BALMORAL MARINE

Marine equipment handbook

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INTRODUCTION

Balmoral Marine

Balmoral Marine was founded in 1986 and is now recognised as the industry's leading supplier of marine and mooring equipment, associated products and services. The company is an established partner to the offshore drilling, marine construction, oceanographic and aquaculture industries, as well as port and harbour authorities, worldwide.

With operational bases in the UK and Norway, supported by a network of strategically placed distributors and agencies serving the world's oceans, Balmoral is in a position to help you.

Whatever your requirement, wherever you may be, 24 hours a day, 365 days a year, Balmoral Marine should be your first call.

The industry's premier reference handbook

In 1998, Balmoral Marine recognised the need for a marine industry "bible" and produced the first truly comprehensive reference handbook. Now, in the new millennium, we are pleased to publish an updated version of the handbook. You will also find this material, and more, on our website: www.balmoralmarine.com.

Inside this guide you will find all you wanted to know about mooring, marine and associated equipment, but didn't know who, or what, to ask. From basic conversion tables to information on complete subsea mooring systems, you'll find all you need to know right here. If you don't, call us.

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Section 1
ANCHORS

Introduction

The size of an anchor is generally referred to by its weight in air.
Anchor holding power is determined by the anchors efficiency multiplied by the weight of the anchor.
Anchor efficiency is determined by design, testing and the type of soils which the anchor will be expected to perform in.
The efficiency of an anchor decreases as the size of the anchor is increased. A concrete sinker has an efficiency of approximately 0.5:1 whereas modern specialist anchors can have efficiencies up to 100:1 depending on soil conditions.

Seabed	General Holding Power Characteristics
Sand	Very good anchoring material unless the sand becomes cemented.
Clay	Good anchoring medium.
Soft Clay/Mud	Generally poor holding power but can be improved on by the use of mud type anchors.
Coral	Mainly poor anchoring medium.
Rock	Very poor anchoring.

Considerations when selecting an anchor

- Shear strength of the anchoring soils
- Shank to fluke angles
- The length of time that the anchor is to be used on location
- Structural strength of the anchor
- The installation facilities available on site

NB - Dimensions are for guidance only.
Dimensions may vary according to different manufacturers and manufacturing tolerances.

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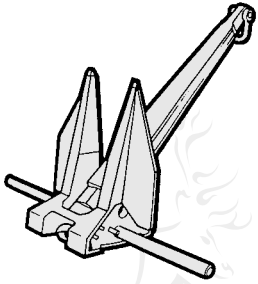
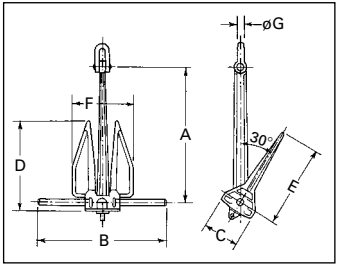
DANFORTH

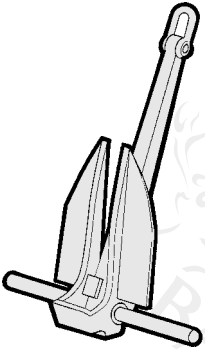


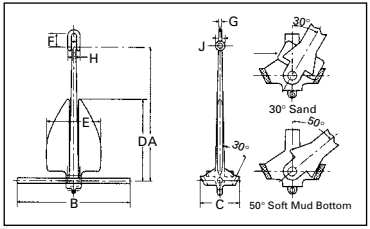


Anchor weight (lbs)	A (mm)	B (mm)	C (mm)	D (mm)	E (mm)	F (mm)	ØG (mm)
300	1420	1240	280	935	870	590	30
500	1600	1380	320	1050	970	660	35
750	1720	1480	370	1129	1040	720	40
1000	1830	1580	410	1206	1110	760	45
2000	2110	1820	530	1391	1270	910	65
3000	2390	2260	600	1641	1500	990	75
4000	2640	2500	660	1815	1660	1050	75
5000	2840	2700	710	1957	1790	1150	90
6000	3000	2860	760	2060	1880	1210	100
7000	3120	2960	790	2165	1970	1260	100
8150	3280	3120	830	2270	2060	1320	100
10,000	3510	3220	890	2435	2210	1420	115
20,000	4360	4140	1110	2920	2620	1770	140
30,000	5320	4760	1280	3390	3040	2040	160
40,000	5590	5205	1410	3530	3330	2245	180

All dimensions are approximate

LIGHTWEIGHT (LWT)





Anchor weight (lbs)	A (mm)	B (mm)	C (mm)	D (mm)	E (mm)	F (mm)	G (mm)	H (mm)	J (mm)
990	1619	1535	552	992	636	259	42	169	131
2000	2040	1933	606	1250	802	326	53	208	166
3000	2335	2213	797	1432	918	374	61	244	190
4000	2570	2436	877	1573	1010	411	67	269	208
5000	2768	2623	945	1696	1088	433	72	290	224
6000	2941	2788	1003	1802	1156	471	77	308	238
7000	3097	2935	1057	1809	1217	495	81	324	251
8150	3238	3069	1104	1983	1273	518	85	338	262
10,000	3488	3306	1190	2173	1371	558	91	365	284
15,000	3993	3784	1362	2446	1569	639	104	418	324
20,000	4394	4166	1498	2692	1727	703	115	460	357
30,000	5030	4768	1716	3082	1977	805	131	526	408
40,000	5536	5248	1887	3392	2276	886	145	579	450
45,000	5759	5459	1965	3528	2264	921	150	603	467

All dimensions are approximate

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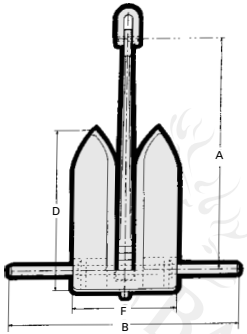
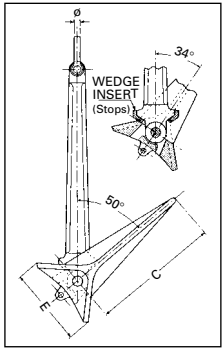
OFFDRILL II

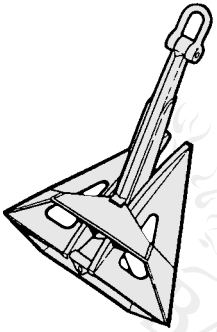


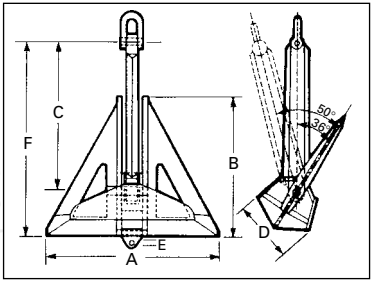


Anchor weight (lbs)	A (mm)	B (mm)	C (mm)	D (mm)	E (mm)	F (mm)	Ø shackle (mm)
4500	2555	3065	1520	1805	830	1065	80
5000	2645	3175	1575	1870	860	100	90
6000	2815	3375	1675	1990	910	1170	100
7000	2950	3540	1755	2090	940	1230	100
8000	3095	3890	1840	2190	1012	1290	100
10,000	3335	4000	1985	2360	1070	1390	115
12,000	3540	4250	2110	2505	1140	1475	115
14,000	3730	4500	2220	2640	1228	1555	130
15,000	3900	4750	2220	2640	1228	1555	130
16,000	3900	4750	2320	2760	1280	1625	130
20,000	4200	4900	2500	2975	1385	1750	130
25,000	4500	5165	2680	3205	1530	1875	130
30,000	4810	5335	2860	3405	1545	2000	130
33,000	4900	5390	2955	3515	1585	2070	140
40,000	5120	5635	3090	3675	1692	2165	155
45,000	5330	5865	3215	3850	1760	2250	155
50,000	5600	6150	3360	4025	1900	2365	155
60,000	5950	6335	3570	4250	1955	2515	170
70,000	6260	6875	3755	4470	2055	2645	155

All dimensions are approximate

FLIPPER DELTA





Anchor weight (kg)	A (mm)	B (mm)	C (mm)	D (mm)	E (mm)	F (mm)
1000	1960	1560	1755	740	45	2604
1500	2250	1800	2025	840	45	2660
2000	2470	2000	2250	930	50	2960
2500	2660	2130	2395	1005	52	3150
3000	2830	2285	2565	1070	55	3380
4000	3180	2560	2880	1190	65	3790
5000	3300	2660	2995	1260	75	3945
7000	3750	2995	3365	1405	78	4440
10,000	4270	3400	3825	1600	85	5040
13,500	4670	3730	4195	1765	90	5535
15,000	4845	3875	4355	1830	90	5735
22,500	5490	4360	4905	2060	105	6470
40,000	6650	5290	5945	2480	120	7850

All dimensions are approximate

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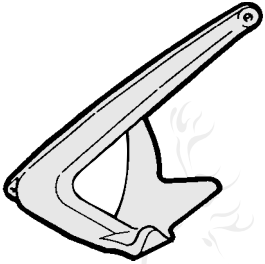
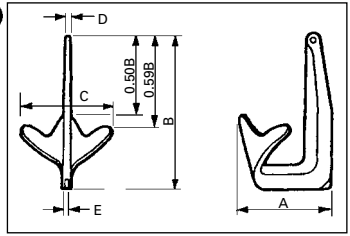
BRUCE SINGLE SHANK





