

Method for

Measurement and reporting of local vibration data of ship structures and equipment

[ISO title: Code for the measurement and reporting of local
vibration data of ship structures and equipment]

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- British Internal Combustion Engine Manufacturers' Association
- British Ship Research Association
- British Steel Corporation
- Department of Trade and Industry (National Engineering Laboratory)
- Electricity Supply Industry in England and Wales
- Engineering Equipment and Materials Users' Association
- Institute of Sound and Vibration Research
- Institution of Electronic and Radio Engineers
- Institution of Mechanical Engineers
- Ministry of Defence
- Motor Industry Research Association
- Power Generation Association (BEAMA Ltd.)
- Society of British Aerospace Companies Limited
- Society of Environmental Engineers
- United Kingdom Atomic Energy Authority

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National foreword

This British Standard has been prepared under the direction of the General Mechanical Engineering Standards Committee. It is identical with ISO 4868:1984 *“Code for the measurement and reporting of local vibration data of ship structures and equipment”* which was prepared by Technical Committee ISO/TC 108 of the International Organization for Standardization (ISO) and in the development of which the United Kingdom played an active part.

Terminology and conventions. The text of the International Standard has been approved as suitable for publication as a British Standard without deviation. Some terminology and certain conventions are not identical with those used in British Standards; attention is drawn especially to the following.

The comma has been used as the decimal marker. In British Standards it is current practice to use a full point on the baseline as the decimal marker. Wherever the words “International Standard” appear, referring to this standard, they should be read as “British Standard”.

Cross-references

International Standards	Corresponding British Standards
ISO 4867:1984	BS 6632:1985 <i>Method for measurement and reporting of shipboard vibration data</i> (Identical)
ISO 6954:1984	BS 6634:1985 <i>Guide for overall evaluation of vibration in merchant ships</i> (Identical)

The Technical Committee has reviewed the provisions of ISO 2041, to which reference is made in the text, and has decided that they are acceptable for use in conjunction with this standard. A related British Standard to ISO 2041 is BS 3015:1976 *“Glossary of terms relating to mechanical vibration and shock”*.

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.

Compliance with a British Standard does not of itself confer immunity from legal obligations.

Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, pages 1 to 14, 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.

0 Introduction

The term “local vibration”, as used in the shipbuilding industry, applies to the dynamic response of a structural element, an assembly of structural elements, machinery or equipment which vibrates at an amplitude significantly greater than that of the basic hull girder at the location. This vibration may occur at a frequency of the hull girder or of a machinery component. Typical examples include the vibration of parts of the superstructure, smokestack, mast, binnacle, turbine, pipe or deck plate. These local vibrations generally result from:

- a) local flexibility of supporting structural elements; or,
- b) the vibratory characteristics of the machinery concerned.

In this International Standard, the term “vibration severity” is used to describe the vibration conditions in the ship and, based on long-established practice in the industry, the peak value of vibration velocity has been chosen as the primary quantity of measurement; since, however, much data have been accumulated in terms of vibration acceleration and vibration displacement, a plotting sheet has been adopted on which data may easily be plotted using any of these quantities of measurement.

1 Scope and field of application

This International Standard establishes uniform procedures for gathering and presenting data on vibrations of local structural elements or equipment in sea-going merchant ships. The procedures, where applicable, can also be used for inland ships and tug boats. Such data are necessary to establish uniformly the vibration characteristics present in various compartments on board ship and to provide a basis for design predictions, improvements and comparison against environmental vibration reference levels or criteria relative to reliability (of machines), safety (of structures) and habitability. The data are not intended to apply to the evaluation of the vibration of machines with respect to noise control or to the design of the machine or equipment under consideration. These latter cases will generally require specific diagnostic treatment and include a broader frequency range and more specialized instrumentation than is necessary for these general considerations.

This International Standard is concerned with local vibration measured on structural elements, superstructure, decks, bulkheads, masts, machines, foundations, equipment, etc., and only relates to the measurement and reporting of the local vibration of the structure or equipment mounted thereon.

Concern over local vibration may be caused by:

- a) the stresses due to the vibration, for example in the structure, in the equipment or attachments;
- b) the necessity of maintaining trouble-free operation of a machine or other equipment which might be jeopardized by the malfunction or degradation of components;
- c) the physical strain on man (habitability and performance);
- d) the effects of the vibration on its environment, such as adjacent instruments, machines, equipment, etc.

