Accessories

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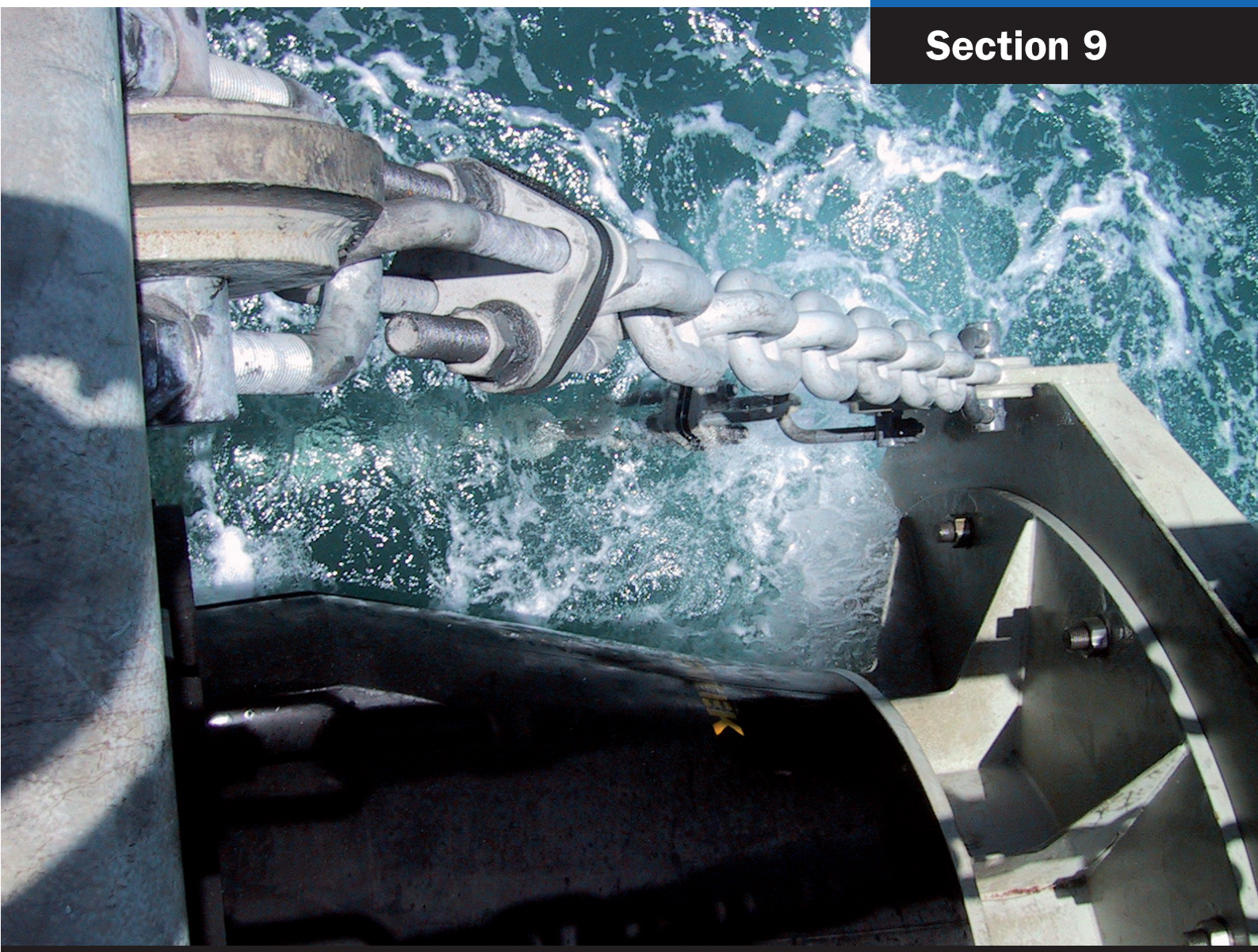
Section 9



Trelleborg Marine Systems

- Fender Panels
- Chains
- Shackles
- Brackets
- NC3 Anchors
- EC2 Anchors
- Fixing Bolts

www.trelleborg.com/marine

Ref. M1100-S09-V1-3-EN

FENDER PANELS

Fender panels are just as important as the rubber units on high performance systems. That's why every panel is purpose designed using structural analysis programs and 3D CAD modelling for optimum strength.

