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Fans — Vocabulary and definitions of categories

Ventilateurs — Vocabulaire et définitions des catégories

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Foreword

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International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 13349 was prepared by Technical Committee ISO/TC 117, *Fans*.

This second edition cancels and replaces the first edition (ISO 13349:1999), which has been technically revised.

Introduction

This International Standard reflects the importance of a standardized approach to the terminology of fans.

The need for an International Standard has been evident for some considerable time. To take just one example, the coding of driving arrangements differs from manufacturer to manufacturer. What one currently calls arrangement no. 1 can be known by another as arrangement no. 3. The confusion for the customer is only too apparent. For similar reasons, it is essential to use standardized nomenclature to identify particular parts of a fan.

Wherever possible, in the interests of international comprehension, this International Standard is in agreement with similar documents produced by Eurovent, AMCA, VDMA (Germany), AFNOR (France) and UNI (Italy). They have, however, been built on where the need for amplification was apparent.

Use of this International Standard will lead to greater understanding among all parts of the air-moving industry. This International Standard is intended for use by manufacturers, consultants and contractors.

Fans — Vocabulary and definitions of categories

1 Scope

This International Standard defines terms and categories in the field of fans used for all purposes.

It is not applicable to electrical safety.

2 Normative references

The following referenced documents are indispensable for the application 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 5167-1, *Measurement of fluid flow by means of pressure differential devices inserted in circular cross-section conduits running full — Part 1: General principles and requirements*

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

ISO 5802:2001, *Industrial fans — Performance testing in situ*

ISO 13351, *Fans — Dimensions*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 5167-1 and ISO 5801 and the following apply

3.1 Fans

3.1.1
fan
rotary-bladed machine that receives mechanical energy and utilizes it by means of one or more impellers fitted with blades to maintain a continuous flow of air or other gas passing through it and whose work per unit mass does not normally exceed 25 kJ/kg

NOTE 1 The term “fan" is taken to mean the fan as supplied, without any addition to the inlet or outlet, except where such addition is specified.

NOTE 2 Fans are defined according to their installation category, function, fluid path and operating conditions.

NOTE 3 If the work per unit mass exceeds a value of 25 kJ/kg, the machine is termed a turbocompressor. This means that, for a mean stagnation density through the fan of 1,2 kg/m^3, the fan pressure does not exceed $1{,}2 \times 25$ kJ/kg, i.e. 30 kPa, and the pressure ratio does not exceed 1,30 since atmospheric pressure is approximately 100 kPa.

3.1.2
bare shaft fan
fan without drives, attachments or apperturbances

See ISO 12759.

3.1.3
driven fan
impeller fitted to or connected to a motor, with or without a drive mechanism, a housing or a means of variable speed drive

See ISO 12759.

3.2
air
abbreviated term for the expression “air or other gas”

3.3
standard air
by convention, air with a density of 1,2 kg/m^3

3.4 Fan installation categories according to the arrangement of ducting

See Figure 1.

3.4.1
installation category A
installation with free inlet and free outlet with a partition

See ISO 5801 and ISO 5802.

3.4.2
installation category B
installation with free inlet and ducted outlet

See ISO 5801 and ISO 5802.

3.4.3
installation category C
installation with ducted inlet and free outlet

See ISO 5801 and ISO 5802.

3.4.4
installation category D
installation with ducted inlet and ducted outlet

See ISO 5801 and ISO 5802.

3.4.5
installation category E
installation with free inlet and free outlet without a partition

3.5 Types of fan according to their function

3.5.1
ducted fan
fan used for moving air within a duct

NOTE This fan can be arranged in installation category B, C or D (see Figures 2, 3, 4 and 5).

3.5.2
partition fan
fan used for moving air from one free space to another, separated from the first by a partition having an aperture in which or on which the fan is installed

NOTE This fan can be arranged in installation category A (see Figure 6).

3.5.3
jet fan
fan used for producing a jet of air in a space and unconnected to any ducting

See Figure 7.

NOTE The air jet can be used, for example, for adding momentum to the air within a duct, a tunnel or other space, or for intensifying the heat transfer in a determined zone.

3.5.4
circulating fan
fan used for moving air within a space which is unconnected to any ducting and is usually without a housing

See Figure 8.

3.5.5
air curtain unit
air moving device which produces an air curtain

See Figure 30.

