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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.

## UK Vote

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## Submission of Comments

- **Annotated drafts are not acceptable and will be rejected.**
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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 13347-1

### Fans — Determination of fan sound power levels under standardized laboratory conditions —

#### Part 1: General overview

ICS: 23.120; 17.140.20

ISO/TC 117

Secretariat: **BSI**

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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.

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 13347-1 was prepared by Technical Committee ISO/TC 117, *Fans*.

ISO 13347 consists of the following parts, under the general title *Fans — Determination of fan sound power levels under standardized laboratory conditions*:

- *Part 1: General overview*
- *Part 2: Reverberant room method*
- *Part 3: Enveloping surface methods*
- *Part 4: Sound intensity method*

## Introduction

Forming part of the ISO/TC 117 series of fan standards, this part of ISO 13347 deals with the determination of the fan sound power level appropriate to a particular application. In describing the test and rating procedures, numerous references are made to ISO 5801 as well as to other relevant ISO standards. This general overview should be read in conjunction with the appropriate part of ISO 13347 that specifies, in detail, methods for determining the sound power propagated from a fan in specified installation conditions as a function of frequency.

This part of ISO 13347 primarily deals with the determination of sound power levels of fans used in five installation categories (see [Clause 4](#)) for ducted and non-ducted applications, including jet fans.

The test procedures described in this part of ISO 13347 relate to laboratory conditions. The measurement of performance under site conditions is not included. Acoustic system effects can be considerable where the airflow into and out of the fan is not free from swirl, nor fully developed.

This part of ISO 13347 describes methods for determining sound power levels of fans in one-third octave bandwidths and one octave bandwidths.

Data obtained in accordance with this part of ISO 13347 may be used for the following purposes amongst others:

- a) comparison of fans which are similar in size and type;
- b) comparison of fans which are different in size, type, design, speed, etc;
- c) determining whether a fan is suitable for a specified upper limit of sound emission;
- d) scaling of fan noise from one size and speed to another size and speed of the same type of fan;
- e) prediction of sound pressure level in application of the fan;
- f) engineering work to assist in developing machinery and equipment with lower sound emissions.

**The intention of this standard (and parts 2 – 4) is to offer a method based on ISO 3740 series and ISO 9614 (part 1 and 2) for the acoustic testing of jet fans (*and partition fans*) from the alternative method currently described in ISO 13350:2015**

# Fans — Determination of fan sound power levels under standardized laboratory conditions —

## Part 1: General overview

### 1 Scope

This part of ISO 13347 deals with the determination of the acoustic performance of fans. In addition, it may be used to determine the acoustic performance of fans combined with an ancillary device such as a roof cowl or damper or, where the fan is fitted with a silencer, the sound power resulting from the fan and silencer combination.

### 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 266, *Acoustics — Preferred frequencies*

ISO 1000, *SI units and recommendations for the use of their multiples and of certain other units*

ISO 3740, *Acoustics — Determination of sound power levels of noise sources — Guidelines for the use of basic standards*

ISO 3741, *Acoustics — Determination of sound power levels and sound energy levels of noise sources using sound pressure — Precision methods for reverberation test rooms*

ISO 3743-1, *Acoustics — Determination of sound power levels and sound energy levels of noise sources using sound pressure — Engineering methods for small movable sources in reverberant fields — Part 1: Comparison method for a hard-walled test room*

ISO 3743-2, *Acoustics — Determination of sound power levels of noise sources using sound pressure — Engineering methods for small, movable sources in reverberant fields — Part 2: Methods for special reverberation test rooms*

ISO 3744, *Acoustics — Determination of sound power levels of noise sources using sound pressure — Engineering method in an essentially free field over a reflecting plane*

ISO 3745, *Acoustics — Determination of sound power levels and sound energy levels of noise sources using sound pressure — Precision methods for anechoic rooms and hemi-anechoic rooms*

ISO 5136, *Acoustics — Determination of sound power radiated into a duct by fans and other air-moving devices — In-duct method*

ISO 5801, *Fans — Performance testing using standardized airways*

ISO 6926, *Acoustics — Requirements for the performance and calibration of reference sound sources used for the determination of sound power levels*

ISO 9614-1, *Acoustics — Determination of sound power levels of noise sources using sound intensity — Part 1: Measurement at discrete*

ISO 9614-2, *Acoustics — Determination of sound power levels of noise sources using sound intensity — Part 2: Measurement by scanning*

ISO 10302-1, *Acoustics - Measurement of airborne noise emitted and structure-borne vibration induced by small air-moving devices - Part 1: Airborne noise measurement*

