



DPC: 25/30492653 DC

**BSI Group Headquarters**

389 Chiswick High Road London W4 4AL

Tel: +44 (0)20 8996 9000

Fax: +44 (0)20 8996 7400

www.bsigroup.com

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## Introduction

This draft standard is based on national and international discussions. Your comments on this draft are invited and will assist in the preparation of the consequent standard.

For international standards, comments will be reviewed by the relevant UK national committee before sending the consensus UK vote and comments to the international committee, which will then decide appropriate action. If the international standard is approved, it is usual for the text to be published as a British Standard.

For national standards, comments will be reviewed by the relevant UK national committee and the resulting standards published as a British Standard.

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## Template for comments and secretariat observations

|                  |                        |
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| 1  | 2                                          | (3)                          | 4               | 5                                                                                                                                  | (6)                                                                      | 7                                                  |
|----|--------------------------------------------|------------------------------|-----------------|------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------|----------------------------------------------------|
| MB | Clause No./ Subclause No./Annex (e.g. 3.1) | Paragraph/ Figure/Table/Note | Type of comment | Comment (justification for change) by the MB                                                                                       | Proposed change by the MB                                                | Secretariat observations on each comment submitted |
|    | 3.1                                        | Definition 1                 | ed              | Definition is ambiguous and needs clarifying.                                                                                      | Amend to read '...so that the mains connector to which no connection...' |                                                    |
|    | 6.4                                        | Paragraph 2                  | te              | The use of the UV photometer as an alternative cannot be supported as serious problems have been encountered in its use in the UK. | Delete reference to UV photometer.                                       |                                                    |



# DRAFT International Standard

## ISO/DIS 13350

### Fans — Performance testing of jet fans

*Ventilateurs — Essai de performance des ventilateurs accélérateurs*

ICS: 23.120

ISO/TC 117

Secretariat: **BSI**

Voting begins on:  
**2025-11-14**

Voting terminates on:  
**2026-02-06**

This document is circulated as received from the committee secretariat.

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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](http://www.iso.org/directives)).

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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](http://www.iso.org/iso/foreword.html).

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

This third edition cancels and replaces the second edition (ISO 13350:2015) which has been technically revised. The main changes to the previous edition are as follows:

- references to standards updated, for example ISO 5801 and ISO 13349-1 and -2;
- [Clause 8](#): Noise is preferably to be measured using the ISO 13347 series, that was developed based on modern metrics by measuring all the way around the fan, as in the ISO 374X or ISO 9614 series. The possibility of using these more basic noise-measuring standards is introduced in this edition of the present standard.
- [Annex A](#) is a practical ad hoc method, where one only measures at select positions to the side of the front of the fan. In this method, reflective surfaces are defined only near the inlet of the fan, while it has been observed that often the sound levels measured at the outlet of the fan are higher. Because of these shortcomings that can lead to significant errors, this annex is to be used only until the fan noise measuring standards ISO 13347-1 to -4 (that now include category E fans) are finally approved and published.
- [Annex F](#), Inclusive measurement capturing the vertical component of thrust for jet fans with deflectors or similar devices

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](http://www.iso.org/members.html).

## Introduction

The need for a new edition of this document has been evident for some time. The use of the so-called jet fan to assist in the control of quality of air in vehicle and train tunnels, as well as enclosed car parks, is an established technology. Longitudinal methods of ventilation can show advantages in both capital cost and running cost compared to alternative systems. Smoke and pollution control in emergency conditions can be readily provided.

This document deals with the determination of those performance criteria essential to the correct application of jet fans. In describing the test and rating procedures, numerous references are made to ISO 5801 as well as to other relevant International Standards. For the determination of the noise generated by the jet fans this standard refers to the fan noise measuring standards ISO 13347-1 to -4 that recently have been updated to include fan category E. These standards base on the established general sound measuring standards in the ISO 374X and ISO 9614 series.

# Fans — Performance testing of jet fans

## 1 Scope

This document deals with the determination of those technical characteristics needed to describe all aspects of the performance of jet fans as defined in ISO 13349-1 and -2. It does not cover those fans designed for ducted applications, nor those designed solely for air circulation, for example ceiling fans and table fans.

The test procedures described in this document relate to laboratory conditions. The measurement of performance under on-site conditions is not included.

