ClassIBS

ISTHMUS BUREAU OF SHIPPING

PART 5
EQUIPMENT

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PRINCIPLES FOR THE CLASSIFICATION AND CONSTRUCTION OF STEEL SHIPS

PART 5 EQUIPMENT

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PRINCIPLES FOR THE CLASSIFICATION AND CONSTRUCTION OF STEEL SHIPS

PART 5 EQUIPMENT

Chapter 1 GENERAL

1.1 General

1.1.1 Application

The equipment other than those prescribed in this Part may be used where specially approved in connection with the design and usage. In such cases, the detailed data relating to the process of manufacture, construction, performance, etc. of the equipment is to be submitted for approval.

1.2 Manufacture and Approval of Equipment

1.2.1 Manufacture of Equipment

1. The equipment in this Part, unless otherwise specially provided or deemed appropriate by the Society, are to be manufactured at the works approved by the Society with regard to the manufacturing process of the equipment.

2. Equipment differing from those specified in this Part is to be in accordance with the requirements of preceding **-1** as appropriate.

1.2.2 Approval of Manufacturing Process

Approval of Manufacturing Process specified in 1.2.1 is to be in accordance with the Guidance for the approval which is separately specified by the Society

1.3 Manufacturing Control of Equipment

1.3.1 Operation of manufacturing Control

1. It is the manufacturer s responsibility to assure that effective process and production controls in operation are adhered to. Where deviation from the controls occurs and/or inferior quality of products exists, especially, the manufacturer is to report these summaries to the Society s Surveyor (hereinafter referred to as the Surveyor). In this case, each affected equipment is to be tested and inspected according to the Surveyor s direction.

2. The manufacturer is to take a suitable measure for identification of equipment, which will enable the equipment to be traced to the processing details at all phases of manufacturing process.

1.3.2 Verification of Controls

1. Where the Society deems necessary or the matter specified in **1.3.1-1(1)** was reported, it is to be verified that the approved process is adhered to and the manufacturing control is effective. In this case, the manufacturer is to afford the Surveyor all necessary facilities and access to all relevant parts of the works.

2. Where deviation from the controls is discovered by the verification specified in **-1**, the Surveyor may require a report of investigation on the substantial cause and the increasing of the frequency of subsequent testing and inspection.

1.4 Testing and Inspection for Equipment

1.4.1 Execution of Testing and Inspection

1. Testing and inspection for equipment specified in this Part are to be carried out in the presence of the Surveyor at the works prior to delivery except where otherwise specially provided, and are to comply with the requirements of **Chapter 3** to **9** in this Part.

2. The testing machines used for the mechanical testing of material are to be those which have the effective certificates issued by the Society or other organization recognized by the Society in accordance with the standards deemed appropriate by the Society.

3. The Society may dispense with the tests and inspections for equipment having the appropriate certificates.

4. The Society may modify the requirement of presence of testing and inspection by the Surveyor where the quality of equipment and the quality control system of manufacturer are deemed appropriate by the Society.

1.4.2 Standard for Testing and Inspection

1. The equipment are to comply with the requirements of **Chapter 3** to **9** in this Part.

2. Equipment differing from those specified in this Part is to be tested and inspected according to the approved specifications or standards for the testing.

3. The Society may request tests under different conditions or different kind of tests specified in this Part in consideration of the intended service condition of the equipment.

1.4.3 Quality and Repair

1. All equipment are to be free from harmful defects. Repairing of defects of anchors and chains is not permitted unless the extent and method of repair (including welding procedure and heat treatment) are approved by the Surveyor, in addition to the compliance with the requirements in this Part and **Part 10**.

2. In the event of any equipment proving unsatisfactory in the process of installation, the equipment is to be rejected, notwithstanding any previous certificate of satisfactory testing and inspection.

1.4.4 Additional Tests before Rejection

Additional tests before rejection for the equipment may be carried out in accordance with the requirements in this Part and **Part 10**.

1.5 Marking and Test Certificate

1.5.1 Marking

1. Every equipment complying with the requirements is to be clearly stamped with Society s brand and marked with the particulars specified in each Chapter.

2. Equipment which are unsuitable for stamping may be marked by other suitable means.

1.5.2 Test Certificate

The Society issues certificates, which contain the following particulars, for the equipment which have passed the specified test and inspection according to the kind.

(1) Identification of manufacturer

(2) Date of testing and inspection

(3) Kind and type of equipment

(4) Particulars of equipment (weight, length, diameter, etc.)

(5) Results of test and inspection

(6) Marking particulars

(7) Others considered necessary

Chapter 2 ANCHORS, CHAIN CABLES AND ROPES

2.1 General Provisions

2.1.1 General

1. All ships, according to their equipment numbers, are to be provided with anchors, chain cables and mooring lines which are not less than that given in **Table 2.1**.

2. Anchors, chain cables and mooring lines for ships having equipment numbers not more than 50 or more than 16,000 are to be as determined by the Society.

3. Two of the anchors given in **Table 2.1** are to be connected to their cables and be positioned on board ready for use.

4. Anchors, chain cables, wire ropes and fibre ropes are to be in compliance with the requirements in **Chapter 3**, **4.1** of **Chapter 4**, **Chapters 5** and **6**, respectively.

2.1.2 Equipment Numbers

1. Equipment number is the value obtained from the following formula:

$W^{2/3} + 2.0hB + 0.1A$

Where:

W : Full load displacement (t)

h and A : Values specified in the following **(1)**, **(2)** and **(3)**

(1) h is the value obtained from the following formula:

$f + h'$

f: Vertical distance (m), at the midship, from the designed maximum load line to the top of the uppermost continuous deck beam at side

h': Height (m) from the uppermost continuous deck to the top of uppermost superstructure or deckhouse having a breadth greater than $B/4$

In the calculation of h', sheer and trim may be ignored. Where a deckhouse having a breadth greater than $B/4$ is located above a deckhouse with a breadth of $B/4$ or less, the narrow deckhouse may be ignored.

(1) A is the value obtained from the following formula:

$f L_1 + \sum h'' L$

f : Value specified in **(1)**

L_1 : Length (m) of ship specified in **1.2.2, Part 1A** or 0.97 *times* the length of ship on the designed maximum load line, whichever is smaller

$\sum h'' L$: Sum of the products of the height h'' (m) and length l (m) of superstructures, deckhouses or trunks which are located above the uppermost continuous deck within L_1 and also have a breadth greater than $B/4$ and a height greater than 1.5 m

(2) In the application of **(1)** and **(2)**, screens and bulwarks more than 1.5 m in height are to be regarded as parts of superstructures or deckhouses.

2. Notwithstanding **-1**, for tugs, the equipment number is to be obtained from the following formula:

$W^{2/3} + 2.0(fB + \sum h''b) + 0.1A$

W, *f* and *A*: As specified in **-1** above

$\sum h''b$*:* Sum of the products of the height h'' (*m*) and the breadth *b* (*m*) of each superstructure and deckhouse which have a breadth greater than *B*/4 and are located above the uppermost continuous deck

2.1.3 Anchors

1. The mass of individual anchors may vary by ±7% of the mass given in **Table 2.1**, provided that the total mass of anchors is not less than that obtained from multiplying the mass per anchor given in the table by the number installed on board. However, where approval by the Society is obtained, anchors which are increased in mass by more than 7% may be used.

Table 2.1 Anchors, Chain Cables and Ropes

Equipment letter	Equipment number		Anchor		Chain cable for anchor (stud anchor for chain)				Tow line			Mooring line			
			number	Mass per anchor (stock-less anchor)	Total length	Diameter			Length	Beaking load		number	Length of each line	Breaking load	
						Grade 1	Grade 2	Grade 3							
	Over	Up to		Kg	*m*	*mm*	*mm*	*mm*	*m*	*kN*			*m*	*kN*	
A1	50	70	2	180	220	14	12.5		180	↑	98	3	80	↑	34
A2	70	90	2	240	220	16	14		180	:	98	3	100	:	37
A3	90	110	2	300	247.5	17.5	16		180	:	98	3	110	:	39
A4	110	130	2	360	247.5	19	17.5		180	:	98	3	110	:	44
A5	130	150	2	420	275	20.5	17.5		180	:	98	3	120	:	49
B1	150	175	2	480	275	22	19		180	:	98	3	120	:	54
B2	175	205	2	570	302.5	24	20.5		180	●	112	3	120	:	59
B3	205	240	2	660	302.5	26	22	20.5	180	:	129	4	120	:	64
B4	240	280	2	780	330	28	24	22	180	:	150	4	120	:	69
B5	280	320	2	900	357.5	30	26	24	180	:	174	4	140	:	74
C1	320	360	2	1020	357.5	32	28	24	180	↓	207	4	140	●	78
C2	360	400	2	1140	385	34	30	26	180	↑	224	4	140	:	88
C3	400	450	2	1290	385	36	32	28	180	:	250	4	140	:	98
C4	450	500	2	1440	412.5	38	34	30	180	:	277	4	140	:	108
C5	500	550	2	1590	412.5	40	34	30	190	:	306	4	160	:	123
D1	550	600	2	1740	440	42	36	32	190	○	338	4	160	:	132
D2	600	660	2	1920	440	44	38	34	190	:	371	4	160	:	147
D3	660	720	2	2100	440	46	40	36	190	:	406	4	160	:	157
D4	720	780	2	2280	467.5	48	42	36	190	:	441	4	170	:	172
D5	780	840	2	2460	467.5	50	44	38	190	↓	480	4	170	:	186
E1	840	910	2	2640	467.5	52	46	40	190	↑	518	4	170	:	201
E2	910	980	2	2850	495	54	48	42	190	:	559	4	170	↓	216

E3	980	1060	2	3060	495	56	50	44	200	:	603	4	180	↑	230
E4	1060	1140	2	3300	495	58	50	46	200	:	647	4	180	:	250
E5	1140	1220	2	3540	522.5	60	52	46	200	:	691	4	180	:	270
F1	1220	1300	2	3780	522.5	62	54	48	200	:	738	4	180	:	284
F2	1300	1390	2	4050	522.5	64	56	50	200	:	786	4	180	:	309
F3	1390	1480	2	4320	550	66	58	50	200	:	836	4	180	:	324
F4	1480	1570	2	4590	550	68	60	52	220	◎	888	5	190	:	324
F5	1570	1670	2	4890	550	70	62	54	220	:	941	5	190	:	333
G1	1670	1790	2	5250	577.5	73	64	56	200	:	1024	5	190	○	353
G2	1790	1930	2	5610	577.5	76	66	58	200	:	1109	5	190	:	378
G3	1930	2080	2	6000	577.5	78	68	60	200	:	1168	5	190	:	402
G4	2080	2230	2	6450	605	81	70	62	240	:	1259	5	200	:	422
G5	2230	2380	2	6900	605	84	73	64	240	:	1356	5	200	:	451
H1	2380	2530	2	7350	605	87	76	66	240	:	1453	5	200	:	480
H2	2530	2700	2	7800	632.5	90	78	68	260	:	1471	6	200	↓	480
H3	2700	2870	2	3800	632.5	92	81	70	260	:	1471	6	200	↑	490
H4	2870	3040	2	8700	632.5	95	84	73	260	:	1471	6	200	:	500
H5	3040	3210	2	9300	660	97	84	76	280	:	1471	6	200	:	520
J1	3210	3400	2	9900	660	100	87	78	280	:	1471	6	200	:	554
J2	3400	3600	2	10500	660	102	90	78	280	:	1471	6	200	:	588
J3	3600	3800	2	11100	687.5	105	92	81	300	:	1471	6	200	:	618
J4	3800	4000	2	11700	687.5	107	95	84	300	:	1471	6	200	:	647
J5	4000	4200	2	12300	687.5	111	97	87	300	:	1471	7	200	:	647
K1	4200	4400	2	12900	715	114	100	87	300	:	1471	7	200	:	657
K2	4400	4600	2	13500	715	117	102	90	300	:	1471	7	200	:	667
K3	4600	4800	2	14100	715	120	105	92	300	:	1471	7	200	:	677
K4	4800	5000	2	14700	742.5	122	107	95	300	:	1471	7	200	◎	686
K5	5000	5200	2	15400	742.5	124	111	97	300	:	1471	8	200	:	686
L1	5200	5500	2	16100	742.5	127	111	97	300	:	1471	8	200	:	696
L2	5500	5800	2	16900	742.5	130	114	100	300	:	1471	8	200	:	706
L3	5800	6100	2	17800	742.5	132	117	102	300	↓	1471	9	200	:	706
L4	6100	6500	2	18800	742.5		120	107				9	200	:	716
L5	6500	6900	2	20000	770		124	111				9	200	:	726
M1	6900	7400	2	21500	770		127	114				10	200	:	726
M2	7400	7900	2	32000	770		132	117				11	200	:	726
M3	7900	8400	2	24500	770		137	122				11	200	:	735
M4	8400	8900	2	26000	770		142	127				12	200	:	735
M5	8900	9400	2	27500	770		147	132				13	200	:	735
N1	9400	10000	2	29000	770		152	132				14	200	:	735
N2	10000	10700	2	31000	770			137				15	200	:	735
N3	10700	11500	2	33000	770			142				16	200	:	735
N4	11500	12400	2	35500	770			147				17	200	:	735
N5	12400	13400	2	38500	770			152				18	200	:	735
O1	13400	14600	2	42000	770			157				19	200	:	735
O1	14600	16000	2	46000	770			162				21	200	:	735

Notes:

1 Where steel wire ropes are used, the following wire ropes corresponding to the marks shown in the Table are to be provided: ● (6 x 12), O (6 x 24), and ◎ (6 x 37).

2 Length of chain cables may include shackles for connection.

3 Where stocked anchors are used, the mass, excluding the stock, is not to be less than 0.80 times the mass shown in the table for ordinary stockless anchors.

4 Where high holding power anchors are used, the mass of each anchor may be 0.75 times the mass shown in the table for ordinary stockless anchors.

5 Where super high holding power anchors are used, the mass of each anchor may be 0.5 times the mass required for ordinary stockless anchors. However, super high holding power anchor mass is not to exceed 1,500*kg*.

2.1.4 Chain Cables

Chain cables for anchors are to be stud link chains of Grade 1, 2 or 3, specified in **4.1** of **Chapter 4**,.However, Grade 1 chains made of Class 1 chain bars (*KSBC*31) are not to be used in association with high holding power anchors.

2.1.5 Mooring Lines

1. As for wire ropes and hemp ropes used as mooring lines, the breaking test load specified in **Chapter 5** or **6** is not to be less than the breaking load given in **Table 2.1** respectively.

2. For ships having the ratio *A*/*EN* above 0.9, the following number of ropes should be added to the number required by **Table 2.1** for mooring lines.

Where *A /EN* is above 0.9 up to 1.1: 1

Where *A /EN* is above 1.1 up to 1.2: 2

Where *A /EN* is above 1.2: 3

EN: Equipment number.

A: Value specified in **2.1.2(2).**

3. For individual mooring lines with a required breaking load above 490 *kN* according to **Table 2.1**, the required strength may be reduced by the corresponding increase of the number of mooring lines and *vice versa*, provided that the total breaking load of all mooring lines aboard the ship is not less than the value obtained from multiplying the required breaking load in **Table 2.1** by the sum of the numbers required in **Table 2.1** and **-2**, irrespective of the requirements in **-1**. However, the number of mooring lines is not to be less than 6 lines in any case, and one of the lines is not to have a breaking load of less than 490 *kN*.

4. Application of synthetic fibre ropes for mooring lines is to be as deemed appropriate by the Society.

5. For mooring lines connected with powered winches where the rope is stored on the drum, steel cored wire ropes of suitable flexible construction may be used instead of fibre cored wire ropes subject to the approval by the Society.

6. The length of individual mooring lines may be reduced by up to 7% of the lengths given in **Table 2.1**, provided that the total length of the stipulated number of mooring lines is not less than that obtained from multiplying the length by the number given in **Table 2.1**.

2.1.6 Tow Lines

Where ships are provided with tow lines, it is advised that tow lines are in accordance with the following:

(1) The length of tow lines is not less than that given in **Table 2.1** according to ships equipment numbers.

(2) As for wire ropes and hemp ropes used as tow lines, the breaking test load specified in **Chapter 5** or **6**, is not to be less than the breaking load given in **Table 2.1** according to the ships equipment numbers. The application of synthetic fibre ropes for tow lines is as deemed appropriate by the Society.

(3) Wire ropes, hemp ropes or synthetic fibre ropes used as tow lines are to be in compliance with the requirements in **Chapter 5** or **6**, respectively.

