

Ventilation for buildings — Air terminal units — Aerodynamic testing and rating of constant and variable rate terminal units

The European Standard EN 12589:2001 has the status of a
British Standard

ICS 91.140.30

National foreword

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

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English version

Ventilation for buildings — Air terminal units — Aerodynamic testing and rating of constant and variable rate terminal units

Ventilation des bâtiments — Unités terminales — Essais
aérodynamiques et évaluation des unités terminales à débit
constant et variable

Lüftung von Gebäuden — Luftdurchlasseinheiten —
Aerodynamische Prüfung und Bewertung von
Luftdurchlasseinheiten mit konstantem und variablem
Luftvolumenstrom

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

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of an identical text or by endorsement, at the latest by March 2002, and conflicting national standards shall be withdrawn at the latest by March 2002.

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 methods for the aerodynamic testing and rating of constant and variable flow rate terminal units suitable for use with air distribution systems.

The terminal units considered are:

- single and dual duct;
- induction;
- fan assisted induction (parallel and series);
- single duct with integral diffuser.

The tests for each type of unit are summarized in Figure 1.

The tests in this standard are designed to determine fully the aerodynamic performance of terminal units and provide a basis for the comparison of the suitability of such assemblies when correctly installed in an air distribution system.

2 Normative references

This European Standard incorporated 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).

CR 12792, *Ventilation for buildings — Symbols, units and terminology*.

ISO 5167-1, *Measurement of fluid flow by means of pressure differential devices — Part 1: Orifice plates, nozzles and venturic tubes inserted in circular cross-section conduits running full*.

ISO 3966, *Measurement of fluid flow in closed conduits — Velocity area method using Pitot static tubes*.

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

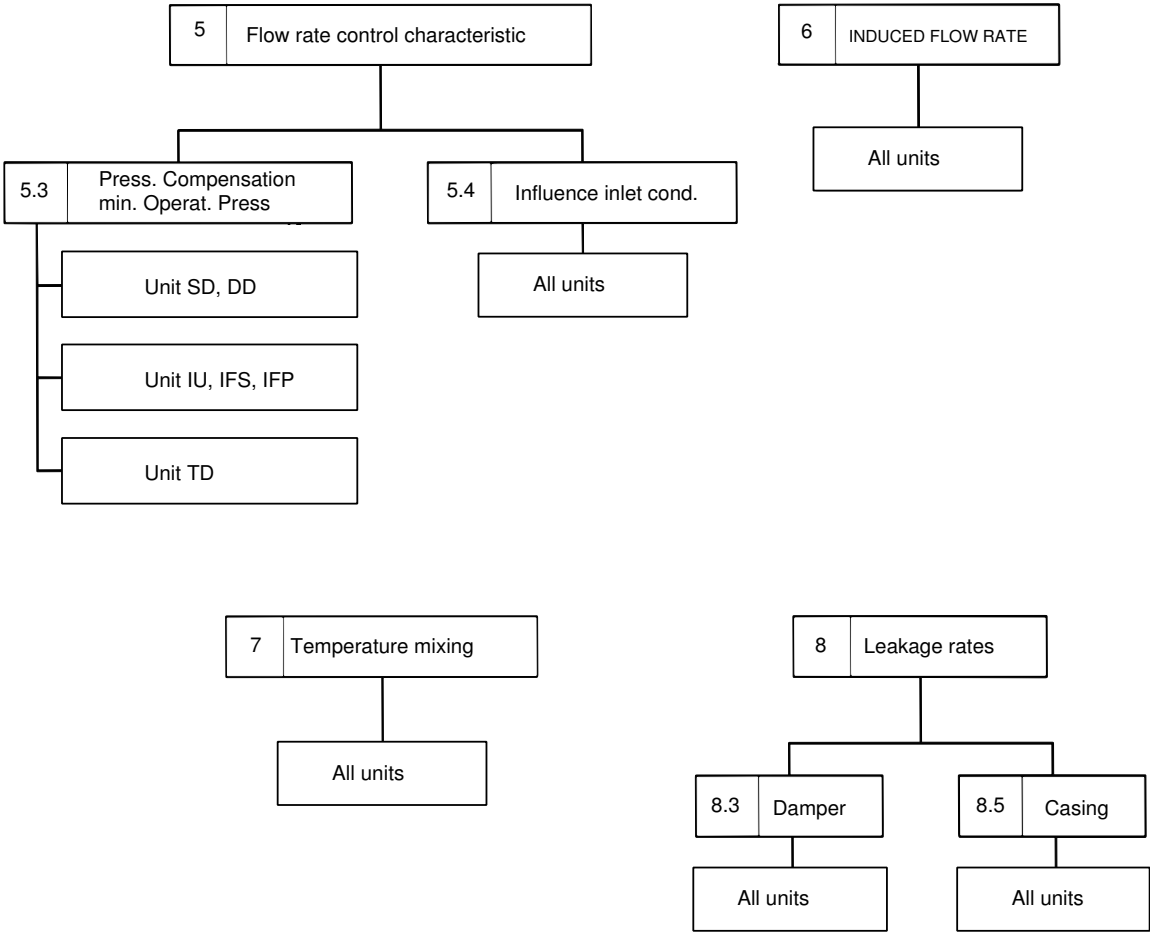
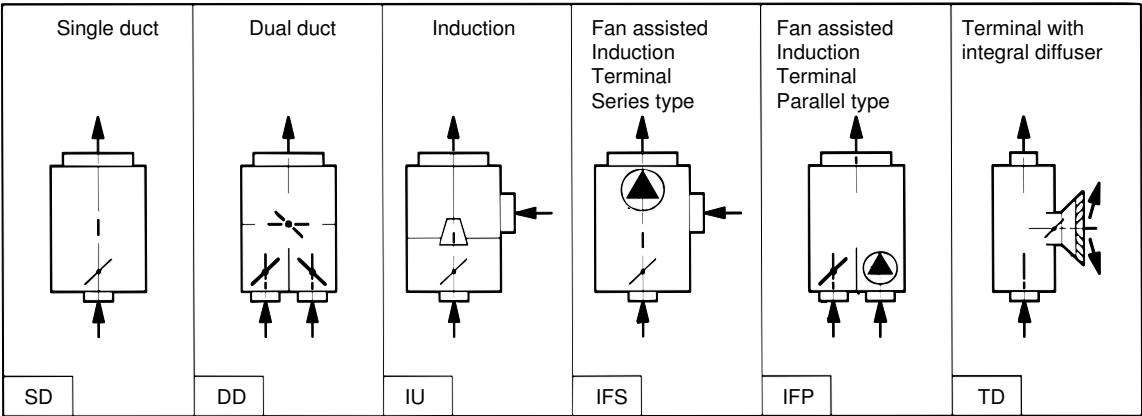


