# INTERNATIONAL STANDARD



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## Ships and marine technology — Manoeuvring of ships —

Part 6: Model test specials

Navires et technologie maritime — Manoeuvres des navires —

iTeh STPartie 6: Spécificités des essais sur modèle

## (standards.iteh.ai)

<u>ISO 13643-6:2017</u> https://standards.iteh.ai/catalog/standards/sist/fc6b565f-1aab-4d56-85e6d695b1a70d40/iso-13643-6-2017



Reference number ISO 13643-6:2017(E)

## iTeh STANDARD PREVIEW (standards.iteh.ai)

<u>ISO 13643-6:2017</u> https://standards.iteh.ai/catalog/standards/sist/fc6b565f-1aab-4d56-85e6d695b1a70d40/iso-13643-6-2017



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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 <a href="https://www.iso.org/directives">www.iso.org/directives</a>).

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 <a href="https://www.iso.org/patents">www.iso.org/patents</a>).

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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: <a href="http://www.iso.org/iso/foreword.html">www.iso.org/iso/foreword.html</a>.

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

This second edition cancelstands replaces the first editions (ISO 1364316:2013), of which it constitutes a minor revision with the following changes 695b1a70d40/iso-13643-6-2017

- in <u>3.6</u>  $xy\psi$ -carriage was inserted;
- in <u>Table 1</u> "DNDPDYS" row, the symbol was changed from " $N_{\phi dyn}$ " to " $N'_{\phi dyn}$ ";
- in <u>Table 1</u> "DYDVTS" row, the SI-unit was changed from "—" to "1";
- in Equation (20) " $\rho_{\rm W}$ " was changed to " $\rho$ ";
- in <u>7.3</u> paragraph 3, "moments" was changed to "motions".

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 6: Model test specials

### 1 Scope

This document defines symbols and terms and provides guidelines for the conduct of tests to determine the hydrodynamic forces and moments due to prescribed motions under a planar-motion, a circular-motion or an oblique towing or flow system for models of surface ships and submarines. It also defines symbols and terms and provides guidelines for the conduct of tests in a wind tunnel. 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 (standards.iteh.ai)

#### **3 Terms and definitions** ISO 13643-6:2017

https://standards.iteh.ai/catalog/standards/sist/fc6b565f-1aab-4d56-85e6-

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 <u>http://www.electropedia.org/</u>
- ISO Online browsing platform: available at http://www.iso.org/obp

#### 3.1

#### planar motion test

manoeuvring test to determine the hydrodynamic forces and moments as functions of lateral velocity and acceleration as well as of angular velocity and acceleration about the *z*-axis or the *y*-axis, respectively

#### 3.2

#### circular motion test

manoeuvring test to determine the hydrodynamic forces and moments as a function of the angular velocity for surface ships primarily about the *z*-axis, for submarines primarily about the *z*-axis, as well as the *y*-axis

#### 3.3

#### oblique towing or flow test

manoeuvring test to determine the forces and moments as a function of the drift angle and of the manoeuvring device angle and, in the case of submarines, the angle of attack and hydroplane deflections, in a towing tank, a circulating water tunnel, or a wind tunnel

#### 3.4

#### wind tunnel test

test to determine the aerodynamic forces and moments acting upon the above-water portion of the ship as a function of the relative wind

Note 1 to entry: A wind tunnel may also be used for the underwater hull.

#### 3.5

#### manoeuvring device

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

#### 3.6

#### $xy\psi$ -carriage

sub carriage (secondary towing system) to the towing carriage that allows a differential longitudinal, a transverse and a rotational motion of the model in the horizontal plane

### 4 Test-related physical quantities

Test-related physical quantities are according to <u>Table 1</u>. General quantities and concepts are according to ISO 13643-1.