Fender panels distribute reaction forces to provide low hull pressures and cope with large tidal variations. They can also be designed to resist line loads from belted ships, or even point loads in special cases. Optional lead-in bevels reduce the snagging risk, whilst brackets (where required) provide highly secure connection points for chains.

Closed box designs are used almost exclusively – all fully sealed and pressure checked. Corrosion protection is provided by high durability C5M class paint systems to ISO 12944, and additional corrosion allowances can be designed in where required.

Features and options

- Closed box steel structure
- Internal structural members
- Blind boss fender connections
- Pressure tested for watertightness
- C5M modified epoxy paint*
- Polyurethane topcoat †
  (RAL5005 blue)
- Studs for UHMW-PE face pads
- Chain brackets
- Lifting points
- Lead-in bevels and chamfers

* Other options available
† Alternative colours on request

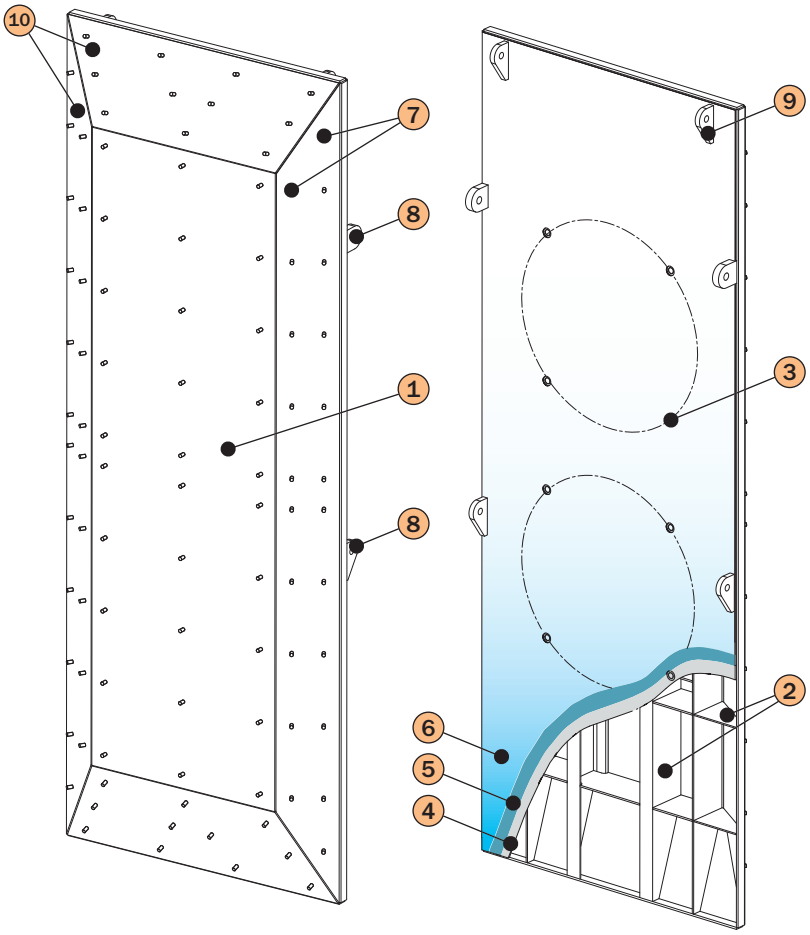
Specification and design of panels

Panel specifications and designs should consider:

