IACS

SECTION 3
EQUIPMENT

SYMBOLS

For symbols not defined in this section, refer to Ch 1, Sec 4.

1 GENERAL

1.1 Application

1.1.1

The anchoring equipment specified in this section is intended for temporary mooring of a ship within a harbour or sheltered area when the ship is awaiting berth, tide, etc.

1.1.2

The equipment specified is not intended to be adequate to hold a ship off fully exposed coasts in rough weather or to stop a ship that is moving or drifting. In such a condition, the loads on the anchoring equipment increase to such a degree that its components may be damaged or lost.

1.1.3

The Equipment Number (*EN*) formula for the required anchoring equipment is based on an assumed current speed of 2.5 m/s, wind speed of 25 m/s and a scope of chain cable between 6 and 10. The scope of chain cable is defined as the ratio between the length of chain paid out and the waters depth.

It is assumed that under normal circumstances a ship will use only one bow anchor and chain cable at a time.

2 EQUIPMENT NUMBER CALCULATION

2.1 Requirements

2.1.1

Anchors and chains are to be in accordance with Table 1 and the quantity, mass and sizes of these are to be determined by the equipment number (EN), given by:

$$EN = \Delta^{2/3} + 2\ B\ h + 0.1\ A$$

where:

h : Effective height, in m, from the summer load waterline to the top of the uppermost house, to be obtained in accordance with the following formula:

$$h = h_{FB} + \Sigma h_n$$

When calculating h, sheer and trim are to be disregarded.

h_{FB} : Freeboard amidships from the summer load waterline to the upper deck, in m.

h_n : Height, in m, at the centreline of superstructure or of deckhouse tier 'n' having a breadth greater than $B/4$. Where a house having a breadth greater than $B/4$ is above a house with a breadth of $B/4$ or less, the upper house is to be included and the lower ignored (see in Figure 1).

A : Area, in m^2, in profile view, of the parts of the hull, superstructures and houses above the summer load waterline which are within the length *L* and also have a breadth greater than *B*/4.

Fixed screens or bulwarks 1.5 m or more in height are to be regarded as parts of houses when determining *h* and *A*. In particular, the hatched area shown in Figure 2 is to be included.

The height of hatch coamings and that of any deck cargo, such as containers, may be disregarded when determining *h* and *A*.

2.1.2

For ships with *EN* greater than 16000, the determination of the equipment will be considered by the Society on a case-by-case basis.