2.1.7 Chain Lockers

1. Chain lockers including spurling pipes are to be watertight up to the weather deck and to be provided with a means for drainage.

2. Chain lockers are to be subdivided by centre line screen walls.

3. Where a means of access is provided, it is to be closed by a substantial cover and secured by closely spaced bolts.

4. Spurling pipes through which anchor cables are led are to be provided with permanently attached closing appliances to minimize water ingress.

2.1.8 Miscellaneous

1. All ships are to be provided with suitable appliances for handling anchors.

2. The inboard end of the chain cable is to be secured to the hull through a strong eye plate by means of a shackle or other equivalent means.

2.2 Towing and Mooring Fittings

2.2.1 General

1. The requirements in **2.2** apply to shipboard fittings used for normal towing (hereinafter referred to as towing fittings) and normal mooring (hereinafter referred to as mooring fittings), and their supporting hull structures (hereinafter referred to as supporting structures).

2. Ships are to be adequately provided with towing and mooring fittings.

3. The scantlings of supporting structures are to be built at least with the gross scantlings obtained by adding the corrosion addition specified in **2.2.2.-5** and **2.2.3.-5** to the net scantlings obtained by applying the criteria specified in this section.

4. The scantlings of supporting structures are to be in accordance with the relevant chapters or sections in addition to this section.

2.2.2 Towing Fittings

1. Arrangement of Towing Fittings

(1) Towing fittings are to be located on longitudinals, beams or girders, which are parts of the deck construction so as to facilitate efficient distribution of the towing load.

(2) When towing fittings cannot be located as specified in **(1)**, towing fittings are to be arranged on reinforced members.

2. Design Load

Design load for towing fittings and their supporting structures (hereinafter referred to as design load on fittings (see **Fig. 2.1)** in this paragraph) are to be as specified in **(1)** to **(6)** below:

(1) For normal towing operations (e.g. harbour/manoeuvring), the design load on the line (see **Fig. 2.1**) is to be 1.25 times the intended maximum towing load.

(2) For other types of towing (e.g. escort), the design load on the line (see **Fig. 2.1**) is to be the breaking strength of the towing line specified in **Table 2.1** according to the equipment number determined in **2.1.2**.

(3) The design load on fittings is to take into account all acting loads.

(4) The point where the towing force acts on towing fittings is to be taken as the attachment point of the towing line.

(5) The design load on fittings is to take into account the total design load on the line specified in **(1)** and **(2)** (see **Fig.2.1**), but need not exceed twice the design load on the line.

(6) If the design load on fittings specified in **(2)** to **(5)** is less than the intended towing load stipulated in the construction specifications for the towing fittings and their supporting structures used for towing operations specified in **(2)**, the design load on fittings is to be not less than the intended towing load.

3. Selection of Towing Fittings Towing fittings are generally to be specified according to standards approved by the Society.

4. Allowable Stresses of Supporting Structures

Allowable stresses of supporting structures are not to be more than below:

(1) Normal stress: 100% of the specified yield point for the material used

(2) Shearing stress: 60% of the specified yield point for the material used

5. Corrosion Addition of Supporting Structures

The corrosion addition of supporting structures is not to be less than the following values:

(1) For bulk carriers specified in **2.1.4, Part 1A**, the corrosion addition specified in **CSR-B**.

(2) For double hull oil tankers specified in **2.1.5, Part 1A**, the corrosion addition specified in **CSR-T**.

(3) For other ships, the value will be considered by the Society, but is not to be less than 2*mm*

6. Safe Working Load (*SWL*)

(1) For towing fittings and their supporting structures used for towing operations specified in **-2(1)**, the *SWL* is not to exceed 80% of the design load on fittings specified in **-2(1)**, **(3)**, **(4)**, and **(5)**.

(2) For towing fittings and their supporting structures used for towing operations specified in **-2(2)**, the *SWL* is not to exceed the design load on fittings specified in **-2(2)** to **(6)**.

(3) For towing fittings and their supporting structures used for towing operations specified in both **-2(1)** and **-2(2)**, the *SWL* is not to exceed the greater of the design loads.

(4) The *SWL* of each fitting is to be marked by weld beads or equivalent on the fitting.

2.2.3 Mooring Fittings

1. Arrangement of Mooring Fittings

(1) Mooring fittings are to be located on longitudinals, beams or girders, which are parts of the deck construction so as to facilitate efficient distribution of the mooring load.

(2) When mooring fittings cannot be located as specified in **(1)**, the mooring fittings are to be arranged on reinforced members.

2. Design Load

Design load for mooring fittings and their supporting structures (hereinafter referred to as design load on fittings (see **Fig. 2.1**) in this paragraph) are to be as specified in **(1)** to **(7)** below:

(1) The design load on the line (see **Fig. 2.1**) is to be 1.25 times the breaking strength of the mooring line specified in **Table 2.1** according to the equipment number determined in **2.1.2.**

(2) The design load on fittings is to take into account all acting loads.

(3) The point where the mooring force acts on mooring fittings is to be taken as the attachment point of the mooring line.

(4) The design load on fittings is to take into account the total design load on the line specified in **(1)** (see **Fig. 2.1**), but need not exceed twice the design load on the line.

(5) If the design load on fittings specified in **(1)** to **(4)** is less than 1.25 times the intended mooring load stipulated in the construction specifications for the mooring fittings and their supporting structures used for mooring operations specified in **(1)**, the design load on the fittings is to be at least 1.25 times the intended mooring load.

(6) The design load applied to supporting hull structures for mooring winches is to be 1.25 times the intended maximum brake holding load.

(7) The design load applied to supporting hull structures for capstans is to be 1.25 times the intended maximum hauling-in force.

3. Selection of Mooring Fittings

Mooring fittings are generally to be specified according to standards approved by the Society.

4. Allowable Stresses of Supporting Structures

Allowable stresses of supporting structure are not to be more than below:

(1) Normal stress : 100% of the specified yield point for the material used

(2) Shearing stress: 60% of the specified yield point for the material used

5. Corrosion Addition of Supporting Structures

The corrosion addition of supporting structures is not to be less than the following values:

(1) For bulk carriers specified in **2.1.4, Part 1A,** the corrosion addition specified in **CSR-B**.

(2) For double hull oil tankers specified in **2.1.5, Part 1A**, the corrosion addition specified in **CSR-T**.

(3) For other ships, the value will be considered by the Society, but is not to be less than 2*mm*

6. Safe Working Load (*SWL*)

(1) The *SWL* is not to exceed 80% of the design load on fittings specified in **-2(1) to (5)** or the design load specified in **-2(6)** or **(7)**.

(2) The *SWL* of each fitting, excluding mooring winches and capstan, is to be marked by weld beads or equivalent on the fitting.

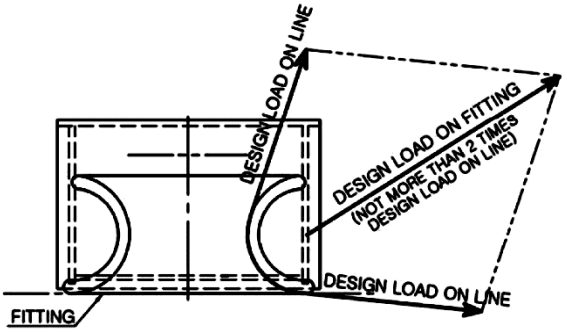
2.2.4 Towing and Mooring Fitting Arrangement Plan

Ships are to have a Towing and Mooring Fitting Arrangement Plan which includes the notes below:

(1) Approved standard and referenced No. of towing and mooring fittings

(2) For each towing and mooring fitting, location on the ship, purpose(mooring, harbour towing, escort towing etc.), *SWL* and manner of applying towing or mooring line load including limiting fleet angles

Fig. 2.1 Design Load



2.3 Emergency Towing Arrangements

2.3.1 Application

The requirements in **2.3** apply to tankers, ships carrying liquefied gases in bulk and ships carrying dangerous chemicals in bulk of not less than 20,000 deadweight tonnage(*DWT*) (hereinafter referred to as “ships”).

2.3.2 General

1. Emergency towing arrangements approved by the Society are classified into two types: the 1,000 *kN* type and the 2,000 *kN* type.

2. Emergency towing arrangements are to be capable of rapid deployment and easy connection to a towing vessel at all times even in the absence of main power on the ship.

3. An appropriate type of emergency towing arrangement selected from below, corresponding to the *DWT* of the ship is to be fitted at both ends on board the ship.

(1) 20,000 *tons* ≤ *DWT* < 50,000 *tons*: 1,000 *kN* type emergency towing arrangement

(2) 50,000 *tons* ≤ *DWT* : 2,000 *kN* type emergency towing arrangement

4. At least one of the emergency towing arrangements specified in **-3**, is to be pre-rigged ready for rapid deployment.

2.4 Emergency Towing procedures

2.4.1 General

1. Ships are to be provide with an emergency towing procedure that describes the towing procedure to be used in emergency situations.

2. The procedure specified in **-1** above is to be based on existing arrangements and equipment available on board the ship and is to include following:

(1) drawings of fore and aft showing possible emergency towing arrangements;

(2) Inventory of equipment on board that can be used for emergency towing;

(3) means and methods of communication; and

(4) sample procedures to facilitate the preparation for and conducting of emergency towing operations.

Chapter 3 ANCHORS

3.1 Anchors

3.1.1 Application

Anchors to be equipped on ships in accordance with the provisions in **Chapter 2** are to be in compliance with the requirements in this Chapter or to be of equivalent quality.

3.1.2 Kinds

1. The kinds of anchor are as follows :

Stocked anchor

Stockless anchor

2. Anchor is classified by holding power coefficient (the value divided holding power into anchor mass). No fewer than 6, less than 12 holding power coefficient is to be treated as high holding power anchor, more than 12 holding power coefficient is to be treated as super high holding power anchor.

3.1.3 Materials

1. Materials for anchor are to be cast steels, forged steels or rolled steels specified in **Part 10**. Cast steels, however, are not to be used for the head pins.

2. Cast steels for super high holding power anchor are to be subjected to the impact test and one set of three V-notch impact test specimens specified in **Chapter 2, Part 10** are to be taken from the test assembly cast integral with the body of casting. The minimum mean absorbed energy is not to be less than 27*J* at °C. In this case, where the absorbed energy of two or more test specimens among a set of test specimens is less than 27*J* or when the absorbed energy of a single test specimen is less than 19J, the test is to be considered to have failed.

3. Anchor rings of super high holding power anchor are to comply with the requirements of impact test for Grade 3 chain in **Chapter 4**.

3.1.4 Processes of Manufacture and Constructions

1. Anchors are to be of such construction and form as to meet the mooring purpose. The manufacturers are to obtain approval by the Society in advance concerning the processes of manufacture, constructions, form and dimensions. The manufactures are not to change the plan without the Society s approval.

2. Anchors are to be built up properly in accordance with approved plan, etc. by the Society.

3. Anchors for which approval is sought as High Holding Power anchors and Super High Holding Power anchors are to be subjected to the holding power test at sea which the Society considers appropriate in addition to the requirements given in **-1**.

4. The welding for rolled steel fabricated anchors is generally to be in accordance with the requirements in **Part 11**.

5. Where anchor pins, etc. are welded, the manufacturers are to obtain approval by the Society in advance concerning their weld methods.

3.1.5 Heat Treatment

1. Components for cast or forged anchors are to properly heat treated in accordance with the requirements in **Part 10**.

2. The welding for rolled steel fabricated anchors may require stress relief after welding depending upon weld thickness. The manufacturers are to obtain approval by the Society in advance concerning stress relief after weld. Stress relief temperatures are not to exceed the tempering temperature of the base material.

3.1.6 Quality and Repair of Defects

1. Anchors are to be free from cracks, notches, inclusions and other defects impairing the performance of the products.

2. Any necessary repairs to forged and cast anchors are carried out in accordance with the requirements in **Part 10, 5.1.11 and 6.1.11**.

3. Any necessary repairs to the welding for rolled steel fabricated anchors are to be carried out in accordance with the requirements in **Part 11, 1.4.2**.

3.1.7 Dimensions and Forms

1. Anchors are to be built up properly in accordance with approved dimensions and forms by the Society.

2. Length of the arm is as follows:

(1) Length of the arm is the distance from the centre of the pin in case of anchors having the head pin and from the top of the crown in case of anchors of other types to the tip of the flukes. (See **Fig. 3.1**)

(2) Where the crown is of concave form, the intersection of the centre line of the shank with the plane in contact with the tops of the arms is considered as the top of the crown.

3. Assembly and fitting of anchors are as follows unless specially approved by the Society.

(1) The clearance either side of the shank within the shackle jaws is to be given in **Table 3.1**, in accordance with the anchor mass.

(2) 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 given in **Table 3.2** in accordance with diameter of the shackle pins.

(3) 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.

(4) The lateral movement of the shank is not to exceed 3 degrees. (see **Figure 3.2**)

4. The dimensional inspections of anchors are to be performed by the manufacture. The manufacture is to show the data of measurement to the Surveyor.

Fig. 3.1

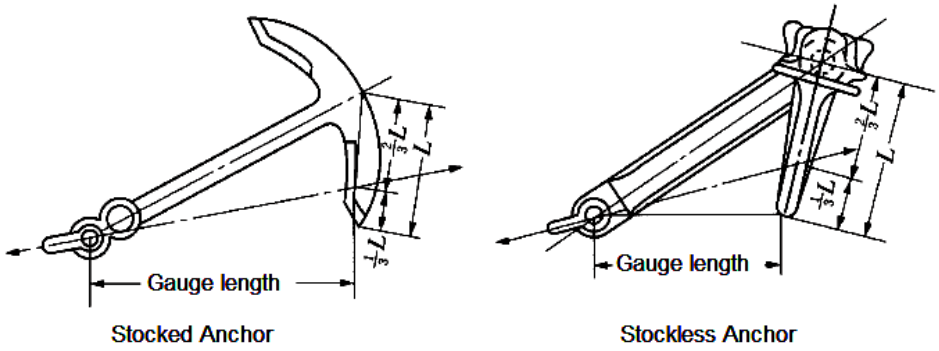


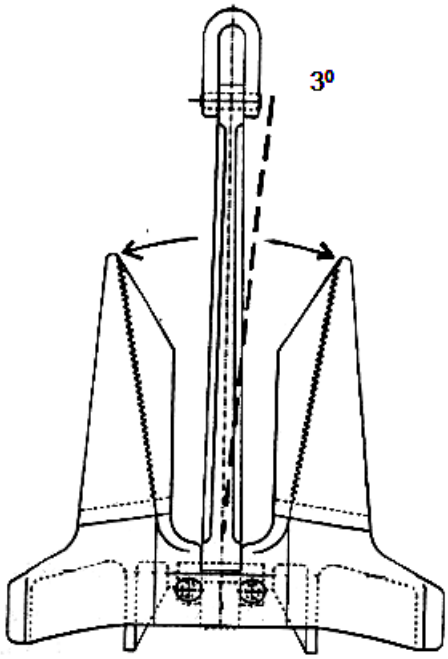
Table 3.1 The clearance either side of the shank within the shackle jaws

Anchor mass (*t*)	Negative Tolerances (*mm*)
up to 3	3
over 3 up to 5	4
over 5 up to 7	6
over 7	12

Table 3.2 The shackle pin to hole tolerance

The diameter of shackle pin (*mm*)	Negative hole tolerance (*mm*)
up to 57	0.5
over 57	1

Fig. 3.2 Allowable range of the lateral movement of the shank



3.1.8 Mass

1. The mass of the stock of a stocked anchor is not to be less than one-fourth of the mass of anchor excluding stock.

2. The mass of stockless anchor excluding shank is not to be less than three-fifths of the total mass of anchor.

3. The mass of the anchor is to exclude the mass of the swivel, unless this is an integral component.

4. The mass inspections of anchors are to be performed by the manufacture before executing proof test. The manufacture is to show the data of measurement to the Surveyor.

5. In case of stocked anchors, the mass of the anchor excluding stock and the mass of the stock are to be measured separately. In case of stockless anchors the total mass of anchor and the mass of shank are to be measured.

3.1.9 Drop and Hammering Tests

Cast steel anchors are to be subjected to the following tests prior to the execution of the tests specified in 3.1.10 and are to comply with the test requirements:

1. Drop tests

(1) Each piece of the cast steel anchor is to be lifted to 4 *metres* in height and dropped on a steel slab on the hard ground without any crack or other defects.

(2) Where shank and arms are cast in one piece in stocked anchors, the anchor is first to be lifted to the specified height with its shank and arms in a horizontal position and then dropped on the steel slab, and to be lifted once more to the specified height with the crown downwards and dropped on two steel

blocks on the slab arranged to enable the anchor to give shock at the middle of each arm without making the crown touch the slab, and are to be found free from cracks, deformation or other defects.

