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American National Standard

Mechanical Vibration—Balance Quality Requirements of Rigid Rotors, Part 1: Determination of Permissible Residual Unbalance, Including Marine Applications

Secretariat
Acoustical Society of America

Approved 3 August 1999
American National Standards Institute, Inc.

Abstract

This Standard is the U.S. parallel to ISO 1940-1:1986, Mechanical vibration—Balance quality requirements of rigid rotors—Part 1: Determination of permissible residual unbalance. It is a revised version of the prior Standard ANSI S2.19-1989, American National Standard Mechanical Vibration—Balance Quality Requirements of Rigid Rotors, Part 1: Determination of Permissible Residual Unbalance, and contains recommended balance tolerances for various types of rotors and a detailed explanation of how they are to be understood for selected rotor planes. This document also deals with methods of allocating the recommended permissible residual unbalance to rotors with narrowly spaced, overhung, and/or unsymmetrically located correction planes. Various representations of the same unbalance in a rigid rotor are illustrated, limitations on the deviation from the recommended tolerances are suggested, the method of determining the residual unbalance in a given rotor plane without having to rely on the balancing machine calibration is described, and errors resulting from end-drive to the rotor are identified. Requirements for marine applications have been incorporated into table 1 by specifying balance quality grade, \( G \), requirements. Clause 10.1, Balancing Report, states what information a report should include about the balancing machine used. An appendix describes a general method for two-plane balancing.
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Foreword

[This foreword is for information only and is not a part of ANSI S2.19-1999, American National Standard Mechanical Vibration—Balance Quality Requirements of Rigid Rotors, Part 1: Determination of Permissible Residual Unbalance, Including Marine Applications.]

This Standard was developed under the jurisdiction of Accredited Standards Committee S2, Mechanical Vibration and Shock, using the American National Standards Institute (ANSI) Accredited Standards Committee Procedures. The Acoustical Society of America provides the Secretariat for Accredited Standards Committee S2, Mechanical Vibration and Shock. This Standard is the national parallel to ISO 1940-1:1986, Mechanical vibration—Balance quality requirements of rigid rotors—Part 1: Determination of permissible residual unbalance.

Accredited Standards Committee S2, Mechanical Vibration and Shock, under whose jurisdiction this Standard was developed, has the following scope:

Standards, specifications, methods of measurement and test, and terminology in the fields of mechanical vibration and shock and condition monitoring and diagnostics of machines, but excluding those aspects which pertain to biological safety, tolerance, and comfort.

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

D. J. Evans, Chair
R. F. Taddeo, Vice Chair
A. Brenig, Secretary

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Suggestions for improvements of this Standard will be welcomed. Send suggestions for improvement to Accredited Standards Committee S2, Mechanical Vibration and Shock, in care of the ASA Standards Secretariat, 120 Wall Street, 32nd Floor, New York, NY 10005-3993, USA.

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American National Standard

Mechanical Vibration—
Balance Quality
Requirements of Rigid
Rotors, Part 1:
Determination of
Permissible Residual
Unbalance, Including
Marine Applications

0 Introduction

Balancing is the process of attempting to improve
the mass distribution of a body so that it rotates in
its bearings without unbalanced centrifugal forces.
Of course, this aim can be attained only to a cer-
tain degree; even after balancing, the rotor will
possess residual unbalance.

The measuring equipment available today enables
unbalance to be reduced to low limits. However, it
would be uneconomical to exaggerate the quality
requirements. It has therefore become necessary
to determine to what extent the unbalance should
be reduced, and where the optimum economic and
technical compromise on balance quality require-
ments would be struck.

It is not readily possible to draw conclusions as to
the permissible residual unbalances from any ex-
isting recommendations on the assessment of the
vibratory state of machinery, since there is often
no easily recognizable relation between the rotor
unbalance and the machine vibrations under oper-
ating conditions. The amplitude of the once-per-
revolution vibrations is influenced by characteris-
tics of the rotor, the machine, the structure and the
foundation, and by the proximity of the service
speed to the various resonance frequencies, etc.
Moreover, the machine vibrations may be due only
in part to the presence of rotor unbalance.

1 Scope and field of application

This part of S2.19 gives recommendations for de-
termining unbalance and for specifying related
quality requirements of rigid rotors. It specifies

(a) a representation of unbalance in one or two
planes;

(b) methods for determining permissible re-
sidual unbalance;

(c) methods for allocating it to the correction
planes;

(d) methods for identifying the residual unbal-
ance state of a rotor by measurement;

(e) a summary of errors associated with the re-
sidual unbalance identification.

In table 1 and figure 2 recommendations are given,
based on worldwide experience, concerning the
balance quality requirements of rigid rotors, ac-
cording to their type, mass, and maximum service
speed.

This part of S2.19 is also intended to facilitate the
relations between manufacturer and user of ma-
chines. Terminology specified in this part of S2.19
may be used for establishing technical specifica-
tions. [For definitions, see ANSI S2.7.]

Detailed consideration of errors associated with
the determination of residual unbalance is not in-
cluded in this standard. Nor does this standard de-
fine permissible residual unbalances for flexible ro-
tors; these are covered in ANSI S2.43. The
methods for balancing are not described.

The recommended balance quality grades are not
intended to serve as acceptance specifications for
any rotor group, but rather to give indications of
how to avoid gross deficiencies as well as exag-
gerated or unattainable requirements; they may
also serve as a basis for more involved investiga-
tions, for example, when a more exact determina-
tion of the required balance quality by measure-
ment in the laboratory or in the field is necessary.
If due regard is paid to the recommended limits,
satisfactory running conditions can most probably
be expected. However, there may be cases when
deviations from these recommendations become
necessary, e.g., because of unusual construction
or geometry.