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INTERNATIONAL STANDARD

NORME INTERNATIONALE

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A.C. ventilating fans and regulators for household and similar purposes – Methods for measuring performance

Aérateurs à courant alternatif et régulateurs pour applications domestiques et analogues – Méthodes de mesure de l'aptitude à la fonction

IEC 60665:2018-11(en-fr)

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A.C. VENTILATING FANS AND REGULATORS FOR HOUSEHOLD AND SIMILAR PURPOSES – METHODS FOR MEASURING PERFORMANCE

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International Standard IEC 60665 has been prepared by subcommittee 59L: Small household appliances, of IEC technical committee 59: Performance of household and similar electrical appliances

This second edition cancels and replaces the first edition published in 1980. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

a) the test chambers have been updated;
b) a test chamber for a type D fan is introduced.

The text of this International Standard is based on the following documents:

CDV	Report on voting
59L/139/CDV	59L/156A/RVC

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Full information on the voting for the approval of this International Standard can be found in the report on voting indicated in the above table.

This document has been drafted in accordance with the ISO/IEC Directives, Part 2.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under "http://webstore.iec.ch" in the data related to the specific document. At this date, the document will be

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A.C. VENTILATING FANS AND REGULATORS FOR HOUSEHOLD AND SIMILAR PURPOSES – METHODS FOR MEASURING PERFORMANCE

1 Scope

This document specifies the performance and the corresponding methods of test of AC ventilating fans for household and similar purposes intended for air forcing and exhaust, driven by single-phase AC motors having a power consumption of less than 125 W (including any associated regulators) for use on single-phase AC circuits not exceeding 250 V.

This document applies to ventilating fans such as partition fans for walls and windows and duct fans.

NOTE This document does not apply to:

– the safety of electric fans for household and similar purposes (IEC 60335-2- 80);
– the performance of comfort fans (IEC 60879);
– range hoods and other cooking fume extractors (IEC 61591);
– airborne acoustic noise for fans (IEC 60704-2-7);
– electromagnetic compatibility of fans (CISPR 14-1 and CISPR 14-2, IEC 61000-3-2, IEC 61000-3-3).

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 5801:2007, *Industrial fans – Performance testing using standardized airways*

3 Terms and definitions

For the purpose of this standard, the following terms and definitions apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at http://www.electropedia.org/
- ISO Online browsing platform: available at http://www.iso.org/obp

NOTE When the terms “voltage” and “current” are used, they imply root mean square (RMS). values unless otherwise specified.

3.1
fan
fan blades connected to and driven by an electric motor, including its associated speed regulator, if any

3.2
ventilating fan
fan intended to displace air either from one side of a partition to the other, or within a duct installed either on the fan inlet or on the fan outlet, or both

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3.3
partition ventilating fan
type A ventilating fan
ventilating fan installed in or upon the aperture of a partition in order to displace air from one side of the partition to the other side, both the sides being free spaces

3.4
free inlet partition ventilating fan
type B ventilating fan
ventilating fan with a direct inlet from free space and with ducted outlet

3.5
free outlet partition ventilating fan
type C ventilating fan
ventilating fan with ducted inlet, and with direct outlet to free space

3.6
fully ducted ventilating fan
type D ventilating fan
ventilating fan with ducted inlet and ducted outlet

3.7
fan inlet diameter
D_1
diameter of the circular opening through which the air first enters the fan casing

Note 1 to entry: If the fan is provided with an inlet connecting flange or spigot, the fan inlet diameter is measured inside this connection.

Note 2 to entry: If the opening through which the air first enters the fan casing is rectangular, the "fan inlet equivalent diameter D_1" is the diameter of a circle for which the inside area is the same as the area A_1 inside this rectangular opening. Thus:

$$D_1 = \sqrt{\frac{4A_1}{\pi}}$$

3.8
fan outlet diameter
D_2
diameter of the circular opening through which the air finally leaves the fan casing

Note 1 to entry: If the fan is provided with an outlet connecting flange or spigot, the fan outlet diameter is measured inside this connection.

Note 2 to entry: If the opening through which the air finally leaves the fan casing is rectangular, the "fan outlet equivalent diameter D_2" is the diameter of a circle for which the inside area is the same as the area A_2 inside this rectangular opening. Thus:

$$D_2 = \sqrt{\frac{4A_2}{\pi}}$$

3.9
air delivery
volume flow rate
quantity of air delivered measured in m^3/s under specified conditions

3.10
rated air delivery
air delivery assigned to the fan by the manufacturer

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3.11
rated voltage
voltage assigned to the fan by the manufacturer

3.12
rated frequency
frequency assigned to the fan by the manufacturer

3.13
fan pressure
air pressure difference produced between the air inlet and the air outlet of the ventilating fan

4 Bearings

Instructions for the proper lubrication of bearings shall be provided by the manufacturer.

5 Speed regulators

5.1 Regulators shall be capable of reducing the speed of the fan by at least

- 35 % of full speed in the case of fans with capacitor motors,
- 20 % of full speed in the case of fans with shaded pole motors,

at the voltage and frequency specified for the air delivery performance test.