- Hull pressures and tidal range
- Lead-in bevels and chamfers
- Bending moment and shear
- Local buckling
- Limit state load factors
- Steel grade
- Permissible stresses
- Weld sizes and types
- Pressure test method
- Rubber fender connections
- UHMW-PE attachment
- Chain connections
- Lifting points
- Paint systems
- Corrosion allowance
- Maintenance and service life

Standard manufacturing and performance tolerances apply (see pages 12–36 to 12–39)

FENDER PANELS



1. Closed box steel structure
2. Internal structural members
3. Blind boss fender connections
4. Shot blasted steel (SA2.5)
5. C5M modified epoxy paint*
6. Polyurethane topcoat (RAL5005 blue)†
7. Studs for UHMW-PE face pads
8. Chain brackets
9. Lifting points
10. Lead-in bevels and chamfers*

* Options available

† Alternative colours on request

Steel Properties

Standard	Grade	Yield Strength (min)		Tensile Strength (min)		Temperature	
		N/mm²	psi	N/mm²	psi	°C	°F
EN 10025	S235JR (1.0038)	235	34 000	360	52 000	–	–
	S275JR (1.0044)	275	40 000	420	61 000	–	–
	S355J2 (1.0570)	355	51 000	510	74 000	-20	-4
	S355J0 (1.0553)	355	51 000	510	74 000	0	32
JIS G-3101	SS41	235	34 000	402	58 000	0	32
	SS50	275	40 000	402	58 000	0	32
	SM50	314	46 000	490	71 000	0	32
ASTM	A-36	250	36 000	400	58 000	0	32
	A-572	345	50 000	450	65 000	0	32

The national standards of France and Germany have been replaced by EN 10025. In the UK, BS4360 has been replaced by BS EN 10025. The table above is for guidance only and is not comprehensive. Actual specifications should be consulted in all cases for the full specifications of steel grades listed and other similar grades.

PIANC steel thicknesses

Exposed both faces	≥12mm
Exposed one face	≥9mm
Internal (not exposed)	≥8mm

Corresponding minimum panel thickness will be 140–160mm (excluding UHMW-PE face pads) and often much greater.

Typical panel weights

Light duty	200–250kg/m²
Medium duty	250–300kg/m²
Heavy duty	300–400kg/m²
Extreme duty	≥400kg/m²

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CHAINS AND ACCESSORIES

Some fender systems need chains to help support heavy components or to control how the fender deflects and shears during impact. Open link or stud link chains are commonly used and these can be supplied in several different strength grades.

Compatible accessories like shackles, brackets and U-anchors are also available. The nominal breaking load (NBL) of these items is matched to chains of similar capacity. Chains and accessories are supplied galvanised as standard. Chain brackets may also be supplied in an optional painted finish.

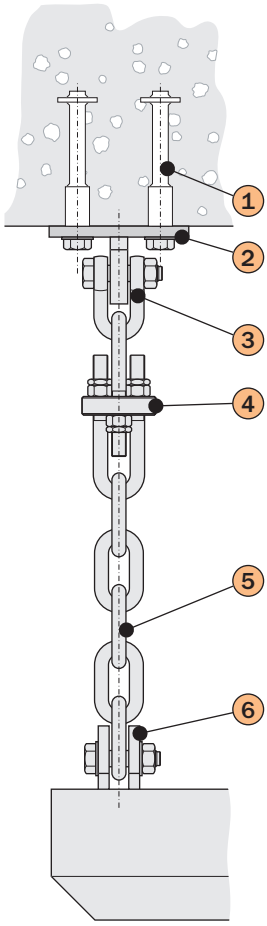
Features

- Choice of open or stud link chain
- Various link lengths available
- Proof load tested and certified
- Galvanised as standard
- Variety of matched accessories

Applications

- Large fender panels
- Cylindrical fenders
- Floating fender moorings
- Safety applications
- Lifting and installing

Typical chain system



1. Anchor bolts
2. Chain bracket (S-series)
3. Alloy D-shackle
4. Chain adjuster
5. Open link chain
6. Chain bracket (T-series)