3.5.5.1
air curtain
airstream
directionally controlled airstream, moving across the entire height and width of an opening, which can reduce the infiltration or transfer of air from one side of the opening to the other, and inhibits insects, dust or debris from passing through

3.6 Types of fan according to the fluid path within the impeller

3.6.1
centrifugal fan
fan in which the air enters the impeller with an essentially axial direction and leaves it in a direction perpendicular to this axis

See Figure 2.

NOTE 1 The centrifugal fan is also known as a radial-flow fan.

NOTE 2 The impeller can have one or two inlet(s) and might include a shroud and/or a backplate (centreplate) (see Figure 16).

NOTE 3 The impeller is defined as “backward-curved or inclined”, “radial” or “forward-curved”, depending on whether the outward direction of the blade at the periphery is backward, radial or forward relative to the direction of the rotation (see Figures 9 and 16).

NOTE 4 A centrifugal fan can be of the low-, medium- or high-pressure type, according to the aspect ratio of fan inlet diameter to outside diameter of the impeller. These terms indicate that the pressure generated at a given flow rate is low, medium or high.

NOTE 5 Figure 9 shows a cross-section through a family of impellers having the same inlet diameter. Fans with ratios of fan inlet/outside impeller diameter of greater than approximately 0,63 mm are considered “low aspect ratio”, and lower than approximately 0,4 mm are considered “high aspect ratio”. Medium aspect ratio centrifugal fans are intermediate between these two.

NOTE 6 The impeller diameter and the casing scroll radii increase with the pressure range for which the fan is designed.

NOTE 7 These categories are also affected by the ability to run at the necessary peripheral speed (see 5.2 and Table 1).

3.6.2
axial-flow fan
fan in which the air enters and leaves the impeller along essentially cylindrical surfaces coaxial with the fan

See Figure 3.

NOTE 1 An axial-flow fan can be of the low-, medium- or high-pressure type, according to the aspect ratio of hub diameter to outside impeller diameter. These terms indicate that the pressure generated at a given flow rate is low, medium or high.

NOTE 2 Figure 10 shows a cross-section through a family of impellers having the same outside diameter. Fans with ratios of hub/outside impeller diameter of less than approximately 0,4 mm are considered “low aspect ratio”, and greater than approximately 0,71 mm are considered “high aspect ratio”. Medium aspect ratio axial fans are intermediate between these two figures.

NOTE 3 These categories are also affected by the ability to run at the necessary peripheral speed.

3.6.2.1
contra-rotating fan
axial-flow fan which has two impellers arranged in series and rotating in opposite directions

See Figure 32.

3.6.2.2
reversible axial-flow fan
axial-flow fan that is specially designed to rotate in either direction, regardless of whether or not the performance is identical in both directions

3.6.2.3
propeller fan
axial-flow fan having an impeller with a small number of broad blades of uniform material thickness and designed to operate in an orifice

3.6.2.4
plate-mounted axial-flow fan
axial-flow fan in which the impeller rotates in an orifice or spigot of relatively short axial length, the impeller blades being of aerofoil section

3.6.2.5
vane-axial fan
axial-flow fan suitable for ducted applications, which has guide vanes before or after the impeller, or both

3.6.2.6
tube-axial fan
axial-flow fan without guide vanes, suitable for ducted applications

3.6.3
mixed-flow fan
fan in which the fluid path through the impeller is intermediate between the centrifugal and axial-flow types

See Figures 5 and 11.

3.6.4
cross-flow fan
fan in which the fluid path through the impeller is in a direction essentially at right angles to its axis both entering and leaving the impeller at its periphery

See Figure 12.

3.6.5
peripheral or side channel fan
air moving device for which the circulation of fluid in the toric casing is helicoidal

NOTE The rotation of the impeller, which contains a number of blades, creates a helicoidal trajectory, which is intercepted by one or more blades depending on the flow rate. The impeller transfers energy to the fluid (see Figure 15).

3.6.6
multi-stage fan
fan having two or more impellers working in series

EXAMPLE A two-stage fan or a three-stage fan.

NOTE 1 Multi-stage fans can have guide vanes and interconnecting ducts between successive impellers.

NOTE 2 The blades of an impeller can be either of a profiled section (as an aerofoil) or of uniform thickness (see Figure 16).

3.6.7
in-line centrifugal fan
fan having a centrifugal impeller used in an in-line ducted configuration

See Figure 4.