Figure 1 : Effective heights of deckhouses

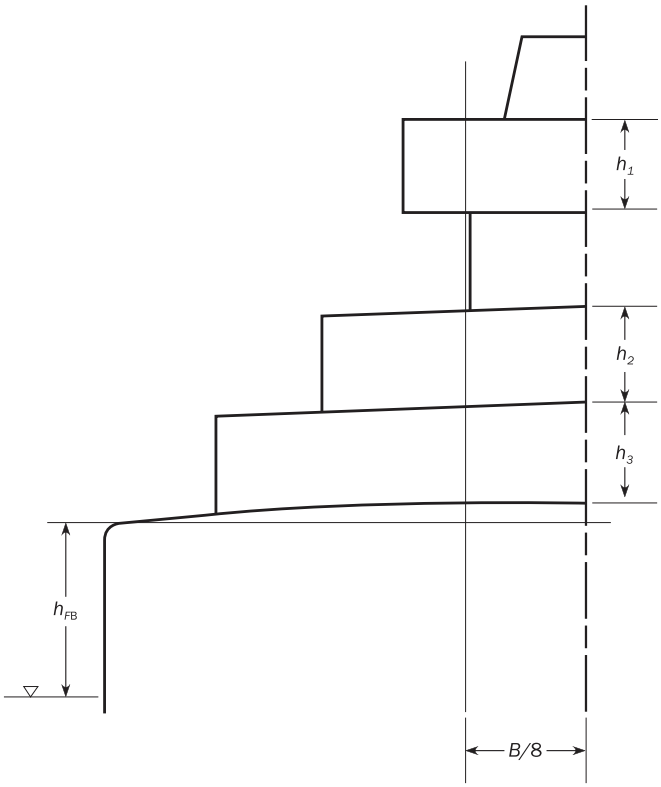

Figure 2 : Profile areas of screens and bulwarks

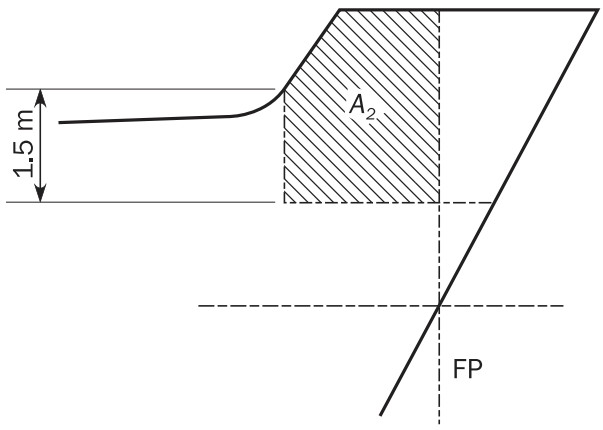

Table 1 : Equipment - Bower anchors and chain cables

Equipment Number		Stockless bower anchors		Chain cable stud link bower chain			
					Diameter, in mm		
Greater than	Equal to or less than	Number of anchors (1)	Mass per anchor, in kg	Length, in m	Normal strength steel (Grade 1)	High strength steel (Grade 2)	Extra high strength steel (Grade 3)
150	175	2	480	275	22	19	*
175	205	2	570	302.5	24	20.5	*
205	240	2	660	302.5	26	22	20.5
240	280	2	780	330	28	24	22
280	320	2	900	357.5	30	26	24
320	360	2	1020	357.5	32	28	24
360	400	2	1140	385	34	30	26
400	450	2	1290	385	36	32	28
450	500	2	1440	412.5	38	34	30
500	550	2	1590	412.5	40	34	30
550	600	2	1740	440	42	36	32
600	660	2	1920	440	44	38	34
660	720	2	2100	440	46	40	36
720	780	2	2280	467.5	48	42	36
780	840	2	2460	467.5	50	44	38
840	910	2	2640	467.5	52	46	40
910	980	2	2850	495	54	48	42
980	1060	2	3060	495	56	50	44
1060	1140	2	3300	495	58	50	46
1140	1220	2	3540	522.5	60	52	46
1220	1300	2	3780	522.5	62	54	48
1300	1390	2	4050	522.5	64	56	50
1390	1480	2	4320	550	66	58	50
1480	1570	2	4590	550	68	60	52
1570	1670	2	4890	550	70	62	54
1670	1790	2	5250	577.5	73	64	56
1790	1930	2	5610	577.5	76	66	58
1930	2080	2	6000	577.5	78	68	60
2080	2230	2	6450	605	81	70	62
2230	2380	2	6900	605	84	73	64
2380	2530	2	7350	605	87	76	66
2530	2700	2	7800	632.5	90	78	68
2700	2870	2	8300	632.5	92	81	70
2870	3040	2	8700	632.5	95	84	73
3040	3210	2	9300	660	97	84	76
3210	3400	2	9900	660	100	87	78
3400	3600	2	10500	660	102	90	78
3600	3800	2	11100	687.5	105	92	81
3800	4000	2	11700	687.5	107	95	84

(1) Spare anchors are not included in the number of required anchors.

Note 1: '*' chain grade not to be used at this diameter.

Equipment Number		Stockless bower anchors		Chain cable stud link bower chain			
					Diameter, in mm		
Greater than	Equal to or less than	Number of anchors (1)	Mass per anchor, in kg	Length, in m	Normal strength steel (Grade 1)	High strength steel (Grade 2)	Extra high strength steel (Grade 3)
4000	4200	2	12300	687.5	111	97	87
4200	4400	2	12900	715	114	100	87
4400	4600	2	13500	715	117	102	90
4600	4800	2	14100	715	120	105	92
4800	5000	2	14700	742.5	122	107	95
5000	5200	2	15400	742.5	124	111	97
5200	5500	2	16100	742.5	127	111	97
5500	5800	2	16900	742.5	130	114	100
5800	6100	2	17800	742.5	132	117	102
6100	6500	2	18800	742.5	*	120	107
6500	6900	2	20000	770	*	124	111
6900	7400	2	21500	770	*	127	114
7400	7900	2	23000	770	*	132	117
7900	8400	2	24500	770	*	137	122
8400	8900	2	26000	770	*	142	127
8900	9400	2	27500	770	*	147	132
9400	10000	2	29000	770	*	152	132
10000	10700	2	31000	770	*	*	137
10700	11500	2	33000	770	*	*	142
11500	12400	2	35500	770	*	*	147
12400	13400	2	38500	770	*	*	152
13400	14600	2	42000	770	*	*	157
14600	16000	2	46000	770	*	*	162

(1) Spare anchors are not included in the number of required anchors.

