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**Ships and marine technology — High
holding power balance anchors**

Navires et technologie maritime — Ancres à grande tenue

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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).

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For an explanation of 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 www.iso.org/iso/foreword.html.

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

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Ships and marine technology — High holding power balance anchors

1 Scope

This document specifies the design and production requirements, test methods, marking and inspection certificate for high holding power balance anchors (hereinafter referred to as anchors).

It is applicable to the design, selection, production and acceptance of high holding power balance anchors.

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 3828, *Shipbuilding and marine structures — Deck machinery — Vocabulary and symbols*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 3828 and the following apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

- ISO Online browsing platform: available at <https://www.iso.org/obp>
- IEC Electropedia: available at <https://www.electropedia.org/>

3.1

high holding power balance anchor **HHPB anchor**

anchor with a rotatory fluke that can be restored back to upright position by gravity once the anchor is hoisted from the sea bed, and with a holding power of at least twice that of an ordinary stockless anchor of the same mass

4 Design

4.1 Structure

An anchor is generally composed of a shank, a fluke, a head pin, a lateral pin, a shackle and an anchor shackle. The typical structure is shown in [Annex A](#).

4.2 Basic specifications and dimensions

Anchors shall be designed as per the quantity required by outfitting. They shall be classified into different specifications based on the anchor theoretical mass. The corresponding basic dimensions are shown in [Table A.1](#).

4.3 Material

4.3.1 The chemical composition of the anchor components shall be as specified in [Table 1](#).

Table 1 — Chemical composition of anchor components

Values in percent (%)

Component	Chemical element content ^a									
	C	Si	Mn ^c	S	P	Residual element ^b				
						Ni	Cr	Cu	Mo	total
shackle body, shank	0,29	0,35	1,10 to 1,60	0,035	0,035	-	-	-	-	-
shank, fluke	0,23	0,60	0,50 to 1,60	0,04	0,04	0,40	0,30	0,30	0,15	0,80
head pin, lateral pin, shackle pin	0,23	0,45	0,30 to 1,50	0,035	0,035	0,25	0,25	0,25	0,15	0,80

^a All figures are maximum values, in %, except the ranges.
^b Unless required by the purchaser, the residual elements do not need to be analyzed.
^c 0,04 % Mn may be added to the upper limit for each 0,01 % carbon reduction.

4.3.2 The mechanical properties of anchor components shall be as specified in [Table 2](#).

Table 2 — Mechanical properties of anchor components

Component	Mechanical property ^a				
	Tensile strength N/mm ²	Yield strength N/mm ²	Extension percentage %	Percentage of breaking area reduction %	Impact energy J
shackle body shank	490	295	22	-	27
shank, fluke, shank	450	230	22	35	25
head pin, lateral pin, shackle pin	410	245	25	35	27

^a All figures are minimum values.

4.3.3 The surface and the inside of cast and forged components of anchors should be free from cracks, airholes, cratering, cold shuts, scabs and any other defects that may affect the strength.

4.3.4 A Charpy V-notch impact test below 0 °C should be carried out regarding ice zone navigation requirements. The impact absorbing energy should not be less than 27 J.

4.3.5 The welding material used during the fabrication of the anchor should be compatible with the parent material.

5 Production

5.1 Visual appearance

Anchor rotary parts should be ground to Ra 25 µm and be able to flexibly rotate around the centre of gravity. The surface roughness of non-processed parts should be not more than Ra 100 µm.

5.2 Dimensional tolerance and geometrical tolerance

5.2.1 The permissible dimensional tolerance on each component of the anchor should be $\pm 4\%$, and its maximum value shall not exceed ± 20 mm.

5.2.2 The permissible tolerance between the swing angles of the anchor flukes should be $\pm 1^\circ$ respectively.

5.2.3 The straightness deviation of the anchor shank should not be more than 3 mm for a length within 1 m.

5.2.4 The anchor assembling tolerances should meet the following provisions.

a) Any side clearance between the shackle and the shank should be as specified in [Table 3](#).

