2022-11-09

ISO/FDIS 4679:20222023(E)

ISO TC 8/SC 8/WG 14

Date: 2023-02-23

Secretariat: KATS

Ships and marine technology — Hydraulic performance tests for waterjet propulsion system

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Contents

Foreword

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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 documents 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~~www.iso.org/directives).

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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~~www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 8, *Ships and marine technology*, Subcommittee SC 8, *Ship design*.

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~~www.iso.org/members.html.

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Ships and marine technology — Hydraulic performance tests for waterjet propulsion system

1 Scope

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This document specifies the measurement and acceptance criteria and the test report of hydraulic performance tests for waterjet propulsion system of Class A and Class B.Introduction

The purpose of this document is to establish a standard for hydraulic performance test of water jet propulsion.

The test methods for the waterjet propulsion pump with and without the inlet duct are both specified. This document is applicable to the hydraulic performance test of water jet propulsion under the specified test conditions. This document specifies the precision grade of Class A for hydraulic model tests of water jet propulsion and Class B for acceptance tests of small and middle-sized or intermediate test modelmodels.

In addition, this document specifies the test conditions of Class A and Class B, and recommendations and requirements for test equipment to ensure that the test can be carried out under the conditions of corresponding accuracy.

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Ships and marine technology — Hydraulic performance tests for waterjet propulsion system

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1 Scope

This document specifies the measurement and acceptance criteria and the test report of hydraulic performance tests for waterjet propulsion system of Class A and Class B.

Class A stands for the precision level and is applicable for hydraulic model tests and prototype model tests which require higher accuracy. Class A is mainly used for laboratorial research and scientific purposes which require higher measurement accuracy. Class B stands for the engineering level and is applicable for acceptance tests of batch inspections of small and middle-sized prototype models.

This document does not include miscellaneous parts of waterjet unit, such as steering and reversing gear, hydraulic system and control system.

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 17769-1, *Liquid pumps and installation — General terms, definitions, quantities, letter symbols and units — Part 1: Liquid pumps*

There are no normative references in this document.

3 Terms, definitions, symbols and abbreviated terms

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

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

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

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

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3.1
waterjet unit
unit that consists of *waterjet propulsion system* (3.2), steering and reversing gear, hydraulic system and control system which is able to steer and reverse the main body

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3.2
waterjet propulsion system
propulsion system that consists of *waterjet pump* (3.3), nozzle and inlet duct (generally the impeller of waterjet pump (3.3) is integrated with the nozzle) and that is able to drive the main body moving

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3.3
waterjet pump
pump that transfers the energy of prime mover to water by rotating impeller

Note 1 to entry: The waterjet pump obtains a counter-acting force and drives the main body moving. It consists of impeller, guide vane, shell and shaft (hereinafter referred to as "pump"). The main types are mixed-flow type and axial flow type. The axial flow waterjet pump is one in which the liquid is discharged axially from the impeller. The mixed-flow waterjet pump is one in which the liquid is discharged from impeller with an angle α ($0° < \alpha < 90°$ ($0° < \alpha < 90°$) to the shaft line, also called the inclined waterjet pump.

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3.4
flow rate
Q
volume of liquid discharged by *waterjet pump* (3.3) per unit time

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3.5
inlet total head
H_1
overall energy at the inlet section of the pump

Note 1 to entry: Inlet total head is given by Formula (1):

$$H_1 = z_1 + \frac{p_1}{\rho g} + \frac{v_1^2}{2g} \quad (1)$$

where

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- z_1 is inlet height above reference plane, expressed in m;
- p_1 is inlet pressure, expressed in Pa;
- ρ is density of liquid, expressed in kg/m³;
- g is acceleration of gravity, expressed in m/s²;
- v_1 is inlet velocity, expressed in m/s.

[SOURCE: ISO 9906:2012, 3.2.13, modified — v_1 takes the place of U_1 and the meaning of each term is explained.]

3.6
outlet total head
H_2
overall energy at the outlet section of the pump

Note 1 to entry: Outlet total head is given by Formula (2):

$$H_2 = z_2 + \frac{p_2}{\rho g} + \frac{v_2^2}{2g} \quad (2)$$

where

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- z_2 is outlet height above reference plane, expressed in m;
- p_2 is outlet pressure, expressed in Pa;
- v_2 is outlet velocity, expressed in m/s.

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[SOURCE: ISO 9906:2012, 3.2.14, modified — v_2 takes the place of U_2 and the meaning of each term is explained.]

3.7

pump total head

H

algebraic difference between the outlet total head (3.6), H_2 H_2, and the inlet total head (3.5), H_1 H_1

Note 1 to entry: Pump total head is given by Formula (31):

$$H = H_2 - H_1 \quad (1)$$

where

$$H = H_2 - H_1 \quad (3)$$

H_1 is the inlet total head, expressed in Pa;

H_2 is the outlet total head, expressed in Pa.

Note 2 to entry: Unless otherwise specified, the baseline of the head is the waterjet propulsion shaft line.

[SOURCE: ISO 9906:2012, 3.2.15, modified — notes 1 and 2 to entry have been modified.]

3.86

pump power input

P

power transmitted to the pump by its driver

[SOURCE: ISO 17769-1:2012, 2.1.11.2], modified — note 1 to entry has been deleted.]

3.97

pump efficiency

η

proportion of the *pump power input* (3.86), *P*, delivered as pump power output, P_u, at given operating conditions

Note 1 to entry: Pump efficiency is given by Formula (42):

$$\eta = \frac{P_u}{P} \quad (4)$$

$$\eta = \frac{P_u}{P} \quad (2)$$

where

P_u is useful mechanical power transferred to the liquid during its passage through the pump, given by Formula (5); (3):

$$P_u = \rho g Q H \quad (5)$$

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$$P_u = \rho g Q H \quad (3)$$

[SOURCE: ISO 17769-1:2012, 2.1.12.1], modified — Formula (3) has been added and the symbols have been explained.]

3.108

type number

K

dimensionless quantity, defined by Formula (64):

$$K = \frac{2\pi n Q'^{1/2}}{(gH')^{3/4}} = \frac{\omega Q'^{1/2}}{(y')^{3/4}} \quad (6)$$

$$K = \frac{2\pi n Q'^{1/2}}{(gH')^{3/4}} = \frac{\omega Q'^{1/2}}{(y')^{3/4}} \quad (4)$$

where

Q' is volume flow rate per eye, expressed in m^3/s;is volume flow rate per eye, expressed in m^3/s;

H' is head of the first stage, expressed in m;

ω is expressed in time, like s^{-1}, and n is expressed in 60 × × min^{-1} form.

Note 1 to entry: The type number should be taken according to the maximum diameter of the first stage impeller.

3.119

net positive suction head

NPSH

pump inlet total head (3.5) above the head, equivalent to the vapour pressure per unit volume liquid, i.e. pump inlet total head (3.5) adds head equivalent to atmospheric pressure and subtracts head equivalent to the vapour pressure

Note 1 to entry: Net positive suction head is calculated by Formula (75):

$$NPSH = H_1 - z_D + \frac{p_b - p_v}{\rho g} \quad (5)$$

where

$$NPSH = H_1 - z_D + \frac{p_b - p_v}{\rho g} \quad (7)$$

where

- p_b is (absolute) atmospheric pressure, expressed in Pa;
- p_v is (absolute) vapour pressure, expressed in Pa;

