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Ships and marine technology — Marine securing devices for ro-ro cargoes

Navires et technologie maritime — Dispositifs de retenue marins pour navires rouliers (ro-ro)

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

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

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Ships and marine technology — Marine securing devices for ro-ro cargoes

1 Scope

This document specifies types, dimensions and strength characteristics of devices used for securing ro-ro cargoes in sea transportation. It can also be used as a reference for road vehicles secured on inland vessels.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 1461, *Hot dip galvanized coatings on fabricated iron and steel articles — Specifications and test methods*

ISO 2768-1, *General tolerances — Part 1: Tolerances for linear and angular dimensions without individual tolerance indications*

ISO 5817, *Welding — Fusion-welded joints in steel, nickel, titanium and their alloys (beam welding excluded) — Quality levels for imperfections*

ISO 7452, *Hot-rolled steel plates — Tolerances on dimensions and shape*

ISO 9013, *Thermal cutting — Classification of thermal cuts — Geometrical product specification and quality tolerances*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

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

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

3.1
ro-ro cargoes
all types of cargoes carried on board a ro-ro ship as road vehicles, roll trailers, etc.

3.2
fixed fitting
securing device permanently installed in the vessel

3.3
portable fitting
loose fitting
securing device not permanently installed in the vessel

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3.4
maximum securing load
MSL
allowable load capacity of a device used to secure cargo to a ship

Note 1 to entry: It is expressed in kN.

3.5
proof test load
test load during testing of securing devices

Note 1 to entry: It is expressed in kN.

3.6
minimum breaking load
MBL
tested minimum breaking strength of a securing device

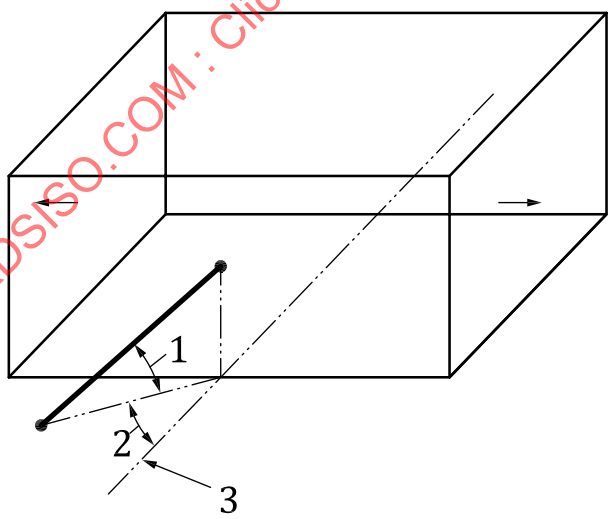
Note 1 to entry: It is expressed in kN.

3.7
vertical lashing angle
α
angle between the lashing device and the horizontal plane

Note 1 to entry: See Figure 1.

3.8
horizontal lashing angle
β
angle between the lashing device and the transverse direction on board the vessel

Note 1 to entry: See Figure 1.



Key
1 vertical lashing angle, α
2 horizontal lashing angle, β
3 axis parallel to the transverse direction of the vessel

Figure 1 — Lashing angles

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3.9
road vehicle
commercial vehicle, semi-trailer, road train, articulated road train or a combination of vehicles

Note 1 to entry: The IMO Resolution MSC .479(102)[2] defines road vehicle in 3.2.

4 Securing method of ro-ro cargoes

Rules and guidelines on the securing of cargoes are found in IMO instruments as well as in the vessel's cargo securing manual. For information, typical securing methods for ro-ro cargoes are given in Annex A.

5 Fixed fittings

5.1 The arrangement of fixed fittings shall be left to the discretion of the shipowner provided that for stowage of road vehicles in the ro-ro lanes, the longitudinal distance of fixed fittings shall be not more than 2,5 m, while the transverse distance should be not more than 3,0 m. The MSL of these fittings shall be not less than 100 kN.

5.2 There shall be no sharp edge or sharp angle of the securing point within the area where road vehicles run.

5.3 Fixed fittings shall be marked according to Clause 13. For information purposes, procedures for typical installation and maintenance of fixed fittings for ro-ro cargoes are given in Annex B.

6 Loose fittings

For information, typical loose fittings used for ro-ro cargoes are given in Annex C.

7 Categorization of fixed fittings

Categorization of fixed fittings is specified in Table 1.

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Table 1 — Categorization of fixed fittings

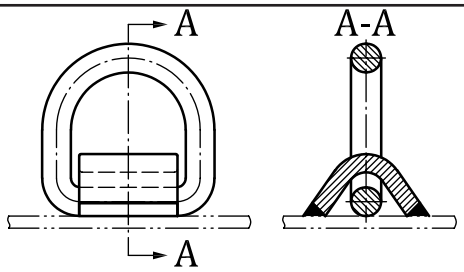
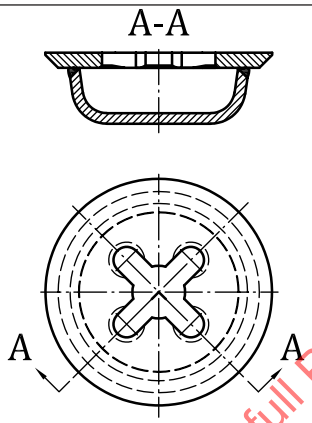
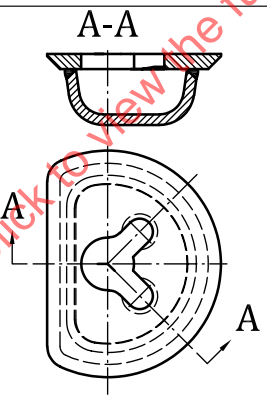
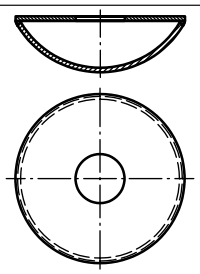
Type	Code	Name	Illustration	Remarks
Fixed fittings	DR	D-ring and clamp		Securing area on deck where no vehicles are running or on bulkheads or other strong structures.
	CL.F4	Flush clover leaf socket		Securing area where the deck is required to be flat and watertight for vehicle running.
	CL.F2	Flush half clover leaf socket		Securing area where the deck is required to be flat and watertight for vehicle running.
	LC	Lashing cup for hole		Securing area where the deck is required to be flat and watertight for vehicle running.

