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Ships and marine technology — Ship's mooring and towing fittings — Universal fairleads with upper roller

Navires et technologie maritime — Corps-morts et ferrures de remorquage de navires — Chaumards universels avec rouleau supérieur

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Foreword

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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 Technical Committee ISO/TC 8, *Ships and marine technology*, Subcommittee SC 4, *Outfitting and deck machinery.*

This second edition cancels and replaces the first edition (ISO 13733:2012), which has been technically revised.

The main changes compared to the previous edition are as follows:

— technical guidelines have been added in 7.3 and 7.4;

— the definition of SWL (3.1) has been reworded;

— the object lines and mark numbers in Figures 1, 2, 3 and 4 have been amended;

— the values of "t" for the vertical roller, lower horizontal and upper horizontal roller in Table 5 (former Table 3) have been amended;

— the thickness of the bushes and washers have been added in Table 5 (former Table 3);

— the description in Clause A.1 has been amended;

— the dimension line (θ_1) in Figure A.2 has been amended;

— the descriptions in Clause A.3 have been amended;

— technical information on FEM and strength calculation have been added in A.3.2 and A.3.3.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

The universal fairlead is a type of ship's mooring fitting installed on board to lead the mooring rope from the ship's inboard to outboard.

Ships and marine technology — Ship's mooring and towing fittings — Universal fairleads with upper roller

1 Scope

This document specifies the types, nominal sizes, dimensions and materials, as well as construction, manufacturing and marking requirements, for universal fairleads with upper roller(s) installed to lead the mooring rope of a ship.

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.

IMO Circular MSC/Circ.1175, *Guidance on shipboard towing and mooring equipment*

3 Terms and definitions

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

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

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

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

3.1
safe working load
SWL
safe load limit (maximum permissible load) of the fittings used for mooring and towing

4 Classification

4.1 Type

Depending on the construction, universal fairleads shall be classified as belonging to one of the following four types:

a) Type 4R: with one rope-passing opening;

b) Type 5RL: with one rope-passing opening with an additional guide roller on the left side;

c) Type 5RR: with one rope-passing opening with an additional guide roller on the right side;

d) Type 7R: with two rope-passing openings.

4.2 Nominal sizes

The nominal sizes, D_n, of universal fairleads are denoted by reference to the outside diameter of the main roller, in millimetres, in terms of the nearest number drawn from a basic series of preferred numbers. For the universal fairleads having the same roller diameter, the code, i.e. 4R, 5RL, 5RR or 7R, is followed by the nominal size for the different SWLs.

The nominal sizes are:

140, 160, 180, 200, 250, 300A, 300B, 400A, 400B and 400C.

5 Dimensions

Universal fairleads shall have dimensions and particulars in accordance with Tables 1, 2, 3, 4, 5 and 6, and Figures 1, 2, 3, 4 and 5.

6 Materials

The following materials shall be used for manufacturing the components of universal fairleads:

a) Frame and other plates: weldable steel plates having a yield point of not less than 235 N/mm^2, except for the frames with a rope guide for nominal sizes 400A, 400B and 400C, which shall be made of weldable steel plates having a yield point of not less than 315 N/mm^2.

b) Roller: weldable steel plates having a yield point of not less than 235 N/mm^2, except for the rollers for nominal sizes 400A, 400B and 400C, which shall be made of weldable steel plates having a yield point of not less than 315 N/mm^2, or equivalent steel tubes.

c) Axle: carbon steel having a yield point of not less than 345 N/mm^2.

d) Bush: brass or bronze or equivalent.

7 Construction

7.1 The rollers of the universal fairleads shall be constructed from steel tubes or formed from plate.

7.2 The foundation of the universal fairleads shall be determined by the manufacturer. The foundation and welding connections to the hull shall guarantee a reliable transmission of the maximum loading of the universal fairleads to the hull construction without any plastic deformation or cracks.

7.3 The selection of ship's mooring fittings and mooring lines should take into account the diameter, D, of surfaces of mooring fittings that are in contact with the mooring line diameter, d, (D/d ratio) to reduce or mitigate bend ross of strength.

7.4 The tensile strength of mooring rope may be reduced depending on bend radius (D/d ratio) through the mooring fittings, in accordance with the rope manufacturer's guidelines.

8 Manufacturing and inspection

8.1 All surfaces of the universal fairleads, including welded surfaces, shall be free from any visible flaws or imperfections.

8.2 All surfaces in contact with the ropes shall be free from surface roughness or irregularities likely to cause damage to the ropes by abrasion.