3.6.8
bifurcated fan
fan having an axial-flow, mixed-flow or centrifugal impeller in an in-line configuration where the direct-drive motor is separated from the flowing air stream by means of a compartment or tunnel

See Figure 27 c).

3.6.9
plug fan
fan having an unhoused impeller arranged such that the system into which it is inserted acts as a housing, allowing air to be drawn into the impeller inlet

See Figure 13.

3.6.10
plenum fan
fan having an unhoused centrifugal impeller which draws air into the impeller through an inlet located in a barrier wall, and having a driver located on the same side of the barrier as the impeller

See Figure 14.

3.6.11
in-line and box fan
fan that incorporates centrifugal/mixed-flow impellers

See Figures 4 and 31.

3.7 Types of fan according to operating conditions

3.7.1
general-purpose fan
fan suitable for handling air which is non-toxic, unsaturated, non-corrosive, non-flammable, free from abrasive particles and within a temperature range from –20 °C to +80 °C

NOTE For temperatures greater than 40 °C, the motor is especially taken into consideration.

3.7.2
special-purpose fan
fan used for special operating conditions

See 3.7.2.1 to 3.7.2.12.

NOTE 1 A fan can have a combination of special features.

NOTE 2 The operating conditions stated below (3.7.2.1 to 3.7.2.12) represent a typical range, but the list is not necessarily complete. It is intended that the manufacturer and purchaser agree on other types having special features to suit specific applications.

3.7.2.1
hot-gas fan
fan used for handling hot gases continuously

NOTE 1 Special materials can be incorporated, as necessary, for the fan which can have a direct or indirect drive.

NOTE 2 The motor on a direct-drive fan can be either in the air stream or separated from it.

NOTE 3 Indirect-drive fans can incorporate a means for cooling belts, bearings or other drive components, where necessary (for designation, see 5.3.2).

3.7.2.2
smoke-ventilating fan
fan suitable for handling hot smoke for a specified time/temperature profile

NOTE 1 Special materials can be incorporated, as necessary, for the fan, which can have a direct or indirect drive.

NOTE 2 The motor can be either in the air stream on a direct-drive fan or separated from it.

NOTE 3 Indirect-drive fans incorporate a means for cooling belts, bearings or other drive components, where necessary (for designation, see 5.3.2).

3.7.2.3
wet-gas fan
fan suitable for handling air containing particles of water or any other liquid

3.7.2.4
gas-tight fan
fan with a suitably sealed casing to match a specified leakage rate at a specified pressure

NOTE Depending upon the leakage specification, this can involve special attention being paid to all services which penetrate the casing, such as inspection means, lubricator fittings and electrical supply, as well as the details of the connecting flanges (for categorization, see 5.3.4).

3.7.2.5
dust fan
fan suitable for handling dust-laden air, designed to suit the dust being handled

3.7.2.6
conveying fan
transport fan
fan suitable for the conveying of solids and dust entrained in the air stream, designed to suit the material being conveyed

NOTE 1 A conveying/transport fan can be of direct or indirect drive type, depending on whether or not the handled material passes through the impeller.

NOTE 2 Examples of solids are wood chips, textile waste and pulverized materials.

3.7.2.7
non-clogging fan
fan having an impeller designed to minimize clogging by virtue of its detailed shape or by the use of special materials

NOTE The fan can also incorporate other features to allow the use of cleaning sprays and facilitate the removal of any material.

3.7.2.8
abrasion-resistant fan
fan designed to minimize abrasion, having parts that are especially subject to wear, constructed from suitably abrasion-resistant materials and easily replaceable

3.7.2.9
corrosion-resistant fan
fan constructed from suitably corrosion-resistant materials or suitably treated to minimize corrosion by specified agents

3.7.2.10
spark-resistant fan
ignition-protected fan
fan with features designed to minimize the risk of sparks or hot spots resulting from contact between moving and stationary parts that may cause the ignition of dust or gases

NOTE No bearings, drive components or electrical devices are placed in the air or gas stream, unless they are constructed in such a manner that failure of that component cannot ignite the surrounding gas stream (for categorization, see 5.3.4).

3.7.2.11
powered-roof ventilator
fan designed for mounting on a roof and having exterior weather protection

3.7.2.12
positive-pressure ventilator
portable fan that can be positioned relative to an opening of a confined space and cause it to be positively pressurized by discharge air velocity

NOTE It is principally used by fire-fighters to mitigate the effect of smoke and is also used to assist in inflating hot air balloons.