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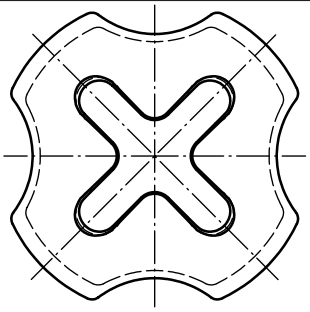
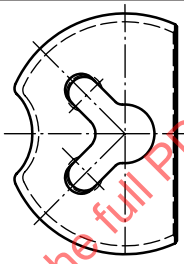
Table 1 *(continued)*

Type	Code	Name	Illustration	Remarks
Fixed fittings	CB	Crinkle bar		Securing area on deck where no vehicles are running close to the main supporting structures such as bulkheads.
	CL.R4	Raised clover leaf socket		Securing area not required to be flat.
	CL.R2	Raised half clover leaf socket		Securing area where securing loads are large and close to the main supporting structure, such as bulkheads, girders and transverses.
	LS.R3	Raised lashing socket		Securing area not required be flat.

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8 Material

The strength grade of materials of fixing fittings shall not be lower than that of the plate to which they are welded; the low-temperature impact performance shall not be lower than the grade of the plate to which they are welded.

9 Dimension and strength requirements of fixed fittings

The dimension and strength requirements of fixed fittings are specified in Tables 2 to 9. Dimensions are in millimetres and strengths in kN. The plate thickness, t, should meet the requirements of the classification society.

The steel plate thickness shall meet the requirements of ISO 7452. Flame cutting unmarked dimensional tolerances shall meet the requirements of ISO 9013, class 2. Tolerances for linear and angular dimensions without individual tolerance indications shall comply with ISO 2768-1.

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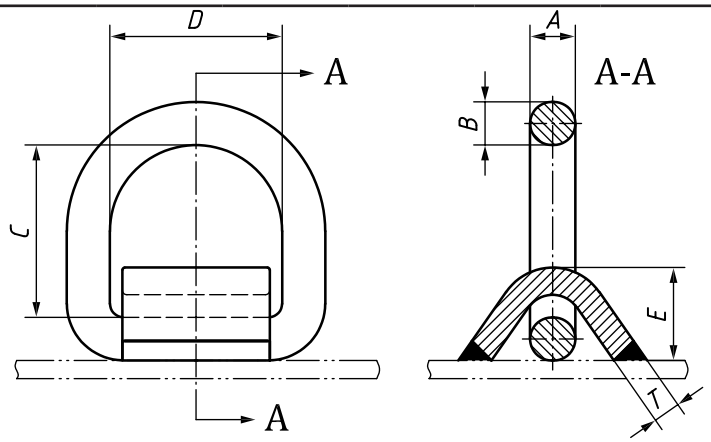
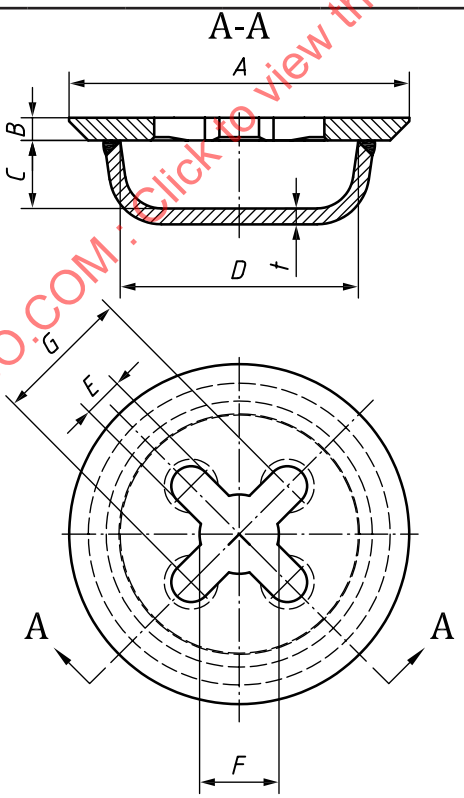
Table 2 — Dimensions and strength of D-rings and clamps, DR



TYPE	*A* **max** mm	*B* **max** mm	*C* **min** mm	*D* **min** mm	*E* **max** mm	*T* **min** mm	**MSL min** kN	**Reference mass max** kg
DR/40	15	16	40	50	25	6	40	0,5
DR/100	20	25	55	65	40	12	100	1,7
DR/180	25	30	60	75	45	14	180	2,7

Table 3 — Dimensions and strength of flush clover leaf socket, CL.F4



TYPE	*A* **approx** mm	*B* **max** mm	*C* **min** mm	*D* **min** mm	*E* mm	*F* **min** mm	*G* mm	*t* **approx** mm	**MSL min** kN	**Reference mass max** kg
CL.F4/100	240	16	27	186	35	65	115	12	100	8,2
CL.F4/160	300	20	60	210	35	70	115	14	160	13,2

