

PART

2

CHAPTER **2 Equipment**

SECTION **1 Anchors**

1 General Requirements (2007)

1.1 Scope

These requirements apply to the materials, manufacture, testing and certification of anchors, shanks and anchor shackles produced from cast or forged steel, or fabricated by welded rolled steel plate and bars.

These manufacturing requirements are applicable to ordinary anchors and superior holding power (SHP) anchors.

1.3 Types of Anchor

1.3.1 Ordinary Anchors (Also see 3-5-1/7)

Ordinary stockless anchors are to be of an approved design. Any changes or alterations from the approved design are to be approved prior to manufacture.

The mass of the heads of stockless anchors including pins and fittings are not to be less than 60% of the total mass of the anchor.

1.3.2 Superior Holding Power (SHP) Anchors (Also see 3-5-1/7)

SHP anchors are to be of an approved design and subject to special approval. Any changes or alterations to the approved design made during manufacture are to have prior approval.

SHP anchors are to be suitable for ship use and are not to require prior adjustment or special placement on the seabed.

SHP anchors are to have at least twice the holding power of ordinary stockless anchors of the same weight.

The mass of each bower anchor can be reduced by up to 25% of the mass specified in 2-2-1/Table 6.

Approved manufacturers of SHP anchors are included in a specific directory maintained by the Bureau.

1.3.3 SHP Anchors for Restricted Service and to a Maximum Weight of 1500 kg (3306 lbs)

Special approval can be given to superior holding power anchors with holding powers of at least 4 times the holding power of ordinary anchors. The mass of each bower anchor can be reduced by up to 50% of the mass specified in 2-2-1/Table 6.

3 Materials for Anchors (2007)

All anchors are to be manufactured from materials meeting the requirements of the *ABS Rules for Materials and Welding (Part 2)*.

Cast steel anchor flukes, shanks, swivels and shackles are to be manufactured and tested in accordance with the requirements of Section 2-1-5 and comply with the requirements for castings for welded construction. The steel is to be fine grain treated with aluminum.

Two test programs “A” and “B” are permitted in accordance with 2-2-1/7.3.1. If test program B is selected in accordance with 2-2-1/7.3.1, then Charpy V notch (CVN) impact testing of cast material is required. Special consideration is to be given to the use of other grades of steels for the manufacture of swivels.

Forged steel anchor pins, shanks, swivels and shackles are to be manufactured and tested in accordance with the requirements of Section 2-1-6. Shanks, swivels and shackles are to comply with the requirements for carbon and carbon-manganese steels for welded construction. Special consideration is to be given to the use of other grades of steels for the manufacture of swivels.

Rolled plates and bars for fabricated steel anchors are to be manufactured and tested in accordance with the requirements of Section 2-1-1.

Rolled bars intended for pins, swivels and shackles are to be manufactured and tested in accordance with the requirements of Section 2-1-1 or Section 2-3-8.

3.1 Superior Holding Power (SHP) Anchors for Restricted Service and to a Maximum Weight of 1500 kg (3306 lbs)

In addition to the above requirements, steel is to be selected in accordance with 3-1-2/Table 1 Class II. The welding consumables are to meet the toughness for the base steel grades. Toughness of the anchor shackles is to meet that for Grade 3 anchor chain. The toughness of steel castings is to be not less than a Charpy V-notch energy average of 27 J at 0°C (2.8 kgf-m at 0°C, 20 ft-lbs at 32°F).

5 Manufacture of Anchors (2007)

5.1 Tolerance

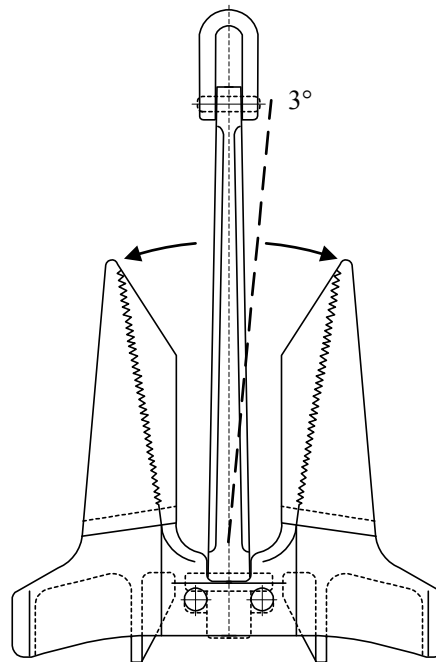
If not otherwise specified in standards or on drawings demonstrated to be appropriate, the following assembly and fitting tolerances are to be applied.

