IEC 60879

Edition 2.0 2019-05

INTERNATIONAL STANDARD

NORME INTERNATIONALE

colour inside

Comfort fans and regulators for household and similar purposes – Methods for measuring performance

Ventilateurs de confort et régulateurs de vitesse pour applications domestiques et analogues – Méthodes de mesure de l'aptitude à la fonction

IEC 60879:2019-05(en-fr)

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INTERNATIONAL
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ICS 23.120

ISBN 978-2-8322-6957-2

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COMFORT FANS AND REGULATORS FOR HOUSEHOLD AND SIMILAR PURPOSES – METHODS FOR MEASURING PERFORMANCE

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International Standard IEC 60879 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 1986. This edition constitutes a technical revision.

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

a) the definitions of fans have been revised;
b) the test methods for the different types of fans have been revised to allow modern test instrumentation to be used;
c) acoustic noise measurement and standby power measurement methods have been introduced.

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

FDIS	Report on voting
59L/171/FDIS	59L/172/RVD

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.

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COMFORT FANS AND REGULATORS FOR HOUSEHOLD AND SIMILAR PURPOSES – METHODS FOR MEASURING PERFORMANCE

1 Scope

This International Standard specifies the performance-measuring methods of comfort fans and regulators for household and similar purposes, including conventional fans, tower fans and bladeless fans, their rated voltage being not more than 250 V for single-phase fans and 480 V for other fans, and their rated power input being less than 125 W.

NOTE 1 According to the testing method, the comfort fans are classified into two groups:

– pedestal fans, table fans, wall fans, louvre fans, tower fans, bladeless fans;
– ceiling fans.

Wherever applicable, the term "fan" used in this document includes its associated regulator, if any.

NOTE 2 This document does not apply to

– safety of electric fans for household and similar purposes (IEC 60335-2-80);
– performance of ventilating fans (IEC 60665);
– 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.

IEC 60704-2-7, *Household and similar electrical appliances – Test code for the determination of airborne acoustical noise – Part 2-7: Particular requirements for fans*

IEC 62301, *Household electrical appliances – Measurement of standby power*

3 Terms and definitions

For the purposes of this document, 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 term “voltage” is used, it implies an RMS value unless otherwise specified.

3.1
comfort fan
fan primarily designed for creating air movement around or on part of a human body for personal cooling comfort, including fans that can perform additional functionalities such as lighting

Note 1 to entry: A comfort fan is hereinafter also referred to by the term "fan".

3.2
conventional fan
comfort fan with a propeller having two or more blades, with free inlet and outlet of air

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3.3
tower fan
comfort fan for use on the floor having a vertically elongated design of the cross-flow type, tangential type, centrifugal type or impeller type with a free inlet and outlet of air

3.4
bladeless fan
comfort fan of any type that is not fitted with a propeller

3.5
ceiling fan
conventional fan provided with a device for suspension from the ceiling of a room so that the blades rotate in a horizontal plane with the diameter of the blade not larger than 1 800 mm

3.6
table fan
comfort fan intended for use on a table

Note 1 to entry: Table fans have a maximum adjustable or non-adjustable height of less than 1 200 mm.

3.7
pedestal fan
comfort fan mounted on a pedestal of fixed or variable height

Note 1 to entry: Pedestal fans have a minimum adjustable height or non-adjustable height equal to or greater than 1 200 mm.

3.8
wall bracket fan
comfort fan for mounting on the wall

3.9
ceiling bracket fan
comfort fan for mounting on the ceiling

3.10
louvre fan
comfort fan having moving louvre which provides a continuously changing multi-directional air flow

3.11
rated fan flow rate
air flow rate assigned to the fan by the manufacturer

Note 1 to entry: The rated fan flow rate is expressed in m^3/min.

3.12
service value
ratio of the calculated maximum fan flow rate [m^3/min] to the measured fan power input [W]

Note 1 to entry: The service value is also known as the "coefficient of performance (COP)".

3.13
fan power input
power input of the fan operating at its maximum flow rate, measured with the oscillation mechanism and the moving louvre, if any, turned off

Note 1 to entry: The power inputs for other functions, such as lighting are not included.