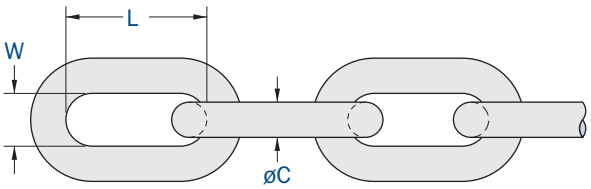
Standard manufacturing and performance tolerances apply (see pages 12–36 to 12–39)

OPEN LINK CHAINS

Open Link Chains

øC	3.0D links			3.5D links			4.0D links			5.0D links			MBL	
	L	W	Weight	L	W	Weight	L	W	Weight	L	W	Weight	SL2	SL3
14	42	18	0.2	49	20	0.2	56	20	0.2	70	21	0.3	124	154
16	48	21	0.3	56	22	0.3	64	22	0.3	80	24	0.4	160	202
18	54	23	0.4	63	25	0.4	72	25	0.5	90	27	0.5	209	262
20	60	26	0.5	70	28	0.6	80	28	0.6	100	30	0.8	264	330
22	66	29	0.7	77	31	0.8	88	31	0.8	110	33	1.0	304	380
25	75	33	1.1	88	35	1.1	100	35	1.2	125	38	1.5	393	491
28	84	36	1.4	98	39	1.6	112	39	1.7	140	42	2.0	492	616
30	90	39	1.8	105	42	2.0	120	42	2.1	150	45	2.5	566	706
32	96	42	2.2	112	45	2.4	128	45	2.5	160	48	3.0	644	804
35	105	46	2.8	123	49	3.1	140	49	3.3	175	53	4.0	770	964
38	114	49	3.6	133	53	3.9	152	53	4.3	190	57	5.1	900	1130
40	120	52	4.2	140	56	4.6	160	56	5.0	200	60	6.0	1010	1260
45	135	59	6.0	158	63	6.5	180	63	7.1	225	68	8.5	1275	1590
50	150	65	8.2	175	70	8.9	200	70	9.7	250	75	11.6	1570	1960
55	165	72	10.9	193	77	11.9	220	77	12.9	275	83	15.5	1900	2380
60	180	78	14.2	210	84	15.4	240	84	16.8	300	90	20.1	2260	2770

[Units: mm, kg/link, kN]

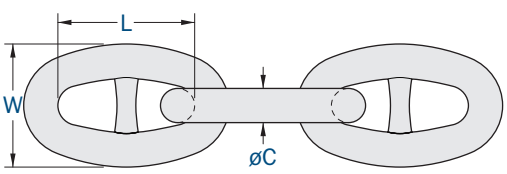


MBL = Minimum Breaking Load (kN)
NBL = Nominal Breaking Load (kN)
Tolerance: all dimensions ±2%

Stud Link Chains

	Common link			MBL	
øC	L	W	Weight	SL2 (U2)	SL3 (U3)
19	76	68	0.6	210	300
22	88	79	0.9	280	401
26	104	94	1.5	389	556
28	112	101	1.9	449	642
32	128	115	2.8	583	833
34	136	122	3.4	655	937
38	152	137	4.7	812	1160
42	168	151	6.3	981	1400
44	176	158	7.3	1080	1540
48	192	173	9.4	1270	1810
52	208	187	12.0	1480	2110
58	232	209	16.7	1810	2600
64	256	230	22.3	2190	3130
70	280	252	29.5	2580	3690
76	304	274	37.9	3010	4300
90	360	324	63.4	4090	5840

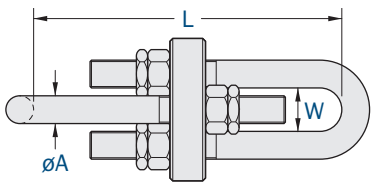
[Units: mm, kg/link, kN]