Anchor weight (kg)	A (mm)	B (mm)	C (mm)	D (mm)	E (mm)	Anchor shackle SWL tonnes	Pendant shackle SWL tonnes
600	1130	2020	1370	56	40	17	9 1/2
1000	1340	2400	1630	64	53	25	17
2000	1690	3030	2050	84	61	35	25
3000	1930	3460	2350	92	70	50	35
6500	2530	4530	3070	125	92	100	55
9000	2790	5000	3380	140	92	130	55

All dimensions are approximate

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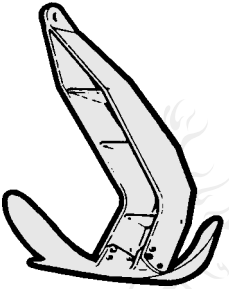
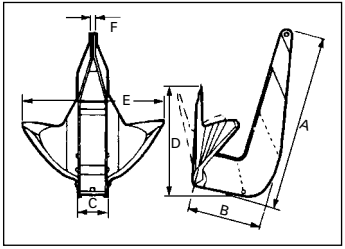
BRUCE TWIN SHANK





Anchor weight (kg)	A (mm)	B (mm)	C (mm)	D (mm)	E (mm)	F (mm)	Anchor shackle SWL tonnes	Pendant shackle SWL tonnes
250	1693	704	272	967	1352	47	12	3 1/4
500	2076	863	335	1187	1658	57	17	4 3/4
750	2322	965	375	1327	1854	57	17	6 1/2
1000	2511	1044	416	1435	2005	67	25	8 1/2
1500	2893	1203	481	1653	2310	75	35	12
2000	3232	1344	529	1846	2580	75	35	13 1/2
2500	3446	1433	569	1969	2752	97	55	17
3000	3731	1551	609	2132	2978	97	55	17
4000	4070	1692	668	2326	3249	97	55	25
5000	4324	1798	714	2471	3453	117	85	50
7000	4900	2038	805	2799	3911	132	100	85
9000	5269	2191	868	3010	4206	157	130	85
12000	5885	2447	964	3362	4697	157	150	85

All dimensions are approximate

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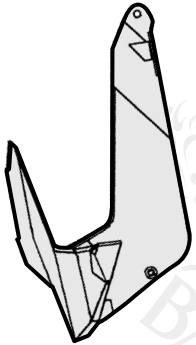
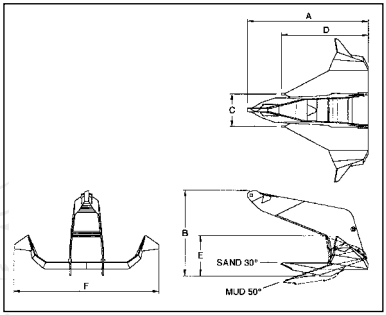
BRUCE FFTS MK 4 ANCHOR





Anchor weight (kg)	A (mm)	B (mm)	C (mm)	D (mm)	E (mm)	F (mm)
500	1827	1280	500	1303	606	2188
1500	2648	1854	723	1888	878	3172
3000	3409	2388	931	2431	1131	4085
5000	4029	2822	1100	2873	1336	4828
9000	4846	3394	1324	3456	1607	5806
10000	5087	3563	1390	3628	1687	6095
12000	5437	3808	1486	3878	1803	6514
15000	5728	4012	1566	4085	1900	6864
18000	6129	4292	1674	4371	2032	7343
20000	6319	4426	1726	4507	2096	7571
30000	7225	5060	1974	5153	2396	8656
40000	8034	5627	2195	5730	2664	9626

All dimensions are approximate

NB - Table gives nominal dimensions of certain sizes but since the anchors are fabricated from steel plate they can be supplied in any size to suit customer requirements, from 250kg up to 60,000kg.

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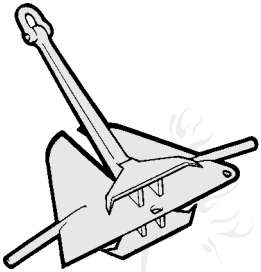
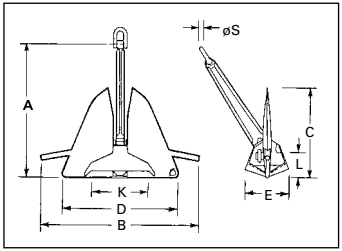
STEVIN ANCHOR





Anchor weight (kg)	A (mm)	B (mm)	C (mm)	D (mm)	E (mm)	K (mm)	L (mm)	Ø S (mm)
1000	2341	2645	1559	2023	737	1010	412	60
1500	2680	3038	1785	2316	843	1156	471	65
3000	3376	3828	2249	2918	1063	1456	594	80
5000	4003	4538	2667	3460	1260	1727	704	80
7000	4478	5077	2983	3871	1409	1932	788	90
9000	4869	5521	3244	4209	1533	2100	857	100
12000	5366	5892	3458	4490	1728	2255	914	130
15000	5780	6347	3725	4837	1861	2430	984	150
20000	6362	6986	4100	5324	2048	2674	1083	160
30000	7283	7997	4694	6094	2345	3061	1240	180

All dimensions are approximate

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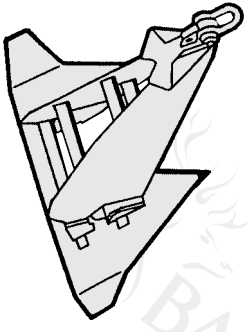
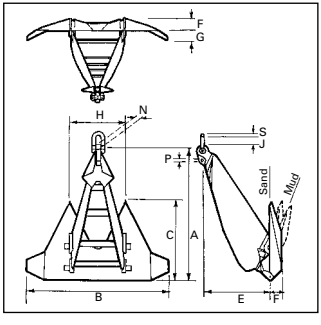
VRYHOF STEVPRIS MK 5

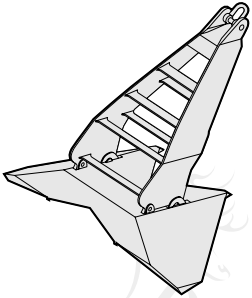


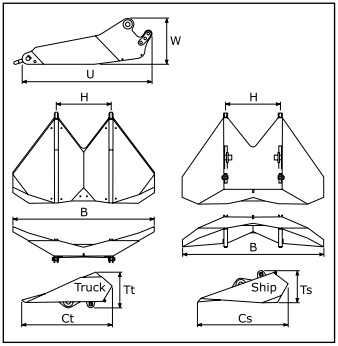


Anchor weight (kg)	A (mm)	B (mm)	C (mm)	E (mm)	F (mm)	G (mm)	H (mm)	J (mm)	N (mm)	P (mm)	S (mm)	T=F+G (mm)
1500	2954	3184	1812	1505	272	223	1230	198	72	72	80	495
3000	3722	4012	2283	1896	343	280	1550	250	91	91	90	623
5000	4413	4757	2707	2248	406	332	1838	296	108	108	100	738
8000	5161	5563	3166	2630	475	389	2150	347	127	127	130	864
10000	5560	5993	3411	2833	512	419	2316	373	136	136	140	931
12000	5908	6368	3625	3010	544	445	2461	397	145	145	150	989
15000	6364	6860	3904	3243	586	479	2651	427	156	156	170	1065
18000	6763	7290	4149	3446	622	510	2817	454	166	166	180	1132
20000	7005	7551	4297	3569	645	528	2918	470	172	172	190	1173
22000	7231	7794	4436	3684	665	545	3012	485	177	177	200	1210
25000	7546	8134	4629	3845	694	568	3143	507	185	185	200	1262
30000	8019	8643	4919	4086	738	604	3440	538	197	197	220	1342
65000	10376	11184	6366	5287	955	782	4322	697	255	255	300	1737

All dimensions are approximate

VRYHOF STEVPRIS MK 6





Anchor weight (kg)	B (mm)	Ct (mm)	Cs (mm)	H (mm)	Tt (mm)	Ts (mm)	U (mm)	V (mm)	W (mm)
1500	3060	1980	1960	1170	780	700	2790	1210	990
3000	3870	2490	2470	1490	980	880	3520	1540	1250
5000	4600	2950	2930	1780	1160	1040	4170	1830	1480
8000	5390	3450	3430	2090	1360	1220	4880	2150	1730
10000	5810	3720	3690	2250	1460	1310	5260	2320	1860
12000	6170	3950	3920	2390	1550	1390	5590	2460	1980
15000	6680	4260	4230	2610	1680	1500	6020	2690	2130
18000	7100	4520	4490	2780	1780	1590	6400	2860	2270
20000	7370	4690	4650	2890	1840	1650	6620	2970	2350
22000	7630	4840	4800	3000	1900	1700	6840	3090	2420
25000	7960	5050	5010	3140	1990	1780	7140	3230	2530
30000	8450	5360	5320	3320	2110	1890	7580	3420	2690

All dimensions are approximate

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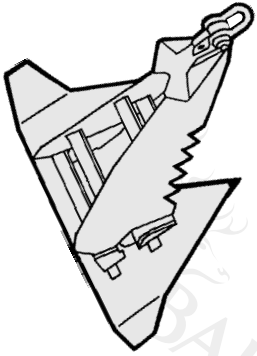
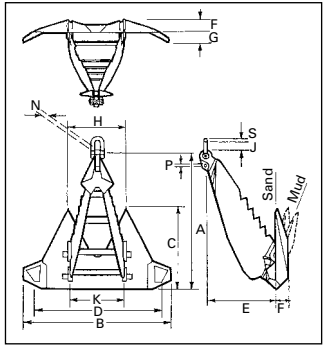
VRYHOF STEVSHARK





