

Acceptance code for gears —

Part 2: Determination of mechanical vibrations of gear units during acceptance testing

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Federation of Manufacturers of Construction Equipment and Cranes	Power Generation Contractors' Association (BEAMA Ltd.)

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	University of Manchester

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National foreword

This Part of BS 7676 has been prepared under the direction of the Machinery and Components Standards Policy Committee. It is identical with ISO 8579-2:1993 *Acceptance code for gears — Part 2: Determination of mechanical vibrations of gear units during acceptance testing* which was prepared jointly by Technical Committee ISO/TC60, Gear, and ISO/TC43, Acoustics, of the International Organization for Standardization (ISO), in which the United Kingdom played an active part.

BS 7676 comprises the following Parts:

- *Part 1: Determination of airborne sound power levels emitted by gear units;*
- *Part 2: Determination of mechanical vibrations of gear units during acceptance testing.*

Cross-reference

International Standard	Corresponding British Standard
ISO 2041:1990	BS 3015:1991 <i>Glossary of terms relating to mechanical vibration and shock</i> (Identical)

A British Standard does not purport to include all the necessary provisions of a contract. Users of British Standards are responsible for their correct application.

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Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, pages 1 to 12, an inside back cover and a back cover.

This standard has been updated (see copyright date) and may have had amendments incorporated. This will be indicated in the amendment table on the inside front cover.

1 Scope

1.1 This part of ISO 8579 specifies the methods for determining mechanical vibration of individually housed, enclosed, speed-increasing and speed-reducing gear units. It specifies methods for measuring housing and shaft vibrations, and the types of instrumentation, measurement methods and testing procedures for determining vibration levels. Vibration grades for acceptance are included.

It does not include torsional vibration measurements of a geared system.

This part of ISO 8579 applies only to a gear unit under test and operating within its design speed, load, temperature range and lubrication for acceptance testing at the manufacturer's facility. The gear unit may be tested at another location if agreed upon and operated in accordance with the manufacturer's recommendations. Other International Standards on vibration evaluation may be required for measuring gear unit vibration in field service.

This part of ISO 8579 does not apply to special or auxiliary drive trains, such as integrated gear-driven compressors, pumps, turbines, etc., and power take-off gears.

NOTE 1 Acceptance limits for tests of these types of equipment should be independently specified. However, if negotiated, this or other appropriate standards may be applied to such equipment.

1.2 Special provisions may be required for vibration measurements: the type of measurement and acceptance level should therefore be agreed between the manufacturer and purchaser at an early stage of negotiation.

2 Normative reference

The following standard contains provisions which, through reference in this text, constitute provisions of this part of ISO 8579. At the time of publication, the edition indicated was valid. All standards are subject to revision, and parties to agreements based on this part of ISO 8579 are encouraged to investigate the possibility of applying the most recent edition of the standard indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 2041:1990, *Vibration and shock — Vocabulary*.

3 Definitions

For the purposes of this part of ISO 8579, the definitions given in ISO 2041, together with the following, apply. For the convenience of users of this part of ISO 8579, some definitions are quoted from ISO 2041:1990.

3.1

non-contact transducer

a transducer which converts a distance or displacement to an electrical signal that is proportional to the distance or displacement

3.2

acceleration

a vector that specifies the time-derivative of velocity
[ISO 2041, 1.3]

NOTE 2 See Annex A.

3.3

displacement; relative displacement

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

[ISO 2041, 1.1]

NOTE 3 See Annex A.

3.4

frequency response

the output signal expressed as a function of the frequency of the input signal. The frequency response is usually given graphically by curves showing the relationship of the output signal and, where applicable, phase shift or phase angle as a function of frequency

[ISO 2041, B.13]

3.5

peak-to-peak value (of a vibration)

the algebraic difference between the extreme values of the vibration

[ISO 2041, 2.35]

3.6

root-mean-square value; r.m.s. value

for a single-valued function $f(t)$ over an interval of time between t_1 and t_2 , the square root of the average of the squared values over the interval

NOTE 4 The r.m.s. value of a single-valued function $f(t)$ over an interval between t_1 and t_2 is

$$\text{r.m.s. value} = \left[\frac{1}{t_2 - t_1} \int_{t_1}^{t_2} f(t)^2 dt \right]^{1/2}$$

NOTE 5 In vibration theory, the mean value of the vibration is equal to zero. In this case, the r.m.s. value is equal to the standard deviation (σ) and the mean-square value is equal to the variance (σ^2).

[ISO 2041, A.37]

3.7**transducer**

a device designed to receive energy from one system and supply energy, of either the same or of a different kind, to another in such a manner that the desired characteristics of the input energy appear at the output

[ISO 2041, 4.1]

3.8**velocity; relative velocity**

a vector that specifies the time-derivative of displacement

[ISO 2041, 1.2]

NOTE 6 See Annex A.

3.9**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

[ISO 2041, 2.1]

4 General**4.1 System considered**

The gear unit should be tested in such a manner as to minimize as far as possible effects of the system (see Annex B).

4.2 Effects of system

Vibration levels of the gear unit in field service may be adversely affected by factors beyond the control of the gear manufacturer, as listed in Annex B. It is preferable to estimate the vibration of the whole system and to check the system effects at the initial design stage of a transmission system. The responsibility for checking should be clearly defined during this stage and all interested parties made aware of the decision.

4.3 Housing or shaft measurements

The vibrations of a gear unit can be measured in two ways, i.e. on the housing or on the shafts. Housing vibration measurements are preferred for gear units operating with rolling contact bearings when the clearance in such bearings is small and little relative movement normally occurs between the shaft and housing.

Both shaft and housing vibration measurements may be made on gear units operating with plain journal bearings. Shaft vibration measurements can provide detailed information which may not be evident from housing measurements, but only over a limited frequency range (typically 0 Hz to 500 Hz). Housing vibration measurements have the advantage of having both an extended frequency range and an extended dynamic range which are essential when considering frequency of tooth contact. See the provisions of 1.2.

Care shall be taken when choosing the measurement instrument for a given gear unit and operating conditions, as each instrument has its own characteristics (see Annex C). It is often useful to combine both shaft and housing vibration measurements to obtain an absolute motion of the gear unit shaft.

When operating conditions during acceptance testing deviate considerably from field service, the differences shall be taken into account in the assessment of vibration data.

5 Instrumentation**5.1 Type**

Vibration shall be measured using a transducer and an instrument with a known accuracy for the measurement of velocity and displacement across a known frequency range. The instrument shall also have an electrical output signal of known accuracy related to velocity or displacement, or both. The transducer shall be used within its calibrated limits for the mounting method and for the prevailing environmental conditions such as temperature, magnetic field, surface finish, etc. The type and use of vibration instrumentation systems shall comply with the appropriate International Standards. The instrumentation should preferably include a facility for narrow-band frequency analysis with a bandwidth not exceeding one-third-octave.

5.1.1 Shaft measurement instrumentation

The recommended type of transducer for measuring shaft vibration is a non-contacting transducer. The instrument shall allow a reading of peak-to-peak values of vibration displacement to be taken. However, contacting transducers are acceptable if the rotational frequency of the shaft is less than $3\,000\text{ min}^{-1}$, the signal frequency is less than 200 Hz, and surface rubbing velocity is less than 30 m/s.