3.14
rated voltage
voltage assigned to the fan by the manufacturer

3.15
rated frequency
frequency assigned to the fan by the manufacturer

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3.16
maximum fan flow rate
air flow rate of the comfort fan at its maximum setting [m^3/min], measured at the fan outlet with the oscillating mechanism and the moving louvre, if any, turned off

3.17
oscillating mechanism
capability of the comfort fan to automatically vary the direction of the air flow while the fan is operating

3.18
fan sound power level
A-weighted sound power level of the comfort fan while providing the maximum fan flow rate, measured at the outlet side

3.19
moving louvre
grill provided at the air outlet of louvre fans, which is used to control the direction of the air flow by its rotation or position

3.20
equivalent sweep size diameter of bladeless fan
value obtained by dividing the perimeter of the bladeless fan air outlet by 3,14

Note 1 to entry: The perimeter is obtained by measuring the length of the rope that wraps along the complete enclosure of the bladeless fan's air outlet.

4 Information provision

Manufacturers shall provide the following information in the instructions:

a) rated fan flow rate m^3/min (rounded to one decimal place);

b) service value (m^3/min)/W (rounded to one decimal place);

c) standby power consumption W (rounded to one decimal place);

d) sound power level dB(A).

5 Tests

5.1 General conditions for testing

5.1.1 Atmospheric conditions

Unless otherwise specified, the test procedures and measurements shall be carried out under the following conditions:

– temperature: 20 °C ± 5°C, in case of doubt the temperature shall be 23 °C ± 2°C;

– relative humidity: 50 % ± 30 %;

– air pressure: 86 kPa to 106 kPa.

NOTE Temperature and humidity conditions within the specified ranges are required for good repeatability and reproducibility.

Care should be taken to avoid changes in temperature and relative humidity during the test.

5.1.2 Conditioning of test equipment

Measuring equipment to be used for the tests shall be stored for at least 16 h at the atmospheric conditions specified in 5.1.1 prior to the test.

5.1.3 Voltage and frequency

The tests shall be conducted at the rated voltage. Fans designed for DC only shall be operated at DC. Fans designed for both AC and DC shall be operated at AC. Fans not marked with rated frequency shall be operated at either 50 Hz ± 1 Hz or 60 Hz ± 1 Hz as is common in the country of use and with a total harmonic distortion ≤ 5 %.

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Unless otherwise specified, the tests are carried out at a specific test voltage within a voltage range (for example 100 V to 240 V) or at the rated voltage or rated voltages (for example 120 V or 120 V and 240 V).

The stability of the voltage shall be ± 1 %.

5.1.4 Running-in of the fan

Prior to starting the tests on a new fan, it shall run at its maximum airflow setting with unrestricted air flow and with the oscillating mechanisms and moving louvres, if any, in operation for at least 1 hour to ensure adequate running-in. Any other functions such as luminaires, purifiers, humidifiers, heaters, if any, shall be connected.

5.1.5 Operation of the fan

Before starting the tests, the fan and its attachments are adjusted in accordance with the manufacturer's instructions for normal operation. Any controls shall be set for maximum continuous air flow unless the manufacturer's instruction states otherwise. Any other functions such as luminaires, purifiers, humidifiers, heaters, if any, shall be turned off.

5.1.6 Conditioning prior to each test

Prior to starting each test, the fan shall be conditioned for 30 min under the provisions given in 5.1.4 but with oscillating mechanisms and moving louvres, if any, not in operation.

5.2 Testing of air performance

5.2.1 Ceiling fans

5.2.1.1 Test chamber

The fan shall be tested in a test chamber having the following dimensions: length 4 500 mm, width 4 500 mm, height 3 000 mm (see Figure 1 and Figure 2).

The above dimensions shall have a tolerance of ± 15 mm.

The top of the test chamber shall be covered by the clapboard, except for a centrally situated circular opening (top-opening), the diameter (D) of the top opening shall be between 1,1 and 1,2 times the blade's sweep. The top clapboard in which the top opening is located shall be not more than 6 mm thick. The bottom of the test chamber is 450 mm from the ground, to leave a suitable space for air outlet.

Readings shall be taken from a position between the chamber and the outer screen, and a small shelf for electrical instruments may be provided in this space. Except for these, the space between the test chamber and the outer screen and the space inside the test chamber shall be clear of all obstructions, and any conditioning apparatus (including heating or cooling) shall have no influence on the movement of air in the test room while the test is in progress.