ISO 10302-2, *Acoustics — Measurement of airborne noise emitted and structure-borne vibration induced by small air-moving devices — Part 2: Structure-borne vibration measurements*

ISO 13347-2, *Fans — Determination of fan sound power levels under standardized laboratory conditions — Part 2: Reverberant room method (ACTION: Update dated reference when part 2 is revised)*

ISO 13347-3, *Industrial fans — Determination of fan sound power levels under standardized laboratory conditions — Part 3: Enveloping surface methods (ACTION: Update dated reference when part 2 is revised)*

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

ISO 13349, *Fans — Vocabulary and definitions of categories*

ISO 13350, *Fans — Performance testing of jet fans*

### 3 Terms, definitions, symbols and units

#### 3.1 Terms and definitions

For the purposes of this document, the non acoustical terms, definitions and units defined in ISO 5801, ISO 13349, ISO 1000, and the following apply.

**Note** The acoustic definitions are taken from ISO 3740 to ISO 3747 and some have been expanded to fit the specific needs of this document.

##### 3.1.1

##### **fan inlet**

opening, usually circular or rectangular, 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 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 to entry:** When the inlet area is not clearly defined, agreement can be reached between the parties to the contract.

**Note 3 to entry:** the fan inlet is defined by the airflow, when you reverse the airflow, what before was the outlet, now becomes the inlet

##### 3.1.2

##### **fan outlet**

opening, usually circular or rectangular, 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 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 may be taken as equal to the outlet area of the diffuser.

**Note 2 to entry:** Fan outlet area is, by convention, taken as the gross area in the outlet plane inside the casing, without deduction for motor, fairings or other obstructions. When the outlet area is not clearly defined, agreement can be reached between the parties to the contract.

**Note 3 to entry:** the fan outlet is defined by the airflow, when you reverse the airflow, what before was the inlet, now becomes the outlet

### 3.1.3

#### **inlet sound power level**

sound power level of a fan determined at the fan inlet in a specified test installation categories A, B, C, D or E

### 3.1.4

#### **outlet sound power level**

sound power level of a fan determined at the fan outlet in a specified installation category A, B, C, D or E

### 3.1.5

#### **casing sound power level**

sound power level radiated from a fan casing

Note 1 to entry: If the fan drive is external to the fan casing, the casing sound power shall include the sound power generated by and radiated from the fan drive

Note 2 to entry: When cataloguing a range of fans, it is not always possible to include the motor noise, as this will vary according to the power and type of motor selected. Motor noise may then be omitted, provided this fact is clearly stated.

### 3.1.6

#### **frequency range of interest**

frequency range including octave bands with centre frequencies between 63 Hz and 8 000 Hz and one-third octave bands with centre frequencies between 50 Hz and 10 000 Hz

Note 1 to entry: For special purposes, the frequency range may be extended at either end, provided that the test environment and instrument accuracy are satisfactory for use over the extended frequency range. For fans which radiate sound at predominantly high (or low) frequency, the frequency range of interest may be limited in order to optimise the test facility and procedures.

### 3.1.7

#### **blade passage frequency**

#### **BPF**

frequency of fan impeller blades passing a single fixed object

Note 1 to entry: The blade passage frequency is calculated by the following formula

$$BPF = \frac{x \times n}{60} \text{ Hz}$$

where

$x$  is the number of blades;

$n$  is the fan speed, expressed in revolutions per minute.

### 3.1.8

#### **chamber**

enclosure used to regulate flow and absorb sound; it may also conform to air test chamber conditions outlined in ISO 5801

### 3.1.9

#### **Classification of fans according to their function**

refer to ISO13349-1 for the fan classification options covered by this standard.

### 3.1.10

#### **fan inlet area**

$A_1$

surface plane bounded by the upstream extremity of the air-moving device

Note 1 to entry: The inlet area is, by convention, taken as the gross area in the inlet plane inside the casing.

**3.1.11****fan outlet area** $A_2$ 

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

Note 1 to entry: The fan outlet area is, by convention, taken as the gross area in the outlet plane inside the casing.

Note 2 to entry: For jet fans, refer to definition in ISO 13350

**3.1.12****end reflection**

phenomenon which occurs whenever sound is transmitted across an abrupt change in area such as at the end of a duct in a room

Note 1 to entry: When end reflection occurs, some of the sound is reflected back into the duct and does not escape into the room.

**3.1.13****reverberant room**

enclosure meeting the requirements of Annex A and/or Annex B of ISO 13347-2:2004 (ACTION: Update dated reference when part 2 is revised)

**3.1.14****reference point of fan equipment**

position that is used to define and locate the measurement surface relative to the fan equipment under test, see Figures 1 to 4 of ISO 13347-3:2004 (ACTION: Update dated reference when part 3 is revised)

Note 1 to entry: Generally, the reference point is the centroid of the centres of all inlets and outlets that contribute to the sound power level being determined.

