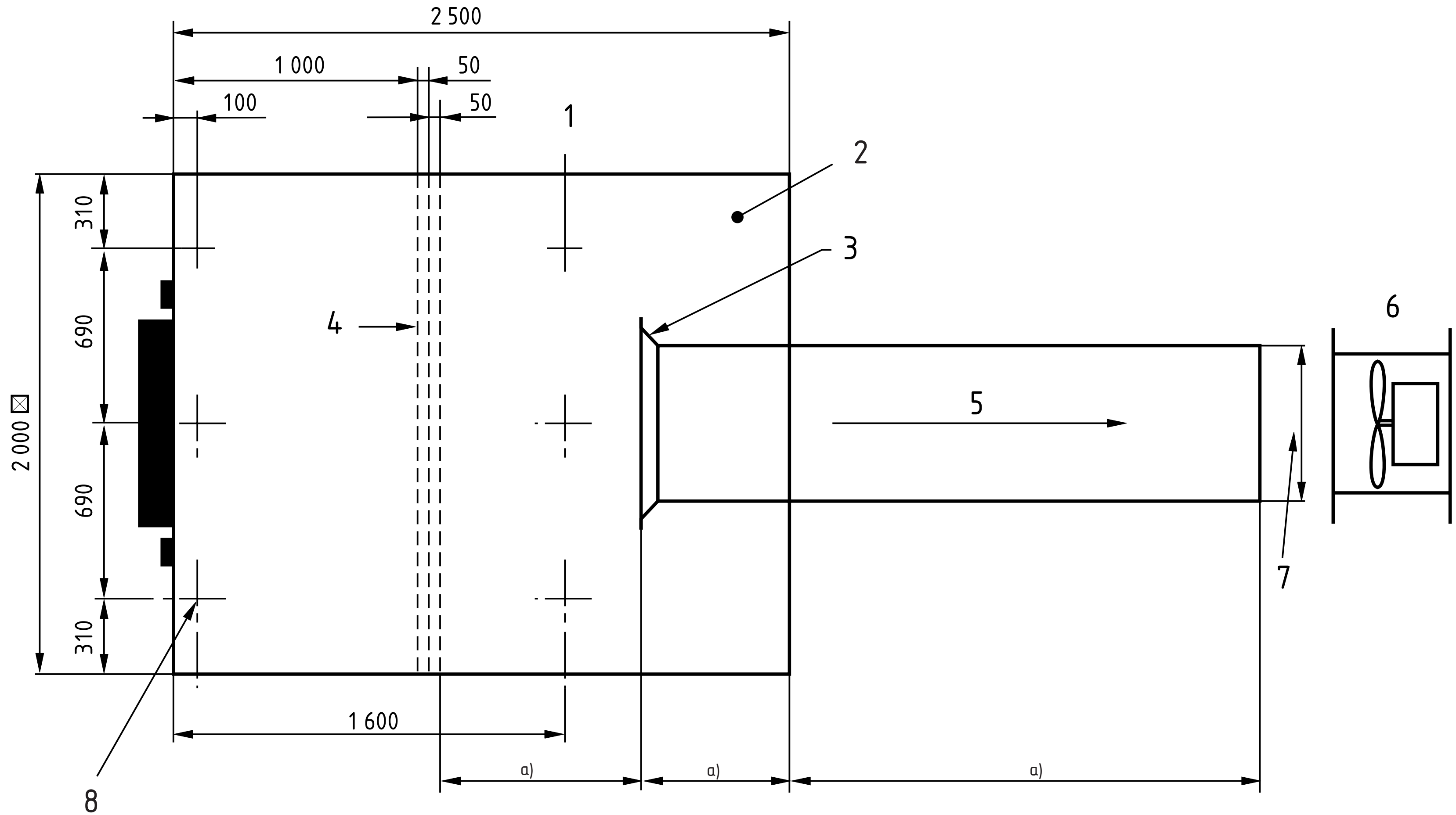
7 Section through calibration plate

8 Note Calibration of weather louvre core area

= $W \bullet H$

Figure C.5 — Core area and rainfall coverage

All dimensions in mm

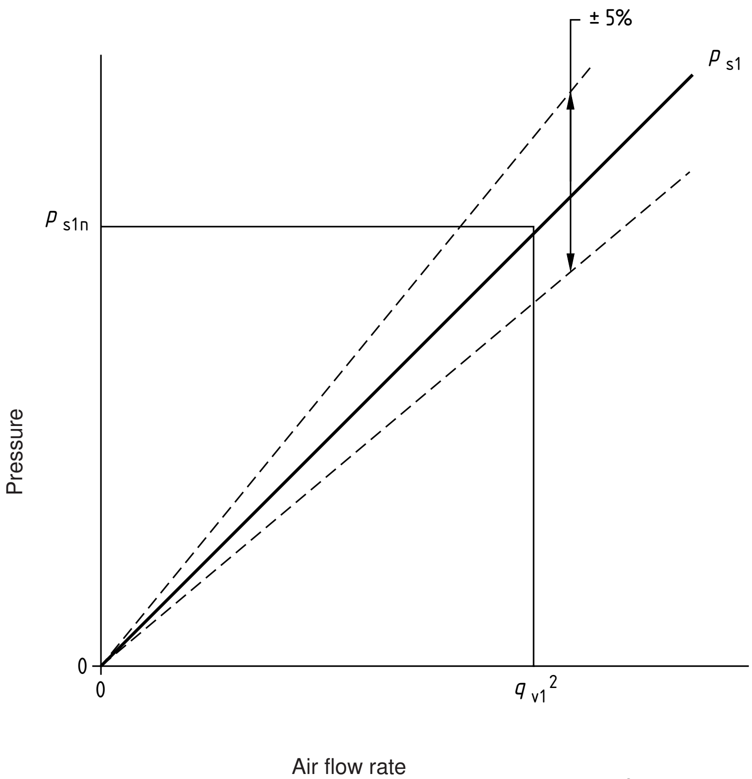