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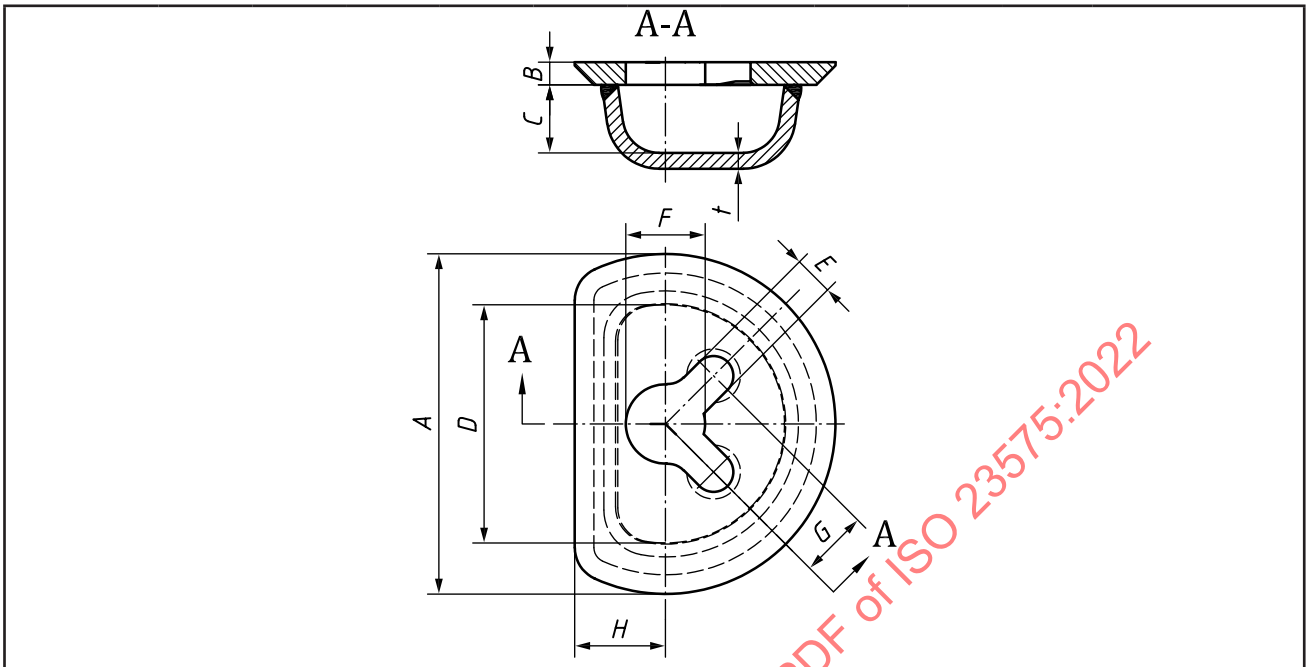
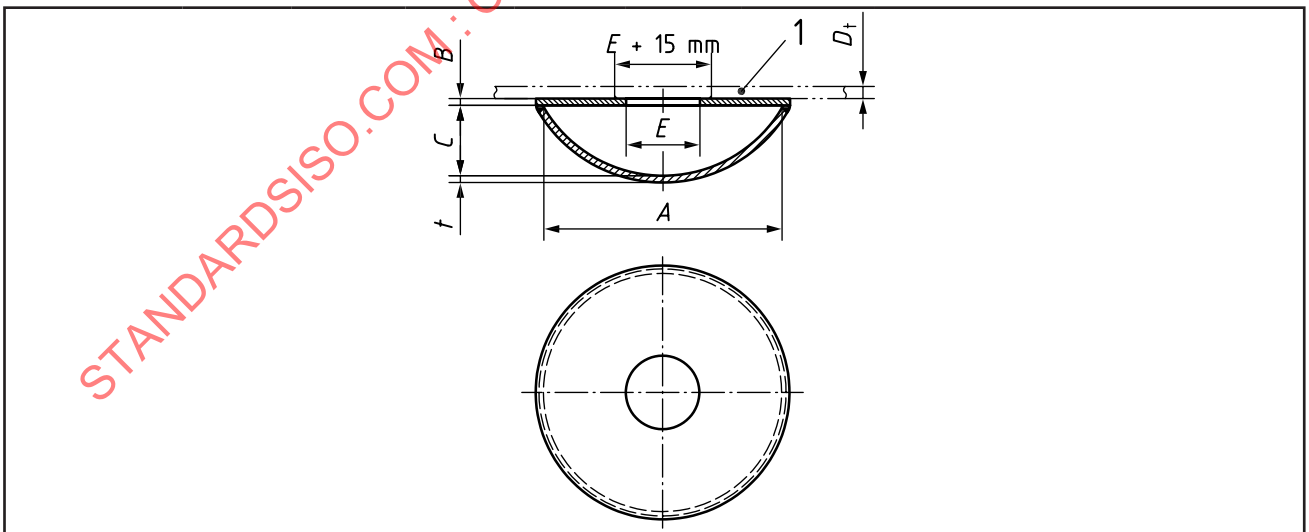
Table 4 — Dimensions and strength of flush half clover leaf socket, CL.F2



TYPE	*A* approx mm	*B* max mm	*C* min mm	*D* min mm	*E* mm	*F* min mm	*G* mm	*H* approx mm	*t* approx mm	MSL min kN	Reference mass max kg
CL.F2/100	240	16	27	186	35	65	57,5	78	12	100	7,3
CL.F2/160	260	20	60	210	35	70	57,5	80	14	160	11,5

Table 5 — Dimensions and strength of lashing cup for hole, LC



Key

1 deck

TYPE	*A* approx mm	*B* mm	*C* min mm	*E* mm	*t* approx mm	D_t min mm	MSL min kN	Reference mass max kg
LC/75	210	6	60	65	6-14	8	75	8,0
LC/100	210	6	60	65	6-14	13	100	8,0

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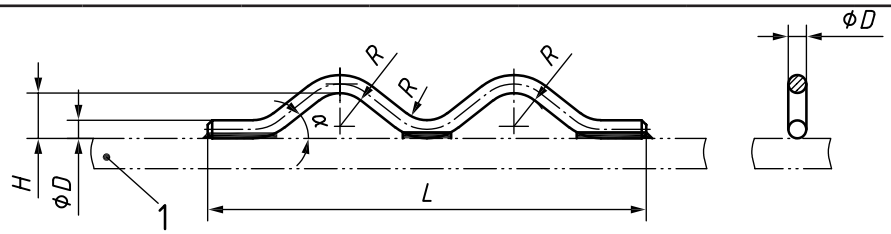
Table 6 — Dimensions and strength of crinkle bars, CB

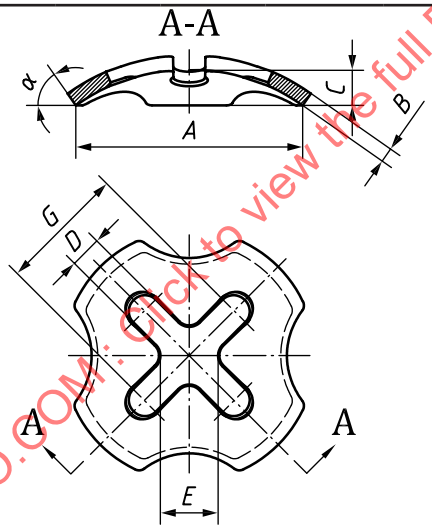


Key

1 deck

TYPE	*L* approx mm	*R* min mm	*H* min mm	*D* max mm	*α* max °	MSL min kN	Reference mass max kg
CB/20	290	23	30	13	40	20	0,4
CB/30	290	22	30	16	40	30	0,5
CB/100	400	25	40	25	40	100	1,7