8.3 The universal fairleads shall be coated externally with an anti-corrosion protective finish.

8.4 All rotating parts shall be greased.

9 Marking

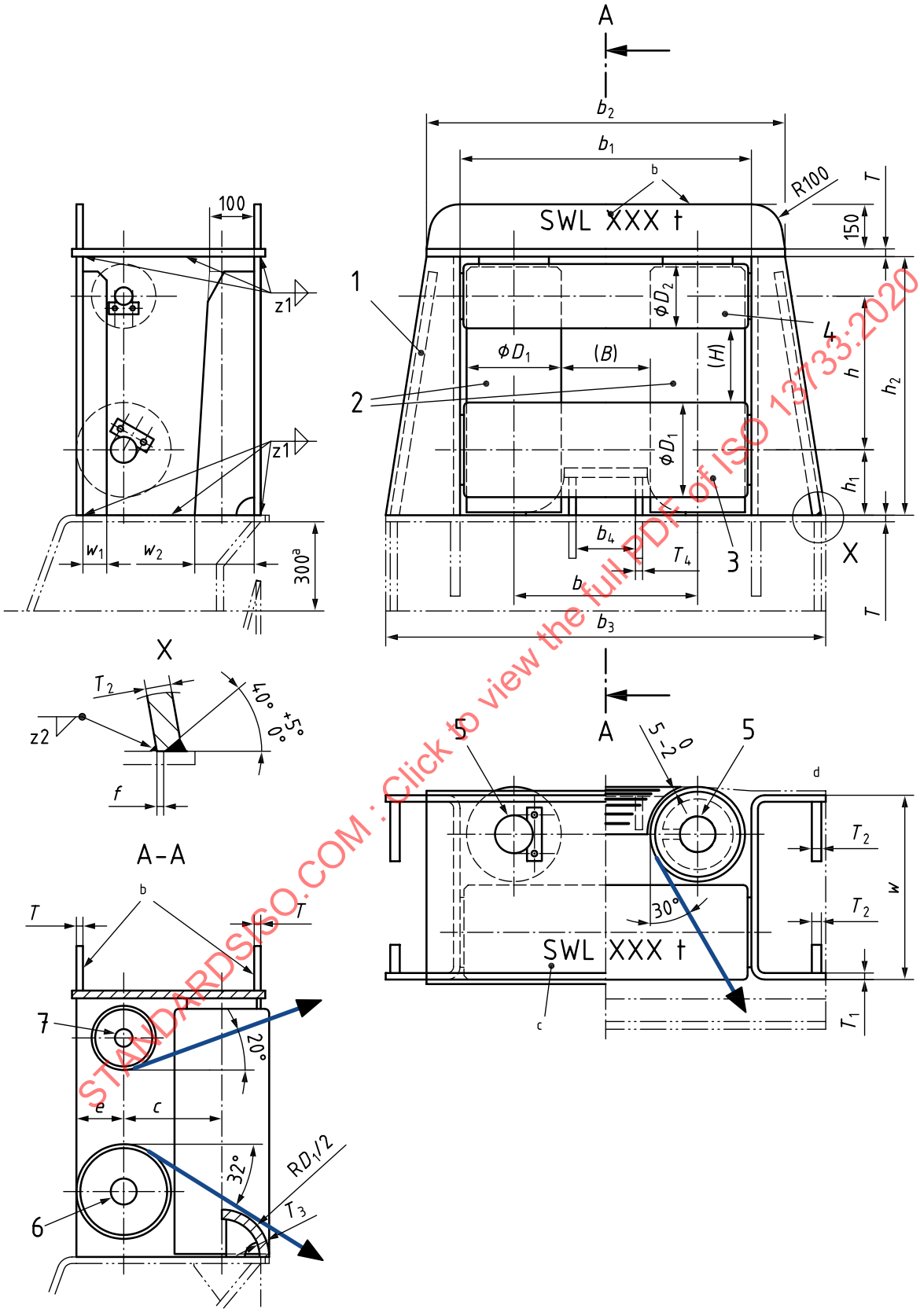
9.1 The safe working load (SWL) for the intended use of the universal fairleads shall be noted in the towing and mooring plan available on board for the guidance of the shipmaster as specified in IMO circular MSC/Circ.1175.

9.2 The actual SWL on board shall be determined by considering the foundation and under deck reinforcement, and it shall be marked on the towing and mooring plan. The actual SWL shall not be over the SWL in this document.

