
**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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Contents

Page

Foreword	v
Introduction	vii
1 Scope	1
2 Normative references	1
3 Terms and definitions	1
4 Fundamentals of dynamics and balancing of rotors with flexible behaviour	2
4.1 General	2
4.2 Unbalance distribution	2
4.3 Mode shapes of rotors with flexible behaviour	2
4.4 Response of a rotor with flexible behaviour to unbalance	3
4.5 Aims of balancing rotors with flexible behaviour	4
4.6 Provision for correction planes	5
4.7 Coupled rotors	5
5 Rotor configurations	5
6 Procedures for balancing rotors with flexible behaviour at low speed	7
6.1 General	7
6.2 Selection of correction planes	8
6.3 Service speed of the rotor	8
6.4 Initial unbalance	8
6.5 Low-speed balancing procedures	8
6.5.1 Procedure A — Single-plane balancing	8
6.5.2 Procedure B — Two-plane balancing	8
6.5.3 Procedure C — Individual component balancing prior to assembly	9
6.5.4 Procedure D — Balancing subsequent to controlling initial unbalance	9
6.5.5 Procedure E — Balancing in stages during assembly	9
6.5.6 Procedure F — Balancing in optimum planes	10
7 Procedures for balancing rotors with flexible behaviour at high speed	10
7.1 General	10
7.2 Installation for balancing	10
7.3 Procedure G — Multiple speed balancing	11
7.3.1 General	11
7.3.2 Initial low-speed balancing	11
7.3.3 General procedure	11
7.4 Procedure H — Service speed balancing	13
7.5 Procedure I — Fixed speed balancing	14
7.5.1 General	14
7.5.2 Procedure	14
8 Evaluation criteria	14
8.1 Choice of criteria	14
8.2 Vibration limits in the balancing machine	15
8.2.1 Overview	15
8.2.2 General	15
8.2.3 Special cases and exceptions	15
8.2.4 Factors influencing machine vibration	15
8.2.5 Critical clearances and complex machine systems	16
8.2.6 Permissible vibrations in the balancing machine	16
8.3 Residual unbalance tolerances	17
8.3.1 Overview	17
8.3.2 General	17
8.3.3 Limits for low-speed balancing	17
8.3.4 Limits for multiple speed balancing	18

9	Evaluation procedures	18
9.1	Evaluation procedures based on vibration limits	18
9.1.1	Vibration assessed in a high-speed balancing machine	18
9.1.2	Vibration assessed on a test facility	19
9.1.3	Vibration assessed on site	19
9.2	Evaluation based on residual unbalance tolerances	20
9.2.1	General	20
9.2.2	Evaluation at low speed	20
9.2.3	Evaluation at multiple speeds based on modal unbalances	20
9.2.4	Evaluation at service speed in two specified test planes	21
Annex A	(informative) Cautionary notes concerning rotors when installed <i>in-situ</i>	23
Annex B	(informative) Optimum planes balancing — Low-speed three-plane balancing	24
Annex C	(informative) Conversion factors	26
Annex D	(informative) Example calculation of equivalent residual modal unbalances	27
Annex E	(informative) Procedures to determine whether a rotor shows rigid or flexible behaviour	30
Annex F	(informative) Method of computation of unbalance correction	32
Bibliography		33

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).

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).

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

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*

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

The following part is under preparation:

- *Part 2: Vocabulary*⁹⁾

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*

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).

Mechanical vibration — Rotor balancing —

Part 12:

Procedures and tolerances for rotors with flexible behaviour

1 Scope

This part of ISO 21940 presents typical configurations of rotors with flexible behaviour in accordance with their characteristics and balancing requirements, describes balancing procedures, specifies methods of assessment of the final state of balance, and establishes guidelines for balance quality criteria.

This part of ISO 21940 can also serve as a basis for more involved investigations, e.g. when a more exact determination of the required balance quality is necessary. If due regard is paid to the specified methods of manufacture and balance tolerances, satisfactory running conditions can be expected.

This part of ISO 21940 is not intended to serve as an acceptance specification for any rotor, but rather to give indications of how to avoid gross deficiencies and unnecessarily restrictive requirements.

Structural resonances and modifications thereof lie outside the scope of this part of ISO 21940.

The methods and criteria given are the result of experience with general industrial machinery. It is possible that they are not directly applicable to specialized equipment or to special circumstances. Therefore, in some cases, deviations from this part of ISO 21940 are possible.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 1925¹⁰⁾, *Mechanical vibration — Balancing — Vocabulary*

ISO 2041, *Mechanical vibration, shock and condition monitoring — Vocabulary*

ISO 21940-11¹¹⁾, *Mechanical vibration — Rotor balancing — Part 11: Procedures and tolerances for rotors with rigid behaviour*

ISO 21940-14, *Mechanical vibration — Rotor balancing — Part 14: Procedures for assessing balance errors*

ISO 21940-32, *Mechanical vibration — Rotor balancing — Part 32: Shaft and fitment key convention*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 1925 and ISO 2041 apply.

10) To become ISO 21940-2 when revised.

11) To be published.