Anchor weight (kg)	A (mm)	B (mm)	C (mm)	D (mm)	E (mm)	F (mm)	G (mm)	H (mm)	J (mm)	K (mm)	N (mm)	P (mm)	S (mm)
1500	2623	2856	1687	2510	1336	244	199	1033	212	1183	70	70	80
3000	3305	2598	2125	3162	1683	307	251	1301	223	1491	75	70	90
5000	3918	4266	2519	3749	1996	364	297	1543	282	1768	95	95	110
8000	4583	4989	2946	4385	2334	426	347	1805	329	2067	120	110	130
10000	4937	5375	3174	4723	2514	459	374	1944	376	2227	140	130	150
12000	5246	5711	3373	5019	2672	487	398	2066	400	2366	150	140	160
15000	5651	6152	3633	5407	2878	525	428	2225	423	2549	150	140	170
18000	6005	6538	3861	5745	3058	558	455	2365	447	2709	160	150	180
20000	6219	6771	3999	5951	3168	578	471	2449	482	2806	180	170	190
22000	6420	6990	4128	6143	3270	596	487	2528	505	2896	180	170	200
25000	6770	7294	4308	6410	3412	622	508	2638	505	3022	180	170	200
30000	7119	7751	4577	6812	3626	661	540	2804	552	3212	210	200	220
65000	9212	10030	5923	8814	4692	856	698	3628	752	4156	280	260	300

All dimensions are approximate

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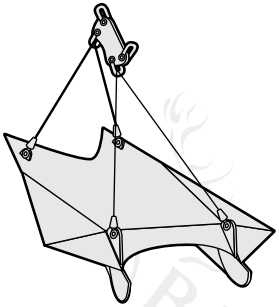
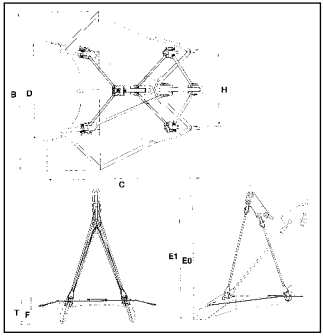
VRYHOF STEVMANTA VLA





Area (m^2)	B (mm)	C (mm)	D (mm)	E0 (mm)	E1 (mm)	F (mm)	H (mm)	T (mm)
5	3143	2976	1945	3075	3371	172	1459	639
8	3975	3765	2460	3890	4264	217	1845	809
10	4445	4209	2750	4349	4767	243	2063	904
12	4869	4611	3013	4764	5222	266	2260	991
15	5443	5155	3368	5326	5839	298	2527	1107
17	5795	5488	3586	5670	6216	317	2690	1179
20	6286	5953	3890	6150	6742	344	2918	1279

All dimensions are approximate

NB - The dimensions of the Stevmanta VLA anchor may be changed for specific applications.

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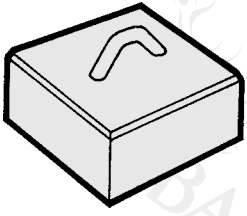
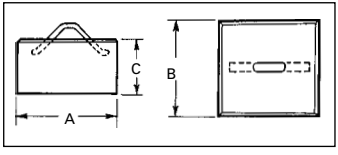
SINKERS - Concrete & Cast Iron

Balmoral supply concrete and cast iron sinkers as described in the adjoining table.
The sizes quoted are for the most commonly used sizes but Balmoral will gladly supply concrete sinkers to any size required by a client.





Sinkers					
Material	Weight in air (kg)	Weight in water (kg)	Nominal envelope size		
			Length A (mm)	Breadth B (mm)	Depth C (mm)
Concrete	250	128	700	700	340
	500	256	850	850	350
	1000	512	1000	1000	630
	3000	1536	1250	1250	1000
Cast Iron	1000	869	1140	860	210
	2000	1738	1400	1000	280
	3000	2607	1500	1200	320

All dimensions are approximate

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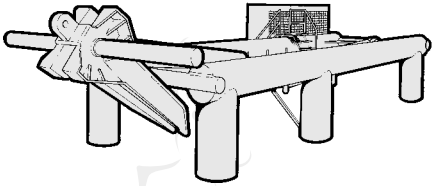
PROOF TEST LOADS FOR ANCHORS

All anchors rated as HHP should be proof loaded for a weight equal to approximately 1.33 times the actual weight of the anchor.



Mass of anchor (kg)	Proof test load (kg)	Mass of anchor (kg)	Proof test load (kg)	Mass of anchor (kg)	Proof test load (kg)
140	5000	2100	36900	6600	78800
200	6250	2200	38300	6800	80200
250	7180	2300	39600	7000	82000
300	8110	2400	40900	7200	83400
350	9050	2500	42200	7400	84800
450	10900	2600	43500	7600	86200
500	11800	2700	44700	7800	87800
550	12700	2800	45900	8000	89400
600	13500	2900	47100	8200	91000
650	14300	3000	48300	8400	92600
700	15200	3200	50500	8600	94000
750	16100	3400	52700	8800	95400
800	16900	3600	54800	9000	96800
850	17800	3800	56800	9200	98000
900	18600	4000	58800	9400	99400
950	19500	4200	60700	9600	100600
1000	20300	4400	62500	9800	101800
1100	22000	4600	64300	10000	103000
1200	23600	4800	65800	11000	109000
1300	25200	5000	67400	12000	113000
1400	26700	5200	69000	13000	118000
1500	28300	5400	70500	14000	123000
1600	29800	5600	72000	15000	128000
1700	31300	5800	73500	18000	144000
1800	32700	6000	74900	24000	175000
1900	34200	6200	76200	30000	203000
2000	35600	6400	77500		

All dimensions are approximate

Section 2
CHAINS AND FITTINGS

Introduction

There are currently two types of chain in common use within the marine industry. Studlink chain, which is the most popular, is used by the shipping and oil industries. Studless chain, which has no studs, is generally used in special mooring applications such as permanent moorings for FPSO's. Open link chain is typically used for marine moorings.

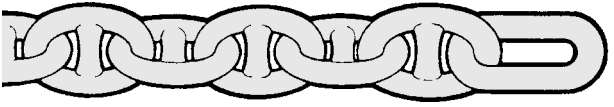
Chain is normally supplied in 27.5m lengths but the oil industry uses chain of much longer lengths of approximately 1370m (4,500 feet). Continuous lengths of chain mean no joining links, which may be the weakest links, but shipping and handling can be problematic.

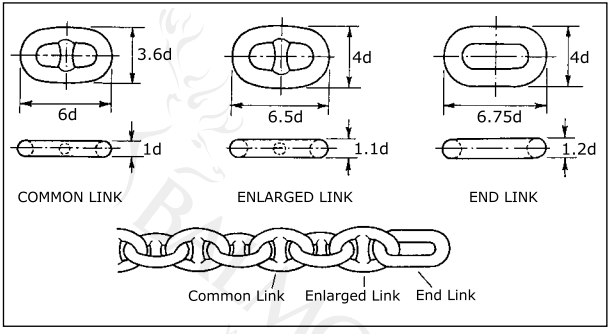
Chain size is generally expressed as the diameter of the steel at the bending area. This can mean that steel bars of 78-79mm may be used to manufacture chain of 76mm diameter. Chain can be fitted with open end links to enable shackle connections to be made. These end links are normally forged to the chain using an intermediate link also known as an enlarged link. These links are larger than the diameter of the chain to take into account the differing radii and the reduced strength of the links due the end link being studless.

Chain strengths are expressed as grades followed by a number. The letter used varies with countries but the strength of the chain remains the same. The United Kingdom uses "U", France and Spain uses "Q" and the Scandinavian countries use "K". The number relates to the type and hence the strength of the steel. U1 grade is mild steel, U2 is a high tensile steel and U3 is a special heat treated steel. These grades are normally only used within the shipping industry as the oil industry demands even greater strengths for the chain used. The original grade designed for the offshore industry was ORQ (Oil Rig Quality). Although this chain is still in use it has been superseded by new grades such as Rig Quality 3 and Rig Quality 4. These grades were introduced by the classification societies in order to standardise quality. The same grades also apply to the joining links that may be used with the chain. Tables showing the various strengths of chain are shown overleaf.

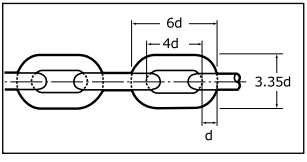
The offshore industry dictates that chain must be periodically inspected for wear and defects. The level of inspection and the intervals of these surveys are laid down by the classification authorities. Balmoral carries out such inspections in line with relevant classification society requirements.