Chain Tensioners

Chain size	øA	L	W	Weight
16	M16	200–240	40	2.7
18	M18	220–280	45	3.5
20	M20	235–305	50	5.3
22	M22	265–345	56	6.6
22	M24	280–370	60	8.8
25	M27	310–420	68	12
30	M30	345–465	76	17
32	M33	385–525	82	21
35	M36	420–560	90	27
40	M42	480–650	106	45
45	M48	545–745	120	64
50	M52	595–805	130	80
55	M56	640–880	140	99
60	M60	685–945	150	122
60	M64	730–1010	160	147

[Units: mm, kg, kN]



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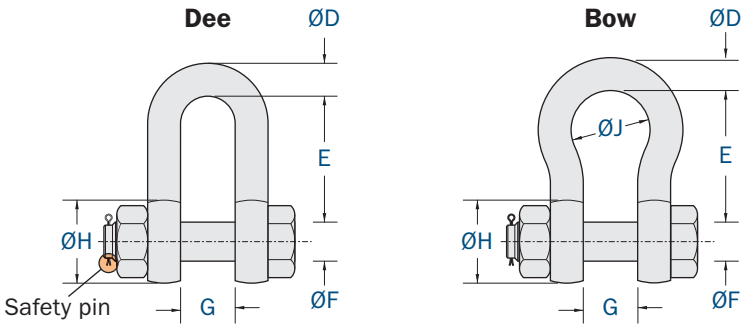
HIGH STRENGTH SHACKLES

ØD	ØF	ØH	G	Dee shackle		Bow shackle			NBL
				E	Weight	E	ØJ	Weight	
13	16	26	22	43	0.4	51	32	0.4	120
16	19	32	27	51	0.7	64	43	0.8	195
19	22	38	31	59	1.1	76	51	1.3	285
22	25	44	36	73	1.5	83	58	1.9	390
25	28	50	43	85	2.6	95	68	2.8	510
28	32	56	47	90	3.3	108	75	3.8	570
32	35	64	51	94	4.7	115	83	5.3	720
35	38	70	57	115	6.2	133	95	7.0	810
38	42	76	60	127	7.6	146	99	8.8	1020
45	50	90	74	149	12.8	178	126	15.0	1500
50	57	100	83	171	18.2	197	138	20.7	2100
57	65	114	95	190	27.8	222	160	29.3	2550
65	70	130	105	203	35.1	254	180	41.0	3330
75	80	150	127	230	60.0	330	190	64.5	5100
89	95	178	146	267	93.0	381	238	110	7200
102	108	204	165	400	145	400	275	160	9000

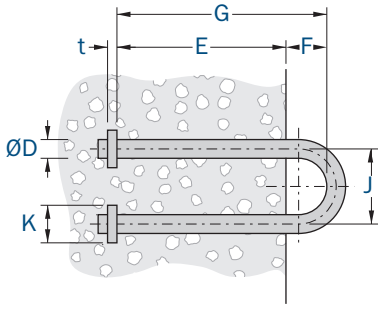
[Units: mm, kg, kN]



U-ANCHORS

øD	E	F	G	J	K	t	Weight	NBL
26	260	60	320	104	50	12	3.4	209
30	300	70	370	120	50	15	5.1	264
34	340	70	410	136	60	15	7.3	304
36	360	70	430	144	60	20	8.6	393
42	420	90	510	168	70	20	13.7	492
44	440	100	540	176	80	20	16.1	566
48	480	100	580	192	80	25	20.5	644
50	500	110	610	200	90	25	23.7	770
56	560	120	680	224	100	30	33.4	900
60	600	130	730	240	110	30	41.1	1010
66	660	140	800	264	120	35	54.8	1275
74	740	160	900	296	130	40	76.9	1570

[Units: mm, kg, kN]



