

Fans for general purposes —

Part 10: Performance testing of jet fans

ICS 23.120

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Foreword

The text of ISO 13350:1999 has been prepared by Technical Committee ISO/TC 117 “Industrial fans” of the International Organization for Standardization (ISO) and has been taken over as EN ISO 13350:2008 by Technical Committee CEN/TC 156 “Ventilation for buildings” the secretariat of which is held by BSI.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by April 2009, and conflicting national standards shall be withdrawn at the latest by April 2009.

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Introduction

The need for this new standard has been evident for some time. The use of the so-called jet fan to assist in controlling the quality of air in vehicle and train tunnels has become increasingly popular. The longitudinal method of ventilation can show advantages in initial cost and running cost compared to alternative systems, and smoke control in emergency conditions can be readily provided. At present, there is no published national or international standard for the performance testing of jet fans.

This International Standard, which forms part of the ISO/TC 117 series of fan standards, 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.

Industrial fans — Performance testing of jet fans

1 Scope

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

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

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Member of IEC and ISO maintain registers for currently valid International Standards.

ISO 1940-1:1986, *Mechanical vibration — Balance quality requirements of rigid rotors — Part 1: Determination of permissible residual unbalance.*

ISO 5801:1997, *Industrial fans — Performance testing using standardized airways.*

ISO 13347:—¹⁾, *Industrial fans — Determination of fan sound power level under standardized laboratory conditions.*

ISO 13349:—¹⁾, *Industrial fans — Vocabulary and definitions of categories.*

ISO 14695:—¹⁾, *Industrial fans — Vibration measurement method.*

IEC 60034-2:1972, *Rotating electrical machines — Part 2: Methods for determining losses and efficiency of rotating electrical machinery from tests (excluding machines for traction vehicles).*

IEC 60034-14:1996, *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.*

¹⁾ To be published.

3 Definitions

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

3.1 effective fan dynamic pressure

ρ_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 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 effective fan outlet area

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

NOTE 1 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 1a).

NOTE 2 If the fan has a silencer without centrebody [see figure 1 b)], 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 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 1c), for the distance between the centrebody and the outlet. Where the motor is on the upstream side, figure 1c) is applied to the impeller hub rather than the motor, as illustrated.

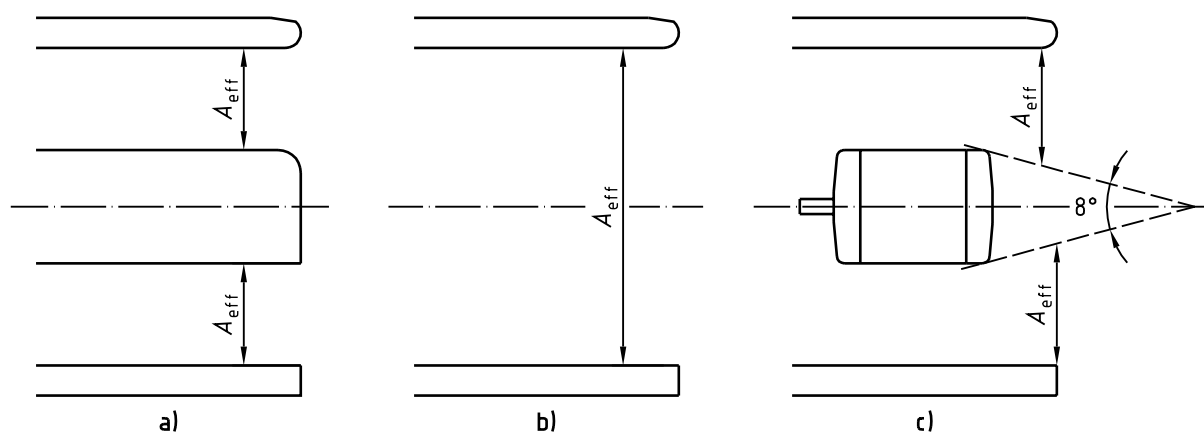


Figure 1 — Effective fan outlet area

3.3 effective fan outlet velocity

V_{eff}
calculated from the thrust, the inlet density and the effective fan outlet area as detailed in 11.2

3.4 fan outlet velocity

in the particular case of a jet fan, inlet volume flow divided by effective fan outlet area, A_{eff}

3.5 fan air power

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

3.6
impeller tip speed

u

peripheral speed of the impeller blade tips

3.7
thrust

T_m, T_c

fan thrust measured or calculated in accordance with this International Standard

3.8
thrust/power ratio

r_t

thrust divided by impeller power

NOTE An alternative definition of thrust/power ratio which has sometimes been used: thrust divided by motor input power. This definition is deprecated, as it will vary according to the motor manufacturer used. It also results in a lower value, as the motor losses are included.

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 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
chamber

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

3.11
test enclosure

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

3.12
impeller balance grade

grade G as specified in ISO 1940-1

3.13
fan vibration velocity

unfiltered r.m.s. vibration velocity over the frequency range 10 Hz to 10 kHz measured in accordance with this International Standard and with ISO 14695

3.14
fan impeller efficiency

η_R

fan air power divided by impeller power

3.15
overall efficiency

η_E

fan air power divided by motor input power

3.16
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

3.17**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

3.18**inlet sound power level** L_{w1}

sound power level of the fan determined at the fan inlet

3.19**outlet sound power level** L_{w2}

sound power level of the fan determined at the fan outlet

3.20**frequency range of interest**

for general purposes, the 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 abbreviations

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

Parameter	Symbol	Unit
Effective fan outlet area	A_{eff}	m^2
Nominal fan diameter	D_R	m
Length of upstream chamber side	D_3	m
Sound pressure level	L_p	dB (ref. 20 Pa)
Sound power level	L_w	dB (ref. 1 pW)
Inlet sound power level	L_{w1}	dB (ref. 1 pW)
Outlet sound power level	L_{w2}	dB (ref. 1 pW)
rotational speed	N	r/s
Differential pressure across a flow measuring device	p	Pa
Effective fan dynamic pressure	p_d	Pa
Volume flow	q_V	m^3/s
Impeller balance grade (ISO 1940-1)	G	m
Thrust/power ratio	r_t	N/kW
Calculated thrust	T_c	N
Measured thrust	T_m	N
Impeller tip speed (see 3.6)	u	m/s
Effective fan outlet velocity	v_{eff}	m/s
Mean throughflow velocity in a tunnel at a specified section	v_t	m/s
Inlet density taken as equal to the density in the test enclosure	ρ	kg/m^3
Overall efficiency	E	—
Motor efficiency	M	—
Fan impeller efficiency	R	—