Contents

RULES FOR THE SURVEY AND CONSTRUCTION OF STEEL SHIPS

Part L EQUIPMENT

Chapter 1 GENERAL

1.1 General

1.1.1 Application

1 Anchors, chains, steel wire ropes, fibre ropes, etc. (hereinafter referred to as "equipment" in this Part) specified in **Chapter 14, Part 1, Part C**, etc. are to be in accordance with the requirements in the following Chapters of this Part.

2 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 are 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** 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 **Chapters 2** 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 "**Rules for Testing Machines**" or other 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 **Chapters 2** to **9** in this Part.

2 Equipment differing from those specified in this Part are 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 K**.

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 K**.

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

1 The manufacturer is to submit the test results which have passed the specified test and inspection according to the kind.

2 The Society issues certificates, which contain the following particulars, for the equipment which have passed the specified test and inspection according to the kind unless the requirements separately specified in other chapters.

(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

2.1 Anchors

2.1.1 Application

Anchors to be equipped on ships in accordance with the provisions in **14.3, Part 1, Part C** are to be in compliance with the requirements in this Chapter or to be of equivalent quality.

2.1.2 Kinds

1 The kinds of anchor are as follows:

Stocked anchor

Stockless anchor

2 Anchors are classified according to their holding power coefficient (value determined by dividing the anchor's holding power by its mass). Anchors with a holding power coefficient of 6 or more but less than 12 are classified as high holding power anchors. Anchors with a holding power coefficient of 12 or more are classified as super holding power anchors.

2.1.3 Materials

1 Materials for anchor are to be cast steels, forged steels or rolled steels specified in **Part K**. 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 K** 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 0℃. 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 19*J*, 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 3**.

2.1.4 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 are generally to be in accordance with the requirements in **Part M**.

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

2.1.5 Heat Treatment

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

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.

2.1.6 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 **5.1.11** and **6.1.11, Part K of the Rules**.

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

2.1.7 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. L2.1**)

(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 L2.1**, in accordance with the anchor mass.

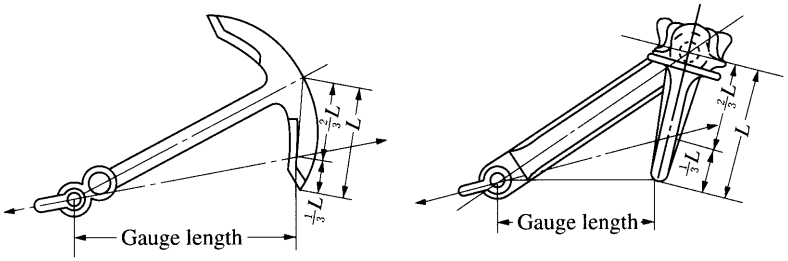
(2) The shackle pin is to be a push fit in the eyes of the shackle, which are to be chamfered on the outside to ensure a good tightness when the pin is clenched over on fitting. The shackle pin to hole tolerance is to be given in **Table L2.2** in accordance with diameter of the shackle pins.

(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* **Fig. L2.2**)

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

Fig. L2.1



Stocked Anchor　　Stockless Anchor

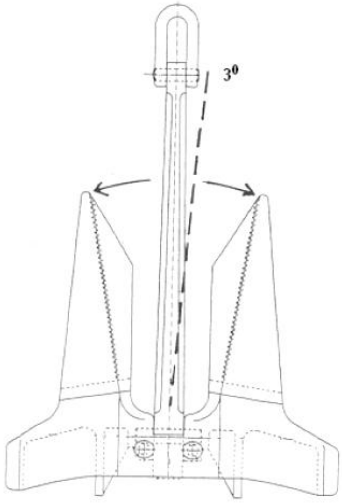
Table L2.1　The Clearance Either Side of the Shank within the Shackle Jaws

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 L2.2　The Shackle Pin to Hole Tolerance

The diameter of shackle pin (*mm*)	Negative hole tolerance (*mm*)
up to 57	0.5
over 57	1.0

Fig. L2.2 Allowable Range of the Lateral Movement of the Shank



2.1.8 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 manufacturer before executing proof test. The manufacturer 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.

2.1.9 Drop and Hammering Tests*

1 Cast steel anchors are to be subjected to the following tests prior to the execution of the tests specified in **2.1.10** and are to comply with the test requirements:

(1) Drop tests

(a) 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.

(b) 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.

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

(2) Hammering tests

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.

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

3 Where additional non-destructive test and mechanical test comply with the approval by the Society in additional of requirements in **2.1.11-2** and **-3**, drop and hammering tests may be omitted subject to the approval by the Society.

2.1.10 Proof Tests

1 Anchors are to be tested in accordance with the requirements in **Table L2.3**, 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. L2.1**)

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.

2.1.11 Visual Inspections and Non-destructive Tests*

1 After the proof load test, visual 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 the visual 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 visual inspection and non-destructive test, repairs are to be carried out in accordance with **2.1.6-2** and **-3**.

2.1.12 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**.

2.1.13 Painting

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

2.1.14 Test Certificate

The Society issues certificates, which contain the following particulars, for the Anchors which have passed the specified test and inspection.

(1) Manufacturer's name
(2) Type
(3) Mass
(4) Fluke and Shank identification numbers
(5) Grade of materials
(6) Proof test loads
(7) Kind of Heat treatment
(8) Marking applied to anchor
(9) Visual Inspection and Non-destructive Test result
(10) Drop and Hammering Tests result, where applicable

Table L2.3 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	1,050	208	4,700	638	11,500	1,090
30	14.5	1,100	216	4,800	645	12,000	1,110
35	16.9	1,150	224	4,900	653	12,500	1,130
40	19.1	1,200	231	5,000	661	13,000	1,160
45	21.2	1,250	239	5,100	669	13,500	1,180
50	23.2	1,300	247	5,200	677	14,000	1,210
55	25.2	1,350	255	5,300	685	14,500	1,230
60	27.1	1,400	262	5,400	691	15,000	1,260
65	28.9	1,450	270	5,500	699	15,500	1,270
70	30.7	1,500	278	5,600	706	16,000	1,300
75	32.4	1,600	292	5,700	713	16,500	1,330
80	33.9	1,700	307	5,800	721	17,000	1,360
90	36.3	1,800	321	5,900	728	17,500	1,390
100	39.1	1,900	335	6,000	735	18,000	1,410
120	44.3	2,000	349	6,100	740	18,500	1,440
140	49.0	2,100	362	6,200	747	19,000	1,470
160	53.3	2,200	376	6,300	754	19,500	1,490
180	57.4	2,300	388	6,400	760	20,000	1,520
200	61.3	2,400	401	6,500	767	21,000	1,570
225	65.8	2,500	414	6,600	773	22,000	1,620
250	70.4	2,600	427	6,700	779	23,000	1,670
275	74.9	2,700	438	6,800	786	24,000	1,720
300	79.5	2,800	450	6,900	794	25,000	1,770
325	84.1	2,900	462	7,000	804	26,000	1,800
350	88.8	3,000	474	7,200	818	27,000	1,850
375	93.4	3,100	484	7,400	832	28,000	1,900
400	97.9	3,200	495	7,600	845	29,000	1,940
425	103	3,300	506	7,800	861	30,000	1,990
450	107	3,400	517	8,000	877	31,000	2,030
475	112	3,500	528	8,200	892	32,000	2,070
500	116	3,600	537	8,400	908	34,000	2,160
550	124	3,700	547	8,600	922	36,000	2,250
600	132	3,800	557	8,800	936	38,000	2,330
650	140	3,900	567	9,000	949	40,000	2,410
700	149	4,000	577	9,200	961	42,000	2,490
750	158	4,100	586	9,400	975	44,000	2,570
800	166	4,200	595	9,600	987	46,000	2,650
850	175	4,300	604	9,800	998	48,000	2,730
900	182	4,400	613	10,000	1,010	-	-
950	191	4,500	622	10,500	1,040	-	-
1,000	199	4,600	631	11,000	1,070	-	-

Note:

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

2.2 Anchors Used for Positioning Systems

2.2.1 Application

1 Anchors used for the positioning systems of the mobile offshore drilling units, special purpose barges and floating offshore facilities, etc., or vessels engaged in specific work for a specified period at a specific location are to be in compliance with the requirements in this section or their equivalent. Mobile offshore drilling units, special purpose barges and floating offshore facilities, etc., (hereinafter referred to as "floating offshore facilities" in this section) refer to steel-made ships and floating structures generally positioned for a specified period at a specific sea area.

2 The kinds of anchors specified in this chapter are to be stockless anchors fabricated by welding rolled steel or stocked anchors and stockless anchors whose main components are cast steel.

2.2.2 Definitions

The wording "long periods of time" specified in this section refers to periods longer than 5 years.

2.2.3 Materials

1 Materials for anchors including anchor rings and head pins, etc., are to be approved according to requirements specified in **Part K,** except where deemed appropriate by the Society.

2 Cast steels for anchors are to be subjected to impact tests. The test assembly is to be integrally cast with the casting and one three-piece set of the *V*-notch impact test specimens specified in **Chapter 2, Part K** is to be taken. The minimum mean absorbed energy is not to be less than 27*J* at 0°C. The impact test is considered to be failed when either the absorbed energy of two or more test specimens among a set of test specimens is less than 27*J*, or the absorbed energy of a single test specimen is less than 19*J*.

3 Cast steels are not to be used for the head pins connecting anchor heads and shanks.

2.2.4 Processes of Manufacture and Constructions

1 Manufacturers are to obtain approval of manufacturing process from the Society in advance. Society approval, however, is not required for the manufacturing processes of anchors intended for use on vessels or floating offshore facilities fixed or positioned at specific sea areas for long periods of time.

2 For anchors intended for use on vessels or floating offshore facilities fixed or positioned at specific sea areas for long periods of time, detailed data relating to performance, etc. are to be submitted for Society approval in accordance with **Chapter 1A, Part 2 of the Guidance for the Approval and Type Approval of Materials and Equipment for Marine Use**.

3 Anchors are to be appropriately fabricated in accordance with Society approved design drawings, etc.

4 Anchor structures and shapes are to be such that the anchor cannot be slid, uplifted, overturned, etc. by any anticipated mooring line tension, etc.

5 The welding for rolled steel fabricated anchors is to be in accordance with the requirements in **Part M**, except where deemed appropriate by the Society.

6 Anchor rings are to be equivalent in strength to that required for the accessories of offshore chains specified in **Chapter 3, Part L**.

7 When anchor pins, etc. are to be welded, manufacturers are to obtain Society approval in advance for the welding methods to be used.

2.2.5 Dimensions and Mass

Anchor dimensions and mass are to be measured by the manufacturer and relevant measurement data is to be made available to surveyors upon request.

2.2.6 Heat Treatment

1 Cast or forged components for anchors are to be properly heat treated in accordance with relevant requirements in **Part K**.

2 The welding for rolled steel fabricated anchors may require stress relief after welding as necessary. Manufacturers are to obtain Society approval in advance for any stress relief methods which may be used. Stress relief temperatures are not to exceed the tempering temperature of the base material.

2.2.7 Product Quality and Defect Repair

1 Anchors are to be free from cracks, notches, inclusions and other defects which may impair performance.

2 Any repairs needed for forged and cast anchors are carried out in accordance with the requirements in **5.1.11** and **6.1.11, Part K of the Rules**.

3 Any repairs needed to the welding of rolled steel fabricated anchors are to be carried out in accordance with the requirements in **1.4.2, Part M of the Rules**.

2.2.8 Drop and Hammering Tests*

1 Main cast components of anchors are to be subjected to and pass the following tests before carrying out proof tests:

(1) Drop tests

(a) Each cast steel component of an anchor is to be lifted to a height of 4 *metres* and then dropped onto a steel slab located on a hard surface. The component is to be found free of any cracks or other defects.

(b) Where shanks and arms for stock anchors are integrally cast as a single piece, said piece is first to be lifted to the specified height with the shank and arms in a horizontal position and then dropped onto a steel slab. The piece is then to be lifted to the specified height once again, but this time with the crown facing downwards. It is then to be dropped onto two steel blocks arranged on the slab in a way that places the force of the impact at the middle of each arm without allowing the crown to touch the slab.