9.3 The universal fairleads shall be clearly marked with their SWL by weld bead or equivalent. The SWL shall be expressed in tonnes (symbol 't') and be placed so that it is not obscured during operation of the fitting.

EXAMPLE SWL XXX t

Dimensions in millimetres



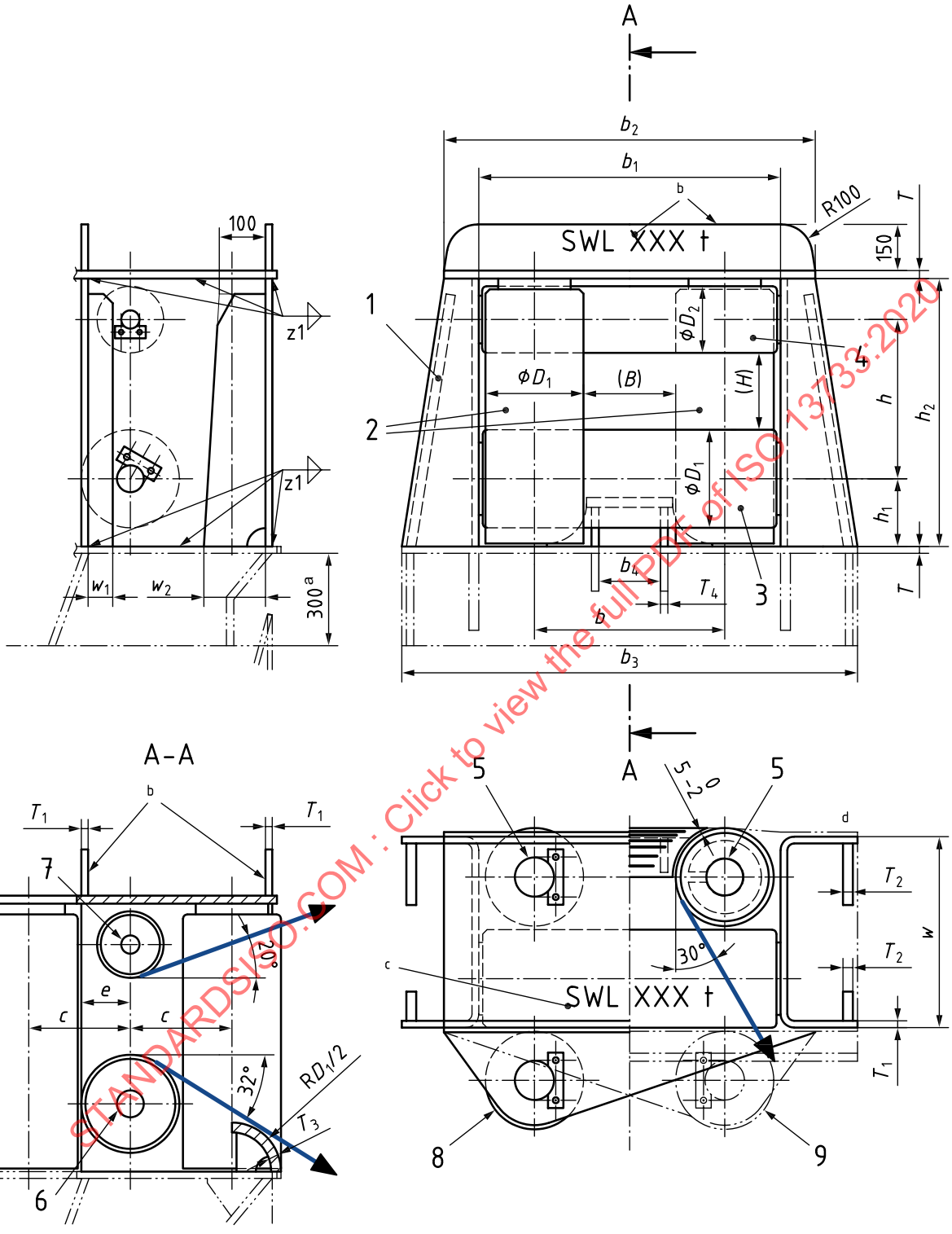
Key

1 frame with rope guide
2 vertical rollers with housing and washers
3 lower horizontal roller with washers

4 upper horizontal roller with washers
5 vertical axles with stopper
6 lower horizontal axle with stoppers
7 upper horizontal axle with stoppers
[a] Height of seat shall be determined in accordance with the hull construction design.
[b] For nominal size 250 and above.
[c] For nominal size between 140 and 200 only.
[d] Side shell.

