INTERNATIONAL STANDARD

ISO 13643-5

Second edition
2017-02

Ships and marine technology — Manoeuvring of ships —

Part 5: Submarine specials

Navires et technologie maritime — Manoeuvres des navires —

Partie 5: Spécificités des sous-marins

Reference number
ISO 13643-5:2017(E)

© ISO 2017



COPYRIGHT PROTECTED DOCUMENT

© ISO 2017, Published in Switzerland

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized otherwise in any form or by any means, electronic or mechanical, including photocopying, or posting on the internet or an intranet, without prior written permission. Permission can be requested from either ISO at the address below or ISO's member body in the country of the requester.

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

Contents

Page

Foreword ... **iv**

1 Scope ... **1**

2 Normative references ... **1**

3 Terms and definitions ... **1**

4 Test-related physical quantities ... **2**

5 General test conditions ... **4**

6 Test 5.1 — Meander test ... **4**
6.1 Description ... 4
6.2 Analysis and presentation of results of a meander test ... 7
6.2.1 Evaluation for subcritical damping ... 7
6.2.2 Damping ratio ... 7
6.3 Evaluation for supercritical or high damping ... 8
6.4 Evaluation of the time to half-value ... 9
6.5 Designation of a meander test ... 10

7 Test 5.2 — Vertical overshoot test ... **10**
7.1 Description ... 10
7.2 Analysis and presentation of results of a vertical overshoot test ... 11
7.3 Designation of a vertical overshoot test ... 12

8 Test 5.3 — Neutral level flight test ... **12**
8.1 Description ... 12
8.1.1 Model test (M) ... 12
8.1.2 Full-scale test (S) ... 13
8.2 Analysis and presentation of results of a neutral level flight test ... 14
8.2.1 Model test ... 14
8.2.2 Full-scale test ... 15
8.3 Designation of a neutral level flight test ... 17
8.3.1 Designation of a neutral level flight test with the model (M) ... 17
8.3.2 Designation of a neutral level flight test with the full-scale ship (S) ... 17

9 Test 5.4 — Critical speed test ... **17**
9.1 General ... 17
9.2 Description ... 18
9.3 Analysis and presentation of results of a critical speed test ... 18
9.4 Designation of a critical speed test ... 20

Bibliography ... **21**

© ISO 2017 – All rights reserved

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 13643-5:2013), of which it constitutes a minor revision with the following changes:

— the numbering has been changed;

— in Figure 1, key 2 has been changed from "boat dynamically unstable" to "boat dynamically stable";

— in Figure 1, key 5 has been changed from "dynamically unstable" to "dynamically stable".

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

© ISO 2017 – All rights reserved

Ships and marine technology — Manoeuvring of ships —

Part 5:
Submarine specials

1 Scope

This document defines symbols and terms and provides guidelines for the conduct of tests to give evidence about the manoeuvring ability in the vertical plane of 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 13643-1:2017, *Ships and marine technology — Manoeuvring of ships — Part 1: General concepts, quantities and test conditions*

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 http://www.iso.org/obp

3.1
meander test
manoeuvring test to establish a submarine's manoeuvring characteristics and to verify the submarine's dynamic stability in the vertical plane

3.2
vertical overshoot test
manoeuvring test to determine the effectiveness of the stern planes when initiating and terminating changes of depth

3.3
neutral level flight test
manoeuvring test to determine the trim angle and the hydroplane angles at which the submarine maintains a constant dived depth at any given speed during submerged operation

Note 1 to entry: Neutral level flight is obtained

— for submarines with retracted bow planes by using a definite trim angle and a definite angle of stern planes, and

— for submarines with non-retractable bow planes, by using definite angles of the bow and stern planes for arbitrary trim angles (preferably $\theta_S = 0°$).

© ISO 2017 – All rights reserved

3.4
critical speed test
manoeuvring test to determine the speed at which the effect of the hydroplanes is reversed during submerged operation

4 Test-related physical quantities

Test-related physical quantities are according to Table 1; general quantities and concepts are according to ISO 13643-1.

Table 1 — Test-related physical quantities

Symbol	CC-code	SI unit	Concept	
			Term	Definition or explanation
a_1	—	rad m^2 s^{-2} [a]	Coefficient	For regression approximation
a_2	—	m^2 s^{-2}	Coefficient	For regression approximation
b_1	—	rad m^2 s^{-2} [a]	Coefficient	For regression approximation
b_2	—	m^2 s^{-2}	Coefficient	For regression approximation
C_c	CCR	1	Damping ratio	Ratio between damping constant $\ln 2/t_{½}$ and eigenfrequency $2\pi/T_0$ of the undamped oscillation
c_1	—	rad m^2 s^{-2} [a]	Coefficient	For regression approximation
d_1	—	rad m^2 s^{-2} [a]	Coefficient	For regression approximation
F_V	FVC	N	Vertical force	—
MA	MAX	—	Main axis	(See ISO 13643-1)
M_T	MYT	Nm	Trim moment	—
T	TIP	s	Period of oscillation	Period of the damped oscillation, average of times $[t_{A(i+1)} - t_{Ai}]$
T_0	TIP0	s	Period of oscillation	Period of the undamped oscillation
t_A	TIA	s	Response time	For meander test: Times to achieve the trim amplitudes, θ_{Ai}, i = 1, 2, 3, …
				For vertical overshoot test: Time to change trim angle by $\Delta\theta_E$
t_C	TIC	s	Overshoot time	Time from putting the stern planes into the opposite direction until reaching maximum trim angle
t_t	TIT	s	Levelling-off time	Time from putting the stern planes into the opposite direction until reaching maximum depth change
$t_{½}$	TI05	s	Time to half-value	Time elapsed before the envelope of time-dependent trim variation has decreased by half
V_{CR}	VCR	m s^{-1} [b]	Critical speed	Speed at which the effect of the hydroplanes is reversed
V_F	VF	m s^{-1} [b]	Final speed	Speed at the end of test (run)
V_0	V0	m s^{-1} [b]	Initial speed	(See ISO 13643-1)
V_{0i}	V0I	m s^{-1} [b]	Initial speed	For neutral level flight and vertical overshoot test: For individual runs of the test
V_{0m}	V0M	m s^{-1} [b]	Mean test speed	—
z_0	Z0	m	Dived depth	Vertical coordinate in the earth-fixed axis system of the origin of the submarine (see ISO 13643-1:2017, Table 2) at any given time

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

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

© ISO 2017 – All rights reserved