(c) When the steel slab is broken by the impact of the component being tested, it is to be replaced and the component is to be retested using the new slab.

(2) Hammering tests

After passing the drop tests specified in **(1)** above, the component to be hung clear of the ground and struck with a hammer whose mass is 3 *kg* or more. The component is to be found free of any cracks or other defects.

2 Repairs are not allowed to be made to components whose test results are unsatisfactory.

3 Drop and hammering tests need not be carried out when components pass additional non-destructive tests and impact tests deemed appropriate by the Society.

2.2.9 Proof Tests*

1 Anchors intended for use on vessels or floating offshore facilities fixed or positioned at specific sea areas for up to 5 years are to be subjected to proof tests.

2 Proof test loads are to be applied at flukes of the anchor, either for each arm separately or for both arms simultaneously depending upon the construction of the anchor, and the anchor is to be found free from cracks, deformation or other defects.

3 Proof test loads are to be taken the greater of 50% of the minimum breaking strength of the mooring line or values obtained from dividing maximum holding capacity of the anchor by a safety factor separately specified by the Society.

4 Notwithstanding the requirement given in **-1** above, proof tests need not be carried out when deemed appropriate by the Society.

2.2.10 Visual Inspections and Non-destructive Tests*

1 Anchors are to be subjected to and pass visual inspections and the non-destructive tests specified in **(1)** to **(4)** below. Such inspections and tests are, however, to be carried out after proof tests are completed.

(1) Cast components of anchors are to be examined using dye penetrant testing or magnetic particle testing in way of feeder heads and risers and where weld repairs have been carried out.

(2) Cast components of anchors are to be examined using ultrasonic testing in way of feeder heads and risers and then dye penetrant testing or the magnetic particle testing of all surfaces is to be carried out in addition to inspections specified in **(1)** above.

(3) Welded sections of rolled steel fabricated anchors are to be examined using dye penetrant testing or magnetic particle testing.

(4) For anchors complying with the requirements in **Chapter 1A, Part 2 of the Guidance for the Approval and Type Approval of Materials and Equipment for Marine Use** or **2.2.9-4** above, ultrasonic testing is to be carried out for all full penetration welding in addition to the tests specified in **(3)** above.

2 Repairs are to be carried out in accordance with **2.2.7-2** and **-3** for any defects detected through visual inspections and non-destructive tests.

2.2.11 Holding Power Tests*

1 Anchors are to be subjected to and pass holding power tests designated by the Society.

2 Notwithstanding the requirement given in **-1** above, holding power tests designated by the Society need not be carried out or need only be partially carried out when previous test results or documents verifying the results of equivalent tests carried out in accordance with standards deemed appropriate by the Society are submitted to the Society and deemed appropriate.

2.2.12 Marking

When anchors have passed the tests and inspections, they are to be stamped with the mass of anchor (excluding the mass of

stock for stocked anchors) at the middle position of the shank and the Society's brand, the test number and the manufacturer's name (or symbol) at a position two-thirds of the length of arm from the tip of the fluke on the same side. When the anchor is formed with a 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. For stocked anchors, the mass of stock, the Society's brand, the test number, and the manufacturer's name (or symbol) are to be stamped on the stock.

2.2.13 Painting

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

2.2.14 Test Certificates

The Society issues certificates containing the following information for anchors which have passed specified tests and inspections.

(1) Manufacturer's name
(2) Type
(3) Mass
(4) Grade of material
(5) Kind of heat treatment, where applicable
(6) Drop and hammering tests results, where applicable
(7) Proof test loads, where applicable
(8) Visual inspection and non-destructive test results
(9) Holding power test results
(10) Identification numbers for flukes and shanks
(11) Markings applied to the anchor

Chapter 3 CHAINS

3.1 Chains

3.1.1 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 **3.1** or to be of equivalent quality.

3.1.2 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

3.1.3 Materials*

1 Chains are to be made of the materials given in **Table L3.1** 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 K**.

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 L3.2** according to the grades and manufacturing processes of the connected chain, respectively.

Table L3.1 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 L3.2 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.

3.1.4 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.

3.1.5 Heat Treatment

1 The heat treatment of chains and accessories is to comply with the requirements given in **Table L3.3**.

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 L3.3 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, Quenched and tempered

Note:

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

3.1.6 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.

3.1.7 Dimensions and Forms*

1 The standard dimensions and forms of each kind of link and accessory are to be as given in **Fig. L3.1**.

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.

3.1.8 Dimensional Tolerances*

The tolerances for chains and accessories are to comply with the following requirements and the dimensions thereof 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 L3.4**, 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 L3.4 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

3.1.9 Mass

The mass of chains is to comply with the standard mass given in **Table L3.5**, in accordance with their kind, and to be measured after the execution of proof tests.

3.1.10 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.

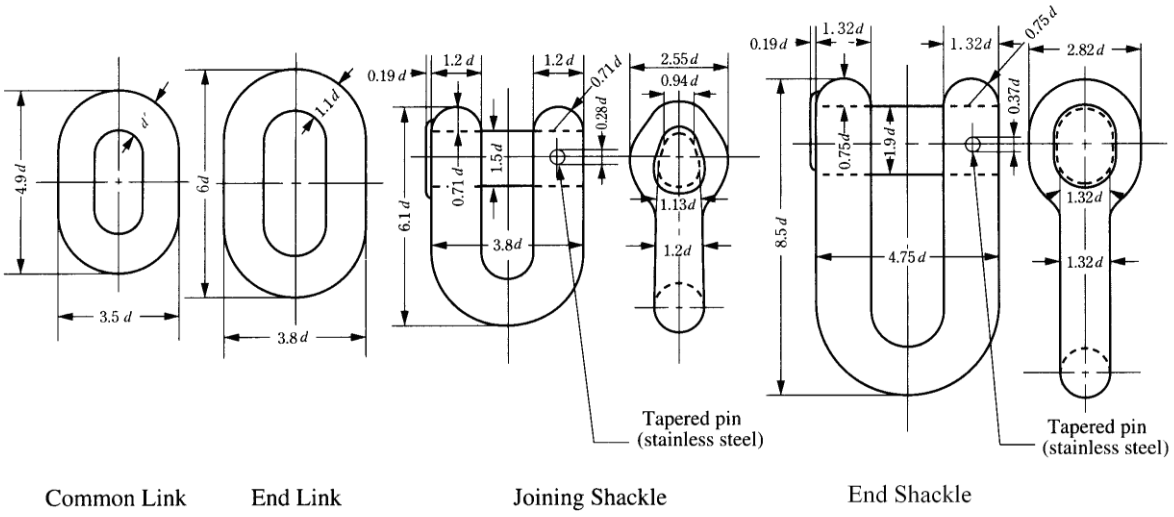
3 The test specimens are to withstand satisfactorily the breaking test loads specified in **Table L3.5** according to their grades. The breaking test load is to be maintained for a minimum of 30 *seconds*.

4 Where the capacity of the testing machine does not reach the breaking test loads specified in **Table L3.5**, the breaking test may be substituted by a method approved by the Society.

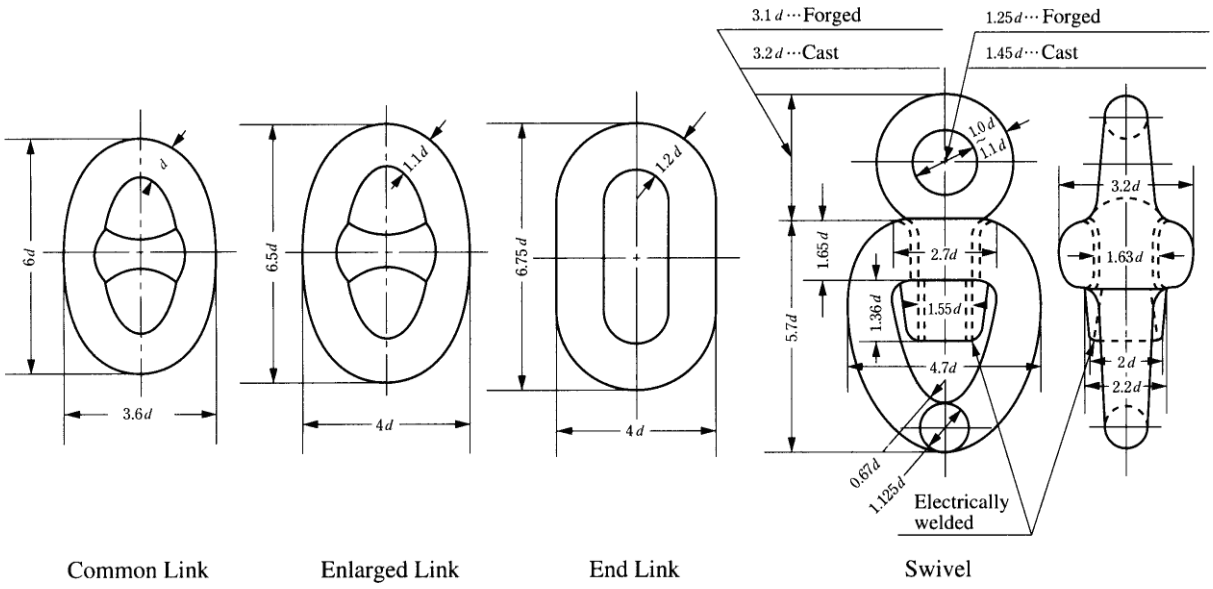
5 Where the test is not satisfactory, the chain may be retested by taking out another set of test specimens from the same length of chain, and where the test specimens comply with the requirements, the remaining three lengths of chain may be accepted. Where the retest fails, the length of chain from which the test specimens 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.

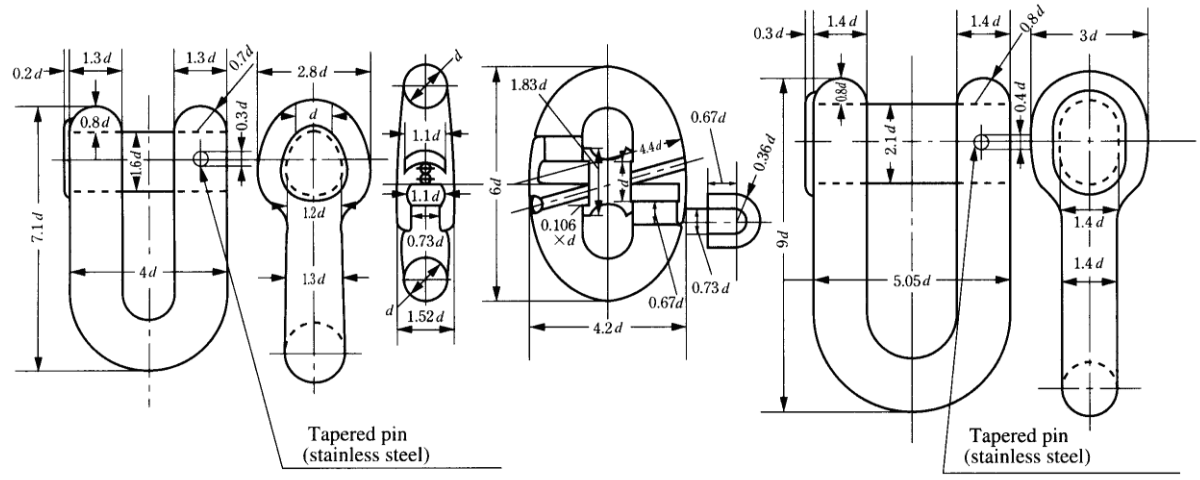
6 Where the missing chain links due to the preparation of the retest of **-5** above are replaced by new chain links, the test specimens manufactured by the same procedure are to be subjected to the breaking test, and are to comply with the requirements.

Fig. L3.1 Dimensions and Forms of Chain Link, Shackle and Swivel



(1) Studless Short Link Chain and Shackle





(2) Stud Link Chain and Shackle

Table L3.5 Breaking and Proof Test Loads for Chains

Nominal diameter d(*mm*)	Stud link chain							Studless chain		
	Grade 1 chain		Grad 2 chain		Grade 3 chain		Mass of chain per metre (*kg*)	Breaking test load (*kN*)	Proof test load (*kN*)	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*)				
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	523	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	54.75	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	2,410	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	5,840	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	441.6			
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 diameter (*mm*)

3.1.11 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 L3.5** 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 test 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.

