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Industrial fans — Method of measurement of fan vibration

*Ventilateurs industriels — Méthode de mesure des vibrations des
ventilateurs*



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ISO copyright office
Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 749 09 47
E-mail copyright@iso.org
Web www.iso.org

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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 14695 was prepared by Technical Committee ISO/TC 117, *Industrial fans*.

Introduction

ISO 14695 is a part of a series of standards covering important aspects of fans which affect their design, manufacture and use. This series includes ISO 5801, ISO 5802, ISO 12499, ISO 13347, ISO 13349, ISO 13350, ISO 13351 and ISO 14694.

Vibration is recognized as an important parameter in the description of the mechanical performance of fans. It gives an indication of how well the fan has been designed and constructed and can forewarn of possible operation problems. The problems may be associated with inadequacies in support structures and machine deterioration, etc.

Vibration measurements may be required for a variety of reasons of which the following are the most important:

- a) design/development evaluations;
- b) *in situ* testing;
- c) as information for a condition-monitoring or machinery health programme (ISO 14694 and Annex C gives recommended measuring positions for machinery health measurement);
- d) to inform the designer of associated supporting structures, foundations, ducting systems, etc., of the residual vibration which will be transmitted by the fan into the associated structure;
- e) as a quality assessment at the final inspection stage;
- f) to be sure of acceptability of specific dynamic loading.

All the information which can be obtained from tests conducted in accordance with this International Standard (see Clause 10) is neither necessary nor appropriate for quality-grading purposes. Reference should be made to ISO 14694 for this purpose. Vibration as a consequence of unbalance should be measured at the fan bearings and, in this connection, the recommendations given in ISO 1940-1 should be followed.

Whilst an open inlet/open outlet test may be useful as a quality guide, this International Standard recognizes that the vibration of a fan will be dependent upon the specified aerodynamic duty, which determines the rotational speed and position on the fan characteristic curve.

Although alternative standards exist which deal with the vibration of machines generally (e.g. ISO 10816), they presently have limitations because of their universal nature when considering a specific family of machines such as fans.

This International Standard describes the methods of measurement which will give consistent results and which may be used as a basis for comparison between products. The amount of information which needs to be presented and the preferred units are given in ISO 14694. Such information is dependent on the purpose for which the test has been conducted, the type of fan, its application and its method of mounting in service.

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Industrial fans — Method of measurement of fan vibration

1 Scope

This International Standard describes a method of measuring the vibrational characteristics of fans of all types, except those designed solely for air circulation, for example, ceiling fans and table fans. However, it is limited to fans of all types installed with a power of less than 300 kW. For fans of greater power than this, the methods described in ISO 10816-1 and the applicable limits given in ISO 10816-3 may be used. This International Standard gives a general method only and does not give criteria for interpretation of data (see ISO 14694).

This International Standard specifies the measurement of vibration that may be recorded as overall root-mean-square r.m.s. velocity, acceleration or displacement, or in terms of a frequency spectrum, within the appropriate frequency range. Methods of testing when suspended on elastic ropes or when installed on resilient mountings are included.

It is recognized that the oscillatory forces at mounting points can be a useful measurement for analysing the effects on support structures; but such measurements are outside the scope of this International Standard.

Annexes are given for information. Annex B gives secondary measurement methods which, whilst not recommended for accurate measurements, may be used for assessing the balance of series-produced fans or for comparative site measurements.

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 1940-1, *Mechanical vibration — Balance quality requirements of rigid rotors — Part 1: Specification and verification balance tolerances*

ISO 2041:1990, *Vibration and shock — Vocabulary*

ISO 2954, *Mechanical vibration of rotating and reciprocating machinery — Requirements for instruments for measuring vibration severity*

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

ISO 10816-3, *Mechanical vibration — Evaluation of machine vibration by measurements on non-rotating parts — Part 3: Industrial machines with nominal power above 15 kW and nominal speeds between 120 r/min and 15 000 r/min when measured in situ*

ISO 14694:2003, *Industrial fans — Specification for balance quality and vibration levels*

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 vibration*

IEC 60651, *Sound level meters*

IEC 61260, *Electroacoustics — Octave-band and fractional-octave band filters*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 2041 and the following apply.

- 3.1 background vibration**
all sources of vibration independent of the source
- 3.2 duty point**
<aerodynamic duty> point on the fan performance curve at which a fan operates
- 3.3 fan performance curve**
<fan characteristic> plot of pressure rise developed by the fan against the airflow through a fan
- 3.4 radius of gyration**
measure of the distribution of mass about a chosen axis, given as the square root of the moment of inertia about that axis divided by the mass
- 3.5 resilient mount**
mount with elastic characteristics, and measurable deflection, but no permanent deformation under normal load conditions

4 Symbols and units

For the purposes of this International Standard, the following symbols and units apply.

Symbol	Term	Unit
a	Instantaneous vibration acceleration	m/s ²
a_0	Reference vibration acceleration	m/s ²
A	Vibration acceleration amplitude of peak	m/s ²
A_{dB}	r.m.s. vibration acceleration level above a reference of 10 ⁻⁶ m/s ²	dB
$A_{dB} = 20 \log_{10} \left(\frac{A_{r.m.s.}}{10^{-6}} \right)$		
$A_{r.m.s.}$	r.m.s. vibration-acceleration amplitude	m/s ²
d	Instantaneous vibration displacement	μm, mm or m
D	Vibration displacement amplitude of peak	μm, mm or m