



American
Gear Manufacturers
Association

ANSI/AGMA 6000-C20
Revision of ANSI/AGMA 6000-B96

American National Standard

Specification for Measurement of Linear Vibration on Gear Units

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ABSTRACT

This standard presents a method for the measurement of linear vibrations on a gear unit. Instrumentation, measuring methods, test procedures and discrete frequency vibration limits are recommended for acceptance testing to confirm integrity. An annex which lists system effects on gear unit vibration and responsibility is also provided.

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Foreword

[The foreword, footnotes, and annexes, if any, in this document are provided for informational purposes only and are not to be construed as a part of ANSI/AGMA Standard 6000-C20, *Specification for Measurement of Linear Vibration on Gear Units*.]

ANSI/AGMA 6000-A88 included and superseded the information previously published in AGMA 426.01 (1972), *Specification for Measurement of Lateral Vibration on High Speed Helical and Herringbone Gear Units*.

Performance of driven equipment is dependent upon the individual characteristics of the prime mover, gear unit, driven machine and support structure, as well as their combined effects as a system. The proper assessment of performance characteristics is essential for realistic evaluation. The knowledge and judgment required to properly evaluate the gear unit vibration comes primarily from years of accumulated experience in designing, manufacturing, and operating gear units. For these reasons, the inexperienced are encouraged to seek assistance.

The complexity of gear vibration phenomena makes most vibration standards difficult to apply or to properly interpret. The AGMA Acoustical Technology Committee developed the *Specification for Measurement of Linear Vibration on Gear Units* to provide a common basis for communication between project engineers, gear manufacturers, and users. The purpose was, also, to encourage the maximum practical degree of uniformity and consistency among vibration measurement practices within the gear industry.

Because of the wide variation of gear driven systems and structural supports, ANSI/AGMA 6000-A88 identified certain areas where special considerations might be necessary and should be agreed upon between purchaser and gear manufacturer when discussing gear vibrations.

ANSI/AGMA 6000-A88 was approved as a standard by the AGMA membership in May 1988 and approved as an American National Standard on June 16, 1988.

ANSI/AGMA 6000-B96 is a revision of ANSI/AGMA 6000-A88. The revision includes clarification of application of the standard, changes to Annex A, and the addition of a new Annex C, from ISO 8579-2.

ANSI/AGMA 6000-C20 replaces ANSI/AGMA 6000-B96. It has been updated to reflect changes and advances in technology. Vibration limits are defined with mathematical functions for ease of implementation into the user's software and reports. An example application of this standard has been added as Annex A. Annex A from the previous edition has been updated and moved to Annex D.

ANSI/AGMA 6000-C20 was approved as a standard by the AGMA membership in September 2020 and approved as an American National Standard on December 4, 2020.

Suggestions for improvement of this standard will be welcome. They may be submitted to tech@agma.org.

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American National Standard –

Specification for Measurement of Linear Vibration on Gear Units

1 Scope

This standard presents a method for measuring steady state vibration of a gear unit. Types of instrumentation, measurement methods, and testing procedures for the determination of linear vibration levels for specific types of gear units are provided. Vibration limits at discrete frequencies are recommended for acceptance testing.

The recommended limits and conditions specified herein are intended as the vibration criteria for performance of the gear drive during the equipment manufacturer's test when specifically agreed to by the manufacturer and purchaser.

This standard is specifically applicable to enclosed speed reducing or increasing gear drive units designed, rated, and lubricated in accordance with ANSI/AGMA product standards as indicated in 4.3.

This standard does not apply to integrated systems, shaft-mounted units, special or auxiliary drive trains or power take-off gears. Vibration amplitudes exceeding the recommendations of this specification for drives with flexible housings or on flexible supports may also be allowable if accounted for in the design. Acceptable limits for this type of equipment should be independently specified. However, if negotiated, this standard may be applied to such equipment.

Torsional and transient vibrations of a geared system are not included in this standard.

NOTE: Compliance with this standard does not constitute a warranty of the measured gear unit's performance under installed field service conditions.

2 Normative References

The following documents contain provisions which, through reference in this text, constitute provisions of this American National Standard. At the time of publication, the editions indicated were valid. All documents are subject to revision, and parties to agreements based on this American National Standard are encouraged to investigate the possibility of applying the most recent editions of the documents indicated below.

AGMA 919-1-A14, *Condition Monitoring and Diagnostics of Gear Units and Open Gears: Part 1 – Basics*

ANSI/ASA S1.1-2013, *Acoustical Terminology*

ANSI/ASA S2.2-1959, *Calibration of Shock and Vibration Pickups*

ANSI/ASA S2.4-1976 *Methods for Specifying the Characteristics of Auxiliary Analog Equipment for Shock and Vibration Measurements*

ISO 1925:2001, *Mechanical vibration – Balancing – Vocabulary*

ISO 2041:2018, *Mechanical vibration, shock and condition monitoring – Vocabulary*

ISO 21940-2:2017, *Mechanical vibration — Rotor balancing — Part 2: Vocabulary*

ISO 2954:2012, *Mechanical vibration of rotating and reciprocating machinery – Requirements for instruments for measuring vibration severity*

ISO 5348:1998, *Mechanical vibration and shock – Mechanical mounting of accelerometers*

3 Symbols and definitions

3.1 Symbols

The symbols used in this standard are shown in Table 1.

