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Ships and marine technology — Offshore mooring chains

Navires et technologie maritime — Chaînes d'amarrage en haute mer

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Foreword

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

This document was prepared by ISO/TC 8, *Ships and marine technology*, SC 4, *Outfitting and deck machinery.*

Ships and marine technology — Offshore mooring chains

1 Scope

This document specifies the requirements for grades, materials, shapes, proportions, dimensions and tolerances of offshore mooring chains.

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 4967, *Steel — Determination of content of non-metallic inclusions — Micrographic method using standard diagrams*

ASTM A255, *Standard test methods for determining hardenability of steel*

ASTM E112, *Standard test methods for determining average grain size*

ASTM E381, *Standard method of macroetch testing steel bars, billets, blooms, and forgings*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 19901-7:2013 and the following 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
mooring chain
component used for positioning and mooring of offshore structures composed of *chain links* (3.2) and *accessories* (3.3)

3.2
chain link
closed, link shaped components of *mooring chain* (3.1), including common stud link, common studless link, enlarged link and end link

3.3
accessory
detachable connectors used for joining different chain components, including *joining shackle(3.8)* and *end shackle(3.9)*

3.4
common stud link
common mooring *chain link* (3.2) with stud

3.5
common studless link
common mooring *chain link* (3.2) without stud

3.6
enlarged link
strengthened link that connects a common link and the *end link* (3.7)

3.7
end link
link that joins *mooring chains* (3.1) and shackles

3.8
joining shackle
accessories used for joining *chain links* (3.2) or other accessories, including "D" type LTM joining shackle, "D" type LTM end joining shackle, Kenter type joining shackle and "H" type LTM joining shackle

3.9
end shackle
accessories used for attaching the *mooring chain* (3.1) to mooring equipment

Note 1 to entry: It usually refers to LTM end shackle.

3.10
LTM shackle
long term moored "D" type joining shackle, "D" type end joining shackle and end shackle with the bolt fastened by nut

3.11
nominal diameter
diameter of the common link

4 Grade

4.1 The mooring chain is classified by tensile strength into five grades: R3, R3S, R4, R4S and R5.

4.2 The mechanical properties of mooring chain for each grade are given in Table 1.

4.3 The proof load and breaking load of mooring chains for each grade are given in Table 2.

5 Materials

5.1 The steel used for manufacturing of mooring chains is classified into five grades: R3, R3S, R4, R4S and R5.

5.2 Mechanical properties for materials of each grade shall meet the requirements of base materials specified in Table 1.

5.3 The steel shall be manufactured by an electric progress or one of the basic oxygen processes or any other process involving secondary refining. The austenite grain size shall be 6 or finer in accordance with ASTM E112.

5.4 Steel grades R4S and R5 shall be vacuum degassed.

5.5 For steel grades R4S and R5, the following test results shall be supplied by steel mills to the mooring chain or accessory manufacturer:

a) Each heat shall be examined for non-metallic inclusions according to ISO 4967 or equivalent standards.

b) A sample from each heat shall be macro etched according to ASTM E381 or equivalent standards to ensure there is no injurious segregation or porosity.

c) Jominy hardenability data according to ASTM A255 or equivalent standards shall be supplied with each heat.

5.6 Steel grades R4, R4S and R5 shall contain a minimum of 0,20 % molybdenum.

6 Shape, dimensions and tolerances

6.1 The shapes of common studless link, common stud link, enlarged studless link, enlarged stud link and end link are indicated in Figures 1 to 5 and their dimensions are specified in Tables 3 to 7.

6.2 The shapes of kenter shackle, "H" type LTM joining shackle (sample), "D" type LTM end joining shackle (sample), "D" type LTM joining shackle, LTM end shackle are indicated in Figures 6 to 10 and their dimensions are specified in Tables 8 to 12.

6.3 Tolerances of common links, enlarged links and end links

The diameter shall be measured at crown, and the average value based on two perpendicular measurements must have no negative tolerance and the plus tolerance shall not exceed 5 % of nominal diameter. The minus tolerance for the diameter measured at crown shall meet the following requirements:

— for nominal diameter from 50 mm to 84 mm: −2 mm;

— for nominal diameter from 85 mm to 122 mm: −3 mm;

— for nominal diameter from 123 mm to 152 mm: −4 mm;

— for nominal diameter from 153 mm to 184 mm: −6 mm;

— for nominal diameter from 185 mm to 210 mm: −7,5 mm;

— for nominal diameter over 210 mm: −8,5 mm.

The cross sectional area of the crown shall not be less than the theoretical cross section of the nominal diameter.

The plus tolerance at weld shall not exceed 15 % of nominal chain diameter.

6.4 Length of five links

The five-link length of links shall be 5 × p + 2 d = 22 d measured from outside. The allowable manufacturing tolerance on a length of five links is $^{+2,5}_{0}$ %.

6.5 All other dimensions

The tolerances of the diameter: $^{+5}_{0}$ %.

The tolerances other than diameter: ± 2,5 %.