5.2 The regulator shall have an "off" position preferably next to the lowest speed position and shall preferably be provided with five running positions.

5.3 The mechanism of the regulator shall be so designed as to ensure positive contact at each running position. In the case of induction type regulators, no portion of the induction winding shall remain permanently short-circuited in any of the running positions.

5.4 Positions of the regulator shall be distinctly and clearly marked and the indicator on the operating handle or knob shall correctly indicate the position of the regulator. If used, "0" shall correspond to the position "off" and the highest number to the highest speed operation, for example 0-1-2-3-4-5 or 0-I-II-III-IV-V.

6 Marking

Each fan shall be indelibly marked with at least the following information:

a) rated air delivery (volume flow rate in m^3/s);
b) rated voltage (in V);
c) rated power input (in W).

7 Tests

7.1 General

The tests specified in this document are type tests. The measurements of air pressure, temperature, input power, voltage and physical dimensions shall be carried out when the measurements of air delivery performance are carried out.

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7.2 Test voltage

7.2.1 The tests shall be conducted at the rated voltage.

7.2.2 If the fan is specified for two or more distinct rated voltages, the tests shall be carried out at the most unfavourable voltage.

7.2.3 When there is a voltage range, the test voltage shall be:

- the more unfavorable voltage of the highest and the lowest values of the range, when the difference between the highest and the lowest values is in excess of 10 % of the mean of the range;
- the mean of the upper and lower limits when the difference of the highest and the lowest values is 10 % or less of the mean of the range.

7.3 Test frequency

7.3.1 Fans shall be tested at rated frequency, if marked.

7.3.2 For AC fans that are not marked with a rated frequency or are marked with a rated frequency range of 50 Hz to 60 Hz, they are tested with either 50 Hz or 60 Hz, whichever is the more unfavorable.

7.4 Limits of voltage variation

The variation in the voltage shall not exceed ±1% of the test voltage during the air performance tests. While taking the current and power readings during these tests, however, the voltage shall be the test voltage.

7.5 Tests for air delivery performance

Air delivery performance is evaluated in accordance with the relevant clauses of ISO 5801:2007 using the test chambers and calculations as modified in Annex A of this document. The fan speed regulator, if any, shall be set to 100 % of full speed.

For Type A ventilating fans, the test chamber in Figure A.2 applies.

For Type B ventilating fans, the test chamber in Figure A.3 applies.

For Type C ventilating fans, the test chamber in Figure A.4 applies.

For Type D ventilating fans, the test chamber in Figure A.5 applies.

Before commencing the tests, the fan shall be operated for approximately 1 h while supplied at rated voltage.

8 Tolerances on fan ratings

8.1 Partition type ventilating fans (Type A)

The measured air delivery shall be at least 90 % of the rated air delivery.

8.2 Free inlet partition ventilating fans (Type B), free outlet partition ventilating fans (Type C) and fully ducted ventilating fans (Type D)

The measured air delivery shall be at least 95 % of the rated air delivery.

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Annex A
(normative)

Air delivery performance evaluation

For Type A ventilating fans, the test chamber in Figure A.2 applies.

For Type B ventilating fans, the test chamber in Figure A.3 applies.

For Type C ventilating fans, the test chamber in Figure A.4 applies.

For Type D ventilating fans, the test chamber in Figure A.5 applies.

The measurement of the average pressure in the airway is specified in Clause 7 of ISO 5801:2007 and the wall tapping used for insertion of the manometer tubes are detailed in Figure 2 of ISO 5801:2007.

The flow rate is determined using multiple nozzles as specified in Clause 22 of ISO 5801:2007. Multiple nozzles without throat tappings are used with length L = 0,6 d ± 0,005 d.

The mass flow rate in general is determined from the following equation:

$$q_{\mathrm{m}} = \frac{\varepsilon\pi}{4}\sum_{i=1}^{n}(\alpha_i d_i^2)\sqrt{2\rho_{\mathrm{a}}\Delta p}$$

where

n is the number of nozzles;

ε is expansibility factor assumed equal to 1 for domestic fans;

d_i is the nozzle diameter for the ith nozzle from Figure 16b of ISO 5801:2007, expressed in m;

Δp is the pressure differential across the nozzle (refer to Figure A.2, Figure A.3, Figure A.4 and Figure A.5 for the test setup for Type A, Type B, Type C and Type D ventilating fans respectively), expressed in Pa;

ρ_{a} is the air density upstream from the nozzles, expressed in kg/m^3;

α_i is the flow rate coefficient obtained from Table 4 of ISO 5801:2007 for the calculated value of Re_d for a given nozzle

The value of α_i can be obtained from the following equation for L / d = 0,6:

$$\alpha_i = \left[0{,}998\,6 - \frac{7{,}006}{\sqrt{\mathrm{Re}_d}} + \frac{134{,}6}{\mathrm{Re}_d}\right]\left[\frac{1}{\sqrt{1-\alpha_{Au}\beta^4}}\right] = \frac{C}{\sqrt{1-\alpha_{Au}\beta^4}}$$

where

α_{Au} is the kinetic energy coefficient upstream of the nozzle, equal to 1,043 for an in-duct nozzle and 1 for a nozzle and a multiple nozzle in chamber or a free-inlet nozzle;