Sumbol	CC codo	iTeh S	TANDARD PR	Concept -
Symbol	CC-Code	SI-unit	Term	Definition or explanation
ALV	ALV	m <sup>2</sup>	Lateral area above waterline	(see ISO 13643-1)
$A_{\rm XV}$	AXV	m² https://standards.i	Transversemojected area of ship above waterline ich av catalog/standards/sist/fc6b565	Projected cross section area above DWL, gener- ally without rigging, railings, etc. 1- raab-4d20-82c0-
АР	AP	—	d695b1a70d40/iso-13643-6-201 After perpendicular	(see ISO 13643-1)
<i>a</i> <sub>0</sub>	A0PMM	m	Displacement amplitude of the model movement	_
С	CWI	Ν	Cross force	Force perpendicular to relative wind direction
C <sub>C</sub>	CC	1	Cross force coefficient	$2C / (\varrho_A V_{WRA}^2 A_{LV})$
CD	CD	1	Drag coefficient	$2D / (\varrho_A V_{WRA}^2 A_{LV})$
C <sub>DAX</sub>	CDAX	1	Drag coefficient	2D / $(\varrho_A v_{WRA}^2 A_{XV})$ , relative to cross section
C <sub>K</sub>	СК	1	Roll-moment coefficient	$2K / (\rho_A V_{WRA}^2 A_{LV} L_{OA})$
C <sub>N</sub>	CN	1	Coefficient of moment about z-axis	$2N / (\varrho_A V_{WRA}^2 A_{LV} L_{OA})$
C <sub>X</sub>	СХ	1	Longitudinal-force coefficient	$2X / (\varrho_A V_{WRA}^2 A_{LV})$
C <sub>XAX</sub>	CXAX	1	Longitudinal-force coefficient	2X / ( $\varrho_A V_{WRA}^2 A_{XV}$ ), relative to cross section
Сү	СҮ	1	Lateral-force coefficient	$2Y / (\varrho_A V_{WRA}^2 A_{LV})$

#### Table 1 — Test-related physical quantities

## ISO 13643-6:2017(E)

		<b>ax x</b> .	Concept	
Symbol	CC-code	SI-unit	Term	Definition or explanation
D	DWI	Ν	Drag	Force in direction in which relative wind blows
DWL	DWL	_	Design waterline	(see ISO 13643-1)
FP	FP	—	Fore perpendicular	(see ISO 13643-1)
$F_{\mathrm{T}}$	FTWI	N	Resultant force	$\sqrt{C^2 + D^2}$ and $\sqrt{X^2 + Y^2}$ , respectively
F <sub>n</sub>	FN	1	Froude number	(see ISO 13643-1)
F <sub>n0</sub>	FN0	1	(Reference) Froude number	$V_0 / \sqrt{gL}$
GM	GM	m	Metacentric height	(see ISO 13643-1)
$H_{\rm LM}$	HLM	m	Mean height of lateral area above design waterline	A <sub>LV</sub> /L <sub>OA</sub>
l <sub>xx</sub>	IXX	kg m²	Moment of inertia of the model about x-axis	(see ISO 13643-1)
l <sub>yy</sub>	ΙΥΥ	kg m²	Moment of inertia of the model about y-axis	(see ISO 13643-1)
l <sub>zx</sub>			Product of inertia of the model	(see ISO 13643-1)
$l_{ZZ}$	IZZ		Moment of inertia of the model about	(see ISO 13643-1)
K	МХ	N m	Roll moment ISO 13643-6:2017	Moment about <i>x</i> -axis Relative to ship-fixed axis system
	https://sta	ndards.iteh.ai/cat	alog/standards/sist/fc6b565f-1aab-4	d56-85e6-
K.	דפתאת	069301 Nm rad-1a	a/0040/1so-13643-6-201/	$\left  \frac{\partial K}{\partial t} \right _{V=0}$
Mφstat	DRDI 51	N III Tau		$d\phi$ from static test or calculation
K'	MXS	1	Non-dimensional roll moment	Especially for submarines: $\frac{K}{\frac{\rho}{2}L^{3}V^{2}}$ where <i>K</i> ( <i>u</i> , <i>v</i> , <i>w</i> , <i>p</i> , <i>q</i> , <i>r</i> , $\dot{v}$ , $\dot{w}$ , $\dot{p}$ , $\dot{q}$ , $\dot{r}$ , $\phi$ , $\theta$ ) For surface ships only: $\frac{K}{\frac{\rho}{2}L^{3}V_{0}^{2}}$
<i>K</i> <sup>'</sup> <sub>in</sub>	MXINS	1	In-phase part of non-dimensional roll moment Quadrature part of non-dimensional	where $K(V_0, \Delta u, v, w, p, q, r, \dot{v}, \dot{w}, \dot{p}, \dot{q}, \dot{r}, \phi, \theta)$ $\frac{2}{nT} \int_{t}^{t+nT} K'(t) \sin \omega t  dt$ $\frac{2}{nT} \int_{t}^{t+nT} K'(t) \cos \omega t  dt$

 Table 1 (continued)