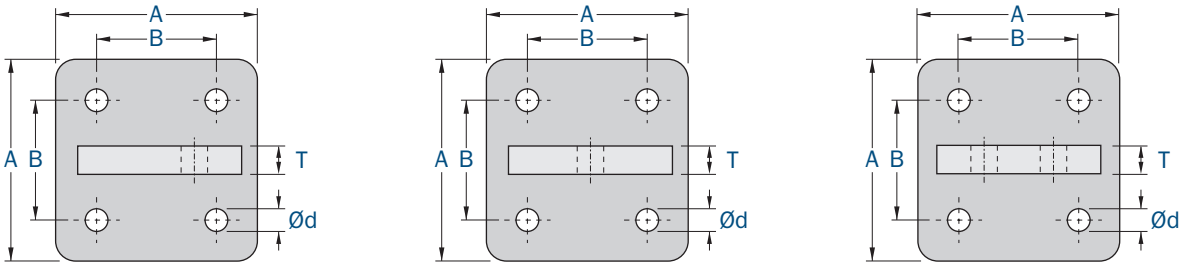
Standard manufacturing and performance tolerances apply (see pages 12–36 to 12–39)

BRACKETS

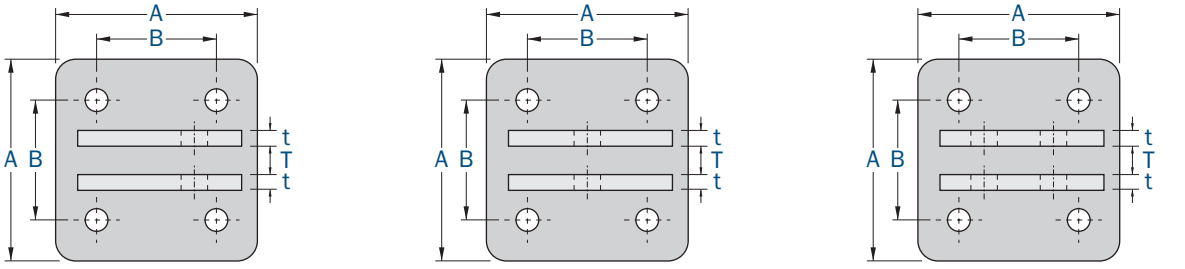
A	B	C		E		F	Ød	R	t	T	Single Lug			Twin Lug		Anchor
		CB1	CB2/ CB3	CB1/ CB3	CB2						Shackle Body	Shackle Pin	ØD	Shackle Bolt pin	ØD	
190	130	30	40	30	65	160	24	40	15	30	19	22	28	M24×100	28	2/4×M20
220	150	35	45	30	75	190	24	50	15	30	22	25	28	M24×100	28	2/4×M20
250	170	40	50	35	85	210	28	55	20	40	25	28	36	M30×120	36	2/4×M24
280	190	45	60	40	95	240	28	65	20	40	28	32	36	M30×120	36	2/4×M24
320	220	50	65	50	110	270	36	75	25	45	32	35	42	M36×150	42	2/4×M30
350	240	55	70	50	120	300	36	80	25	50	35	38	42	M36×150	42	2/4×M30
380	260	60	80	55	130	320	42	85	30	50	38	42	50	M42×170	50	2/4×M36
420	290	65	85	60	145	360	42	95	30	60	42	28	50	M42×170	50	2/4×M36
440	300	70	90	60	150	380	50	100	30	60	45	50	60	M48×190	60	2/4×M42

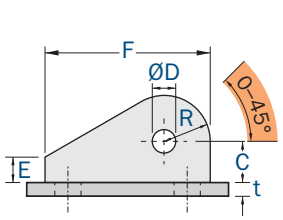
Standard steel grade: S235/S275. Finish: Galvanised (85µm). [Units: mm, kN]