The clearance either side of the shank within the shackle jaws is to be no more than 3 mm (0.12 inch) for small anchors up to 3 tonnes (3.3 tons) weight, 4 mm (0.16 inch) for anchors up to 5 tonnes (5.5 tons) weight, 6 mm (0.24 inch) for anchors up to 7 tonnes (7.7 tons) weight and is not to exceed 12 mm (0.47 inch) for larger anchors. The shackle pin is to be a push fit in the eyes of the shackle, which are to be chamfered on the outside to ensure a good tightness when the pin is clenched over on fitting. The shackle pin to hole tolerance is to be no more than 0.5 mm (0.02 inch) for pins up to 57 mm (2.24 inch) and 1.0 mm (0.04 inch) for pins of larger diameter.

The trunnion pin is to be a snug fit within the chamber and be long enough to prevent horizontal movement. The gap is to be no more than 1% of the chamber length.

The lateral movement of the shank is not to exceed 3 degrees, see 2-2-1/Figure 1.

FIGURE 1
Allowable Lateral Movement of Shank (2007)



5.3 Welding of Anchors

Welded construction of fabricated anchors is to be in accordance with approved procedures in accordance with Section 2-4-1 and Section 2-4-3. NDE is to be carried in accordance with the requirements of 2-2-1/Table 3 or 2-2-1/Table 4 or 2-2-1/Table 5 product tests.

5.5 Heat Treatment

Components for cast or forged anchors are to be properly heat treated; fully annealed; normalized or normalized and tempered in accordance with 2-1-5/5 or 2-1-6/5. Fabricated anchors may require stress relief after welding depending upon weld thickness. Stress relief is to be carried out as indicated in the approved welding procedure. Stress relief temperatures are not to exceed the tempering temperature of the base material.

5.7 Surface Cleanliness

All parts are to have a clean surface consistent with the method of manufacture and intended method of inspection.

5.9 Repairs

Any necessary repairs to forged and cast anchors are to be agreed to by the Surveyor and carried out in accordance with the repair criteria indicated in 2-1-5/13 and 2-1-6/11.9. Repairs to fabricated anchors are to be agreed to by the Surveyor and carried out in accordance with qualified weld procedures, by qualified welders, following the parameters of the welding procedures used in construction.

5.11 Anchor Assembly

Assembly and fitting are to be done in accordance with the design details. Securing of the anchor pin, shackle pin or swivel nut, by welding, is to be in accordance with an approved procedure.

7 Testing and Certification (2007)

All anchors are to be inspected and tested in the presence of the Surveyor, the proof testing is to be done in a machine recognized for such purposes. The Surveyor is to be satisfied that all testing machines, including material testing machines, are maintained in a satisfactory condition, and is to keep a record of the dates and by whom the machines were rechecked and calibrated.

7.1 Proof Load Testing of Anchors

Proof load testing for ordinary and SHP anchors is to be carried out by an approved testing facility.

7.1.1 Proof Load Testing of Ordinary Anchors (2009)

Before application of proof test load, the anchors are to be visually examined, and all defects are to be removed, and if necessary repaired by welding, prior to testing. Proof tests are to be carried out on all anchors after being temporarily assembled. The proof tests are to be in accordance with the values given in 2-2-1/Table 6. The proof load in accordance with 2-2-1/Table 6 is to be applied on the fluke at a location one third of the distance from the tip of the fluke to the center of the crown as shown in 2-2-1/Figure 2.

