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Standards Secretariat
Acoustical Society of America
335 East 45th Street
New York, New York 10017

AMERICAN NATIONAL STANDARD Techniques of Machinery Vibration Measurement

ABSTRACT

This standard is concerned with vibration measurement quantities, equipment, and procedures involved in operating machinery. Calibration of vibration measurement and calibration equipment are discussed in the document. The standard has application to preventive maintenance programs, equipment selection, and equipment quality.

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AMERICAN NATIONAL STANDARDS ON ACOUSTICS

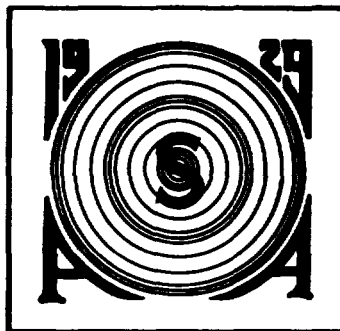
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This Standard was approved by the American National Standards Institute as ANSI S2.17-1980 on 22 May 1980.

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FOREWORD

[This foreword is not a part of American National Standard Techniques of Machinery Vibration Measurement, S2.17-1980]

The proposed standard provides a basis for the measurement of rectilinear machinery vibration. The standard can be applied by manufacturers and users of mechanical, electrical, and hydraulic machinery as well as others interested in measuring vibration. Specifically, it can be applied by:

- (1) Machinery manufacturers for preshipment inspection and evaluation of machines.
- (2) Machinery purchasers for incoming inspection and start-up evaluation of machines.
- (3) Operating personnel for periodic or continuous check of the mechanical condition of machines.
- (4) Operating personnel for troubleshooting the source of suspected incipient machinery defects.
- (5) Research, design, and engineering personnel for investigation, evaluation, and testing of new machinery products.
- (6) Operating personnel for postoverhaul or repair check on the mechanical condition of machines.

Use of the standard will facilitate the establishment of accurate baseline machinery vibration data and the meaningful comparison of vibration data measured on various machines. The standard, when used with other appropriate American National Standard Institute documents, will permit quantitative evaluation of the mechanical condition of a vibrating machine.

The scope of this standard has been broadened from earlier drafts to reflect the interdependence of measurement and analysis and to include all commonly accepted measurement quantities: displacement, velocity, and acceleration. It is recognized that the type, accuracy, and quantity of analysis and measurement will vary with the requirements of each measurement program. However, where vibration measurements are performed according to procedures described in this standard, there will be a high degree of commonality among all such measurements.

This standard has been developed under the jurisdiction of American National Standards Committee S2 using the American National Standards Institute (ANSI) Standards Committee Procedure. The Acoustical Society of America holds the Secretariat for Committee S2. This standard has been approved for publication by ANSI and by the Acoustical Society of America Committee on Standards (ASACOS).

The S2 Standards Committee on Mechanical Shock and Vibration, 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 shock and vibration, but excluding those aspects which pertain to biological safety, tolerance, and comfort.

At the time this standard was submitted to Standards Committee S2 for approval, the membership was as follows:

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Society of Automotive Engineers ● S. Rubin, M.L. Stoner (*Alt*)
Society of Experimental Stress Analysis ● E.G. Fischer
Telephone Group ● J.P. White
U.S. Department of the Air Force (liaison) ● R. Bingman, R.F. Wilkus (*Alt*), J.P. Henderson (*Alt*)

U.S. Army Electronics Command ● O.A. Biamonte
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Individual members of the S2 committee were

L. Batchelder
K.M. Eldred
R. Eshleman

E.E. Gross, Jr.
W. Melnick
A.O. Sykes

H.E. von Gierke
R.W. Young

Working Group S2-71, Techniques of Machinery Vibration Measurement, which prepared this standard, has the following membership:

W.S. Mitchell, R. Cohen, *Co-chairmen*

J. Catlin
D.J. DeMichele
T.J. Finneran
P. Howes
C. Jackson

A.C. Keller
P. Maedel, Jr.
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J. Ramboz
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P.C. Sundt
K.W. Templin
G.H. Thomas
E.J. Wootten

Suggestions for improvement of this standard will be welcomed. They should be sent to the Standards Secretariat, Acoustical Society of America, 335 East 45th Street, New York, NY 10017.