Figure 1 — Test units and test requirements

3 Terms, definitions and symbols

3.1 For the purposes of this standard, the terms and definitions given in CR 12792 apply.

3.2 The symbols and the suffixes used in this standard are shown in Tables 1 and 2 respectively.

Table 1 — Symbols used for testing air terminal units

Symbol	Quantity	Units
A_c	Internal cross-sectional area of duct	m^2
d_e	Equivalent diameter $\sqrt{4A_c/\pi}$	m
p	Absolute static pressure	Pa
p_a	Atmospheric pressure	Pa
p_d	Velocity pressure	Pa
p_r	Stagnation (or absolute total pressure)	Pa
p_s	Static gauge pressure ($p - p_a$)	Pa
p_t	Total pressure ($p_r - p_a$)	Pa
Δp	Flow meter pressure difference	Pa
Δp_t	Total pressure difference	Pa
q_v	Volume rate of air flow at the flow meter	$m^3.s^{-1}$ or $l.s^{-1}$
q_{vL}	Leakage volume rate of air flow	$m^3.s^{-1}$ or $l.s^{-1}$
Q_{vLBA}	Leakage volume rate of air flow across a valve per unit cross-sectional area	$m^3.s^{-1}.m^{-2}$ or $l.s^{-1}.m^{-2}$
Q_{vLCA}	Leakage volume rate of air flow through casing per unit cross-sectional area	$m^3.s^{-1}.m^{-2}$ or $l.s^{-1}.m^{-2}$
v	Velocity	$m.s^{-1}$
ρ	Air density	$kg.m^{-3}$
θ	Celsius temperature	°C
S	Position of valve or induction damper setting	% or α
n	Fan speed control setting	V or position

Table 2 — Suffixes used with the symbols in Table 1

0	recommended value (usually by the manufacturer)
1	inlet of the unit under test
2	outlet of the unit under test
3	induction port(s) of the unit under test
i	outlet air temperature
c	cold side of the unit under test
w	warm side of the unit under test
u	measuring point upstream of the flow meter
D	measuring point upstream of the discharge flow meter
sn	nett surface area of the unit under test
ca	casing of the unit under test
va	valve of the unit under test