Table 7 — Dimensions and strength of raised clover leaf socket, CL.R4



TYPE	*A* approx mm	*B* max mm	*C* min mm	*D* mm	*E* min mm	*G* mm	*α* min °	MSL min kN	Reference mass max kg
CL.R4/100	250	16	39	35	65	115	45	100	5,1
CL.R4/160	300	20	60	35	70	115	45	160	11,4

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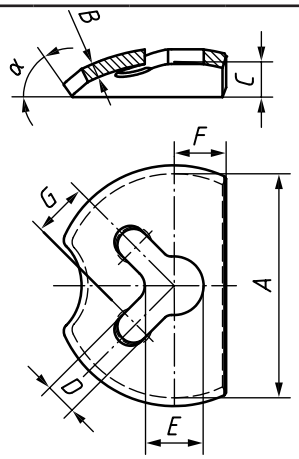
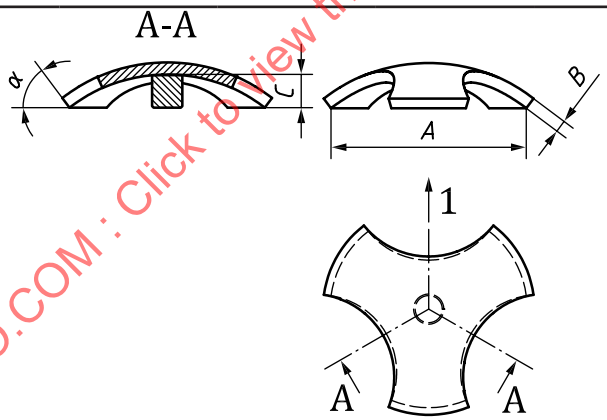
Table 8 — Dimensions and strength of raised half clover leaf socket, CL.R2



TYPE	*A* approx mm	*B* max mm	*C* min mm	*D* mm	*E* min mm	*F* approx mm	*G* mm	*α* min °	MSL min kN	Reference mass max kg
CL.R2/100	250	16	39	35	65	58	57,5	45	100	4,5
CL.R2/160	210	20	60	35	70	60	57,5	45	160	8,9

Table 9 — Dimensions and strength of raised lashing socket, LS.R3



Key

1 aft/fwd

TYPE	*A* approx mm	*B* max mm	*C* min mm	*α* min °	MSL min kN	Reference mass max kg
LS.R3/30	127	6	22	45	30	0,8
LS.R3/50	140	8	22	45	50	1,1
LS.R3/100	140	13	27	45	100	3,1

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10 Test method of fixed fittings

10.1 General requirement

Fixed fittings shall be tested according to this Clause at the manufacturing site. Type testing shall be carried out to prove the capability of new designs and subsequent production testing shall be carried

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out to ensure the quality of the product. When mounted on board the vessel, tests shall be carried out according to the class requirements, to verify proper installation.

Classification societies may require additional testing procedures.

10.2 Type testing

Test of compliance with strength requirements shall be carried out according to 10.4 to 10.8 with at least three samples of each product in each direction. All samples must pass the requirements given in 10.6.

Test of compliance with tightness requirements shall be carried out according to Clause 12 with at least three samples that have been subjected to a test load of at least 1,25 MSL in the direction that produces the greatest deformation.

10.3 Production testing

For production testing, test of compliance with strength requirements shall be carried out according to 10.4 to 10.8 in the direction that produced the greatest deformation at a test force of at least 1,25 MSL in the type test.

The minimum test frequency in the production of fixed fittings shall be as given in Table 10.

Table 10 — Sampling rate for fixed fittings

Maximum securing load (MSL) kN	**One sample per lot**
Up to 30	Every 500 pieces
Over 30 to 100	Every 250 pieces
Over 100	Every 100 pieces

If the manufacturer operates a third party certified quality system according to ISO 9001, the lot sizes in the table above may be tripled.

If, during production testing, the sample does not meet the requirements in 10.6, but sustains a load of not less than 1,8 MSL without critical failure in the form of breakage or visible cracks, two further samples shall be tested. If one or more of these additional samples does not meet the requirements in 10.6, fixed fittings of this batch shall be deemed not to comply with this document.

10.4 Test profiles to be used (hook/elephant foot)

The tests of fixed fittings are to be carried out by one of the reference test profiles specified in Table 11.

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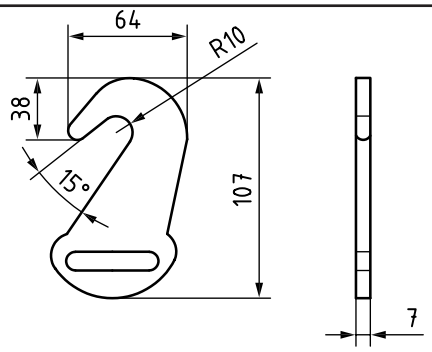
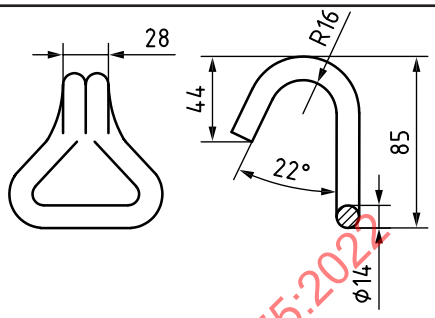
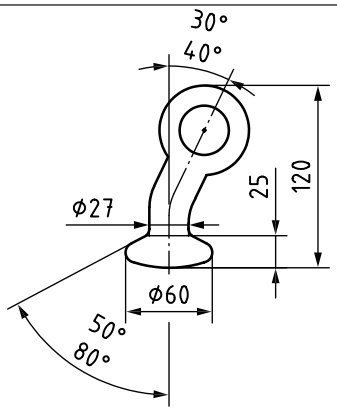
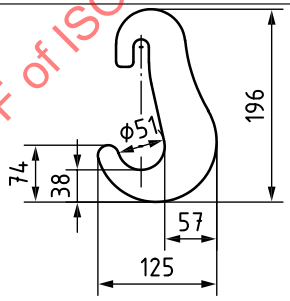
Table 11 — Reference test profiles to be used for testing of fixed fittings

Dimensions in millimetres

	
1. Car lashing hook, used up to MSL 25 kN	2. Rollash and web lashing hook, used for MSL up to 50 kN
	
3. Elephant foot	4. Chain lashing hook

The profile of test devices used during testing of the fixed fittings shall be specified in the test certificate and test report. Systems not able to take any of the reference test profiles in Table 11, shall be tested with the end fittings they are intended for. The end fitting used shall be specified in the test certificate and the test report.