3.1.12 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 L3.5** 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 L3.5**, 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.

3.1.13 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 L3.6**.

3 Except for applying **Notes (2)** and **(3)** of **Table L3.6,** 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 K**.

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 **3.6.11, Part K**.

3.1.14 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.

3.1.15 Painting

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

3.1.16 Test Certificate

1 The Society issues certificates, which contain the following particulars, for the Chains which have passed the specified test and inspection.

(1) Manufacturer's name

(2) Grade

(3) Chemical composition (including total aluminum content)

(4) Nominal diameter and weight

(5) Proof and break load
(6) Kind of Heat treatment
(7) Marks applied to chain
(8) Length
(9) Mechanical properties, where applicable

2 The Society issues certificates, which contain the following particulars, for the Accessories which have passed the specified test and inspection.

(1) Manufacturer's name
(2) Grade
(3) Heat number
(4) Chemical composition (including total aluminum content)
(5) Nominal diameter and weight
(6) Proof and break load
(7) Kind of Heat treatment
(8) Marks applied to accessories
(9) Mechanical properties, where applicable

Table L3.6 Mechanical Properties

Kind 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 (℃)	Minimum mean absorbed energy (J)	Testing temperature (℃)	Minimum mean absorbed 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.

3.2 Offshore Mooring Chains and Others

3.2.1 Application

Offshore mooring chains (hereinafter referred to as "offshore chain") and shackles and swivels, etc. which are connected to the offshore chain (hereinafter referred to as "accessories for offshore chain") are to comply with the requirements in **3.2** or to be of equivalent quality.

Where, an offshore chain is used for mobile offshore drilling units and special purpose barges defined in **Part P**.

3.2.2 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 **3.2**. 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 **3.2**. In this case, Number and type of joining shackles used are to be subject to the

approval of the Society.

3.2.3 Kinds of Offshore Chains

Offshore chains are to be subdivided into five grades that are Grade *R*3 offshore chain, Grade *R*3*S* offshore chain, Grade *R*4 offshore chain, Grade *R*4*S* offshore chain and Grade *R*5 offshore chain.

3.2.4 Materials*

1 Offshore chains are to be made of the materials given in **Table L3.7** 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 L3.8** corresponding to the grades of the connected offshore chain.

Table L3.7 Materials for Offshore Chain Link

Grades of offshore chain	Materials	Grade of material
Grade *R*3 offshore chain	Grade *R*3 offshore chain bar	*KSBCR*3
Grade *R*3*S* offshore chain	Grade *R*3*S* offshore chain bar	*KSBCR*3*S*
Grade *R*4 offshore chain	Grade *R*4 offshore chain bar	*KSBCR*4
Grade *R*4*S* offshore chain	Grade *R*4*S* offshore chain bar	*KSBCR*4*S*
Grade *R*5 offshore chain	Grade *R*5 offshore chain bar	*KSBCR*5

Table L3.8 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	*KSCCR*3*S*	Grade *R*3*S* steel forging for offshore chain	*KSFCR*3*S*
Grade *R*4 offshore chain	Grade *R*4 steel casting for offshore chain	*KSCCR*4	Grade *R*4 steel forging for offshore chain	*KSFCR*4
Grade *R*4*S* offshore chain	Grade *R*4*S* steel casting for offshore chain	*KSCCR*4*S*	Grade *R*4*S* steel forging for offshore chain	*KSFCR*4*S*
Grade *R*5 offshore chain	Grade *R*5 steel casting for offshore chain	*KSCCR*5	Grade *R*5 steel forging for offshore chain	*KSFCR*5

3.2.5 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 Bar materials for links are to be heated by electric resistance, induction or in a furnace.

3 In cases where the studs for Grade *R*3 offshore chains and Grade *R*3*S* offshore chains are welded, the following **(1)** to **(7)** are to be complied with:

(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. The stud is to be fixed firmly to the link, and the fixed stud is not to cause any harmful notch effect or stress concentration in the link.

(2) The toes of the fillets are to have a smooth transition to the link.

(3) The size of the fillets is to be not less than the dimensions specified in *API* Specification 2F.

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

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

(6) The welds are to be free from defects such as clacks, lack of fusion, gross porosity and undercuts exceeding 1 *mm*.

(7) Welding is to be carried out according to an approved procedure, by a welder qualified by the Society, with approved low hydrogen electrodes.

4 Welding of studs in grade *R*4 offshore chain, grade *R*4*S* offshore chain and grade *R*5 offshore chain is not permitted unless specially approved by the Society.

5 Accessories for 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.

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

7 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℃. However, an alternative procedure may be applied to this joining method where specially approved by the Society.

3.2.6 Offshore Chain Manufacturers

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

3.2.7 Heat Treatment and Grain Size*

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. In cases where tempering is carried out, a control standard for the combination of holding temperature and time is to be established and such standard is to be complied with. Cooling after tempering is to be appropriate to avoid temper embitterment.

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

3 Offshore chains are to be austenitized in accordance with the established control standard for the combination of austenitizing temperature and time.

4 The austenitic grain size of an offshore chain is to be 6 or finer in accordance with *ASTM E*112 or an equivalent grain size index in accordance with *ISO* 643, or to be deemed as equivalent by the Society. Measurements of grain size are to be taken at the surface, at a depth of 1/3 radius and at the central region for welded material, base metals and heat-affected zones from the maximum sampling interval corresponding to the nominal diameter of the offshore chain specified in **Table L3.11**.

3.2.8 Dimensions and Forms

1 The standard dimensions and forms of each kind of link and accessory are to be as given in **Fig. L3.2**.

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.

3.2.9 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 L3.9**. The plus tolerance at the crown part of each kind of link may be up to 5% of its nominal diameter. In cases where the diameter is less than 20 *mm*, the plus tolerance at the crown part of each kind of link is to be agreed upon by the Society and the purchaser at the time of approval.

(2) The cross sectional area at the crown is to be calculated using the average of the diameters with negative tolerance and plus tolerance, measurements are to be taken from at least 2 locations approximately 90 degrees apart.

(3) No negative tolerances other than the crown part and the flash butt weld of each kind of link are permitted and the plus tolerances are to be up to +5% in cases where deemed appropriate by the Society. In cases where the diameter is less than 20 *mm*, the plus tolerances are to be agreed upon by the Society and the purchaser at the time of approval.

(4) Notwithstanding to the requirements specified in **(1)** and **(3)** above, no negative tolerance of the diameter at the flash butt weld is permitted. The plus tolerances thereof are left to the discretion of the Society.

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

(6) The tolerances except for the requirements specified in **(1)** to **(5)** above are to be $\pm$2.5%.

3 For all offshore chain, a length of five common links which are connected is to be measured. The measurement of a length of five links is 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 L3.10**. Any deviations from link tolerances are to be agreed upon by the Society and the purchaser.

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 approved load.

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 inserted in their place. In this case, proof tests are to be carried out again after insertion of a connecting common link, and dimensions of a connecting common link are to be 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)**. These tolerances do not apply to machined surfaces.

(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 $\pm$2.5%.

8 The manufacturer of accessories for offshore chains is to provide a statement indicating compliance with the purchaser's requirements.

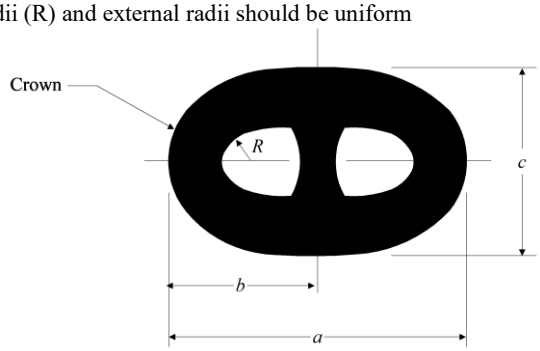
9 If link diameter, length, and stud alignment do not conform to the required dimensions, these are to be compared to the dimensions of 40 more links; on each side of the affected link. If a single of the aforementioned dimensions fails to meet the required dimensional tolerance in more than 2 of the sample links, all links are to be examined and comply with **-6** above.

3.2.10 Mass

The mass of offshore chains is to comply with the standard mass given in **Table L3.10**, in accordance with their kind, and to be measured after the execution of proof tests.

Fig. L3.2 Stud Link and Studless Common Link, Proportions Dimensions and Tolerances

Stud link - The internal link radii (R) and external radii should be uniform

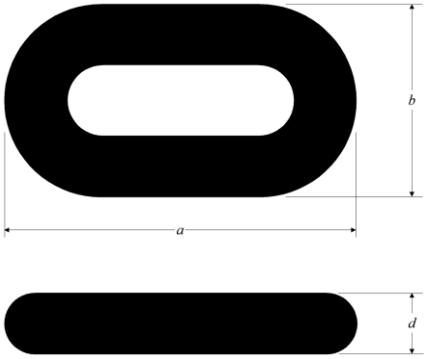


Designation(1)	Description	Nominal Dimension of the Link	Minus Tolerance	Plus Tolerance
a	Link Length	6*d*	0.15*d*	0.15*d*
b	Link Half Length	$a^*/2$	0.1*d*	0.1*d*
c	Link Width	3.6*d*	0.09*d*	0.09*d*
e	Stud Angular Misalignment	0 *degrees*	4 *degrees*	4 *degrees*
R	Inner Radius	0.65*d*	0	-----

Notes:

(1) Dimension designation is shown in above figure.
d = Nominal diameter of chain
a^* = Actual link length

Studless - The internal link radii (R) and external radii 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 Width	3.35*d*	0.09*d*	0.09*d*
R	Inner Radius	0.60*d*	0	-----

Notes:

(1) Dimension designation is shown in above figure.
d = Nominal diameter of chain

(2) Other dimension ratios are subject to special approval.

Table L3.9 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 up to 152	4
over 152 up to 184	6
over 184 up to 222	7.5

Table L3.10 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*4*S* Stud Link	Grade *R*5 Stud Link
Proof test load (*kN*)	$0.0148d^2(44-0.08d)$	$0.0180d^2(44-0.08d)$	$0.0216d^2(44-0.08d)$	$0.0240d^2(44-0.08d)$	$0.0251d^2(44-0.08d)$
Breaking test load (*kN*)	$0.0223d^2(44-0.08d)$	$0.0249d^2(44-0.08d)$	$0.0274d^2(44-0.08d)$	$0.0304d^2(44-0.08d)$	$0.0320d^2(44-0.08d)$
Test Load	Grade *R*3 Studless	Grade *R*3*S* Studless	Grade *R*4 Studless	Grade *R*4*S* Studless	Grade *R*5 Studless
Proof test load (*kN*)	$0.0148d^2(44-0.08d)$	$0.0174d^2(44-0.08d)$	$0.0192d^2(44-0.08d)$	$0.0213d^2(44-0.08d)$	$0.0223d^2(44-0.08d)$
Breaking test load (*kN*)	$0.0223d^2(44-0.08d)$	$0.0249d^2(44-0.08d)$	$0.0274d^2(44-0.08d)$	$0.0304d^2(44-0.08d)$	$0.0320d^2(44-0.08d)$
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*				

3.2.11 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 L3.11** corresponding to its nominal diameter provided that every cast is represented.

(3) Each specimen is to be capable of withstanding the breaking test load specified in **Table L3.10** without fracture maintained at that load for 30 *seconds*.

(4) If a breaking test fails, a thorough test is to be carried out to identify the cause of failure. Tests to identify the cause of failure may be required where deemed necessary by the Society.

(5) 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 **(4)**.

(6) If either or both results of the additional test and failure investigation specified in **(4)** and **(5)** 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 inserted in its place and the breaking test may be carried out again. If the result of the retest is found satisfactory, the sampling length of offshore chain represented may be passed.

(7) 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 be approved by the Society, every heat is to be represented, the test frequency is to be in accordance with **Table L3.11**, 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. A batch is defined as accessories made from the same charge and heat treated simultaneously in the same furnace.

(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, individually heat treated 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 breaking test 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.

