BS ISO 13643-3:2017

BSI Standards Publication

Ships and marine technology — Manoeuvring of ships

Part 3: Yaw stability and steering

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Full document details: BS ISO 13643-3:2017

National foreword

This British Standard is the UK implementation of ISO 13643-3:2017. It supersedes BS ISO 13643-3:2013 which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee EPL/80, Maritime navigation and radiocommunication equipment and systems.

A list of organizations represented on this committee can be obtained on request to its secretary.

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Published by BSI Standards Limited 2017

ISBN 978 0 580 94633 2

ICS 47.020.70

Compliance with a British Standard cannot confer immunity from legal obligations.

This British Standard was published under the authority of the Standards Policy and Strategy Committee on 28 February 2017.

Amendments/corrigenda issued since publication

Date	Text affected

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INTERNATIONAL STANDARD

ISO 13643-3

Second edition
2017-02

Ships and marine technology — Manoeuvring of ships —

Part 3: Yaw stability and steering

Navires et technologie maritime — Manoeuvres des navires —

Partie 3: Stabilité en lacet et pilotage

Reference number
ISO 13643-3:2017(E)

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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 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).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation on 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 the following URL: www.iso.org/iso/foreword.html.

The committee responsible for this document is ISO/TC 8, *Ships and marine technology*, Subcommittee SC 6, *Navigation and ship operations*.

This second edition cancels and replaces the first edition (ISO 13643-3:2013), of which it constitutes a minor revision with the following changes:

— the numbering has changed;

— in Clause 4, Table 1, the SI-Unit in first line was changed from "rad s^{-1}" to "rad s^{-1}";

— in the second line of 9.4, "δ_{Ri} = 10° (10)" was changed to "δ_{Ri} = −10° (10)".

A list of all parts in the ISO 13643- series can be found on the ISO website.

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INTERNATIONAL STANDARD ISO 13643-3:2017(E)

Ships and marine technology — Manoeuvring of ships —

Part 3: Yaw stability and steering

1 Scope

This document defines symbols and terms and provides guidelines for the conduct of tests to give evidence about the yaw stability and steering of surface ships, submarines, and models. It is meant to be read in conjunction with ISO 13643-1.

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 13643-1:2017, *Ships and marine technology — Manoeuvring of ships — Part 1: General concepts, quantities and test conditions*

ISO 13643-5:2017, *Ships and marine technology — Manoeuvring of ships — Part 5: Submarine specials*

ISO 80000-1, *Quantities and units — Part 1: General*

ISO 80000-3, *Quantities and units — Part 3: Space and time*

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:

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

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

3.1
astern test
manoeuvring test to determine the ship's ability to maintain course while making way astern

3.2
astern zig-zag test
manoeuvring test to determine the ship's ability to maintain course while making way astern by assessing manoeuvring devices efficiency from a zig-zag test

3.3
direct astern test
manoeuvring test to determine the ship's ability to maintain course when making way astern using its manoeuvring devices and tunnel thrusters as available

3.4
direct spiral test (according to Dieudonné)
manoeuvring test to determine the yaw stability and turning ability when using constant manoeuvring device settings

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3.5
manoeuvring device
rudder, azimuthing thruster, hydroplane, cycloidal propeller, or equivalent system used to manoeuvre a vessel

3.6
pull-out test
manoeuvring test for quick determination of a ship's yaw stability related to its speed through the water

3.7
reverse spiral test (according to Bech)
manoeuvring test to determine the yaw stability and turning ability when using constant yaw rates of turn

3.8
sine test
manoeuvring test to determine the ship's turning and yaw-checking ability in relation to initial speed and manoeuvring device settings for the purpose of setting up auto pilots

3.9
weave test
manoeuvring test to determine the extent of a ship's potential yaw instability

4 Test-related physical quantities

Test-related physical quantities are listed in Table 1. The more general quantities and concepts concerning the manoeuvring of ships are set out in ISO 13643-1.

For quantities and their units, ISO 80000-1 and ISO 80000-3 shall be used.