Table 3 — Clearance between shackle and shank

Nominal mass of the anchor t	Clearance value mm
≤ 3	≤ 3
>3 to ≤ 5	≤ 4
>5 to ≤ 7	≤ 6
> 7	≤ 12

- b) When the diameter of the shackle pin is less than or equal to 57 mm, the diameter difference between the shackle pin and the shackle pin hole shall not be more than 0,5 mm. When the diameter of the shackle pin is more than 57 mm, the diameter difference between the shackle pin and the shackle pin hole should not be more than 1,0 mm.
- c) The clearance difference between the pin, the shackle pin and the anchor shank hole should not be more than 1,0 mm.
- d) The length of the head pin shall be able to prevent the longitudinal movement of the anchor. Its clearance shall be no more than 1 % of the pin slot length.
- e) The lateral inclination of the anchor shank shall not exceed 3° . See [Figure 1](#).

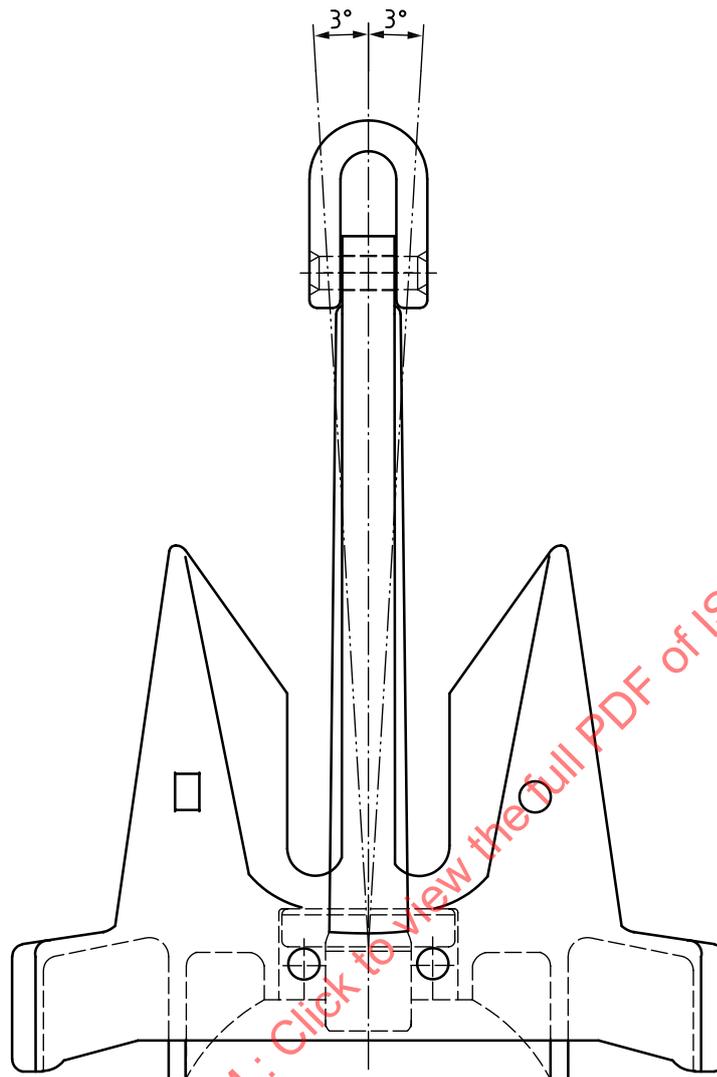


Figure 1 — Lateral inclination of the anchor

5.3 Welding and welding repair

Allowable defects should be repaired only after being evaluated through a qualified technical process. Stress relieving should be implemented.

5.4 Heat treatment

The anchor shank, fluke and shackle should be treated with a normalizing and tempering process, with a tempering temperature of not less than 600 °C.

5.5 Non-destructive test

The surface of cast and forged parts after machining shall be subject to a non-destructive test (NDT). The test for anchor cast components should be conducted in accordance with IACS REC. 69; the test for anchor forged parts should be conducted in accordance with IACS REC. 68.

