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Ships and marine technology —Verification method for portable power measurement using a strain gauge

ISO copyright office

Ch. de Blandonnet 8 • CP 401

CH-1214 Vernier, Geneva, Switzerland

Tel. + 41 22 749 01 11

Fax + 41 22 749 09 47

copyright@iso.org

www.iso.org

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Foreword

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This document was prepared by Technical Committee ISO/TC 8, *Ships and marine technology*, Subcommittee SC 2, *Marine environment protection*.

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Ships and marine technology —Verification method for portable power measurement using a strain gauge

1 Scope

This document specifies a procedure for the verification of portable power measurement equipment using a strain gauge in the laboratory.

The power measurement equipment verified in accordance with this document can be used on merchant ships.

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2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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.

ISO 15016:2015, *Ships and marine technology — Guidelines for the assessment of speed and power performance by analysis of speed trial data*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

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— IEC Electropedia: available at http://www.electropedia.org/

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3.1
strain gauge
gauge used to measure the strain on an object

Note 1 to entry: As the object is deformed it causes a change in electrical resistance. This change in resistance, usually measured using a Wheatstone bridge, is related to the strain by the quantity known as the gauge factor.

3.2
shaft power meter verification equipment
equipment designed to provide a real torque, produced by a torque arm weighted with a known exact mass, to the torque measurement device

3.3
portable power measurement equipment
equipment temporarily installed on the ship and operated during a sea trial to measure the power delivered to the propeller by the engine and transmission systems, as opposed to the fixed-type shaft power measurement equipment, if installed

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4 Composition of the shaft power meter verification equipment

4.1 General

The verification equipment is composed of a torque arm, a weight surface plate, a torque arm axis, a shaft, a torque sensor, a weight and an RPM (revolutions per minute) generator. See Figure 1. The real torque is generated by weights with known exact mass, attached to a torque arm of known length which is attached to the shaft.

Shaft torque shall be measured by means of a verified permanent torque sensor or strain gauges on the shaft.

4.2 Torque generator and RPM generator

4.2.1 General

Torque and RPM are needed for calculating the shaft power output. The ship's power output can be simulated by multiplying the RPM, which are generated by an RPM generator, generating exact RPM, and the torque which is generated by a torque generator.

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4.2.2 Torque generator

Torque is applied to the shaft by a torque generator using weights with exact mass and a torque arm with exact length, see Figure 2. Weight shall be corrected and calibrated accurately.

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The shaft material properties of the torque generator shall be stated in a test report in accordance with ISO 15016:2015, 6.1.

4.2.3 RPM generator

a) The RPM generator is composed of a body of revolution, which can be controlled from 0 RPM to 1 RPM, and a tacho sensor which measures the number of revolutions.

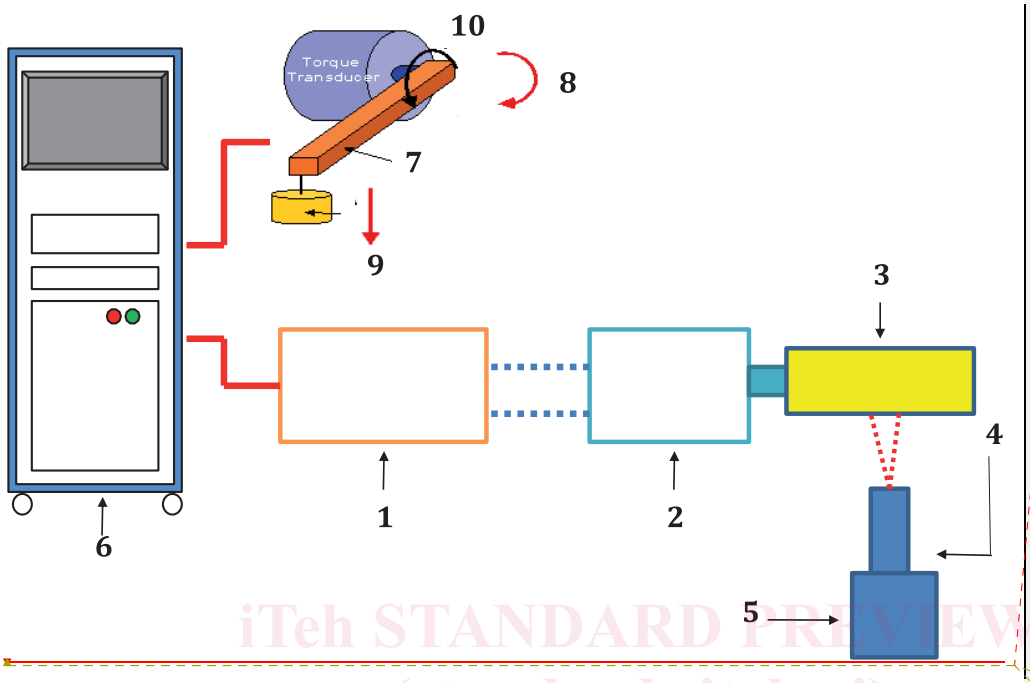
b) The RPM generator shall control the RPM precisely. It shall be designed to attach to the various types of tacho sensors to be linked with the shaft power device.