### Table 1 (continued)

C	CC-code	SI-unit	Concept		
Symbol			Term	Definition or explanation	
к <sup>′</sup> р	DKDPS	1	_	$\frac{\partial K'}{\partial p'} \Big _{K' = \hat{K}'_0}$	
к', р	DKDPTS	1	_	$\left \frac{\partial K'}{\partial \dot{p}'}\right _{K'=\hat{K}'_{0}}$	
, К <sub>р</sub>	DKDP3TS	1	-	$\frac{\partial \kappa'}{\partial p'} _{\kappa'=\hat{\kappa}'_0}$	
, K <sub>r</sub>	DKDRS	1	Slope through zero of K' versus r'	$\frac{\partial K'}{\partial r'} \Big _{K' = \hat{K}'_0}$	
ĸ,	DKDRTS	1	_	$\frac{\partial K'}{\partial \dot{r'}} \mid_{K' = \hat{K'}_0}$	
ќ <sub>v</sub>	DKDVS	1	Slope through zero of $K'$ versus $v'$	$\left \frac{\partial K'}{\partial v'}\right _{K'=\hat{K}'_{0}}$	
, K <sub>v</sub>	DKDVTS	1	_	$\frac{\partial K'}{\partial \dot{v}'} \Big _{K' = \hat{K}'_0}$	
$\hat{K}_{pq}$	MXPQS	iTeh S	Non-dimensional coefficient used in representing $K'$ as a function of $p' q'$	EVIEW	
$\hat{K}'_{r}$	MXRS	1	Non-dimensional coefficient used in representing $K'_{13}$ (a function of $F_{n0} r'$	(for surface ships only)	
$\hat{K}'_{ur}$	MXURS	1	Non-dimensional coefficient used in $1$ representing K' as a function of u' r'	7 (especially for submarines)	
<sub>Ŕ</sub> ' <sub>uu</sub>	MXUUS	1	Non-dimensional coefficient used in representing K' as a function of u'2	(especially for submarines)	
<sup>κ̂</sup> uuδR	MXUUDRS	1	Non-dimensional coefficient used in representing K' as a function of $u'^2 \delta_R$	(especially for submarines)	
<sup>Ќ</sup> ииббб R	MXUUDR3S	1	Non-dimensional coefficient used in representing K' as a function of $u'^2 \delta_{\rm R}^3$	(especially for submarines)	
κ΄ <sub>uν</sub>	MXUVS	1	Non-dimensional coefficient used in representing K' as a function of u' v'	(especially for submarines)	
κ̂ <sub>uvδ</sub> r	MXUVDRS	1	Non-dimensional coefficient used in representing $K'$ as a function of $u' v' \delta_R$	(especially for submarines)	
$\hat{K}'_{v}$	MXVS	1	Non-dimensional coefficient used in representing $K'$ as a function of $F_{n0} v'$	(for surface ships only)	
κ̂' <sub>ννν</sub>	MXV3S	1	Non-dimensional coefficient used in representing K' as a function of $v' \mid v' \mid \sqrt{v'^2 + w'^2} F_{n0}$	(for surface ships only)	

## ISO 13643-6:2017(E)

Symbol	CC-code	SI-unit	Concept		
Symbol			Term	Definition or explanation	
$\hat{K}_{v v }$	MXVVAS	1	Non-dimensional coefficient used in representing K' as a function of $v'\sqrt{v'^2 + w'^2}$	_	
$\hat{K}_{\nu\delta R}$	MXVDRS	1	Non-dimensional coefficient used in representing K' as a function of $F_{n0} v' \delta_R$	(for surface ships only)	
$\hat{K}'_{wp}$	MXWPS	1	Non-dimensional coefficient used in representing K' as a function of w' p'	_	
$\hat{K}'_{wr}$	MXWRS	1	Non-dimensional coefficient used in representing K' as a function of w' r'	_	
$\hat{K}_{\Delta u}$	MXDUS	1	Non-dimensional coefficient used in representing $K'$ as a function of $\Delta u'$	(for surface ships only)	
$\hat{K}'_{\Delta uv}$	MXDUVS	1	Non-dimensional coefficient used in representing $K'$ as a function of $\Delta u'v'$	(for surface ships only)	
$\hat{K}_{\Delta\Delta u}$	MXDU2S	eh S₁TAN (stan	Non-dimensional coefficient used in representing $K'$ as a function of $(\Delta u')^2$	(for surface ships only)	
κ΄ δR	MXDRS	1	Non-dimensional coefficient used in representing $K'$ as a function of $F_{n0}2 \delta_{R} 643-6:2017$	(for surface ships only)	
κ΄ δδδR	https://sta MXDR3S	ndards.iteh.ai/cata d695b1 1	Hog/standards/sist/Cob5651-1aab-4 Non-dimensional coefficient used in Tepresenting K' as a function of $F_{n0}^{2} \delta_{R}^{3}$	d56-85e6- (for surface ships only)	
<sub>Ŕ0</sub>	MX0S	1	Non-dimensional coefficient used in representing $K'$ when angle of attack $\alpha$ , drift angle $\beta$ , manoeuvring device, and plane angles are zero	_	
$\hat{K}_{\phi}$	MXOPHS	1	Non-dimensional oscillatory roll co- efficient	_	
L	L	m	Model length	Reference length (see ISO 13643-1)	
L <sub>OA</sub>	LOA	m	Length overall	Length between the most aft and most forward points of the ship, permanent outfit included, measured parallel to DWL	
М	МҮ	N m	Moment about <i>y</i> -axis	Relative to ship-fixed axis system	
MA	MAX	_	Main axis	(see ISO 13643-1)	
$M_{ heta  ext{stat}}$	DMDTST	N m rad <sup>-1 a</sup>		$\frac{\partial M}{\partial \theta} \Big _{V=0}$ from static test or calculation	