5.6 Painting

Anchors should be painted with two coats, of asphalt and black paint; other paints can be used if mutually agreed.

5.7 Mass

The permissible deviation of the weighted mass relative to the nominal mass should be within 7 % to -3 %.

5.8 Balance

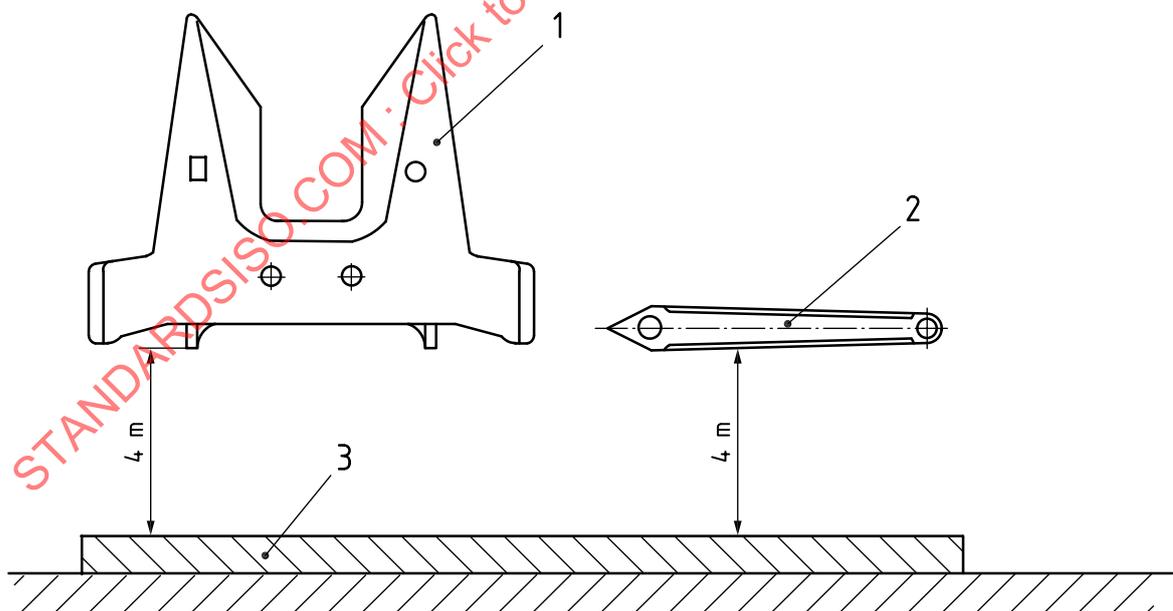
The fluke should be able to be restored back to its upright position automatically when the anchor is fully hanged. The alignment of the two fluke bills should not exceed any lateral plane of the anchor shank.

6 Test methods

6.1 Drop test

Anchors should be subject to a drop inspection, where the anchor is dropped from a height of 4,0 m; the anchor should be free from crack defects. The detailed procedures are as follows.

- Being hung horizontally and vertically (head-down) respectively (see [Figure 2](#)), the shank and anchor fluke are dropped from a height of 4,0 m onto a steel lining (with a thickness of not less than 50 mm) fixed onto a solid foundation.
- After the drop inspection, the anchor flukes and shank should be lifted off the ground with a non-metal rope and subject to a hammering test with a hammer weighing 3 kg to 7 kg.
- Check whether the sound is clear or not. If there is any abnormal sound, they should be re-inspected with a NDT, and re-tested after defects repair.



Key

- 1 fluke
- 2 shank
- 3 steel foundation

Figure 2 — Drop test

6.2 Proof test

The proof test load for high holding power anchors shall be the load specified for the nominal anchor, the mass of which is 1,33 times the actual total mass of the high holding power anchor. Conduct a proof load test using the proof loads specified in [Table 4](#). When the nominal mass lies between two values in the table, the proof test load should be determined by an interpolation method.

