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Ships and marine technology — Manoeuvring of ships —

Part 4: Stopping, acceleration, traversing

Navires et technologie maritime — Manoeuvres des navires —

Partie 4: Arrêt, accélération, déplacement

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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 13643-4:2013), of which it constitutes a minor revision with the following changes:

— the numbering has changed;

— in Clause 4, Table 1, in the second line of the table (CC-Code DECFAC), the Definition was changed;

— in Clause 4, Table 1, in line 9 of the table (CC-Code TIACC), the SI-Unit was changed from “m” to “s”.

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

Ships and marine technology — Manoeuvring of ships —

Part 4:
Stopping, acceleration, traversing

1 Scope

This document defines symbols and terms and provides guidelines for the conduct of tests to give evidence about the stopping, acceleration, and traversing of surface ships, submarines, and models. It is intended 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, *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*

IMO MSC Circular 1053, *Explanatory Notes to the Standard for Ship Manoeuvrability*

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
acceleration test
manoeuvring test to determine the ship's performance under positive acceleration or negative acceleration (deceleration)

3.2
coasting stop test
manoeuvring test to determine the ship's behaviour after the propulsion plant has been disengaged and/or shut down

3.3
manoeuvring device
rudder, azimuthing thruster, hydroplane, cycloidal propeller, or equivalent system used to manoeuvre a vessel

3.4
stopping test
manoeuvring test to determine the ship's behaviour after active reversal of the thrust direction of the propulsion plant

3.5
traversing test
manoeuvring test to determine the ship's capability to execute a lateral movement, if possible without turning and moving in the longitudinal direction

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
s_F	SPF	m	Track reach	Distance travelled from $t = 0$ up to the time the ship is "practically dead in the water" measured along the ship's track
$\frac{s_F}{V_0}$	DECFAC	s[a]	Track reach deceleration factor	Average time to decelerate by one knot
s_S	SPS	m	Track reach to propulsor stop	If the propulsion is shut down, distance travelled along the ship's track before the propulsion has come to a complete stop
s_a	SPACC	m	Acceleration distance	Distance travelled along the ship's track before the target speed is achieved
$s_{(t)\min}$	SP(t)	m	Track reach after (t) minutes	(t) stands for elapsed time after $t = 0$, example: track reach after 3 minutes: $s_{3\min}$ or SP3
t_F	TIF	s	Stopping time	For stopping test: From $t = 0$ to the time when the ship is "dead in the water"
			Coasting time	For coasting stop test: From $t = 0$ to the time when the ship is "practically dead in the water" ($V \leq 2$ kn)
t_S	TIS	s	Time to propulsor stop	If the propulsion is shut down, the time until the propulsion has come to a complete stop
t_U	TIU	s	Reversal time	Until full astern power is achieved
t_a	TIACC	s	Acceleration time	Time elapsed to achieve the target speed (within a margin of 1 kn)
V_L	VL	m s $^{-1}$ [b]	Steerage way	Speed down to which the ship still follows the manoeuvring devices
V_i	VI	m s $^{-1}$ [b]	Target speed	Speed to which the ship is accelerated or decelerated
V_{x0}	VX0	m s $^{-1}$ [b]	Advance speed	Component in x_0-direction, relative to the initial heading of the ship

[a] The unit m/kn may be used.
[b] The unit kn, common in navigation, may be used.
[c] For angles, the unit ° (degree), may be used.

Table 1 *(continued)*

Symbol	CC-Code	SI-Unit	Concept	
			Term	Definition or explanation
V_{y0}	VY0	m s $^{-1}$ [b]	Traversing speed	Component in y_0-direction, relative to the initial heading of the ship
V_0	V0	m s $^{-1}$ [b]	Initial speed	(See ISO 13643-1)
x_0	X0	m	—	Coordinate in the direction of initial heading in the earth-fixed axis system moving with the water, the origin of which coincides with that of the ship-fixed axis system at $t = 0$ (see also ISO 13643-1)
x_{0F}	X0F	m	Advance at end of test (run)	x_0-component of ship's track at t_F
y_0	Y0	m	Transverse axis	Coordinate in the 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 ISO 13643-1)
z_0	Z0	m	Dived depth	—
β	BET	rad[c]	Drift angle	(See ISO 13643-1)
Δz_{0F}	DZ0F	m	Change of dived depth	z_0-component of the ship's track at t_F relative to value at the commencement of a test (run)
$\Delta\psi$	DPSIH	rad[c]	Change of heading	$\psi - \psi_0$
$\Delta\psi_F$	DPSIHF	rad[c]	Change of heading at end of test (run)	$\psi_F - \psi_0$
ψ	PSIH	rad[c]	Heading	(See ISO 13643-1)
ψ_F	PSIHF	rad[c]	Final heading	Heading at the end of a test (run)
ψ_0	PSIH0	rad[c]	Initial heading	Heading of a vessel at the commencement of a test (run)

[a] The unit m/kn may be used.