β is d / D (which may be taken as 0 for a chamber) (β < 0,525 for an in-duct nozzle);

D is the **fan inlet diameter** (= D_1) or **fan outlet diameter** (= D_2)

C is the nozzle discharge coefficient;

Re_d is the Reynolds number based on the exit diameter, which may be estimated by the following equation:

$$\mathrm{Re}_d = 0{,}95\varepsilon d_i \frac{\sqrt{2\rho_{\mathrm{a}}\Delta p}}{17{,}1 + 0{,}048 t_{\mathrm{a}}} \times 10^6$$

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where

ρ_a is the air density upstream from the nozzle, expressed in kg/m^3;

t_a is the temperature upstream from the nozzle, expressed in °C;

d_i is the nozzle throat diameter for the ith nozzle, expressed in m;

ε is the expansibility factor assumed equal to 1 for domestic fans.

$$\rho_a = \frac{p_a - 0{,}378\, p_v}{287\left(t_a + 273{,}15\right)}$$

where

p_a is the ambient air pressure, expressed in Pa;

t_a is the dry bulb ambient air temperature, expressed in °C;

p_v is the partial pressure of water vapour in the air, expressed in Pa.

The value of p_v is given by

$$p_v = h_u\left(610{,}8 + 44{,}442 t_a + 1{,}413\,3 t_a^2 + 0{,}027\,68 t_a^3 + 2{,}556\,67 \times 10^{-4} t_a^4 + 2{,}891\,66 \times 10^{-6} t_a^5\right)$$

where h_u is the relative humidity

A plot of partial pressure of water vapour in the air against laboratory ambient temperature for different values of relative humidity is shown in Figure A.1.

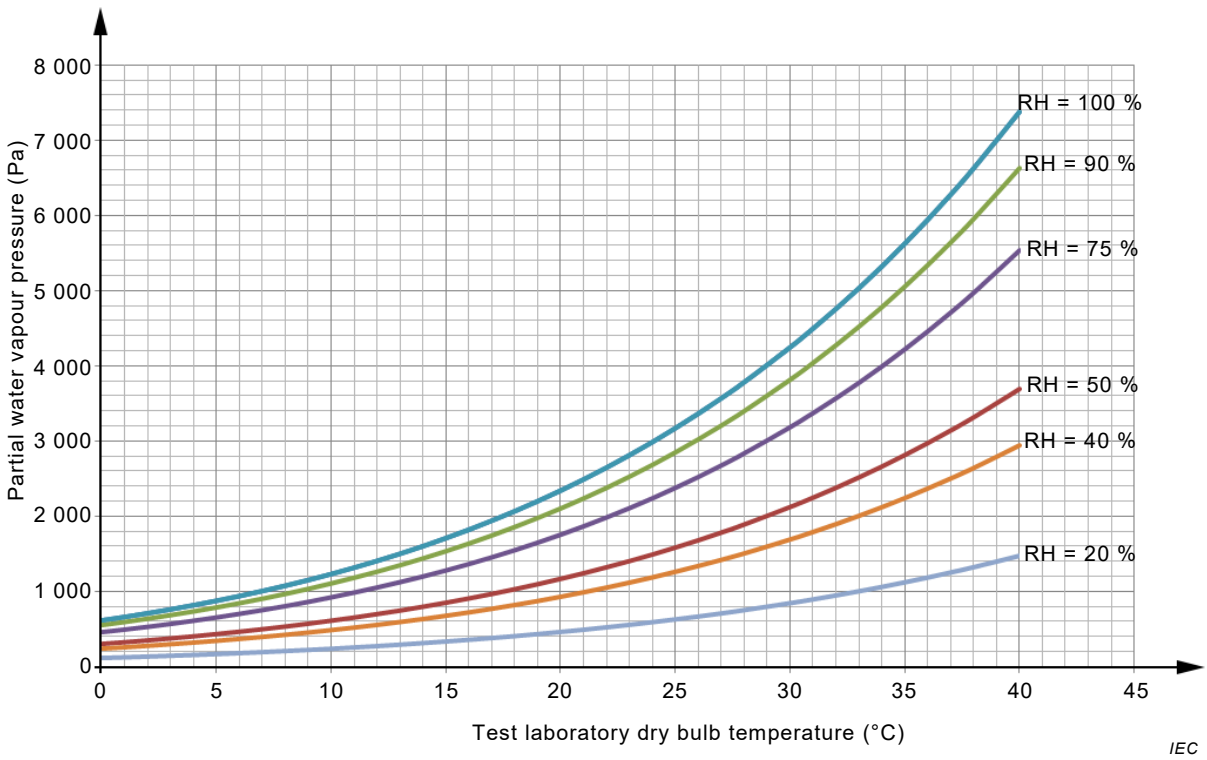

Figure A.1 – Plot of partial pressure of water vapour in the air against laboratory ambient temperature for different values of relative humidity (RH)

The reference test conditions are:

- RH < 90 % at 25 °C;

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