## 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, *Fans — Performance testing using standardized airways*

ISO 13347-1, *Fans — Determination of fan sound power levels under standardized laboratory conditions — Part 1: General overview*

ISO 13347-2, *Fans — Determination of fan sound power levels under standardized laboratory conditions — Part 2: Reverberant room method*

ISO 13347-3, *Fans — Determination of fan sound power levels under standardized laboratory conditions — Part 3: Enveloping surface methods*

ISO 13347-4, *Fans — Determination of fan sound power levels under standardized laboratory conditions — Part 4: Sound intensity method*

ISO 14694, *Industrial fans — Specifications for balance quality and vibration levels*

ISO 14695, *Industrial fans — Method of measurement of fan vibration*

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

ISO 13349-2, *Fans — Vocabulary and definitions of categories — Part 2: Categories*

ISO 21940-11, *Mechanical vibration — Rotor balancing — Part 11: Procedures and tolerances for rotors with rigid behaviour*

IEC 60034-2-1, *Rotating electrical machines — Part 2-1: Standard methods for determining losses and efficiency from tests (excluding machines for traction vehicles)*

IEC 60034-14, *Rotating electrical machines — Part 14: Mechanical vibration of certain machines with shaft heights 56 mm and higher — Measurement, evaluation and limits of the vibration severity*

## 3 Terms and definitions

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

ISO and IEC maintain terminological 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/>

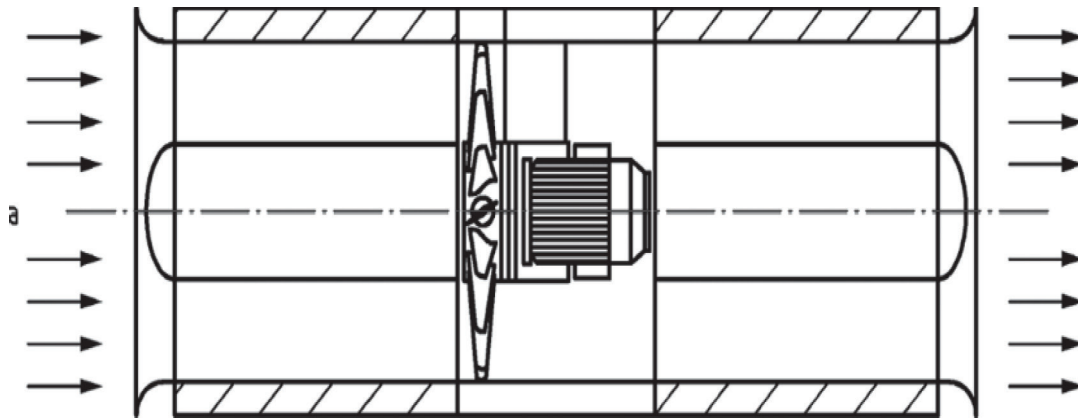
### 3.1

#### jet fan

fan used for producing a jet of air in a space and not connected to any ducting, of type E category/test configuration

Note 1 to entry: Performance shall only be expressed as thrust and efficiency is determined from thrust measurement or calculation. Performance characteristics relating to pressure development are not compliant.

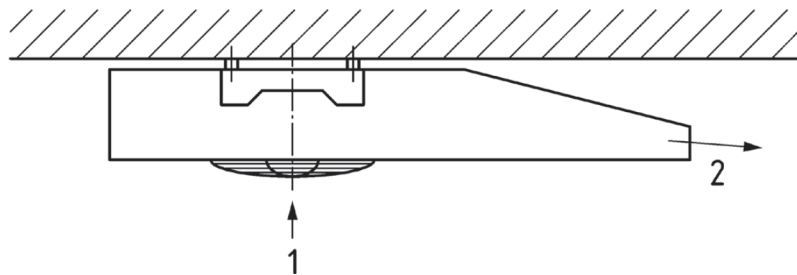
Note 2 to entry: The air jet can be used, for example, for adding momentum to the air within a tunnel or other space (e.g. enclosed car park), or for intensifying the heat transfer in a determined zone.



#### Key

a flow of air

Figure 1 — a Example of axial jet fan



#### Key

1 inlet  
2 discharge

Figure 1 — b Example of centrifugal jet fan

#### 3.1.1

##### jet fan – reference configuration (axial jet fan)

fan with 1D long silencers on inlet and outlet; no internal components within each silencer, and no accessories fitted to either end that impact performance.

### 3.2 effective fan dynamic pressure

$p_d$   
conventional quantity representative of the dynamic component of the fan output, calculated, in the particular case of a jet fan, from the effective fan outlet velocity and the inlet density.

Note 1 to entry: The effective fan dynamic pressure will not be the same as the average of the dynamic pressures across the section because it excludes from consideration that part of the dynamic energy flux which is due only to departures from uniform axial velocity distribution.