STUD LINK MOORING CHAIN





STUDLESS CHAIN



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STUD LINK CHAIN

Shot = 90ft = 27.5m

Weight kg/shot incl Kenter	mm	inches	U2		U3		ORQ	
			PL kN	BL kN	PL kN	BL kN	PL kN	BL kN
222	19	3/4	150	211	211	301		
306	22	7/8	200	280	280	401		
418	26	1	278	389	389	556		
497	28	1 1/8	321	449	449	642		
652	32	1 1/4	417	583	583	833		
734	34	1 5/16	468	655	655	937		
826	36	1 7/16	523	732	732	1050		
919	38	1 1/2	581	812	812	1160		
1105	42	1 5/8	703	981	981	1400		
1209	44	1 3/4	769	1080	1080	1540		
1437	48	1 7/8	908	1280	1280	1810		
1555	50	2	981	1370	1370	1960	1400	2110
1809	54	2 1/8	1140	1590	1590	2270	1620	2441
1946	56	2 3/16	1220	1710	1710	2430	1746	2639
2100	58	2 5/16	1290	1810	1810	2600	1854	2797
2253	60	2 3/8	1380	1940	1940	2770	1976	2978
2573	64	2 1/2	1560	2190	2190	3130	2230	3360
2742	66	2 5/8	1660	2310	2310	3300	2361	3559
3097	70	2 3/4	1840	2580	2580	3690	2634	3970
3374	73	2 7/8	1990	2790	2790	3990	2846	4291
3681	76	3	2150	3010	3010	4300	3066	4621
4187	81	3 3/16	2410	3380	3380	4820	3453	5209
4832	87	3 7/16	2750	3850	3850	5500	3924	5916
5385	92	3 5/8	3040	4260	4260	6080	4342	6544
5723	95	3 3/4	3230	4510	4510	6440	4599	6932
6613	102	4	3660	5120	5120	7320	5220	7868

All dimensions are approximate

9.81 kN = 1 tonne

PL = Proof Load

BL = Breaking Load

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STUD LINK/STUDLESS CHAIN – OIL INDUSTRY GRADES

Dia	Break Load				Weight	
	R4-RQ4	R3S	R3	RQ3-API		
	Stud and Studless				Stud	Studless
mm	kN	kN	kN	kN	kg/m	kg/m
66	4621	4200	3761	3559	95	87
68	4885	4440	3976	3762	101	92
70	5156	4685	4196	3970	107	98
73	5572	5064	4535	4291	117	107
76	6001	5454	4884	4621	126	116
78	6295	5720	5123	4847	133	122
81	6745	6130	5490	5194	144	131
84	7208	6550	5866	5550	155	141
87	7682	6981	6252	5916	166	151
90	8167	7422	6647	6289	177	162
92	8497	7722	6916	6544	185	169
95	9001	8180	7326	6932	198	181
97	9343	8490	7604	7195	206	188
100	9864	8964	8028	7596	219	200
102	10217	9285	8315	7868	228	208
105	10754	9773	8753	8282	241	221
107	11118	10103	9048	8561	251	229
111	11856	10775	9650	9130	270	246
114	12420	11287	10109	9565	285	260
117	12993	11807	10574	10005	300	274
120	13573	12334	11047	10452	315	288
122	13964	12690	11365	10753	326	298
124	14358	13048	11686	11057	337	308
127	14955	13591	12171	11516	353	323
130	15559	14139	12663	11981	370	338
132	15965	14508	12993	12294	382	348
137	16992	15441	13829	13085	411	375
142	18033	16388	14677	13887	442	403
147	19089	17347	15536	14700	473	432
152	20156	18317	16405	15522	506	462
157	21234	19297	17282	16352	540	493
162	22320	20284	18166	17188	575	525
165	22976	20879	18699	17693	596	545
168	23633	21477	19234	18199	618	564
171	24292	22076	19771	18707	640	585
175	25174	22877	20488	19386	671	613
178	25836	23479	21027	19896	694	634

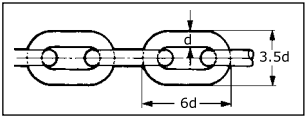
All dimensions are approximate

Dia	Proof Load						Weight	
	R4-RQ4		R3S		R3	RQ3-API		
	Stud	Studless	Stud	Studless	Stud Studless	Stud Studless	Stud	Studless
mm	kN	kN	kN	kN	kN	kN	kg/m	kg/m
66	3643	3238	3036	2935	2631	2361	95	87
68	3851	3423	3209	3102	2782	2496	101	92
70	4064	3613	3387	3274	2935	2634	107	98
73	4392	3904	3660	3538	3172	2847	117	107
76	4731	4205	3942	3811	3417	3066	126	116
78	4962	4411	4135	3997	3548	3216	133	122
81	5317	4726	4431	4283	3840	3446	144	131
84	5682	5051	4735	4577	4104	3683	155	141
87	6056	5383	5046	4878	4374	3925	166	151
90	6439	5723	5365	5187	4650	4173	177	162
92	6699	5954	5582	5396	4838	4342	185	169
95	7096	6307	5913	5716	5125	4599	198	181
97	7365	6547	6138	5933	5319	4774	206	188
100	7776	6912	6480	6264	5616	5040	219	200
102	8054	7159	6712	6488	5817	5220	228	208
105	8478	7536	7065	6829	6123	5495	241	221
107	8764	7790	7304	7060	6330	5681	251	229
111	9347	8308	7789	7529	6750	6058	270	246
114	9791	8703	8159	7887	7071	6346	285	260
117	10242	9104	8535	8251	7397	6639	300	274
120	10700	9511	8916	8619	7728	6935	315	288
122	11008	9785	9173	8868	7950	7135	326	298
124	11319	10061	9432	9118	8175	7336	337	308
127	11789	10479	9824	9497	8515	7641	353	323
130	12265	10903	10221	9880	8858	7950	370	338
132	12585	11187	10488	10138	9089	8157	382	348
137	13395	11906	11162	10790	9674	8682	411	375
142	14216	12637	11847	11452	10267	9214	442	403
147	15048	13376	12540	12122	10868	9753	473	432
152	15890	14124	13241	12800	11476	10299	506	462
157	16739	14879	13949	13484	12089	10850	540	493
162	17596	15641	14663	14174	12708	11405	575	525
165	18112	16100	15094	14590	13081	11739	596	545
168	18631	16560	15525	15008	13455	12075	618	564
171	19150	17022	15959	15427	13831	12412	640	585
175	19845	17640	16538	15986	14333	12863	671	613
178	20367	18104	16972	16407	14709	13201	694	634

All dimensions are approximate

OPEN LINK MOORING CHAIN

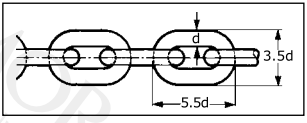
Long link (Mild steel)



Size		Weight kg/m	Proof Load kg	Minimum Breaking Load kg
mm	inches			
13	1/2	3.34	3190	7970
16	5/8	5.06	4830	12090
19	3/4	7.14	6820	17050
22	7/8	10.46	10000	24990
26	1	13.38	12770	31940

All dimensions are approximate

Medium Link (Mild steel)

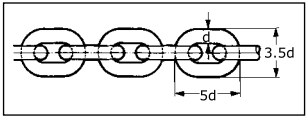


Size		Weight kg/m	Proof Load kg	Minimum Breaking Load kg
mm	inches			
13	1/2	3.50	3200	6400
16	5/8	5.20	4800	9600
19	3/4	7.40	6800	13600
22	7/8	10.00	9100	18200
25	1	12.80	11800	23600
28	1 1/8	16.50	14800	29500
32	1 1/4	21.00	19400	38700
34	1 3/8	23.50	21800	43600
38	1 1/2	29.50	27300	54600
42	1 5/8	36.00	33300	66600
44	1 3/4	39.50	36600	73200
48	1 7/8	47.00	43500	87000
51	2	53.00	49200	98300

All dimensions are approximate

OPEN LINK MOORING CHAIN

Short link (Mild steel)



Size		Weight kg/m	Proof Load kg	Minimum Breaking Load kg
mm	inches			
6	1/4	0.89	700	1400
7	9/32	1.13	900	1800
8	5/16	1.39	1250	2500
10	3/8	1.95	2000	4000
11	7/16	2.67	2240	4480
13	1/2	3.72	3200	6400
16	5/8	5.64	5000	10000
19	3/4	7.96	6820	13640

All dimensions are approximate

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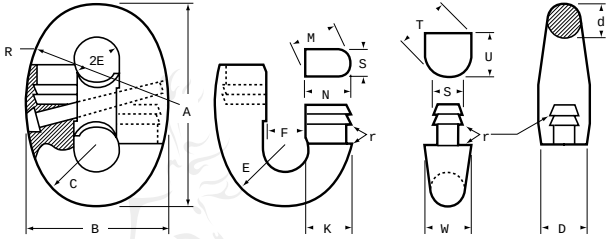
RAMFOR JOINING LINKS



Dimension Designation	Ramfor Nominal Dimension Times d	Tolerance %	
		+	-
A	6.00	2.0	2.0
B	4.20	2.0	2.0
C	1.83	2.0	2.5
E	0.67	2.5	0.0
R	4.50	2.0	2.5
K	1,40	2.0	2.5
S	1.0	2.5	2.5
M	1.41	2.5	2.5
N	1.28	2.5	2.5
W	1.34	2.5	2.5
F	1.13	2.5	0.0
T	1.59	2.0	2.5
U	1.30	2.0	2.5
D	1.52	2.0	2.5
d	1.00	2.0	0.0
r	0.03	-	-

All dimensions are approximate d = chain diameter

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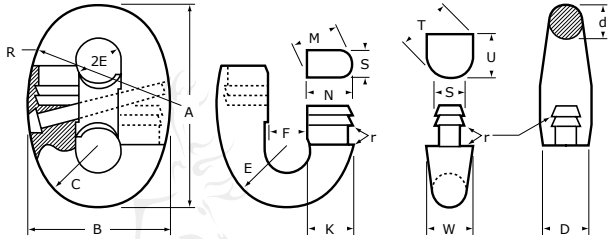
RAMFOR SLIM JOINING LINKS