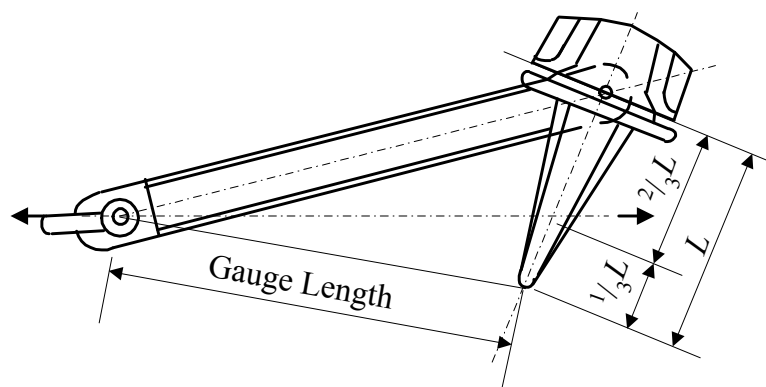
In the case of stockless anchors, both arms are to be tested at the same time, first on one side of the shank, then reversed and tested on the other.

After proof load testing the anchors are to be examined for cracks and other defects, and for excessive deformation due to seating.

Upon completion of the proof load tests, anchors made in more than one piece are to be examined for free rotation of their heads over the complete angle.

The gauge lengths (see 2-2-1/Figure 2) under a load equal to one-tenth of the proof test load are to be determined before and after the application of full proof load on each side. The gauge length after the application of full proof load is to be not more than 1% in excess of the corresponding gauge length before the application of full proof load.

FIGURE 2
Proof Load Application



7.1.2 Proof Load Testing of SHP Anchors

SHP anchors are to be proof tested with loads required by 2-2-1/Table 6 for an anchor mass equal to 1.33 times the actual mass of the SHP anchor. The proof loading procedure and examination procedure for SHP anchors are to comply with those for ordinary anchors, described in 2-2-1/7.1.

7.1.3 Testing of SHP Anchors for Restricted Service with 4 Times Holding Power of Ordinary Anchors

These anchors are to be proof tested with the load required by 2-2-1/Table 6 for an anchor mass equal to 2 times the actual mass of the SHP anchor. The proof loading procedure and examination procedure for SHP anchors are to comply with those for ordinary anchors, described in 2-2-1/7.1.

7.1.4 SHP Full Scale Anchor Holding Power Tests at Sea

In addition to proof tests SHP anchors are to undergo anchor holding power sea tests on various types of sea bottom, using anchors representative of the full range of anchor size proposed.

7.3 Product Tests

7.3.1 Product Test Programs

There are two test programs, which apply to anchor manufacture.

- Program A, or
- Program B.

TABLE 1
Applicable Test Programs for Each Product Form

<i>Product Test</i>	<i>Product Form</i>		
	<i>Cast Components</i>	<i>Forged Components</i>	<i>Fabricated/Welded Components</i>
Program A	Applicable	Not Applicable	Not Applicable
Program B	Applicable ⁽¹⁾	Applicable	Applicable

Notes:

- 1 CVN impact tests are to be carried out to demonstrate at least 27 J average at 0°C (2.8 kgf-m at 0°C, 20 ft-lbs at 32°F).

TABLE 2
Product Test Requirements for Program A and B

<i>Program A</i>	<i>Program B</i>
Drop test	---
Hammering test	---
Visual inspection	Visual inspection
General NDE	General NDE
---	Extended NDE

7.3.2 Drop Test

Each anchor fluke and shank is to be individually raised to a height of 4 m (13.1 ft) and dropped on to a steel slab without fracturing. The steel slab is to be suitable to resist the impact of the dropped component.

7.3.3 Hammering Test

After the drop test, hammering tests are to be carried out on each anchor fluke and shank, which is slung clear of the ground, using a non-metallic sling, and hammered to check the soundness of the component. A hammer of at least 3 kg (6.6 lbs) mass is to be used.

7.3.4 Visual Inspection

After proof loading visual inspection of all accessible surfaces is to be carried out.

7.3.5 General Nondestructive Examination

After proof loading, general NDE is to be carried out as indicated in 2-2-1/Table 3 and 2-2-1/Table 4.

TABLE 3
General NDE for Ordinary and SHP Anchors

<i>Location</i>	<i>Method of NDE</i>
In way of feeders of castings	PT or MT
In way of risers of castings	PT or MT
In way of weld repairs	PT or MT
Forged components	Not required
Fabrication welds	PT or MT

Part 2, Appendix 6, “Guidelines for Nondestructive Examination of Marine Steel Castings” is regarded as an example of an acceptable standard for surface and volumetric examination.