The residual deformation after the test should not exceed 1 % of the gauge length, and the fluke should be able to rotate freely to $35^\circ \pm 1^\circ$. The roof test shall be conducted according to [Annex B](#).

Table 4 — Nominal mass and proof test load for anchor

Nominal mass of the anchor	Proof test load	Nominal mass of the anchor	Proof test load	Nominal mass of the anchor	Proof test load	Nominal mass of the anchor	Proof test load
kg	kN	kg	kN	kg	kN	kg	kN
50	23,2	1 200	231,0	4 800	645,0	11 000	1 070,0
55	25,2	1 250	239,0	4 900	653,0	11 500	1 090,0
60	27,1	1 300	247,0	5 000	661,0	12 000	1 110,0
65	28,9	1 350	255,0	5 100	669,0	12 500	1 130,0
70	30,7	1 400	262,0	5 200	677,0	13 000	1 160,0
75	32,4	1 450	270,0	5 300	685,0	13 500	1 180,0
80	33,9	1 500	278,0	5 400	691,0	14 000	1 210,0
90	36,3	1 600	292,0	5 500	699,0	14 500	1 230,0
100	39,1	1 700	307,0	5 600	706,0	15 000	1 260,0
120	44,3	1 800	321,0	5 700	712,0	15 500	1 270,0
140	49,0	1 900	335,0	5 800	721,0	16 000	1 300,0
160	53,3	2 000	349,0	5 900	728,0	16 500	1 330,0
180	57,4	2 100	362,0	6 000	735,0	17 000	1 360,0
200	61,3	2 200	376,0	6 100	740,0	17 500	1 390,0
225	65,8	2 300	388,0	6 200	747,0	18 000	1 410,0
250	70,4	2 400	401,0	6 300	754,0	18 500	1 440,0
275	74,9	2 500	414,0	6 400	760,0	19 000	1 470,0
300	79,5	2 600	427,0	6 500	767,0	19 500	1 490,0
325	84,1	2 700	438,0	6 600	773,0	20 000	1 520,0
350	88,8	2 800	450,0	6 700	779,0	21 000	1 570,0
375	93,4	2 900	462,0	6 800	786,0	22 000	1 620,0
400	97,9	3 000	474,0	6 900	794,0	23 000	1 670,0
425	103,0	3 100	484,0	7 000	804,0	24 000	1 720,0
450	107,0	3 200	495,0	7 200	818,0	25 000	1 770,0
475	112,0	3 300	506,0	7 400	832,0	26 000	1 800,0
500	116,0	3 400	517,0	7 600	845,0	27 000	1 850,0
550	125,0	3 500	528,0	7 800	861,0	28 000	1 900,0
600	132,0	3 600	537,0	8 000	877,0	29 000	1 940,0
650	140,0	3 700	547,0	8 200	892,0	30 000	1 990,0
700	149,0	3 800	557,0	8 400	908,0	31 000	2 030,0
750	158,0	3 900	567,0	8 600	922,0	32 000	2 070,0
800	166,0	4 000	577,0	8 800	936,0	34 000	2 160,0
850	175,0	4 100	586,0	9 000	949,0	36 000	2 250,0

Table 4 (continued)

Nominal mass of the anchor	Proof test load	Nominal mass of the anchor	Proof test load	Nominal mass of the anchor	Proof test load	Nominal mass of the anchor	Proof test load
kg	kN	kg	kN	kg	kN	kg	kN
900	182,0	4 200	595,0	9 200	961,0	38 000	2 330,0
950	191,0	4 300	604,0	9 400	975,0	40 000	2 410,0
1 000	199,0	4 400	613,0	9 600	987,0	42 000	2 490,0
1 050	208,0	4 500	622,0	9 800	998,0	44 000	2 570,0
1 100	216,0	4 600	631,0	10 000	1 010,0	46 000	2 650,0
1 150	224,0	4 700	638,0	10 500	1 040,0	48 000	2 730,0

Stress-bearing areas shall be checked after a pull force load test.