Figure 1 — Assembly of type 4R universal fairleads

Dimensions in millimetres



Key

1 frame with rope guide
2 vertical rollers with housing and washers
3 lower horizontal roller with washers
4 upper horizontal roller with washers
5 vertical axles with stopper
6 lower horizontal axle with stoppers
7 upper horizontal axle with stoppers

8 type 5RL

9 type 5RR

[a] Height of seat shall be determined in accordance with the hull construction design.

[b] For nominal size 250 and above.

[c] For nominal size between 140 and 200 only.

[d] Side shell.

NOTE Details not shown in this figure; refer to Figure 1.

Figure 2 — Assembly of type 5RL and 5RR universal fairleads

Table 1 — Dimensions of type 4R, 5RL and 5RR universal fairleads

Dimensions in millimetres

Nominal size D_n	$B \times H$	D_1	D_2	h	h_1	h_2	b	b_1	b_2	b_3	b_4	w	c
140	195 × 150	139,8	114,3	277	130	480	335	515	656	820	140	260	150
160	200 × 150	165,2	114,3	290	145	515	365	570	730	920	140	310	175
180	200 × 150	190,7	139,8	315	155	560	391	620	800	1 000	140	360	200
200	200 × 150	216,3	139,8	328	170	590	416	675	896	1 110	140	410	225
250	250 × 200	267,4	165,2	416	195	715	517	825	1 046	1 270	180	520	280
300A	300 × 250	318,5	216,3	517	220	870	618	980	1 206	1 480	200	620	330
300B	300 × 250	318,5	216,3	517	220	870	618	980	1 206	1 480	200	620	330
400A	350 × 250	406,4	216,3	561	265	960	756	1 210	1 450	1 750	200	795	420
400B	350 × 250	406,4	216,3	561	265	960	756	1 210	1 450	1 750	200	795	420
400C	350 × 250	406,4	216,3	561	265	960	756	1 210	1 450	1 750	200	795	420

Table 2 — Dimensions *(continued)* and SWL of type 4R, 5RL and 5RR universal fairleads

Dimensions in millimetres

Nominal size D_n	e	w_1	w_2	T	T_1	T_2	T_3	T_4	f	Welding leg length[a,b]		SWL[c]		Calculated weight[d] kg	
										z_1	z_2	kN	t	4R	5R
140	70	30	100	12	10	10	12	12	3	7	4	137	14	173	213
160	83	40	100	14	10	14	14	14	4	7	5	196	20	246	305
180	95	40	100	16	10	14	16	16	4	7	5	245	25	313	392
200	108	50	100	18	12	16	18	18	6	9	7	314	32	430	532
250	133	65	200	22	16	18	20	20	6	11	7	510	52	841	1 031
300A	159	80	200	24	20	22	24	22	7	14	8	687	70	1 364	1 666
300B	159	80	200	26	22	24	24	22	8	15	9	736	75	1 463	1 786
400A	203	100	200	26	22	22	32	28	7	15	8	981	100	1 971	2 387
400B	203	100	200	28	24	26	32	28	8	17	9	1 256	128	2 240	2 731
400C	203	100	200	30	26	28	32	28	8	18	9	1373	140	2 395	2 922

[a] Welding with chamfering is available based on the same welding volume/strength.