Key

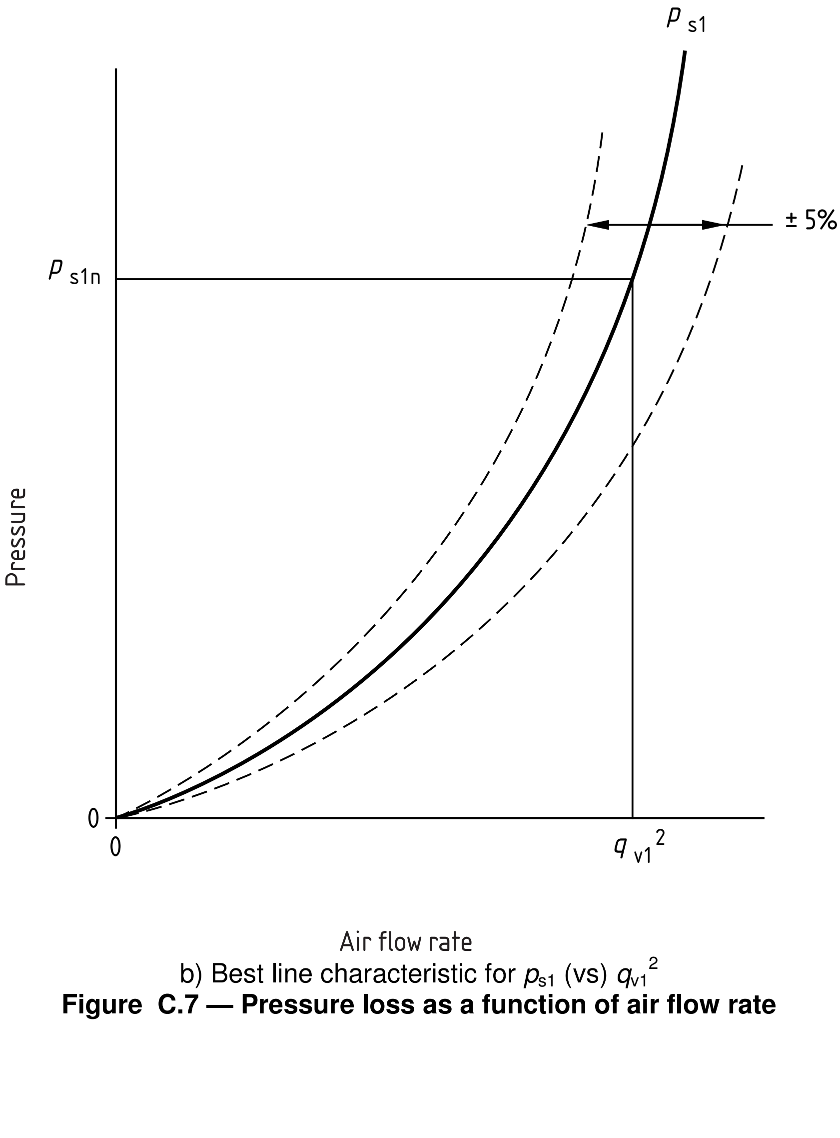
1 Plane A
2 Plenum chamber
3 Inlet cone or alternative measuring station
4 Resistance screens
5 Ventilation air
6 Ventilation fan
7 600 diameter
8 Pressure measuring points