6.3 Holding power test

A holding power test shall be carried out on three kinds of experimental ground, i.e. muddy ground, sandy ground and rocky ground, as specified in [Annex C](#).

7 Marking

Qualified anchors shall be marked or branded on the shank and flukes with the following:

- Class Society approved mark and certificate serial number;
- mass of the anchor;
- HHPB mark for high holding power balance anchors.

8 Certificate

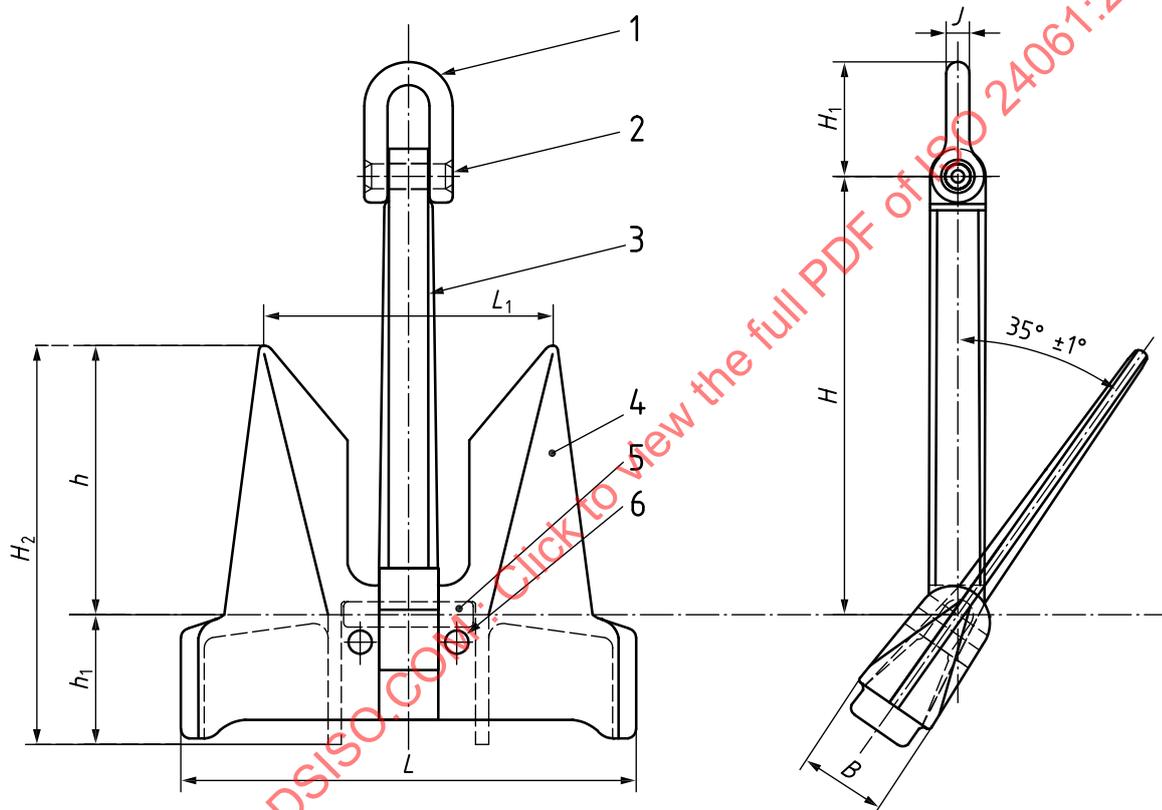
Qualified anchors should be provided with inspection certificates containing at least the following:

- raw material quality certificate;
- physical and chemical properties test report;
- heat treatment record and NDT record;
- drop tests report and proof testing report.

Annex A (informative)

Anchor structure and dimensions

For the typical structure of anchors, see [Figure A.1](#); for the structure dimensions, see [Table A.1](#).