The room in which the test chamber and the outer screen are erected shall be suitably protected against extraneous draughts.

Any ceiling external to the test chamber or any projecting beam which might interfere with the air flow shall be not less than 1 000 mm above the top opening, i.e. not less than 4 000 mm from the ground level at this point.

The distances between the walls of the chamber and the walls of the outer screen shall be 1 000 mm to 1 250 mm.

The fan shall be placed at such a height that the plane of the fan blades is 3 000 mm ± 10 mm from the ground level and lies in the plane of the top edge of the clapboard containing the top opening in the roof of the test chamber.

5.2.1.2 Measuring instrument

The air movement shall be measured by means of vane anemometers having an internal diameter not exceeding 100 mm.

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5.2.1.3 Arrangement of apparatus

The plane of the fan blades lies in the plane of the top edge of the clapboard containing the top opening in the roof of the test chamber.

A flat plate is installed above the ceiling fan, the size of which shall be between 1,1 and 1,2 times the blade diameter. The distance between the plate and the plane of the fan blades is determined by the distance between the plane of the fan blades and the ceiling after the ceiling fan has been installed in accordance with the instructions for use.

The plane of the anemometer's vane is parallel to the plane of the fan blades. The anemometers shall be moved in either direction along both diagonals of the test chamber in a test plane 1 500 mm ± 10 mm below the plane of the fan blades. The anemometers shall be supported in such a manner as to cause as little obstruction as possible to the air flow.

5.2.1.4 Procedure for test

The measurements shall be carried out with the fan running at full speed at the test voltage.

Air velocity measurements in each of four directions shall commence at a point 40 mm from the axis of the fan blades and shall progress horizontally to the fan blade axis in increments of 80 mm along the semi-diagonals of the test chamber (3 to A, 3 to B, 3 to AA and 3 to BB in Figure 2). The measurements shall be continued in the 80-mm increments until the air velocity in each of the four directions falls below 9 m/min.

The air velocity shall be averaged over a period of 60 s using an update rate of not less than 2 Hz.

The average air velocity through each annulus is taken as the mean of the 8 air velocities obtained at each anemometer position on the inner and outer radii of the annulus. The mean radius of each annulus is equal to the mean of the inner and outer radii of the annulus. Average air velocities below 9 m/min are discarded.

5.2.1.5 Calculation of flow rate

For each annulus having an average air velocity equal to or greater than 9 m/min, the product of the area of the annulus and the average air velocity through that annulus, shall be taken as the air delivery through that annulus.

The sum of the air deliveries through all such annuli shall be taken as the measured flow rate of the fan for the purposes of this document.

No correction is made for relative humidity or air pressure.

5.2.2 Comfort fans other than ceiling fans

5.2.2.1 Test chamber

The fan shall be tested in a test chamber having the following dimensions: length: 4 500 mm for the sweep size or the equivalent sweep size (for bladeless fans) not larger than 400 mm, and 6 000 mm for the sweep size or the equivalent sweep size (for bladeless fans) larger than 400 mm, width: 4 500 mm, height: 3 000 mm. The chamber shall be suitably protected from extraneous draughts.

The test chamber shall be free from obstructions other than the stand on which the fan is kept. Any table or shelf for electrical instruments shall be on the opposite side of the fan to the test plane, beyond a distance of 900 mm from the plane of fan blades for the fans other than tower fans and bladeless fans, or the plane of the air outlet for tower fans and bladeless fans.

NOTE For tower fans, the plane of the air outlet refers to the longitudinal cross-sectional plane, vertical to the central line. For bladeless fans, the plane of the air outlet refers to the outlet plane closer to the anemometers.

Any air conditioning apparatus used in the test room shall have no influence on the movement of the air in the test chamber while the test is in progress.

5.2.2.2 Arrangement of apparatus

The fan shall be located in the test chamber and arranged as follows:

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The distance from the geometrical centre of the fan blades or the air outlet to the floor shall be at least:

– 1 200 mm for the sweep size or the equivalent sweep size (for bladeless fans) not larger than 400 mm; or
– 1 500 mm for the sweep size or the equivalent sweep size (for bladeless fans) larger than 400 mm.

The distance to the back wall from the plane of the air outlet for tower fans and bladeless fans or the plane of the blade for fans other than tower fans and bladeless fans shall be at least 1 200 mm.

