ASA/ANSI S2.81-2019/Part 12/ ISO 21940-12:2016

AMERICAN NATIONAL STANDARD

Mechanical vibration — Rotor balancing — Part 12: Procedures and tolerances for rotors with flexible behaviour

(a nationally adopted international standard)

Secretariat:

Acoustical Society of America

Approved on September 24, 2019:

American National Standards Institute, Inc.

Abstract

This nationally adopted international standard 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. 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. 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 document. 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 document are possible.

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Accredited Standards Committee S2, Mechanical Vibration and Shock

Standards Secretariat
Acoustical Society of America
1305 Walt Whitman Road
Melville, NY 11747

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Foreword

[*This Foreword is for information only and is not a part of the American National Standard ANSI/ASA S2.81-2019/* Part 12/ISO 21940-12:2016 American National Standard Mechanical vibration – Rotor balancing – Part 12: Procedures and tolerances for rotors with flexible behaviour (a nationally adopted international standard)*. As such, this Foreword may contain material that has not been subjected to public review or a consensus process. In addition, it does not contain requirements necessary for conformance to the standard.*]

This standard comprises a part of a group of definitions, standards, and specifications for use in mechanical vibration and shock. It was developed and approved by Accredited Standards Committee S2 Mechanical Vibration and Shock under its approved operating procedures. Those procedures have been accredited by the American National Standards Institute (ANSI). The Scope of Accredited Standards Committee S2 is as follows:

> *Standards, specification, methods of measurement and test, and terminology in the field of mechanical vibration and shock, and condition monitoring and diagnostics of machines, including the effects of exposure to mechanical vibration and shock on humans, including those aspects which pertain to biological safety, tolerance and comfort.*

This standard is an identical national adoption of ISO 21940-12:2016 Mechanical vibration — Rotor balancing —Part 12: Procedures and tolerances for rotors with flexible behaviour, which was prepared by ISO/TC 108/SC 2.

The ANSI/ASA equivalents to ISO/IEC standards referenced herein are given below:

- ANSI/ASA S2.1/ISO 2041 is an identical national adoption of ISO 2041.
- ANSI/ASA S2.80/Part 1/ISO 20816-1 is an identical national adoption of ISO 20816-1.
- ANSI/ASA S2.81/Part 11/ISO 21940-11 is an identical national adoption of ISO 21940-11.
- ANSI/ASA S2.81/Part 14/ISO 21940-14 is an identical national adoption of ISO 21940-14.

At the time this Standard was submitted to Accredited Standards Committee S2, Mechanical Vibration and Shock for approval, the membership was as follows:

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George Johnson
Robert Koch
Richard J. Peppin
Donald Wasserman

Working Group S2/WG 10, Operational Monitoring and Condition Evaluation, which assisted Accredited Standards Committee S2, Mechanical Vibration and Shock, in the development of this standard, had the following membership.

Max L'vov, Chair

David P. Butchy	Mark T. McGown	Thomas Turek
Art J. Cautilli	John Niemkiewicz	John J. Weil
Eric J. Lambert	Rajagopal Subbiah	Marion Williams

Suggestions for improvements to this standard will be welcomed. They should be sent to Accredited Standards Committee S2, Mechanical Vibration and Shock, in care of the Standards Secretariat of the Acoustical Society of America, 1305 Walt Whitman Road, Suite 300, Melville, New York 11747. Telephone: 631-390-0215; FAX: 631-923-2875; E-mail: asastds@acousticalsociety.org.

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).

American National Standard

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 1925[1], *Mechanical vibration — Balancing — Vocabulary*

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

ISO 21940-11[2], *Mechanical vibration — Rotor balancing — Part 11: Procedures and tolerances for rotors with rigid behaviour*

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[1] To become ISO 21940-2 when revised.