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## **Mechanical vibration — Rotor balancing —**

### **Part 12: Procedures and tolerances for rotors with flexible behaviour**

*Vibrations mécaniques — Équilibrage des rotors —*

*Partie 12: Modes opératoires et tolérances pour les rotors à  
comportement flexible*



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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)).

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. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see [www.iso.org/patents](http://www.iso.org/patents)).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT) see the following URL: [Foreword - Supplementary information](#)

The committee responsible for this document is ISO/TC 108, *Mechanical vibration, shock and condition monitoring*, Subcommittee SC 2, *Measurement and evaluation of mechanical vibration and shock as applied to machines, vehicles and structures*.

This first edition of ISO 21940-12 cancels and replaces ISO 11342:1998, which has been technically revised. The main changes are deletion of the terms and definitions which were transferred to ISO 21940-2 and deletion of former Annex F which is a duplication of a part of [D.1](#). It also incorporates the Technical Corrigendum ISO 11342:1998/Cor.1:2000.

ISO 21940 consists of the following parts, under the general title *Mechanical vibration — Rotor balancing*:

- *Part 11: Procedures and tolerances for rotors with rigid behaviour*<sup>1)</sup>
- *Part 12: Procedures and tolerances for rotors with flexible behaviour*<sup>2)</sup>
- *Part 13: Criteria and safeguards for the in-situ balancing of medium and large rotors*<sup>3)</sup>
- *Part 14: Procedures for assessing balance errors*<sup>4)</sup>
- *Part 21: Description and evaluation of balancing machines*<sup>5)</sup>

1) Revision of ISO 1940-1:2003 + Cor.1:2005, *Mechanical vibration — Balance quality requirements for rotors in a constant (rigid) state — Part 1: Specification and verification of balance tolerances*

2) Revision of ISO 11342:1998 + Cor.1:2000, *Mechanical vibration — Methods and criteria for the mechanical balancing of flexible rotors*

3) Revision of ISO 20806:2009, *Mechanical vibration — Criteria and safeguards for the in-situ balancing of medium and large rotors*

4) Revision of ISO 1940-2:1997, *Mechanical vibration — Balance quality requirements of rigid rotors — Part 2: Balance errors*

5) Revision of ISO 2953:1999, *Mechanical vibration — Balancing machines — Description and evaluation*

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- *Part 23: Enclosures and other protective measures for the measuring station of balancing machines*<sup>6)</sup>
- *Part 31: Susceptibility and sensitivity of machines to unbalance*<sup>7)</sup>
- *Part 32: Shaft and fitment key convention*<sup>8)</sup>

The following part is under preparation:

- *Part 2: Vocabulary*<sup>9)</sup>

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6) Revision of ISO 7475:2002, *Mechanical vibration — Balancing machines — Enclosures and other protective measures for the measuring station*

7) Revision of ISO 10814:1996, *Mechanical vibration — Susceptibility and sensitivity of machines to unbalance*

8) Revision of ISO 8821:1989, *Mechanical vibration — Balancing — Shaft and fitment key convention*

9) Revision of ISO 1925:2001, *Mechanical vibration — Balancing — Vocabulary*

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## Introduction

The aim of balancing any rotor is to achieve satisfactory running when installed *in-situ*. In this context, “satisfactory running” means that not more than an acceptable magnitude of vibration is caused by the unbalance remaining in the rotor. In the case of a rotor with flexible behaviour, it also means that not more than an acceptable magnitude of deflection occurs in the rotor at any speed up to the maximum service speed.

Most rotors are balanced in manufacture prior to machine assembly because afterwards, for example, there might be only limited access to the rotor. Furthermore, balancing of the rotor is often the stage at which a rotor is approved by the purchaser. Thus, while satisfactory running *in-situ* is the aim, the balance quality of the rotor is usually initially assessed in a balancing machine. Satisfactory running *in-situ* is, in most cases, judged in relation to vibration from all causes, while in the balancing machine, primarily, once-per-revolution effects are considered.

This part of ISO 21940 classifies rotors in accordance with their balancing requirements and establishes methods of assessment of residual unbalance.

This part of ISO 21940 also shows how criteria for use in the balancing machine can be derived from either vibration limits specified for the assembled and installed machine or unbalance limits specified for the rotor. If such limits are not available, this part of ISO 21940 shows how they can be derived from ISO 10816 and ISO 7919 if desired in terms of vibration, or from ISO 21940-11, if desired in terms of permissible residual unbalance. ISO 21940-11 is concerned with the balance quality of rotating rigid bodies and is not directly applicable to rotors with flexible behaviour because rotors with flexible behaviour can undergo significant bending deflection. However, in this part of ISO 21940, methods are presented for adapting the criteria of ISO 21940-11 to rotors with flexible behaviour.

There are situations in which an otherwise acceptably balanced rotor experiences an unacceptable vibration level *in situ*, owing to resonances in the support structure. A resonance or near resonance condition in a lightly damped structure can result in excessive vibratory response to a small unbalance. In such cases, it can be more practicable to alter the natural frequency or damping of the structure rather than to balance to very low levels, which might not be maintainable over time (see also ISO 21940-31).