Note 1: '*' chain grade not to be used at this diameter.

3 ANCHORING EQUIPMENT

3.1 General

3.1.1 General

Two bower anchors are to be connected to chain cable and stowed in position ready for use.

A third anchor is recommended to be provided as a spare bower anchor and is listed for guidance only; it is not required as a condition of classification.

3.1.2 Design

Anchors are to be of an approved design. The design of anchor heads is to be such as to minimise stress concentrations. In particular, the radii, on all parts of cast anchor heads are to be as large as possible, especially where there is considerable change of section.

If the anchor design is different from standard or approved anchor types, drawing of the anchor, including material specification, is to be submitted for approval.

3.1.3 Testing

All anchors and chain cables are to be tested at establishments and on machines recognised by the Society, under the supervision of surveyors or other representatives of the Society and in accordance with the relevant requirements for materials of the Society.

Test certificates showing particulars of weights of anchors, or size and weight of cable and of the test loads applied are to be available. These certificates are to be examined by the surveyor when the anchors and cables are placed onboard the ship.

3.2 Ordinary anchors

3.2.1 Anchor mass

The mass per anchor of bower anchors given in Table 1 is for anchors of equal mass. The mass of individual anchors may vary 7% above or below the tabulated value, provided that the combined mass of all anchors is not less than that required for anchors of equal mass.

Anchors are to be of the stockless type. The mass of the head of anchor, including pins and fittings, is not to be less than 60% of the total mass of the anchor.

3.3 High and Super High Holding power anchors

3.3.1 General

Where agreed by the owner, consideration will be given to the use of special types of anchors. High Holding Power (HHP) and Super High Holding Power (SHHP) anchors, i.e. anchors for which a holding power higher than that of ordinary anchors has been proved according to the applicable requirements of the Society's Rules for Materials, do not require prior adjustment or special placement on the sea bottom.

3.3.2 HHP or SHHP anchor mass

Where HHP or SHHP anchors are used as bower anchors, the mass of each anchor is to be not less than 75% or 50%, respectively, of that required for ordinary stockless anchors in Table 1.

The mass of SHHP anchors is to be, in general, less than or equal to 1500 kg.

3.3.3 Application

High holding power anchors are to be of a design that will ensure that the anchors will take effective hold of the sea bed without undue delay and will remain stable, for holding forces up to those required by [3.3.4], irrespective of the angle or position at which they first settle on the sea bed when dropped from a normal type of hawse pipe. A demonstration of these abilities may be required.

The design approval of high holding power anchors may be given as a general/type approval, and listed in a published document by the Society.

3.3.4 Testing

An anchor for which approval is sought as a high holding power (HHP) anchor, is to be tested at sea to show that it has a holding power of twice that approved for a standard stockless anchor of the same mass.

If approval is sought for a range of sizes, then at least two are to be tested. The smaller of the two anchors is to have a mass not less than one-tenth of that of the larger anchor. The larger of the two anchors tested is to have a mass not less than one-tenth of that of the largest anchor for which approval is sought.

Each test is to comprise a comparison between at least two anchors: one ordinary stockless bower anchor and one HHP anchor. The masses of the anchors are to be approximately equal.

The tests are generally to be carried out by means of a tug. The pull is to be measured by a dynamometer or determined from recently verified data of the tug's bollard pull as a function of propeller rpm.

During the test, the length of the chain cable on each anchor is to be sufficient to obtain an approximately horizontal pull on the anchor. Generally, a horizontal distance between anchor and tug equal to 10 times the water depth will be sufficient.

For SHHP, the tests are to be conducted on at least three different types of bottom, which may be soft mud or silt, sand or gravel, and hard clay or similarly compacted material.

3.4 Chain cables

3.4.1 General

The chain cables are classified as Grade 1, 2 or 3 depending on the type of steel used and its manufacture.

The characteristics of the steel used and the method of manufacture of chain cables are to be approved by the Society for each manufacturer. The material from which chain cables are manufactured and the completed chain cables themselves are to be tested in accordance with the applicable requirements of the Society's Rules for Materials.

