INTERNATIONAL STANDARD

ISO 20283-4

First edition
2012-04-15

AMENDMENT 1
2014-09-01

Mechanical vibration — Measurement of vibration on ships —

Part 4: Measurement and evaluation of vibration of the ship propulsion machinery

AMENDMENT 1

Vibrations mécaniques — Mesurage des vibrations à bord des navires —

Partie 4: Mesurage et évaluation des vibrations des machines de propulsion des navires

AMENDEMENT 1

Reference number
ISO 20283-4:2012/Amd.1:2014(E)

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Published in Switzerland

Foreword

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The committee responsible for this document is ISO/TC 108, *Mechanical vibration, shock and condition monitoring*, Subcommittee SC 2, *Measurement and evaluation of mechanical vibration and shock as applied to machines, vehicles and structures*.

Mechanical vibration — Measurement of vibration on ships —

Part 4: Measurement and evaluation of vibration of the ship propulsion machinery

AMENDMENT 1

Page 7, 4.5.5.1, last line

Delete “4.5.5.8”, insert “4.5.5.9”.

Page 14, 4.5.5.8

Add 4.5.5.9 after 4.5.5.8.

4.5.5.9 Transverse thrusters driven by vertical electric motors

For transverse thrusters normally in operation for short periods per day, it is not appropriate to apply the same limits as for electric motors in continuous operation and electric motors in the quiet factory. In order to analyse only self-induced vibration, the thruster electric motor bearing housing vibration shall be measured when it is running individually. This permits separation of induced vibration from vibration such as that induced by other thrusters running at the same time.

NOTE Self-induced vibration is vibration having its source in any part of the thruster unit (gearbox, thruster propeller, electric motor, etc.).

For both variable-speed (Fixed Pitch propeller) and constant-speed (Controllable Pitch propeller) transverse thrusters driven by vertical electric motors, running individually at 100 % of power, the limit of self-induced r.m.s. vibration velocity measured on the bearings of the electric motor, and particularly at the highest casing point as indicated in Figure D.1, is 18 mm/s.

For thrusters with CP propeller running individually at zero pitch and nominal rotational speed, the limit of self-induced r.m.s. vibration velocity measured on the bearings of the electric motor, and particularly at the highest casing point as indicated in Figure D.1, is 10 mm/s.

For thrusters of variable speed and with FP propeller, the self-induced r.m.s. vibration velocity should not exceed the limit of 18 mm/s at any operational speed. Additionally for such thrusters, audible load reversal in the gear box is in general to be restricted at any continuous stage of load and rotational speed.

Details of vibration measurements on thruster electric motors are described in Annex D.

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Add the following Annex D before the Bibliography.

Annex D
(informative)

Measurements on thruster electric motors

D.1 General

The given limit values and measuring procedures are standard procedures for acceptance purposes during initial sea or quay trials. In cases of trouble shooting, operational restrictions due to vibrations or cavitation effects, altered procedures may be applied. The general r.m.s. limit values as defined in 4.5.5.9 apply to each direction of measurement and include the effect of propeller excitation as well as vibration initiated by unbalance of the vertical electric motor rigidly connected to the foundation and the housing, and they refer to the assembled system.

NOTE The acceptable vibration velocity values due to unbalance of the electric motor itself at nominal speed under test bed conditions are much lower, commonly having an r.m.s. value of less than 5 mm/s.

If the limit values for the installed thruster are exceeded, further investigations should be initiated. In the course of such investigations it is necessary to determine the source of each excitation by frequency analysis techniques as well as the amplification effect due to vicinity to structural or thruster's natural frequencies. High response values of vibratory velocities can be caused by excessive excitation of the propeller (cavitation effects, unfavourable torsional vibration behaviour, etc.) or lateral resonances of the thruster excited either by the rotational frequency or the propeller impulses, or a combination of both.

D.2 Procedure for measurement of self-induced vibration

For each thruster running individually at 100 % of power, measurements should be performed in correspondence to the bearings of the electric motor in three directions (vertical, transverse and longitudinal) at the measuring positions shown in Figure D.1. The transverse and longitudinal readings should be taken radially toward the motor shaft, rather than aligned with the global ship coordinate system. The exact location of the transducers as well as the orientation of the two horizontal measurement axes are to be clearly documented in the report.

The thruster should be tested while running in both directions, due to different wake fields caused by the propeller boss.

For reasons of reproducibility, the measurements at transverse thrusters and particularly typical bow thrusters should be carried out at zero ship's speed.

The readings should be taken under steady-state condition with changes less than 30 % over a 2 s period. The measurement duration is defined by the frequency band and resolution (see 4.4.1 and D.3). Several readings may be averaged.

D.3 Representation of the results

Self-induced vibration values should be expressed as r.m.s. vibration velocity in mm/s from 2 Hz to 500 Hz (narrow-band representation).

NOTE The upper narrow-band limit specified here takes precedence over the guideline of 1 000 Hz in 4.1.

Magnitude versus frequency or harmonic order spectra are recommended for steady runs because they provide diagnostic information for use if the measured vibration amplitudes exceed guidelines established between the involved parties. A resolution of at least 400 spectral lines and a Hanning

window are often used, but different parameters may be more appropriate for better amplitude or frequency resolution. Spectra should be averaged over the length of the data record, see also 4.4.1.

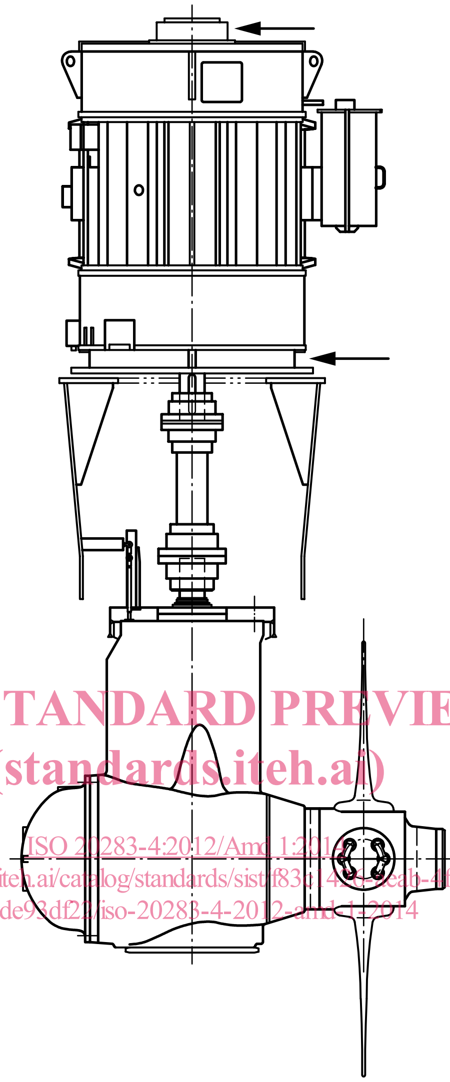

Figure D.1 — Measuring positions on a thruster electric motor

D.4 Documentation

All measurements should be collected in a technical report that contains at least the following information:

— identification of the system analysed;

— identification of the measuring device positions;

— identification of the measurement conditions with reference to the thruster: effective electric power or current, revolutions for FP propeller, pitch for CP propeller, direction of thrust and turning direction of ship;

— results of the measurements in form of graph and/or table.

ICS 17.140.30;47.020.01
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