Key

- 1 anchor shackle
- 2 shackle pin
- 3 shank
- 4 fluke
- 5 head pin
- 6 lateral pin

Figure A.1 — High holding power anchor

Table A.1 — Basic dimension of the anchor

Dimensions in millimetres

Actual mass of the anchor kg	H	H_2	H_1	h	h_1	L	L_1	B	J
90	587	578	130	365	195	655	349	202	28
135	672	662	145	418	223	750	399	231	32
180	742	728	160	460	246	825	441	254	36
225	797	784	175	495	265	889	474	274	40
270	847	833	175	526	281	944	503	291	40
315	891	877	192	554	296	994	530	307	45
360	920	917	215	579	310	1 039	554	321	48
430	989	973	215	615	328	1 103	588	340	48
495	1 036	1 020	235	644	344	1 156	616	357	50
585	1 095	1 078	235	681	364	1 222	651	377	50
675	1 149	1 131	255	714	382	1 281	683	395	60
765	1 198	1 179	255	745	398	1 336	712	412	60
855	1 243	1 223	280	773	413	1 386	739	428	62
970	1 297	1 276	280	806	431	1 446	771	446	62
1 080	1 344	1 322	280	836	446	1 498	799	462	62
1 195	1 390	1 368	310	864	462	1 550	826	478	68
1 305	1 431	1 408	310	890	475	1 596	851	493	68
1 440	1 479	1 455	310	920	491	1 649	879	509	68
1 575	1 524	1 499	340	948	506	1 699	906	524	74
1 710	1 566	1 541	340	974	520	1 746	931	539	74
1 845	1 606	1 580	340	999	534	1 791	955	553	74
1 980	1 645	1 618	380	1 023	546	1 833	978	566	82
2 140	1 688	1 660	380	1 049	561	1 882	1 003	581	82
2 295	1 728	1 699	380	1 074	574	1 926	1 027	594	82
2 475	1 772	1 743	385	1 102	589	1 975	1 053	610	82
2 655	1 814	1 784	385	1 128	602	2 022	1 078	624	82
2 835	1 854	1 823	410	1 153	616	2 066	1 102	638	90
3 040	1 897	1 866	410	1 180	630	2 115	1 128	653	90
3 240	1 938	1 906	410	1 205	644	2 160	1 152	667	90
3 445	1 978	1 946	415	1 230	657	2 205	1 176	681	100
3 670	2 020	1 987	415	1 256	671	2 252	1 201	695	100
3 940	2 069	2 035	450	1 286	687	2 306	1 230	712	100
4 210	2 115	2 080	450	1 315	703	2 357	1 257	728	100
4 500	2 162	2 127	450	1 344	718	2 410	1 286	744	100
4 840	2 215	2 179	480	1 378	736	2 469	1 317	762	110
5 175	2 265	2 228	480	1 409	753	2 525	1 347	780	110
5 515	2 314	2 276	500	1 439	769	2 579	1 376	796	110
5 850	2 360	2 321	500	1 467	784	2 630	1 403	812	110
6 225	2 409	2 369	540	1 498	800	2 685	1 432	829	117
6 525	2 447	2 407	540	1 522	813	2 727	1 455	842	117
6 975	2 502	2 461	580	1 556	831	2 789	1 488	861	121

Table A.1 (continued)

