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Fans — Vocabulary and definitions of categories —

Part 2:
Categories

Ventilateurs — Vocabulaire et définitions des catégories —

Partie 2: Catégories

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 117, *Fans*, in collaboration with the European Committee for Standardization (CEN) Technical Committee CEN/TC 156, *Ventilation for buildings*, in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

This document, along with ISO 13349-1, cancels and replaces ISO 13349:2010, which has been technically revised.

The main changes are as follows:

— document split into two parts: Vocabulary and Categories;

— Clause 3 revised to refer to ISO 13349-1;

— positions of the illustrations modified;

— editorial errors corrected.

A list of all parts in the ISO 13349 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user’s national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

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

Fans — Vocabulary and definitions of categories —

Part 2: Categories

1 Scope

This document defines categories in the field of fans used for all purposes.

It is not applicable to electrical safety.

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 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, *Fans — Performance testing using standardized airways*

ISO 13349-1, *Fans — Vocabulary and definitions of categories —Part 1:Fans—Vocabulary*

ISO 13351, *Fans — Dimensions*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 5167-1, ISO 5801 and ISO 13349-1 apply.

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

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

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
NOTE 1 For sound units, see ISO 13347-1.		
NOTE 2 For efficiency units, see ISO 5801.		

Parameter	Symbol	Unit
Gas density	ρ	kg/m³
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·m²
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, kilowatt 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 Measures (CIPM) as necessary to be retained for use because of its practical importance. Manufacturers may, therefore, continue with the use of r/min ("r" stands for revolutions) 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;

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

5.2.1 General

A fan may also be defined as being low-, medium- or high-pressure, according to the level of flow 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. 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 and less than 1,1. The reference Mach number 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 equal to or greater than 1,1 and a pressure rise greater than 10 kPa.

5.2.2 Work per unit mass

A convention is used for all industrial fans except jet fans (see ISO 13350), denoting the work per unit mass as the quotient of air power and mass flow rate. The fan pressure is approximately equal to the product of work per unit mass and the mean stagnation density of the fluid within the fan.

5.2.3 Fan categories

Depending on, for example, its peripheral speed, impeller and casing design, a fan impeller develops more or less pressure. This document defines a range of “fan categories” where the fan pressure at maximum efficiency and maximum rotational speed is not less than the value given in Table 1. In any event, this defined fan pressure (as shown in Table 1) shall not exceed 95 % of the maximum pressure developed by the fan at its maximum speed.

5.2.4 Changes in air density

These categories shall also be used to indicate whether or not the change in air density within the fan shall be considered. For a low-pressure fan, this change may be neglected. For a high-pressure fan, this change shall not be neglected, whereas for a medium-pressure fan, it may be neglected depending on the desired accuracy. Detailed mechanical design and construction of the rotational elements are determined by the peripheral speed and, therefore, the pressure for which the fan is specified. For examples of centrifugal fans, see ISO 13349-1:2022, Figure 14.

Table 1 — Categorization of fan according to fan pressure at maximum safe rotational speed

Fan description	Code	Maximum fan pressure, p_F (for standard air) kPa	Category
Low pressure	L	$0 < p_F \leq 0,7$	0
		$0,7 < p_F \leq 1$	1
		$1 < p_F \leq 1,6$	2
		$1,6 < p_F \leq 2,0$	3

Table 1 *(continued)*

Fan description	Code	Maximum fan pressure, p_F (for standard air) kPa	Category
Medium pressure	M	$2,0 < p_F \le 3,6$	4
		$3,6 < p_F \le 6,3$	5
		$6,3 < p_F \le 10$	6
High pressure	H	$10 < p_F \le 16$	7
		$16,0 < p_F \le 22,4$	8
		$22,4 < p_F \le 30$	9

5.3 Suitability of construction

5.3.1 Categorization according to casing construction

Fans are used for a variety of purposes. The air or gas handled can be clean or contain moisture or solid particles and may be at ambient or other temperature. Connection to its associated ducting can be via flexible elements or alternatively it can be attached directly, such that the casing has to withstand additional loads due to the dead weight of these connections. Where a high or low temperature is present, further loading can result from the effects of expansion or contraction. Casing thickness and stiffening are also determined by the ability to withstand the specified fan pressure and dynamic loads and by the need for a margin to counter the effects of any erosion or corrosion. For all these and other reasons, different methods of casing construction and different casing thicknesses are appropriate to the application.

The categorization in Table 2 reflects current practice and shall be used only to assist specification. It in no way indicates any form of grading. Category 1 is as valid for clean air ventilation as category 3 is preferred for heavy industrial requirements.

Table 2 — Categorization of fans according to method of casing construction

Category	Typical casing features	Usage	Casing thickness
1	Lockformed, spot welded or screwed construction. Cradle or angle frame mounting.	— Light HVAC clean air	< 0,002 5D
2	Lockformed, seam welded or continuously welded construction. Semi-universal design with bolted-on side-plates.	— Heavy HVAC — Light industrial — Light dust or moisture	> 0,002 5D
3	Fully welded fixed discharge.	— Heavy industrial — Dirty air containing moisture or solids — High pressure — High power	> 0,003 33D
Key D nominal impeller diameter, in millimetres			

5.3.2 Designation for hot-gas fan

Where a fan is suitable for continuous operation up to a stated maximum temperature this should be indicated on the conventional fan rating plate itself.