Note 2 to entry: For total sound power testing of fan equipment with a single inlet and a single outlet, the reference point is the midpoint of the line that joins the centres of the inlet and the outlet.

Note 3 to entry: For fan inlet (or outlet) sound power testing of equipment with a single inlet (or single outlet), the reference point is the centre of that inlet (or outlet)

**3.1.15****standard air**

air with a density of 1,2 kg/m<sup>3</sup>

Note 1 to entry: Standard air has a ratio of specific heats of 1,4 and a viscosity of 1,815 E-03 Pa·s.

Note 2 to entry: Air at 16 °C dry bulb temperature, 50 % relative humidity and 100 kPa barometric pressure has these properties, but this is not part of the definition.

Note 3 to entry: Air at 20 °C dry bulb temperature, 50 % relative humidity and 101,325 kPa barometric pressure also has these properties but this is not a part of the definition.

**3.2 Fan sound power levels**

Considering all possible combinations for installation conditions specified in [Clause 4](#), twelve different sound power level ( $L_W$ ) descriptions are defined in [Table 1](#), for example  $L_W$  (A,in).

**Table 1 — Sound power levels**

| Number | Suffix     | Description                                                                       |
|--------|------------|-----------------------------------------------------------------------------------|
| 1      | (A,in)     | free-inlet sound power level, installation category A.                            |
| 2      | (A,out)    | free-outlet sound power level; installation category A.                           |
|        |            |                                                                                   |
| 3      | (B,in)     | free-inlet sound power level; installation category B.                            |
| 4      | (B,in+cas) | free-inlet sound power level plus casing-radiated noise; installation category B. |

Table 1 (continued)

| Number | Suffix      | Description                                                                                                                         |
|--------|-------------|-------------------------------------------------------------------------------------------------------------------------------------|
| 5      | (B,out)     | ducted outlet sound power level; installation category B.                                                                           |
| 6      | (C,in)      | ducted inlet sound power level; installation category C.                                                                            |
| 7      | (C,out)     | free-outlet sound power level; installation category C                                                                              |
| 8      | (C,out+cas) | free-outlet sound power level plus casing-radiated noise; installation category C                                                   |
| 9      | (D,in)      | ducted inlet sound power level; installation category D.                                                                            |
| 10     | (D,out)     | ducted outlet sound power level; installation category D.                                                                           |
| 11     | (D,cas)     | casing-radiated sound power level; installation category D.                                                                         |
| 12     | (E,in)      | non-ducted inlet sound power level; installation category E.                                                                        |
| 13     | (E,out)     | non-ducted outlet sound power level; installation category E.                                                                       |
| 14     | (E,cas)     | casing-radiated sound power level; installation category E.                                                                         |
| 15     | (E,tot)     | total sound power level of a fan installation category E (includes the contributions from the inlet, outlet, fan casing and drive). |

NOTE 1 All of these symbols may be used to indicate levels in one-third octave or octave frequency bands as well as overall sound power levels and A-weighted sound power levels, provided that the sound power to which the symbols relate is clearly defined.

Where noise from the drive may contribute to the noise radiated from a casing then this should be clearly stated by the addition of +dr e.g.,  $L_W(D_{cas} + dr)$

NOTE 2 Not all of the above levels need to be measured for a particular fan.

### 3.3 Other symbols

For consistency and mutual understanding, it is recommended that the symbols and units shown in [Table 2](#) be used in reporting and calculation. Unless otherwise noted, the subscript number refers to the mid-frequency of the octave band or one-third octave band number.

Table 2 — Symbols, units

| Symbol    | Term                                                                                   | SI unit          |
|-----------|----------------------------------------------------------------------------------------|------------------|
| $A_1$     | fan inlet area                                                                         | m <sup>2</sup>   |
| $A_2$     | fan outlet area                                                                        | m <sup>2</sup>   |
| $c$       | speed of sound                                                                         | m/s              |
| $dr$      | drive noise                                                                            | dB               |
| $D_r$     | distance between reference box and rectangular measurement surface                     | m                |
| $D_o$     | characteristic acoustic source dimension                                               | m                |
| $D_N$     | nominal diameter of bellmouth/opening in reflecting plane                              | m                |
| $D_{min}$ | minimum distance between equipment under test and reverberant room measurement surface | m                |
| $d$       | duct diameter                                                                          | m                |
| $d_e$     | equivalent diameter (of rectangular duct)                                              | m                |
| $E_o$     | duct outlet end correction                                                             | dB               |
| $E_i$     | duct inlet end correction                                                              | dB               |
| $E_W$     | adjustment to sound power level for duct end correction(s)                             | dB               |
| $f$       | frequency                                                                              | Hz               |
| $h$       | height of centre of orifice above floor level, or above another reflection plane       | m                |
| $I$       | sound intensity                                                                        | W/m <sup>2</sup> |
| $\bar{I}$ | surface average sound intensity                                                        | W/m <sup>2</sup> |

