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Ships and marine technology — Specifications for the assessment of speed and power performance by analysis of speed trial data

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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.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO document should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

ISO draws attention to the possibility that the implementation of this document may involve the use of (a) patent(s). ISO takes no position concerning the evidence, validity or applicability of any claimed patent rights in respect thereof. As of the date of publication of this document, ISO had not received notice of (a) patent(s) which may be required to implement this document. However, implementers are cautioned that this may not represent the latest information, which may be obtained from the patent database available at www.iso.org/patents. ISO shall not be held responsible for identifying any or all such patent rights.

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For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 8, *Ships and marine technology*, Subcommittee SC 6, *Navigation and ship operations*.

This third edition cancels and replaces the second edition (ISO 15016:2015), which has been technically revised.

The main changes are as follows:

— the status of Annex K has been changed to normative;

— the requirements for the wind sensor have been updated;

— the wind limits have been made more specific;

— new wind coefficient reference data has been added;

— wave correction methods have been updated (SNNM method has been added; “STAWAVE-2” and “Theoretical method with simplified tank tests in short waves” have been deleted);

— the application of wave correction methods has been clearly defined;

— with regard to shallow water correction, the Lackenby method has been replaced by the modern Raven method.

Any feedback or questions on this document should be directed to the user’s national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

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Introduction

This document concerns the procedure of analysing the results obtained from ship speed-power trials.

The primary purpose of speed and power trials is to determine a ship's performance in terms of its speed, power and propeller shaft speed under the ship's prescribed conditions, and thereby verify the satisfactory attainment of a ship speed stipulated by the Energy Efficiency Design Index (EEDI) regulations and the shipbuilding contract. To determine the contracted ship speed and the ship speed for EEDI, the same procedure is followed. The EEDI forms an integral part of the sea trial conduct and analysis.

The contracted ship speed and the ship speed for EEDI are determined at specific draughts (either contract draught or EEDI draught, or both). For EEDI, the environmental conditions are: no wind, no waves, no current and deep water of 15 °C.

Normally, such stipulated conditions are unlikely to be experienced in part or in full during the actual trials. In practice, certain corrections for the environmental conditions such as water depth, surface wind, waves, current [1][2] and deviating ship draught, should be considered. For this reason, during the speed and power trials, not only shaft power and ship speed are measured, but also relevant ship data and environmental conditions.

The purpose of this document is to define the basic requirements for the performance of speed trials and to provide methods for the evaluation and correction of speed trial data, covering all influences which can be relevant to the individual trial runs based on sound scientific grounds, thereby enabling owners and others to have confidence in the validity of the final results.

This document is intended to help the interested parties to achieve the desired target accuracy of within 2 % in shaft power and 0,1 knot[1)] in speed.[1]

The procedure specified in this document has been developed largely based on published data on speed trials and on ship's performance, including the International Towing Tank Conference (ITTC) documents listed in Clause 2.

The basic development of sea trial procedures using the Direct Power Method has been initiated by the STA-Group and later by ITTC. This document takes into account the work of the STA-Group[3] and the guidelines of ITTC which are approved by the Maritime Environmental Protection Committee (MEPC) MEPC 65 for EEDI.[1]

In 2002, the first edition of this document was published. ISO 15016:2002 was based on the evaluation of resistance increase and propeller characteristics.

The second edition (ISO 15016:2015) enabled this document to be used for EEDI regulations as well as for the shipbuilding contract. This new procedure was based on the direct power method. The "mean of means" and the "iterative" method were selected for the correction of current effects. For wave correction, several methods were offered as options in combination with observed wave conditions.

This third edition takes into account methods for the correction of wind, waves and shallow water which have been recently developed and validated. The application of these methods has been made consistent and ambiguities are avoided. This document includes modern accurate measurement methods of wind and waves. It has been updated to achieve the specified target accuracy of speed and power.

This document generally applies to ships for which survey and certification of EEDI and Energy Efficiency Existing Ship Index (EEXI) is required under the International Maritime Organization Resolutions.[4][7][8] For other ships, to which the above International Maritime Organization (IMO) resolutions are not applicable, the terms or phrases of this document are deemed to be replaced as necessary (e.g. "agreement between the shipbuilder, the owner and the verifier" can be read as "agreement between the shipbuilder and the owner" etc.)

In this document, the unit used to express the amount of an angle is "rad" (radian) and the unit of speed is "m/s" (metres per second). Nevertheless, "degree" as a unit for an angle and "knots" as a unit for speed

1) 1 kn = 1 852/3 600 m/s.

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are used wherever indicated. Moreover, for the convenience of the users of this document, numerical values using the units of degree and knots are stated together, where appropriate.

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Ships and marine technology — Specifications for the assessment of speed and power performance by analysis of speed trial data

1 Scope

This document specifies requirements for the preparation, execution and reporting of speed trials of ships of the displacement type with a length between perpendiculars (L_{pp}) from 50 metres to 500 metres. It provides a procedure for the analysis, evaluation and correction of the gathered speed trial data covering all influences that can be relevant to the individual trial runs reporting on speed trials for ships, including effects that can influence the speed, power and propeller shaft speed relationship.

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.

ITTC 7.5-02-03-01.4, *ITTC Recommended Procedures and Guidelines, 1978 ITTC Performance Prediction Method*

ITTC 7.5-02-07-02.2, *ITTC Recommended Procedures and Guidelines, Prediction of Power Increase in Irregular Waves from Model Tests.*

3 Terms and definitions

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

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

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

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

3.1
brake power
power, in watts, delivered by the output coupling of the propulsion machinery before passing through any speed-reducing and transmission devices

3.2
contract power
brake power (3.1) or *shaft power* (3.20), in watts, that is stipulated in the new build or conversion contract between the *shipbuilder* (3.21) and the *owner* (3.14)

3.3
contract speed
ship speed (3.23) to be achieved as agreed within the terms of the new build/conversion contract

3.4
direct power method
procedure where the measured power is directly corrected by the power increase due to added resistance in the trial conditions

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