Table 1 — Test-related physical quantities

Symbol	CC-Code	SI-Unit	Concept	
			Term	Definition or explanation
$\frac{d\dot{\psi}_C}{d\delta_{Ri}}$	GRDNTD	s^{-1}	Gradient of the $\dot{\psi}_C(\delta_{Ri})$ curve at δ_0	—
$\frac{d\dot{\psi}_i}{d\delta_R}$	GRDNTB	s^{-1}	Gradient of the $\dot{\psi}_i(\delta_R)$ curve at δ_0	—
L	L	m	Length	Reference length of a ship (see ISO 13643-1)
l_δ	LWRD	rad[a]	Loop width	For a ship with yaw instability: measured between the two extremes of the curve $\delta_R(\dot{\psi})$
$h\dot{\psi}$	LHRD	rad s^{-1} [b]	Loop height	For a ship with yaw instability: measured between the intersections of the $\dot{\psi}(\delta_R)$ curve with the axis $\delta_R = 0$
n_i	NI	s^{-1}	Test propeller speed	—
P/D	PDR	1	Pitch ratio	—
P_i	PITCHI	m	Test propeller pitch	Propeller pitch given relative to the pitch for zero thrust at zero speed

[a] For angles, the unit ° (degree) may be used.
[b] For rate of turn, the unit °/s (degree per second) may be used.
[c] The unit kn, common in navigation, may be used.

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Table 1 *(continued)*

Symbol	CC-Code	SI-Unit	Concept	
			Term	Definition or explanation
T	TIP	s	Period of manoeuvring device oscillation	Specified time to move the manoeuvring device, e.g. from the specified amplitude to starboard (S) to the same amplitude to port (P) and back to the specified amplitude to starboard (S)
t_{C1}	TIC1	s	First time to check yaw	Elapsed time from initiating 1st application of manoeuvring devices in the opposite direction until maximum change of heading is reached
t_{C2}	TIC2	s	Second time to check yaw	Elapsed time from initiating 2nd application of manoeuvring devices in the opposite direction until maximum change of heading is reached
t_F	TIF	s	Course keeping time	Time during which the ship maintains course in accordance with 10.2.1
V_F	VF	m s^{-1} [c]	Final speed	Speed at the end of test (run)
V_i	VI	m s^{-1} [c]	Target speed	Speed corresponding to propeller speed/pitch setting on straight track
V_0	V0	m s^{-1} [c]	Initial speed	(See ISO 13643-1)
x_0	X0	m	—	Coordinate in the direction of the initial heading of the earth-fixed axis system moving with the water, the origin of which coincides with that of ship-fixed axis system at $t = 0$ (see also ISO 13643-1)
x_{0F}	X0F	m	Sternboard	x_0-component (astern) of the ship's track at t_F
y_0	Y0	m	Transverse axis	Coordinate of the earth-fixed axis system in water surface perpendicular to x_0, analogous definition (see also ISO 13643-1)
y_{0F}	Y0F	m	Transfer at end of test (run)	y_0-component of the ship's track at t_F
z_0	Z0	m	Vertical axis	Coordinate of the earth-fixed axis system orthogonal to x_0 and y_0, vertically down, analogous definition (see also ISO 13643-1)
Δz_{0F}	DZ0F	m	Change of dived depth	z_0-component of the ship's track at t_F, relative to the value at the commencement of a test (run)
$\Delta\delta_{Ri}$	DANRUI	rad[a]	Manoeuvring device angle step	—
$\Delta\psi$	DPSIH	rad[a]	Change of heading	$\psi - \psi_0$
$\Delta\psi_E$	DPSIHE	rad[a]	Execute change of heading	Specified absolute amount of change of heading for applying the manoeuvring devices into the opposite direction
$\Delta\psi_F$	DPSIHF	rad[a]	Change of heading at end of test	$\psi_F - \psi_0$
$\Delta\psi_{MAX}$	DPSIHM	rad[a]	Maximum change of heading	—
$\Delta\dot{\psi}_C$	DYARTC	rad s^{-1} [b]	Difference between final asymptotic rates of turn	Resulting from S and P turns at the same V_0
δ_{Ra}	ANRUA	rad[a]	Manoeuvring device angle amplitude	If necessary, an equivalent manoeuvring device amplitude shall be given, e.g. for submarines with X-planes: ¼ ($\delta_{Aa2} + \delta_{Aa3} - \delta_{Aa1} - \delta_{Aa4}$).

[a] For angles, the unit ° (degree) may be used.

[b] For rate of turn, the unit °/s (degree per second) may be used.

[c] The unit kn, common in navigation, may be used.

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