S-Series

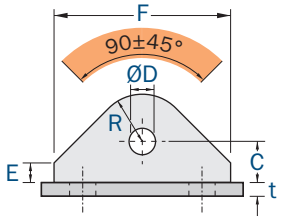


T-Series

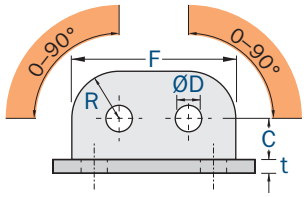




CB1



CB2



CB3

- All chain and accessory information is for guidance only.
- Every chain design should be checked to confirm suitability for the intended application.
- Select chain system components so MBL≈NBL.
- Every chain system is different. Check all dimensions for fit, clearance and tolerance.
- Chain brackets can be specified with 2 or 4 anchors to suit application and loads.
- If extra long life is required, add a corrosion allowance.
- Some slack in the chain is unavoidable and will not affect operation.
- For special sizes and applications, please refer to Trelleborg Marine Systems office.

Standard manufacturing and performance tolerances apply (see pages 12–36 to 12–39)

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FENDER FIXINGS

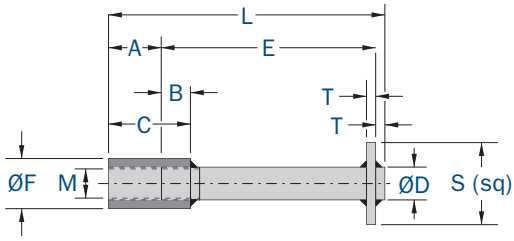
NC3 anchors

The NC3 is a traditional cast-in anchor design used for installing fenders to new concrete. The NC3 anchor has a threaded socket, a long tail and a square anchor plate. Non-standard sizes and other cast-in anchor types are available on request.

Thread	A	B	C	ØD	E	ØF	L	S (sq)	T	Weight
M20	40	20	60	20	160	30	200	63	10	1.1
M22	44	22	66	22	181	32	225	63	10	1.4
M24	48	25	73	24	202	36	250	75	10	1.9
M27	54	30	84	27	211	40	265	75	10	2.4
M30	60	35	95	30	210	45	270	100	10	3.5
M36	72	40	112	36	248	54	320	100	12	5.5
M42	84	50	134	42	276	63	360	100	12	8.1
M48	96	60	156	48	304	72	400	100	15	11.5
M56	112	70	182	56	438	84	550	120	15	19.5
M64	128	80	208	64	472	100	600	130	20	29.8
M76	152	90	242	76	548	114	700	150	20	46.1

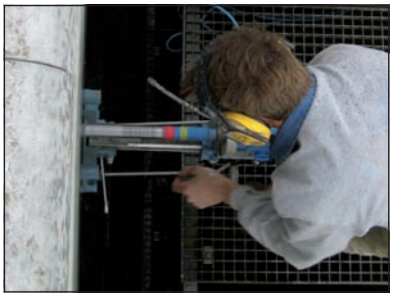
Standard anchors are available in Grade 8.8/galvanised or 100% Stainless Steel 316 (1.4401).
Larger sizes and special dimensions available on request. [Units: mm]

Always check min/max clamping thickness and socket depths actual threaded length on bolts.



EC2 anchors

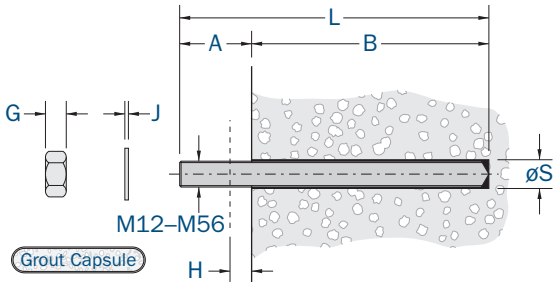
The EC2 anchor is used for installing fenders onto existing concrete or where cast-in anchors are unsuitable. The anchor is usually secured into a drilled hole using special grout capsules. Non-standard sizes and other grout systems are available on request.