Table 1 — Mechanical properties of mooring chain

Grade	Minimum yield strength N/mm^2	Minimum tensile strength N/mm^2	Minimum elongation %	Minimum reduction in area %	Average impact energy J				
					Temperature °C	Base material		Weld	
						Average	Single value	Average	Single value
R3	410	690	17	50	0	60	45	50	38
					−20	40	30	30	23
R3S	490	770	15	50	0	65	49	53	40
					−20	45	34	33	25
R4	580	860	12	50	−20	50	38	36	27
R4S	700	960	12	50	−20	56	42	40	30
R5	760	1000	12	50	−20	58	44	42	32

NOTE 1 Reduction of area of cast steel accessories is to be for Grades R3 and R3S: minimum 40 %; for Grades R4, R4S, and R5: minimum 35 %.

NOTE 2 CVN Impact Test of R3 and R3S may be performed either at 0 Deg. C or at −20 Deg. C.

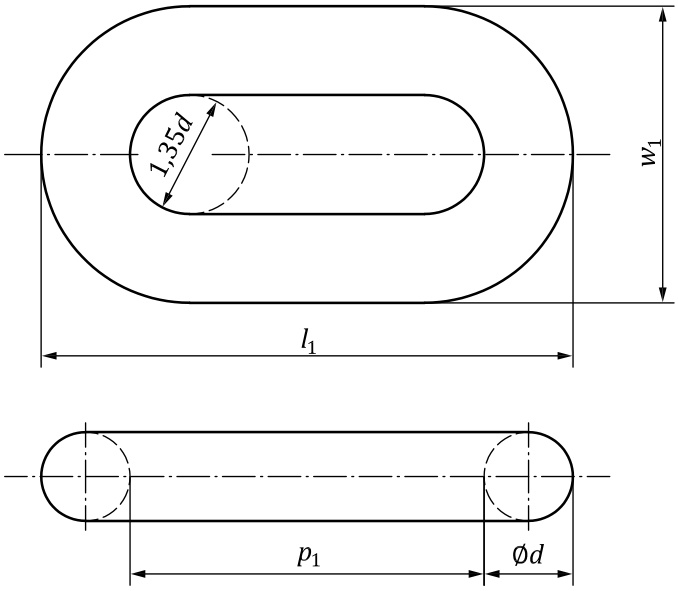
NOTE 3 Aim maximum hardness for R4S is HB330 and R5 HB340.

NOTE 4 For guidance only: Typical yield to tensile strength ration is in the range of 0,85 to 0,95.

Table 2 — Proof load and breaking load

Dimensions in KN

	R3	R3S	R4	R4S	R5
Proof load of stud chain	0,0156d^2 (44-0,08d)	0,0180d^2 (44-0,08d)	0,0216d^2 (44-0,08d)	0,0240d^2 (44-0,08d)	0,0251d^2 (44-0,08d)
Proof load of studless chain	0,0156d^2 (44-0,08d)	0,0174d^2 (44-0,08d)	0,0192d^2 (44-0,08d)	0,0213d^2 (44-0,08d)	0,0223d^2 (44-0,08d)
Breaking load	0,0223d^2 (44-0,08d)	0,0249d^2 (44-0,08d)	0,0274d^2 (44-0,08d)	0,0304d^2 (44-0,08d)	0,0320d^2 (44-0,08d)
NOTE *d* is the nominal diameter.					



Key

d nominal diameter of common link

l_1 = 6d

p_1 = 4d

w_1 = 3,35d

NOTE For nominal dimensions, see Table 3.

Figure 1 — Common studless link

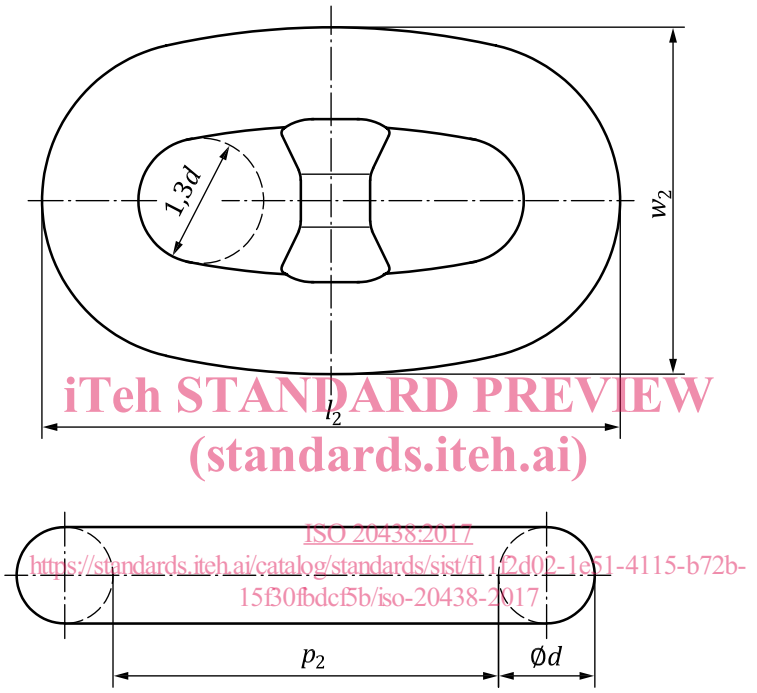
Table 3 — Dimensions of common studless link