#### 3.2.1 gross fan outlet area

$A_2$   
surface plane bounded by the downstream extremity of the air-moving device

Note 1 to entry: Gross fan outlet area is, by convention, taken as the gross area in the outlet plane inside the casing or duct or silencer (see [Figure 2](#)) without taking into account any obstructions inside the fan outlet.

#### 3.2.2 effective fan outlet area

$A_{eff}$   
<jet fan> outlet area with deductions for motors, fairings or other obstructions (in the particular case of a jet fan)

Note 1 to entry: If the silencer centrebody reaches the outlet plane of the fan, then the effective fan outlet area is defined as the annulus area at the fan outlet plane, as shown in [Figure 2a](#).

Note 2 to entry: If the fan has a silencer without centrebody [see [Figure 2b](#)], the effective fan outlet area will be close to the cross-sectional area inside the silencer in order to clear any exit bellmouth form.

Note 3 to entry: If the centrebody (motor or silencer core) does not extend to the outlet plane, the effective fan outlet area will approach the annulus area between the casing and the motor, but with some increase, as defined in [Figure 2c](#), for the distance between the centrebody and the outlet. Where the motor is on the upstream side, [Figure 2c](#) is applied to the impeller hub rather than the motor, as illustrated.

Note 4 to entry: For comparisons within the scope of research and development, alternative definitions have been used with some success.

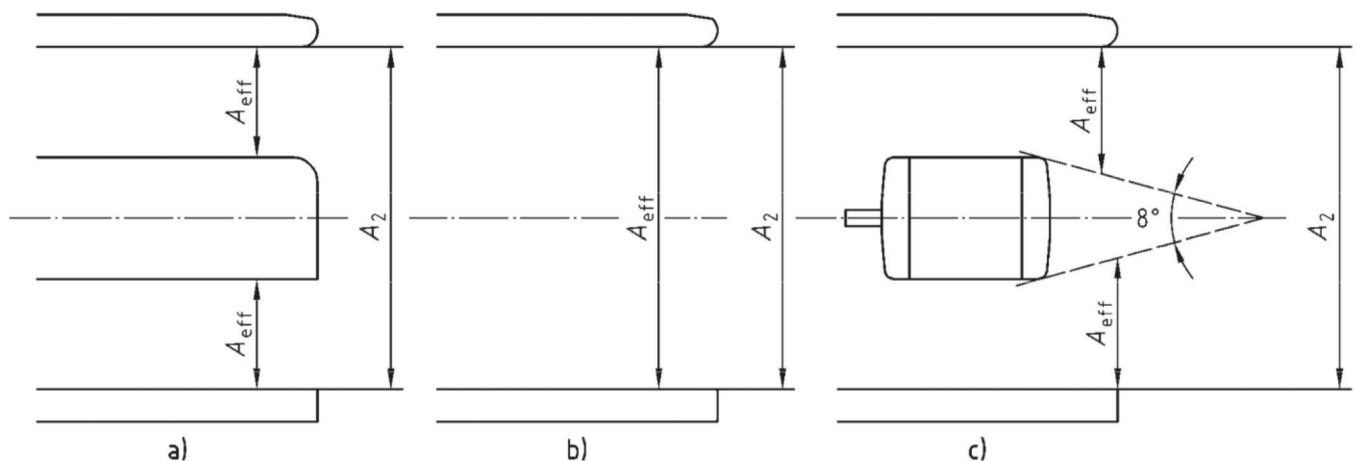
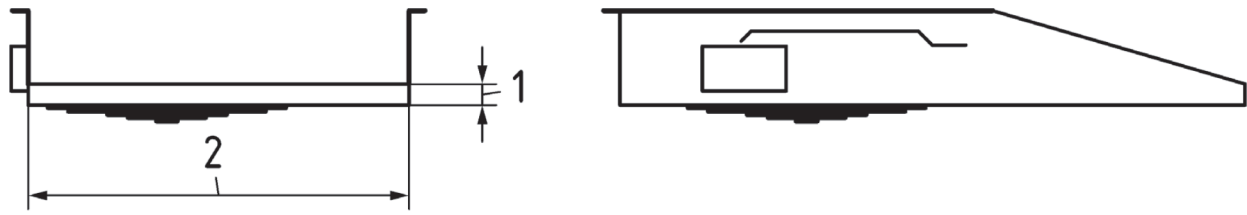


Figure 2 — a Gross fan outlet areas (axial type)



$$A_2 = A_{\text{eff}} = 1 \times 2$$

where

1 is the height of the unit outlet;

2 is the width of the fan outlet.