TABLE 4
General NDE for SHP Anchors for Restricted Service with 4 Times Holding Power of Ordinary Anchors

<i>Location</i>	<i>Method of NDE</i>
In way of feeders of castings	PT or MT and UT
In way of risers of castings	PT or MT and UT
In way of weld repairs	PT or MT
Forged components	Not required
Fabrication welds	PT or MT

Part 2, Appendix 6, “Guidelines for Nondestructive Examination of Marine Steel Castings” is regarded as an example of an acceptable standard for surface and volumetric examination.

7.3.6 Extended Nondestructive Examination

After proof loading extended NDE is to be carried out as indicated in 2-2-1/Table 5.

TABLE 5
Extended NDE for Ordinary and all SHP Anchors

<i>Location</i>	<i>Method of NDE</i>
In way of feeders of castings	PT or MT and UT
In way of risers of castings	PT or MT and UT
All surfaces of castings	PT or MT
Random areas of castings	UT
In way of weld repairs	PT or MT
Forged components	Not required
Fabrication welds	PT or MT

Part 2, Appendix 6, “Guidelines for Nondestructive Examination of Marine Steel Castings” is regarded as an example of an acceptable standard for surface and volumetric examination.

7.3.7 Repair Criteria

If defects are detected by NDE, repairs are to be carried out in accordance with 2-2-1/5.9. For fracture and unsoundness detected in a drop test or hammering test, repairs are not permitted and the component is to be rejected.

7.5 Mass and Dimensional Inspection

Unless otherwise agreed, the verification of mass and dimensions is the responsibility of the manufacturer. The Surveyor is only required to monitor this inspection. The mass of the anchor is to exclude the mass of the swivel, unless the swivel is an integral component.

7.7 Retests

Mechanical retest is permitted in accordance with the requirements of 2-1-5/3.3 and 2-1-6/3.3.

9 Marking for Anchors

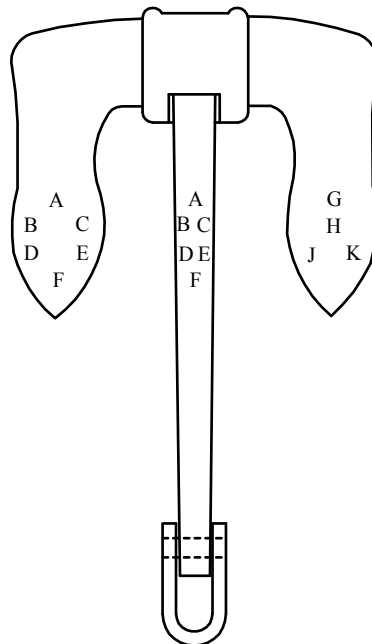
9.1 Markings

When anchors have satisfactorily passed the above test requirements, they are to be clearly stamped by the manufacturer, as shown in 2-2-1/Figure 3.

9.3 Provisions for Marks (2005)

One side of the anchor is to be reserved solely for the above marks and the other side used for the maker’s name or other trademarks that may be desired. If the design of the anchor does not permit the above marks being placed or grouped as indicated, a suitable boss is to be cast on each arm on which the marks are to be stamped. The Maltese Cross, ☒ is to be stamped at positions “B” & “J” along with the witnessing Surveyor’s initials per 2-2-1/Figure 3.

FIGURE 3
Stockless Anchor (2008)



A	The number of Certificate. (Furnished by the Surveyor)	00-PA123
B	(2005) The Maltese Cross Stamp and the Initials of the Surveyor who witnesses the Proof Test	☒ X.Y.X.
C	Month and Year of Test	1-00
D	Proof Test applied	34680
E	Signifying that the Testing Machine is recognized by the Committee of the American Bureau of Shipping	AB
F	The Weight of Anchor	1906
G	(2008) Signifying that Anchor Head has been verified by a Surveyor to the American Bureau of Shipping	AB
H	The Weight of Anchor Head	1140
J	(2005) The Maltese Cross Stamp and the Initials of the Surveyor who witnesses the Drop Test	☒ X.Y.X.
K	Month and Year of Drop Test	6-00

11 Certification (2007)

Anchors which meet the requirements of this section are to be certified by the Bureau. The following items that are to be included in the certificate:

- Manufacturer's name
- Type
- Mass
- Fluke and Shank identification numbers

- Grade of materials
- Proof test loads
- Heat treatment
- Markings applied to anchor

13 Painting (2007)

All types of anchor are to remain unpainted until all tests and inspections have been completed.