(5) In the event of a failure of the breaking test, the entire batch represented is to be rejected unless the cause of failure has been determined and it can be demonstrated to the Surveyor's satisfaction that the condition causing the failure is not present in any of the remaining accessories.

Table L3.11 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
$186 < d \leq 198$	370
$198 < d \leq 210$	395
$210 < d \leq 222$	420

3.2.12 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 L3.10** without crack, breakage or any other defects. Proof test load is not to exceed 110% of the minimum proof load specified in **Table L3.10**.

(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 failure investigation is to be carried out to identify the probable cause of failure of the proof test from the manufacturing records. Tests to identify the cause of failure may be required where deemed necessary by the Society. 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 investigation, a retest is to be carried out in accordance with the following **(a)** to **(c)** and where these results are found satisfactorily, it will be decided what length of offshore chain can be considered for acceptance based upon the results of that investigation.

(a) A breaking test specimen is to be taken from each side of one failed link in accordance with **3.2.11-1(1)** and subjected to a breaking test.

(b) The defective link is to be cut out, a connecting common link inserted in their place and the proof load test is to be carried out again.

(c) Notwithstanding the requirements in **(a)** and **(b)** above, in cases where multiple chains having the same diameter and grade which produced at the same time are tested simultaneously, the chains connected with one failed link may be treated as being on an alternative chain length or the other end of the chain length. In such cases, breaking test specimens that include the link connected with one failed link may be taken in accordance with **3.2.11-1(1)** and subjected to a breaking test in cases where deemed necessary by the Society.

(4) In the event that two or more links in the proof loaded length fail, that section of proof loaded length of offshore chain is to be rejected, a thorough failure investigation is to be carried out to identify the probable cause of failure of the proof test from the manufacturing records. Tests to identify the cause of failure may be required where deemed necessary by the Society. In cases 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 investigation, a retest is to be carried out in accordance with the following **(a)** to **(c)** and where these results are found satisfactorily, it will be decided what length of offshore chain can be considered for acceptance based upon the results of that investigation.

(a) A breaking test specimen is to be taken from each side of the failed section in accordance with **3.2.11-1(1)** and subjected to a breaking test.

(b) The failed section is to be cut out, a connecting common link inserted in its place and the proof load test is to be carried out again.

(c) Notwithstanding the requirements in **(a)** and **(b)** above, in cases where multiple chains having the same diameter and grade which produced at the same time are tested simultaneously, the chains connected with the failed section may be treated as being on an alternative chain length or the other end of the chain length. In such cases, breaking test specimens that include the link connected with the failed section may be taken in accordance with **3.2.11-1(1)** and subjected to a breaking test in cases where deemed necessary by the Society.

(5) If the investigation identifies defects in the flash butt weld or a lower strength flash weld is found from the investigations in **(3)** and **(4)** above, an additional non-destructive test is to be carried out to identify if other links are affected. A full assessment of the flash butt welding machine is to be carried out together with assessment of the condition of the bar ends prior to welding.

2 All kinds of accessories and connecting common links are to be proof tested in accordance with the following:

(1) They are tested to the proof test loads specified in **Table L3.10**, in accordance with the kinds and diameters of the offshore chains to be connected therewith, and they are to withstand the tests without cracking, breaking or any other defects. This test may be carried out simultaneously with the proof test for offshore chains or together with any offshore chains of the same diameter with which the accessories are connected.

(2) In the event of a failure of the proof test, the entire batch represented is to be rejected unless the cause of failure has been determined and it can be demonstrated to the Surveyor's satisfaction that the condition causing the failure is not present in any of the remaining accessories.

3.2.13 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 L3.11**. Test specimens are to be taken from the location given in **Fig. L3.3** 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 K**.

(3) Mechanical properties are to comply with the requirements specified in **Table L3.12**.

(4) If the tensile test results do not conform to the requirements, a retest of two further specimens selected from the same sample may be carried out. If the results of both additional tensile tests comply with the requirements specified in **Table L3.12**, the sampling length of offshore chain is considered acceptable. If the retest results do not comply with the requirements, the sampling length of offshore chain is to be cut out, a connecting common link inserted in its place and the proof load test is to be carried out again.

(5) If the impact test results do 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 L3.12** and the new average comply with the requirements specified in **Table L3.12**, the sampling length of offshore chain is considered acceptable. If the retest results do not comply with the requirements, the sampling length of offshore chain is to be cut out, a connecting common link inserted in its place and the proof load test is to be carried out again.

(6) Hardness tests for offshore chains are to be carried out in the following manner:

(a) One hardness test specimen is to be taken at a depth of 1/3 radius for flash butt weld with base metal from the maximum sampling interval corresponding to the nominal diameter of offshore chain specified in **Table L3.11**.

(b) The results of hardness tests are reference values. However, hardness is to be a maximum of 330 *HBW* at the base metal for grade *R*4*S* and 340 *HBW* at the base metal for grade *R*5.

(c) Based upon the results of hardness tests, it is to be verified that the heat treatment process has been stable during chain production.

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 and proof loaded.

(1) One tensile test specimen and one set (3 pieces) impact test specimen are to be taken at the frequency specified in **3.2.11-2(1)** and in the locations specified in **Fig. L3.4** of accessories of offshore chains and connecting common links and mechanical tests are to be carried out. The locations of mechanical tests of other accessories with complex geometries are to be at the discretion of the Society.

(a) The mechanical test pieces of cast shackles and cast kenter shackles are to be taken from the straight part or crown of the accessory.

(b) The mechanical test pieces of forging shackles and forging kenter shackles are to be taken from the crown of the shackle. In cases where the diameter of shackle is small or the geometry does not permit a tensile specimen from the crown, tensile test pieces may be taken from the straight part of shackles.

(c) The mechanical test pieces of pins of shackles are taken as per **Fig. L3.4** from the mid length of a sacrifice pin of the same diameter as the final pin. For oval pins the diameter taken is to represent the smaller dimension. Mechanical tests may be taken from an extended pin of the same diameter as the final pin that incorporates a test prolongation and a heat treatment buffer prolongation, where equivalence with mid length test values have been established. The length of the buffer is to be at least equal to 1 pin diameter which is removed after the heat treatment cycle is finished. The test coupon can then be removed from the pin. The buffer and test are to come from the same end of the pin as per **Fig. L3.5**.

(2) Mechanical properties are to comply with the requirements specified in **Table L3.12**.

(3) Where the test results specified in **(1)** and **(2)** 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 L3.12**, 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 L3.12**, the sampling rot represented is to be subjected to rejection.

(4) For individually produced accessories or accessories produced in small batches (less than 5), alternative tests may be accepted provided they are deemed appropriate by the Society.

(5) In the event of a failure of the mechanical test, the entire batch represented is to be rejected unless the cause of failure has been determined and it can be demonstrated to the Surveyor's satisfaction that the condition causing the failure is not present in any of the remaining accessories.

(6) Hardness tests for offshore chains are to be carried out in the following manner:

(a) One hardness test specimen is to be taken at a depth of 1/3 radius from surface and the frequency specified in **3.2.11-2(1)**.

(b) The results of hardness tests are reference values. However, hardness is to be a maximum of 330 *HBW* at the base metal for grade *R*4*S* and 340 *HBW* at the base metal for grade *R*5.

(c) Based upon the results of hardness tests, it is to be verified that the heat treatment process has been stable during chain production.

Fig. L3.3 Location for Sampling Test Specimens for Links of Offshore Chains

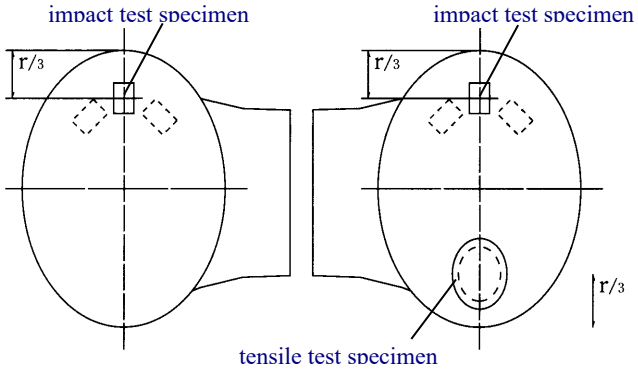


Fig. L3.4 Sampling Locations of Test Pieces for Shackles

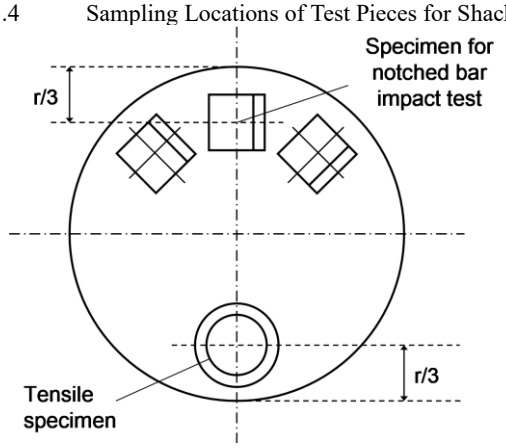


Fig. L3.5 Location of Buffer and Test Pieces for Extended Pins

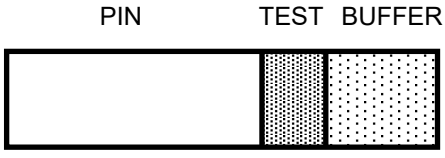


Table L3.12 Mechanical Properties

Kinds of off-shore 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 absorbed 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.

Table L3.13

	except welded part	welded part
Grade *R*3 offshore chain	60*J*	50*J*
Grade *R*3*S* offshore chain	65*J*	53*J*

3.2.14 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. Prior to test, offshore chains are to have a suitably prepared surface by sanding or be shot blasted in accordance with the applicable non-destructive test standard.

(1) Visual Inspection

All surfaces of every link are to be examined visually. Chains are to be positioned in order to have good access to all surfaces.

(2) Magnetic Particles Test

(a) Flash butt welded areas, including the area gripped by the clamping dies, of each link are to be subjected to magnetic particle tests in accordance with standards deemed appropriate by the Society. A fluorescent magnetization technique is to be used and the links are to be free from defects exceeding the following values. However, a non-fluorescent magnetization technique may be accepted in cases where deemed appropriate by the Society for special cases where standard test procedures are impractical.

i) Linear defects in transverse direction of links: 1.6 *mm*

ii) Linear defects in longitudinal direction of links: 3.2 *mm*

iii) Non-linear defects: 4.8 *mm*

(b) For 10% of the links, magnetic particles test are to be carried out on all accessible surfaces.

(c) At least 10% of all studs welds within each length of offshore chain are to be examined by a magnetic particles test or dye penetrant test in accordance with standards deemed appropriate by the Society where studs are set to links by welding. If any harmful defects such as cracks or lack of fusion are found, all welded parts of the studs are to be examined.

(3) Ultrasonic Test

All links are to be subjected to ultrasonic tests to examine flash weld fusion in accordance with standards deemed appropriate by the Society.

3 All accessories for offshore chain and connecting common links are to be subjected to the non-destructive test specified in the following **(1)** to **(3)** after proof tests. Prior to test, the accessories for offshore chains and connecting common links are to have a suitably prepared surface in accordance with the applicable non-destructive test standard. All non-machined surfaces are to be sanded or shot blasted. In cases where applicable, accessories for offshore chains are to be dismantled for inspection of internal surfaces. In the event of a failure of the above tests, the entire batch represented is to be rejected unless the cause of failure has been determined and it can be demonstrated to the Surveyor's satisfaction that the condition causing the failure is not present in any of the remaining accessories.

(1) Visual Inspection

All surfaces of each accessory for an offshore chain and connecting common link are to be examined visually. Special attention is to be paid to machined surfaces and high stress regions.

(2) Magnetic Particles Test or Dye Penetrant Test

A magnetic particles test or dye penetrant test for each accessory of an offshore chain and connecting common link is to be employed in accordance with standards deemed appropriate by the Society. In cases where magnetic particles test is employed, a fluorescent magnetization technique is to be used and the accessories and links are to be free from defects exceeding following values.

