BRITISH STANDARD

Rotating electrical machines of particular types or for particular applications –

Part 3: Generators to be driven by reciprocating internal combustion engines – Requirements for resistance to vibration

ICS 29.160.20

Publishing and copyright information

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The following BSI references relate to the work on this standard:
Committee reference PEL/2

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Contents

List of figures

Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, pages 1 to 5 and a back cover.

Foreword

Publishing information

This part of BS 5000 was published by BSI and came into effect on 29 September 2006. It was prepared by Technical Committee PEL/2, *Rotating electrical machinery*. A list of organizations represented on this committee can be obtained on request to its secretary.

Supersession

This part of BS 5000 supersedes BS 5000-3:1980, which is withdrawn.

Information about this document

The requirements for generators to be driven by reciprocating internal combustion engines that were specified in BS 5000-3:1980 are now specified in BS EN 60034-22:1998 (which is identical with IEC 60034-22:1996), with the exception of the requirements for resistance to imposed vibration.

A proposal has been put to IEC to amend IEC 60034-22 to include requirements for resistance to imposed vibration. To cover the period before the publication of such an amendment, this revision of BS 5000-3 has been produced to specify just the requirements for resistance to imposed vibration. When the amendment to IEC 60034-22 is published, this will be implemented by the publication of an amendment to BS EN 60034-22, and BS 5000-3:2006 will be withdrawn.

Presentational conventions

The provisions of this standard are presented in roman (i.e. upright) type. Its requirements are expressed in sentences in which the principal auxiliary verb is “shall”.

Commentary, explanation and general informative material is presented in smaller italic type, and does not constitute a normative element.

Contractual and legal considerations

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

Compliance with a British Standard cannot confer immunity from legal obligations.

1 Scope

This part of BS 5000 specifies requirements for the vibration resistance of generators, together with their exciters, to be driven by reciprocating internal combustion (RIC) engines. The standard is applicable to generators with a maximum continuous rating with outputs greater than 0.75 kW or kVA per 1 000 r/min, of the following types:

a) salient pole alternating current generators;

b) cylindrical rotor (distributed field) alternating current generators;

c) direct current generators.

This part of BS 5000 is not applicable to generators intended for use in ships, traction vehicles or turbine type machines.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

BS EN 60034-1:2004, *Rotating electrical machines – Part 1: Rating and performance*

BS EN 60034-22, *Rotating electrical machines – Part 22: AC generators for reciprocating internal combustion (RIC) engine driven generating sets*

3 Terms and definitions

For the purposes of this part of BS 5000, the definitions given in BS EN 60034-1, BS EN 60034-22 and the following apply.

3.1 inertia torque
opposing torque exerted by a mass when being accelerated

3.2 forced frequency method
tabulation method, taking damping into account, to determine forced vibration amplitudes at non-resonant frequencies

3.3 first major order
predominant frequency of the engine torque reaction divided by the rotational frequency

3.4 supplier of the set
engine manufacturer or manufacturer of the driven machinery or a third contractor

NOTE If a purchaser buys an engine from one manufacturer and the driven machinery from another, the purchaser is regarded as the supplier of the set to himself.

4 Imposed vibration, torsional and linear

COMMENTARY ON CLAUSE 4

*The values in **4.1** and **4.2** have been specified with the intention of defining maximum vibratory conditions for the generator and any attached ancillary equipment, e.g. integral cooling fans, terminal boxes and other attachments to the generator frame. These values are inclusive of the limits specified in BS EN 60034-14 for self-induced vibration.*

4.1 Torsional vibration

Generator rotors shall be capable of continuously withstanding vibratory inertia torque amplitudes of $\pm 2.0T$ for d.c. generators or $\pm 2.5T$ for a.c. generators (where T is the rated full load torque), over the speed range from 95% to 110% of the rated speed, and $\pm 6.0T$ when passing through critical speeds below 95% of the rated speed. The total inertia torque acting on the rotor shall be taken into consideration in the speed range from 95% to 110% of the rated speed.

NOTE In the case of generating sets driven by reciprocating internal combustion engines, the supplier of the set is responsible for ensuring that the torsional vibration conditions of the complete dynamic system are satisfactory. BS ISO 3046-5 details definitions and general requirements.

To allow the calculations to be completed, the generator manufacturer should make available to the supplier of the set adequate and accurate drawings and data, including moments of inertia, relating to the rotating parts of the generator and any integral excitation equipment.

Where two or more generators are driven from one engine, each generator should be considered separately in relation to its own maximum rating. The calculations should be based on the forced frequency method, taking account of all significant harmonic exciting torques and their relative phase relationships, together with torsional system damping where applicable. Alternatively, the total vibratory torque may be calculated as the arithmetical sum of the vibratory torque due to any resonant order and the non-resonant contributions of all other significant orders, including the first major order.

Where the calculations show the results to be only marginally acceptable, confirmatory measurements should be taken under running conditions.

4.2 Linear vibration

Generators shall be capable of continuously withstanding linear vibration levels with amplitudes of 0.25 mm between 5 Hz and 8 Hz and velocities of 9.0 mm/s r.m.s. between 8 Hz and 200 Hz when measured at any point directly on the carcass or mainframe of the generator and on separate pedestal bearing blocks, if fitted. These limits refer only to the predominant frequency of vibration of any complex waveform. These vibration levels are shown in Figure 1 in terms of amplitude and frequency.