Dimension Designation	Ramfor Slim Nominal Dimension Times d	Tolerance %	
		+	-
A	6.00	2.0	2.0
B	4.20	2.0	2.0
C	1.83	2.0	2.5
E	0.67	2.5	0.0
R	4.50	2.0	2.5
K	1.40	2.0	2.5
S	0.82	2.5	2.5
M	1.41	2.5	2.5
N	1.32	2.5	2.5
W	1.22	2.0	2.5
F	1.13	2.5	0.0
T	1.59	2.0	2.5
U	1.30	2.0	2.5
D	1.30	2.0	2.5
d	1.00	2.0	2.0
r	0.03	-	-

All dimensions are approximate d = chain diameter

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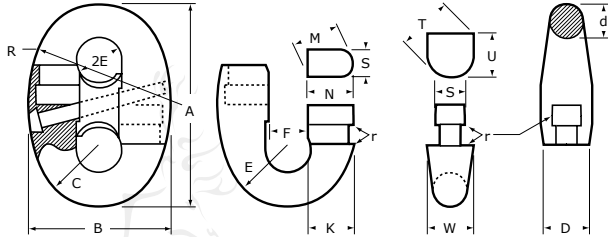
KENTER JOINING LINKS



Dimension Designation	Kenter Nominal Dimension Times d	Tolerance %	
		+	-
A	6.00	2.0	2.0
B	4.20	2.0	2.0
C	1.83	2.5	2.0
E	0.67	0.0	2.5
R	4.50	2.5	2.0
K	1.40	2.5	2.0
S	1.10	2.5	2.5
M	1.45	2.5	2.5
N	1.32	2.5	2.5
W	1.34	2.5	2.0
F	1.13	0.0	2.5
T	1.59	2.5	2.0
U	1.30	2.5	2.0
D	1.52	2.5	2.0
d	1.00	2.0	2.0
r	0.03	-	-

All dimensions are approximate d = chain diameter

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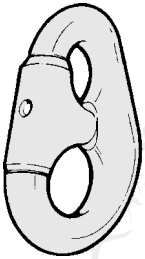
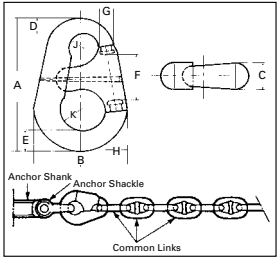
PEAR SHAPE ANCHOR CONNECTING LINK





No	Chain size mm	A (mm)	B (mm)	C (mm)	D (mm)	E (mm)	F (mm)
4	32-40	298	206	59	40	48	83
5	42-51	378	260	76	51	64	100
6	52-60	454	313	92	60	76	121
7	62-79	562	376	117	79	95	149
8	81-92	654	419	133	92	124	149
9	94-95	692	435	146	98	130	159
10	97-102	889	571	190	121	165	190

No	G	H	J	K	Weight kg
4	40 x 44	56	26	43	13
5	51 x 60	74	32	52	27
6	62 x 73	88	37	64	49
7	85 x 79	111	48	76	94
8	111 x 102	130 x 133	54	79	149
9	124 x 137	141	57	83	236
10	130	181	73	108	386

All dimensions are approximate

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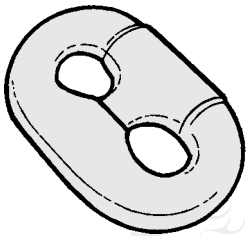
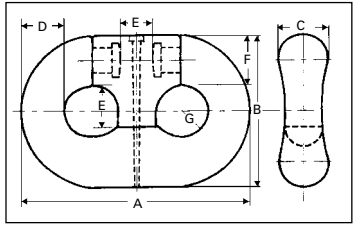
DETACHABLE CONNECTING LINK

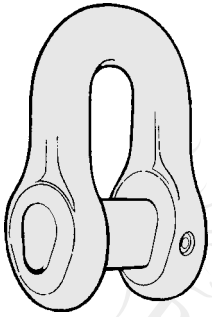




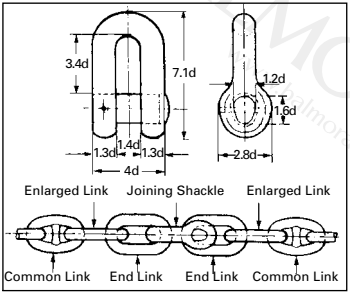
Chain size mm	A	B	C	D	E	F	G	Weight kg
30-32	190.5	127	44	32	35	39	21	4.5
33-35	210	140	49	35	39	42	23	6.0
36-38	229	152	53	38	43	46	25	7.8
40-42	248	165	57	41	50	50	27	10.0
43-44	267	190	62	44	51	56	30	12.5
46-48	286	194	64	48	55	60	31	14.5
50-51	305	197	64	51	59	64	33	16.5
52-54	324	210	67	54	64	67	36	20.0
56-58	343	221	71	57	67	71	38	23.5
59-60	362	234	78	60	70	75	40	27.5
62-64	381	246	79	64	73	78	42	32.0
66-67	400	246	83	67	78	79	44	37.0
68-70	419	275	92	73	83	90	46	45.5
71-73	438	283	94	73	85	93	48	48.5
74-76	457	295	95	76	90	94	50	54.5
78-79	476	308	102	79	92	96	52	62.5
81-83	495	320	103	83	92	103	55	73.0
84-86	514	332	107	86	100	107	57	80.5
87-89	537	350	116	92	105	114	59	93.5
90-92	552	356	119	92	106	116	61	97.5
94-95	571	368	122	95	114	119	62	116.0
97-98	590	381	127	98	117	121	67	123.0
100-102	607	394	132	102	119	122	68	130.0

All dimensions are approximate

'D' TYPE JOINING SHACKLES



Size mm	Weight kg
19	1.7
22	2.7
26	4.3
30	7
32	7.8
34	8.5
38	13.8
41	18
44	22
48	27
52	29
54	39
57	46
60	52
64	64
67	74
70	84
73	98
76	110
79	122
83	134
86	144
89	154
92	168
95	184
98	200
102	220
105	230
108	264
110	285
114	320
120	340



All dimensions are approximate

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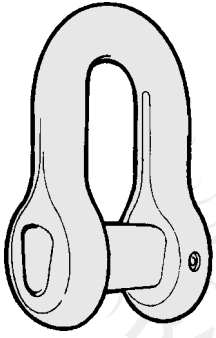
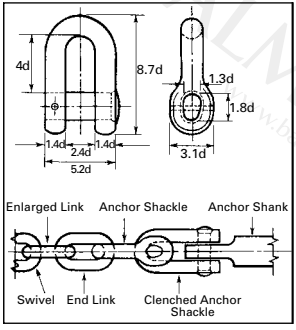
'D' TYPE ANCHOR SHACKLES





All dimensions are approximate

Size mm	Weight kg
19	2.5
22	3.8
26	6.0
30	9
32	11.3
34	14
38	19.8
41	26
44	32
48	39
52	48
54	57
57	67
60	80
64	93
67	106
70	121
73	141
76	159
79	172
83	189
86	200
89	230
92	258
95	290
98	301
102	344
105	390
108	422
110	431
114	475
120	530

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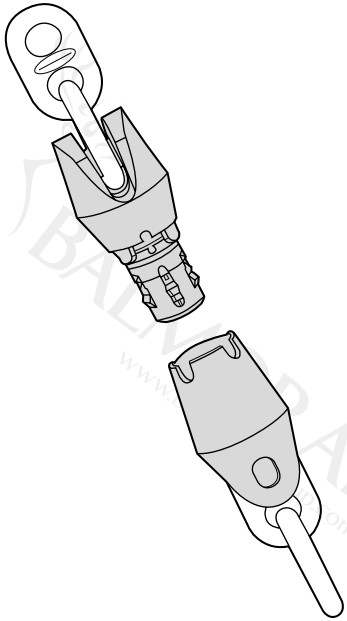
LONG TERM MOORING CONNECTOR

For use with any combination of chain, wire and synthetic ropes



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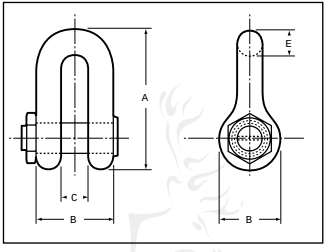
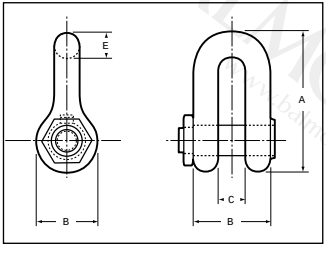
A. SPECIAL LTM ANCHOR SHACKLE WITH ROUND PIN



B. SPECIAL LTM JOINING SHACKLE WITH ROUND PIN



Shackle	A (mm)	B (mm)	C (mm)	D (mm)	E (mm)	F (mm)
A	8.25d	5d	2.2d	3.4d	1.4d	r1.7d
B	7d	4d	1.4d	3.1d	Ø1.3d	r1.55d