(a) Linear defects in transverse direction of accessories: 1.6 *mm*

(b) Linear defects in longitudinal direction of accessories: 3.2 *mm*

(c) Non-linear defects: 4.8 *mm*

(3) Ultrasonic Test

All accessories for offshore chains and connecting common links are to be subjected to ultrasonic tests in accordance with standards deemed appropriate by the Society. The acceptance/rejection criteria of the ultrasonic test established for the design is to be met.

4 Non-destructive test procedures together with rejection/acceptance criteria are to be submitted to the Society for approval.

5 Non-destructive test operators are to be appropriately qualified in performing non-destructive tests.

3.2.15 Repair of Defects

1 Where insignificant defects are found from non-destructive test specified in **3.2.14**, 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 **3.2.9**, those offshore chains and their accessories are considered acceptable.

2 Where harmful defects are found from non-destructive test specified if **3.2.14-2**, a defective link may be cut out and connecting common link or joining shackle inserted in its place. Retests specified in **3.2.11** to **3.2.13** are to be carried out, and where the results comply with the requirements, these offshore chains and their accessories are considered acceptable.

3 For offshore chains, accessories for offshore chains and connecting common links, repairs by welding are not permitted.

3.2.16 Markings

1 Where offshore chains and accessories of offshore chains have satisfactorily passed the tests and inspections required by **3.2**, they are to be marked as follows.

(1) Places of markings

(a) At stud of each end of offshore chains

(b) At stud of each end at intervals not exceeding 100 *m*

(c) On connecting common link (Stud links are marked at the stud. Studless links are marked at the outside of straight parts without flash butt welds.)

(d) On stud of common links next to connecting common links or shackles

(e) All kinds of accessories for offshore chains

(2) Kinds of markings

(a) Society’s stamp

(b) The grade of offshore chains and accessories of offshore chains (e.g. *NK-R*3, *NK-R*3*S*, *NK-R*4, *NK-R*4*S* and *NK-R*5)

(c) The nominal diameter of offshore chains and accessories for offshore chain Manufacturer’s number

(d) The certificate number (an abbreviation or equivalent is to be indicated on certificates.)

2 In addition to **-1** above, markings are to make it possible to determine the individual charge of all links in an offshore chain. However, such markings need only be provided for the first and last common link of each individual charge in cases where links from

the same charge are continuously connected. For the ends of a chain, markings are to make it possible to differentiate the lead and tail ends.

3.2.17 Painting

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

3.2.18 Records*

1 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 Surveyor when requested .

2 For the manufactures of offshore mooring chains and accessories which are grades *R*4*S* and *R*5, the following information for each heat is to be included on test certificates.

(1) The results of the microscopic examinations for non-metallic inclusions

(2) The results of macro etched examinations in order to confirm that there is no injurious segregation or porosity

(3) The results of Jominy hardenability tests

3.2.19 Test Certificate

1 The Society issues certificates, which contain the following particulars, for the offshore Chains which have passed the specified test and inspection. All relevant documents, appendices and reports are to reference the original certificate number.

(1) Manufacturer’s name

(2) Grade

(3) Chemical composition (including total aluminum content)

(4) Nominal diameter and weight

(5) Proof and break load

(6) Kind of Heat treatment

(7) Marks applied to chain and the locations of marked links

(8) Length

(9) Mechanical properties, where applicable

(10) Non-destructive test result

(11) Number and locations of any connecting common links (an abbreviation or equivalent is to indicate on certificates.)

2 The Society issues certificates, which contain the following particulars, for the Accessories for offshore chain which have passed the specified test and inspection. All relevant documents, appendices and reports are to reference the original certificate number.

(1) Manufacturer’s name

(2) Grade

(3) Heat number

(4) Chemical composition (including total aluminum content)

(5) Nominal diameter and weight

(6) Proof and break load

(7) Kind of Heat treatment

(8) Marks applied to accessories

(9) Mechanical properties, where applicable

(10) Non-destructive test result

Chapter 4 STEEL WIRE ROPES

4.1 Steel Wire Ropes

4.1.1 Application*

1 The steel wire ropes used for mast riggings, mooring lines, etc. to be equipped on ships in accordance with the provisions in **14.4, Part 1, Part C** (hereinafter referred to as "steel wire rope") are to comply with the requirements in this chapter or to be of equivalent quality.

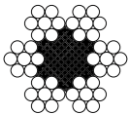
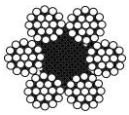
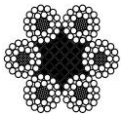
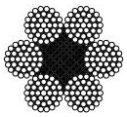
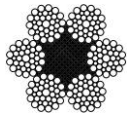
2 The provisions in this Chapter are applicable to the wire ropes constructed with fibre rope core and from individual wires having the tensile strength level of 1,500N/mm^2. However, wire ropes constructed from other individual wires than those described above or steel wire ropes constructed with an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

4.1.2 Grades

1 Steel wire ropes are classified into five grades according to their composition as specified in **Table L4.1.** 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. 4, 6 and 21 for running riggings.

Table L4.1 Grades of Wire Ropes

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

4.1.3 Processes of Manufacture

1 The individual wire composing the strands of steel wire ropes is to consist of wires of *JIS G* 3506 (Hard Steel Wires) or equivalent thereto.

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.

4.1.4 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 L4.2**.

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 L4.2 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

4.1.5 Mass

The standard mass of steel wire ropes is as given in **Table L4.3** according to the grade and diameter.

4.1.6 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 L4.3** 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 L4.3**, 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 L4.3** can not 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 L4.3 Masses and Breaking Test Loads for Steel Wire Ropes

Grade	No.1		No.3		No.4		No.6		No.21	
Composition mark	(6×7)		(6×19)		(6×24)		(6×37)		(6×*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*)
10	52.4	0.371	47.9	0.364	45.5	0.332	48.9	0.359	50.5	0.396
12	75.4	0.534	71.6	0.524	65.5	0.478	70.5	0.517	72.8	0.570
14	103	0.727	97.4	0.713	89.1	0.651	96.2	0.704	99.0	0.776
16	134	0.950	127	0.932	117	0.850	126	0.920	129	1.01
18	170	1.20	161	1.18	147	1.08	159	1.16	164	1.28
20	210	1.48	199	1.46	181	1.33	195	1.44	202	1.58
22	253	1.80	240	1.77	221	1.61	237	1.74	244	1.92
24	302	2.14	286	2.10	262	1.91	281	2.07	291	2.28
26	354	2.51	336	2.47	308	2.24	330	2.43	341	2.68
28	411	2.91	389	2.85	357	2.60	382	2.82	396	3.10
30	472	3.34	447	3.28	410	2.99	439	3.23	454	3.56
32	536	3.80	509	3.73	466	3.40	501	3.68	517	4.06
34	605	4.29	575	4.21	526	3.84	566	4.16	583	4.58
36	679	4.81	644	4.72	589	4.30	634	4.66	654	5.13
38	756	5.36	718	5.26	657	4.79	707	5.19	730	5.72
40	838	5.93	795	5.82	728	5.31	782	5.75	808	6.34
42			877	6.42	802	5.86	863	6.34	890	6.99
44			963	7.05	881	6.43	947	6.96	978	7.67
46			1,050	7.70	963	7.03	1,040	7.61	1,070	8.38
48			1,150	8.39	1,050	7.65	1,130	8.28	1,140	9.12
50			1,250	9.10	1,150	8.30	1,230	8.98	1,260	9.90
52					1,230	8.98	1,320	9.73	1,360	10.7
54					1,320	9.68	1,420	10.5	1,470	11.5
56					1,420	10.4	1,530	11.3	1,590	12.4
58					1,530	11.2	1,650	12.1	1,700	13.3
60					1,640	12.0	1,760	12.9	1,810	14.3
62					1,750	12.8	1,880	13.8	1,940	15.2
65					1,920	14.0	2,070	15.2	2,140	16.7

4.1.7 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 L4.4**. 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

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 L4.5** except for the 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 twisted until the specimen is broken. The tests are to show that 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 L4.5** except for the core of the strand.

(b) 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

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 **4.1.4-1** are not to be more than given in **Table L4.5** except for the core of the strand.

Table L4.4 Number of Specimens for Individual Wire Tests

Grade	Composition mark	Number of specimens
No.1	(6×7)	3
No.3	(6×19)	6
No.4	(6×24)	8
No.6	(6×37)	12
No.21	(6×WS(36))	19

Table L4.5 Permissible Number of Failed Specimens in Individual Wire Tests

Grade	Composition mark	Number
No.1	(6×7)	0
No.3	(6×19)	1
No.4	(6×24)	1
No.6	(6×37)	1
No.21	(6×WS(36))	3

Table L4.6 Number of Times of Twisting in Twisting Tests

Diameter of individual wired (*mm*)	Number of twisting
$0.26 \leq d < 1.00$	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.

4.1.8 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.

4.1.9 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 5 FIBRE ROPES

5.1 Fibre Ropes

5.1.1 Application

1 Hemp ropes and synthetic fibre ropes used for mooring lines to be equipped on ships in accordance with the provisions in **14.4, Part 1, Part C** (hereinafter referred to as "fibre rope" in **Chapter 5**) 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 **1.1.1-2**.

5.1.2 Kinds of Fibre Ropes

Fibre ropes are classified into 9 kinds as **Table L5.1**.

Table L5.1 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	Polyethylene
		Grade 2	
	Polyester rope		Polyester
	Polypropylene rope	Grade 1	Polypropylene
		Grade 2	
	Polyamide rope		Polyamide

5.1.3 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.

5.1.4 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.

5.1.5 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.

5.1.6 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.

5.1.7 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) Fibre ropes are, in principle, to be subjected to breaking tests at room temperature in as dried condition and on the spliced rope. Nylon ropes are to be subjected to breaking tests at room temperature in as wet condition immediately after having been immersed in water at normal temperature for more than 30 *minutes*.

(5) The load at the time of breaking is not to be less than the loads guaranteed by manufacturers.

(6) Where the breaking tests carried out in accordance with the requirement in **(2)** fail to meet the load guaranteed by the manufacturer, 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 guaranteed by manufacturers can not be applied to specimen for the lack of capacity of testing machine, any other alternative test procedure approved by the Society may be adopted.

5.1.8 Inspection of Appearance and Dimensions

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

5.1.9 Marking

The fibre rope which has satisfactorily passed the tests and inspections specified in **5.1.7** and **5.1.8** 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 6 HATCH TARPAULINS

6.1 Hatch Tarpaulins

6.1.1 Application

Hatch tarpaulins to be equipped on ships in accordance with the provisions in **14.6, Part 1, Part C** 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.

6.1.2 Grades

The grades of tarpaulins are as follows:

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

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

6.1.3 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 quality.

6.1.4 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.

6.1.5 Mass

The mass of cloths used for tarpaulins before waterproof treatment is not to be less than the values indicated in **Table L6.1**.

Table L6.1 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.

6.1.6 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 L6.2**, being tested with specimens 30*mm* wide and 200*mm* long.

Table L6.2 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.

6.1.7 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℃ and 66℃.

6.1.8 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 7 SIDE SCUTTLES

7.1 Side Scuttles

7.1.1 Application

The side scuttles to be fitted up on ships according to the requirements in **14.11, Part 1, Part C** (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.

7.1.2 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*)

7.1.3 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 L7.1**, **Table L7.2** and **Table L7.3**, 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 L7.1**, **Table L7.2** and **Table L7.3**.

(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 L7.1**, **Table L7.2** and **Table L7.3**.

(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 **7.1.5**.

(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 *ISO*3902 are to be used.

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

Table L7.1 Class *A* Side Scuttle

		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 L7.2 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	2	3	3	3

Table L7.3 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

7.1.4 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 L7.4**. These materials are to have the following properties in **(1)** and **(2)**.

(1) Corrosion resistance is to be obtained through galvanising, painting, etc. where steel or iron is used.

(2) Minimum mechanical properties as given in **Table L7.5**. (One tensile test specimen is to be taken from each cast. Where the number of castings from one cast exceeds 50, an additional specimen is to be taken from each 50 castings or fraction thereof. For aluminium extruded shapes, one tensile test specimen is to be taken per each lot. Extruded shapes of similar thickness made from the same melting and heat treated simultaneously are treated as one lot. Where the size of a lot exceeds 50, an additional specimen is to be taken for each 50 or fraction thereof.)