Actual mass of the anchor kg	H	H_2	H_1	h	h_1	L	L_1	B	J
7 425	2 555	2 513	580	1 589	849	2 847	1 519	879	121
7 875	2 606	2 562	600	1 620	866	2 904	1 549	897	130
8 325	2 654	2 610	600	1 650	882	2 958	1 578	913	130
8 775	2 701	2 656	630	1 680	897	3 010	1 606	930	135
9 225	2 747	2 701	630	1 708	912	3 061	1 633	945	135
9 675	2 791	2 744	640	1 735	927	3 110	1 659	960	140
10 125	2 833	2 786	660	1 762	941	3 157	1 685	975	145
10 575	2 875	2 827	660	1 787	955	3 203	1 709	989	145
11 025	2 915	2 866	680	1 812	968	3 248	1 733	1 003	150
11 550	2 960	2 911	680	1 841	983	3 299	1 760	1 019	150
12 075	3 005	2 954	700	1 868	998	3 348	1 786	1 034	155
12 675	3 054	3 002	700	1 899	1 014	3 402	1 815	1 051	155
13 350	3 107	3 055	700	1 932	1 032	3 461	1 847	1 069	155
14 100	3 164	3 111	730	1 967	1 051	3 525	1 881	1 089	160
15 000	3 230	3 175	730	2 008	1 073	3 598	1 920	1 111	160
16 125	3 309	3 253	770	2 057	1 099	3 686	1 967	1 139	170
17 250	3 384	3 327	770	2 104	1 124	3 770	2 012	1 164	170
18 375	3 456	3 397	800	2 149	1 148	3 850	2 055	1 189	180
19 500	3 525	3 465	800	2 192	1 171	3 927	2 096	1 213	180
20 625	3 592	3 531	820	2 233	1 193	4 001	2 135	1 236	185
21 750	3 656	3 594	820	2 273	1 214	4 072	2 173	1 258	185
23 250	3 738	3 674	830	2 324	1 242	4 164	2 222	1 286	190
24 750	3 817	3 752	860	2 373	1 268	4 251	2 269	1 313	195
26 625	3 911	3 844	880	2 432	1 299	4 356	2 325	1 346	200
28 875	4 018	3 949	910	2 498	1 335	4 475	2 389	1 383	205
31 500	4 136	4 065	940	2 572	1 374	4 607	2 459	1 423	210
34 500	4 263	4 190	960	2 651	1 416	4 749	2 535	1 467	220

Annex B (normative)

Anchor proof test method

B.1 Testing equipment

B.1.1 The testing equipment shall be of horizontal pulling type.

B.1.2 The testing equipment shall be furnished with a holding-time display function.

B.1.3 The testing equipment shall be inspected by a statutory metering agency and have a valid conformity certificate.

B.1.4 The testing equipment shall be approved by the concerned Classification Society.

B.1.5 The select tool holder with the corresponding identification load in accordance with the test load of the anchor shall be inspected.

B.2 Proof test load

B.2.1 The nominal mass of the anchor shall be 1,33 times its actual mass (see [Table A.1](#)).

B.2.2 Select the proof test load according to the nominal mass of the anchor in [Table 4](#).

B.2.3 When the nominal mass is of a medium value, the proof test load shall be determined by an interpolation method.

B.3 Test anchor

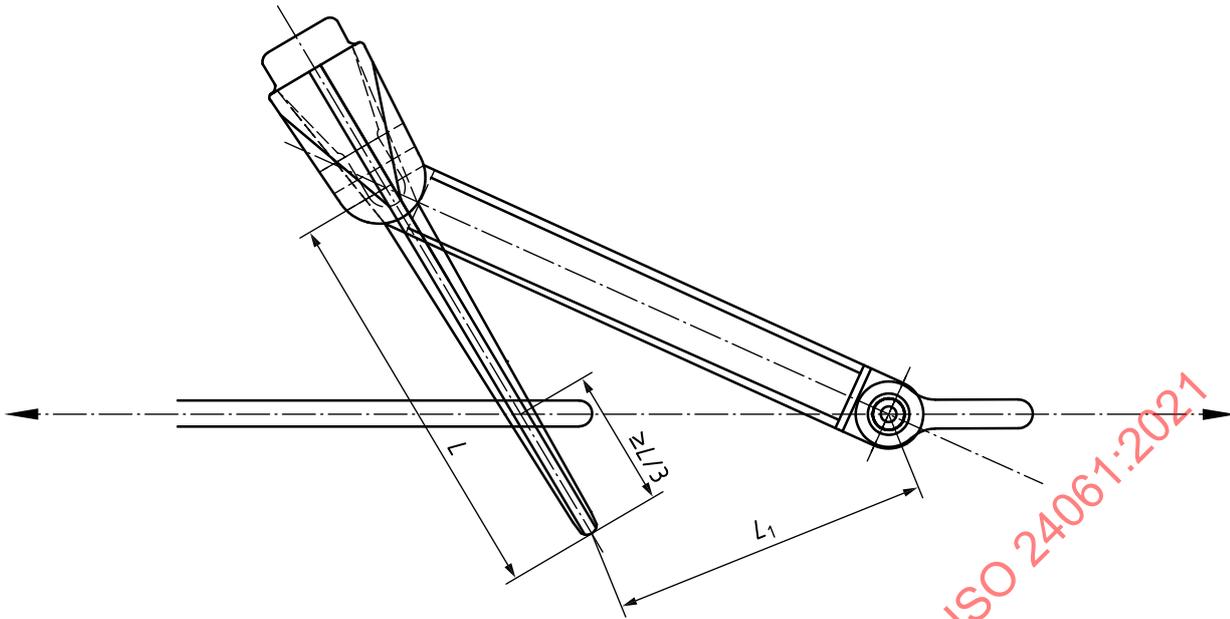
B.3.1 The test anchor shall be verified as qualified according to [5.1](#) to [5.5](#), [5.7](#), [5.8](#) and [6.1](#).