(3) Where the slab is broken by the impact, the anchor is to be retested with a new slab.

2. Hammering tests

3. After the drop test specified in **-1**, the anchor is to be slung clear of the ground and thoroughly hammered with a hammer which the mass is 3 kg and over, and is to be found free from cracks or other defects.

4. For fracture and unsoundness detected in a drop test or hammering test, repairs are not permitted and the component is to be rejected.

5. Where additional non-destructive test and mechanical test comply with the approval by the Society in additional of requirements in **3.1.11-2.** and **-3**, drop and hammering tests may be omitted subject to the approval by the Society.

3.1.10 Proof Tests

1. Anchors are to be tested in accordance with the requirements in **Table 3.3**, applying the required load corresponding to the mass of anchor (excluding the mass of stock for stocked anchor) at the position of one-third of the length of the arm from the tip of the fluke, for every arm or for both arms simultaneously or for each position in case of the anchor having the head pin, and to be found free from cracks, deformation or other defects. In every test, the difference between the gauge lengths, where one-tenth of the required load was applied first and where the load has been released to one-tenth of the required load from the full load, may be permitted up to 1% of the gauge length before proof test. (See **Fig. 3.1**)

2. The proof test load for high holding power anchors is to be the load specified for an ordinary anchor of which mass is equal to 4/3 times the actual total mass of high holding power anchor.

3. The proof test load for super high holding power anchors is to be the load specified for an ordinary anchor of which the mass is 2 times the actual mass of super high holding power anchor.

3.1.11 Non-destructive Test

1. After the proof load test, surface inspection for anchors is to be carried out.

2. After the proof load test, components for cast anchors are to be examined by the dye penetrant testing or the magnetic particle testing, in way of areas where feeder heads and risers have been removed and where weld repairs have been carried out, in addition to surface inspection specified above **-1**.

3. After the proof load test, components for cast super high holding power anchors are to be examined by the ultrasonic testing in way of areas where feeder heads and risers, the dye penetrant testing or the magnetic particle testing at all surfaces in addition to inspection specified above **-1**.and **-2**.

4. After the proof load test, the rolled steel fabricated anchors are to be examined by the dye penetrant testing or the magnetic particle testing at weld, in addition to inspection specified above **-1**.

5. If defects are detected by non-destructive test, repairs are to be carried out in accordance with **3.1.6-2.** and **-3**.

3.1.12 Marking

1. Where anchors have satisfactorily passed the tests and inspections, they are to be stamped with the mass of anchor (excluding the mass of stock for stocked anchor) at the middle position of the shank and the Society s brand, the test number and manufacturer s mark at the position two-thirds of the length of arm from the tip of the fluke on the same side. Where the anchor is formed with separate shank and arms, the Society s brand, the test number and manufacturer s mark are also to be stamped on the shank in the neighbourhood of the head pin, and in case of stocked anchor, the mass of stock, the Society's brand and the test number are also to be stamped on the stock.

2. In case of high holding power anchors, "*H*" is to be stamped in front of the Society s brand in addition to the stamps specified in **-1**.

3. In case of super high holding power anchors, "*SH*" is to be stamped before the Society s brand in addition to the stamps specified in **-1**.

3.1.13 Painting

Anchors are not to be painted until the tests and inspections are finished.

Table 3.3 Proof Test Load for Anchors

Mass of anchor (*kg*)	Proof test load (*kN*)	Mass of anchor (*kg*)	Proof test load (*kN*)	Mass of anchor (*kg*)	Proof test load (*kN*)	Mass of anchor (*kg*)	Proof test load (*kN*)
25	12.6	1.000	199	4.500	622	10.000	1.010
30	14.5	1.050	208	4.600	631	10.500	1.040
35	16.9	1.100	216	4.700	638	11.000	1.070
40	19.1	1.150	224	4.800	645	11.500	1.090
45	21.2	1.200	231	4.900	653	12.000	1.110
50	23.2	1.250	239	5.000	661	12.500	1.130
55	25.2	1.300	247	5.100	669	13.000	1.160
60	27.1	1.350	255	5.200	677	13.500	1.180
65	28.9	1.400	262	5.300	685	14.000	1.210
70	30.7	1.450	270	5.400	691	14.500	1.230
75	32.4	1.500	278	5.500	699	15.000	1.260
80	33.9	1.600	292	5.600	706	15.500	1.270
90	36.3	1.700	307	5.700	713	16.000	1.300
100	39.1	1.800	321	5.800	721	16.500	1.330
120	44.3	1.900	335	5.900	728	17.000	1.360
140	49.0	2.000	349	6.000	735	17.500	1.390
160	53.3	2.100	362	6.100	740	18.000	1.410
180	57.4	2.200	376	6.200	747	18.500	1.440
200	61.3	2.300	388	6.300	754	19.000	1.470
225	65.8	2.400	401	6.400	760	19.500	1.490
250	70.4	2.500	414	6.500	767	20.000	1.520
275	74.9	2.600	427	6.600	73	21.000	1.570
300	79.5	2.700	438	6.700	779	22.000	1.620
325	84.1	2.800	450	6.800	786	23.000	1.670
350	88.8	2.900	462	6.900	794	24.000	1.720
375	93.4	3.000	474	7.000	804	25.000	1.770
400	97.9	3.100	484	7.200	818	26.000	1.800
425	103	3.200	495	7.400	832	27.000	1.850
450	107	3.300	506	7.600	845	28.000	1.900
475	112	3.400	517	7.800	861	29.000	1.940
500	116	3.500	528	8.000	877	30.000	1.990
550	124	3.600	537	8.200	892	31.000	2.030
600	132	3.700	547	8.400	908	32.000	2.070
650	140	3.800	557	8.600	922	34.000	2.160
700	149	3.900	567	8.800	936	36.000	2.250
750	158	4.000	577	9.000	949	38.000	2.330
800	166	4.100	586	9.200	961	40.000	2.410
850	175	4.200	595	9.400	975	42.000	2.490
900	182	4.300	604	9.600	987	44.000	2.570
950	191	4.400	613	9.800	998	46.000	2.650

Note: Where mass of anchor is intermediate in this Table, proof test load is to be determined by linear interpolation

Chapter 4 CHAINS

4.1 Chains

4.1.1 Application

Anchor chains to be equipped on ships, steering chains (hereinafter referred to as chain), shackles and swivels (hereinafter referred to as accessories) are to comply with the requirements in **4.1** or to be of equivalent quality.

4.1.2 Kinds of Chains

The kinds of chains are as follows:

(1) Studless chain

(2) Stud link chain

(a) Grade 1 chain

(b) Grade 2 chain

(c) Grade 3 chain

4.1.3 Materials

1. Chains are to be made of the materials given in **Table 4.1** according to their grades and manufacturing processes, respectively.

2. Notwithstanding **-1**, the rolled steel round bars may be used for chain round bars, provided they satisfactorily comply with the Society and comply with the requirements **3.6.4, Part 10**.

3. The studs are to be made of steel whose the carbon content is in general less than 0.25% if the studs are welded in place; however, the studs may be made of steel bars corresponding to that of the chain or of an equivalent thereto considered by the Society.

4. Accessories are to be made of the materials given in **Table 4.2** according to the grades and manufacturing processes of the connected chain, respectively.

Table 4.1 Materials for Chain Links

kind	Manufacturing Process		
	Pressure butt welded	Flash butt welded	Cast
Studless chain	Grade 1 chain bar (*KSBC*31)	Grade 1 chain bar (*KSBC*31)	—
Grade 1 chain	—	Grade 1 chain bar (*KSBC*31)	—
Grade 2 chain	—	Grade 2 chain bar (*KSBC*50)	Grade 2 cast steel for chain (*KSCC*50)
Grade 3 chain	—	Grade 3 chain bar (*KSBC*70)	Grade 3 cast steel for chain (*KSCC*70)

Note:

Materials for Grade 2 chains may be used for Grade 1 chain

Table 4.2 Materials for Accessories

kind of connected chain	Manufacturing Process	
	Casting	Forging
Studless chain Grade 1 chain Grade 2 chain	Grade 2 steel casting for chain (*KSCC*50)	Grade 2 steel forging for chain (*KSFC*50)
Grade 3 chain	Grade 3 steel casting for chain (*KSCC*70)	Grade 3 steel forging for chain (*KSFC*70)

Note: Materials for Grade 3 chains may be used for accessories for Grade 2 chains.

4.1.4 Processes of Manufacture

1. Chains are to be made by pressure butt welding, flash butt welding or casting. Their manufacturers are to obtain approval by the Society in advance concerning their manufacturing methods.

2. Studless short link chains more than 26 *mm* in diameter and stud link chains are not to be made by pressure butt welding.

3. Inserted studs are to be pressed completely to the centre position of the link and at right angles to the sides of the link.

4. Accessories are to be made by casting or forging. Their manufacturers are to obtain approval by the Society in advance concerning their manufacturing methods.

4.1.5 Heat Treatment

1. The heat treatment of chains and accessories is to comply with the requirements given in **Table 4.3**.

2. Notwithstanding **-1**, Grade 2 flash butt welded chains subjected to sufficient preheating may not be required heat treatment on the approval by the Society.

Table 4.3 Heat Treatment of chains and accessories

kind of chain	Heat treatment	
	Chains	Accessories
Studless chain Grade 1 chain	As welded or Normalized	—
Grade 2 chain	Normalized, in principle	Normalized(1)
Grade 3 chain	Normalized, Normalized and tempered, Quenched and tempered	Normalized, Normalized and tempered, Queched and tempered

Note:

1 Heat treatment may be normalized and tempered or quenched and tempered subject to the approval by the Society.

4.1.6 Quality and Repair of Defects

1. Chains and accessories are to be free from cracks, notches, inclusions and other defects impairing the performance of the products.

2. Minor surface defects other than preceding **-1**, can be partly removed by grinder. In this case the grinding is so as to leave gentle transition to the surrounding surface and, in principle, local grinding up to 5% of the nominal link diameter may be permitted.

4.1.7 Dimensions and Forms

1. The standard dimensions and forms of each kind of link and accessory are to be as given in **Fig. 4.1**.

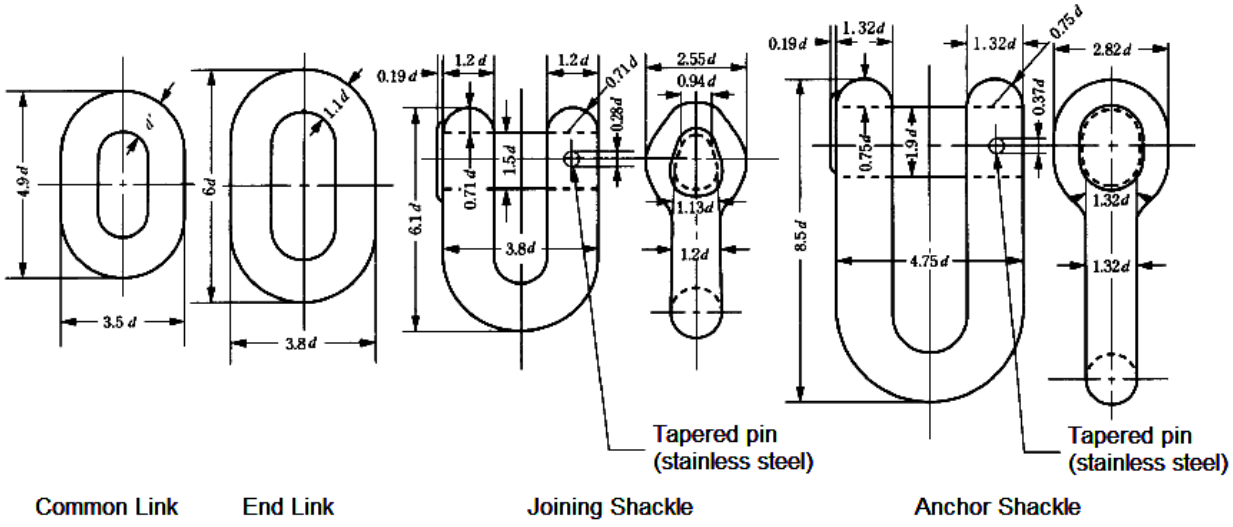
2. The nominal diameter of chains is to be denoted by the diameter of the common link.

3. One length of chain is the distance from the outer end of the internal bent portion of the link at one end of the chain to that at the other end of the chain. The standard length of anchor chain is 27.5 *metres*.

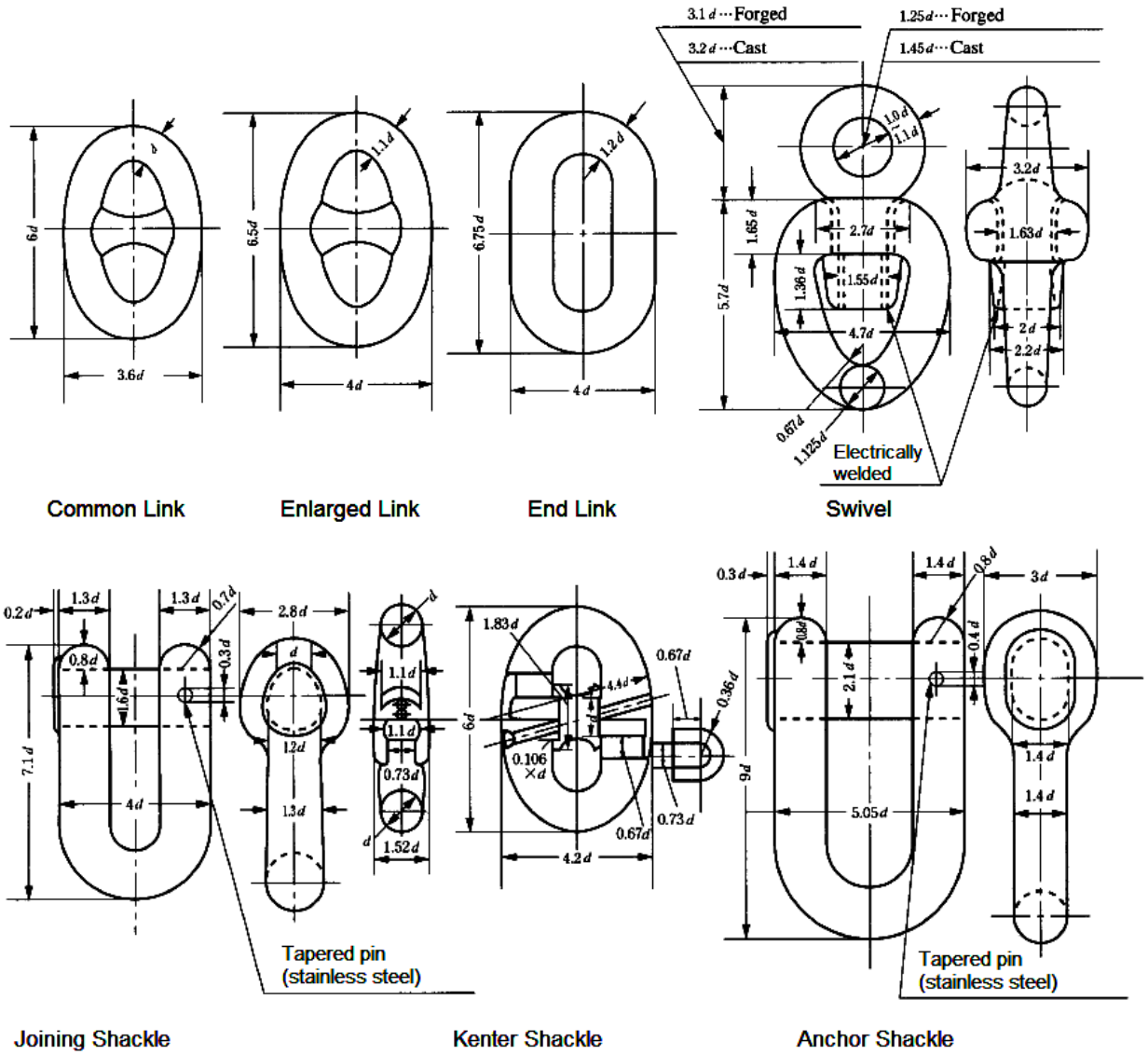
4. There is to be an odd number of links in each length of anchor chains, except where swivels are fitted.

5. Links of every kind and accessories are to be of uniform shape and their bent portions are to be sufficient to allow each link to work smoothly.

