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**Mechanical vibration — Rotor  
balancing —**

Part 21:  
**Description and evaluation of balancing  
machines**

*Vibrations mécaniques — Équilibrage des rotors —*

*Partie 21: Description et évaluation des machines à équilibrer*





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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 21940-21 was prepared by Technical Committee 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 21940-21 cancels and replaces ISO 2953:1999, of which it constitutes an editorial revision. The main change is that for all definitions, reference is made to ISO 1925. Additionally, the Scope has been reworded in order to exactly reflect what this part of ISO 21940 is dealing with. Furthermore, some rough rounding in the numbers given in the Tables has been smoothened, and some Figures drawn more exactly.

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

- *Part 1: Introduction*<sup>1)</sup>
- *Part 2: Vocabulary*<sup>2)</sup>
- *Part 11: Procedures and tolerances for rotors with rigid behaviour*<sup>3)</sup>
- *Part 12: Procedures and tolerances for rotors with flexible behaviour*<sup>4)</sup>
- *Part 13: Criteria and safeguards for the in-situ balancing of medium and large rotors*<sup>5)</sup>

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<sup>1)</sup> Revision of ISO 19499:2007, *Mechanical vibration — Balancing — Guidance on the use and application of balancing standards*

<sup>2)</sup> Revision of ISO 1925:2001, *Mechanical vibration — Balancing — Vocabulary*

<sup>3)</sup> 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*

<sup>4)</sup> Revision of ISO 11342:1998 + Cor.1:2000, *Mechanical vibration — Methods and criteria for the mechanical balancing of flexible rotors*

<sup>5)</sup> Revision of ISO 20806:2009, *Mechanical vibration — Criteria and safeguards for the in-situ balancing of medium and large rotors*

- *Part 14: Procedures for assessing balance errors*<sup>6)</sup>
- *Part 21: Description and evaluation of balancing machine*<sup>7)</sup>
- *Part 23: Enclosures and other protective measures for the measuring station of balancing machines*<sup>8)</sup>
- *Part 31: Susceptibility and sensitivity of machines to unbalance*<sup>9)</sup>
- *Part 32: Shaft and fitment key convention*<sup>10)</sup>

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<sup>6)</sup> Revision of ISO 1940-2:1997, *Mechanical vibration — Balance quality requirements of rigid rotors — Part 2: Balance errors*

<sup>7)</sup> Revision of ISO 2953:1999, *Mechanical vibration — Balancing machines — Description and evaluation*

<sup>8)</sup> Revision of ISO 7475:2002, *Mechanical vibration — Balancing machines — Enclosures and other protective measures for the measuring station*

<sup>9)</sup> Revision of ISO 10814:1996, *Mechanical vibration — Susceptibility and sensitivity of machines to unbalance*

<sup>10)</sup> Revision of ISO 8821:1989, *Mechanical vibration — Balancing — Shaft and fitment key convention*



# Mechanical vibration — Rotor balancing —

## Part 21:

## Description and evaluation of balancing machines

### 1 Scope

This part of ISO 21940 specifies requirements for evaluating the performance of machines for balancing rotating components by the following tests:

- a) test for minimum achievable residual unbalance,  $U_{\text{mar}}$  test;
- b) test for unbalance reduction ratio, URR test;
- c) test for couple unbalance interference on single-plane machines;
- d) compensator test.

These tests are performed during acceptance of a balancing machine and also later, on a periodic basis, to ensure that the balancing machine is capable of handling the actual balancing tasks. For periodic tests, simplified procedures are specified. Tests for other machine capacities and performance parameters, however, are not contained in this part of ISO 21940.

For these tests, three types of specially prepared proving rotors are specified, covering a wide range of applications on horizontal and vertical balancing machines. An annex describes recommended modifications of proving rotors prepared in accordance with ISO 2953:1985.<sup>[2]</sup>

Moreover, this part of ISO 21940 also stresses the importance attached to the form in which the balancing machine characteristics are specified by the manufacturer. Adoption of the format specified enables users to compare products from different manufacturers. Additionally, in an annex, guidelines are given on the information by which users provide their data and requirements to a balancing machine manufacturer.

This part of ISO 21940 is applicable to balancing machines that support and rotate rotors with rigid behaviour at balancing speed and that indicate the amounts and angular locations of a required unbalance correction in one or more planes. Therefore, it is applicable to rotors with rigid behaviour as well as to rotors with shaft-elastic behaviour balanced in accordance with low-speed balancing procedures. It covers both soft-bearing balancing machines and hard-bearing balancing machines. Technical requirements for such balancing machines are included; however, special features, such as those associated with automatic correction, are excluded.

This part of ISO 21940 does not specify balancing criteria; such criteria are specified in ISO 1940-1<sup>[1]</sup> and ISO 11342<sup>[3]</sup> (only low-speed balancing procedures apply).

## 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 1925, *Mechanical vibration — Balancing — Vocabulary*<sup>11)</sup>

## 3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 1925 apply.

## 4 Capacity and performance data of the balancing machine

### 4.1 General

The manufacturer shall specify the data listed in 4.2 for horizontal or 4.3 for vertical balancing machines, as applicable, and in a similar format.

NOTE Information provided by the user to the balancing machine manufacturer is summarized in Annex A.

### 4.2 Data for horizontal balancing machines

#### 4.2.1 Rotor mass and unbalance limitations

**4.2.1.1** The maximum mass of a rotor,  $m$ , which can be balanced shall be stated over the range of balancing speeds ( $n_1$ ,  $n_2$ , ...).

The maximum moment of inertia of a rotor with respect to the shaft axis,  $m r^2$ , where  $m$  is the rotor mass and  $r$  is the radius of gyration, which the machine can accelerate in a stated acceleration time shall be given for the range of balancing speeds ( $n_1$ ,  $n_2$ , ...) together with the corresponding cycle rate (see Table 1).

**4.2.1.2** Production efficiency (see Clause 7) shall be stated, as follows.

**4.2.1.2.1** Time per measuring run:

- |  |   |
|--|---|
| a) Time for mechanical adjustment: .....                           | S |
| b) Time for setting indicating system: .....                       | S |
| c) Time for preparation of rotor: .....                            | S |
| d) Average acceleration time: .....                                | S |
| e) Reading time (including time to stabilize): .....               | S |
| f) Average deceleration time: .....                                | S |
| g) Relating readings to rotor: .....                               | S |
| h) Other necessary time: .....                                     | S |
| i) Total time per measuring run [a) to h) in the preceding]: ..... | S |

<sup>11)</sup> To become ISO 21940-2 when revised.