**Figure 2b — Gross fan outlet area (centrifugal type)**

### 3.3 effective fan outlet velocity

$v_{\text{eff}}$   
velocity calculated from thrust at standard conditions, the standard air density and the effective fan outlet area

Note 1 to entry: See [11.2](#).

### 3.4 fan outlet velocity

$v_2$   
velocity calculated from the thrust at standard conditions, divided by gross fan outlet area,  $A_2$

#### 3.5.1 motor input power

$P_e$   
electrical power supplied at the terminals of the electric motor drive

#### 3.5.2 impeller power

$P_r$   
mechanical power supplied to the impeller of the fan

#### 3.5.3 fan air power

$P_u$   
conventional power output at standard conditions; in the particular case of a jet fan, product of inlet volume flow and effective fan dynamic pressure

### 3.6 impeller tip speed

$v_p$   
peripheral speed of the impeller blade tips

### 3.7 thrust

$T_m$   
fan thrust measured in accordance with this document at standard conditions

### 3.8.1

#### **thrust/impeller power ratio**

$r_r$   
thrust divided by impeller power

Note 1 to entry: The thrust/impeller power ratio is calculated as  $r_r = T_m/P_r$ .

### 3.9

#### **fan guard**

guard designed to prevent the ingestion of relatively large foreign bodies, such as drink cans, and sometimes fitted to the inlet and outlet of jet fans

Note 1 to entry: Guards can have a marked effect on the thrust performance and noise level. Where they are specified, measurements should be made with these guards in place.

### 3.10

#### **Unit deflection devices/solutions**

apparatus designed to improve installed performance through reduction of losses in certain circumstances.

### 3.11

#### **chamber**

airway in which the air velocity is small compared with that at the fan inlet or outlet

### 3.12

#### **test enclosure**

room, or other space protected from draught, in which the fan and test airways are situated

### 3.13

#### **impeller balance grade**

G grade as specified in ISO 14694

### 3.14

#### **fan vibration velocity**

root mean square (r.m.s.) vibration velocity over the frequency range 10 Hz to 10 kHz measured in accordance with this document and with ISO 14695

### 3.15

#### **fan impeller efficiency**

$\eta_r$   
fan air power divided by impeller power

### 3.16

#### **fan overall efficiency**

$\eta_e$   
fan air power divided by motor input power

### 3.17

#### **sound pressure level**

$L_p$   
ten times the logarithm to the base 10 of the ratio of the square of the sound pressure radiated by the sound source under test to the square of the reference sound pressure defined in ISO13349-1

### 3.18

#### **sound power level**

$L_W$   
ten times the logarithm to the base 10 of the ratio of the sound power radiated by the sound source under test to the reference sound power defined in ISO13349-1

**3.19****inlet sound power level** $L_W(\text{in})$ 

sound power level of the fan determined at the fan inlet

**3.20****outlet sound power level** $L_W(\text{out})$ 

sound power level of the fan determined at the fan outlet

**3.21****total sound power level** $L_W(\text{tot})$ 

sound power level determined for the entire fan which includes the inlet and outlet sound power levels

**3.22****noise frequency range of interest**

&lt;general&gt; frequency range including the octave bands with centre frequencies between 63 Hz and 8 000 Hz and the one-third octave bands with centre frequencies between 50 Hz and 10 000 Hz