Fig 4.1 Dimensions and Forms of Chain Link, Shackle and Swivel



(1) Studless Short Link Chain and Shackle



(2) Stud Link Chain and Shackle

4.1.8 Dimensional Tolerances

The tolerances for chains and accessories are to comply with the following requirements and the dimensions there of are to be measured after the execution of a proof test.

(1) Chains

(a) The negative tolerance at the crown part of each kind of link is to comply with the requirements in accordance with its nominal diameter as given in **Table 4.4**, and the plus tolerance may be up to 5 % of its nominal diameter. However, no negative tolerance of the cross sectional area of the crown part of the link is permitted.

(b) The tolerances other than the crown part of each kind of link are to be up to +5%, but is not to be negative.

(c) Notwithstanding to the requirements in **(a)** and **(b)** above, no negative tolerance of the diameter at welded part is permitted. The positive tolerances thereof are left to the discretion of the Society.

(d) The tolerance for a length of 5 links is to be up to 2.5%, but is not to be negative.

(e) The tolerances except for the requirements specified in **(a)** to **(d)** above are to be ±2.5%.

(2) Accessories

(a) The tolerances of the diameter of accessories are to be up to +5% of their nominal diameters, but are not to be negative.

(b) The tolerances other than diameter of accessories are to be ±2.5%.

Table 4.4 Negative Tolerances of Diameters

Nominal Diameter (*mm)*	Negative Tolerances (*mm*)
up to 40	1
over 40 up to 84	2
over 84 up to 122	3
over 122	4

4.1.9 Mass

The mass of chains is to comply with the standard mass given in **Table 4.5**, in accordance with their kind, and to be measured after the execution of proof tests.

4.1.10 Breaking Tests of Chains

1. The breaking tests are to be carried out for test specimens consisting of at least three links taken from the chains at random. The test is to be carried out after the chains were heat treated where necessary.

2. One specimen is to be taken from each four length in the presence of a surveyor. Where however, one length of chain is short and total length of two lengths of chain is less than 27.5 *metres*, such two lengths may be regarded as one length.

3. The test specimens are to withstand satisfactorily the breaking test loads specified in **Table 4.5** according to their grades. The breaking load is to be maintained for a minimum of 30 *seconds*.

4. Where the capacity of the testing machine does not reach the breaking test loads specified in **Table 4.5**, the breaking test may be substituted by a method approved by the Society.

5. Where the test is not satisfactory, the chain may be retested by taking out another set of test specimens from the same length of chain, and where the test specimens comply with the requirements, the remaining three lengths of chain may be accepted. Where the retest fails, the length of chain from which the test specimen have been taken is rejected, and the remaining three chains are to be subjected to the breaking tests individually. If one of such test fails to meet the requirements, all the remaining three lengths of the chain are rejected.

6. Where the missing chain links due to the preparation of the retest of **-5** above are replaced by new chain links, the test specimens manufactured by the same procedure are to be subjected to the breaking test, and are to comply with the requirements.

Table 4.5 Breaking and Proof Test Loads for Chains

Nominal diameter d(*mm*)	Stud link chain							Studless chain		
	Grade 1 chain		Grade 2 chain		Grade 3 chain		Mass of chain per metre (kg)			
	Breaking test load *(kN)*	Proof test load (*kN*)	Breaking test load *(kN)*	Proof test load (*kN*)	Breaking test load *(kN)*	Proof test load (*kN*)		Breaking test load (kN)	Proof test load (kN)	Mass of chain per metre (kg)
12.5	66	46	92	66	132	92	3.422	58	29	3.40
14	82	58	116	82	165	116	4.292	72	36	4.26
16	107	76	150	107	216	150	5.606	95	47	5.56
17.5	127	89	179	127	256	179	6.707	113	57	6.66
19	150	105	211	150	301	211	7.906	133	67	7.84
20.5	175	123	244	175	349	244	9.203	155	78	9.14
22	200	140	280	200	401	280	10.60	178	89	10.52
24	237	167	332	237	476	332	12.61	213	107	12.52
26	278	194	389	278	556	389	14.80	250	125	14.72
28	321	225	449	321	642	449	17.17	290	145	17.08
30	368	257	514	368	735	514	19.71	332	174	19.60
32	417	291	583	417	833	583	22.43	379	189	22.28
34	468	328	655	468	937	655	25.32	428	214	25.16
36	523	366	732	553	1.050	732	28.38	480	239	28.20
38	581	406	812	581	1.160	812	31.62	533	267	31.44
40	640	448	896	640	1.280	896	35.04	591	296	34.80
42	703	492	981	703	1.400	981	38.63	652	327	38.40
44	769	538	1.080	769	1.540	1.080	42.40	716	358	42.00
46	837	585	1.170	837	1.680	1.170	46.34	783	391	46.00
48	908	635	1.270	908	1.810	1.270	50.46	852	426	50.00
50	981	686	1.370	981	1.960	1.370	54.71	925	462	54.40
52	1.060	739	1.480	1.060	2.110	1.480	59.22			
54	1.140	794	1.590	1.140	2.270	1.590	63.86			
56	1.220	851	1.710	1.220	2.430	1.710	68.68			
58	1.290	909	1.810	1.290	2.600	1.810	73.67			
60	1.380	969	1.940	1.380	2.770	1.940	78.84			
62	1.470	1.030	2.060	1.470	2.940	2.060	84.18			
64	1.560	1.100	2.190	1.560	3.130	2.190	89.70			
66	1.660	1.160	2.310	1.660	3.300	2.310	95.40			
68	1.750	1.230	2.450	1.750	3.500	2.450	101.3			
70	1.840	1.290	2.580	1.840	3.690	2.580	107.3			
73	1.990	1.390	2.790	1.990	3.990	2.790	116.7			

76	2.150	1.500	3.010	2.150	4.300	3.010	126.5			
78	2.260	1.580	3.160	2.260	4.500	3.160	133.2			
81	2.410	1.690	3.380	1.410	4.820	3.380	143.7			
84	2.580	1.800	3.610	2.580	5.160	3.610	154.5			
87	2.750	1.920	3.850	2.750	5.500	3.850	165.8			
90	2.920	2.050	4.090	2.920	5.800	4.090	177.4			
92	3.040	2.130	4.260	3.040	6.080	4.260	185.4			
95	3.230	2.260	4.510	3.230	6.440	4.510	197.6			
97	3.340	2.340	4.680	3.340	6.690	4.680	206.1			
98	3.400	2.380	4.770	3.400	6.820	4.770	210.3			
100	3.530	2.470	4.940	3.530	7.060	4.940	219.0			
102	3.660	2.560	5.120	3.660	7.320	5.120	227.8			
105	3.850	2.700	5.390	3.850	7.700	5.390	241.4			
107	3.980	2.790	5.570	3.980	7.960	5.570	250.7			
108	4.040	2.830	5.660	4.050	8.090	5.660	255.4			
111	4.250	2.970	5.940	4.250	8.480	5.940	269.8			
114	4.440	3.110	6.230	4.440	8.890	6.230	284.6			
117	4.650	3.260	6.510	4.650	9.300	6.510	299.8			
120	4.850	3.400	6.810	4.850	9.720	6.810	315.4			
122	5.000	3.500	7.000	5.000	9.990	7.000	326.0			
124	5.140	3.600	7.200	5.140	10.280	7.200	336.7			
127	5.350	3.750	7.490	5.350	10.710	7.490	353.2			
130	5.570	3.900	7.800	5.570	11.140	7.800	370.1			
132	5.720	4.000	8.000	5.720	11.420	8.000	381.6			
137	6.080	4.260	8.510	6.080	12.160	8.510	411.0			
142	6.450	4.520	9.030	6.450	12.910	9.030	441.0			
147	6.840	4.790	9.560	6.840	13.660	9.560	473.2			
152	7.220	5.050	10.100	7.220	14.430	10.100	506.0			
157	7.600	5.320	10.640	7.600	15.200	10.640	539.8			
162	7.990	5.590	11.170	7.990	15.970	11.170	574.7			

Note:
Where nominal diameter is less than 12.5 *mm* or intermediate in this Table, breaking test loads, proof test loads and mass of chain per metre are to be determined by following table:

Kind of chain	Breaking test load (*N*)	Proof test load (*N*)	Mass of chain per meter (*Kg*)
Studless chain	$370d^2$	$184d^2$	$0.0217d^2$
Grade 1 chain	$9.81d^2(44\text{-}0.08d)$	$6.86d^2(44\text{-}0.08d)$	$0.0219d^2$
Grade 2 chain	$13.73d^2(44\text{-}0.08d)$	$9.81d^2(44\text{-}0.08d)$	$0.0219d^2$
Grade 3 chain	$19.61d^2(44\text{-}0.08d)$	$13.73d^2(44\text{-}0.08d)$	$0.0219d^2$
where : d= Nominal diametre (*mm*)			

4.1.11 Breaking Tests of Accessories

1. From each manufacturing lot, which have the same grade, size and heat treatment, of 25 units or less of shackles swivel shackles, large links and end links made by casting and from each manufacturing lot of 50 units or less of kenter shackles, one unit is to withstand satisfactorily the breaking test loads specified in **Table 4.5** according to the grades of chain to be connected.

2. Where the test of **-1** above is not satisfactory, the accessories may be retested by taking out two units from the same lot. If one such test fails to meet the requirements, the entire unit test quantity is rejected.

3. Accessories used for the breaking test are generally not to be put into use in service. However, the accessories, which have been successfully tested at the breaking load appropriate to the chain, may be used in service at the discretion of the Society.

4. When the accessories are in accordance with the following requirements in **(1)** to **(3)**, no breaking testing is required subject to the approval by the Society.

(1) The breaking load test has been demonstrated on the occasion of the approval testing of parts of the same design.

(2) The tensile test and impact test have been demonstrated by each manufacturing lot.

(3) Non-destructive testing has been demonstrated before forwarding the products.

4.1.12 Proof Tests

1. The proof tests are to be carried out for each length of the chains and the chains are to withstand the proof test loads specified in **Table 4.5** without crack, breakage or any other defects. The test is to be carried out after the chains were heat treated where necessary.

2. Where the test of **-1** above is not satisfactory, the chain may be retested only once more by link of same manufacturing process after replacing the defective link. Where, however, more than 5% of the total links are found defective, the retest is not permitted.

3. Each kind of accessory is to be tested to the proof test loads specified in **Table 4.5**, in accordance with the kinds and diameters of the chains to be connected therewith, and they are to withstand the tests without crack, breakage or any other defects. This test may be carried out simultaneously with the proof test for the chains or together with any chains of the same diameter with which accessories are connected.

4.1.13 Mechanical Tests of Grade 2 and Grade 3 Chain Links

1. Grade 2 and grade 3 flash butt welded chain links are to be subjected to the mechanical tests, and are to comply with the requirements.

2. Mechanical properties of chain links are to comply with requirements given in **Table 4.6**.

3. Except for applying **Notes (2)** and **(3)** of **Table 4.6,** one tensile test specimen and one set of three impact test specimens are to be taken from the parts other than the welded joint links; in addition for Grade 2 chains which is not heat treated and Grade 3 chains, one set of three impact test specimens are to be taken from the welded joint for which the centre of notch of the specimens is to be located at the welded joint. These

specimens are to be taken at random among four lengths of chain but not from the chain subjected to breaking test.

4. Test procedures and forms of test specimens are to comply with the requirements in **Chapter 2, Part 10**.

5. Where the test results of mechanical properties of chain links do not conform to the requirements, additional tests are to be carried out in accordance with the requirements specified in **3.6.9, Part 10**.

Table 4.6 Mechanical Properties

Kinds of chain	Except welded part						Welded part	
	Tensile test(2)(3)				Impact test(1)(2)(3)		Impact test(1)(2)	
	Yield point or proof stress (N/mm^2)	Tensile strength (N/mm^2)	Elongation (L=5d) (%)	Reduction of area (%)	Testing Temperature (°C)	Minimum mean absorved energy (J)	Testing Temperature (°C)	Minimum mean absorved energy (J)
Grade 2	295 min.	490~690	22 min.	___	0	27	0	27
Grade 3	410 min.	690 min.	17 min.	40 min.	0	60	0	50

Notes:

(1) When the absorbed energy of two or more test specimens among a set of test specimens is less in value than the specified minimum mean absorbed energy or when the absorbed energy of a single test specimen is less in value than 70% of the specified minimum mean absorbed energy, the test is considered to have failed.

(2) For Grade 2 chain heat treated, mechanical testing may be dispensed.

(3) For Grade 2 chain which is not heat treated, mechanical testing except welded part may be dispensed subject to the approval by the Society.

4.1.14 Marking

Where chains and accessories have satisfactorily passed the tests and inspections, they are to be stamped with the Society s brand giving kind of chain, nominal diameter and test number.

4.1.15 Painting

Chains and accessories are not to be painted until the tests and inspections are finished.

4.2 Offshore Mooring Chains

4.2.1 Application

Offshore mooring chains (hereinafter referred to as offshore chain) and shackles and swivels which are connected to the offshore chain (hereinafter referred to as “accessories for offshore chain”) are to comply with the requirements in **4.2** or to be of equivalent quality.

4.2.2 General

1. Offshore chains are to be manufactured in continuous lengths by flash butt welding and are to be heat treated in a continuous furnace.

2. The connecting common links may be used in order to replace defective links which does not comply with tests and examinations required by **4.2**. However, the use of connecting common links is restricted to 3 links in each 100 m of offshore chain.

3. Notwithstanding the requirement of **-2**, the joining shackles may be used in order to replace defective links which does not comply with tests and examinations required by **4.2**. In this case, Number and type of joining shackles used are to be subject to the approval of the Society.

4.2.3 Kinds of Offshore Chains

Offshore chains are to be subdivided into three grades that are Grade *R3* offshore chain, Grade *R3S* offshore chain and Grade *R4* offshore chain.

4.2.4 Materials

1. Offshore chains are to be made of the materials given in **Table 4.7** according to their grades and manufacturing processes, respectively.

2. The studs are to be made of steel whose the carbon content is in general less than 0.25% if the studs are welded in place however, the studs may be made of steel bars corresponding to that of the offshore chain or of equivalent thereto considered by the Society.

3. Accessories for offshore chains are to be made of the materials given in **Table 4.8** corresponding to the grades of the connected offshore chain.

Table 4.7 Materials for Offshore Chain Link

Grade of offshore chain	Materials	Grade of material
Grade *R*3 offshore chain	Grade *R*3 offshore chain bar	*KSBCR3*
Grade *R*3*S* offshore chain	Grade *R*3*S* offshore chain bar	*KSBCR3S*
Grade *R*4 offshore chain	Grade *R*4 offshore chain bar	*KSBCR4*
Grade *R*4*S* offshore chain	Grade *R*4*S* offshore chain bar	*KSBCR4S*
Grade *R*5 offshore chain	Grade *R*5 offshore chain bar	*KSBCR5*

Table 4.8 Materials for accessories of Offshore Chain

Kind of connected offshore chain	Manufacturing process			
	Casting	Grade of material	Forging	Grade of material
Grade *R*3 offshore chain	Grade *R*3 steel casting for offshore chain	*KSCCR*3	Grade *R*3 steel forging for offshore chain	*KSFCR*3
Grade *R*3*S* offshore chain	Grade *R*3*S* steel casting for offshore chain	*KSCCR3S*	Grade *R*3*S* steel forging for offshore chain	*KSFCR3S*
Grade *R*4 offshore chain	Grade *R*4 steel casting for offshore chain	*KSCCR4*	Grade *R*4 steel forging for offshore chain	*KSFCR4*
Grade *R*4*S* offshore chain	Grade *R*4*S* steel casting for offshore chain	*KSCCR4S*	Grade *R*4*S* steel forging for offshore chain	*KSFCR4S*
Grade *R*5 offshore chain	Grade *R*5 steel casting for offshore chain	*KSCCR5*	Grade *R*5 steel forging for offshore chain	*KSFCR5*

4.2.5 Processes of Manufacture

1. The manufacturers of offshore chains including connecting common links are to obtain approval of the Society in advance concerning their manufacturing methods.

2. Where the studs are welded to offshore chain excluding Grade *R3* and *R3S* offshore chain, are to be complied with following **(1)** to **(3)**.

(1) Both ends of the stud are to be a good fit into the link and are not to be fitted on the flash butt weld of the link as far as practicable, and the full periphery of the stud end is to be welded. Welding of both ends of the stud is not permitted unless specially approved by the Society.

(2) Welding position is to be flat as possible.

(3) All welds are to be carried out before the final heat treatment of offshore chains.