TABLE 6
Proof Tests for Anchors

Note See also 3-5-1/7

SI Units		Proof Test	Mass of Anchor	Proof Test	Mass of Anchor	Proof Test	Mass of Anchor	Proof Test	Mass of Anchor	Proof Test	Mass of Anchor	Proof Test	
kg	kN	kg	kN	kg	kN	kg	kN	kg	kN	kg	kN	kg	kN
50	23	500	116	2000	349	4500	622	7000	804	15000	1260	38000	2330
55	25	550	125	2100	362	4600	631	7200	818	15500	1270	40000	2410
60	27	600	132	2200	376	4700	638	7400	832	16000	1300	42000	2490
65	29	650	140	2300	388	4800	645	7600	845	16500	1330	44000	2570
70	31	700	149	2400	401	4900	653	7800	861	17000	1360	46000	2650
75	32	750	158	2500	414	5000	661	8000	877	17500	1390	48000	2730
80	34	800	166	2600	427	5100	669	8200	892	18000	1410		
90	36	850	175	2700	438	5200	677	8400	908	18500	1440		
100	39	900	182	2800	450	5300	685	8600	922	19000	1470		
120	44	950	191	2900	462	5400	691	8800	936	19500	1490		
140	49	1000	199	3000	474	5500	699	9000	949	20000	1520		
160	53	1050	208	3100	484	5600	706	9200	961	21000	1570		
180	57	1100	216	3200	495	5700	713	9400	975	22000	1620		
200	61	1150	224	3300	506	5800	721	9600	987	23000	1670		
225	66	1200	231	3400	517	5900	728	9800	998	24000	1720		
250	70	1250	239	3500	528	6000	735	10000	1010	25000	1770		
275	75	1300	247	3600	537	6100	740	10500	1040	26000	1800		
300	80	1350	255	3700	547	6200	747	11000	1070	27000	1850		
325	84	1400	262	3800	557	6300	754	11500	1090	28000	1900		
350	89	1450	270	3900	567	6400	760	12000	1110	29000	1940		
375	93	1500	278	4000	577	6500	767	12500	1130	30000	1990		
400	98	1600	292	4100	586	6600	773	13000	1160	31000	2030		
425	103	1700	307	4200	595	6700	779	13500	1180	32000	2070		
450	107	1800	321	4300	604	6800	786	14000	1210	34000	2160		
475	112	1900	335	4400	613	6900	794	14500	1230	36000	2250		