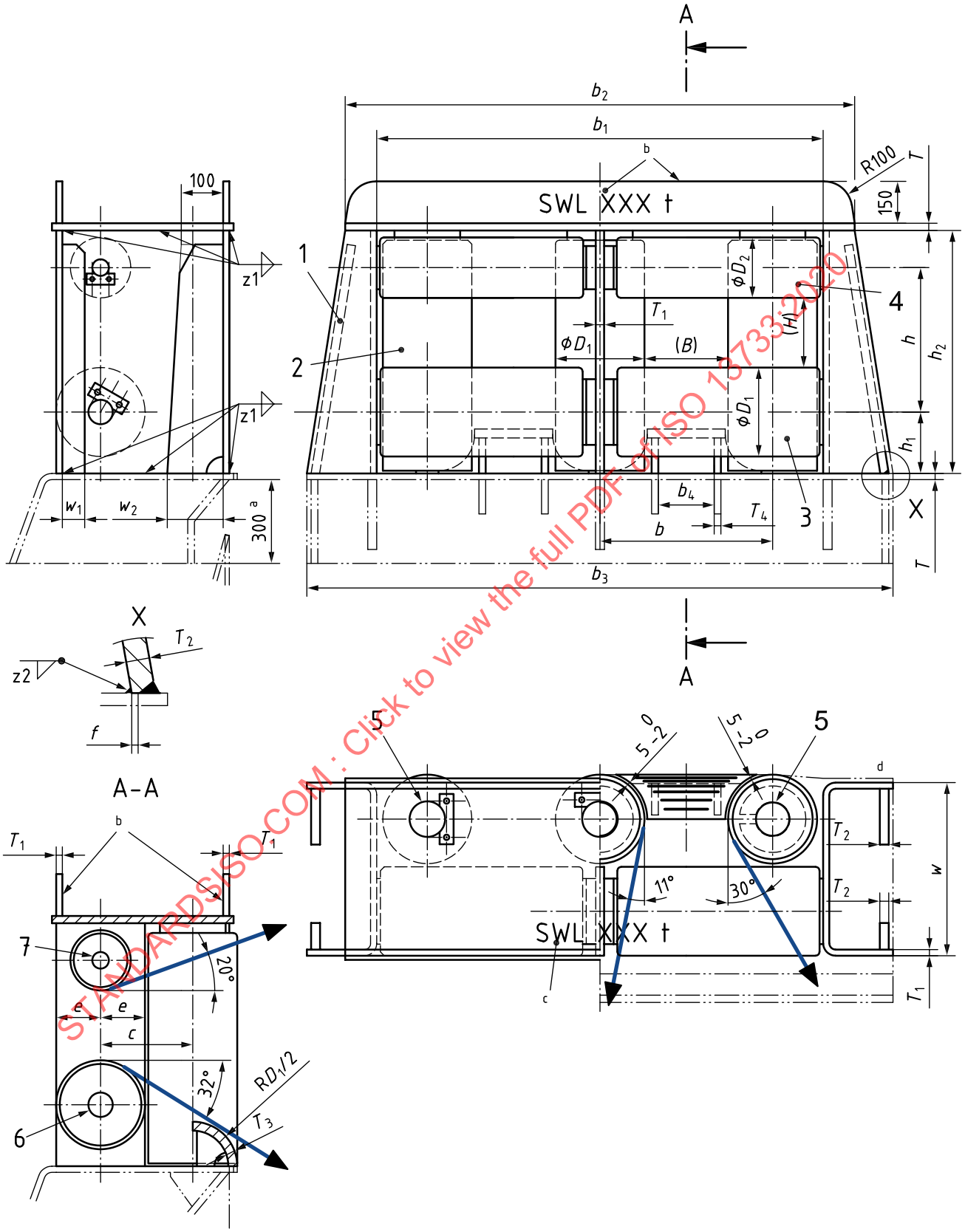
[b] Welding otherwise than mentioned in the Figures in this document and in this table: minimum leg length shall be 1/2 of thinner plate thickness.

[c] The SWLs shown in this table are for reference only. These are based on the loadings as mentioned in Annex A.

The "SWL" which is marked on the fitting may be adjusted depending on the actual loading conditions of mooring rope under the agreement between the user and the manufacturer.

[d] The calculated weight (mass) is for reference only excluding foundation.

Dimensions in millimetres



Key

1 frame with rope guide
2 vertical rollers with housing and washers
3 lower horizontal roller with housing and washers
4 upper horizontal roller with housing and washers
5 vertical axles with stopper
6 lower horizontal axle with stoppers

7 upper horizontal axle with stoppers

[a] Height of seat shall be determined in accordance with the hull construction design.

[b] For nominal size 250 and above.

[c] For nominal size between 140 and 200 only.

[d] Side shell.

Figure 3 — Assembly of type 7R universal fairleads

Table 3 — Dimensions of type 7R universal fairleads

Dimensions in millimetres

Nominal size D_n	$B \times H$	D_1	D_2	h	h_1	h_2	b	b_1	b_2	b_3	b_4	w	c
140	195 × 150	139,8	114,3	277	130	480	335	850	1 000	1 160	140	260	150
160	200 × 150	165,2	114,3	290	145	515	365	935	1 100	1 286	140	310	175
180	200 × 150	190,7	139,8	315	155	560	391	1 011	1 200	1 400	140	360	200
200	200 × 150	216,3	139,8	328	170	590	416	1 091	1 320	1 550	140	410	225
250	250 × 200	267,4	165,2	416	195	715	517	1 342	1 580	1 820	180	520	280
300A	300 × 250	318,5	216,3	517	220	870	618	1 598	1 840	2 150	200	620	330
300B	300 × 250	318,5	216,3	517	220	870	618	1 598	1 840	2 150	200	620	330
400A	350 × 250	406,4	216,3	561	265	960	756	1 966	2 250	2 550	200	795	420
400B	350 × 250	406,4	216,3	561	265	960	756	1 966	2 250	2 550	200	795	420
400C	350 × 250	406,4	216,3	561	265	960	756	1 966	2 250	2 550	200	795	420