The distance from the plane of the air outlet for tower fans and bladeless fans or the plane of the blade for fans other than tower fans and bladeless fans to the front wall shall be at least:

– 1 800 mm for the sweep size or the equivalent sweep size (for bladeless fans) not larger than 400 mm; or
– 4 000 mm for the sweep size or the equivalent sweep size (for bladeless fans) larger than 400 mm.

The distance from the geometrical centre of the air outlet or of the blade to the side walls shall be at least 1 800 mm.

NOTE It is possible to make it central as long as it is larger than 1800 mm.

When the ceiling bracket fans and the wall bracket fans are tested, they shall be mounted on a vertical 1 000 mm × 1 000 mm flat wooden board with a thickness of 20 mm ± 1mm.

The plane of the vane anemometers is parallel to the plane of the air outlet for tower fans and bladeless fans or the plane of the blade for fans other than tower fans and bladeless fans. The distance between the two planes is 3 times the sweep size or the equivalent sweep size (for bladeless fans) with a tolerance of ± 15 mm.

For tower fans, the plane of the vane anemometers is parallel to the plane of the air outlet and the distance between the two planes is 1 200 mm ± 15 mm. The tower fan is then adjusted so that the air flow direction is perpendicular to the plane of the vane anemometer. See Annex C.

The anemometer shall be supported in such a manner as to offer as little obstruction as possible to the airflow.

5.2.2.3 Testing instrument

The air movement shall be measured by means of vane anemometers suitable for the range of velocities to be measured. At least 4 vane anemometers shall be used.

A greater number of anemometers may be used to reduce the time taken to map the airflow of the fan under test. Care should be taken to use an even number of anemometers.

– For conventional fans, a set of vane anemometers having an internal diameter not exceeding 100 mm shall be used;
– For bladeless fans and tower fans, an airflow auto test rig is used that:
  - consists of a set of vane anemometers not exceeding 40 mm of external diameter. The size of the anemometer shall enable it to be fitted in the space of 40 mm between two anemometers. Dimensions, measuring ranges and accuracies for some vane anemometers are given in Annex B;
  - is capable of holding vane anemometers in a horizontal line or a vertical line at a spacing of 40 mm;
  - is maneuverable in the Z-axis (manually or automatically) to an accuracy of ± 2 mm;
  - is remotely controllable to move in the X-axis and Y-axis to an accuracy of ± 1 mm.

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NOTE The size of the fan under test will determine the number of measurements required to capture the total airflow distribution. Before commencing a test, the airflow distribution can be checked in order to determine that the distribution fits within the limits of the adjustment of the test rig in both Y-axis and X-axis. For instance, if the test rig can be adjusted from −500 mm to +500 mm in the X-axis and Y-axis, a fan creating a distribution of 540 mm or above will not be suitable for the rig and a larger rig will be required. Conducting measurements at the extremes of the rig to ensure the airflow is below 24 m/min will identify whether the rig has a suitable amount of adjustment before the test commences.

5.2.2.4 Procedure for test for conventional fans

The measurements shall be carried out with the fan running at full speed at the test voltage, with the guard, if normally provided, in position, and with the oscillating mechanism, if any, disconnected. For the louvre fan, the moving louvre is removed.

Anemometer vanes shall be moved both horizontally and vertically with respect to the fan blades' horizontal axis, the movement being at right angles to this axis and extendable in both directions. The axis of the anemometer vanes shall always be parallel to the fan blades' horizontal axis. An example of positioning of 4 anemometers in horizontal and vertical directions is given in Annex A.

Air velocity measurements in each of four directions shall commence at a point 20 mm from the axis of the fan blades and shall progress horizontally and vertically to the fan blade axis in increments of 40 mm. The measurements shall continue in the 40 mm increments until the average air velocity in each of the four directions falls below 24 m/min.

The average air velocity shall be the average of the measurements over a period of 60 s using an update rate of not less than 2 Hz. The axis of the fan blades shall be horizontal during the test.

The average air velocity through each annulus is the mean of the 8 air velocities obtained at each anemometer position taken horizontally and vertically at each of the inner and outer radii of the annulus. The mean radius of each annulus is equal to the mean of the inner and outer radii of the annulus. Average air velocities below 24 m/min are discarded.

NOTE For conventional fans it is possible to use the test method for bladeless fans and tower fans as specified in 5.2.2.6, but it is more time consuming.