All dimensions are approximate

d = chain diameter

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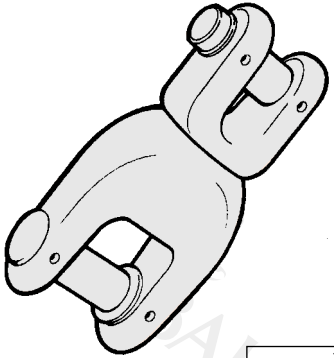
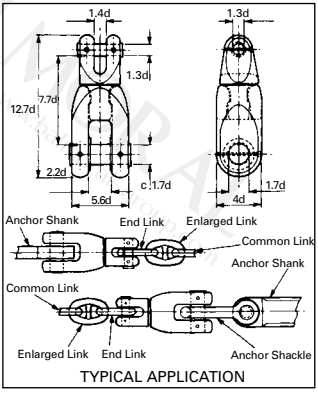
JAW & JAW SWIVELS



Size mm	Weight kg
54	120
57	156
60	200
64	258
68	303
70	330
73	361
76	394
84	493
90	600
95	700
102	970
105	1060
108	1170
114	1440
120	1650

All dimensions are approximate



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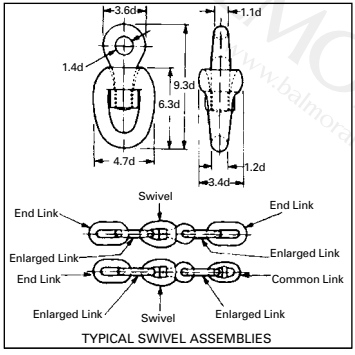
BOW & EYE SWIVELS



TYPICAL SWIVEL ASSEMBLIES

All dimensions are approximate

Size mm	Weight kg
19	2.8
22	4.4
26	6.8
30	9.4
32	12.7
34	17.5
38	22
41	29
44	36
48	43
52	54
54	64
57	75
60	78
64	90
67	104
70	114
73	134
76	152
79	171
83	189
86	196
89	217
92	256
95	275
98	300
102	342
105	387
108	420
110	450
114	520
120	620

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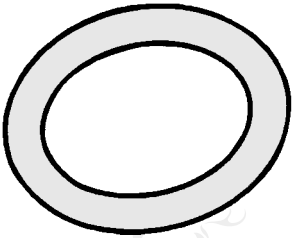
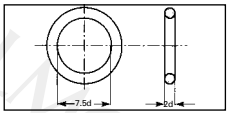
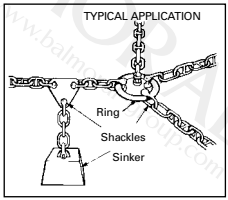
MOORING RINGS



Size mm	Weight kg
19	6
25	12
32	24
38	40
44	63
51	98
57	136
64	193
70	252
76	323
83	421
89	518
95	630
102	780

All dimensions are approximate





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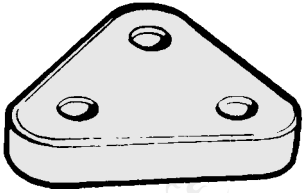
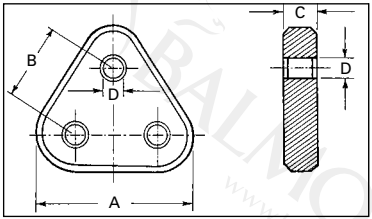
TRIANGULAR PLATES

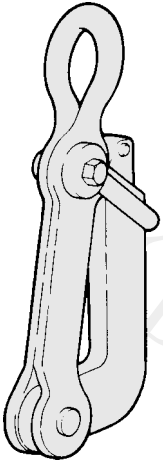


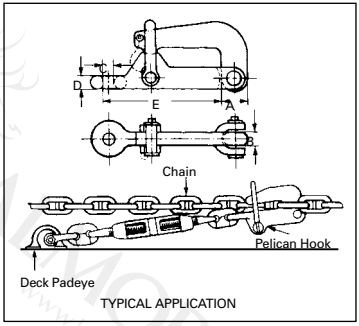


Chain size in mm	A (mm)	B (mm)	C (mm)	D (mm)	Proof Load Tonnes	Breaking Load Tonnes	Weight kg
38	320	168	50	76	81.2	106	13
48	360	184	60	88	127	181	25
58	430	225	80	102	190	287	50
70	506	266	90	120	270	404	81
76	550	290	90	130	313	472	96
83	600	316	100	142	356	549	127
95	685	361	120	162	508	794	199
102	736	388	120	174	594	910	230

All dimensions are approximate

PELICAN HOOKS





TYPICAL APPLICATION

Chain size mm	A (mm)	B (mm)	C (mm)	D (mm)	E (mm)	SWL tonnes	Weight kg
25-28	90	35	38	30	358	10	24
32	100	40	45	35	390	15	35
34-42	110	45	55	42	430	25	50
44-48	120	50	60	50	475	35	70
51-58	135	60	75	60	525	50	98
60-64	150	70	86	70	600	60	150
67-70	170	80	90	80	705	75	230
76-83	200	100	105	100	880	100	430

All dimensions are approximate

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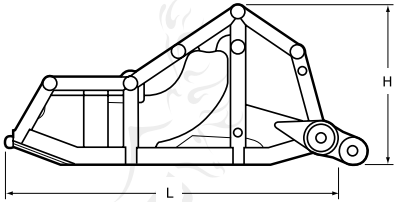
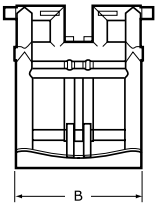
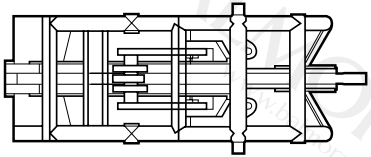
STEVTENSIONERS

Models VA 220, VA 500







Model	Tension (Te)	L(m)	B(m)	H(m)	Weight (Te)
VA 220	220	2.6	1.0	1.2	5
VA 500	500	5.4	2.4	2.6	20

All dimensions are approximate

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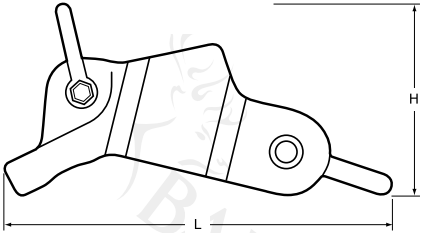
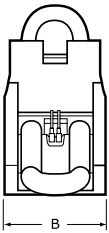
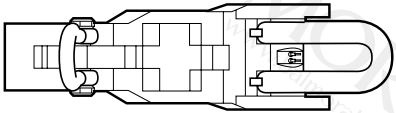
STEVTENSIONERS

Models VA 600, VA 1000, VA 1250







Model	Tension (Te)	L(m)	B(m)	H(m)	Weight (Te)
VA 600	600	2.2	0.6	0.9	2.5
VA 1000	1000	3.1	0.8	1.2	6
VA 1250	1250	3.5	0.9	1.4	9

All dimensions are approximate

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Section 3
CHASERS AND GRAPNELS

Introduction

These tools are commonly used in the recovery of rig anchors. Balmoral Marine is the exclusive worldwide agent for BEL Grapnel, supplying "J" chasers; permanent chain chasers; "J" lock chain chasers; permanent wire chasers and detachable permanent chain chasers. Grapnels, used for recovering chain and wire from the sea bed, are also provided. Upgraded designs for deep water have been included.
All models have been verified by the University of Newcastle.

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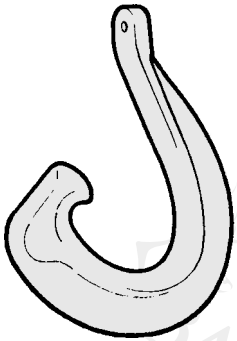
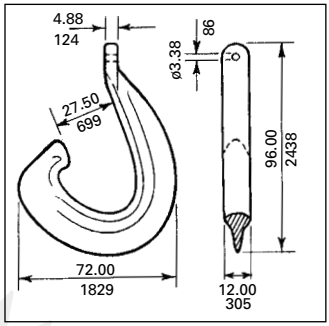
BEL 101 'J' CHAIN CHASER

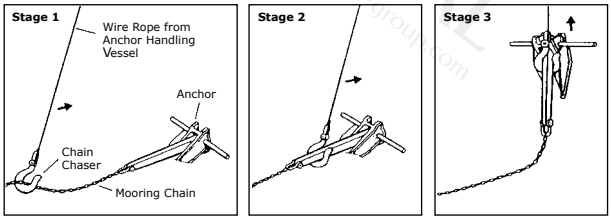


Safe Working Load:	100	tonnes
Proof Test Load:	250	tonnes
Weight:	1882	kg



CHAIN CHASERS

Chain chasers were developed to overcome the problems of recovering rig anchors when anchor pendant lines failed in service. The operational sequence of chasing is shown below.