a) Dimensions determined from ISO 5221

Figure C.6 – Aerodynamic measurement section



a) Straight line characteristic for p_{s1} (vs) q_{v1}^2



b) Best line characteristic for p_{s1} (vs) q_{v1}^2

Figure C.7 — Pressure loss as a function of air flow rate

Annex D
(informative)

Typical calculation examples

D.1 Test results

Tables D.1 and D.2 show in tabulation form typical test results and data derived from these results for a louvre having a core area of 0,893 m^2.

Table D.1 — Calibration plate test results

Air		Water				Curve fit	
Test flow rate	**Test core velocity**	**Test supply rate**	**Test penetration rate**	**Target penetration rate**	**Nominal supply rate**	**Calculated supply rate**	**Variance**
q_v	$v_c = q_v A^{-1}$	q_{so}	q_{do}	q_{dt}	$q_{s\ nom}$	$q_{s\ corr}$	
m^3·s^{-1}	m·s^{-1}	l·h^{-1}	l·h^{-1}	l·h^{-1}	l·h^{-1}	l·h^{-1}	%
0,00	0,00	74,00	67,15	66,97	73,81	73,83	-0,03
0,45	0,50	74,00	68,84	66,97	71,99	71,83	0,22
0,89	1,00	74,00	70,66	66,97	70,14	70,48	-0,48
1,38	1,55	74,00	70,96	66,97	69,84	69,56	0,41
1,79	2,00	74,00	71,78	66,97	68,05	69,12	-0,10
2,26	2,53	74,00	71,97	66,97	68,86	68,82	0,06
2,68	3,00	74,00	72,35	66,97	68,51	68,62	-0,16
3,08	3,45	74,00	72,43	66,97	68,42	68,37	0,07

Table D.2 — Weather louvre performance data

Air		Water supply		Water penetration		
Flow rate q_v $m^3 \cdot s^{-1}$	Core velocity $q_v A^{-1}$ $m \cdot s^{-1}$	Test rate q_s $l \cdot h^{-1}$	Calculated rate $q_{s\ nom}$ $l \cdot h^{-1}$	At test flow rate q_d $l \cdot h^{-1}$	At calculated rate $q_{d\ corr}$ $l \cdot h^{-1}$	Louvre effectiveness ε %
0,00	0,00	74,00	73,83	0,30	0,30	99,6
0,45	0,50	74,00	71,83	0,59	0,57	99,1
0,89	1,00	74,00	70,48	0,91	0,86	98,7
1,43	1,60	74,00	69,49	0,99	0,93	98,6
1,79	2,00	74,00	69,12	1,89	1,76	97,4
2,21	2,47	74,00	68,84	2,10	1,95	97,1
2,68	3,00	74,00	68,62	19,76	18,33	72,6
3,17	3,55	74,00	68,30	36,78	33,94	49,3