3. Welding of studs in Grade *R4* offshore chain, Grade *R4S* offshore chain and Grade *R5* is not permitted unless specially approved by the Society.

4. Accessories of offshore chains are to be made by casting or forging. Their manufacturers are to obtain approval by the Society in advance concerning their manufacturing methods.

5. Machining of kenter shackles is to result in fillet radius minimum 3% of nominal diameter.

6. Connecting common links are to be substituted for defective common links of offshore chain without necessity for re-heat treatment of the whole length and with the method of heat treatment which is not to affect the properties of the adjoining links whose temperature is nowhere exceed 250°C. However, an alternative procedure may be applied to this joining method where specially approved by the Society.

4.2.6 Offshore Chain Manufacturers

Manufactures which manufacture the offshore chains and accessories of them are to obtain approval by the Society.

4.2.7 Heat Treatment

1. Offshore chains are to be heat treated as normalized, normalized and tempered or quenched and tempered in a continuous furnace. In principle, batch heat treatment is not permitted.

2. Accessories of offshore chain are to be heat treated as normalized, normalized and tempered or quenched and tempered.

4.2.8 Dimensions and Forms

1. The standard dimensions and forms of each kind of link and accessory are to be as given in **Fig. 4.2**

2. The nominal diameter of offshore chains is to be denoted by the diameter at the crown of the common link.

3. Every kind of links and accessories are to be of uniform shape and their bent portions are to be sufficient to allow each link to work smoothly.

4.2.9 Dimensional Tolerances

1. The dimensions of offshore chains are to be measured at least 5% of all links after the execution of a proof test.

2. The tolerances of offshore chains are to comply with the following requirements.

(1) The negative tolerance at the crown part of each kind of link is to comply with the requirements in accordance with its nominal diameter as given in **Table 4.9**, and the plus tolerance may be up to 5 % of its nominal diameter. However, no negative tolerance of the cross sectional area of the crown part of the link is permitted.

(2) The tolerances other than the crown part of each kind of link are to be up to +5%, but is not to be negative.

(3) Notwithstanding to the requirements in **(1)** and **(2)** above, no negative tolerance of the diameter at welded part is permitted. The positive tolerances thereof are left to the discretion of the Society.

(4) The tolerances with regard to the location of stud set are left to the discretion of the Society.

(5) The tolerances except for the requirements specified in **(1)** to **(4)** above are to be ± 2.5%.

3. For all offshore chain, a length of 5 common links which are connected is to be measured. The measurement of a length of 5 links are to be carried out in accordance with the following procedures while the offshore chain is loaded to 5 - 10% of the minimum proof load.

(1) The first five links is to be measured.

(2) The next set of five links, at least two links from the previous five links are to be included, is to be measured.

(3) The measurement procedure specified in **(2)** is to be followed for the entire offshore chain length.

(4) The links held in the end blocks may be excluded from this measurement.

4. The allowable manufacturing tolerance on a length of five links by measuring procedure specified in **-3** is to comply with the requirements as given in **Table 4.10**.

5. If a length of five links is shorter than allowable value, offshore chain may be stretched by tensile loading. In this case, however, tensile load is not to exceed 110% of minimum proof load required.

6. If links are found to be defective or not to meet the dimensional tolerance requirement specified in **-1**, defective links may be cut off and a connecting common link or joining shackle inserted in their place. In this case, proof tests are to be carried out again after insertion of a connecting common link or a joining shackle, and dimensions of a connecting common link or a joining shackle are to measured.

7. At least one accessory (of the same type, size and nominal strength) out of 25 is to be measured for dimensions after proof load testing. Dimensions are subjected to the manufacturing tolerances of the following **(1)** and **(2)**.

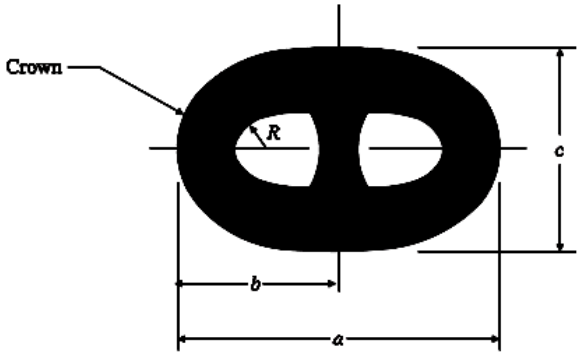
(1) The tolerances of the diameter of accessories are to be up to +5% of their nominal diameters, but are not to be negative.

(2) The tolerances other than diameter of accessories are to be ±2.5%.

4.2.10 Mass

The mass of offshore chains is to comply with the standard mass given in **Table 4.10**, in accordance with their kind, and to be measured after the execution of proof tests.

Fig. 4.2 Stud link and studless common link, proportions dimensions and tolerances Stud link-The internal link radio (*R*) and external radio should be uniform



Designation(1)	Description	Nominal Dimension of the Link	Minus tolerance	Plus Tolerance
a	Link Length	6*d*	0.15*d*	0.15*d*
b	Link Half Length	*a**/2	0.1*d*	0.1*d*
c	Link Width	3.6*d*	0.09*d*	0.09*d*
e	Stud Angular Misalignment	0 *degrees*	4 *degrees*	4 *degrees*
R	Inner Radius	0.65*d*	0	-----

Notes:

1 Dimension designation is shown in above figure

d-Nominal diameter of chain

*a**-Actual link length

Table 4.9 Negative Tolerance of Diameters

Nominal Diameter (*mm*)	Negative tolerances (*mm*)
up to 40	1
over 40 up to 84	2
over 84 up to 122	3
over 122 up to 152	4
over 152 up to 184	6
over 184 up to 210	7.5

Table 4.10 Braking and Proof Test Loads, Mass and Length over 5 Links for Offshore Chains

Test Load	Grade *R*3 Stud Link	Grade *R*3*S* Stud Link	Grade *R*4 Stud Link	Grade *R*4S Stud Link	Grade *R*5 Stud Link
Proof test load (*KN*)	$0.0148d^2(44\text{-}0.08d)$	$0.0180d^2(44\text{-}0.08d)$	$0.0216d^2(44\text{-}0.08d)$	$0.0240d^2(44\text{-}0.08d)$	$0.0251d^2(44\text{-}0.08d)$
Breaking test load (*KN*)	$0.0223d^2(44\text{-}0.08d)$	$0.0249d^2(44\text{-}0.08d)$	$0.0274d^2(44\text{-}0.08d)$	$0.0304d^2(44\text{-}0.08d)$	$0.0320d^2(44\text{-}0.08d)$
Test Load	Grade *R*3 Studless	Grade *R*3S Studless	Grade *R*4 Studless	Grade *R*4S Studless	Grade *R*5 Studless
Proof test load (*kN*)	$0.0148d^2(44\text{-}0.08d)$	$0.0174d^2(44\text{-}0.08d)$	$0.0192d^2(44\text{-}0.08d)$	$0.0213d^2(44\text{-}0.08d)$	$0.0223d^2(44\text{-}0.08d)$
Breaking test load (*KN*)	$0.0223d^2(44\text{-}0.08d)$	$0.0249d^2(44\text{-}0.08d)$	$0.0274d^2(44\text{-}0.08d)$	$0.0304d^2(44\text{-}0.08d)$	$0.0320d^2(44\text{-}0.08d)$
Chain Weight (*Kg*/*m*)	Stud Link			$0.0219d^2$	
	Studless chain			Weight calculations for each design are to be submitted	
Length over 5 links (*mm*)	over 22*d* up to 22.55*d*.				

4.2.11 Breaking Tests

1. The breaking test for offshore chain is to be carried out by the following procedures after final heat treatment.

(1) A breaking test specimen consisting of at least 3 links is to be either taken from the offshore chain or produced at the same time and in the same manner as the offshore chain.

(2) The breaking test frequency is to be based on tests at sampling intervals according to **Table 4.11** corresponding to its nominal diameter provided that every cast is represented.

(3) Each specimen is to be capable of withstanding the break load specified in **Table 4.10** without fracture maintained at that load for 30 *seconds.*

(4) Where the capacity of the testing machine does not reach the breaking test loads specified in **Table 4.10**, the breaking test may be substituted by a method approved by the Society.

(5) If a breaking test fails, a thorough examination is to be carried out to identify the cause of failure.

(6) If a breaking test fails, two additional breaking test specimens representing the same sampling length of offshore chain are to be subjected to the breaking test. If two additional breaking test result satisfactorily, it will be decided what lengths of offshore chain can be accepted based upon the results of the failure investigation specified in **(5)**.

(7) If either or both results of the additional test and failure investigation specified in **(5)** and **(6)** fail, the sampling length of offshore chain represented will be rejected. If a single link is found to be defective or not to meet the requirement of breaking test, defective links may be cut out and connecting common link or joining shackle inserted in its place and retest of breaking test may be carried out. If the result of the retest is found satisfactory, the sampling length of offshore chain represented may be passed.

(8) For chain diameters over 100 *mm*, alternative breaking test proposals to the above breaking test will be considered whereby a one link specimen is used. Alternatives are to approved by the Society, every heat is to be represented, the test frequency is to be in accordance with **Table 4.11**, and it is to be demonstrated and proven that the alternative test represents an equivalent load application to the three link test.

2. The breaking test for accessories of offshore chain and connecting common link is to be carried out by the following procedures after final heat treatment.

(1) For accessories of offshore chain, the breaking test is to be carried out for the following frequency which is the least. However, for connecting common link and individually produced accessories or accessories produced in small batches, the frequency of the breaking test is at the discretion of the Society.

(a) one accessory from each manufacturing lot, which have the same grade, size, and heat treatment, of 25 units or less of accessories

(b) one accessory out of every batch

(2) Each specimen of accessories of offshore chain and connecting common link is to be capable of withstanding the break load specified for the grade and size of offshore chain for which they are intended without fracture maintained at that load for 30 *seconds*.

(3) Where the breaking test is not satisfactory, the accessories may be retested by taking out two units from the same lot specified in **(1)**. If one such test fails to meet the requirements, the entire unit of the same lot is rejected.

(4) Accessories and connecting common links used for the breaking test are generally not to be put into use in service. However, where the accessories are of increased dimension or alternatively a material with higher strength characteristics is used, they may be used in service at the discretion of the Society.

Table 4.11 Number of Breaking Test

Nominal diameter of offshore chain *d*(*mm*)	Maximum sampling interval (*m*)
$d \leq 48$	91
$48 < d \leq 60$	110
$60 < d \leq 73$	131
$73 < d \leq 85$	152
$85 < d \leq 98$	175
$98 < d \leq 111$	198
$111 < d \leq 124$	222
$124 < d \leq 137$	250
$137 < d \leq 149$	274
$149 < d \leq 162$	297
$162 < d \leq 175$	322
$175 < d \leq 186$	346
$186 < d \leq 199$	370
$199 < d \leq 210$	395

4.2.12 Proof Tests

1. The proof test is to be carried out for the entire length of offshore chain by the following procedures after final heat treatment.

(1) Offshore chains are to withstand the proof test loads specified in **Table 4.10** without crack, breakage or any other defects.

(2) Notwithstanding the requirements of **(1)** above, where plastic straining is used to set studs, the applied proof load is not to be greater than that in approval tests for manufacturing.

(3) If a link fails during proof load testing, a thorough examination is to be carried out to identify the probable cause of failure of the proof test from the manufacturing records. Where the cause of failure is identified and the presence in other lengths of factors or conditions thought to be causal to failure is not found from the above failure investigation, this length of chain except a failure link may be accepted.

(4) In the event that two or more links in the proof loaded length fail, that length of offshore chain is to be rejected. An investigation and retest are to be carried out in accordance with the following **(a)** to **(c)** and where these results are found satisfactorily, this length of offshore chain may be accepted.

(a) A thorough examination is to be carried out to identify the probable cause of failure of the proof test from the manufacturing records. The tests in order to identify the cause of failure may be required where deemed necessary by the Society.

(b) A breaking test specimen is to be taken from each side of the one failed link according to **4.2.11-1(1)**, and subjected to the breaking test.

(c) Defective links may be cut out and connecting common link or joining shackle inserted in its place and retest of proof load test is to be carried out.

2. All kinds of accessories and connecting common links are to be tested to the proof test loads specified in **Table 4.10**, in accordance with the kinds and diameters of the offshore chains to be connected therewith, and they are to be withstand the tests without crack, breakage or any other defects. This test may be carried out simultaneously with the proof test for the offshore chains or together with any offshore chains of the same diameter with which accessories are connected.

4.2.13 Mechanical Tests

1. Mechanical tests for offshore chains are to be carried out in accordance with following manner after final heat treatment.

(1) One tensile test specimen and 3 sets (9 pieces) impact test specimens are to be taken from the maximum sampling interval corresponding to the nominal diameter of offshore chain specified in **Table 4.11**. Test specimens are to be taken from the location given in **Fig. 4.3** of the part specified in the followings.

(a) The tensile test specimen is to be taken in the side opposite the flash weld.

(b) One set (3 pieces) impact test specimens are to be taken across the flash butt weld with the notch centered in the middle, one set are to be taken across the unwelded side and one set are to be taken from the bent region.

(2) Test procedures and form of test specimen are to comply with the requirements in **Chapter 2, Part 10**.

(3) Mechanical properties are to comply with the requirements specified in **Table 4.12**.

(4) If the tensile test result does not conform to the requirements, a retest of two further specimens selected from the same sample may be carried out. Where both additional tensile tests show satisfactory results, the sampling length of offshore chain is considered acceptable.

(5) If the impact test results does not conform to the requirements, a retest of three further 1 set (3 pieces) specimens selected from the same sample may be carried out. The results of a retest are to be added to those previously obtained to form a new average. If the results of a retest comply with the requirements specified in **Table 4.12** and the new average comply with the requirements specified in **Table 4.12**, the sampling length of offshore chain is considered acceptable.

2. Mechanical tests for accessories of offshore chains and connecting common links are to be carried out in accordance with following manner after final heat treatment.

(1) One tensile test specimen and one set (3 pieces) impact test specimen are to be taken at the frequency specified in **4.2.11-2(1)** and in locations specified in **Fig 4.4** of accessories of offshore chains and connecting common links and mechanical tests are to be carried out. The locations of mechanical test of other accessories with complex geometries are to be approved by the Society.

(2) Where the test results specified in **(1)** above do not conform to the requirements, additional tests may be carried out by the two tensile test specimens and 2 sets impact test specimens taken from the same lot specified in **(1)** above. The results of the retest of impact test specimens are to be added to those previously obtained to form a new average. Where one tensile test does not conform to the requirement specified in **Table 4.12**, the sampling rot represented is to be subjected to rejection and where the new

average value does not comply with the requirements specified in Table 4.12, the sampling rot represented is to be subjected to rejection.

Fig 4.3 Location for Sampling Test Specimens for Links of Offshore Chains

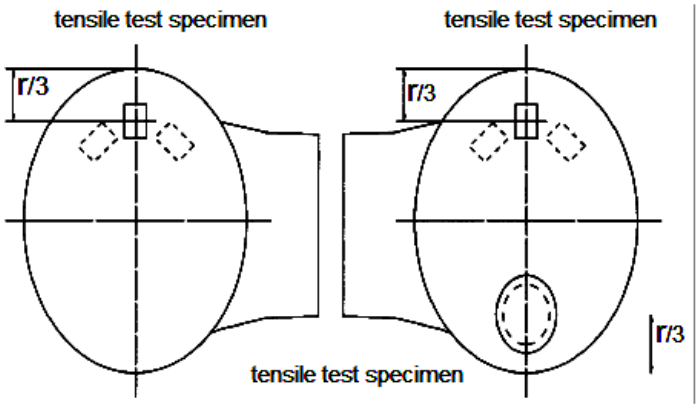


Fig. 4.4 Sampling Locations of Test Pieces for Shackles

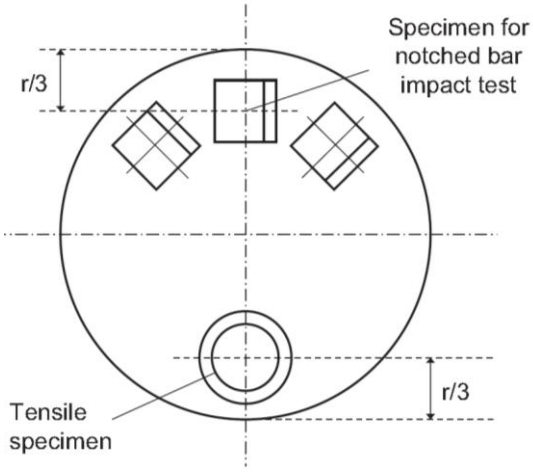


Table 4.12 Mechanical Properties

Kinds of offshore chains	Tensile test				Impact test(1)		
	Yield point or proof stress(2) (N/mm^2)	Tensile strength(2) (N/mm^2)	Elongation (L=5d) (%)	Reduction of area (%)	Testing Temperature (°C)	Minimum mean absorved energy (J)	
						Except welded part	welded part
Grade *R*3	410 min.	690 min.	17 min.	50 min.	-20(3)	40(3)	30(3)
Grade *R*3*S*	490 min.	770 min.	15 min.	50 min.	-20(3)	45(3)	33(3)
Grade *R*4	580 min.	860 min.	12 min.	50 min.	-20	50	36
Grade *R*4*S*	700 min.	960 min.	12 min.	50 min.	-20	56	40
Grade *R*5	760 min.	1000 min.	12 min.	50 min.	-20	58	42

Notes:

1 When the absorbed energy of two or more test specimens among a set of test specimens is less in value than the specified minimum mean absorbed energy or when the absorbed energy of a single test specimen is less in value 70% of the specified minimum mean absorbed energy, the test is considered to have failed.