The test device used shall show no deformation at a test force of 1,25 MSL and shall be able to withstand a test force of at least 2 MSL without critical failure in the form of breakage or visible cracks.

The test device may not be deformed in such a way that it gives misleading test results.

Any test device showing permanent deformation shall be replaced for subsequent testing.

10.5 Support of tested fitting

The tested fixed fitting shall be fitted during the test as when mounted onboard the vessel. The plate to which it is fitted shall have no greater thickness than the minimum thickness of the deck plate for which it is intended to be mounted in. There shall be a free distance between the fixed fitting and the test fixture of at least 100 mm.

10.6 Test force

10.6.1 All load-bearing parts of the fixed fitting shall show no evidence of deformation or any other defect that affects the function at a proof test load of 1,25 MSL.

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10.6.2 After the release of this force the fixed fitting shall be inspected for permanent deformation and other defects. The test specimen shall show no greater deformations than those listed below.

— Permanent deformations shall not affect the function of the fitting or ship operations.

— Maximum deflection of the top plate of a socket type fitting or hole is 3 mm, measured at the opposite side of where the test profile was attached.

— Maximum elongation of D-ring or crinkle bar type fitting is 2 % in any direction.

— Maximum indentation in the test specimen from the test profile is 1,5 mm.

10.6.3 After the lashing fitting has been inspected in accordance with 10.6.2 it shall withstand a force of at least 2 MSL without critical failure in the form of breakage or visible cracks.

The minimum breaking load (MBL) may then be determined by increasing the load till ultimate failure occurs

10.6.4 Lashing fittings intended to accommodate more than one lashing shall be tested by that number of lashings that can be under maximum tension simultaneously during use on board the vessel. When multiple lashings are used, the force in each lashing shall be applied in approximately the same direction, as permitted by the design of the fitting.

For example, clover leaf sockets of type CL.F4 may accommodate four lashings, but only two will be under strain simultaneously during use.

10.7 Test duration

The test force shall be applied for at least 1 min.

10.8 Test angles

10.8.1 The direction of application of the test force shall lie within the following range of angles:

a) α: 10°, 45° and 80°;

b) β: between 0° and 360°, at intervals not exceeding 45°.

The fittings are not needed to be tested in directions for which symmetry of the design ensures that previously performed tests proves the strength.

10.8.2 For type testing, the test force needs to be applied in the most unfavourable direction of application only, if this has been established by calculations.

10.8.3 For production testing, the test force needs to be applied in the most unfavourable direction of application only, as established by calculations or by the results of the type testing.

10.8.4 A calculation model used to determine the most unfavourable test angle must have been verified by comparison to physical tests on similar designs.

11 Appearance requirements

11.1 There shall be no cracks or folding in forgings, and the surface shall be polished to eliminate flash.

11.2 Defects of castings that do not affect strength may be repaired with electric welding.

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11.3 The welds shall be flat without any defect, such as cracks, slag, weld flashes and pores. The welding quality shall conform to the Grade II requirement of ISO 5817.

11.4 For products used in open air, their outside surfaces shall be galvanized in accordance with ISO 1461.

12 Tightness requirements

12.1 General requirement

Products with tightness requirements shall pass the tightness test specified in 12.2, conducted under a pressure from underneath.

12.2 Test methods

12.2.1 Air tightness test

Apply a soap solution on the outer surface of the tested product. Then, inflate to the product with a pressure of 0,015 MPa and keep it for 5 min. Check the pressure. If no pressure drop or bubble on the outer surface of the product is observed, the product is qualified.

12.2.2 Other methods

Tests can alternatively be carried out using other methods approved by the classification society.

13 Marking

Fixed fittings shall be marked with the following information, where a) is mandatory and b) to f) are optional:

a) maximum securing load mark: MSL and its value in kN;

b) maximum securing load: MSL and its approximate value in kg;

c) manufacturer's mark;

d) code name of the product according to Clause 7;

e) batch number of the product;

f) reference to this document i.e. ISO 23575.

14 Test report of fixed fitting

After a fixed fitting has been type tested according to the test procedures described in 10.2, a test report shall be issued to be part of the technical file of the manufacturer and signed by the person responsible for the tests. The report shall have the following contents:

a) identification of manufacturer of lashing fitting;

b) manufacturer or test organization, name, address, phone number and e-mail address of the person responsible for the tests;

c) test report number;

d) type of the tested fixed fitting including type of end fitting profile used in the tests (hook/elephant foot);

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e) test methods for each step in verifying the strength requirements (e.g. calculation or static test);

f) test result or calculations (for each angle of application of the test force);

g) test methods for verifying tightness requirements;

h) manufacturer's mark on the fitting, code name of the fitting, batch ID of the fitting, other markings on the fitting;

i) other relevant information;

j) reference to this document i.e. ISO 23575;

k) place and date;

l) signature of the person responsible for the tests;

m) printed name of the person responsible for the tests.

The information shall be provided in English. In addition, further language versions are allowed.

15 Manufacturers certificate to customer

After a fixed fitting has been production tested according to the test procedures described in 10.3, a test certificate shall be issued and signed by the person responsible for the tests. The information shall be provided in English. In addition, further language versions are allowed. The certificate shall have a layout and contents as shown below:

a) manufacturer, name, address, phone number and e-mail address;

b) manufacturer or test organization, name, address, phone number and e-mail address of the person responsible for the tests;

c) test report number;

d) test methods;

e) identification of manufacturer of the lashing fitting;

f) manufacturer's mark on the fitting, code name of the fitting, batch number of the fitting, other markings on the fitting;

g) type of the tested fixed fitting including type of end fitting used in the tests (hook/elephant foot);

h) obtained MSL and MBL in kN;

i) other relevant information;

j) statement to certify that the tested fixed fitting complies with test requirements set up in this document;

k) place and date;

l) signature of the person responsible for the tests (and printed name);

m) signature of the person responsible for compliance (and printed name).

16 Packaging, storage and transportation

16.1 Products shall be packed tightly to maintain their integrity during transportation.

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16.2 Products shall be handled and placed with caution during handling and transportation to prevent any collision, and shall be moisture-proof.

