AMERICAN NATIONAL STANDARD

Mechanical vibration — Measurement and evaluation of machine vibration — Part 2: Land-based gas turbines, steam turbines and generators in excess of 40 MW, with fluid-film bearings and rated speeds of 1 500 r/min, 1 800 r/min, 3 000 r/min and 3 600 r/min (a nationally adopted international standard)

ANSI/ASA S2.80-2019/Part 2/ ISO 20816-2:2017

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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Secretariat:

Acoustical Society of America

Approved September 24, 2019 by:

American National Standards Institute, Inc.

Abstract

This nationally adopted international standard is applicable to land-based gas turbines, steam turbines and generators (whether coupled with gas and/or steam turbines) with power outputs greater than 40 MW, fluid-film bearings and rated speeds of 1 500 r/min, 1 800 r/min, 3 000 r/min or 3 600 r/min. The criteria provided in this document can be applied to the vibration of the gas turbine, steam turbine and generator (including synchronizing clutches). This document establishes provisions for evaluating the severity of the following *in-situ*, broad-band vibration: a) structural vibration at all main bearing housings or pedestals measured radial (i.e. transverse) to the shaft axis; b) structural vibration at thrust bearing housings measured in the axial direction; c) vibration of rotating shafts radial (i.e. transverse) to the shaft axis at, or close to, the main bearings.

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The Acoustical Society of America (ASA) provides the Secretariat for Accredited Standards Committees S1 on Acoustics, S2 on Mechanical Vibration and Shock, S3 on Bioacoustics, S3/SC 1 on Animal Bioacoustics, and S12 on Noise. These committees have wide representation from the technical community (manufacturers, consumers, trade associations, organizations with a general interest, and government representatives). The standards are published by the Acoustical Society of America through the American Institute of Physics as American National Standards after approval by their respective Standards Committees and the American National Standards Institute (ANSI).

These standards are developed and published as a public service to provide standards useful to the public, industry, and consumers, and to Federal, State, and local governments.

Each of the accredited Standards Committees (operating in accordance with procedures approved by ANSI) is responsible for developing, voting upon, and maintaining or revising its own Standards. The ASA Standards Secretariat administers Committee organization and activity and provides liaison between the Accredited Standards Committees and ANSI. After the Standards have been produced and adopted by the Accredited Standards Committees, and approved as American National Standards by ANSI, the ASA Standards Secretariat arranges for their publication and distribution.

An American National Standard implies a consensus of those substantially concerned with its scope and provisions. Consensus is established when, in the judgment of the ANSI Board of Standards Review, substantial agreement has been reached by directly and materially affected interests. Substantial agreement means much more than a simple majority, but not necessarily unanimity. Consensus requires that all views and objections be considered and that a concerted effort be made towards their resolution.

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NOTICE: This American National Standard may be revised or withdrawn at any time. The procedures of the American National Standards Institute require that action be taken periodically to reaffirm, revise, or withdraw this Standard.

Acoustical Society of America
Standards Secretariat
1305 Walt Whitman Road, Suite 300
Melville, New York 11747
Telephone: 1 (631) 390-0215
Fax: 1 (631) 923-2875
E-mail: asastds@acousticalsociety.org

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Foreword

[*This Foreword is for information only and is not a part of the American National Standard ANSI/ASA S2.80-2019/* Part 2/ISO 20816-2:2017 American National Standard Mechanical vibration – Measurement and evaluation of machine vibration – Part 2: Land-based gas turbines, steam turbines and generators in excess of 40 MW, with fluid-film bearings and rated speeds of 1 500 r/min, 1 800 r/min, 3 000 r/min and 3 600 r/min (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 20816-2:2012 Mechanical vibration – Measurement and evaluation of machine vibration – Part 2: Land-based gas turbines, steam turbines and generators in excess of 40 MW, with fluid-film bearings and rated speeds of 1 500 r/min, 1 800 r/min, 3 000 r/min and 3 600 r/min, which was prepared by ISO/TC 108/SC 2.

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

- ANSI/ASA S2.80-2019/Part 1/ISO 20816-1:2016 is an identical national adoption of ISO 20816-1:2016
- ANSI/ASA S2.81/ISO 21940 Parts 2, 11, 12, and 14 are identical national adoptions of ISO 21940-2:2017, ISO 21940-11:2017, ISO 21940-12:2016, and ISO 21940-14:2012, respectively.

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

James T. Nelson, *Chair*
Richard J. Peppin, *Vice-Chair*

Nancy A. Blair-DeLeon, *Secretary*

Acoustical Society of America ..... James T. Nelson
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Siemens Power Generation, Inc. ..... Max L'vov

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U.S. Army Public Health Command ..... Steven Chervak
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..... Diedre Gilmer (Alt.)

University of Washington ..... Peter Johnson

VibeTech, Inc. ..... Jeff Leismer

Vibration Institute ..... Ronald L. Eshleman
..... Brian Biby (Alt.)

Z-R Consulting ..... Zlatan Racic
..... Marin Racic (Alt.)

Individual Experts of Accredited Standards Committee S2, Mechanical Vibration and Shock, were:

Anthony Brammer
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

ISO 20816-1 provides the general requirements for evaluating the vibration of various machine types when the vibration measurements are made on both non-rotating and rotating parts. This document provides specific provisions for assessing the vibration of the bearing housings or pedestals and rotating shafts of large, land-based gas turbines, steam turbines and generators. Measurements at these locations characterize the state of vibration reasonably well. Evaluation criteria, based on previous experience, are presented. These can be used for assessing the vibratory condition of such machines. It should be noted that in those cases where there is a high ratio between the mass of the bearing supports and the rotor, lower values of vibration of the bearing housings or pedestals can be appropriate.

Two criteria are provided for assessing the machine vibration when operating under steady-state conditions. One criterion considers the magnitude of the observed vibration; the second considers changes in the magnitude. In addition, different criteria are provided for transient operating conditions.

The evaluation procedures presented in this document are based on broad-band measurements. However, because of advances in technology, the use of narrow-band measurements or spectral analysis has become increasingly widespread, particularly for the purposes of vibration evaluation, condition monitoring and diagnostics. The specification of criteria for such measurements is beyond the scope of this document. They are dealt with in greater detail in the relevant parts of ISO 13373 which establish provisions for the vibration condition monitoring of machines.

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1 Scope

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a) structural vibration at all main bearing housings or pedestals measured radial (i.e. transverse) to the shaft axis;

b) structural vibration at thrust bearing housings measured in the axial direction;

c) vibration of rotating shafts radial (i.e. transverse) to the shaft axis at, or close to, the main bearings.

These are in terms of the following:

— vibration under normal steady-state operating conditions;

— vibration during other (non-steady-state) conditions when transient changes are taking place, including run up or run down, initial loading and load changes;

— changes in vibration which can occur during normal steady-state operation.

This document is not applicable to the following:

i) electromagnetic excited vibration with twice line frequency at the generator stator windings, core and housing;

ii) aero-derivative gas turbines (including gas turbines with dynamic properties similar to those of aero-derivatives);

NOTE ISO 3977-3 defines aero-derivatives as aircraft propulsion gas generators adapted to drive mechanical, electrical or marine propulsion equipment. Large differences exist between heavy-duty and