Table D.3 — Air flow test results and derived data

Pressure	Air flow		C_D	
Louvre pressure loss p_s Pa	Flow rate q_v $m^3 \cdot s^{-1}$	Flow rate squared q_v^2 $(m^3 \cdot s^{-1})^2$	Value	Variance from mean %
10	1,065	1,134	0,293	0,6
16	1,304	1,700	0,284	-2,6
25	1,688	2,849	0,294	0,9
36	2,000	4,000	0,290	-0,4
46	2,268	5,144	0,291	-0,1
56	2,507	6,285	0,292	0,1
67	2,726	7,431	0,290	-0,5
76	2,928	5,573	0,292	0,4
83	3,099	9,604	0,295	1,6
MEAN C_D = 0,291				

Typical example of test results showing the progression from tables to graphs as described in 7.1.7.

Table D.1 to Figure D.1.

Table D.2 to Figures D.2 and D.3

D.2 Entry loss coefficient of entry

Application of the procedure using typical results given in Table D.3 with test area A = 0,893 m^2 and ρ = 1,2 $kg{\cdot}m^{-3}$ is as follows:

1) Determine the best straight line between $q_{V1}{}^2$ and p_{S1};

2) At any actual air flow rate establish the corresponding differential pressure across the louvre p_S. (from graph - best fit line);

3) Using the formula detailed in 7.2.4;

$$C_E = \frac{\text{Actual flow}}{\text{Theoretical flow}}$$

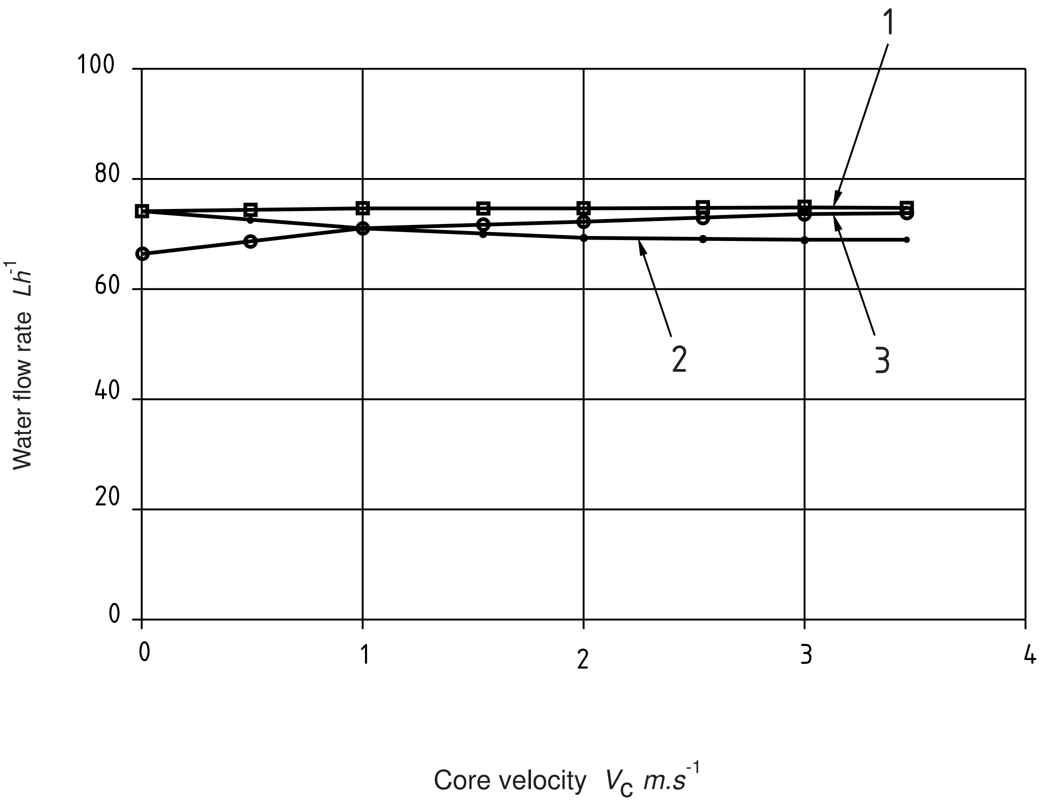
$$= q_{vn} \cdot \{(A\ (2 \cdot p_{sn} \cdot \rho\ 1n^{-1})^{½}\}^{-1}$$