### Table 1 (continued)

### Table 1 (continued)

Course a l	CC and a	CL	Concept	
Symbol	CC-code	SI-unit	Term	Definition or explanation
Μ'	MVC	1	Non-dimensional moment about	Especially for submarines $\frac{M}{\frac{\rho}{2}L^{3}V^{2}}$ where <i>M</i> ( <i>u</i> , <i>v</i> , <i>w</i> , <i>p</i> , <i>q</i> , <i>r</i> , $\dot{v}$ , $\dot{w}$ , $\dot{p}$ , $\dot{q}$ , $\dot{r}$ , $\phi$ , $\theta$ )
101	MIS	-	<i>y</i> -axis	For surface ships only: $\frac{M}{\frac{\rho}{2}L^{3}V_{0}^{2}}$ where $M(V_{0}, \Delta u, v, w, p, q, r, \dot{v}, \dot{w}, \dot{p}, \dot{q}, \dot{r}, \phi, \theta)$
, M <sub>in</sub>	MYINS	iTeh S	In-phase part of non-dimensional moment about y-axis RD PR	$\frac{t+nT}{t} \int_{t}^{t} M'(t) \sin \omega t  dt$
, M <sub>out</sub>	MYOUTS	1 https://standards.i	Quadrature part of non-dimensional moment about y-axis 180 y-axis teh.ai/catalog/standards/sist/fc6b565	$\frac{2}{nT}\int_{T}M'(t)\cos\omega t dt$ F 1aab-4d56-85e6-
, M <sub>q</sub>	DMDQS	1	d695b1a70d40/iso-13643-6-201 Slope through zero of <i>M</i> ' versus <i>q</i> '	$\frac{7}{\frac{\partial M'}{\partial q'}} \Big _{M' = \hat{M}_0}$
, M . q	DMDQTS	1	_	$\frac{\partial M'}{\partial \dot{q}'}  _{M' = \hat{M}_0}$
, M q	DMDQ3TS	1	_	$\frac{\partial M'}{\partial \vec{q}'} \mid_{M' = \hat{M}_0'}$
, M <sub>w</sub>	DMDWS	1	Slope through zero of $M'$ versus $w'$	$\frac{\partial M'}{\partial w'} \Big _{M' = \hat{M}_0'}$
, M <sub>w</sub>	DMDWTS	1	_	$\frac{\partial M'}{\partial \dot{w'}} \mid_{M' = \hat{M}_0}$
, М <sub>.</sub>	DMDTHS	rad-1 a	-	$\frac{\partial M'}{\partial \theta} \Big _{M' = \hat{M}_0'}$
$\hat{M}_{pp}^{'}$	MYPPS	1	Non-dimensional coefficient used in representing $M'$ as a function of $p'^2$	_
$\hat{M}_{pr}^{'}$	MYPRS	1	Non-dimensional coefficient used in representing <i>M</i> ′ as a function of <i>p</i> ′ <i>r</i> ′	_

