

INTERNATIONAL STANDARD

ISO
10816-6

First edition
1995-12-15

Mechanical vibration — Evaluation of machine vibration by measurements on non- rotating parts —

Part 6:

Reciprocating machines with power ratings
above 100 kW

*Vibrations mécaniques — Évaluation des vibrations des machines par
mesurages sur les parties non tournantes —*

Partie 6: Machines alternatives de puissance nominale supérieure à 100 kW



Reference number
ISO 10816-6:1995(E)

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electro-technical standardization.

Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

International Standard ISO 10816-6 was prepared jointly by Technical Committees ISO/TC 108, *Mechanical vibration and shock*, Subcommittee SC 2, *Measurement and evaluation of mechanical vibration and shock as applied to machines, vehicles and structures*, and ISO/TC 70, *Internal combustion engines*, Subcommittee SC 2, *Performance and tests*.

ISO 10816 consists of the following parts, under the general title *Mechanical vibration — Evaluation of machine vibration by measurements on non-rotating parts*:

- Part 1: *General guidelines*
- Part 2: *Large land-based steam turbine generator sets in excess of 50 MW*
- Part 3: *Industrial machines with nominal power above 15 kW and nominal speeds between 120 r/min and 15 000 r/min when measured in situ*
- Part 4: *Gas turbine driven sets excluding aircraft derivatives*
- Part 5: *Machine sets in hydraulic power generating and pumping plants*
- Part 6: *Reciprocating machines with power ratings above 100 kW*

Annex A forms an integral part of this part of ISO 10816. Annexes B to D are for information only.

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Case postale 56 • CH-1211 Genève 20 • Switzerland

Printed in Switzerland

Introduction

ISO 10816-1 gives general guidelines for the evaluation of machine vibration by measurements on non-rotating parts. This part of ISO 10816 is a new document which establishes procedures and guidelines for the measurement and classification of mechanical vibration of reciprocating machines. In general, this part of ISO 10816 refers to vibration of the main structure of the machine, and the guide values given for these vibrations are defined primarily to classify the vibration of the machine and to avoid problems with auxiliary equipment mounted on this structure. Recommendations for measurements and evaluation criteria are provided in this part of ISO 10816.

Typical features of reciprocating machines are the oscillating masses, the cyclically varying output (input) torques and the pulsating forces in the associated pipework. All these features cause considerable alternating forces on the main supports and vibration amplitudes of the main frame. The vibration amplitudes are generally higher than for rotating machinery but, since they are largely determined by the design features of the machine, they tend to remain more constant over the life of the machinery than for rotating machinery.

In the case of reciprocating machines, the vibration measured on the main structure of the machine and quantified according to this part of ISO 10816 may only give a rough idea of the stresses and vibratory states of the components within the machine itself. For example, torsional vibration of rotating parts cannot generally be determined by measurements on the structural parts of the machine. The damage, which can occur when exceeding the guide values based on experience with similar machines, is sustained predominantly by machine-mounted components (e.g. turbochargers, heat-exchangers, governors, filters, pumps), connecting elements of the machine with its peripheral parts (e.g. pipelines) or monitoring instruments (e.g. pressure gauges, thermometers). The question as from which vibration values damage is to be expected largely depends on the design of these components and their fastenings.

In some cases, special measurements on certain machine components will be required to ascertain that the vibration values are permissible. It also happens that even if measured values are within permissible guide values, problems may occur owing to the great variety of components which can be attached. Such problems can be, and have to be, rectified by specific "local measures" (e.g. by elimination of resonances). Experience has shown, however, that it is possible in the majority of cases to state measurable quantities characterizing the vibratory state and to give guide values for these. This shows that the measurable variables and the guide values permit a reliable evaluation in most cases. For the quantity described, which characterizes the vibration values of reciprocating piston machines in a simple manner, the term "vibration severity" will be used.

The vibration values of reciprocating piston machines are not only affected by the properties of the machine itself but also to a large degree by the foundation. Since a reciprocating machine can act as a vibration generator, vibration isolation between the machine and its foundation may be necessary. This, as well as the vibration response of the foundation, can have considerable effect on the vibration of the machine itself. These vibration conditions are also dependent on the transmissibility of the environment surrounding the machine and are therefore not entirely determined by the vibration values of the machine itself. This part of ISO 10816 can therefore only take an advisory role in relation to the effects of the machine on the environment.

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Mechanical vibration — Evaluation of machine vibration by measurements on non-rotating parts

Part 6:

Reciprocating machines with power ratings above 100 kW

1 Scope

This part of ISO 10816 specifies the general conditions and procedures for the measurement and evaluation of vibration, using measurements made on the non-rotating and non-reciprocating parts of complete machines. Shaft vibration, including torsional vibration, is beyond the scope of this part of ISO 10816.

It generally applies to reciprocating piston machines mounted either rigidly or resiliently with power ratings of above 100 kW. Typical examples of application are: marine propulsion engines, marine auxiliary engines, engines operating in diesel generator sets, gas compressors and engines for diesel locomotives.

The general evaluation criteria which are presented relate to both operational monitoring and acceptance testing. They are also used to ensure that the machine vibration does not adversely affect the equipment directly mounted on the machine.

Consideration should also be given to the machinery driven by or driving the reciprocating machine. These should be evaluated in accordance with relevant standards and classification for the intended duty.

It is recognized that the evaluation criteria may only have limited application when considering the effects of internal machine components; for example, problems associated with valves, loose pistons, piston rings, etc. are unlikely to be reflected in the measurements. Identification of such problems requires investigative

techniques which are outside the scope of this part of ISO 10816. Noise is also outside the scope of this part of ISO 10816.

This part of ISO 10816 does not apply to machines installed in road vehicles (e.g. trucks, passenger cars, self-propelling construction machinery and tractors).

2 Normative reference

The following standard contains provisions which, through reference in this text, constitute provisions of this part of ISO 10816. 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 10816 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 10816, the definitions given in ISO 2041 and the following definition apply.

3.1 vibration severity: A generic term that designates a value, or set of values, such as a maximum value, average or r.m.s. value, or other parameter that is