Thread	B	E	G	J	L (typ.)	øS	Capsule
M12	110	5–8	10	2.5	–	15	1 × C12
M16	140	6–9	13	3	175	20	1 × C16
M20	170	6–9	16	3	240	25	1 × C20
M24	210	8–12	19	4	270	28	1 × C24
M30	280	8–12	24	4	360	35	1 × C30
M36	330	10–15	29	5	420	40	1 × C30
M42	420	14–21	34	7	500	50	2 × C30
M48	480	16–24	38	8	580	54	2 × C30+1 × C24
M56	560	18–27	45	9	–	64	4 × C30

A = E+G+H+J, rounded up to nearest 10mm. [Units: mm]
E = clear threads after assembly.
H = clamping thickness of fender or bracket.

Always follow the manufacturer's instructions when installing EC2 anchors.



Standard manufacturing and performance tolerances apply (see pages 12–36 to 12–39)

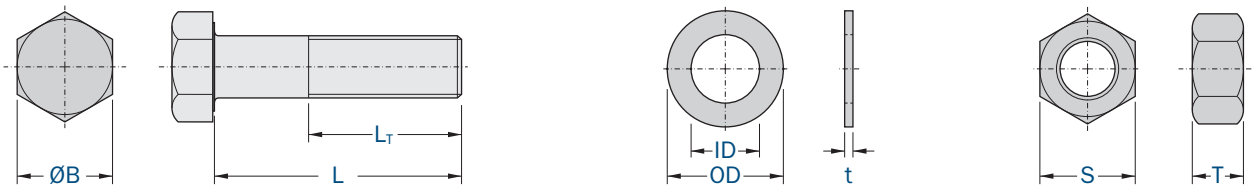
FENDER FIXINGS

Size	Thread area*	Washers†			Nuts		Typical thread lengths‡		Thread
	(mm²)	OD	ID	t	AF	T	L≤125	L>125	pitch
M16	157	30	18	3	24	13	38	44	2.0
M20	245	37	22	3	30	16	46	52	2.5
M24	353	44	26	4	36	19	54	60	3.0
M30	561	56	33	4	46	24	66	72	3.5
M36	817	66	39	5	55	29	78	84	4.0
M42	1120	78	45	7	65	34	90	96	4.5
M48	1470	92	52	8	75	38	102	108	5.0
M56	2030	105	62	9	85	45	118	124	5.5
M64	2680	115	70	9	95	51	134	140	6.0

* According to BS 3692: Table 13. [Units: mm]

† Standard washers given. Large OD washers available on request.

‡ Thread lengths may vary depending on standard. Other lengths available.



Grades

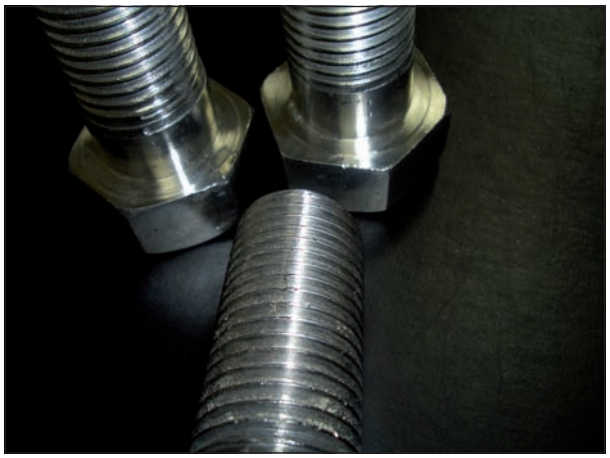
	ISO 898 Galvanised		ISO 356 Stainless Steel*	
Bolt grade	4.6	8.8	A-50†	A-70‡
Nut grade	4	8	A-50†	A-70‡
Tensile strength (MPa)	400	800	500	700
0.2% yield stress (MPa)	240	640	210	450

* Refer to p12–31 for further details about PREN and galling.

† Size ≤M39 unless agreed with manufacturer.

‡ Size ≤M24 unless agreed with manufacturer.

Fenders must be properly fixed to operate correctly. Anchors are supplied to suit new or existing structures, in various strength ratings and with the choice of galvanised or various stainless steels.



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