Table 4 — Dimensions *(continued)* and SWL of type 7R universal fairleads

Dimensions in millimetres

Nominal size D_n	e	w_1	w_2	T	T_1	T_2	T_3	T_4	f	Welding leg length[a,b]		SWL[c]		Calculated weight[d]
										z_1	z_2	kN	t	kg
140	70	30	100	12	12	18	12	12	6	9	7	137	14	276
160	83	40	100	14	14	20	14	14	6	10	7	196	20	398
180	95	40	100	16	16	28	16	16	8	11	9	245	25	547
200	108	50	100	18	18	28	18	18	8	13	9	314	32	713
250	133	65	200	22	26	36	20	20	10	18	10	510	52	1 473
300A	159	80	200	24	28	46	24	22	10	20	10	687	70	2 301
300B	159	80	200	26	30	48	24	22	10	21	10	736	75	2 449
400A	203	100	200	26	30	40	32	28	10	21	10	981	100	3 317
400B	203	100	200	28	32	52	32	28	10	22	10	1 256	128	3 767
400C	203	100	200	30	34	54	32	28	10	24	10	1 373	140	4 012

[a] Welding with chamfering is available based on the same welding volume/strength.

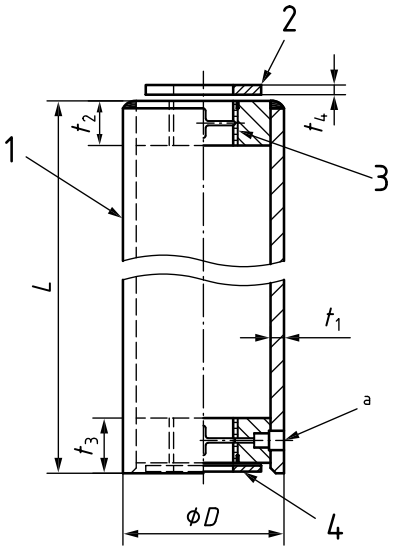
[b] Welding otherwise than mentioned in the Figures in this document and in this table: minimum leg length shall be 1/2 of the thinner plate thickness.

[c] The SWLs shown in this table are for reference only. These are based on the loadings as mentioned in Annex A.

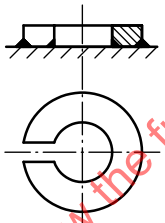
The "SWL" which is marked on the fitting may be adjusted depending on the actual loading conditions of mooring rope under the agreement between the user and the manufacturer.

[d] The calculated weight (mass) is for reference excluding foundation.

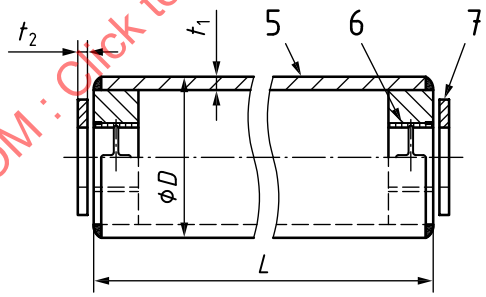
Dimensions in millimetres



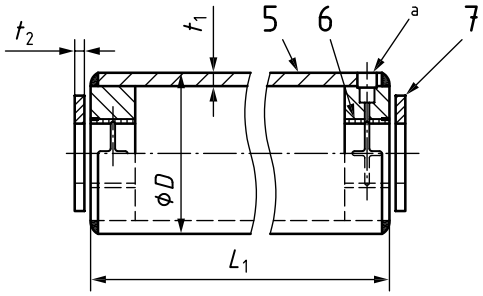
a) Vertical roller



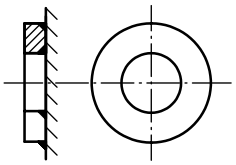
b) Lower support for vertical roller



c) Horizontal roller



d) Type 7R horizontal roller



e) Horizontal supports for type 7R horizontal rollers

Key

1 vertical roller
2 upper washer for vertical roller
3 bushes for vertical roller
4 lower washer for vertical roller
5 horizontal roller
6 bushes for horizontal roller
7 washer for horizontal roller
[a] Grease nipple shall be sunken to avoid rope damage.