Table 2 (continued)

| Symbol                     | Term                                                                                                     | SI unit        |
|----------------------------|----------------------------------------------------------------------------------------------------------|----------------|
| $I_n$                      | sound intensity $I$ at measurement location $n$                                                          | $\text{W/m}^2$ |
| $I_{\text{ref}}$           | reference intensity, $1 \text{ pW/m}^2$ ( $1 \times 10^{-12} \text{ W/m}^2$ )                            | —              |
| $l_c$                      | measurement surface characteristic dimension (length)                                                    | m              |
| $l_s$                      | measurement surface ratio                                                                                | —              |
| $K_1$                      | background-noise correction                                                                              | dB             |
| $K_2$                      | environmental noise correction                                                                           | dB             |
| $l$                        | dimensions of the reference box                                                                          | m              |
| $L_i$                      | sound intensity level (re. $1 \text{ pW/m}^2$ )                                                          | dB             |
| $\overline{L_i}$           | surface average sound intensity level                                                                    | dB             |
| $L_{\text{if}}$            | fan sound intensity level                                                                                | dB             |
| $\overline{L_{\text{if}}}$ | surface average fan sound intensity level                                                                | dB             |
| $L_{\text{iq}}$            | RSS sound intensity level                                                                                | dB             |
| $\overline{L_{\text{iq}}}$ | surface average RSS sound intensity level                                                                | dB             |
| $L_p$                      | sound pressure level, re $20 \text{ } \mu\text{Pa}$ ( $2 \times 10^{-5} \text{ Pa}$ )                    | dB             |
| $L_{\text{pc}}$            | corrected sound pressure level of the fan                                                                | dB             |
| $L_{\text{pb}}$            | recorded sound pressure level of room background as measured over the normal microphone path             | dB             |
| $\overline{L_{\text{pb}}}$ | background sound pressure level                                                                          | dB             |
| $L_{\text{pbn}}$           | $L_{\text{pb}}$ at measurement location $n$                                                              | dB             |
| $L_{\text{Wrq}}$           | RSS calibration sound power level                                                                        | dB             |
| $L_{\text{pnm}}$           | recorded sound pressure level of fan and room background as measured over the normal microphone path     | dB             |
| $L_{\text{pq}}$            | corrected sound pressure level of the RSS                                                                | dB             |
| $L_{\text{pqm}}$           | recorded sound pressure level of the RSS and room background as measured over the normal microphone path | dB             |
| $L_W$                      | sound power level, re $1 \text{ pW}$ ( $1 \times 10^{-12} \text{ W}$ )                                   | dB             |
| $L_{\text{Wr}}$            | sound power level of RSS                                                                                 | dB             |
| $\lambda$                  | wavelength                                                                                               | m              |
| $M$                        | Mach number                                                                                              | Dimensionless  |
| $p$                        | sound pressure                                                                                           | Pa             |
| $p_{\text{ref}}$           | reference sound pressure, $20 \text{ } \mu\text{Pa}$ ( $2 \times 10^{-5} \text{ Pa}$ )                   | —              |
| $p_s$                      | fan static pressure                                                                                      | Pa             |
| $p_t$                      | fan (total) pressure                                                                                     | Pa             |
| $r$                        | radius of spherical (hemispherical) measurement surface                                                  | m              |
| $r_d$                      | duct area/Orifice area                                                                                   | Dimensionless  |
| $s$                        | standard deviation                                                                                       | dB             |
| $\theta$                   | air temperature                                                                                          | K              |
| $S$                        | measurement surface area                                                                                 | $\text{m}^2$   |
| $S_H$                      | cross-sectional area of a section through the fan in the measurement surface plane                       | $\text{m}^2$   |
| $S_s$                      | portion of measurement surface in contact with discharge flow for fans with outlet orifice               | $\text{m}^2$   |
| $W$                        | sound power                                                                                              | W              |
| $W_{\text{ref}}$           | reference sound power, $1 \text{ pW}$ ( $1 \times 10^{-12} \text{ W}$ )                                  | dB             |
| $z$                        | measurement surface characteristic dimension (height above reflecting plane)                             | m              |
| $\delta_{Wn}$              | convergence index (with $n$ measurement locations)                                                       | dB             |