**4 Symbols and abbreviated terms**

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

| Abbreviated term/represented quantity                      | Symbol            | SI unit           |
|------------------------------------------------------------|-------------------|-------------------|
| Impeller annulus area                                      | $A_a$             | m <sup>2</sup>    |
| Gross fan outlet area                                      | $A_2$             | m <sup>2</sup>    |
| Effective fan outlet area                                  | $A_{\text{eff}}$  | m <sup>2</sup>    |
| Nominal fan diameter                                       | $D_R$             | m                 |
| Length of upstream chamber side                            | $D_3$             | m                 |
| Sound pressure level                                       | $L_p$             | dB (re 20 µPa)    |
| Average sound pressure level of the measured device        | $L_{p(m)}$        | dB (re 20 µPa)    |
| Average sound pressure level of the reference sound source | $L_{p(r)}$        | dB (re 20 µPa)    |
| Sound power level                                          | $L_W$             | dB (re 1 pW)      |
| Inlet sound power level                                    | $L_W(\text{in})$  | dB (re 1 pW)      |
| Outlet sound power level                                   | $L_W(\text{out})$ | dB (re 1 pW)      |
| Total sound power level                                    | $L_W(\text{tot})$ | dB (re 1 pW)      |
| Sound power level of the reference sound source            | $L_{W(r)}$        | dB (re 1 pW)      |
| Rotational speed                                           | $n$               | revolution/s      |
| Differential pressure across a flow measuring device       | $p$               | Pa                |
| Gauge pressure at the fan outlet                           | $p_{e2}$          | Pa                |
| Gauge pressure in the fan chamber                          | $p_{e2}$          | Pa                |
| Effective fan dynamic pressure                             | $p_d$             | Pa                |
| Volume flow                                                | $q_v$             | m <sup>3</sup> /s |
| Impeller balance grade (ISO 14694)                         | $G$               | µm                |
| Motor input power                                          | $P_e$             | W                 |
| Impeller power                                             | $P_r$             | W                 |
| Fan air power                                              | $P_u$             | W                 |
| Thrust/impeller power ratio                                | $r_r$             | N/W               |
| Thrust/motor input power ratio                             | $r_e$             | N/W               |
| Non-dimensional thrust/power ratio                         | $r_t$             | —                 |

| Abbreviated term/represented quantity                                                                                                                                               | Symbol      | SI unit           |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|-------------------|
| Calculated thrust                                                                                                                                                                   | $T_c$       | N                 |
| Measured thrust                                                                                                                                                                     | $T_m$       | N                 |
| Impeller tip speed                                                                                                                                                                  | $v_p$       | m/s               |
| Effective fan outlet velocity                                                                                                                                                       | $v_{eff}$   | m/s               |
| Fan outlet velocity                                                                                                                                                                 | $v_2$       | m/s               |
| Mean throughflow velocity in a tunnel at a specified section                                                                                                                        | $v_t$       | m/s               |
| Total pressure rise                                                                                                                                                                 | $\Delta p$  | Pa                |
| Standard air density 1,2 kg/m <sup>3</sup>                                                                                                                                          | $\rho$      | kg/m <sup>3</sup> |
| Inlet density taken as equal to the density in the test enclosure                                                                                                                   | $\rho_a$    | kg/m <sup>3</sup> |
| Fan overall efficiency                                                                                                                                                              | $\eta_e$    | —                 |
| Motor efficiency                                                                                                                                                                    | $\eta_m$    | —                 |
| Fan impeller efficiency                                                                                                                                                             | $\eta_r$    | —                 |
| Fan overall efficiency based on thrust                                                                                                                                              | $\eta_e(T)$ | —                 |
| Fan impeller efficiency based on thrust                                                                                                                                             | $\eta_r(T)$ | —                 |
| Flow coefficient                                                                                                                                                                    | $\phi$      | —                 |
| Thrust coefficient                                                                                                                                                                  | $\theta$    | —                 |
| Power coefficient                                                                                                                                                                   | $\phi_r$    | —                 |
| NOTE (T) denotes the term or quantity stated to be a function of the thrust (see <a href="#">Annex E</a> ). For example, $\eta_e(T)$ is the fan overall efficiency based on thrust. |             |                   |

## 5 Characteristics to be measured

### 5.1 General

In order that a jet fan is correctly applied and gives satisfactory performance and reliability in service, it is necessary to determine a number of technical performance characteristics in addition to knowing the more obvious mechanical features, such as mass, overall dimensions, and installation dimensions.

### 5.2 Thrust

Friction on the tunnel walls, inlet and outlet losses and sometimes traffic drag, combined with climatic effects at tunnel portals, create a pressure drop through the tunnel. The pressure drop is matched by the sum of the pressure increases by the jet fans due to the momentum transfer between fan discharge airflow and airflow in the tunnel. As it is impossible to measure the momentum of the fan discharge airflow, and the rate of change in momentum is equal and opposite to the thrust, thrust is measured instead.

### 5.3 Input power

In order to design the tunnel installation, it is necessary to know the input power to the fan motor. Also, this is needed to determine the overall efficiency of the jet fan.

### 5.4 Sound levels

Sound levels, usually at both inlet and outlet, and, where significant, also the casing break out noise, are established in order to ensure that the jet fan and silencer combination is optimized to match the tunnel sound level requirements.

NOTE The fan manufacturer can only guarantee the sound power level of the fan. The sound pressure in the tunnel will depend on the size and sound absorption characteristics of the tunnel, which are outside the fan manufacturer's responsibility.