2 Closing device

The materials used for the closing devices of the side scuttles (swingbolts, pins 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 L7.6**. (One tensile test specimen is to be taken from each cast. Where the number of castings from one cast exceeds 50, an additional specimen is to be taken from each 50 castings or fraction thereof. For aluminium extruded shapes, one tensile test specimen is to be taken per each lot. Extruded shapes of similar thickness made from the same melting and heat treated simultaneously are treated as one lot. Where the size of a lot exceeds 50, an additional specimen is to be taken for each 50 or fraction thereof.)

3 Glass panes

Toughened safety glass panes according to *ISO* 1095 or glass panes of equivalent quality are to be used. For fire resistant glass panes, glass panes according to *ISO* 5797 or glass panes of equivalent quality are to be used.

Table L7.4 Material Classes

<table>
<tr><th rowspan="2">Type of side scuttle</th><th rowspan="2">Method of fastening the side scuttle</th><th colspan="3">Material</th></tr>
<tr><th>Main frame</th><th>Glassholder and/or glass retaining ring</th><th>Deadlight</th></tr>
<tr><td rowspan="2">Class A</td><td>Bolted</td><td colspan="2">Copper alloy(1)</td><td>Iron or steel(2)</td></tr>
<tr><td>Welded</td><td>Mild steel</td><td>Copper alloy</td><td>Iron or steel(2)</td></tr>
<tr><td rowspan="5">Class B</td><td rowspan="2">Bolted</td><td colspan="2">Copper alloy(1)</td><td>Iron or steel(2)</td></tr>
<tr><td colspan="3">Aluminium alloy(3)</td></tr>
<tr><td rowspan="3">Welded</td><td>Mild steel</td><td>Copper alloy</td><td>Iron or steel(2)</td></tr>
<tr><td colspan="3">Aluminium alloy</td></tr>
<tr><td>Alluminium alloy(4)</td><td colspan="2">Aluminium alloy(3)</td></tr>
<tr><td rowspan="5">Class C</td><td rowspan="2">Bolted</td><td colspan="2">Copper alloy(1)</td><td rowspan="5">—</td></tr>
<tr><td colspan="2">Aluminum alloy(3)</td></tr>
<tr><td rowspan="3">Welded</td><td>Mild steel</td><td>Copper alloy</td></tr>
<tr><td colspan="2">Aluminium alloy</td></tr>
<tr><td>Aluminium alloy(4)</td><td>Aluminium alloy(3)</td></tr>
</table>

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 L7.5 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 L7.6 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

7.1.5 Testing

1 Watertightness test

The side scuttles are to be tested by being subjected to the hydraulic pressures given in **Table L7.7**. An equivalent hydraulic test is to be carried out by means of batch tests (approximately 10% of the delivery batch, with a minimum of two side scuttles) with glass pane and open deadlight, and without glass pane and closed deadlight.

2 Mechanical strength test

(1) 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 L7.8**. For this test, *ISO* 614 is to be used as a guide.

(2) The punch is to be placed on that side of the deadlight which could be subjected to direct contact with the sea. Where the construction of the deadlight makes it necessary, a plate of 100*mm* diameter and 10*mm* thickness may be placed between the punch and the deadlight.

(3) When subjected to the pressure given in **Table L7.8**, the permanent deformation of the deadlight is not to exceed 1% of the nominal size of the side scuttle.

3 Fire-resistance test

Side scuttles for fire-resistant constructions are to be subjected to prototype testing as given in *ISO* 5797.

Table L7.7 Test Pressures for Watertightness

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

Table L7.8 Test Pressure for Mechanical Strength

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

7.1.6 Dispensation with Tests

The tensile test specified in **7.1.4** and fire-resistant test specified in **7.1.5-3** for side scuttles may be dispensed with, where these scuttles have appropriate certificates accepted by the Society.

7.1.7 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 8 RECTANGULAR WINDOWS

8.1 Rectangular Windows

8.1.1 Application

The rectangular windows to be fitted up on ships according to the requirements in **14.11, Part 1, Part C** (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.

8.1.2 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*)

8.1.3 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 L8.1** and **Table L8.2**, 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 **Tables L8.1** and **L8.2**. Where one or both dimensions (width or height) of a window are different from those given in **Tables L8.1** and **L8.2**, maximum allowable pressure (p) is to be determined using the following equation.

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

t : glass thickness (mm)

β : factor obtained from the graph of **Fig L8.1**.

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 **Tables L8.1** and **L8.2**.

(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 **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 glass retaining frame

(a) For ensuring watertightness between the glassholder and main frame, gaskets type *A*, *B* or *C* according to *ISO* 3902 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

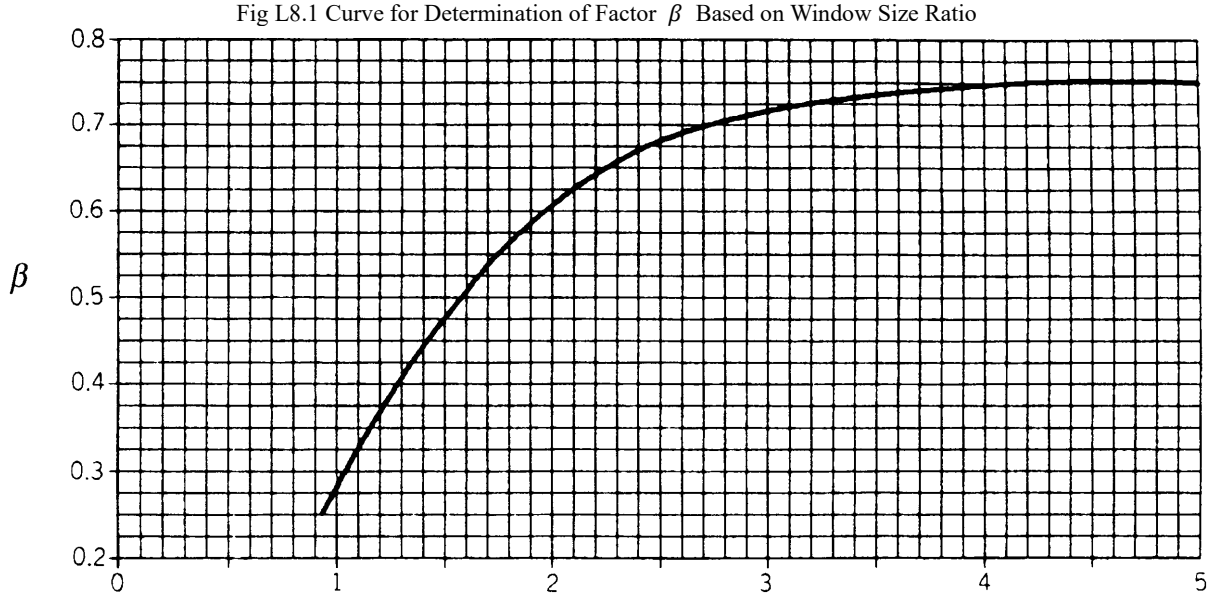
Table L8.1 Class *E* Rectangular Window

	Nominal size width (*mm*) ×height (*mm*)							
	300×425	355×500	400×560	450×630	500×710	560×800	900×630	1000×710
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 L8.2 Class *F* Rectangular Window

	Nominal size width (*mm*) ×height (*mm*)								
	300×425	355×500	400×560	450×630	500×710	560×800	900×630	1000×710	1100×800
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 L8.1 Curve for Determination of Factor β Based on Window Size Ratio



$$\text{Window size ratio} = \frac{\text{large dimension}}{\text{small dimension}}$$

8.1.4 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 L8.3**. These materials are to have the following properties in **(1)** and **(2)**.

(1) Corrosion resistance is to be obtained through galvanising, painting, etc. where steel or iron is used.

(2) Minimum mechanical properties as given in **Table L8.4**. (One tensile test specimen is to be taken from each cast. Where the number of castings from one cast exceeds 50, an additional specimen is to be taken from each 50 castings or fraction thereof. For aluminium extruded shapes, one tensile test specimen is to be taken per each lot. Extruded shapes of similar thickness made from the same melting and heat treated simultaneously are treated as one lot. Where the size of a lot exceeds 50, an additional specimen is to be taken for each 50 or fraction thereof.)

2 Closing device

The materials used for the closing devices of the rectangular windows (bolts, pins 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 L8.5**. (For casting, one tensile test specimen is to be taken from each cast. Where the number of castings from one cast exceeds 50, an additional specimen is to be taken from each 50 castings or fraction thereof. For aluminium extruded shapes, one tensile test specimen is to be taken per each lot. Extruded shapes of similar thickness made from the same melting and heat treated simultaneously are treated as one lot. Where the size of a lot exceeds 50, an additional specimen is to be taken for each 50 or fraction thereof.)

3 Glass panes

Toughened safety glass panes according to *ISO* 3254 of glass panes of equivalent quality are to be used. For fire resistant glass panes, glass panes according to *ISO* 5797 or glass panes of equivalent quality are to be used. For heated glass panes, glass panes according to *ISO* 3434 or glass panes of equivalent quality are to be used.

Table L8.3 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:

(1) The use of cast or wrought alloy is optional.

Table L8.4 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 L8.5 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

8.1.5 Testing

1 Watertightness test

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

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 *ISO* 5797.

4 Test for heated windows

Heated rectangular windows are to be subjected to the electrical testing as given in *ISO* 3434 clause 5.

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 rectangular windows may be dispensed with, where these rectangular windows have appropriate certificates accepted by the Society.

8.1.7 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 9 CONTAINER SECURING FITTINGS

9.1 Container Securing Fittings

9.1.1 Application

1 Fittings used for container securing (hereinafter, this includes loose securing fittings and fixed securing fittings except where specified otherwise) are to be in compliance with this chapter or are to be of an equivalent quality.

2 This chapter applies to fittings made from castings, forgings or rolled steel manufactured by an assembly process (including welding).

3 Fittings for which complying with chapter is difficult special shapes or materials are to be as deemed acceptable by the Society.

4 This chapter does not apply to structures such as lashing bridges, container stanchions and cell guides, and container corner castings.

9.1.2 Terms

1 "Fixed container fitting" means those fittings (e.g. deck sockets, eye plates, container guides and positioning cones) attached to structural members such as deck plates by welding or other means in order to transmit securing force to loose securing fittings used to secure containers.

2 "Loose securing fitting" means removable fittings (e.g. lashing rods, turnbuckles and twist locks) provided to transmit securing force between containers or between a container and fixed securing fittings.

9.1.3 Materials*

1 Materials used for fittings are to comply with **Part K** or be deemed by the Society as being equivalent thereto.

2 The chemical composition of materials used for fixed securing fittings is, in principle, to have a carbon content of 0.23 % or less, taking weldability into consideration.

3 For materials used for fittings used in low temperature environments, special consideration is to be given to material toughness.

9.1.4 Heat Treatment

Fittings made from castings or forgings are, in principle, to be heat treated by either normalising or quenching and tempering, except in cases where specifically approved by the Society.

9.1.5 Manufacturing Processes and Product Shape*

The manufacturing process, safe working load (*SWL*), proof test load, breaking test load, structure, shape, dimensions, materials, etc. of fittings are to be approved in advance by the Society, and manufacturers are not to change such plans without the Society's approval.

9.1.6 Dimensional Measurements

1 Manufacturers are responsible for the dimensional measurements of fittings and are to present records of such measurements to surveyors.

2 Based on submitted measurement records, surveyors are to verify that actual dimensions meet manufacturer specifications.

9.1.7 Visual Inspections

Before conducting proof tests, the external appearances of fittings are to be inspected to confirm that they are in good order.

9.1.8 Proof Tests

1 A lot consists of 50 pieces of the same type and model of fittings and proof tests are to be carried out on any one piece of each lot. Even if the number of pieces is less than 50, tests are to be carried out on at least one piece.

2 Proof test loads are to be at least equal to or greater than the proof test load applied to the same type at the time of the approval test. The direction of loading is to be in accordance with *ISO* 3874.

3 Test loads are to be applied in the presence of a surveyor, and it is to be confirmed after unloading that there is no permanent deformation or abnormalities.