5.2.2.5 Calculation of flow rate for conventional fans

For each annulus having an average air velocity equal to or greater than 24 m/min, the product of the area of the annulus and the average air velocity through that annulus, shall be taken as the total air delivery through that annulus.

The sum of the air deliveries through all such annuli shall be taken as the measured fan flow rate of the fan for the purposes of this document.

No correction is made for relative humidity or air pressure.

5.2.2.6 Procedure for test for bladeless fans and tower fans

The measurements shall be carried out with the fan running at the highest settings at the test voltage, with the guard, if normally provided, in position, and with the oscillating mechanism, if any, disconnected.

The measurements shall be taken by moving the arm of the airflow test rig supporting the anemometers as follows:

– along the X-axis if the anemometers are arranged along the Y-axis;

– along the Y-axis if the anemometers are arranged along the X-axis.

For anemometers arranged along the X-axis, the arm of the anemometer airflow test rig is placed at the mid-height of the air outlet of the fan.

For anemometers arranged along the Y-axis, the arm of the anemometer airflow test rig is placed at the mid-width of the air outlet of the fan.

Where the anemometers are arranged along the X-axis, the test rig is moved up along the Y-axis at increments of 40 mm until the measurements at all anemometer positions do not

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exceed 24 m/min. The anemometer airflow test rig is then returned to its starting position and is then moved down along the Y-axis at increments of 40 mm until the measurements at all anemometer positions do not exceed 24 m/min.

Where the anemometers are arranged along the Y-axis, the test rig is moved to the left along the X-axis at increments of 40 mm until the measurements at all anemometer positions do not exceed 24 m/min. The anemometer airflow test rig is then returned to its starting position and is then moved to the right along the X-axis at increments of 40 mm until the measurements at all anemometer positions do not exceed 24 m/min.

The measurements at each position are taken approximately 1 min after positioning the anemometers.

The measurement from each anemometer shall be averaged over a period of 60 s using an update rate of not less than 2 Hz.

5.2.2.7 Calculation of flow rate for bladeless fans and tower fans

The total fan flow rate shall be calculated by assuming that each measurement point is indicative of the air velocity through a square of 40mm × 40mm centred about that point (see Figure 3). Therefore, the flow rate can be calculated by multiplying the measured air velocity by the area, A, of each square (see Figure 3).

The area A of each square = 40 mm × 40 mm = 1 600 mm^2 = 0,001 6 m^2

If each of the air velocity measurements in m/min is U_i and the number of the squares with a air velocity measurement above 24 m/min is N, then the total air flow rate of the fan will equal the sum of all individual air flow rates through each square as given by:

$$\text{Total flow rate of the fan in m}^3\text{/min} = \sum_{i=1}^{N}(0{,}001\,6\ U_i)$$

5.3 Measurement of regulator performance

5.3.1 Measurement of the regulation ratio for comfort fans other than bladeless fans

The regulators of comfort fans other than bladeless fans shall be capable of reducing the speed of the fan, expressed in r/min. The regulation ratio is measured as follows. The fan is supplied at the rated voltage and at the rated frequency. The oscillating mechanism, if any, is disconnected. The regulator is set at the highest speed position and the speed of rotation is measured. Then the regulator is set at the lowest speed position and the speed of rotation is measured. The regulation ratio is the measured speed at the lowest setting divided by the measured speed at the highest setting.

5.3.2 Measurement of the regulation ratio for bladeless fans

Bladeless fans regulators shall be capable of reducing the air velocity. The regulation ratio is measured as follows. The fan is supplied at the rated voltage and at the rated frequency. The oscillating mechanism, if any, is disconnected. The regulator is set at the highest air velocity position and the air velocity is measured. Then the regulator is set at the lowest air velocity position and the air velocity is measured. The regulation ratio is the measured air velocity at the lowest setting divided by the measured air velocity at the highest setting.

5.4 Measurement of fan power input

The fan power input is measured with the fan connected to the supply at the test voltage and, for AC fans, at the test frequency. Capacitors, if any, associated with the fan shall be retained in the circuit. The regulator, if provided, shall be set at its maximum setting and the oscillating mechanism and the moving louvre, if any, shall be inoperative. Luminaires, if any, shall be disconnected.

5.5 Measurement of sound power level

IEC 60704-2-7 applies.

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