2 Aim value of yield to tensile ration is maximum 0.92.

3 Impact test of Grade *R*3 and *R*3*S* offshore chains may be carried out at the temperature of 0°C where approved by the Society. In this case, minimum mean absorbed energy is not to be less than following values.

	except welded part	welded part
(a) Grade *R*3 offshore chain	60 *J*	50 *J*
(b) Grade *R*3*S* offshore chain	65 *J*	53 *J*

4.2.14 Non-destructive Test

1. Offshore chains and accessories of offshore chains are to be free from harmful defects in use such as of pipe, cracks, notches, cuts, flakes and lack of fusion.

2. All offshore chains are to be subjected to the non-destructive test specified in the following **(1)** and **(2)** after proof tests.

(1) Magnetic Particles test or Dye Penetrant Test

(a) Magnetic particles test or dye penetrant test for every link, is to be employed to examine the flash butt welded area including the area gripped by the clamping dies.

(b) At least 10% of all studs welds within each length of offshore chains are to be examined by magnetic particles test or dye penetrant test where studs are set to link by welding. If cracks or lack of fusion are found, all welded parts are to be examined.

(2) Ultrasonic Test

Ultrasonic test for all links is to be employed to examine the flash weld fusion.

3. Magnetic particles test or dye penetrant test for every accessories of offshore chain and connecting common link, is to be employed to examine after proof test.

4.2.15 Repair of Defects

1. Where insignificant defects are found from non-destructive test specified in **4.2.14**, they are to be repaired by grinding down no more than 5% of the link diameter in depth and streamlined to provide no sharp contours, and where their final dimensions are to be within the dimensional tolerances required by **4.2.9**, those offshore chains and their accessories are considered acceptable.

2. Where harmful defects are found from non-destructive test specified if **4.2.14-2**, a defective link may be cut out and connecting common link or joining shackle inserted in its place. Retests specified in **4.2.11** to **4.2.13** are to be carried out, and where the results comply with the requirements, these offshore chains and their accessories are considered acceptable.

4.2.16 Markings

Where offshore chains and accessories of offshore chains have satisfactorily passed the tests and inspections required by **4.2**, they are to be marked as follows.

(1) Places of markings

At stud of each end of offshore chains

At stud of each end at intervals not exceeding 100 m

On connecting common link

On stud of common links next to connecting common links or joining shackles all kind of accessories of offshore chains

(2) Kinds of markings

Society's stamp

The grade of offshore chains and accessories of offshore chains (e.g *NK-R3, NK-R3S, NK-R4,NK-R4S* and *NK-R5*)

The nominal diameter of offshore chains and accessories of offshore chains Manufacturer´s number

4.2.17 Painting

Offshore chains and accessories of offshore chains are not to be painted until the tests and inspections are finished.

4.2.18 Records

Manufacturers producing offshore chains and accessories of offshore chains are to make records with regard to the manufacturing processes tests and inspections required to offshore chains and accessories of offshore chains, and the results of them, and such records are to readily available to the Surrey or when requested .

Chapter 5 STEEL WIRE ROPES

5.1 Steel Wire Ropes

5.1.1 Application

1. The steel wire ropes used for steering ropes, mast riggings, stream wires or mooring lines to be equipped on ships in accordance with the provisions in **Chapter 2** (hereinafter referred to as steel wire rope) are to comply with the requirements in this Chapter or to be of equivalent quality.

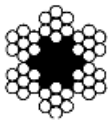
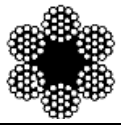
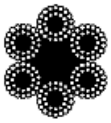
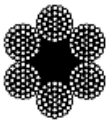
2. The provisions in this Chapter are applicable to the wire ropes constructed with fibre rope core and from individual wires having the tensile strength level of 1,500N/mm^2. However, wire ropes constructed from other individual wires than those described above or steel wire ropes constructed with an independent wire rope core may be used where specially approved in connection with their manufacture.

5.1.2 Grades

1. Steel wire ropes are classified into seven grades according to their composition specified in **Table 5.1.** The classification may be indicated by grade number or composition mark.

2. Steel wire ropes No. 1 are used for standing riggings, No. 3 for standing and running riggings and No. 2, 4, 5, 6 and 21 for runnings riggings.

Table 5.1 Grades of Wire Ropes

Grade		No.1	No.2	No.3	No.4	No.5	No.6	No.21
Sectional view								
Composition	Number of wires	7	12	19	24	30	37	36
	Number of strands	6	6	6	6	6	6	6
	Fibre core	Centre	Centre and centres of strands	Centre	Centre and centres of strands	Centre and centres of strands	Centre	Centre
Composition mark		(6 x 7)	(6 x 12)	(6 x 19)	(6 x 24)	(6 x 30)	(6 x 37)	(6 x WS (36))

5.1.3 Processes of Manufacture

1. The individual wire composing the strands of steel wire ropes is to consist of wires of recognized standard (Hard Steel Wires), approved by the Society.

2. The individual wire is to have no joint for the whole length of a steel wire rope. However, in an unavoidable case in the manufacturing process, they may be jointed by welding, brazing or twisting at only one position for each 10 *metres* length of strand.

3. The individual wire is to be galvanised or to be drawn after being galvanised, and they are to be applied with oil to the extent necessary for maintenance unless otherwise specified. The galvanising is to be performed effectively to the satisfaction of the Society. The oil is to be free from harmful acid or heavy alkali.

4. Fibre of good quality which suitably contains oil is to be used for core of steel wire rope and strand. The oil is to be free from harmful acid or heavy alkali.

5. Steel wire ropes are to be left hand lay and the strands are to be right hand lay (called as "Z twisting").

6. Diameter, degree of twist, etc. are to be finished uniformly for the whole length of the steel wire ropes.

5.1.4 Diameter of Steel Wire Ropes and Individual Wire

1. The difference between the maximum and minimum diameters of the individual wire composing the strand of steel wire ropes is not to exceed the limits given in **Table 5.2**.

2. The diameter of steel wire ropes is the diameter of the circumscribed circle of ropes and it is taken as an average diameter measured at any two or more positions except within 1.5 metres from the ends of ropes. In this case, the tolerance for the diameter of ropes is to be within +7% and -0%.

Table 5.2 Permissible Variation in Diameter of Individual Wire

Diameter of individual wire d (*mm*)	Difference between maximum and minimum diameters (*mm*)
$0.26 \leq d < 1.00$	0.06
$1.00 < d \leq 2.30$	0.09
$2.30 < d \leq 3.70$	0.12
$3.70 < d \leq 4.50$	0.14

5.1.5 Mass

The standard mass of steel wire ropes is as given in **Table 5.3** according to the grade and diameter.

5.1.6 Breaking Tests

Breaking tests for steel wire ropes are to be carried out in accordance with the following requirements in **(1)** to **(8)**:

(1) One specimen is to be taken from each coil of steel wire ropes.

(2) Where steel wire ropes are continuously manufactured by the same machine with the same wires and divided into several coils, one specimen may be taken from one coil selected by the Surveyor at random, regardless of **(1)**.

(3) The specimen of which both ends are either loosened and solidified to cone with suitable metal alloy or gripped by other suitable methods, is to be set to the testing machine and gradually pulled until it breaks down.

(4) The distance between the grips is not to be less than 40 times the diameter of ropes. However, it need not exceed 2 *metres*.

(5) The specimens are to withstand the breaking test loads specified in **Table 5.3** according to the grade and diameter of steel wire rope.

(6) Where the specimen has broken down at the parts of the grips before reaching the required breaking load, one more specimen taken from the steel wire rope may be retested.

(7) Where the breaking tests carried out in accordance with the requirements in **(2)** fail to meet the requirements given in **Table 5.3**, the coil is to be rejected. Then, two further specimens taken from two coils of the remaining ropes selected by the Surveyor at random may be subjected to the breaking tests. If both of these additional tests meet the requirements, the remaining ropes may be accepted. If one or both of additional tests are unsatisfactory, the remaining ropes are, also, to be rejected.

(8) Where the test load specified in **Table 5.3** cannot be applied to specimen for the lack of capacity of testing machine, any other alternative test procedure approved by the Society may be adopted.

Table 5.3 Masses and Breaking Test Loads for Steel Wire Ropes

Grade	No.1		No.2		No.3		No.4		No.5		No.6		No.21	
composition mark	(6 x 7)		(6 x 12)		(6 x 19)		(6 x 24)		(6 x 30)		(6 x 37)		(6 x ws(36))	
Diameter of steel wire rope (*mm*)	Breaking test load (*kN*)	Mass per metre in length (*kg*)	Breaking test load (*kN*)	Mass per metre in length (*kg*)	Breaking test load (*kN*)	Mass per metre in length (*kg*)	Breaking test load (*kN*)	Mass per metre in length (*kg*)	Breaking test load (*kN*)	Mass per metre in length (*kg*)	Breaking test load (*kN*)	Mass per metre in length (*kg*)	Breaking test load (*kN*)	Mass per metre in length (*kg*)
10	52.4	0.371	32.7	0.273	47.9	0.634	45.5	0.332	41.1	0.310	48.9	0.359	50.5	0.396
12	75.4	0.534	47.1	0.393	71.6	0.524	65.5	0.478	59.1	0.446	70.5	0.517	72.8	0.570
14	103	0.727	64.0	0.535	97.4	0.713	89.1	0.651	80.5	0.607	96.2	0.704	99.0	0.776
16	134	0.950	83.6	0.699	127	0.932	117	0.850	105	0.793	126	0.920	129	1.01
18	170	1.20	106	0.885	161	1.18	147	1.08	133	1.00	159	1.16	164	1.28
20	210	1.48	130	1.09	199	1.46	181	1.33	164	1.24	195	1.44	202	1.58
22	253	1.80	158	1.32	240	1.77	221	1.61	199	1.50	237	1.74	244	1.92
24	302	2.14	188	1.57	286	2.10	262	1.91	236	1.79	281	2.07	291	2.28
26	354	2.51	221	1.85	336	2.47	308	2.24	278	2.10	330	2.43	341	2.68
28	411	2.91	256	2.14	389	2.85	357	2.60	322	2.43	382	2.82	396	3.10
30	472	3.34	294	2.46	447	3.28	410	2.99	369	2.79	439	3.23	454	3.56
32	536	3.80	334	2.80	509	3.73	466	3.40	421	3.17	501	3.68	517	4.06
34	605	4.29	378	3.16	575	4.21	526	3.84	475	3.58	566	4.16	583	4.58
36	679	4.81	424	3.54	644	4.72	589	4.30	533	4.02	634	4.66	654	5.13
38	756	5.36	472	3.94	718	5.26	657	4.79	593	4.48	707	5.19	730	5.72
40	838	5.93	523	4.37	795	5.82	728	5.31	657	4.95	782	5.75	808	6.34
42					877	6.42	802	5.86	725	5.47	863	6.34	890	6.99
44					963	7.05	881	6.43	794	6.00	847	6.96	978	7.67
46					1.050	7.70	963	7.03	869	6.56	1.040	7.61	1.070	8.38
48					1.150	8.39	1.050	7.65	945	7.14	1.130	8.28	1.140	9.12
50					1.250	9.10	1.150	8.30	1.020	7.74	1.230	8.98	1.260	9.90
52							1.230	8.98	1.110	8.38	1.320	9.73	1.360	10.7
54							1.320	9.68	1.200	9.04	1.420	10.5	1.470	11.5
56							1.420	10.4	1.280	9.71	1.530	11.3	1.590	12.4
58							1.530	11.2	1.380	10.4	1.650	12.1	1.700	13.3
60							1.640	12.0	1.470	11.1	1.760	12.9	1.810	14.3
62							1.750	12.8	1.580	11.9	1.880	13.8	1.940	15.2
65							1.920	14.0	1.740	13.1	2.070	15.2	2.140	16.7

5.1.7 Individual Wire Tests

1. Steel wire ropes are to be subjected to the individual wire tests for each length and are to comply with the requirements.

2. Where steel wire ropes are continuously manufactured by the same machine with the same wires and divided into several lengths, the tests may be carried out on one length selected by the Surveyor at random. Where the tests are satisfactory, the tests for the other lengths may be dispensed with.

3. For tests on the individual wires, a suitable length of a strand is to be cut off the rope and unstranded. The number of wires to be taken therefrom for tests is to be as specified in **Table 5.4**. Any straightening of test specimens which may be needed is to be done at the room temperature by a suitable method without injuring the specimens.

4. The individual wire tests are to be carried out in accordance with the following requirements:

(1) Wrapping Tests

(a) In wrapping tests, the specimens are to be wrapped at least eight times around the wire with the same diameter as the specimen. Where they are unwrapped, the number of broken specimens is not to exceed the number given in **Table 5.5** except for the core of the strand.

(b) Where the test is not satisfactory, new specimens of the required number may be prepared and retested. In this case, the number of broken specimens including those of the first test is not to exceed the number given in **Table 5.5** except for core of the strand.

(2) Twisting Tests

(a) In twisting tests, the specimen with the length 100 times the diameter of the specimen is to be hardly gripped at the ends, and then one end is to be revolved until the specimen is broken down. The tests are to show that no specimen has been broken down with the number of times of twisting not more than one-half of that specified in **Table 5.6** and the number of the specimens which have been broken down with the number of times of twisting less than that specified in the above Table is not to be more than that given in the **Table 5.5** except for the core of the strand.

(b) Where the test is not satisfactory, new specimens of the required number may be taken and retested. Where, however, there is any specimen which has been broken down with the number of times of twisting not more than one-half of the specified number, the retest is not allowed. The retest is to show that no specimen has been broken down with the number of times of twisting not more than one-half of the specified number and the number of the specimens including those of the first test which have been broken down with the number of times of twisting less than the specified number is not to exceed the number given in **Table 5.5** except for the core of the strand.

(c) Where the specimen has been broken down at the parts of the grips, and the results of the test do not comply with the requirements, a retest may be allowed.

(3) Inspection of Diameter

(a) Diameters of individual wires are to be inspected at the time of other tests. The number of specimens which fail to meet the requirements in **5.1.4-1** are not to be more than given in **Table 5.5** except for the core of the strand.

(b) Where any specimen fails to pass the inspection specified in **-1**, further inspection may be carried out on specimens of the specified number. In this case, the total number of specimens which fail to meet the requirements in **5.1.4-1** in both inspections are not to be more than the number given in **Table 5.5**.

Table 5.4 Number of Specimens for Individual Wire Tests

Grade	Composition mark	Number of specimens
No.1	(6x7)	6
No.2	(6x12)	12
No.3	(6x19)	18
No.4	(6x24)	12
No.5	(6x30)	15
No.6	(6x37)	18
No.21	(6XWS(36))	35

Table 5.5 Permissible Number of Failed Specimens in Individual Wire Tests

Grade	Composition mark	Number	
		First test	Retest
No.1	(6x7)	0	2
No.2	(6x12)	1	3
No.3	(6x19)	1	4
No.4	(6x24)	1	3
No.5	(6x30)	1	4
No.6	(6x37)	1	4
No.21	(6XWS(36))	3	9

Table 5.6 Number of Times of Twisting in Twisting Tests

Diameter of individual wire $d(mm)$	Number of twisting
$0.26 \leq d \leq 1.00$	21
$1.00 < d \leq 2.30$	20
$2.30 < d \leq 3.70$	18
$3.70 < d \leq 4.50$	17

Notes:

1 The figures in the Table are based on the twisting speed of 60 *rpm*.

2 Where it is necessary to modify the interval of the grips, the number of times of twisting is to be increased or decreased in direct proportion to the interval of the grips.