3.8 Fan elements

3.8.1
fan inlet
opening, usually circular or rectangular, through which the air first enters the fan casing

NOTE 1 If the fan is provided with an inlet-connecting flange or spigot, the fan inlet dimensions are measured inside this connection. The inlet area is the gross area measured inside this flange, i.e. no deductions are made for blockages, such as motors and bearing supports.

NOTE 2 When the inlet area is not clearly defined, agreement can be reached between the parties to the contract.

3.8.2
fan outlet
opening, usually circular or rectangular, through which the air finally leaves the fan casing

NOTE 1 If the fan is provided with an outlet connecting flange or spigot, the fan outlet dimensions are measured inside this connection. When the fan is delivered with a diffuser and the performance is quoted with this fitted, the area of the fan outlet can be taken as equal to the outlet area of the diffuser.

NOTE 2 When the outlet area is not clearly defined, agreement can be reached between the parties to the contract.

NOTE 3 For the special requirements of jet fans, see ISO 13350.

NOTE 4 For roof ventilators and unhoused fans, the outlet area can be considered as the product of the maximum circumference of trailing edges by the width of the impeller blade or the gross casing area at the impeller for axial types.

3.8.3
impeller tip diameter
maximum diameter measured over the tips of the blades of the impeller

NOTE This is expressed in millimetres.

See ISO 13351.

3.8.4
size designation
nominal impeller tip diameter, defined as the impeller tip diameter on which the design of that fan is based

4 Symbols and units

4.1 Symbols

The following symbols and primary units for the parameters listed apply.

Parameter	Symbol	Unit
Volume flow rate	q_V	m^3/s
Fan pressure	p_F	Pa
Power	P	W
Torque	τ	Nm
Gas density	ρ	kg/m^3
Impeller tip speed	u	m/s
Outlet or duct velocity	v	m/s
Rotational frequency	n	r/s
Rotational speed	N	r/min
Dimensions	—	mm
Moment of inertia	I	$kg·m^2$
Stress	σ	Pa
Energy	E	J
Temperature	Θ	K
Temperature	T	°C
Work per unit mass	W	J/kg
Thrust (calculated, measured)	T_c, T_m	N

Note 1 For sound units, see ISO 13347-1.

Note 2 For efficiency units, see ISO 5801.

4.2 Multiples of primary units

The choice of the appropriate multiple or submultiple of an SI unit is governed by convenience. The multiple chosen for a particular application shall be that which leads to numerical values within a practical range (e.g. kilopascal for pressure, kilowatts for power and megapascal for stress).

4.3 Units of time

The second is the SI base unit of time, although outside SI the minute has been recognized by the International Committee for Weights and Measurements (CIPM) as necessary to be retained for use because of its practical importance. Manufacturers may, therefore, continue with the use of r/min for rotational speed.

4.4 Temperature of air or gas

The kelvin is the SI base unit of thermodynamic temperature and is preferred for most scientific and technological purposes. The degree Celsius (°C) is acceptable for practical applications.

5 Fan categories

5.1 General

Fans may be categorized according to

a) suitability for the fan pressure,

b) suitability of construction (including features required for smoke ventilation, gas tightness and ignition protection),

c) driving arrangement,

d) inlet and outlet conditions,

e) method of fan control,

f) rotation and position of parts, and

g) characteristic dimensions.

Examples of the use of the definitions and categories to identify a fan in a specification are given in Annex A.

5.2 Suitability for the fan pressure

A fan may also be defined as being low, medium or high pressure, according to the level of work per unit mass, and whether the influence of compressibility of the air or gas being handled has to be taken into account. For a detailed account of these considerations, see ISO 5801.

A low-pressure fan is then defined as having a pressure ratio less than 1,02 kPa and a reference Mach No. of less than 0,15. This corresponds to a pressure rise of less than 2 kPa when handling standard air.

A medium-pressure fan is defined as having a pressure ratio greater than 1,02 kPa and less than 1,1 kPa. The reference Mach No. shall be less than 0,15. This corresponds to a pressure rise of 2 kPa to 10 kPa.

A high-pressure fan is defined as having a pressure ratio and pressure rise greater than the above-mentioned.