Chain cables which are intended to form part of the equipment are not to be used as check chains when the ship is launched.

3.4.2 Application

The total length of chain required to be carried onboard, as given in Table 1, is to be divided approximately equally between the two anchors.

Where the owner requires equipment for anchoring at depths greater than 82.5 m, it is the owner's responsibility to specify the appropriate total length of the chain cable required. In such a case, consideration can be given to dividing the chain cable into two unequal lengths.

3.5 Chain lockers

3.5.1 General

The chain locker is to have adequate capacity and be of a suitable form to provide for the proper stowage of the chain cable, allowing an easy direct lead for the cable into the chain pipes when the cable is fully stowed. Port and starboard cables are to have separate spaces.

The chain locker boundaries and access openings are to be watertight. Provisions are to be made to minimise the probability of the chain locker being flooded in bad weather. Adequate drainage facilities for the chain locker are to be provided.

Chain or spurling pipes are to be of suitable size and provided with chafing lips.

3.5.2 Application

Provisions are to be made for securing the inboard ends of the chain to the structure. This attachment and its supporting structure are to be able to withstand a force of not less than 15% or more than 30% of the minimum breaking strength of the fitted chain cable.

The fastening of the chain to the ship is to be arranged in such a way that in case of an emergency, when the anchor and chain have to be sacrificed, the chain can be readily released from an accessible position outside the chain locker.

3.6 Chain stoppers

3.6.1 General

Chain stoppers are to be provided to secure each chain cable once it is paid out.

3.6.2 Application

Securing arrangements of chain stoppers are to be capable of withstanding a load equal to 80% of the breaking load of the chain cable as required by [3.4.1], without undergoing permanent deformation.

3.7 Windlass

3.7.1 General

A windlass of sufficient power and suitable for the size of chain is to be fitted to the ship in accordance with the requirements of the Society. Where an owner requires equipment significantly in excess of Rule requirements, it is the owner's responsibility to specify increased windlass power.

The windlass is to be capable of heaving in either cable.

3.7.2 Application

The design of the windlass is to be such that access to the chain pipe is adequate to permit the fitting of a cover or seal of sufficient strength over the spurling pipe.

Special consideration will be given to the acceptance of equivalent arrangements that minimise the probability of the chain locker or forecastle being flooded.

3.7.3 Anchor windlass trial

Each windlass is to be tested under working conditions after installation onboard to demonstrate satisfactory operation. Each unit is to be independently tested for the following:

a) Braking.

b) Clutch functioning.

c) Lowering and hoisting of chain cable and anchor.

d) Proper riding of the chain over the chain lifter.

e) Proper transit of the chain through the hawse pipe and the chain pipe.

f) Effecting proper stowage of the chain and the anchor.

During trials onboard ship, the windlass is to be shown to:

a) For all specified design anchorage depths, raise the anchor from a depth of 82.5 m to a depth of 27.5 m at a mean speed of 9 m/min.

b) For specified design anchorage depths greater than 82.5 m, in addition to (a), raise the anchor from the specified design anchorage depth to a depth of 82.5 m at a mean speed of 3 m/min.

c) Where the depth of the water in the trial area is inadequate, suitable equivalent simulating conditions will be considered as an alternative.

3.8 Hawse pipes

3.8.1 General

Hawse pipes are to be of a suitable size and configuration to ensure adequate clearance and an easy lead of the chain cable from the chain stopper through the ship's side.

Hawse pipes are to be of sufficient strength.

Their position and slope are to be so arranged as to create an easy lead for the chain cables and efficient housing for the anchors, where the latter are of the retractable type, avoiding damage to the hull during these operations.

For this purpose, chafing lips of suitable form with ample lay-up and radius adequate to the size of the chain cable are to be provided at the shell and deck. The shell plating in way of the hawse pipes is to be reinforced as necessary.

Where hawse pipes are not fitted, alternative arrangements will be specially considered.

3.8.2 Application

Hawse pipes are to be securely attached to thick, doubling or insert plates, by continuous welds.

3.8.3 Stowage and deployment arrangements for anchors

Hawse pipes and anchor pockets are to have full-rounded flanges or rubbing bars in order to minimise the nip on the cables and to minimise the probability of cable links being subjected to high bending stresses. The radius of curvature is to be such that at least three links of chain will bear simultaneously on the rounded parts of the upper and lower ends of the hawse pipes in those areas where the chain cable is supported during paying out and hoisting and when the ship is at anchor.