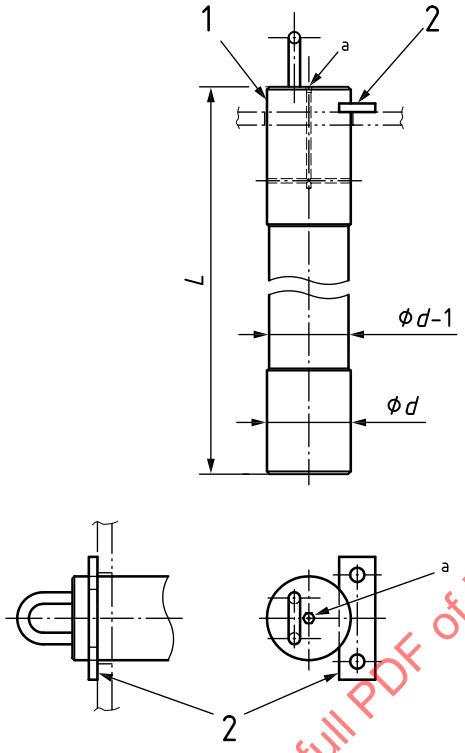
Figure 4 — Assembly of rollers

Table 5 — Dimensions of rollers

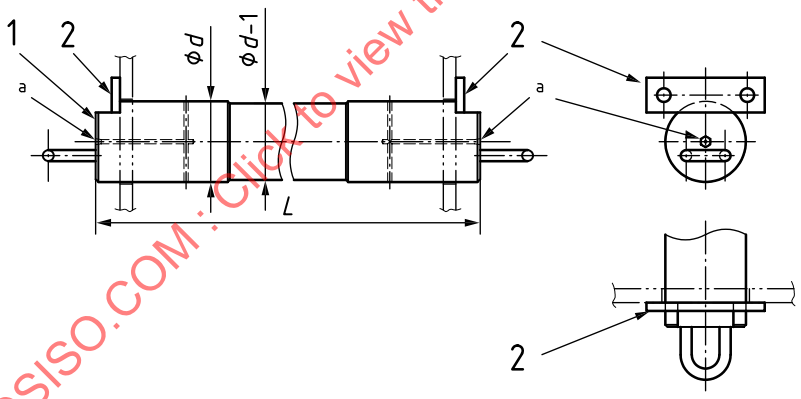
Dimensions in millimetres

Nominal size D_n	Vertical roller						Lower horizontal roller					Upper horizontal roller				
	D	t_1	t_2	t_3	t_4	L	D	t_1	t_2	L	L_1	D	t_1	t_2	L	L_1
140	139,8	14	40	61	27	445	139,8	10	6	499	383	114,3	6	6	499	383
160	165,2	16	50	73	27	480	165,2	11	6	554	422	114,3	8	6	554	422
180	190,7	17	55	82	27	525	190,7	12	8	600	453	139,8	9	6	604	457
200	216,3	18	60	89	27	555	216,3	12	8	655	490	139,8	10	6	659	494
250	267,4	23	75	110	27	680	267,4	15	10	799	602	165,2	12	6	807	610
300A	318,5	25	90	129	32	830	318,5	18	10	954	725	216,3	13	8	958	729
300B	318,5	27	90	129	32	830	318,5	19	10	954	724	216,3	13	8	958	728
400A	406,4	21	120	159	32	920	406,4	18	10	1 184	908	216,3	12	8	1 188	912
400B	406,4	26	120	159	32	920	406,4	19	10	1 184	907	216,3	13	8	1 188	911
400C	406,4	28	120	159	32	920	406,4	20	10	1 184	906	216,3	13	8	1 188	910

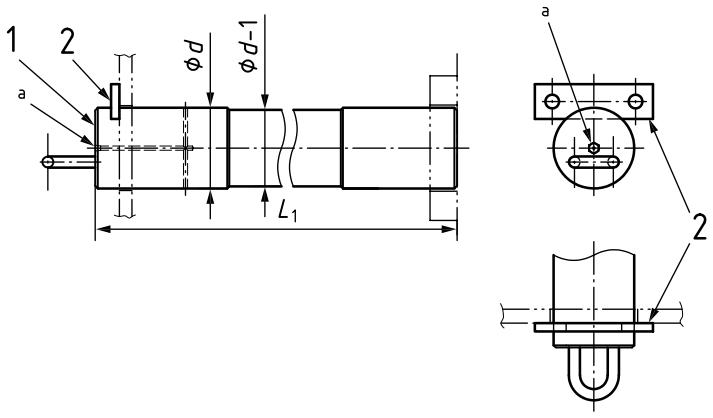
Dimensions in millimetres



a) Vertical axle



b) Horizontal axle



c) Type 7R horizontal axle

Key

1 axle
2 key set for axle
[a] Grease nipple.