Dimensions in millimeters

Nominal size d	l_1	p_1	w_1	Nominal size d	l_1	p_1	w_1
50	300	200	168	120	720	480	402
52	312	208	174	122	732	488	409
54	324	216	181	124	744	496	415
56	336	224	188	127	762	508	425
58	348	232	194	130	780	520	436
60	360	240	201	132	792	528	442
62	372	248	208	137	822	548	459
64	384	256	214	142	852	568	476
66	396	264	221	147	882	588	492
68	408	272	228	152	912	608	509
70	420	280	235	157	942	628	526
73	438	292	245	162	972	648	543
76	456	304	255	165	990	660	553
78	468	312	261	168	1 008	672	563
81	486	324	271	171	1 026	684	573
84	504	336	281	175	1 050	700	586
87	522	348	291	178	1 068	712	596
90	540	360	302	180	1 080	720	603
92	552	368	308	182	1 092	728	610
95	570	380	318	185	1 110	740	620

Table 3 *(continued)*

Nominal size d	l_1	p_1	w_1	Nominal size d	l_1	p_1	w_1
97	582	388	325	188	1 128	752	630
100	600	400	335	191	1 156	764	640
102	612	408	342	194	1 164	776	650
105	630	420	352	197	1 182	788	660
107	642	428	358	200	1 200	800	670
111	666	444	372	205	1 230	820	687
114	684	456	382	210	1 260	840	704
117	702	468	392				



Key

d nominal diameter of common link

l_2 = $6d$

p_2 = $4d$

w_2 = $3{,}6d$

NOTE For nominal dimensions, see Table 4.

Figure 2 — Common stud link

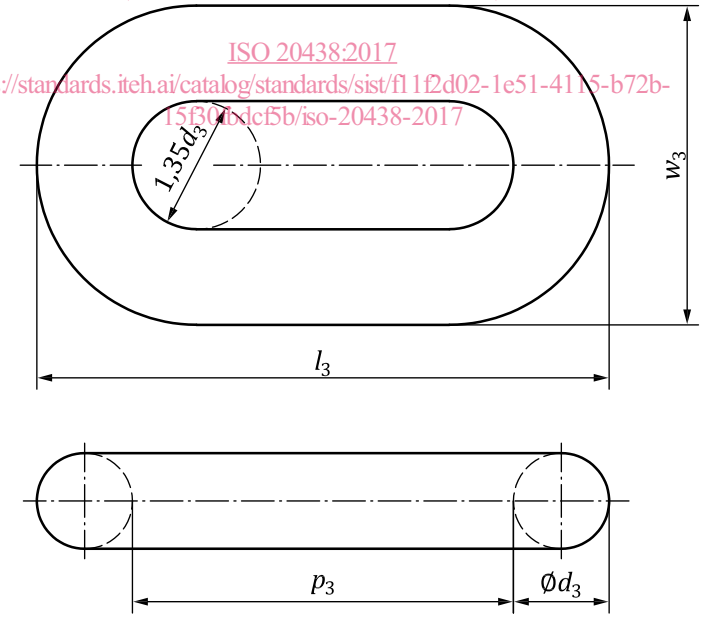
Table 4 — Dimensions of common stud link

Dimensions in millimeters

Nominal size d	l_2	p_2	w_2	Nominal size d	l_2	p_2	w_2
50	300	200	180	120	720	480	432
52	312	208	187	122	732	488	439
54	324	216	194	124	744	496	446
56	336	224	202	127	762	508	457
58	348	232	209	130	780	520	468
60	360	240	216	132	792	528	475
62	372	248	223	137	822	548	493

Table 4 *(continued)*

Nominal size d	l_2	p_2	w_2	Nominal size d	l_2	p_2	w_2
64	384	256	230	142	852	568	511
66	396	264	238	147	882	588	529
68	408	272	245	152	912	608	547
70	420	280	252	157	942	628	565
73	438	292	263	162	972	648	583
76	456	304	274	165	990	660	594
78	468	312	281	168	1 008	672	605
81	486	324	292	171	1 026	684	616
84	504	336	302	175	1 050	700	630
87	522	348	313	178	1 068	712	641
90	540	360	324	180	1 080	720	648
92	552	368	331	182	1 092	728	655
95	570	380	342	185	1 110	740	666
97	582	388	349	188	1 128	752	677
100	600	400	360	191	1 146	764	688
102	612	408	367	194	1 164	776	698
105	630	420	378	197	1 182	788	709
107	642	428	385	200	1 200	800	720
111	666	444	400	205	1 230	820	738
114	684	456	410	210	1 260	840	756
117	702	468	421				



Key

d nominal diameter of common link

d_3 nominal diameter of enlarged studless link, $d_3 = 1{,}1d$

l_3 $= 6d_3$

p_3 $= 4d_3$

w_3 $= 3{,}35d_3$

NOTE For nominal dimensions, see Table 5.

Figure 3 — Enlarged studless link