**TABLE 6 (continued)
 Proof Tests for Anchors**

Note See also 3-5-1/7

Metric Units		Proof Test		Mass of Anchor		Proof Test		Mass of Anchor		Proof Test		Mass of Anchor		Proof Test		Mass of Anchor	
kg	kgf	kg	kgf	kg	kgf	kg	kgf	kg	kgf	kg	kgf	kg	kgf	kg	kgf	kg	kgf
50	2370	500	11800	2000	35600	4500	63400	7000	82000	15000	128000	38000	238000				
55	2570	550	12700	2100	36900	4600	64300	7200	83400	15500	130000	40000	246000				
60	2760	600	13500	2200	38300	4700	65100	7400	84800	16000	133000	42000	254000				
65	2950	650	14300	2300	39600	4800	65800	7600	86200	16500	136000	44000	262000				
70	3130	700	15200	2400	40900	4900	66600	7800	87800	17000	139000	46000	270000				
75	3300	750	16100	2500	42200	5000	67400	8000	89400	17500	142000	48000	278000				
80	3460	800	16900	2600	43500	5100	68200	8200	91000	18000	144000						
90	3700	850	17800	2700	44700	5200	69000	8400	92600	18500	147000						
100	3990	900	18600	2800	45900	5300	69800	8600	94000	19000	150000						
120	4520	950	19500	2900	47100	5400	70500	8800	95400	19500	152000						
140	5000	1000	20300	3000	48300	5500	71300	9000	96800	20000	155000						
160	5430	1050	21200	3100	49400	5600	72000	9200	98000	21000	160000						
180	5850	1100	22000	3200	50500	5700	72700	9400	99400	22000	165000						
200	6250	1150	22800	3300	51600	5800	73500	9600	100600	23000	170000						
225	6710	1200	23600	3400	52700	5900	74200	9800	101800	24000	175000						
250	7180	1250	24400	3500	53800	6000	74900	10000	103000	25000	180000						
275	7640	1300	25200	3600	54800	6100	75500	10500	106000	26000	184000						
300	8110	1350	26000	3700	55800	6200	76200	11000	109000	27000	189000						
325	8580	1400	26700	3800	56800	6300	76900	11500	111000	28000	194000						
350	9050	1450	27500	3900	57800	6400	77500	12000	113000	29000	198000						
375	9520	1500	28300	4000	58800	6500	78200	12500	115000	30000	203000						
400	9980	1600	29800	4100	59800	6600	78800	13000	118000	31000	207000						
425	10500	1700	31300	4200	60700	6700	79400	13500	120000	32000	211000						
450	10900	1800	32700	4300	61600	6800	80200	14000	123000	34000	220000						
475	11400	1900	34200	4400	62500	6900	81000	14500	125000	36000	229000						

**TABLE 6 (continued)
 Proof Tests for Anchors**

US Units		Mass of Anchor		Proof Test		Mass of Anchor		Proof Test		Mass of Anchor		Proof Test		Mass of Anchor		Proof Test		Mass of Anchor		Proof Test	
lb	lbf	lb	lbf	lb	lbf	lb	lbf	lb	lbf	lb	lbf	lb	lbf	lb	lbf	lb	lbf	lb	lbf	lb	lbf
100	5000	1000	24100	3000	57700	5000	86500	7000	110500	9000	131500	28000	256000	56000	400000						
125	5900	1100	25900	3100	59200	5100	87800	7100	112000	9500	136000	29000	262000	58000	410000						
150	6800	1200	27700	3200	60700	5200	89100	7200	113000	10000	140500	30000	266000	60000	419000						
175	7600	1300	29500	3300	62200	5300	90400	7300	114000	11000	148500	31000	272000	62000	428000						
200	8300	1400	31200	3400	63700	5400	91700	7400	115000	12000	156000	32000	275000	64000	437000						
250	9700	1500	32900	3500	65200	5500	93000	7500	116000	13000	163500	33000	281000	66000	446000						
300	10900	1600	34600	3600	66700	5600	94300	7600	117000	14000	170500	34000	287000	68000	455000						
350	12000	1700	36300	3700	68200	5700	95500	7700	118000	15000	177000	35000	292000	70000	464000						
400	13000	1800	38000	3800	69700	5800	96700	7800	120000	16000	185000	36000	298000	75000	486000						
450	14000	1900	39700	3900	71200	5900	97900	7900	120500	17000	192000	37000	303000	80000	507000						
500	15000	2000	41400	4000	72600	6000	99100	8000	121500	18000	200000	38000	309000	85000	528000						
550	16000	2100	43100	4100	74100	6100	100500	8100	122500	19000	208000	39000	314000	90000	549000						
600	16900	2200	44700	4200	75500	6200	101500	8200	123500	20000	214000	40000	320000	95000	569000						
650	17800	2300	46400	4300	76900	6300	102500	8300	124500	21000	221000	42000	330000	100000	590000						
700	18700	2400	48000	4400	78300	6400	104000	8400	125500	22000	227000	44000	341000	105000	610000						
750	19600	2500	49700	4500	79700	6500	105000	8500	126500	23000	232000	46000	351000	110000	630000						
800	20500	2600	51300	4600	81100	6600	106500	8600	127500	24000	239000	48000	361000								
850	21400	2700	52900	4700	82500	6700	107500	8700	128500	25000	243000	50000	371000								
900	22300	2800	54500	4800	83800	6800	108500	8800	129500	26000	247000	52000	381000								
950	23200	2900	56100	4900	85200	6900	109500	8900	130500	27000	251000	54000	390000								

Note See also 3-5-1/7