On ships provided with a bulbous bow, where it is not possible to obtain a suitable clearance between shell plating and the anchors during anchor handling, local reinforcements of the bulbous bow are to be provided in the form of increased shell plate thickness.

3.9 Towlines and mooring line

3.9.1 General

Mooring lines and towlines are not required as a condition of Classification. The hawsers and towlines listed in Table 2 are intended as a guide. Where the tabular breaking strength is greater than 490kN, the breaking strength and the number of individual hawsers given in Table 2 may be modified, provided that their product is not less than that of the breaking strength and the number of hawsers given in Table 2.

Table 2 : Towline and hawsers

Equipment Number		Towline wire or rope		Hawsers		
Greater than	Equal to or less than	Length, in m	Breaking strength, in kN	Number	Length of each, in m	Breaking strength, in kN
150	175	180	98.0	3	120	54.0
175	205	180	112.0	3	120	59.0
205	240	180	129.0	4	120	64.0
240	280	180	150.0	4	120	69.0
280	320	180	174.0	4	140	74.0
320	360	180	207.0	4	140	78.0
360	400	180	224.0	4	140	88.0
400	450	180	250.0	4	140	98.0
450	500	180	277.0	4	140	108.0
500	550	190	306.0	4	160	123.0

Equipment Number		Towline wire or rope		Hawsers		
Greater than	Equal to or less than	Length, in m	Breaking strength, in kN	Number	Length of each, in m	Breaking strength, in kN
550	600	190	338.0	4	160	132.0
600	660	190	371.0	4	160	147.0
660	720	190	406.0	4	160	157.0
720	780	190	441.0	4	170	172.0
780	840	190	480.0	4	170	186.0
840	910	190	518.0	4	170	201.0
910	980	190	559.0	4	170	216.0
980	1060	200	603.0	4	180	230.0
1060	1140	200	647.0	4	180	250.0
1140	1220	200	691.0	4	180	270.0
1220	1300	200	738.0	4	180	284.0
1300	1390	200	786.0	4	180	309.0
1390	1480	200	836.0	4	180	324.0
1480	1570	220	888.0	5	190	324.0
1570	1670	220	941.0	5	190	333.0
1670	1790	220	1024.0	5	190	353.0
1790	1930	220	1109.0	5	190	378.0
1930	2080	220	1168.0	5	190	402.0
2080	2230	240	1259.0	5	200	422.0
2230	2380	240	1356.0	5	200	451.0
2380	2530	240	1453.0	5	200	480.0
2530	2700	260	1471.0	6	200	480.0
2700	2870	260	1471.0	6	200	490.0
2870	3040	260	1471.0	6	200	500.0
3040	3210	280	1471.0	6	200	520.0
3210	3400	280	1471.0	6	200	554.0
3400	3600	280	1471.0	6	200	588.0
3600	3800	300	1471.0	6	200	618.0
3800	4000	300	1471.0	6	200	647.0
4000	4200	300	1471.0	7	200	647.0
4200	4400	300	1471.0	7	200	657.0
4400	4600	300	1471.0	7	200	667.0
4600	4800	300	1471.0	7	200	677.0
4800	5000	300	1471.0	7	200	686.0
5000	5200	300	1471.0	8	200	686.0
5200	5500	300	1471.0	8	200	696.0
5500	5800	300	1471.0	8	200	706.0
5800	6100	300	1471.0	8	200	706.0
6100	6500	300	1471.0	9	200	716.0
6500	6900	300	1471.0	9	200	726.0

Equipment Number		Towline wire or rope		Hawsers		
Greater than	Equal to or less than	Length, in m	Breaking strength, in kN	Number	Length of each, in m	Breaking strength, in kN
6900	7400	300	1471.0	10	200	726.0
7400	7900	300	1471.0	11	200	726.0
7900	8400	300	1471.0	11	200	735.0
8400	8900	300	1471.0	12	200	735.0
8900	9400	300	1471.0	13	200	735.0
9400	10000	300	1471.0	14	200	735.0
10000	10700	–	–	15	200	735.0
10700	11500	–	–	16	200	735.0
11500	12400	–	–	17	200	735.0
12400	13400	–	–	18	200	735.0
13400	14600	–	–	19	200	735.0
14600	16000	–	–	21	200	735.0