4.3 Electro-mechanical frequency of vibration

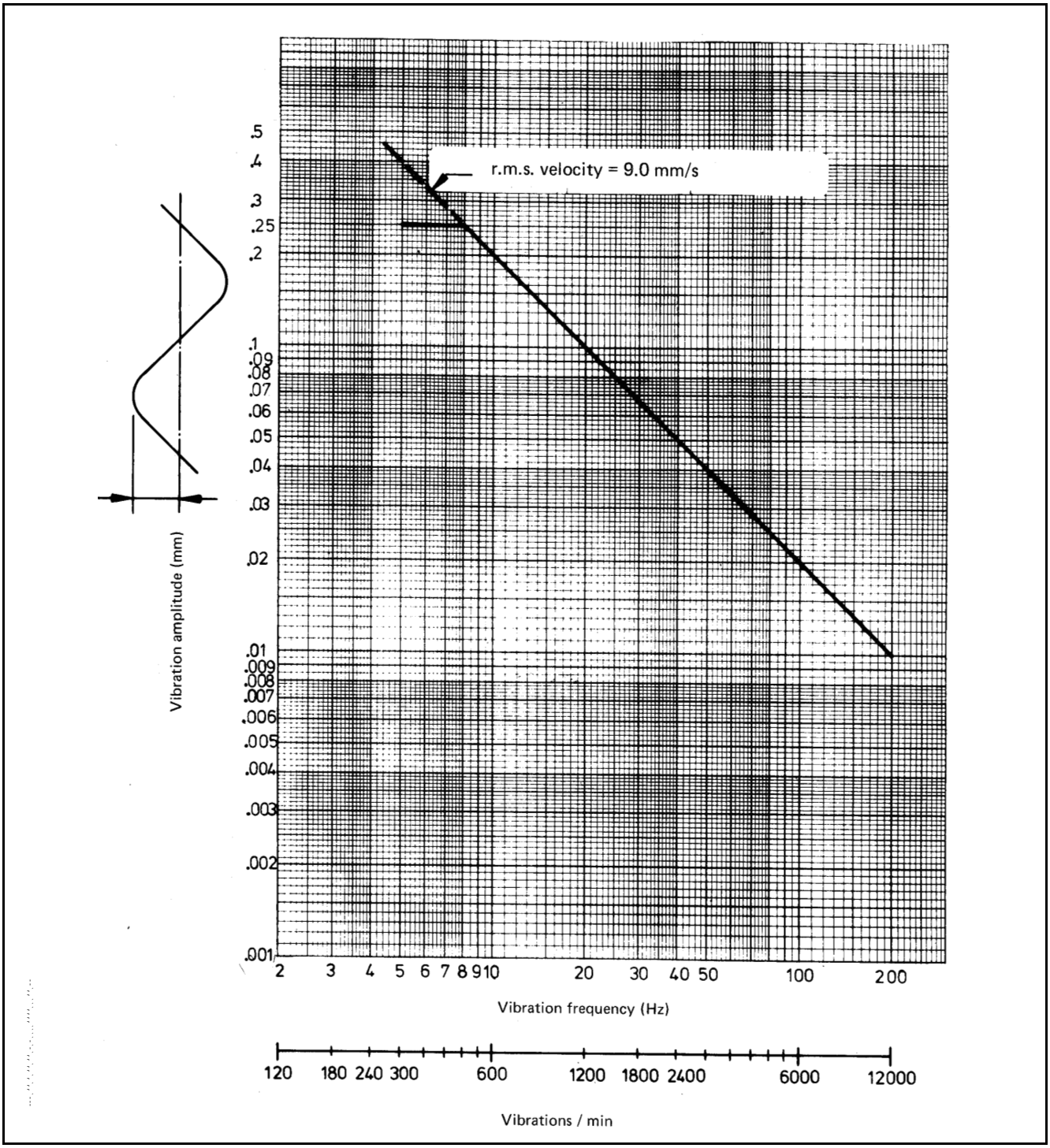
In special cases, particularly with gas and dual-fuel engines, it may be necessary to calculate the electro-mechanical resonant frequency of vibration of the combined set to ensure stable operation in the presence of possible disturbing frequencies from, for example, the mounting system, fuel system or torque variations from the engine or load. In such cases, when specified at the time of the enquiry or order, it is the responsibility of the supplier of the set to ensure that this work is carried out. The generator manufacturer shall provide the necessary information relating to the generator.

5 Rating plate marking

To conform to the requirements specified in BS EN 60034-1:2004, Clause **10**, the rating plate shall carry the number of this standard, i.e. BS 5000-3[1)].

[1)] Marking BS 5000-3 on or in relation to a product represents a manufacturer's declaration of conformity, i.e. a claim by or on behalf of the manufacturer that the product meets the requirements of the standard. The accuracy of the claim is solely the claimant's responsibility. Such a declaration is not to be confused with third-party certification of conformity.

Figure 1 **Limits of linear vibration**



Bibliography

Standards publications

For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

BS EN 60034-14, *Rotating electrical machines – Part 14: Mechanical vibration of certain machines with shaft heights 56 mm and higher – Measurement, evaluation and limits of vibration severity*

BS ISO 3046-5, *Reciprocating internal combustion engines – Performance – Part 5: Torsional vibrations*

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