16.3 Products shall be stored in a dry and well-ventilated room. Moving parts, such as screw threads, shall be lubricated and subjected to a rust prevention treatment on a regular basis according to actual use.

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Annex A
(informative)

Securing methods of ro-ro cargoes

NOTE Rules and guidelines on the securing of cargoes on board ships are found in IMO instruments (CSS code IMO resolution MSC 479(102)[2] as well as in the vessels' individual Cargo Securing Manuals (according to MSC.1/Circ.1353, rev.2[3]).

A.1 Securing methods for cars

In pure car truck carriers (PCTCs), cars are generally tightly stowed in longitudinal direction with a distance of 0,1 m to 0,3 m in transverse as well as in longitudinal direction, see Figure A.1. The hand brakes of the cars are applied and a low gear is engaged.

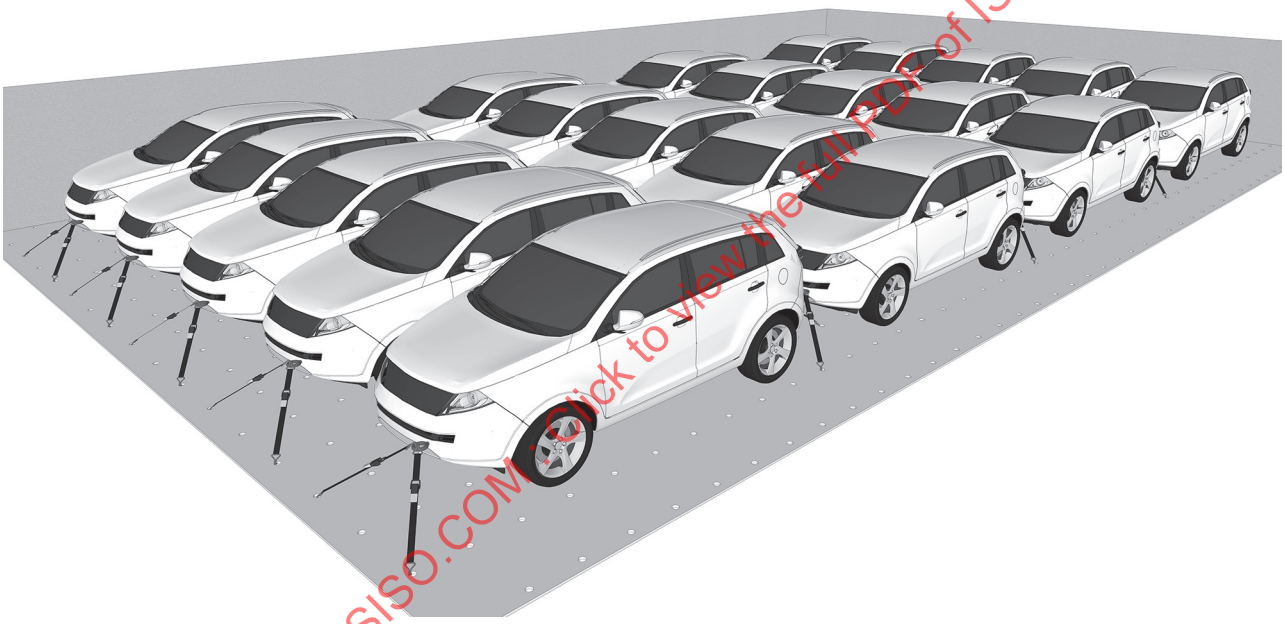

Figure A.1 — Stowage and securing arrangements of cars in PCTCs

The cars are normally secured by four car lashings, with MSL between 7,5 kN (0,75 ton) and 15 kN (1,5 ton) applied in securing fittings on the cars or to the rims of the wheels, in accordance with Figure A.2.

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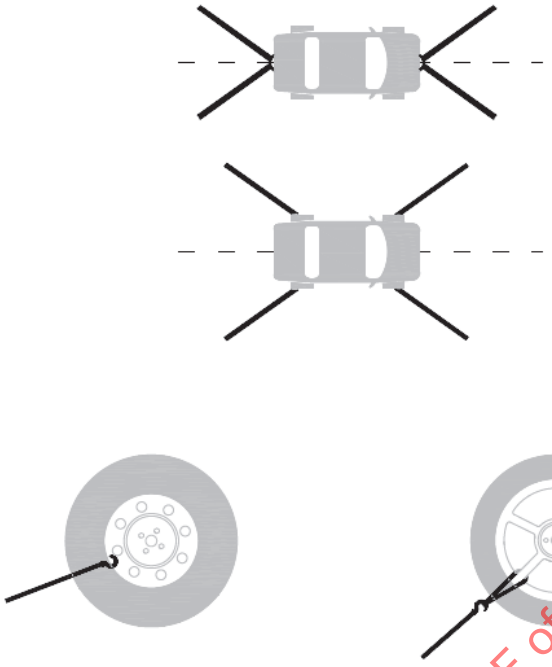

Figure A.2 — Different securing methods for cars

Passenger cars on board ro-ro ferries are normally not lashed, but if that would be needed due to hard weather they are normally stowed in the ro-ro lanes, see Figure A.3, and secured by four lashings as described above.