4 When permanent deformation or abnormalities are confirmed in the preceding **-3**, the Society may permit a re-test as it deems appropriate.

9.1.9 Records

Manufacturers are to submit test reports for each type of fitting that has passed the specified tests and inspections, and such reports are to include, depending on the type of fitting, the following items.

(1) Fitting type and model
(2) Fitting description (reference drawings including length, diameter, etc. are acceptable)
(3) Number of tests conducted
(4) Test load direction
(5) Proof test load
(6) Safe working load (*SWL*)

9.1.10 Test Certificates

The Society issues certificates for fittings which have passed the specified tests and inspections, and such certificates include the following information.

(1) Manufacturer name and manufacturing facility location
(2) Applicant name
(3) Test and inspection dates (including test location)
(4) Test results
(5) Marking items on the approved products
(6) Other items deemed necessary
(7) Serial number

Contents

GUIDANCE FOR THE SURVEY AND CONSTRUCTION OF STEEL SHIPS

Part L EQUIPMENT

L1 GENERAL

L1.4 Testing and Inspection for Equipment

L1.4.1 Execution of Testing and Inspection

1 To implement the surveys specified in **1.4.1-1, Part L of the Rules**, in lieu of traditional ordinary surveys where the Surveyor is in attendance, the Society may approve survey methods which it considers to be able to obtain information equivalent to that obtained through traditional ordinary surveys.

2 The wording “deemed appropriate by the Society” in **1.4.1-4**, **Part L of the Rules**, means that the quality of equipment and the quality control system of manufacturer are approved by the Society according to “**Rules for Approval of Manufacturers and Service Suppliers**” or deemed equivalent thereto.

L2 ANCHORS

L2.1 Anchors

L2.1.9 Drop and Hammering Tests

1 "Additional non-destructive test" specified in **2.1.9-3, Part L of the Rules** means the followings:

(1) Ultrasonic testing in random area of castings (for example, root of arm, shank, head pin, etc.)

(2) Non-destructive test in **2.1.11-3, Part L of Rules**, even in case of components for cast used excluding super high holding power anchors

2 "Mechanical test" specified in **2.1.9-3, Part L of the Rules** is to be conducted in accordance with the requirement of **2.1.3-2, Part L of the Rules**.

L2.1.11 Visual Inspections and Non-destructive Tests

1 A visual inspection is to be carried out on all visible surfaces of the anchor.

2 The testing procedures and acceptable criteria of the magnetic particle testing are as follows:

(1) Testing procedures are to conform to *ISO* 9934-1, *ISO* 9934-2, *ISO* 9934-3, *JIS Z* 2320-1, *JIS Z* 2320-2, *JIS Z* 2320-3 or their equivalent thereto;

The aforementioned standards, in principle, refer to the most recent version published.

(2)Acceptable criteria are to be in accordance with **Table L2.1.11-1** or **Table L2.1.11-2** in the case of cast anchors or rolled steel fabricated anchors respectively.

3 The testing procedures and acceptable criteria of penetrant testing are as follows:

(1) Testing procedures are to conform to *ISO* 3452-1, *ISO* 3452-2, *ISO* 3452-3, *ISO* 3452-4, *JIS Z* 2343-1, *JIS Z* 2343-2, *JIS Z* 2343-3, *JIS Z* 2343-4 or their equivalent thereto;

The aforementioned standards, in principle, refer to the most recent version published.

(2)Acceptable criteria are to be in accordance with those in **-2(2)** above.

4 The testing procedures and acceptable criteria of ultrasonic testing are as follows:

(1) The ultrasonic flaw detector is, in principle, to be of a reflection type with a frequency range of 1 ~ 5*MHz*;

(2) The conditions of ultrasonic testing are, as a standard, to be those specified in the following **Table L2.1.11-3**; and

(3) Anchors are acceptable where bottom echoes are detected and flaw echoes cannot be detected. In cases where indications are detected, the Surveyors make the decision, judging generally from the results of tests using different frequencies or different probes as well as the results of the surface inspections specified in above **-1** to **-3**, except in those cases where the cause is the configuration of the product.

5 Qualification of Operator:

Operators are to have Level 2 qualification or above, and such qualifications are to be certified by a certification body deemed appropriate by the Society, e.g. The Japanese Society for Non-destructive Inspection, in accordance with *ISO* 9712, *JIS Z* 2305 or the equivalent thereto. Notwithstanding the above, operators having Level 1 qualification can perform the procedures under the supervision of another operator having Level 2 qualification or above. The aforementioned standards, in principle, refer to the most recent version published.

Table L2.1.11-1 Acceptance Criteria for Cast Anchors(1)(2)

Detection area	Kind of defect		
	Crack	Blowhole	Sand inclusion (scab, seizure)
Machined portions	Not accepted	4*mm*	
Other	Not accepted	10*mm*	

Notes:

(1) The values of defect sizes in the Table are the actual size.

(2) The degree of concentration of defects is to be as considered appropriate by the Society.

Table L2.1.11-2 Acceptance Criteria for Rolled Steel Fabricated Anchors

Type of defect	Acceptance Criteria
Crack	Not accepted
Lack of fusion	Not accepted
Incomplete root penetration	Not accepted
Surface pore	Single pore diameter d (*mm*) $\leqq$ $0.25a$(1) with a maximum diameter of 3*mm* 2.5d as the minimum distance to the adjacent pore which have any dimension greater than 2*mm*.
Undercut	For fillet welds: depth $\leqq$ 0.8*mm* at any length

Note:

(1) a: Throat of the fillet weld (*mm*)

Table L2.1.11-3 Standard Conditions of Ultrasonic Testing

Test frequency	2*MHz*
Working sensitivity	The echo height against the flaw of the standard test block SII shown in Annex K5.1.9(1) 1.2.7 is to be 20%
Couplant	Machine oil

L2.2 Anchors Used for Positioning Systems

L2.2.8 Drop and Hammering Tests

1 The "additional non-destructive tests" specified in **2.2.8-3, Part L of the Rules** means the following:

(1) Ultrasonic testing in random areas of the casting selected by the attending surveyor. For example, the roots of arms, shanks, head pins, etc.

(2) The non-destructive tests specified in **2.2.10-1(2), Part L of the Rules**.

2 The "impact tests deemed appropriate by the Society" specified in **2.2.8-3, Part L of the Rules** means test conducted in accordance, mutatis mutandis, with the requirements of **2.2.3-2, Part L of the Rules**.

L2.2.9 Proof Tests

1 The "safety factor separately specified by the Society" means the safety factors for horizontal holding capacities of seabed mooring points specified in **Chapter 4, Part PS of the Rules**.

2 When the breaking strength of the mooring line is not known, the proof test load is to be the value obtained from dividing maximum holding capacity of the anchor by the safety factor specified for the seabed mooring points.

3 "When deemed appropriate by the Society" specified in **2.2.9-4, Part L of the Rules** means when documentation related to assessments of structural calculations of anchors carried out using suitable methods such as FEM, etc. is submitted, and it is verified the anchors have adequate strength.

4 The standard procedures for the FEM analysis specified in **-3** above are as follows:

(1) The load used for analysis is to be the proof test load specified in **2.2.9-3. Part L of the Rule**.

(2) The allowable value used for von Mises stress is to be 90 % of the specified yield strength of the materials used for the anchor.

L2.2.10 Visual Inspections and Non-destructive Tests

The testing procedures and acceptable criteria for visual inspections and non-destructive tests are to be in accordance, mutatis mutandis, with the requirements specified in **L2.1.11**.

L2.2.11 Holding Power Tests

1 "Holding power tests designated by the Society" refers to the tests specified in **1.6.1(3), Part 2 of the "Guidance for the Approval and Type Approval of Materials and Equipment for Marine Use"**. For anchors intended to be used for vessels and floating offshore facilities fixed or positioned at specific sea areas for long periods of time, it means the tests specified in **1A.2.2(3)(b), Part 2 of the "Guidance for the Approval and Type Approval of Materials and Equipment for Marine Use"**.

2 "Standards deemed appropriate by the Society" means standards such as API RP 2SK (American Petroleum Institute (API), Recommend Practice for Design and Analysis of Stationkeeping Systems for Floating Structures)

L3 CHAINS

L3.1 Chains

L3.1.3 Materials

1 The materials for studs are to be materials for chain, rolled steel, cast steel or forged steel. If this is the case, mechanical tests are not required. Malleable cast iron and grey cast iron are not to be used.

2 The terms of "round bars for chains, provided they satisfactorily comply with the required tests approved by the Society" specified in **3.1.3-2, Part L of the Rules**, means as follows:

(1) The rolled round bars are to have been made at the millmaker approved by the Society in accordance with the manufacturing process of round bars for chain.

(2) The rolled round bars are to comply with the requirements specified in **3.6, Part K of the Rules** or equivalent properties.

(3) Chain manufactures are to show the certificates issued by the millmaker to the surveyor, which contain steel making process, ingot casting, cast number and chemical composition, etc.

L3.1.4 Processes of Manufacture

1 When the studs will be welded with the link, the treatments are to be carried out in accordance with the following requirements **(1)** to **(3)** in addition to the requirements of **Part M of the Rules**.

(1) The studs are to be welded at one end only that is opposite to the weldment of link.

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

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

2 The tolerances of stud positions are to comply with the standard as follows, except the final link at each end of one length of chain.

Maximum off-centre distance "X":

10% of the nominal diameter

Maximum deviation "α" from the 90 degrees-position:

4 degrees diameter

where: X and α are as specified in **Fig. L3.1.4**.

3 For the purpose of **3.1.4-1, Part L of the Rules**, manufacturing process approval for studs is not required as the studs are not a part of the chain manufacturing process.

L3.1.7 Dimensions and Forms

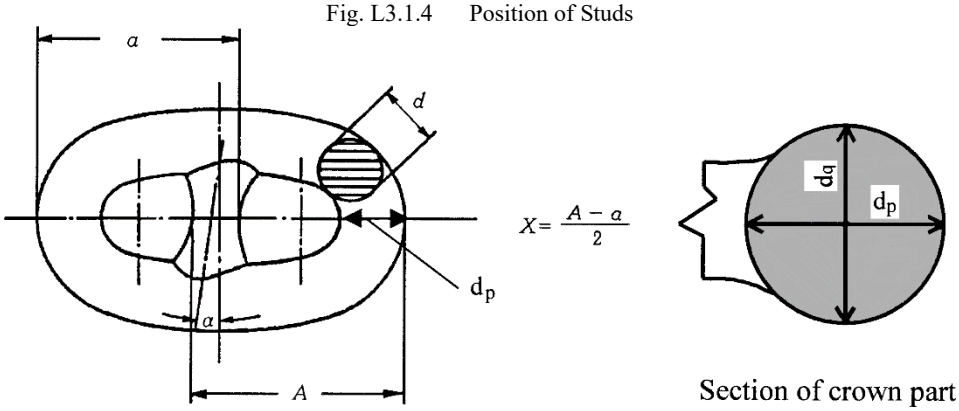
1 In **3.1.7-1, Part L of the Rules**, when manufacturer would make chains different from standard dimensions, the dimension tables are to be approved by the Society except the case where the dimensions comply with *JIS* or *ISO*.

2 For anchor chain cables for anchor specified in **14.3, Part 1, Part C of the Rules**, the length of the shackle and accessories may be included in one length of chain.

L3.1.8 Dimensional Tolerances

Diameter at crown part is to be measured for both of d_p and d_q as shown in **Fig. L3.1.4**.

Fig. L3.1.4 Position of Studs



L3.1.10 Breaking Test of Chains

The omissions of breaking test of chains due to the shortage of capacity of testing machine specified in **3.1.10-4, Part L of the Rules** is to be in accordance with the following requirements in **(1)** to **(3)**.

(1) Chains are to comply with the requirements as follows.

(a) Chains are to be Grade 2 or Grade 3 chain.

(b) Breaking test loads specified in **Table L3.5 of the Rules** are to be above 6,000*kN*.

(c) Chains are to be heat treated.

(d) Breaking test had been demonstrated at approval test for manufacturing process for the nominal diameter or more.