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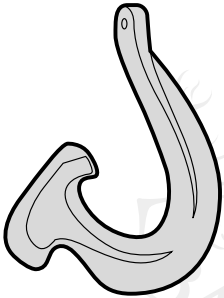
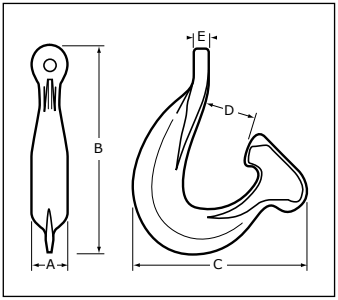
'J' CHAIN CHASERS

BEL 4101





Type	Weight (kg)	SWL (tonnes)	Proof test (tonnes)	Dim	A	B	C	D	E
BEL 4101	3170	250	400	in	18	101.9	8.6	27.5	7.5
				mm	457	2565	2185	699	191

All dimensions are approximate

Material: BS EN 1563 Grade 450/10

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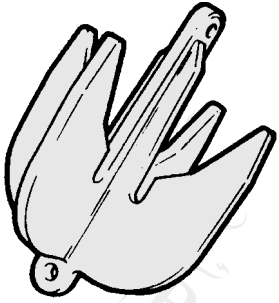
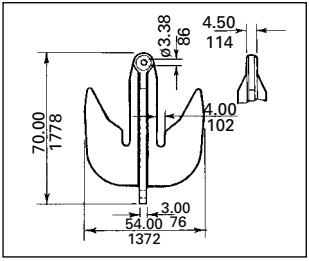
BEL 109 GRAPNEL

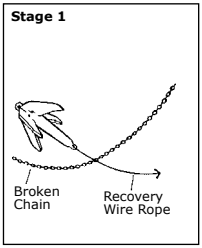


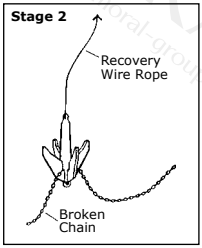
Safe Working Load:	100	tonnes
Proof Test Load:	150	tonnes
Weight:	1351	kg



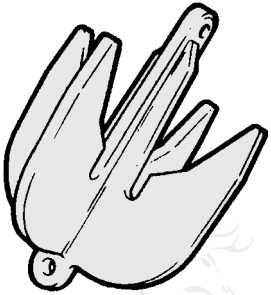
GRAPNELS

The grapnel was designed as a "fishing" tool primarily for the purpose of recovering an anchor and chain which has become detached and has fallen to the sea bed. The operational sequence is as follows:

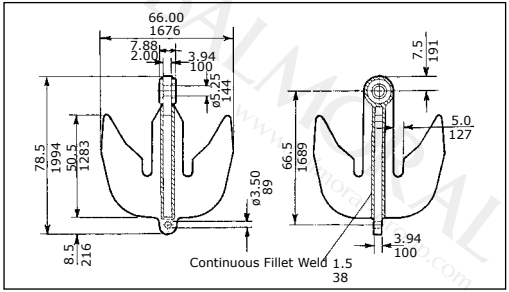




BEL 139 GRAPNEL



Safe Working Load:	250	tonnes
Proof Test Load:	350	tonnes
Weight:	2630	kg



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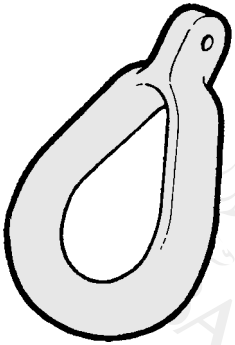
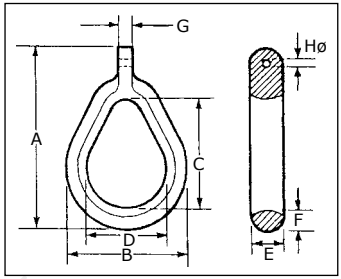
PERMANENT CHASERS

3.6

BEL 102 - 106 - 110 - 4110





Type	Weight (kg)	SWL (tonnes)	Proof test (tonnes)	Dim	A	B	C	D	E	F	G	H
BEL 102	1088	100	250	in	65.25	45.00	39.00	30.00	12.00	7.50	4.88	3.38
				mm	1657	1143	991	762	305	191	124	86
BEL 106	1451	130	250	in	67.00	46.00	39.00	30.00	15.00	8.00	5.13	3.88
				mm	1702	1168	991	762	381	203	130	99
BEL 110	1433	130	250	in	73.50	49.00	44.50	33.00	13.00	8.00	5.13	3.88
				mm	1867	1245	1130	838	330	203	130	99
BEL 4110	2390	250	400	in	80.3	53.6	44.5	33.0	16.0	-	7.5	-
				mm	2040	1361	1130	838	406	-	191	144

All dimensions are approximate

Lifting eye dimensions shown are standard for each type.
Specials can be made to suit customer requirements.

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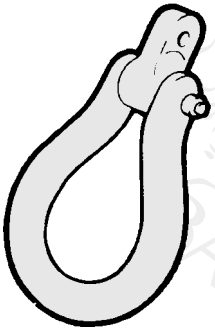
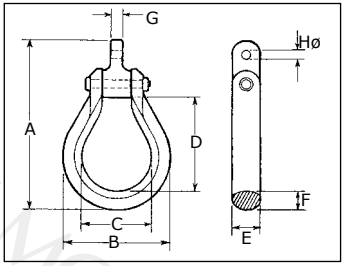
DETACHABLE PERMANENT CHAIN CHASERS

BEL 107 - 108 - 111





Type	Weight (kg)	SWL (tonnes)	Proof test (tonnes)	Dim	A	B	C	D	E	F	G	H
BEL 107	1238	100	250	in	74.25	45.00	42.50	30.00	12.00	7.50	4.88	3.38
				mm	1886	1143	1080	762	305	191	124	86
BEL 108	1656	130	250	in	76.00	46.00	42.00	30.00	15.00	8.00	5.13	3.88
				mm	1931	1168	1067	762	381	203	130	99
BEL 111	1742	130	250	in	78.50	49.00	44.50	33.00	13.00	8.00	5.13	3.88
				mm	1994	1245	1130	838	330	203	130	99

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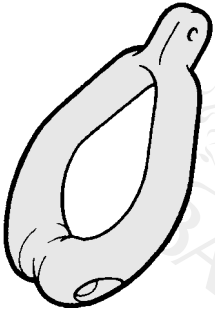
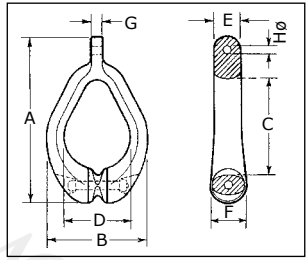
PERMANENT WIRE CHASERS

BEL 210 - 213 - 214 - 215 - 4214





Type	Weight (kg)	SWL (tonnes)	Proof test (tonnes)	Dim	A	B	C	D	E	F	G	H
BEL 210	1959	130	250	mm	2073	1245	1203	838	432	330	130	99
BEL 213	1846	130	250	mm	1962	1099	1086	692	445	330	130	99
BEL 214	2530	130	250	mm	2318	1308	1397	902	508	330	130	99
BEL 215	2495	250	400	mm	2051	1168	1060	711	445	356	178	127
BEL 4214	3560	250	400	mm	2540	1422	1397	902	391	610	191	144

All dimensions are approximate

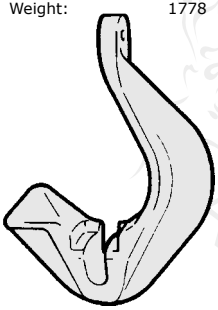
Lifting eye dimensions shown are standard for each type.
Specials can be made to suit customer requirements.

'J' LOCK CHAIN CHASERS

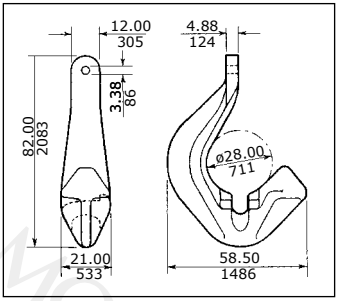
BEL 115/35-45

BEL 115/35 for chain 64mm to 90mm
BEL 115/45 for chain 95mm to 115mm

Safe Working Load: 100 tonnes
Proof Test Load: 250 tonnes
Weight: 1778 kg

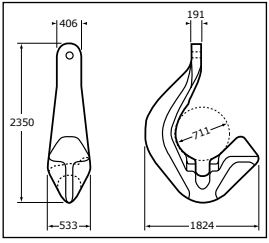


BEL 115/35-45



BEL 4115/35-45

BEL 4115/35 for chain 64mm to 90mm
BEL 4115/45 for chain 95mm to 115mm

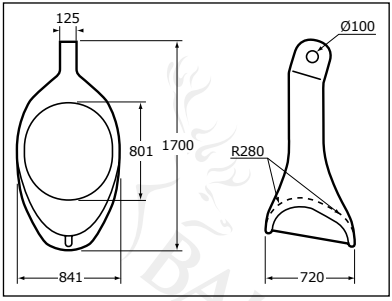


Safe Working Load: 250 tonnes
Proof Test Load: 400 tonnes
Weight: 2950 kg

BRUCE RING CHASER

3.10

A LIGHTWEIGHT PERMANENT CHAIN CHASER



- Based on proven BRUCE chaser technology
- Large asymmetrical sliding shoe designed to ride chain smoothly at ultra short scope
- Streamlined sections to minimise soil resistance
- Designed for use in deep water
- Large riding radii to avoid cable damage
- Cast steel construction, strong, compact, robust design
- Hard-faced sliding shoe for maximum life, minimum wear
- Aperture sized to pass wire rope/chain connectors

This chaser is designed to chase down an anchor chain or cable right to the front of the anchor shank. A simple procedure of heaving on the chaser while simultaneously hauling in the anchor line with the rig winch surfaces the anchor easily, ready for retrieval.