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

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

5 General test conditions

When operating submerged, submarines shall be trimmed according to the results of the neutral level flight test (see ISO 13643-5:2017, Clause 8). During the test, the dived depth shall be kept as constant as possible. The dived depth and the plane angles are to be recorded continuously. If the submarine is equipped with planes acting in the horizontal as well as the vertical direction at the same time (e.g. X-planes), these planes should be controlled in a way that a steady dived depth is maintained as matter of priority.

During the test, including the approach phase, each successive position of the ship is to be recorded, e.g. using an onboard navigation system during surface operations, at suitable time intervals (usually every second).

The reference point on the ship relative to which its track is measured should be defined in advance (e.g. location of the positioning system antenna). This point is not necessarily identical with the origin of the ship-fixed axis system for which the ship's track is given (see ISO 13643-1). Data which are to be recorded continuously include (but need not be limited to) manoeuvring device setting, propulsion setting, speed through the water, heading, rate of turn, heel angle, true wind velocity and direction, and relative wind velocity and direction.

6 Test 4.1 — Stopping test

6.1 General

The general test conditions outlined in ISO 13643-1 and Clause 5 shall be complied with.

6.2 Description

The ship approaches at a constant speed, V_0.

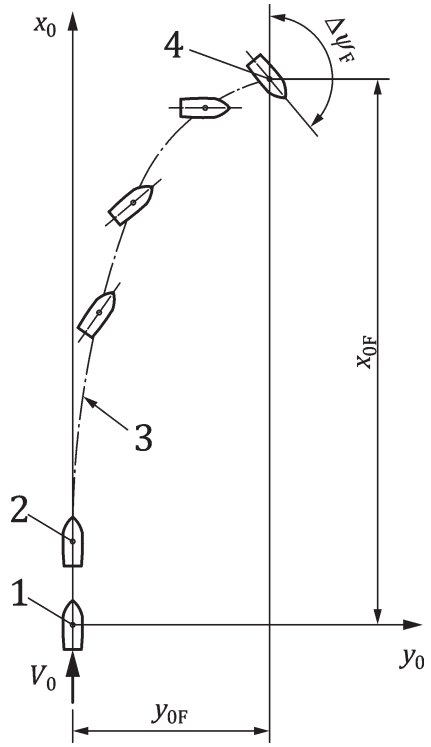
After the ship has been going straight ahead at the specified speed without significant application of the manoeuvring devices for at least two minutes, the active reversal of the thrust of the propulsion system is initiated (t = 0). Usually, this is achieved by reversing the propulsion to full astern. The ship shall be kept on its initial heading for as long as possible.[1)] If the ship no longer responds to the manoeuvring device, the device is returned to and held amidships (see Figure 1). In the case of a multi-shaft/-engine system, the different modes of operation and settings shall be observed.

Data which is to be recorded continuously includes (but need not be limited to) manoeuvring device angle, power setting, speed through the water, heading, rate of turn, propeller shaft speed/torque, propeller pitch, true wind velocity and direction, and relative wind velocity and direction. In addition, if possible, the thrust in the thrust bearing and the torque are to be recorded continuously.

The test is complete when the ship is dead in the water (see Figure 1). Deviating conditions for the end of the test shall be recorded.

NOTE If the test is performed from maximum continuous speed and with the maximum reverse thrust, it is designated as a “crash-stop”.

1) According to IMO MSC/Circ. 1053, the manoeuvring device shall be held amidships after reversing thrust.



Key

1 thrust reversal initiated, $t = 0$

2 full astern power achieved, $t = t_u$

3 the ship's track (track reach, s_F, measured along the track)

4 ship dead in the water

Figure 1 — Stopping test

6.3 Analysis and presentation of results of a stopping test

The following data are obtained from the test:

— track reach s_F

— stopping time t_F

— reversal time t_U

— advance at end of test x_{0F}

— transfer at end of test y_{0F}

— change of dived depth Δz_{0F}

— change of heading at end of test $\Delta\psi_F$

— track reach deceleration factor $\frac{s_F}{V_0}$

— track reach after (t) minutes, e.g. 1 min, 2 min, 3 min $s_{1min}, s_{2min}, s_{3min}, \ldots$