B.3.2 The test anchor shall not be painted.

B.4 Testing procedures

B.4.1 The testing equipment shall be started and preheated for half an hour; select the proof test load range.

B.4.2 Locate the anchor into the anchor bed. The anchor shackle (ring) shall be connected to the pile crown of the testing equipment. The application point between the anchor holder and the flukes shall be in accordance with [Figure B.1](#).



Key

L_1 gauge length

Figure B.1 — Proof test

B.4.3 The anchor shank and every fluke peak should be marked for measuring the spacing L and L_1 .

B.4.4 Apply 10 % of the proof test load determined for the anchor with a 5 min loading time, and measure the spacing between the marks. If no abnormal phenomena is found after checking, increase the load to 100 % of the proof test load gradually for a loading period of 5 min, and then reduce the load to 10 % of the proof test load, measure the spacing between the marks, and discharge the load.

B.4.5 Pull the two anchor flukes simultaneously; apply the proof test load on one side and then on the other side in turned-over state; apply the test again as per [B.4.2](#), [B.4.3](#) and [B.4.4](#).

B.4.6 The following inspections should be carried out after the anchor proof test:

- a) visual inspection, NDT;
- b) residual deformation measurement;
- c) rotation flexibility.

Annex C (normative)

Anchor holding power test method at sea

C.1 Test anchor

C.1.1 The test anchor shall be determined according to anchor production series.

C.1.2 A proof test should be carried out on the test anchor according to [Annex B](#). The holding power test at sea can be carried out only after getting the approval from a Classification Society.

C.1.3 At least two specifications shall be selected for the test anchor. One smaller anchor shall have a mass of not less than 1/10 of the mass of the bigger one, while the bigger one shall have a mass of not less than 1/10 of the mass of the biggest anchor among its series.

C.1.4 Select a proper length of mooring chain depending on the water depth of the test area (a length of 10 times the water depth is generally taken). The mooring chain can be replaced by steel rope.

C.2 Meteorological conditions for testing

C.2.1 The test shall not be carried out during rainy and snowy weather that could affect the test.

C.2.2 The wind speed shall be not greater than 5 m/s.

C.2.3 Visibility shall be not less than 500 m.

C.2.4 The ambient temperature shall be -10 °C to 40 °C.

C.3 Sea condition for testing

C.3.1 Test sea waters should be stable and open; the wave height shall be not more than 1,0 m.

C.3.2 The sea water flow rate shall be not more than 0,5 m/s.

C.3.3 The test shall be carried out over 3 different kinds of seabed soil conditions.

C.3.4 The anchor chain length shall be 10 times the vertical length measured from the hawse pipe opening to the seabed. The anchor chain can be replaced by steel rope during testing.

C.3.5 No obstacles affecting the test are allowed in the water in front of or at the back of the test ship.

C.3.6 The test shall be carried out in safe areas far from the testing equipment.