
Industrial fans — Specifications for balance quality and vibration levels

*Ventilateurs industriels — Spécifications pour l'équilibrage et les
niveaux de vibration*



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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 14694 was prepared by Technical Committee ISO/TC 117, *Industrial fans*.

Introduction

ISO 14694 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 13348, ISO 13349, ISO 13350, ISO 13351, ISO 14695 and CEN/BTS 2/AH 17.

This International Standard addresses the needs of both users and manufacturers of fan equipment for a technically accurate but uncomplicated set of information on the subjects of balance precision and vibration levels.

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

Although alternative standards exist which deal with vibration of machines generally (e.g. ISO 10816), they currently have limitations because of their universal nature, when considering a specific family of machines such as fans, with installed powers below 300 kW.

Vibration measurements may therefore 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 14695:2003, Annex C gives recommended measuring positions for machinery health measurement);
- d) to inform the designer of supporting structures, foundations, ducting systems, etc., of the residual vibration which will be transmitted by the fan into the structure;
- e) as a quality assessment at the final inspection stage.

NOTE All the information which can be obtained from tests conducted in accordance with this International Standard (see Clause 10 of ISO 14695:2003) is neither necessary nor appropriate for quality-grading purposes.

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 aerodynamic duty specified, which determines the rotational speed and position on the fan.

This International Standard should be read in conjunction with ISO 10816-1, ISO 10816-3 and ISO 14695 which describe the methods to be used and the positions of the transducers. When information is required on vibration transmitted to ducting connections or foundations, then this is especially important. The gradings included are such as are generally recommended for commercially available fans.

It is important to remember that vibration testing can be extremely expensive, sometimes considerably in excess of the fan's initial cost. Only when the functioning of the installation may be affected should discrete frequency or band limitations be imposed. The number of test points should also be limited according to the usage envisaged. Readings at the fan bearings are of most importance and for normal quality gradings should be sufficient.

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Industrial fans — Specifications for balance quality and vibration levels

1 Scope

This International Standard gives specifications for vibration and balance limits of fans for all applications 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 or to a commercially available standard electric motor with a maximum power of 355 kW (following an R20 series). For fans of greater power than this, the applicable limits are those given in ISO 10816-3. Where the fans in an installation have varying powers both above and below 300 kW, and have been the subject of a single contract, then the manufacturer and purchaser shall agree on the appropriate standard to be used. This should normally be based on the majority of units.

Vibration data may be required for a variety of purposes as detailed in Clause 5.

The International Standard recognizes that vibrational measurements may be recorded as velocity, acceleration or displacement either in absolute units or in decibels above a given reference level. The magnitude of vibration measurements may be affected by assembly practices at balancing machines (see Annex B). The preferred parameter is, however, the velocity, in millimeters per second (mm/s). As the conventions vary in different parts of the world, both r.m.s. (root mean square) and peak-to-peak or peak values are given. It should also be remembered that a fan and its parts may be considered as a spring-mass system. An understanding of this fact helps to resolve most vibrational problems (see Annex D).

Account has also been taken of the fact that factory tests are usually conducted with the fan unconnected to a ducting system, such that its aerodynamic duty may be considerably different from that during normal operation. It may also be supported on temporary foundations of different mass and stiffness to those used in situ. Accordingly, such tests are specified with vibration measured "filter-in". In situ tests are specified "filter-out" and as such represent a measure of overall vibration severity.

This International Standard covers fan equipment with rigid rotors, generally found in: commercial heating, ventilating and air conditioning, industrial processes, mine/tunnel ventilation and power-generation applications. Other applications are not specifically excluded. Excluded are installations which involve severe forces, impacts or extreme temperatures. Any or all portions of this International Standard, or modifications thereof, are subject to agreement between the parties concerned.

Fan-equipment foundations and installation practices are beyond the scope of this International Standard. Foundation design and fan installation are not normally the responsibilities of the fan manufacturer. It is fully expected that the foundations upon which the fan is mounted will provide the support and stability necessary to meet the vibration criteria of the fan as it is delivered from the factory.

Other factors, such as impeller cleanliness, aerodynamic conditions, background vibration, operation at speeds other than those agreed upon, and maintenance of the fan, affect the fan-vibration levels but are beyond the scope of this International Standard.

This International Standard is intended to cover only the balance or vibration of the fan and does not take into account the effect of fan vibration on personnel, equipment or processes.

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 254, *Belt drives — Pulleys — Quality, finish and balance*

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

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

ISO 4863:1984, *Resilient shaft couplings — Information to be supplied by users and manufacturers*

ISO 5348:1998, *Mechanical vibration and shock — Mechanical mounting of accelerometers*

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

ISO 7919-1, *Mechanical vibration of non-reciprocating machines — Measurements on rotating shafts and evaluation criteria — Part 1: General guidelines*

ISO 10816-3:1998, *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 13348:—²⁾, *Industrial fans — Specification of technical data and verification of performance*

ISO 14695:2003, *Industrial fans — Method of measurement of fan vibration*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1

vibration severity

generic term that designates a value, or set of values, such as a maximum value, average or r.m.s. value, or other parameter that is descriptive of the vibration

NOTE 1 The vibration severity may refer to instantaneous values or to average values.

NOTE 2 Adapted from ISO 2041:1990, definition 2.42.

3.2

axis of rotation

instantaneous line about which a body rotates

NOTE 1 If the bearing are anisotropic, there is no stationary axis of rotation.

NOTE 2 In the case of rigid bearings, the axis of rotation is the shaft axis, but if the bearings are not rigid, this axis of rotation is not necessarily the shaft axis.

NOTE 3 Adapted from ISO 1925:2001, definition 1.4.

1) To be published. (Revision of ISO 1940-1:1986)

2) To be published.