The frequency range considered includes propulsion shaft rotational frequencies, rotational frequency of machines and other significant source frequencies, such as diesel firing, blade or vane passage, etc.

This International Standard gives general principles of vibration measurement on board ships to improve vibration engineering. Therefore, in individual cases, items to be measured may be selected or added to meet the aims of the vibration measurement of each ship.

2 References

- ISO 2041, *Vibration and shock — Vocabulary*.
- ISO 4867, *Code for the measurement and reporting of shipboard vibration data*.
- ISO 6954, *Mechanical vibration and shock — Guidelines for the overall evaluation of vibration in merchant ships*.

3 Definitions

In addition to the terms defined in ISO 2041, the following definitions are applicable.

3.1 free route

that condition achieved when the ship is proceeding at a constant speed and course with minimum throttle or helm adjustment

3.2 hull girder

the primary hull structure such as the shell plating and continuous strength decks contributing to flexural rigidity of the hull and the static and dynamic behaviour of which can be described by a free-free non-uniform beam approximation

3.3**hull girder vibration**

that component of vibration which exists at any particular transverse plane of the hull so that there is little or no relative motion between elements intersected by the plane

3.4**local vibration**

the dynamic response of a structural element, deck, bulkhead or piece of equipment which is significantly greater than that of the hull girder at that location

3.5**severity of vibration**

the peak value of vibration (velocity, acceleration or displacement) during periods of steady-state vibration, representative of maximum repetitive behaviour, under the conditions defined in 4.2

when using autographic records, suitable lengths of record may easily be recognized

when using electronic methods of recording and analysis, care shall be taken to use lengths of record, time constants and averaging times so that a good approximation to the steady-state amplitude is obtained

4 Measurement of data**4.1 Instrumentation**

Measurement should preferably be made with an electronic system which produces a permanent record. The transducers may generate signals proportional to acceleration; velocity or displacement. Recording can be made either on magnetic tape, paper oscillographs, or a combination of both. Use of paper oscillographs during the tests means that the vibration traces can be inspected directly and is very helpful in evaluating existing vibration problems. When displacement rather than either velocity or acceleration is recorded, the desired low-frequency signals associated with significant vibratory motion are the major components of a recorded trace. Thus, they are readily evaluated since they overshadow possible higher frequency signals with low displacement amplitudes.

Provision should be made for suitable attenuation control to enable the system to accommodate a wide range of amplitudes.

An event marker should be provided on the propeller shaft. Its position with respect to top dead centre of cylinder number 1 and a propeller blade should be noted.

The complete measuring system should be calibrated in the laboratory prior to the test and it is desirable to check the calibration of each recording channel before each stage of the test.

Portable electronic and mechanical instruments capable of single-point measurements may be used.

4.2 Preferable test conditions

The preferable conditions shall be as follows:

- a) the test should be conducted in a depth of water not less than five times the draught of the ship, with machinery running under normal conditions, unless otherwise specified;

NOTE For exploratory purposes, tests may be carried out at the quayside if there is no reason to suppose that shallow water will influence the results.

- b) the test should be conducted in a quiet sea (sea state 3 or less);
- c) the ship should be ballasted to a displacement as close as possible to the operating conditions within the ordinary ballasting capacity of the vessel. The draught aft should ensure full immersion of the propeller;
- d) during the free-route portion of the test, the rudder angle should be restricted to about two degrees port or starboard (minimum rudder action is desired);
- e) individual machines may be run in isolation as required to investigate particular problems.

Any divergence from these conditions should be clearly stated in Table 4.

4.3 Transducer locations**4.3.1 Stern**

Vertical, athwartship and longitudinal measurements as close as possible to the centreline and the stern, to establish the hull girder vibration characteristics. The location should be chosen so that the results are not influenced by local vibration effects.

4.3.2 Superstructure

Vertical, athwartship and longitudinal measurements on the superstructure front bulkhead, at a minimum of three different deck levels.

4.3.3 Local structures

Vertical, athwartship and longitudinal measurements at any local structure where evidence of local vibration occurs.

4.3.4 Local deck traverse

Vertical, athwartship and longitudinal measurements at a sufficient number of points in the area of local vibration to determine the relative vibration with respect to the hull girder.