5.1.8 Inspection of Appearance and Dimensions

Steel wire ropes are to be inspected on the appearance and dimensions, and they are to be in good order.

5.1.9 Marking

The steel wire ropes which have satisfactorily passed the tests and inspections are to be sealed with lead and stamped with the Society s brand, the test number and grade number on the lead.

Chapter 6 FIBRE ROPES

6.1 Fibre Ropes

6.1.1 Application

1. Hemp ropes and synthetic fibre ropes used for mooring lines to be equipped on ships in accordance with the provisions in **Chapter 2,** (hereinafter referred to as "fibre rope" in **Chapter 6**) are to comply with the requirements in this Chapter.

2. Filaments and fibre ropes having characteristics differing from those specified in this Chapter are to comply with the requirements in **1.1.1**.

6.1.2 Kinds of Fibre Ropes

Fibre ropes are classified into 9 kinds as **Table 6.2**.

6.1.3 Processes of Manufacture

1. Filaments to be used for synthetic fibre rope are to be approved by the Society.

2. Synthetic fibre ropes, except for hemp ropes, specified in this Chapter are to be manufactured by approved processes at approved works.

3. The end part of fibre ropes are to be manufactured in uniformly as far as practicable and in hardening in order capable of standing for the specific use.

6.1.4 Materials

1. Hemp ropes are to be made of pure manila hemp not containing any other similar fibre.

2. Synthetic fibre ropes are to be made of pure filaments not containing any other filaments, which are not to be restored.

6.1.5 Construction of Fibre Ropes and Others

1. Hemp ropes are, in general, to be composed of three strands and synthetic fibre ropes are to be composed of three or eight strands.

2. Three strand ropes are, in general, to be made of strands twisted together with a *Z* lay, these strands themselves being made with an *S* lay. Eight strand ropes are, in general, to be formed of four pairs of strands, the pairs being constituted successively of two strands twisted in the S direction and then of two strands twisted in the Z direction.

3. The number of the yarns of a strand is to be same, and the dimensions and laying of the yarns composing ropes are to be uniform for the whole length of the rope.

4. The lead for the strand is, in general, to be below 3.2 times the nominal diameter for three strand rope and below 3.5 times the nominal diameter for eight strand rope.

5. Polyamide ropes are to be suitably heat treated by induction furnace or others to set the lay and obtain dimensional stability. Vinylon and polypropylene ropes may be subjected to suitable heat treatment if necessary.

6. Synthetic fibre ropes may be subjected to resin treatment and dye treatment subject to the approval by the Society.

7. Oil of good quality is to be used in manufacturing hemp ropes. Ropes are not to contain excessive quantity of oil.

6.1.6 Diameter

The diameter of fibre ropes is to be measured on circumscribed circle of the ropes under the load equal to 5% of the specified breaking test load. Its tolerance is to be ±3% of its nominal diameter.

6.1.7 Breaking Tests

Breaking tests for fibre ropes are to be carried out in accordance with the following requirements in **(1)** to **(7)**:

(1) One specimen is to be taken from each coil of the fibre ropes.

(2) Where fibre ropes are continuously manufactured by the same machine with the yarns of the same type and divided into several coils, one specimen may be taken from one coil of the ropes selected by the Surveyor at random, regardless of **(1)**.

(3) The length of the specimen is not to be less than 30 times the diameter of the hemp rope, but need not exceed one *metre.*

(4) Specimens for polyethylene and polypropylene ropes are to be subjected to breaking tests in as wet condition immediately after having been immersed in warm water at 35±2°C for more than 30 minutes. For other fibre ropes than the above ropes, specimens are to be subjected to breaking tests in as dried condition.

(5) The load at the time of breaking is not to be less than given in **Table 6.1**.

(6) Where the breaking tests carried out in accordance with the requirement in **(2)** fail to meet the requirement given in **Table 6.1**, the coil is to be rejected. Then, two further specimens taken from two coils of the remaining ropes selected at random by the Surveyor may be subjected to the breaking test specified in **(3)** and **(4)**. If both of these additional tests meet the requirement, the remaining ropes may be accepted. If one or both of additional tests are unsatisfactory, the remaining ropes are, also, to be rejected.

(7) Where the test load specified in **Table 6.1** cannot be applied to specimen for the lack of capacity of testing machine, any other alternative test procedure approved by the Society may be adopted.

Table 6.1 Breaking Test Loads for Fibre Ropes (*kN*)

Diameter of rope (*mm*)	Hemp rope(1)	Synthetic fibre rope							
		Vinylon(1)		Polyethylene(2)		Polyester(1)	Polypropylene(2)		Polyamide(1)
		Grade 1	Grade 2	Grade 1	Grade 2		Grade 1	Grade 2	
10	7.06	9.32	15.7	9.71	12.7	15.6	10.8	12.7	18.1
12	9.90	13.4	21.8	13.9	17.7	22.0	15.7	17.7	27.5
14	13.1	17.9	28.4	18.6	23.5	29.2	20.6	23.5	36.6
16	16.9	22.9	36.3	23.8	29.4	37.5	26.5	29.4	46.9
18	21.0	28.6	45.1	29.7	37.3	46.7	32.4	37.3	58.3
20	25.6	34.8	54.9	36.1	44.1	56.8	39.2	44.1	70.9
22	30.5	41.6	65.7	43.1	54.9	67.8	47.1	54.9	84.6
24	35.9	48.8	77.5	50.7	63.7	79.6	54.9	63.7	100
26	41.6	56.7	89.2	58.8	73.5	92.4	63.7	73.5	116
28	47.8	65.1	103	67.5	83.4	106	73.5	83.4	132
30	54.3	74.0	117	76.8	97.1	121	83.4	97.1	151
32	61.2	83.5	131	86.5	108	136	94.1	108	170
35	72.3	99.0	155	102	127	161	111	127	201
40	95.4	127	198	131	164	206	142	164	258
45	119	157	247	163	203	260	177	203	321
50	144	191	300	198	250	312	214	250	390
55	173	228	358	237	294	373	255	294	466
60	203	269	421	279	348	438	300	348	547
65	235	312	487	324	402	508	348	402	635
70	271	358	559	371	461	583	399	461	729
75	307	407	635	422	525	663	453	525	829
80	346	459	716	476	593	747	511	593	935
85	387	514	801	533	667	837	572	667	1.050
90	431	571	895	592	735	931	635	735	1.170
95	477	632	981	655	814	1.030	702	814	1.280
100	525	694	1.080	721	897	1.140	772	897	1.410

Notes:

1 Breaking load at room temperature in dried condition.

2 Breaking load at room temperature after having been immersed in warm water at 35 ±2°C for more than 30 *minutes*.

Table 6.2 Kinds of Fibre Ropes

Kind of fibre rope			Filament (material
Hemp rope			Manila hemp
Synthetic fibre rope	Vinylon rope	Grade 1	Vinylon
		Grade 2	
	Polyethylene rope	Grade 1	Polethylene
		Grade 2	
	Polyester rope		Polyester
	Polypropylene rope	Grade 1	Polypropylene
		Grade 2	
	Polyamide rope		Polyamide

6.1.8 Inspection of Appearance and Dimensions

Fibre ropes are to be inspected on the appearance and dimensions, and they are to be in good order.

6.1.9 Marking

The fibre rope which has satisfactorily passed the tests and inspections specified in **6.1.7** and **6.1.8** is to be sealed with lead and affixed with the Society s brand indicating compliance with the Rules requirements and the test number. Furthermore, diameter, mass, kind of ropes, coil length, manufacturing number and manufacturer are to be marked in proper way.

Chapter 7 HATCH TARPAULINS

7.1 Hatch Tarpaulins

7.1.1 Application

Hatch tarpaulins to be equipped on ships in accordance with the provisions in **Chapter 19, Part 2** are to comply with the requirements in this Chapter or to be of equivalent quality. However, the manufacturing approval test by the Society is not required.

7.1.2 Grades

The grades of tarpaulins are as follows:

Grade *A* tarpaulins (Mark, *TA*)

Grade *B* tarpaulins (Mark, *TB*)

7.1.3 Materials

Tarpaulins are to be made from cloths woven with flax yarn or cotton yarn of good quality or synthetic fiber equivalent to or higher than those in guality.

7.1.4 Sewing

The overlapping, sewing threads and method of sewing for the purpose of joining the cloths used for tarpaulins are to be to the satisfaction of the Surveyor.

7.1.5 Mass

The mass of cloths used for tarpaulins before waterproof treatment is not to be less than the values indicated in **Table 7.1**.

Table 7.1 Mass of hatch tarpaulins

Materials	Mass per square (g/m^2)	
	Grade *A*	Grade *B*
Flax yarn and cotton yarn	650	490
Synthetic fiber	400	300

Note:

Where the waterproof mediums other than tar are used to cloths woven with flax yarn or cotton yarn, the minimum mass may be reduced to 85% of the above mass in accordance with the characteristics of the mediums.

7.1.6 Tensile Tests

The tensile strength of cloths used for tarpaulins before the waterproof treatment is not to be less than the values indicated in **Table 7.2**, being tested with specimens 30*mm* wide and 200*mm* long.

Table 7.2 Tensile strength of hatch tarpaulins

Materials	Tensile Strength (*N*)	
	Grade *A*	Grade *B*
Flax yarn and cotton Yarn	785	590
Synthetic fiber	1470	1176

Note:

Where the waterproof mediums other than tar are used to cloths woven with flax yarn or cotton yarn, the minimum tensile strength may be reduced to 85% of the above mass in accordance with the characteristics of the mediums.

7.1.7 Waterproof Treatments

1. Waterproof mediums are to be made of suitable tar, grease or chemicals.

2. Tarpaulins are to pass the waterproofness tests which the Surveyor considers appropriate.

3. The Waterproof mediums applied to the tarpaulin is to prove free from adhesion, cracking or any other defect on its surface where it is folded at -30°C and -60°C.

7.1.8 Marking

The hatch tarpaulins which have satisfactorily passed the tests and inspections are to be marked with the Society s brand, the name of manufacturer, the grade and the test number.

Chapter 8 SIDE SCUTTLES

8.1 Side Scuttles

8.1.1 Application

The side scuttles to be fitted up on ships according to the requirements in **Chapter 22, Part 2** (hereinafter referred to as side scuttles) are to comply with the requirements in this Chapter or to be of equivalent quality. However, the manufacturing approval test by the Society is not required.

8.1.2 Classes

Side scuttles are classified into the following three classes and divided into fixed type and hinged type according to the types of glass holders of the scuttles, and divided into bolted type and welded type according to the method of fastening the scuttles.

(1) Class *A* scuttle (Mark, *KQA*)

(2) Class *B* scuttle (Mark, *KQB*)

(3) Class *C* scuttle (Mark, *KQC*)

8.1.3 Construction and Dimensions

An area of openings of side scuttles is not to exceed $0.16m^2$. The construction and dimensions of the main parts of the side scuttles are to be in accordance with the requirements in the following **(1)** through **(4)** and **Table 8.1**, **Table 8.2** and **Table 8.3**, according to their nominal diameters and grades, and those of other parts are to be determined at the discretion of the Surveyor.

(1) Maximum allowable pressure

The maximum allowable pressure for standard side scuttles is to be in accordance with the requirements as given in **Table 8.1**, **Table 8.2** and **Table 8.3**.

(2) Glazing

(a) Glazing Material

An appropriate glazing material resistant to sea water and ultraviolet light is to be used.

(b) Mounting

When glazing, glass pane is to be centralized in the glass holder of opening side scuttles or in the main frame of non-opening side scuttles so that there is the same clearance all round.

(3) Fasteners (closing devices and hinges)

(a) The minimum number of fasteners comprising closing devices and hinges with round hole for glassholders and deadlights of class ***A***, ***B*** and ***C*** scuttle is to be in accordance with the requirements as given in **Table 8.1**, **Table 8.2** and **Table 8.3**.

(b) The total number of the fasteners and their construction is to be such that the side scuttle meets the strength and weathertightness requirements according to **8.1.5**.

(c) Where the hole for the hinge of the glassholder and deadlight is oval, the hinge is not regarded as a fastener.

(4) Gaskets for glassholder and deadlight

(a) For ensuring watertightness between the glassholder and main frame and also between the deadlight and glassholder, gaskets type ***A*** or ***B*** according to *ISO3902* are to be used.

(b) The gaskets are to be secured in the grooves by means of a suitable adhesive.

Table 8.1 Class A side scuttles

		Nominal diameter of scuttle (*mm*)				
		200	250	300	350	400
Maximum allowable pressure (*kPa*)		328	302	328	241	297
Glass thickness (*mm*)		10	12	15	15	19
Thickness of obscured glass panes when the obscured surface is facing inwards (*mm*)		15	19	—	—	—
Minimum number of fasteners	Glass holder	2	3	3	3	3
	Deadlight	2	2	3	3	3

Table 8.2 Class B side scuttle

		Nominal diameter of scuttle (*mm*)					
		200	250	300	350	400	450
Maximum allowable pressure (*kPa*)		210	134	146	154	118	146
Glass thickness (*mm*)		8	8	10	12	12	15
Thickness of obscured glass panes when the obscured surface is facing inwards (*mm*)		12	12	15	19	19	___
Minimum number of fasteners	Glass holder	2	3	3	3	3	4
	Deadlight	2	2	3	3	3	3

Table 8.3 Class C side scuttle

		Nominal diameter of scuttle (*mm*)					
		200	250	300	350	400	450
Maximum allowable pressure (*kPa*)		118	75	93	68	82	65
Glass thickness (*mm*)		6	6	8	8	10	10
Thickness of obscured glass panes when the obscured surface is facing inwards (*mm*)		10	10	12	12	15	15
Minimum number of fasteners	Glass holder	2	2	3	3	3	3

8.1.4 Materials

1. Main frame, glassholder, glass retaining ring and deadlight

The materials used for the main components of the side scuttles (main frame, glassholder, glass retaining ring and deadlight) are to be in accordance with the requirements as given in **Table 8.4**. These materials are to have the following properties in **(1)** and **(2)**.

(1) resistant corrosion;

(2) minimum mechanical properties as given in **Table 8.5**. (One tensile test specimen is to be taken from each cast.

Where the number of casting from one cast exceeds 50, an additional specimen is to be taken from each 50 castings of fraction thereof.)

2. Closing device

The materials used for the closing devices of the side scuttles (swingbolts, pin and nuts) are to have the following properties in **(1)** to **(3)**. For aluminium alloy side scuttles, the swingbolts and hinge pins are to be made of non-corrodible steel, stainless steel or such alloys which are not likely to cause corrosion of side scuttles, bolts or pins.

(1) resistant to corrosion;

(2) no effect on the corrosion resistance of other parts;

(3) Minimum mechanical properties as given in **Table 8.6**. (One tensile test specimen is to be taken from each cast.

Where the number of casting from one cast exceeds 50, an additional specimen is to be taken from each 50 castings of fraction thereof.)

3. Glass panes

Toughened safety glass panes according to *ISO1095* or glass panes of equivalent quality are to be used. For fire resistant glass panes, glass panes according to *ISO5797* or glass panes of equivalent quality are to be used.

4. Where steel or iron is used, the side scuttles are to be galvanized.

Table 8.4 Material classes

Type of side scuttle	Method of fastening the side scuttle	Material		
		Main frame	Glassholder and/or glass retaining ring	Deadlight
Class *A*	Bolted	Copper alloy(1)		Iron or steel(2)
	Welded	Mild steel	Copper alloy	Iron or steel(2)
Class *B*	Bolted	Copper alloy(1)		Iron or steel(2)
		Aluminium alloy(3)		
	Welded	Mild steel	Copper alloy(1)	Iron or steel(2)
		Aluminium alloy		
		Aluminium alloy(4)	Aluminium alloy(3)	
Class *C*	Bolted	Copper alloy(1)		—
		Aluminium alloy(3)		
	Welded	Mild steel	Copper alloy	
		Aluminium alloy		
		Aluminium alloy(4)	Aluminium alloy(3)	

Notes:

1 The use of brass (cast or wrought) or gun metal is optional.

2 The use of iron (spheroidal graphite cast iron) or steel (mild steel or cast steel) is optional.

3 The use of cast or wrought alloy is optional.

4 The use of plate or extruded material is optional.

Table 8.5 Tensile strength and elongation for the main components

Type of side scuttle	Minimum tensile strength (N/mm^2)	Minimum elongation (%)
Class *A*	300	15
Class *B*	180	10
Class *C*	140	3

Table 8.6 Tensile strength and elongation for the closing devices

Type of side scuttle	Swingbolt and pin		Nut	
	Minimum tensile strength (N/mm^2)	Minimum elongation (%)	Minimum tensile strength (N/mm^2)	Minimum elongation (%)
Class *A*	350	20	250	14
Class *B*	350	15	250	14
Class *C*	250	14	180	8

8.1.5 Testing

1. Watertightness test

The side scuttles are to be tested by being subjected to the hydraulic pressures given in **Table 8.7**. An equivalent hydraulic test is to be carried out by means of patch tests (approximately 10% of the delivery patch, with a minimum of two side scuttles) with glass pane and open deadlight, and without glass pane and closed deadlight.