For example, at the maximum flow rate of 3,099 $m^3{\cdot}s^{-1}$ and related pressure loss of 83 Pa, from Table D.3;

$$C_E = 3{,}099\ \{0{,}893\ (2 \times 83 \times 1{,}2^{-1})^{½}\}^{-1} = 3{,}099 \times 10{,}5^{-1}$$

$$= 0{,}295$$

By repeating this calculation for each of the flow rates in Table D.3, the mean value of 0,291 can be calculated and the variance from the mean C_E established (this variance should comply with the requirements of 7.2.3.2).



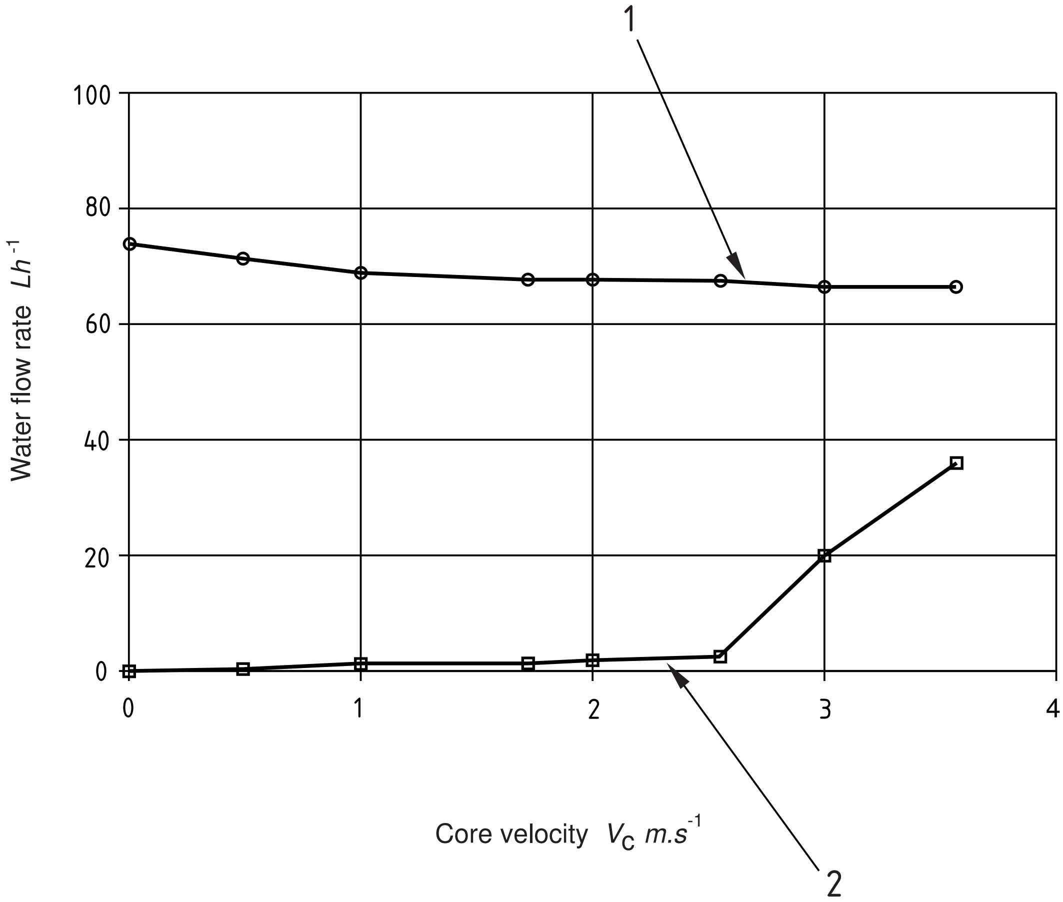
Key

1 Supply q_{so}

2 Corr. supply q_{snom}

3 Penetrated q_{do}

Figure D.1 — Rain penetration of calibration plate with simulated wind effect



Key

1 ——■—— Water penetrated q_{dcorr}

2 ——○—— Water supply q_{snom}

Figure D.2 — Rain penetration of louvre with simulated wind effect

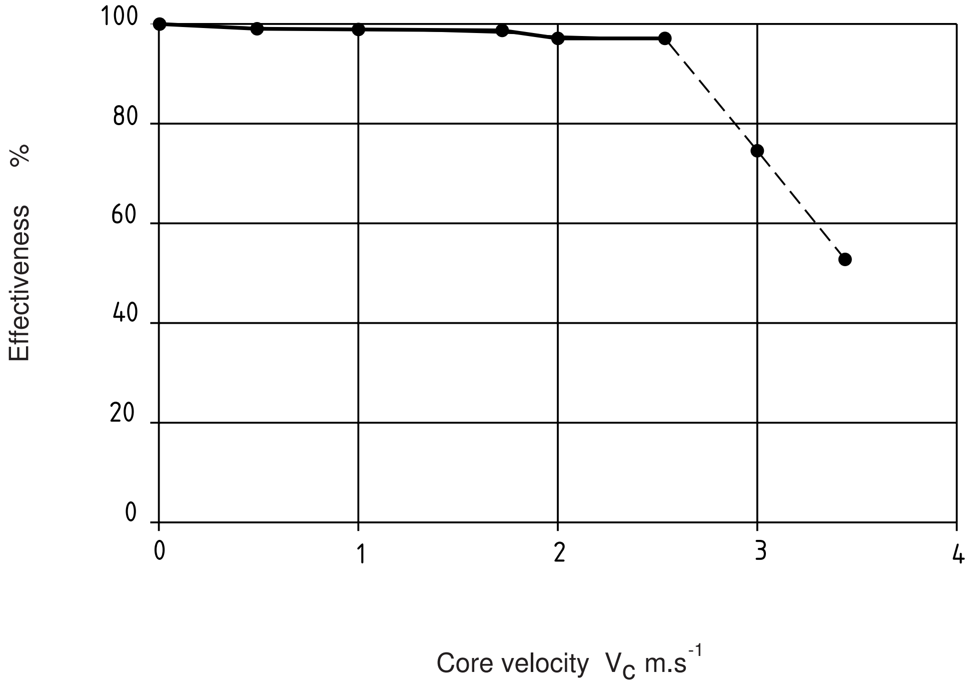


Figure D.3 — Effectiveness of louvre with simulated wind

D.3 Louvre effectiveness

An example of the calculation of louvre effectiveness using the data in Table D.4 is given below:

Table D.4 — Test data

Air flow rate $m^{-3} \cdot s^{-1}$ q_v	Core velocity $m \cdot s^{-1}$ $q_v . a^{-1}$	Test louvre penetration $l \cdot h^{-1}$ $q_{d\ corr}$
1,79	2,0	1,76

$$\text{Louvre effectiveness } \varepsilon = [75 \cdot A - q_{d\ corr}] \cdot 100 \cdot [75 \cdot A]^{-1}$$

$$= [75 \times 0,893 - 1,76] \times 100 \times [75 \times 0,893]^{-1}$$

$$= 97,4\ \%$$

D.4 Classification

Examples of classifications are given in Table D.5.

Table D.5 — Classification examples from typical results

Water penetration classification	Entry loss coefficient classification	Up to core velocity of $m \cdot s^{-1}$
A	3	0,5
B	3	2,5
B	3	2,8
D	3	3,5

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: 020 8996 9000. Fax: 020 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: 020 8996 9001. Fax: 020 8996 7001. 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: 020 8996 7111. Fax: 020 8996 7048.

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: 020 8996 7002. Fax: 020 8996 7001. 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