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

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

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

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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

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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of an identical text or by endorsement, at the latest by April 2002, and conflicting national standards shall be withdrawn at the latest by April 2002.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.