INTERNATIONAL STANDARD

ISO 10055

First edition
1996-12-15

Mechanical vibration — Vibration testing requirements for shipboard equipment and machinery components

Vibrations mécaniques — Exigences requises pour les essais de vibrations des équipements de bord et des composants des machines

Reference number
ISO 10055:1996(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 electrotechnical 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 10055 was prepared by Technical Committee 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*.

Annex A of this International Standard is for information only.

International Organization for Standardization
Case Postale 56 • CH-1211 Genève 20 • Switzerland

Printed in Switzerland

Introduction

All machinery installed aboard ship will ordinarily be subjected to a vibratory environment consisting of various frequencies and amplitudes of vibration, possibly for long periods of time during which the machinery and equipment must continue to function normally. Structural arrangements on board ships may result in machinery placed in areas which result in magnification of vibratory amplitudes and, therefore, many items of equipment may be subjected to more severe vibrations than those imposed by the hull.

For equipment and machinery in general, the frequency range of interest is governed by the prime mover (such as a diesel engine) and by propeller and blade excitation (including harmonics). This range does not usually extend beyond 100 Hz.

Vibration measurements for steady-state conditions are usually made in relatively quiet seas and during constant-speed operations. However, actual ship operations occur in all sea states and headings. Any change in a ship's speed, heading, or sea state may have a significant effect on the vibration values.

Based on these considerations, the proposed test severities for vibration testing of shipboard equipment and machinery components cannot be interpreted as simulating normal environmental conditions, but as representing vibration values sufficiently large to obtain a reasonably high degree of probability that the equipment will not fail or malfunction during service life.

This page intentionally left blank

Mechanical vibration — Vibration testing requirements for shipboard equipment and machinery components

1 Scope

This International Standard defines vibration test requirements for shipboard equipment and machinery components to ensure consistency in vibration resistance requirements for such equipment and machinery components. The tests are intended to locate resonances of the equipment and impose endurance tests at these frequencies, if any. The vibration test is a type test, unless otherwise agreed between the parties concerned.

This International Standard is applicable to the following shipboard equipment:

— control and instrumentation,

— navigation and communication,

— mast-mounted equipment,

— machinery components.

For special machinery, equipment and installations such as antennae, large machinery items and certain unusual designs, it may be necessary to deviate from this International Standard, subject to approval by the parties concerned.

The maximum size and mass of equipment and machinery that can be tested in accordance with this International Standard cannot be defined because the capacities of available vibration-testing machines vary. Furthermore, a given piece of equipment or machinery, although too large to be accommodated on a vibration-testing machine, may be separated into components that are small enough for testing. Control and instrumentation equipment, although often attached to larger pieces of machinery, are tested in this manner.

2 Normative reference

The following standard contains provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the edition indicated was valid. All standards are subject to revision, and parties to agreements based on this International Standard 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 International Standard, the definitions given in ISO 2041 and the following definitions apply.

3.1 machinery: A system of mechanical and electrical elements that operates in a definable way.

3.2 machinery component: A physical portion of a machine which can operate as a separate system.

3.3 shipboard equipment: Machinery and electronic devices which are normal constituents of the operating mechanism of ships.

3.4 resilient mounts: Supports of equipment in which input dynamic forces are attenuated at the output ends (machinery attachment points).

4 Requirements

4.1 Basis of acceptability

Acceptability is contingent upon the ability of the equipment to perform its function during and after the tests specified in this International Standard. Minor damage or distortion will be permitted during the testing provided that such damage or distortion does not in any way impair the ability of the equipment to function. Because the types of equipment covered by this International Standard are numerous, a definite demarcation between major and minor failures cannot be specified, and decisions must necessarily be left to the judgement of the test engineer or authorized representative of the party concerned. In general, a major failure is one which would cause malfunction of the equipment. Non-repetitive failures of such parts as soldered joints and components on circuit boards, which can easily be replaced or repaired, are generally considered minor failures. As such, the repair could be made and the test continued with no negative effect on the remainder of the equipment. However, repetitive failure of such components should be considered as a basis for non-acceptability.

4.2 Testing machines

Vibration tests shall be performed using a testing machine capable of meeting the conditions specified in table 1. Means shall be provided for controlling the direction of vibration of the testing machine and for adjusting and measuring its frequencies and amplitudes of vibration in order to keep them within specified limits. If the lower frequency limit of 2 Hz cannot be reached, another available machine may be used, with the permission of the party concerned, provided that the natural frequencies of the equipment in translational and rocking modes of vibration are not less than the lowest frequency of the testing machine. This may sometimes be determined by properly controlled transient excitation, such as bumping the equipment to see whether low-frequency resonances exist. In no case shall a vibration-testing machine with a minimum frequency of greater than 5 Hz be used.

4.3 Method of attachment

4.3.1 Shipboard equipment

For all tests, the equipment shall be secured to the mounting brackets of the testing machine in the same manner as it will be aboard ship. If alternative methods of mounting are specified, tests shall be made using each method of mounting specified by the party concerned. For equipment designed to be secured to a deck and a headbrace support, a vertical bracket shall be used to simulate a bulkhead. The bracket shall be sufficiently rigid to ensure that its motion will be essentially the same as the motion of the platform of the testing machine.