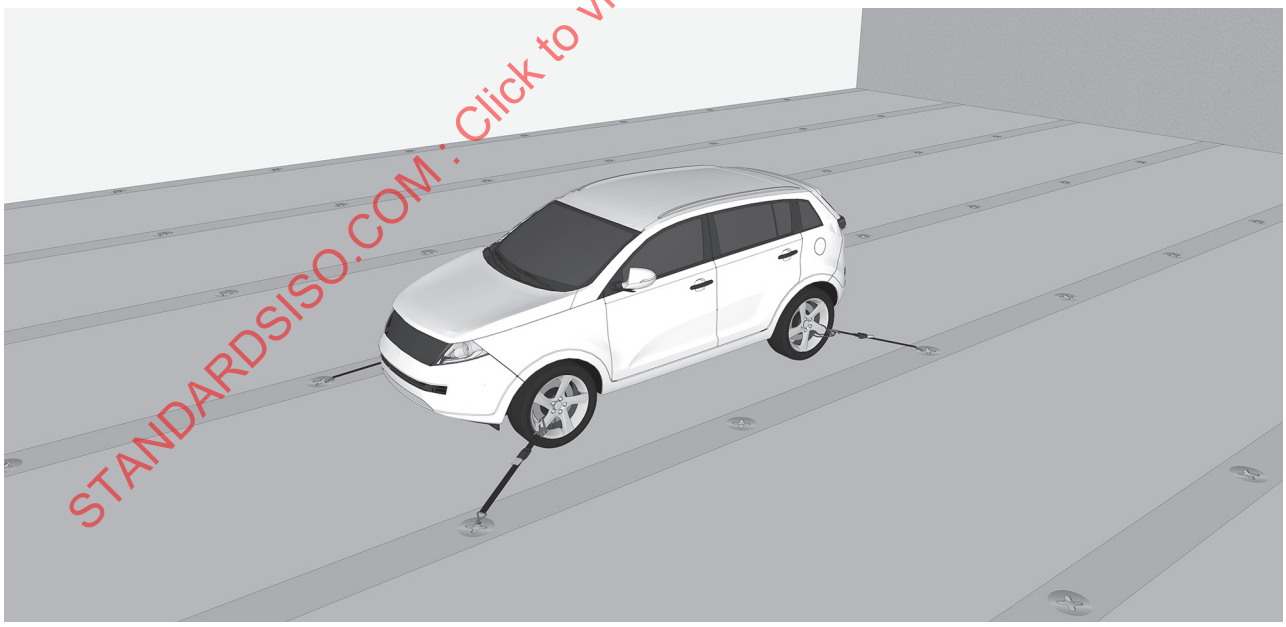

Figure A.3 — Stowage and securing of cars in ro-ro ferries

Wheel chocks are generally not used for cars except on some occasions such as when:

a) the cars are stowed in transverse direction;

b) the cars are stowed in ramps;

c) the hand brake of the car is defective;

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d) the weight of the car is extreme.

A.2 Securing method for load-carrying trucks

Load-carrying vehicles are stowed in lanes with the parking brake applied and a low gear engaged. Wheel chocks may be used in accordance with the vessel's cargo securing manual. On short routes with limited wave heights, the vehicles may be unlashed, otherwise they are secured to the ships' decks by two to four lashings per side, see Figure A.4.

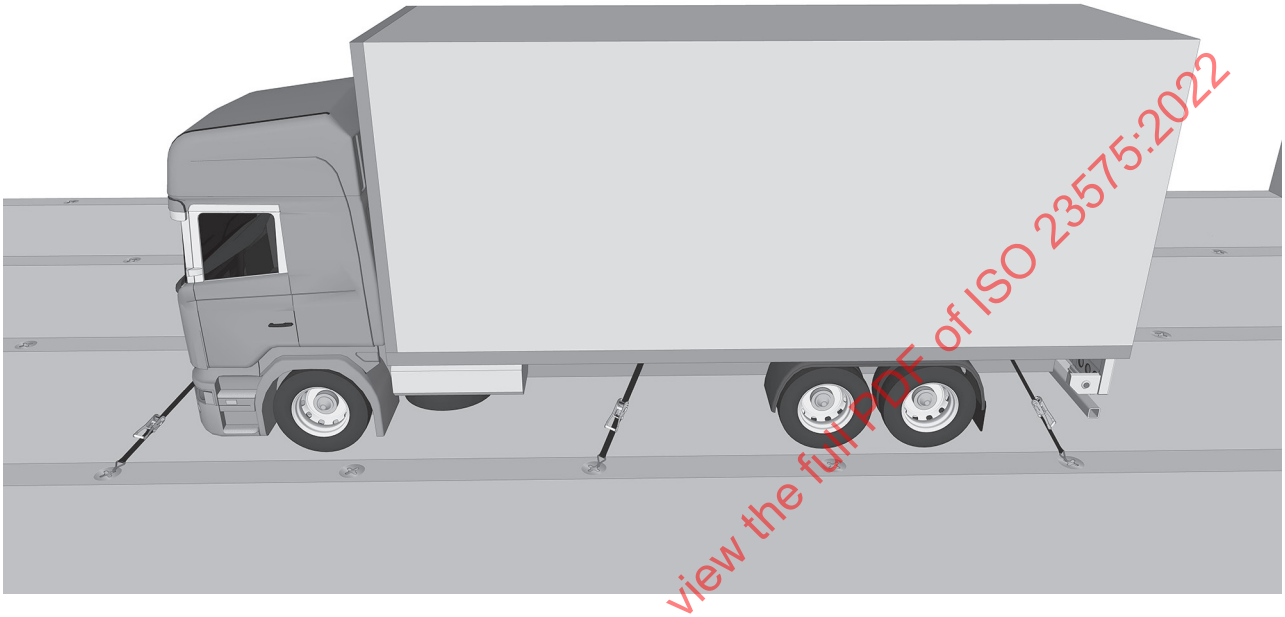

Figure A.4 — Securing method for trucks

The lashings consist of web or chain lashings and are tightened by a tensioner.

A.3 Securing method for semi-trailers

Semi-trailers are stowed and secured as other load-carrying vehicles. In the forward end, they are be supported by a trestle. The trestle is generally hand-operated with a support in the vertical direction only, but it can also be automatically operated and used to mechanically lock the kingpin on the semi-trailer to the ship's deck.