	CC-code	SI-unit	Concept		
Symbol			Term	Definition or explanation	
$\hat{M}_{q}^{'}$	MYQS	1	Non-dimensional coefficient used in representing <i>M</i> ′ as a function of <i>u</i> ′ <i>q</i> ′	_	
$\hat{M}_{q q }$	MYQQAS	1	Non-dimensional coefficient used in representing <i>M</i> ' as a function of <i>q</i> '  <i>q</i> '	_	
$\hat{M}_{ q \delta S}$	MYQADSS	1	Non-dimensional coefficient used in representing $M'$ as a function of $u' q' \delta_S$	_	
<sup>Â</sup> rr	MYRRS	1	Non-dimensional coefficient used in representing <i>M</i> ′ as a function of <i>r</i> ′ <sup>2</sup>	_	
, M <sub>uu</sub>	MYUUS	1	Non-dimensional coefficient used in representing <i>M</i> ′ as a function of <i>u</i> ′ <sup>2</sup>	_	
´vp	MYVPS	1	Non-dimensional coefficient used in representing $M'$ as a function of $v' p'$	_	
, M <sub>vr</sub>	MYVRS	eh S <sup>ı</sup> TAI	Non-dimensional coefficient used in representing <i>M</i> as a function of <i>v</i> / <i>r</i> as a function of the second s	EW	
<sub>.</sub> $\hat{M}_{W}$	MYWS	(stan	Non-dimensional coefficient used in representing $M'$ as a function of $u'w'$	_	
М <sub>ww</sub>	https://sta MYWWS	ndards.iteh.ai/cata <sup>1</sup> d695b1	Non-dimensional coefficient used in representing M as a function of ab-4 a70d40 $fisc-13643$ -6-2017   w'   $vv + w$	d56-85e6-	
$\hat{M}_{w w }$	MYWWAS	1	Non-dimensional coefficient used in representing $M'$ as a function of $w' \sqrt{v'^2 + w'^2}$	_	
$\hat{M}'_{ w }$	MYWAS	1	Non-dimensional coefficient used in representing <i>M</i> ' as a function of <i>u</i> '  <i>w</i> '	_	
$\hat{M}'_{ w q}$	MYWAQS	1	Non-dimensional coefficient used in representing $M'$ as a function of $q'\sqrt{v'^2 + w'^2}$	_	
$\hat{M}_{\delta B}^{'}$	MYDBS	1	Non-dimensional coefficient used in representing $M'$ as a function of $u'^2 \delta_{\rm B}$	_	
<sup>, μ</sup> ΄ <sub>δS</sub>	MYDSS	1	Non-dimensional coefficient used in representing $M'$ as a function of $u'^2 \delta_{\rm S}$	_	
$\hat{M}_{0}^{'}$	MYOS	1	Non-dimensional coefficient used in representing $M'$ when angle of attack $\alpha$ , drift angle $\beta$ , manoeuvring device, and plane angles are zero	_	
$\tilde{M}_{\theta}^{'}$	муотня	1	Non-dimensional oscillatory coeffi- cient about <i>y</i> -axis	-	

## Table 1 (continued)

т

MA

kg

Model mass

\_

		CI	Concept	
Symbol	LL-CODE	51-unit	Term	Definition or explanation
Ν	MZ	N m	Moment about z-axis	Relative to ship-fixed axis system
N ødyn	DNDPDYS	rad-1 a	_	$\frac{\partial N'}{\partial \phi}  _{N' = \hat{N}_0} - \frac{N_{\phi \text{ stat}}}{\frac{\rho}{2} L^3 V^2}$
$N_{\phi { m stat}}$	DNDPST	N m rad <sup>-1 a</sup>	_	$\frac{\partial N}{\partial \phi}  _{V=0}$ from static test or calculation
N′	MZS	iTeh S ( https://standards.i	Non-dimensional moment about R z-axis Standards.iteh.a <u>ISO 13643-6:2017</u> teh.ai/catalog/standards/sist/fc6b565 d695b1a70d40/iso-13643-6-201	Especially for submarines: $ \frac{N}{\frac{\rho}{L} V^{2}} $ where <i>N</i> ( <i>u</i> , <i>v</i> , <i>w</i> , <i>p</i> , <i>q</i> , <i>r</i> , $\dot{v}$ , $\dot{w}$ , $\dot{p}$ , $\dot{q}$ , $\dot{r}$ , $\phi$ , $\theta$ ) <b>EVIEW</b> For surface ships only: $ \frac{N}{\frac{\rho}{2} 3 2} $ For submarine <i>N</i> ( <i>V</i> <sub>0</sub> , $\Delta u$ , <i>v</i> , <i>w</i> , <i>p</i> , <i>q</i> , <i>r</i> , $\dot{v}$ , $\dot{w}$ , $\dot{p}$ , $\dot{q}$ , $\dot{r}$ , $\phi$ , $\theta$ )
N <sub>in</sub>	MZINS	1	In-phase part of non-dimensional moment about <i>z</i> -axis	$\frac{2}{nT} \int_{t}^{t+nT} N'(t) \sin \omega t  dt$
, N <sub>out</sub>	MZOUTS	1	Quadrature part of non-dimensional moment about <i>z</i> -axis	$\frac{2}{nT} \int_{t}^{t+nT} N'(t) \cos \omega t  dt$
N <sub>p</sub>	DNDPS	1	_	$\frac{\partial N'}{\partial p'} \Big _{N' = \hat{N}_0}$
N'p	DNDPTS	1	_	$\frac{\partial N'}{\partial \dot{p}'} \mid_{N' = \hat{N}_0'}$
N' p	DNDP3TS	1	_	$\frac{\partial N'}{\partial p}  _{N'=\hat{N}_{0}'}$
, N <sub>r</sub>	DNDRS	1	Slope through zero of N' versus r'	$\frac{\partial N'}{\partial r'} \Big _{N' = \hat{N}_0}$