Figure 5 — Assembly of axles

Table 6 — Dimensions of axles

Dimensions in millimetres

Nominal size D_n	Vertical axle		Lower horizontal axle			Upper horizontal axle		
	d	L	d	L	L_1	d	L	L_1
140	65	517	43	555	456	30	555	456
160	76	554	49	614	499	34	610	499
180	82	604	55	670	541	37	660	541
200	91	636	61	729	582	40	719	582
250	111	765	78	893	712	51	881	712
300A	128	929	89	1 056	848	60	1 050	848
300B	131	931	92	1 060	849	62	1 054	849
400A	153	1 021	106	1 290	1 033	69	1 284	1 033
400B	166	1 023	115	1 294	1 034	75	1 288	1 034
400C	171	1 025	119	1 298	1 035	78	1 292	1 035

Annex A
(normative)

Basis for strength assessment of universal fairleads

A.1 General

The strength of the universal fairleads was evaluated by finite element model analysis for frames, and rope guide plates, and simple beam theory for rollers, and determined based on the following design criteria.

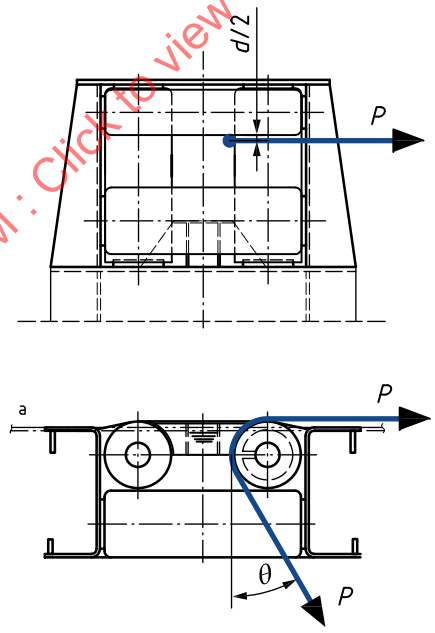
A.2 Loading

The universal fairleads shall be designed to withstand the horizontal and vertical load cases.

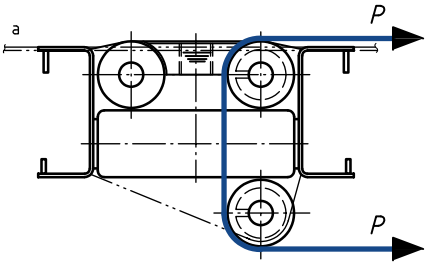
Horizontal and vertical loadings were considered individually, but both loadings were not considered simultaneously.

A.2.1 Case 1 — Horizontal loading

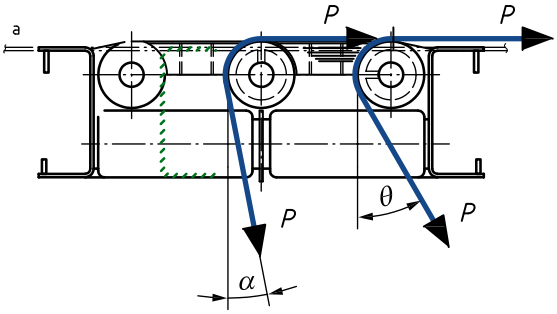
See Figure A.1.



a) Type 4R



b) Type 5R



c) Type 7R

Key

P mooring force

d diameter of mooring rope (wire rope base) as in Table A.1

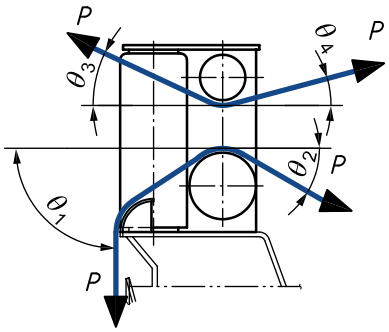
[a] Ship side.

NOTE The loads were considered with rope deflected θ = 30° and α = 11° through the universal fairlead as shown in this figure.

Figure A.1 — Horizontal loading

A.2.2 Case 2 — Vertical loading

See Figure A.2.



Key

P mooring force

NOTE The loads were considered with rope deflected to down side θ_1 = 90° and θ_2 = 30°, and to up side θ_3 = 20° and θ_4 = 5° through the universal fairlead respectively as shown in this figure.

Figure A.2 — Vertical loading