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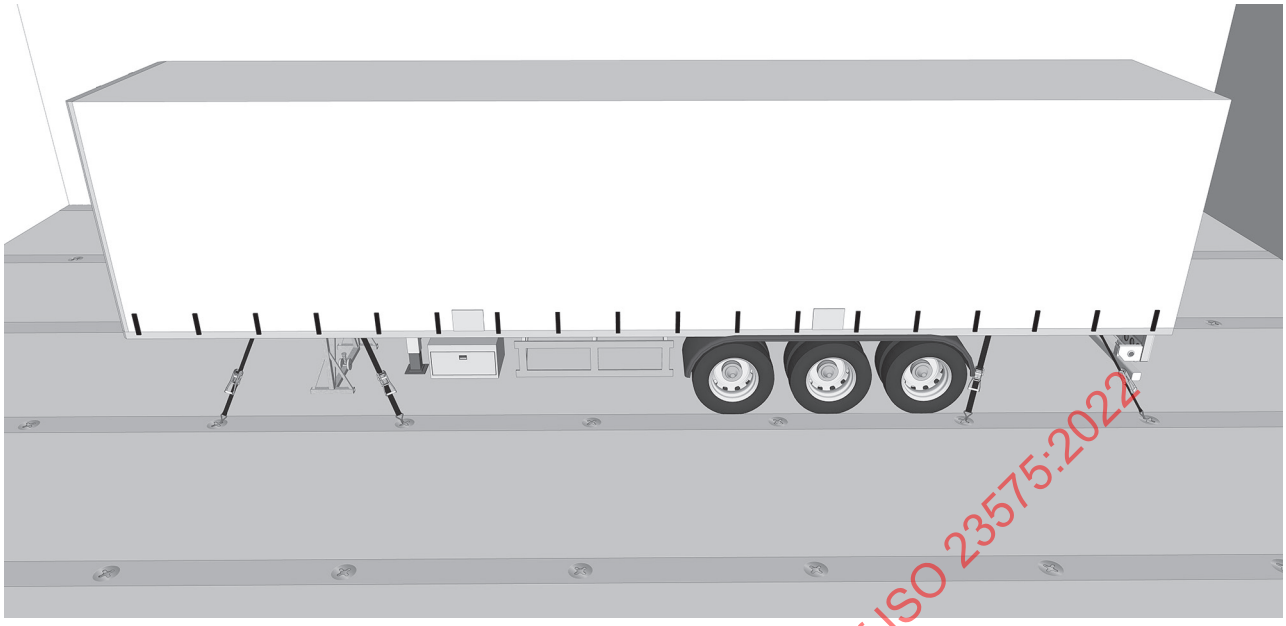

Figure A.5 — Securing method for semi-trailers

The hand-brake, and in many cases even the driving brake, are applied during the sea transport and thus wheel chocks are required in exceptional cases only.

Semi-trailers are always lashed in the forward-end and, in most cases, also in the rear end, see Figure A.5. Semi-trailers built according to ISO 9367-2 can always be secured by four heavy lashings with MSL 100 kN (10 ton) on each side. Due to the location of the lashings fittings on the trailers, the lashing angles are always favourable between 30° and 60° to effectively prevent sliding and tipping in all directions. This is valid as long as the longitudinal distance between the fixed lashing fittings on the ship's deck is maximum 2 500 mm.

A.4 Securing method for roll-trailers

For heavy cargo items, roll-trailers are frequently used in the ro-ro vessels. The roll-trailers can have load bearing capacities up to and above 120 ton.

They are generally stowed in lanes on the decks, but depending on the dimensions of the load carried on the roll-trailers they can be stowed in any patterns on the decks. The roll-trailers are lashed to the ships' decks to prevent sliding and tipping in all directions (see Figure A.6). The number of lashings is generally calculated by the rule of thumb method, so that the sum of the lashings MSL, in tons, per side equal the weight of the roll-trailer in tons. On board the PCTCs, the lashings are fixed to elephant-foot fittings or lashing holes on the ships' decks.

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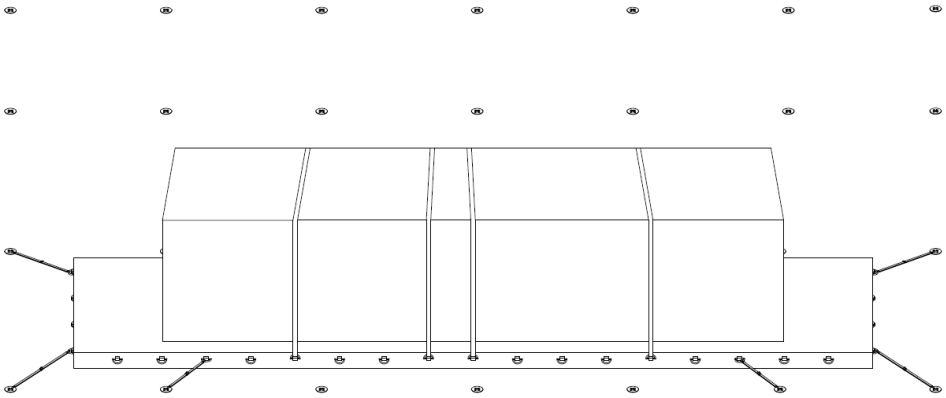

Figure A.6 — Securing method for roll-trailers

Even if the wheels of roll-trailers are un-braked, wheel chocks are normally not used. However, to prevent tipping, if the roll-trailers are loaded by goods with a high centre of gravity, jacks may be used to increase the tipping base of the unit.

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Annex B
(informative)

Installation and maintenance

B.1 Installation

Fixed fittings should be installed on the hull according to the requirements of the vessel's arrangement plan.

B.2 Maintenance

B.2.1 General

Securing devices should be timely maintained, to ensure they are always in good, serviceable condition. Maintenance is generally conducted twice a year, right after the inspection and every six months thereafter. In case of permanent deformation and damage, the securing devices should be scrapped; especially in the adverse condition which results in the damage of the devices, the corresponding parts should be replaced simultaneously.

B.2.2 Maintenance of fixed fittings

B.2.2.1 The weld attached to the hull structure should be inspected; in case of defects and cracks, welding should be made with the electrode matching the materials after the problems are solved by slotting or other methods. Before welding, rust, greasy dirt and moisture should be removed from the welding position and around 20 mm in all directions and polishing made until the metallic luster is exposed. In case of pores and cracks during welding, they should be polished until pores and cracks are eliminated before rewelding.

B.2.2.2 If the hull itself is defective (such as uneven), the part of the hull where the device is to be rewelded should be repaired in a proper manner.

B.2.2.3 If the body has cracks, it should be replaced, and repair welding cannot be used.

B.2.2.4 If the body has deformation, it should be replaced.

B.2.2.5 Where there is light corrosion, rust should be removed and the cleaned area repainted. For heavy corrosion, where the plate thickness is reduced by more than 2 mm after rust-removal or the pitting depth is more than 1 mm, replacement is required.

B.2.2.6 If a small quantity of products are replaced during regular operation, they should be replaced with others of at least the same strength (same type or other types), the welding of the products to the hull should be carried out in accordance with established welding procedures to ensure welding quality.

B.2.2.7 The fixed fittings should be cleared of dusts, gravels or other residues before use.

B.2.2.8 Regular maintenance, such as rust-removal and painting, should be conducted.

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