NOTE: The symbols and terms contained in this document may vary from those used in other AGMA information sheets. Users of this standard should assure themselves that they are using these symbols and terms in the manner indicated herein.

Table 1 – Symbols and terms

Symbols	Description	Units	Where first used
a	Class A or Class B acceleration limit	m/s ²	Eq. 3
b	Velocity offset	--	Eq. 2
f	Frequency	Hz	Eq. 2
F_s	Sample Rate	Hz	Eq. 1
m	Velocity slope	--	Eq. 2
n	Number of data points in the time window	--	Eq. 1
T	Time window length	s	Eq. 1
v	Class A or Class B velocity limit	mm/s	Eq. 2
Δf	Frequency Resolution	Hz	Eq. 1

3.2 Definitions

The following definitions are provided to identify specific terms and phrases used in this standard. For further explanation see ISO 21940-2, ISO 2041, or ANSI S1.1.

acceleration: A vector that specifies the time derivative of velocity.

accelerometer: A transducer which converts an input acceleration to an output that is proportional to the input acceleration (see definition of transducer).

bearing block: The structural component which supports the bearing. It may be part of the housing casing or supported inside the oil-retaining casing.

bearing journal: That part of a rotor (shaft) which is in contact with or supported by a bearing in which it revolves.

displacement: A vector quantity that specifies the change of position of a body, or particle, with respect to a reference frame.

discrete frequency: A single frequency of vibration that is generated by a gear unit component.

frequency: The reciprocal of the fundamental period (time rate of repetition of a periodic phenomenon).

NOTE: The unit of frequency is Hertz (Hz), which corresponds to cycles per second.

gear mesh frequency: The frequency at which gear teeth enter their mesh.

linear vibration: A vibration along a line, generally perpendicular to a surface.

non-contact probe: A sensor that measures shaft displacement without contacting the shaft, often used for measuring shaft orbits.

peak value: The maximum value of a quantity (acceleration, velocity, displacement).

peak-to-peak value (of an oscillating quantity): The algebraic difference between the extreme values of the quantity.

resonance: Resonance of a system in forced oscillation exists when any change, however small, in the frequency of excitation causes a decrease in the response of the system.

runout, combination: The net resulting measurement of electrical and mechanical runout.

runout, electrical: The apparent displacement of a rotating element measured with inductive or eddy current sensors caused by variations in the electric and magnetic properties of the rotating element.

runout, mechanical: The maximum variation of the distance between a surface of revolution and a datum surface, measured perpendicular to that datum surface.

transducer: A sensor used to make a measurement. In the current context, the sensor measures vibration as displacement, velocity or acceleration.

velocity: A vector that specifies the time derivative of displacement.

vibration: The variation with time of the magnitude of a quantity which is descriptive of the motion or position of a mechanical system, when the magnitude is alternately greater and smaller than some average value or reference.

4 Application

4.1 Unit type limitations

This standard applies only to power transmission gear units, comprised of a gear train and the necessary bearings and shafts in an individual housing. The gear unit should be tested in a manner to minimize system effects such as listed in Annex B.

Acceptable limits for tests of geared equipment outside the scope of this standard should be independently specified and agreed upon between the purchaser and supplier.

4.2 System considerations

Vibration levels of the gear unit in field service may be adversely affected by factors not under the control of the gear manufacturer, as listed in Annex B. Therefore, gear manufacturers cannot be held responsible for higher vibration levels resulting from environmental and system influences in field installation.

CAUTION: System effects should be analyzed during the initial design stage of a transmission system. The responsibility for this analysis shall be clearly defined during this stage. All system component manufacturers should be made aware of this decision on responsibility.

4.3 Applicable designs

This standard applies to gear units designed generally in accordance with the following standards:

ANSI/AGMA 6011-J14, *Specification for High Speed Helical Gear Units*.

ANSI/AGMA 6113-B16, *Standard for Industrial Enclosed Gear Drives (Metric Edition)*

ANSI/AGMA 6034-B92, *Practice for Enclosed Cylindrical Wormgear Speed Reducers and Gearmotors*.

ANSI/AGMA 6135-A02, *Design, Rating and Application of Industrial Globoidal Wormgearing (Metric Edition)*

5 Instrumentation

5.1 Type

Vibration shall be measured with any measurement system that has a known accuracy and linear output proportional to acceleration, velocity, or displacement across a defined frequency range. The defined frequency range shall be from 0.3 times the lowest shaft rotational speed or 5 Hz, whichever is greater, to 3.5 times the greatest gear mesh frequency. This requires a sample rate of at least 7 times the greatest gear mesh frequency. The type and use of vibration instrumentation systems should conform to the applicable sections of ANSI/ASA S2.4, or ISO 2954.

CAUTION: The instrumentation may indicate an erroneous vibration level due to its response limitations, transducer mounting resonance, and electrical, or magnetic fields.