4.3.2 Portable shipboard equipment and test equipment

Test equipment and portable equipment which are designed for permanent and semi-permanent attachment to ship structures shall be attached as specified in 4.3.1. Equipment which is not designed for permanent or semi-permanent attachment shall be secured to the testing machine by means of suitable straps.

4.3.3 Orientation for vibration test

Equipment shall be installed on vibration-testing machines in such a manner that the direction of vibration will be, in turn, along each of the three mutually perpendicular axes of the equipment installed aboard ship: vertical, athwartship, and fore-aft.

4.3.4 Resiliently mounted equipment

Equipment which is to be installed on resilient mounts or on distributed isolation material shall be tested with its mounts. The resonance frequencies of the equipment on its resilient mounts, determined during the vibration response investigation, shall not be used as the fixed frequencies for endurance testing. Equipment which incorporates other resilient mounts integrally in the enclosure, such as electronic cabinets, shall be tested as supplied. This requirement does not contradict those given in 4.3.1.

NOTE — The presence of resilient mountings will generally produce lower frequency resonances during testing, and prolonged excitation at these frequencies may tend to wreck the mounts. Care should be taken to ensure that these resonance frequencies will be sufficiently below the frequencies of main shipboard excitations. For certain applications, distributed isolators or other types of mounts ought not to be used during the test. In these cases, the test may be performed with the external mounts removed.

5 Test procedures

The tests specified in this International Standard are sinusoidal vibration tests. Each of the tests for resonance identification and endurance shall be conducted separately in each of the three principal directions of vibration. Tests in one direction shall be completed before proceeding to test in another direction. The equipment shall be energized to perform its normal functions during the testing if appropriate, and the test item shall be monitored for any malfunction or damage during the test. Functional testing before and after the vibration testing shall be performed if the equipment is not energized and operating during the vibration testing. If major damage (see 4.1) occurs, the test shall be discontinued and the entire test shall be repeated following repairs and correction of deficiencies, unless otherwise directed by the party concerned. The manufacturer may, at his option, substitute entirely new equipment for retest. If this option is taken, it should be noted in the test report furnished in accordance with clause 7.

5.1 Exploratory vibration test (resonance search)

To determine the presence of significant resonances, i.e. responses with amplification factor exceeding 2, in the equipment under test, vibrate the equipment as follows:

a) either at discrete frequency intervals of 1 Hz over the frequency range with the vibration amplitudes as specified for category 1 of table 1, maintained at each frequency for about 15 s; take finer increments of frequency resolution near observed resonances to identify more accurately the frequencies at which endurance testing (see 5.2) will be performed;

b) or by sweeping test over the frequency range with the vibration amplitudes as specified for category 1 of table 1; a sweep rate of one octave per two minutes is considered adequate.

5.2 Fixed-frequency endurance test

Vibrate the equipment for a period of 1,5 h at each of the four most significant resonance frequencies as determined by the test engineers (or at all resonances if there are less than four) and at the corresponding vibration amplitudes shown in table 1. If no resonances are observed, for each category perform this test at 30 Hz for a duration of 2 h.

Table 1 — Vibration test requirements for shipboard equipment and machinery components

Category	Frequency range	Displacement or acceleration amplitude (zero-peak)[1]		Duration
	Hz	Displ. mm	Acc. m/s^2	
1: Communication and navigation equipment, control and instrumentation equipment, and other equipment and machinery components	2 to 13,2	1,0	–	1,5 h at each resonance frequency or 2 h at 30 Hz if no resonances
	13,2 to 100	–	7	
2: Control and instrumentation when mounted on diesel engines, air compressors and other severe environments	2 to 25	1,6	–	
	25 to 100	–	40	
3: Mast-mounted equipment	2 to 15	2,5	–	
	15 to 50	–	22,5	

1) Allowable deviation from these values is ± 10 %.

6 Certification of testing

Any shipboard equipment that has met the requirements of this International Standard shall be so identified by an accompanying certificate or other documentation, for reference. Although not required, an identification plate furnishing the number of this International Standard, securely fastened to the equipment, is recommended.

7 Test report

The test report to be furnished by the testing laboratory shall include a listing of the items tested, giving manufacturer's model and serial numbers, the type of testing machine used, its capabilities and limitations, and a description of the tests conducted, including type of test, and the corresponding frequency and amplitude data. In addition, detailed descriptions of any damage or malfunctioning incurred and what stage in the tests shall be included. Recommendations should be given regarding what corrective measures, if any, should be taken. At the discretion of the test engineer, it should also include other pertinent information, such as overall dimensions of the equipment, its mass, approximate location of the centre of gravity, and a sketch or photograph of its mounting on the test machine.

Annex A
(informative)

Bibliography

[1] IEC 68-2-6:1995, *Environmental testing — Part 2: Tests — Test Fc: Vibration (sinusoidal).*

[2] IEC 92-504:1994, *Electrical installations in ships — Part 504: Special features — Control and instrumentation.*

[3] IEC 945:1994, *Marine navigational equipment — General requirements — Methods of testing and required test results.*

[4] IACS E10:1993, *Unified environmental test specification for testing procedure for electrical, control and instrumentation equipment, marine computers and peripherals covered by classification.*[1)]

1) International Association of Classification Societies, Genoa, Italy.