(e) For welded chains specified in **3.1.13, Part L of the Rules** is to pass the mechanical test of chain link.

(2) Following tests are to be carried out as an alternative test. Manufacturers are to obtain approval of the concrete testing plan by the Society in advance. The test is able to confirm the strength of welded part for welded chain.

(a) Non-destructive inspection

(b) Marco-structure inspection

(c) Bend test

(d) Tensile test

(e) For Grade 3 chain impact test may be required for reference.

(3) Where the test had been performed as specified in **(2)** without breaking test, "Alternative breaking test has been applied" is indicated in the certificate.

L3.1.11 Breaking Test of Accessories

1 "at the discretion of the Society" specified in **3.1.11-3, Part L of the Rules** is where the accessories are manufactured with the following **(1)** or **(2)**.

(1) The material having higher strength characteristics than those specified for the part in question (e.g. Grade 3 materials for accessories for Grade 2 chain).

(2) The same grade materials as the chain but with increased dimensions subject to the successful procedure tests that such accessories are so designed that the breaking strength is not less than 1.4 times the breaking test load of the chain which they are intended.

2 Where the accessories complied with requirement in **-1** have not been passed the breaking test specified in **3.1.11-1, Part L of the Rules**, the requirement of **3.1.11-2, Part L of the Rules** is not to be applied thereto.

L3.2 Offshore Mooring Chains and Others

L3.2.2 General

Where a joining shackle is used in accordance with the requirements of **3.2.2-3, Part L of the Rules**, the document indicating that manufacturers and purchasers agreed with the number of joining shackles and their forms to be used is to be submitted to the Society.

L3.2.4 Materials

The materials for studs are to be materials for offshore mooring chains, rolled steel, cast steel or forged steel. If this is the case,

mechanical tests are not required. Malleable cast iron and grey cast iron are not to be used.

L3.2.5 Processes of Manufacture

1 The position of studs is to comply with the requirements of **L3.1.4-2**.

2 The wording "where specially approved by the Society" specified in **3.2.5-7, Part L of the Rules**, means that it is verified that any part of common links which are connected with connecting common link under the proposed connecting method has not been adversely affected and that such connecting method is approved by the Society and the purchaser.

3 For the purpose of **3.2.5-1, Part L of the Rules**, manufacturing process approval for studs is not required as the studs are not a part of the offshore mooring chain manufacturing process.

L3.2.7 Heat Treatment and Grain Size

For the offshore chains specified in **3.9.1-2, Part PS of the Rules**, batch heat treatment may be permitted in cases where the heat treatment can be conducted for whole of them at the same time.

L3.2.11 Breaking Tests

1 With respect to **3.2.11-2(1), Part L of the Rules,** offshore chain manufacturers are to obtain approval of a test plan containing information on the casting or forging method, heat treatment method (position of products in furnace and quenching method are included) and details of product inspection (proof test, breaking test, mechanical test and non-destructive test are included) in cases where an alternative test is carried out. Documents related to the following **(1)** to **(3)** may be required in cases where deemed necessary by the Society.

(1) The results of demonstrations showing that the accessory has a safety margin over and above the break load of the chain by finite element analysis provided at the break load

(2) The results of strain age testing carried out by approved procedures on the material grade produced to the same parameters at the time of qualification

(3) Reports which demonstrate that strain gauges during production are comparable with strain gauges during the proof and breaking tests during initial qualification in cases where an accessory is of a large size which makes heat treating in batches unfeasible or has a unique design.

2 The wording "at the discretion of the Society" specified in **3.2.11-2(4), Part L of the Rules** is where the accessories are manufactured in accordance with the following **(1)** to **(4)**.

(1) The accessories or connecting common link are successfully tested at the breaking load appropriate to the offshore chain for which they are intended.

(2) It is verified by breaking test carried out by the manufacturer of accessories for offshore chain that such accessories are so designed that breaking strength is not less than 1.4 times the breaking test load of the offshore chain for which they are intended.

(3) Strain age properties have been verified according to the material grade produced to the same parameters.

(4) Strain gauges are applied during the break load test at high stress locations to verify that the strains stay within allowable limits.

3 Where the accessories for offshore chains complied with requirement in **-2** have not been passed the breaking test specified in **3.2.11-2(1)** and **3.2.11-2(2), Part L of the Rules**, the requirement of **3.2.11-2(3), Part L of the Rules** is not to be applied thereto.

L3.2.13 Mechanical Tests

1 Where applying the **Notes(3)** of **Table L3.12 of the Rules**, manufacturer is to submit the documents indicating that manufacturer and purchaser agreed to conduct impact test in accordance with **Notes(3)** of **Table L3.12 of the Rules**, to the Society for approval.

2 The wording "at the discretion of the Society" specified in **3.2.13-2(1), Part L of the Rules** means the following **(1)** and **(2)**.

(1) For non-circular sections, at a depth of 1/4 thickness from the surface

(2) For production from rolled plates, the manufacturer's standard

3 With respect to **3.2.13-2(4), Part L of the Rules,** an alternative test means the following **(1)** and **(2)**.

(1) In cases where separately forged or cast coupons are used, they are to have the same cross-section and are to be heat treated in the same furnace and quenched in the same tank at the same time, as the actual forgings or castings. Thermocouples are to be attached to the coupon and to the accessories. For forged coupons, a reduction ratio is to be similar to that of the accessories represented.

(2) In cases where the separately forged or cast coupons in **(1)** above are used, it is to be verified that coupon properties are representative of the accessory properties.

L3.2.14 Non-destructive Test

1 In applying the requirements in **3.2.14-2(1), Part L of the Rules**, it is recommended that the chain be hung in a vertical position in order to allow optimal access to the surface area. Access to inspect the interlink area, however, may only be possible with the chain in the horizontal position.

2 The wording "standards deemed appropriate by the Society" specified in **3.2.14-2(2)(a), Part L of the Rules** means the wet continuous fluorescent magnetization techniques specified in *ASTM E*709 or *ISO* 9934, or the equivalent thereto.

3 The wording "standards deemed appropriate by the Society" specified in **3.2.14-2(2)(c), Part L of the Rules** means the following standards or the equivalent thereto.

(1) Magnetic particle test: *ASTM E*1444

(2) Dye penetrant test: *ASTM E*1417

4 The wording "standards deemed appropriate by the Society" specified in **3.2.14-3(2), Part L of the Rules** is conform to *ASTM E*587 or the equivalent thereto using single probe, angle-beam shear waves in the range from 45 to 70 degrees. A tandem technique, TOFD or phased array may be used in cases where deemed necessary by the Society.

5 The wording "standards deemed appropriate by the Society" specified in **3.2.14-3(2), Part L of the Rules** means the following standards or the equivalent thereto.

(1) Castings:

(a) Magnetic particle test: the wet continuous magnetization techniques specified in *ASTM E*709

(b) Ultrasonic test: *ASTM A*609 or *ISO* 13588

(2) Forgings:

(a) Magnetic particle test: the wet continuous magnetization techniques specified in *ASTM E*709 or *EN* 10228-1 or equivalent standards such as *ISO* 4986 or *IACS Rec.* 69

(b) Ultrasonic test: *ASTM A*609, *EN* 10228-3 or *IS* 13588

6 The wording "to be appropriately qualified in performing non-destructive tests" specified in **3.2.14-5, Part L of the Rules**, means those qualified *Level* II or higher in accordance with *ISO* 9712, *ACCP* or an equivalent qualification deemed appropriate by the Society.

7 Non-destructive test operator qualification according to an employer or responsible agency qualification scheme based on SNT-TC-1A may be accepted if the employer's written practice is reviewed and found acceptable and the Level III is *ASNT Level* III, *ISO* 9712 *Level* III or *ACCP* Professional *Level* III and certified in the applicable method. In such cases, notwithstanding the requirements in **-6** above, the wording "to be appropriately qualified in performing non-destructive tests" specified in **3.2.14-5, Part L of the Rules**, means those qualified Level II or higher.

L3.2.18 Records

1 Records of manufacturing processes such as heating of bar materials, flush butt welding, heat treatment are to include the followings.

(1) Process of heating of bar materials

(a) For electric resistance heating or induction heating

The heating phase is to be controlled by an optical heat sensor. The controller is to be checked at least once every 8 *hours* and records made.

(b) For furnace heating

The heat is to be controlled and temperature continuously recorded using thermocouples in close proximity to the bars. The controls are to be checked at least once every 8 *hours* and records made.

(2) Process of flash butt welding

The welding parameters of the following **(a)** to **(c)** are to be controlled during welding of each link, and the controls are to be checked at least once every 4 *hours* and records made.

(a) Platen motion

(b) Current as a function of time

(c) Hydraulic pressure

(3) Process of heat treatment

Temperature and time of temperature and offshore chains speed are to be controlled and continuously recorded.

2 Records of tests and inspections are to indicate the following **(1)** to **(5)**.

(1) The results of dimension measurement required by **3.2.9** and **3.2.10, Part L of the Rules**.

(2) The results of testing required by **3.2.11** to **3.2.13, Part L of the Rules**.

(3) The results, procedure, and acceptance/rejection criteria of non-destructive test required by **3.2.14, Part L of the Rules**.

(4) If the testings and inspections do not meet the requirements specified in **3.2.9** to **3.2.14, Part L of the Rules**, photographs of the failure of offshore chains and accessories of offshore chains as well as nonconformity, corrective actions and repair works are included in records.

(5) Example photographs of components positioned in furnaces.

L4 STEEL WIRE ROPES

L4.1 Steel Wire Ropes

L4.1.1 Application

Special approval on steel wire rope with an independent wire rope core (hereinafter referred to as "wire rope with wire core") under the provisions of **4.1.1-2, Part L of the Rules** are to be treated as follows:

Where wire rope with wire core is used as a mooring lines in place of wire rope with fibre rope core (hereinafter referred to as "wire rope with fibre core"), the testing and inspection on these wire rope are to be carried out as mentioned below in addition to the requirements of **Chapter 4, Part L of the Rules**.

(1) Breaking Test Load

Breaking test load is to obtain by the following formula.

$$T_{bw} = T_{bf} \times K_1$$

where:

T_{bw}= Breaking test load for wire rope with wire core

T_{bf}= Breaking test load for wire rope with fibre core

K_1= Coefficient (1.12 for Class No.6 & 21 wire)

(2) Standard Mass

Standard mass of the wire rope with wire core is to obtain by the following formula.

$$W_w = W_f \times K_2$$

where:

W_w= Standard mass of wire rope with wire core

W_f= Standard mass of wire rope with fibre core

K_2= Coefficient (1.09 for Class No. 6 & 21 wire)

L5 FIBRE ROPES

L5.1 Fibre Ropes

L5.1.3 Processes of Manufacture

Where the tests for the filaments specified in **Chapter 4, Part 2 of Guidance for the Approval and Type Approval of Materials and Equipment for Marine Use** as a part of the approval test of synthetic fibre rope are carried out by synthetic fibre rope manufacture and passed them, the filaments may be used for synthetic fibre rope.

L5.1.7 Breaking Tests

Where test specimen is broken in way of the chucking part at the load less than the stipulated breaking load, re-test using the new specimen may be accepted.

L8 RECTANGULAR WINDOWS

L8.1 Rectangular Windows

L8.1.5 Testing

The wording “a suitable test method” in **8.1.5-2**, **Part L** of the Rules means the punch method in accordance with *ISO*614 or the equivalent thereto.

L9 CONTAINER SECURING FITTINGS

L9.1 Container Securing Fittings

L9.1.3 Materials

The wording "special consideration" in **9.1.3-3, Part L of the Rules** means that impact tests are to be carried out in accordance with **12.4.4, Chapter 12, Part 2 of Guidance for the Approval and Type Approval of Materials and Equipment for Marine Use** to confirm notch toughness at the design temperature of the ship provided with the fittings at the time of "Society's approval" referred to in **9.1.5, Part L of the Rules**.

L9.1.5 Manufacturing Processes and Product Shapes

The wording "Society's approval" in **9.1.5, Part L of the Rules** means obtaining approval in accordance with **Chapter 12, Part 2 of Guidance for the Approval and Type Approval of Materials and Equipment for Marine Use**.