 Table 1 (continued)

Gumhal	CC and a	CI	Concept		
Symbol	CC-code	SI-unit	Term	Definition or explanation	
, N <sub>ŕ</sub>	DNDRTS	1	_	$\frac{\partial N'}{\partial \dot{r'}}  _{N' = \hat{N}_0}$	
Ň <sub>v</sub>	DNDVS	1	Slope through zero of <i>N'</i> versus <i>v'</i>	$\frac{\partial N'}{\partial v'} _{N'=\hat{N}_{0}'}$	
N <sub>v</sub>	DNDVTS	1	_	$\frac{\partial N'}{\partial \dot{v}'} \Big _{N' = \hat{N}_0}$	
Ŷ pq	MZPQS	1	Non-dimensional coefficient used in representing $N'$ as a function of $p' q'$	_	
$\hat{N}_{qr}$	MZQRS	1	Non-dimensional coefficient used in representing $N'$ as a function of $q' r'$	_	
$\hat{N}_{r}^{'}$	MZRS	1	Non-dimensional coefficient used in representing $N'$ as a function of $F_{n0} r'$	(for surface ships only)	
$\hat{N}_{r r }$	MZRRAS	eh S <sub>1</sub> TAI	Non-dimensional coefficient used/in representing N <sup>2</sup> as a function of r <sup>4</sup> [r <sup>4</sup> ]	EW	
<sup>,</sup> <sup>N</sup> rδδR	MZRDDS	(Stan 1 ndards iteh ai/cat	Non-dimensional coefficient used in representing N' as a function of ISO r13243-6:2017 no R	(for surface ships only)	
$\hat{N}'_{ r \delta R}$	MZRADS	d695b1 1	<b>Non-dimensional-coefficient</b> /used in representing N' as a function of $F_{n0}   r'   \delta_{R}$	(for surface ships only)	
$\hat{N}'_{ur}$	MZURS	1	Non-dimensional coefficient used in representing $N'$ as a function of $u'r'$	(especially for submarines)	
, N <sub>urδδ</sub> R	MZURDDS	1	Non-dimensional coefficient used in representing N' as a function of $u'r'\delta_{\rm R}^2$	(especially for submarines)	
$\hat{N}'_{u r \delta R}$	MZURADS	1	Non-dimensional coefficient used in representing N' as a function of $u'   r'   \delta_R$	(especially for submarines)	
<sup>^</sup> N <sub>uu</sub>	MZUUS	1	Non-dimensional coefficient used in representing $N'$ as a function of $u'^2$	(especially for submarines)	
<sup>.</sup> <sup>N</sup> uuδR	MZUUDS	1	Non-dimensional coefficient used in representing N' as a function of $u'^2 \delta_R$	(especially for submarines)	
,΄ <sup>N</sup> uuδδδR	MZUUD3S	1	Non-dimensional coeffi cient used in representing N' as a function of $u'^2 \delta_R^3$	(especially for submarines)	
<sup>^</sup> N <sub>uv</sub>	MZUVS	1	Non-dimensional coefficient used in representing $N'$ as a function of $u'v'$	(especially for submarines)	