4 Instrumentation

4.1 Air flow rate measurement

4.1.1 The air flow rate shall be measured using instruments in accordance with ISO 5167-1.

4.1.2 Air flow meters shall have the ranges and accuracies shown in Table 3.

Table 3 — Ranges and accuracies of air flow meters

Range $\text{m}^3 \cdot \text{s}^{-1}$	Measurement error %
$> 0,007 \leq 0,07$	± 5
$> 0,07 \leq 7,00$	$\pm 2,5$

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

4.1.3 Leakage air flow meters shall have the ranges and accuracies shown in Table 4.

Table 4 — Ranges and accuracies of leakage air flow meters

Range $\text{m}^3 \cdot \text{s}^{-1}$	Measurement error %
$\leq 0,018$	$0,9 \times 10^{-3} \text{ m}^3 \cdot \text{s}^{-1}$
$> 0,018$	$\pm 5 \%$

NOTE Alternatively, other devices such as variable-area, flow-rate meters or integrating air flow meters of the positive displacement type may be used if calibrated in accordance with 4.1.3.

4.1.4 Flow meters shall be checked at intervals, as appropriate, but not exceeding 12 months. This check may 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 in accordance with ISO 5221.

4.2 Pressure measurement

4.2.1 Pressure in the duct shall be measured by means of a liquid-filled calibrated manometer, or any other device conforming to 4.2.2.

4.2.2 The maximum scale or display interval shall not be greater than the characteristics listed for the accompanying range of manometers, shown in Table 5.

Table 5 — Maximum scale or display interval

Range Pa	Maximum scale interval Pa
≤ 25	1,0
> 25 to 250	2,5
> 250 to 500	5,0
> 500	25,0

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

- a) 25 Pa with an inclined tube manometer or micro-manometer;
- b) 500 Pa with a vertical tube manometer.

4.2.4 The calibration standards shall be:

- a) for instruments with the range up to 25 Pa, a micro-manometer accurate to $\pm 0,5$ Pa;
- b) for instruments with the range of 25 Pa to 500 Pa, a manometer accurate to $\pm 2,6$ Pa (hook gauge or micro-manometer);
- c) for instruments with the range of 500 Pa and upwards, a manometer accurate to ± 25 Pa (vertical manometer).

4.3 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 to an accuracy of $\pm 0,25$ K.

5 Tests for flow rate control characteristics

5.1 Principle

To determine the changes in primary air flow rate resulting either from variations in the pressure differential between the inlet duct(s) and the outlet duct(s) or chamber or upstream pressure whichever is appropriate.

Also, to determine the pressure differential between upstream and downstream of the terminal unit, and additionally the minimum pressure difference which is necessary to reach the performance of the terminal unit within the specified operating tolerances (minimum operating pressure difference).

5.2 Test measurements

The following parameters shall be measured during the tests:

- a) p_{s1} inlet duct static gauge pressure.
- b) p_{s2} static gauge pressure in the chamber into which the outlet duct discharges ($p_{s2} = 0$ if free outlet conditions are used).
- c) θ_1 air temperature at the inlet to the unit under test.
- d) Δp the flow meter pressure difference (or the appropriate parameter that relates to the air flow q_{v1}).
- e) p_{su} the static gauge pressure immediately upstream of the flow meter.
- f) θ_u the air temperature immediately upstream of the flow meter.
- g) p_a the atmospheric pressure at the beginning and end of the tests.

5.3 Pressure compensation and minimum operating pressure difference($\Delta p_{\min}$)

5.3.1 Units without induction SD, DD

NOTE This test is required for pressure independent units only.

5.3.1.1 Test installation

A typical test installation for type SD units is shown in Figure 2.

Performance of static pressure measurement device is described in annex A.

A typical test installation for type DD units is shown in Figure 3. All the test equipment described in clause 4 should be installed for both supply ducts. Discharge temperature measurement equipment should be installed if mixing efficiency is to be determined.

5.3.1.2 Test procedure

5.3.1.2.1 With the supply fan running, set the flow rate controller to its maximum setting. Increase the pressure differential between the inlet(s) and the outlet(s) to the manufacturers recommended maximum operating pressure differential and record the test measurements in accordance with 5.2.

5.3.1.2.2 Decrease the pressure differential in stages, approximately to the values given in Table 6 until the flow rate has reached a value equal to or less than 50 % of the value obtained in the pressure differential range where the flow rate is seen to be approximately constant. At each stage record the test measurements in accordance with 5.2.

When making the adjustments to pressure, if the pressure falls below the next prescribed value, increase it to the value at the start of the test, and then slowly decrease it to the specified value before a further measurement is taken.