2. Mechanical strength test

a. A prototype side scuttle without glass pane and with closed deadlight is to be subjected to a mechanical strength test by a punch method according to the test pressures given in **Table 8.8**. For this test, *ISO614* is to be used as a guide.

b. The punch is to be placed on that side of the deadlight which could be subjected to direct contact with the sea.

3. Where the construction of the deadlight makes it necessary, a plate of 100mm diameter and 10mm thickness may be placed between the punch and the deadlight.

a. When subjected to the pressure given in **Table 8.8**, the permanent deformation of the deadlight is not to exceed 1% of the normal size of the side scuttle.

4. Fire-resistance test

Side scuttles for fire-resistant constructions are to be subjected to prototype testing as given in *ISO5797*.

Table 8.7 Test pressures for watertightness

Type of side scuttle	Test pressure (*kPa*)	
	With glass pane, deadlight open	Without pane, deadlight closed
Class *A*	150	100
Class *B*	75	50
Class *C*	35	__

Table 8.8 Test pressure for mechanical strength

Type of side scuttle	Test pressure (kPa)
Class *A*	240
Class *B*	120

8.1.6 Dispensation with Tests

The tensile test specified in **8.1.4** and fire-resistant test specified in **8.1.5-3** for side scuttles may be dispensed with, where these scuttles have appropriate certificates accepted by the Society.

8.1.7 Marking

For the side scuttles which have been satisfactory tested and inspected, the Society s brand, test number and grade identification of the side scuttles are to be stamped on suitable places of the side scuttles.

Chapter 9 RECTANGULAR WINDOWS

9.1 Rectangular Windows

9.1.1 Application

The rectangular windows to be fitted up on ships according to the requirements in **Chapter 22, Part 2** (hereinafter referred to as "rectangular windows") are to comply with the requirements in this Chapter or to be of equivalent quality. However, the manufacturing approval test by the Society is not required.

9.1.2 Classes

Rectangular windows are classified into the following two classes and divided into fixed type and hinged type according to the types of glass holders of the windows, and divided into bolted type and welded type according to the method of fastening the windows.

(1) Class *E* window (Mark, *kQE*)

(2) Class *F* window (Mark, *kQF*)

9.1.3 Construction and Dimension

The construction and dimensions of the main parts of the rectangular windows are to be in accordance with the requirements in the following **(1)** through **(5)** and **Table 9.1** and **Table 9.2**, according to their nominal diameters and grades, and those of other parts are to be determined at the discretion of the Surveyor.

(1) Maximum allowable pressure

The maximum allowable pressure for standard rectangular windows is to be in accordance with the requirements as given in **Table 9.1** and **9.2**. Where one or both dimensions (width or height) of a window are different from those given in **Table 9.1** and **9.2**, maximum allowable pressure (p) is to be determined using the following equation.

$$p = \frac{40000t^2}{\beta b^2} \quad (kPa)$$

t : glass thickness (mm)

β: factor obtained from the graph of **Fig 9.1**.

b: minor dimension of the window (mm)

(2) Glazing

(a) Glazing Material

An appropriate glazing material resistant to sea water and ultraviolet light is to be used.

(b) Mounting

When glazing, glass pane is to be centralized in the glass holder of opening rectangular windows or in the main frame of non-opening rectangular windows so that there is the same clearance all round.

(3) Fasteners (closing devices and hinges)

(a) The minimum number of fasteners comprising closing devices and hinges with round hole for glassholders and deadlights of class E and F window is to be in accordance with the requirements as given in **Table 9.1** and **9.2**.

(b) The total number of the fasteners and their construction is to be such that the rectangular window meets the strength and weathertightness requirements according to **9.1.5**.

(c) Where the hole for the hinge of the glassholder and deadlight is oval, the hinge is not regarded as a fastener.

(4) Gaskets for glassholder and glass retaining frame

(a) For ensuring watertightness between the glassholder and main frame, gaskets type *A*, *B* or *C* according to *ISO3902* are to be used.

(b) The gaskets are to be secured in the grooves by means of a suitable adhesive.

(5) Fixing device

All sidewards opening rectangular windows are to be provided with a fitted fixing device like a hook.

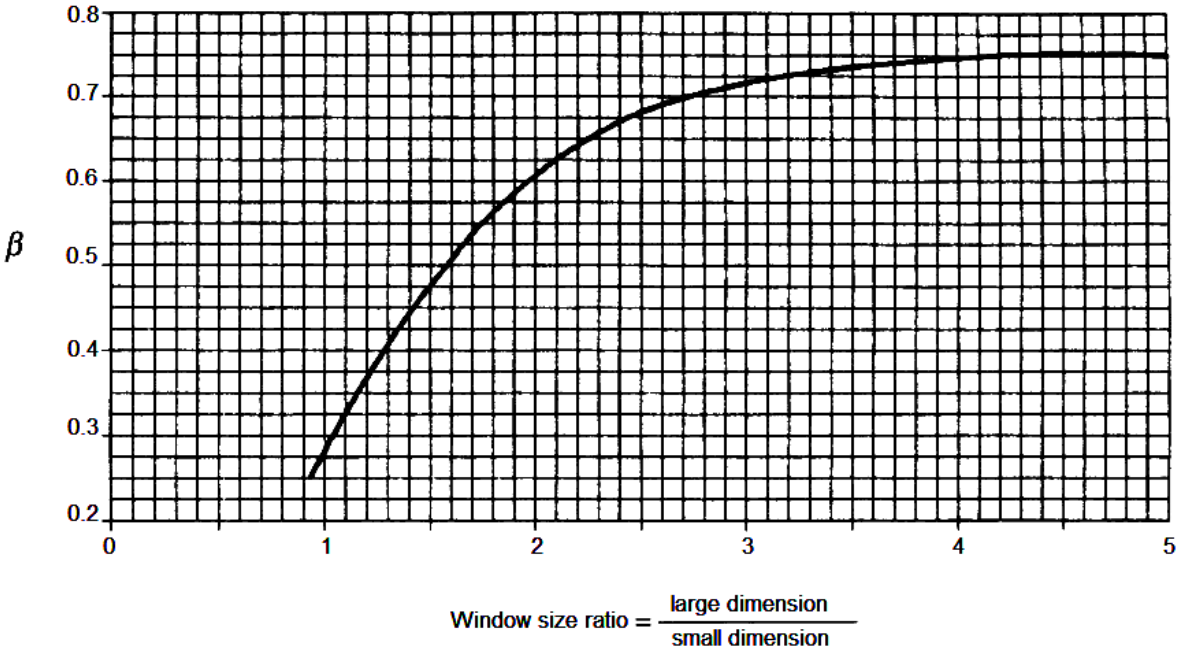
Table 9.1 Class E rectangular window

	Nominal size width (*mm*) X height (*mm*)							
	300 x 425	355 x 500	400 x 560	450 x 630	500 x 710	560 x 800	900 x 630	1000 x 710
Maximum allowable pressure (*kPa*)	99	71	80	63	80	64	81	64
Glass thickness (*mm*)	10	10	12	12	15	15	19	19
Thickness of obscured glass panes when the obscured surface is facing inwards (mm)	15	15	19	19	—	—	—	—
Minimum number of fasteners	4	4	4	4	6	6	6	8

Table 9.2 Class F rectangular window

	Nominal size width (*mm*) X height (*mm*)								
	300 x 425	355 x 500	400 x 560	450 x 630	500 x 710	560 x 800	900 x 630	1000 x 710	1100 x 800
Maximum allowable pressure (*kPa*)	63	45	36	28	36	28	32	25	31
Glass thickness (*mm*)	8	8	8	8	10	10	12	12	15
Thickness of obscured glass panes when the obscured surface is facing inwards (mm)	12	12	12	12	15	15	19	19	—
Minimum number of fasteners	4	4	4	4	6	6	6	8	8

Fig 9.1 Curve for determination of factor β based on window size ratio



9.1.4 Materials

1. Main frame, glassholder and glass retaining frame

The materials used for the main components of the rectangular windows (main frame, glassholder and glass retaining frame) are to be in accordance with the requirements as given in **Table 9.3**. These materials are to have the following properties in **(1)** and **(2)**.

(1) Resistant corrosion;

(2) Minimum mechanical properties as given in **Table 9.4**. (One tensile test specimen is to be taken from each cast. Where the number of casting from one cast exceeds 50, an additional specimen is to be taken from each 50 castings of fraction thereof.)

2. Closing device

The materials used for the closing devices of the rectangular windows (bolts, pin and nuts) are to have the following properties in **(1)** to **(3)**. For aluminium alloy rectangular windows, the swingbolts and hinge pins are to be made of non-corrodible steel, stainless steel or such alloys which are not likely to cause corrosion of rectangular windows, bolts or pins.

(1) resistant to corrosion;

(2) no effect on the corrosion resistance of other parts;

(3) minimum mechanical properties as given in **Table 9.5**. (For casting, one tensile test specimen is to be taken from each cast. Where the number of casting from one cast exceeds 50, an additional specimen is to be taken from each 50 castings of fraction thereof. For aluminium extruded shapes, one tensile test specimen is to be taken one piece per each lot. The extruded shapes of similar thickness made from the same melting and heat treated simultaneously are treated as one lot. Where the number of lots from one lot exceeds 50, an additional specimen is to be taken from each 50 lots of fraction thereof.)

3. Glass panes

Toughened safety glass panes according to *ISO3254* of glass panes of equivalent quality are to be used. For fire resistant glass panes, glass panes according to *ISO5797* or glass panes of equivalent quality are to be used. For heated glass panes, glass panes according to ISO3434 or glass panes of equivalent quality are to be used.

4. Where steel or iron is used, the rectangular windows are to be galvanized.

Table 9.3 Material

Type of rectangular window	Method of fastening the rectangular window	Material		
		Main frame	Glassholder	Glass retaining ring
Opening	Bolted	Brass(1)		
		Aluminium alloy(1)		
	Welded	Mild steel	Brass(1)	
		Mild steel		Brass(1)
		Mild steel		
		Mild steel	Aluminium alloy(1)	
		Aluminium alloy (only wrought or extruded)	Aluminium alloy(1)	
Fixed	Bolted	Brass(1)	___	Brass(1)
		Aluminium alloy(1)	___	Aluminium alloy (1)
	Welded	Mild steel	___	Brass(1)
		Mild steel	___	Mild steel
		Mild steel	___	Aluminium alloy(1)
		Aluminium alloy (only wrought or extruded)	___	Aluminium alloy(1)

Note:
The use of cast or wrought alloy is optional.

Table 9.4 Tensile strength and elongation for the main components

Type of rectangular window	Minimum tensile strength (N/mm^2)	Minimum elongation (%)
Class *E*	180	10
Class *F*	140	3

Table 9.5 Tensile strength and elongation for the closing device

Type of rectangular window	Swingbolt and pin		Nut	
	Minimum tensile strength (N/mm^2)	Minimum elongation (%)	Minimum tensile strength (N/mm^2)	Minimum elongation (%)
Class *E*	350	15	250	14
Class *F*	250	14	180	8

9.1.5 Testing

1. Watertightness test

An equivalent hydraulic test is to be carried out by means of patch tests (approximately 10% of the delivery patch, with a minimum of one window) at a test pressure of *25kPa*.

2. Mechanical strength test

A prototype rectangular window is to be subjected to a mechanical strength test by a suitable test method, applying a load equivalent to the following pressures.

class *E* window:75 *kPa*

class *F* window:35 *kPa*

3. Fire-resistant test

Rectangular windows for fire-resistant constructions are to be subjected to prototype testing as given in *ISO5797*.

4. Test for heated windows

Heated rectangular windows are to be subjected to the electrical testing as given in *ISO3434* clause 5.

9.1.6 Dispensation with Tests

The tensile test specified in **9.1.4** and fire-resistant test specified in **9.1.5-3** for side scuttles may be dispensed with, where these scuttles have appropriate certificates accepted by the Society.

9.1.7 Marking

For the rectangular windows which have been satisfactory tested and inspected, the Society's brand, test number and grade identification of the rectangular windows are to be stamped on suitable places of the rectangular windows.

Chapter 10 NAVIGATION BRIDGE VISIBILITY

10.1 General

10.1.1 Application

Navigation bridge visibility is to be in accordance with the requirements of this Part except ships of less than 55 *m* in length overall.

10.1.2 Ships of unconventional design

With ships of unconventional design which, in the opinion of the Society cannot comply with the requirements of this Part, arrangements are to be provided to achieve a level of visibility that is as near as practical to those prescribed in this Part.

10.1.3 Definition

The definitions of terms which appear in this Part are to be as specified in the following (1) to (8), unless otherwise specified:

(1) Conning position is a place on the bridge with a commanding view and which is used by navigators when commanding, maneuvering and controlling a ship.

(2) Navigator is a person navigating, operating bridge equipment and maneuvering the ship.

(3) Workstation is a position at which one or several tasks constituting a particular activity are carried out.

(4) Field of vision is an angular size of a scene that can be observed from a position on the ships bridge.

(5) Main steering position is a workstation that helmsman steers the ship manually in normal condition.

(6) Bridge is an area from which the navigation and control of the ship is exercised, including the wheelhouse and Bridge wings.

(7) Bridge wings are parts of the bridge on both sides of the ships wheelhouse which extend to the ships side.

(8) Wheelhouse is an enclosed area of the bridge.

10.1.4 Approval Drawings

Three copies of the following drawings are to be submitted for the approval by the Society.

(1) General arrangement of the bridge (showing the conning position, bridge windows, doors, etc.)

(2) Drawings showing the horizontal and vertical fields of vision from the conning position when the ship is in the condition deemed worst such as full load condition, light ballast condition, etc. (If the view from the conning position is obstructed by cargo, cargo gear or other obstructions outside of the wheelhouse, those obstructions are to be shown on the drawings)

10.2 Navigation Bridge Visibility

10.2.1 The View of the Sea Surface

The view of the sea surface from the main conning position is not to be obscured by more than two ship length overall or 500 *m*, whichever is less, forward of the bow to 10° on either side under all conditions of draught, trim and deck cargo.

10.2.2 Blind Sectors

Blind sectors caused by cargo, cargo gear and other obstructions outside of the wheelhouse forward of the beam obstructing the view of the sea surface as seen from the conning position are not to exceed 10° each. The total arc of blind sectors is not to exceed 20°. The clear sectors between blind sectors are not to be less than 5°. However, in the view described in **10.2.1**, each individual blind sector is not to exceed 5°.

10.2.3 Horizontal Field of Vision

1. The horizontal field of vision from the main conning position is to extend over an arc of not less than 225° that is from right ahead to not less than 22.5° abaft the beam on either side of the ship.

2. From each bridge wing the horizontal field of vision is to extend over an arc of at least 225° on the opposite bow through right ahead and then from right ahead to right astern through 180 on the same side of the ship.

3. From the main steering position the horizontal field of vision is to extend over an arc from right ahead to at least 60° on each side of the ship.

10.2.4 Ships Side

The ships side is to be visible from the bridge wing.

10.2.5 Bridge Front Windows

1. The height of the lower edge of the navigation bridge front windows above the bridge deck is to be kept as low as possible. The lower edge is not to obstruct the forward view in any case.

2. The upper edges of bridge front windows are to allow a forward view of the horizon, for a person with a height of eye of 1,800 *mm* above at the main conning position, when the ship is pitching in heaving seas. The flag Government, if satisfied that a 1,800 *mm* height of eye is unreasonable and impractical, allows reduction of the height of eye but not less than 1,600 *mm*.

10.3 Windows

10.3.1 Windows

1. Framing between bridge windows is to be kept to a minimum and is not to be installed immediately forward of any workstation.

2. To help avoid reflections, bridge front windows are to be inclined from the vertical plane top out, at an angle of not less than 10° and not more than 25°.

3. Polarized and tinted windows are not to be fitted.

4. At all times regardless of weather conditions, at least two of the navigation bridge front windows is to provide a clear view, in addition depending on the bridge configuration, an additional number of windows is to provide a clear view.