c) The RPM generator shall be capable of displaying the current RPM status data. The RPM error rate shall be recorded in the test report as specified in Annex C.

d) The RPM generator should be calibrated by a facility meeting ISO/IEC 17025. If it is not, it should be verified by a calibrated tachometer.

e) The engine RPM generator shall be included for exact verification of the shaft power meter as shown in Figure 1.

f) The RPM error rate shall be measured at least five times for each of the RPM testing conditions.



Key

1 motor precise control system
2 precise servo meter
3 rotating shaft
4 tachometer
5 shaft power verification simulator (SW)
6 control and data processing unit
7 torque arm
8 torque
9 weight
10 moment

Figure 1 — Composition of the verification equipment

5 Guidelines for installation and verification test

5.1 General

The verification equipment shall be designed to enable a comparison with the output of the portable shaft power meter by generating torque and RPM.

When the weights are installed to the torque arm, the specimen shaft is twisted by the torque and this torque is measured by the shaft power verification equipment.

The torque can be verified by a torque arm weighted with a known exact mass and exact length. The shaft power meter can be verified by comparing the output values with the verification equipment. It is possible to verify whether the torque output measured by the torque sensor is equal to the calculated values or not.

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Measured values of the verification equipment torque sensor are the standard values.

Final power (kW) of the shaft power meter for the ship's engine can be verified when RPM data is provided by the RPM generator.

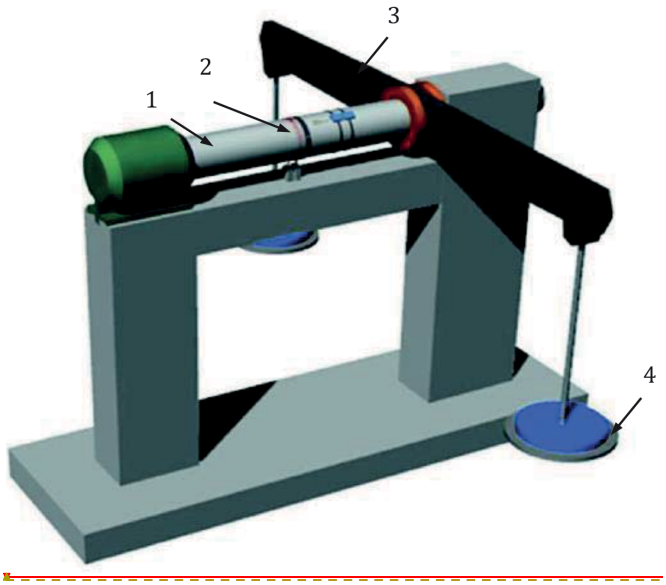
NOTE The verification equipment is designed for the portable torque meter; however, this equipment can verify other types of shaft power meters by agreement between manufacturers and purchasers.

5.2 Installation guidelines

The verification equipment can be designed as given in Table 1, however other types of equipment designs can be applied by agreement between manufacturers and purchasers, see Annex B.

Table 1 — Installation guidelines

Name	Use	Guidelines
Torque sensor	Sensor to measure torque values at specimen shaft	Comparing and analysing the output values installed in the test shaft and suggesting the standard value allows verification of the shaft power meter.
Shaft	Shaft for verification test	4.2.2 shall be followed for the shaft property of the shear modules.
Torque arm	Mechanism for transferring the torque moment by weight to the test specimen shaft	Distance between rotation pivot point of torque arm and acting point of weighting shall be 1 m for the sake of convenient calculation of moment of rotation and torsional rigidity.
Weight	Device for generating artificial torque	Predictable standard torque is generated by weight with exact mass.
RPM generator	Device for generating RPM	It shall be designed to equip the tacho sensor of shaft power equipment and precisely control the RPM.



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Key

1 shaft
2 shaft angle of distortion sensor
3 torque arm
4 weight surface plate

Figure 2 — Torque generator

6 Test procedure

a) Install the shaft power meter to the shaft of the verification equipment in accordance with A.2.

b) Test the strain gauge to ensure it is attached correctly in accordance with A.2 d).

c) Put weight in surface plate and generate torque.

d) Compare the installed shaft power meter values and the shaft power values by the verification equipment, and record the error rate of these compared values.

e) Compare the number of revolutions generated by the RPM generator and measured output data and calibrated tachometer and record the error rate of these compared values.

7 Test report

The results of the verification test shall be reported in the form specified in Annex C.

8 Verification

If the torque given by the torque generator is correctly indicated, the power measurement equipment is deemed to have correct performance of shaft power measurement.