The designation that shall be used is: T, followed by the maximum temperature in degrees Celsius (°C), for continuous operation.

EXAMPLE T/500 denotes a fan rated for a maximum continuous temperature of 500 °C.

5.3.3 Designation and recommended categorization for smoke-ventilating fans

If the fan is also, or only, capable of short-term operation at a high temperature, this information shall be clearly stated on a separate label.

5.3.4 Categorization for gas-tight fans

Gas-tight fans shall be categorized in accordance with Table 3. The amount of leakage is dependent on the pressure within the fan casing and the time for which this must be maintained. The leakage rate is obtained by blocking off the fan inlet and outlet and "pumping up" or extracting the casing using an auxiliary test fan. The change in the test pressure shall be measured by a manometer as a function of time. The leakage rate is then determined from the flow of the auxiliary test fan or other pressure sources. This leakage shall be less than the value calculated from the formula appropriate to the category.

Normally, the fan is stationary during this test. However, if the correct functioning of the shaft seal is dependent on fan rotation, the test shall be carried out with the impeller removed and the remainder of the fan running.

Categories A to D match the established classes of allowable ductwork leakage rate used in the air-conditioning industry. Category E is often specified for systems handling toxic fumes, while categories F and G relate to nuclear and defence equipment specifications, respectively.

Table 3 — Categorization of gas-tight fans — Leakage as a function of test pressure

Leakage category	Maximum test pressure kPa	Time at maximum pressure min	Acceptance criteria/maximum leakage rate
A	0,5	15	$0{,}027 \times p^{0{,}65}$
B	1	15	$0{,}009 \times p^{0{,}65}$
C	2	15	$0{,}003 \times p^{0{,}65}$
D	2,5	15	$0{,}001 \times p^{0{,}65}$
E	2,5	15	$0{,}000\,5 \times p^{0{,}65}$
F	3	60	Fall in $p < 500$ Pa
G	10,5	15	No detectable leaks
H1	1,5	60	Fall in $p < 150$ Pa
H2	1,5	60	Fall in $p < 15$ Pa

NOTE 1 Leakage rates in categories A, B, C, D and E are in litres per second per square metre of casing wetted area and p is the test pressure in pascals.

NOTE 2 Leakage is defined as loss of pressure in categories F, H1 and H2. Especially when measuring the pressure loss according to leakage categories H1 or H2, attention is drawn to changes of the gas temperature inside the casing or the ambient pressure during measurement as they can taint the result significantly.

5.4 Transmission arrangements

The six most commonly used types of transmission are:

a) Direct transmission from the shaft of the motor or other prime mover: the impeller is fixed to the shaft extension.

b) Transmission through an in-line direct coupling: the transmission shaft and the impeller shaft are each fixed on a part of the in-line direct coupling and rotate at the same speed.

c) Transmission through an in-line slipping coupling: the transmission shaft is fixed to the primary part of the coupling and the impeller shaft to the secondary part of the coupling, enabling them to rotate at different speeds, the relative difference of which (i.e. the slip) depends upon the speed, the torque to be transmitted and, when appropriate, the degree of control applied to the coupling.

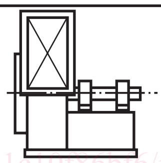
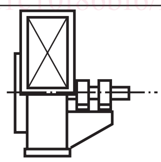
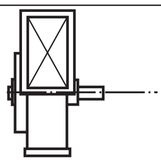
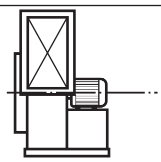
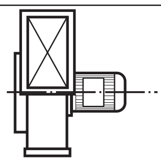
d) Transmission through a gearbox: the transmission shaft and the impeller shaft are not necessarily coaxial; they may be parallel or at an angle, their speeds being in one or more given ratio(s).

e) Belt transmission: the transmission shaft and the impeller shaft are not in-line but parallel, the transmission between the two being by means of flat, toothed or vee belts (or belts of some other section) and suitable pulleys. Their speeds are in a given ratio subject to a small amount of slip, except in the case of the toothed belt.

f) Direct transmission with inset motor: the motor is set inside the fan casing or impeller, such as an external rotor motor.

Fans shall be classified according to the transmission arrangements of the fan, especially as far as direct and belt transmission units are concerned. These are shown in Table 4 for centrifugal units and Table 5 for axial units.

Table 4 — Transmission arrangements for centrifugal fans

Arrangement no.	Description	Motor position (see Figure 8)	Illustration
1	Single-inlet fan for belt transmission. Impeller overhung on shaft running in two plummer block, pillow block bearings or a double-bearing block supported by a pedestal.	—	
2	Single-inlet fan for belt transmission. Impeller overhung on shaft running in bearings supported by a bracket attached to the fan casing.	—	
3	Single-inlet fan for belt transmission. Impeller mounted on shaft running in bearings on each side of casing and supported by the fan casing.	—	
4	Single-inlet fan for direct transmission. Impeller overhung on motor shaft. No bearings on fan. Motor supported by base.	—	
5	Single-inlet fan for direct transmission. Impeller overhung on motor shaft. No bearings on fan. Motor attached to casing side by its flanged end-shield.	—	
NOTE Arrangement numbers 1, 3, 6, 7, 8 and 17 can also be provided with the bearings mounted on pedestals for base set independent of the fan housing.			