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American National Standard Techniques of Machinery Vibration Measurement

1 PURPOSE AND SCOPE

The purpose of this standard is to identify procedures for the measurement of machinery vibration so that results will be comparable when machines of the same type, with similar mounting conditions, are measured by the same technique. The standard has direct application to preventive maintenance programs, vibration diagnostics, and basic measurement.

The standard contains a description of measurement equipment, measurement procedures, and calibration related to the measurement of machinery vibration. Measurement noted herein is for displacement, velocity, and acceleration. The standard can be applied to machines having rigid or flexible foundations, and to machines having rigid or flexible rotors. Vibration measurement should be limited in accordance with pickup and pickup mounting characteristics as described herein.

1.1 Units. The standard makes use of SI units, where applicable.

2 STANDARDS

The following standards are recommended for reference. Consideration should be given to applicable standards before selecting instruments and performing vibration measurements.

American National Standards Institute:

Z24.21-1957(R1978), Specifying the Characteristics of Pickups for Shock and Vibration Measurement, Method for
S1.1-1960(R1976), American Standard Acoustical Terminology
S1.11-1966(R1976), Octave, Half-Octave, and Third-Octave Band Filter Sets, Specification for
S2.2-1959(R1976), Calibration of Shock and Vibration Pickups, Method for the
S2.4-1976(ASA8-1976), Specifying the Characteristics of Auxiliary Analog Equipment for Shock and Vibration Measurements, Method for
S2.10-1971(R1976), Analysis and Presentation of Shock and Vibration Data, Methods for
S2.11-1969(R1978), Calibrations and Tests for Electrical Transducers used for Measuring Shock and Vibration, Selection of

American Petroleum Institute:

670-1976, Non-contacting Vibration and Axial Position Monitoring System

3 MEASUREMENT QUANTITIES

3.1 Displacement. Displacement measurement is typically associated with frequencies below 1000 Hz (see

Table I). Displacement measurements can be made directly by use of displacement pickups, dial indicators, or other suitable pickups. Displacement values can also be obtained from electrical integration of measured velocities or accelerations.

The following frequency ranges are suggested as guides only for the selection of measurement instrumentation:

Displacement—0.01 to 2 Hz. Select a mechanical or contact or noncontact, electrical displacement pickup.

Displacement—2 to 4000 Hz. Select noncontact, electrical displacement pickup (Alternative selection: velocity or acceleration pickup with integration).

3.2 Velocity. Velocity measurement is typically associated with frequencies between 10 and 1000 Hz. Velocity values can be measured directly by use of velocity pickups or other suitable pickups. They can also be obtained from electrical integration of measured accelerations.

3.3 Acceleration. Acceleration measurement is typically associated with frequencies greater than 1000 Hz, although it may be used at lower frequencies. Acceleration values can be measured directly by use of ac-

TABLE I. Maximum frequencies (hertz) for valid vibration measurements with various pickup mountings.

Pickup ^a type	Mounting Method ^b			
	Rigid bolting	Threaded stud	Insulated stud	Adhesive ^c
Displacement	NA ^d	1000	NA	NA
Velocity	1500	1000	1500	1000
Acceleration	10 000	10 000	8000	4000

^aIf a mounting block is welded to the part to be measured, it can be considered part of the measured structure. If a mounting block is fastened to the part with an adhesive or by other means, the allowable measurement frequency shall be reduced to the corresponding frequency listed in the table (See also 6.3.1). If a mounting bracket is used, its maximum frequency should be determined by measurement of the bracket resonant response (See also 6.3.6).

^bSee also Appendix A (A2.1, A2.2, A2.3) for frequency ranges applicable to the pickups themselves.

^cNA (Not Applicable).

^dSome adhesives, if properly applied, may allow vibration measurement at frequencies higher than indicated. In such cases valid use at higher frequencies should be demonstrated (See also 6.3.2).