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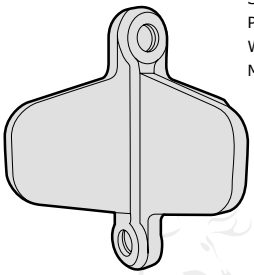
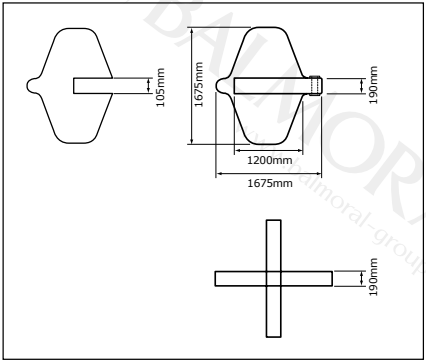
CHASER STOPPER



Safe Working Load:	250	tonnes
Proof Test Load:	1000	tonnes
Weight:	2	tonnes
Material	BSEN 1563 Grade 450/10	



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Section 4
WIRE ROPE

Introduction

Wire ropes can be grouped into two broad categories by the type of central core used. Independent wire rope core (IWRC) ropes are the stronger of the two and offer the greater resistance to crushing and high temperatures. Fibre core (FC) wire ropes while weaker, offer advantages in terms of flexibility, weight and of course price.

Along with the diameter, two numbers are normally used to define the construction of a wire rope. The first refers to the number of strands in the rope and the second to the number of wires per strand. In general, the greater the number of wires, the greater the flexibility of the rope. As the number of strands increase, so the section of the rope tends towards an even circle which is essential for the wear characteristics of ropes which pass over sheaves.

While it is impossible to include a comprehensive list of all wire ropes in a publication of this size, this section should be a useful reference guide for those constructions in common use.

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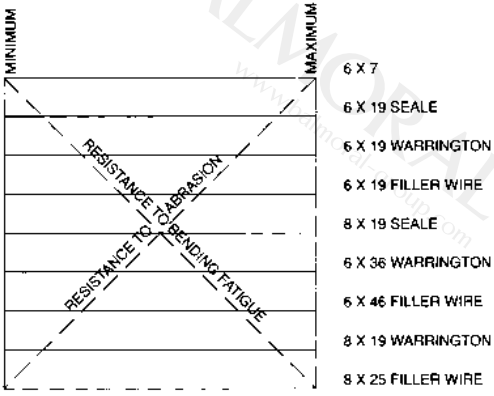
SELECTION OF WIRE ROPE

Wire ropes are affected by wear and bending as they operate over sheaves and drums. When selecting a wire rope for a particular service in addition to the minimum breaking load, the required resistance to abrasion and to bending fatigue must be considered.

Resistance to bending fatigue and resistance to abrasion require two different types of rope. Maximum resistance to bending fatigue is obtained from a flexible rope with small outer wires whereas to obtain maximum resistance to abrasion a less flexible rope with larger outer wires is required.

The correct selection of a wire rope involves a compromise between these two characteristics, the following diagram gives an indication of the relative abilities of various constructions to withstand wear and abrasion.

Where a rope may be subjected to crushing and/or distortion a steel wire core is recommended.



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CORROSION

Where corrosive conditions exist the use of galvanised wires is recommended. In addition to physical protection due to the complete envelopment of steel wire, zinc provides sacrificial protection as corrosion of the steel is prevented until the zinc is removed from comparatively large areas.

In extreme cases corrosion can be combated by the use of stainless steel wire rope.

Further guidance to rope selection is given in BS6570 Code of Practice for 'The selection, care, and maintenance of steel wire ropes'.

LUBRICATION

Unless otherwise indicated, by the customer or the intended duty, our ropes are thoroughly lubricated both internally and externally, during manufacture.

In addition to providing internal lubrication for free movement of the component wires, the lubricant also gives protection against corrosion. Due to the internal pressures set up as the rope flexes, and other outside influences met during its work, the original lubricant may soon be reduced and to ensure maximum rope life supplementary lubricant should be applied periodically during service. How rigorous the duty or corrosive the conditions will dictate the frequency of these applications.

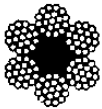
All steel wire ropes, including galvanised and stainless, will derive benefits from lubrication.

MAIN CORE OF ROPE

The function of the core in a steel wire rope is to serve as a foundation for the strands, providing support and keeping them in their proper position throughout the life of the rope.

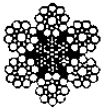
Fibre cores are generally used, as, when impregnated with grease, they help to provide internal lubrication as well as contributing to flexibility.

Where high resistance to crushing or to heat is needed and where additional strength or low stretch is required steel wire cores are used.



Fibre Main Core

Wire Strand Main Core (WSMC)



Independent Wire Rope Main Core (IWRC)

ROPE LAYS

LENGTH OF LAY

That distance in a rope, measured parallel to its axis, in which a strand in a rope makes one complete turn about the axis of the rope. Variations in length of lay alter the elastic properties of the rope, e.g. shortening the length of lay will increase a rope's elastic stretch but slightly reduce its breaking load.

ORDINARY (REGULAR) LAY AND LANG'S LAY

In an ordinary lay rope the direction of lay of the outer layer or wires in the strands is opposite to the direction of lay of the strands in the rope, whereas in a Lang's lay rope the direction of lay of the outer layer of wires in the strands is the same as the direction of lay of the strands in the rope.

Both ordinary lay and Lang's lay ropes are normally laid up in a right hand direction, but left hand lay can be supplied on request.

Ordinary lay ropes are suitable for all general engineering purposes. A Lang's lay rope offers a greater wearing surface and can be expected to last longer than an ordinary lay rope on an installation where resistance to wear is important, but it has less resistance to unlaying than an ordinary lay and its application must be limited to installations in which both ends of the rope are secured against rotation.

EQUAL LAY

An equal lay construction is one in which the wires in the strand are so spun that they will have an equal length of lay. It follows that the contact between all wires in the strand is linear. Ropes of this construction are not subject to failure by the bending of wires over the wires of the underlying layer.

Example

6 x 19 (9/9/1)	6 x 19 (12/6 + 6F/1)	6 x 36 (14/7 & 7/7/1)
Seale	Filler	Warrington

ROPE LAYS

CROSS LAY

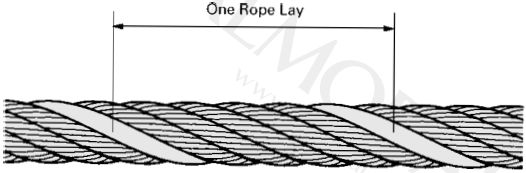
A cross lay construction is one in which the wires in successive layers of the strand are spun approximately the same angle of lay.

It follows that the wires in successive layers make point contact.

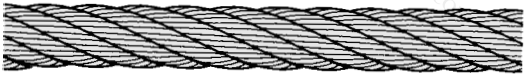
Where ropes are operating over pulleys, nicking of wires and secondary bending at these points of contact occur, and failure of the wires by early fatigue may result.

Example

6 x 19 (12/6/1) 6 x 37 (18/12/6/1)



Length of lay



Ordinary Lay

Lang's Lay

ROPE AND STRAND DESCRIPTION

For most applications wire ropes are constructed with six strands which are generally laid round a fibre or wire rope core. It is seldom that fewer strands are used but, for special applications, more than six are employed.

Throughout this catalogue, the figures given to describe the construction of a rope, are arranged so that the FIRST figure always indicates the number of STRANDS in the rope, and the SECOND figure the number of WIRES in each strand.

eg 6 x 7 denotes a rope constructed with 6 STRANDS each strand comprising 7 WIRES

8 x 19 denotes a rope constructed with 8 STRANDS each strand comprising 19 WIRES

Where there are seven wires in a strand, they can be arranged in only one way, ie 6 around 1, given in the catalogue as 6/1, a rope arranged 6 strands each of 7 wires is shown as

6 x 7 (6/1)

Where there are more than seven wires in a strand, they can sometimes be arranged in different ways and it is because of this that in this catalogue the arrangement of the wires in the strand is invariably shown in brackets following the total number of wires per strand, eg where in 6 x 19 construction the 19 wires in each strand are laid 12 around 6 around 1 centre wire, the construction is shown as

6 x 19 (12/6/1)

Similarly, where the 19 wires in a strand are laid 9 around 9 around 1 centre wire, or 'SEALE' the arrangement is shown as

6 x 19 (9/9/1) 'SEALE'

Where the wires in the strands are laid on the 'WARRINGTON' principle, the figures denoting a layer of large and small diameter wires are separated by the word 'and'

eg 6 x 19 (6 and 6/6/1) 'WARRINGTON'

Where small 'FILLER' wires are introduced between layers of wires they are denoted by the '+' sign and the number of 'FILLER' wires followed by the letter 'F'

eg 6 x 19 (12/6+6F/1) 'FILLER'

PREFORMING

Preforming is a manufacturing process which has the effect of relieving the wires and the strands of much of the internal stress which exist in non-preformed ropes. During the process the strands and wires are given the helical shape they will assume in the finished rope.

In a preformed rope broken wires do not protrude and greater care is required when inspecting for broken wires.

Preformed rope offers certain advantages over non-preformed rope, eg:

1 It does not tend to unravel and is less liable to form itself into loops or kinks and is thus more easily installed

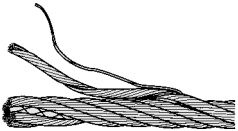
2 It is slightly more flexible and conforms to the curvature of sheaves and pulleys

3 Due to the reduction in internal stresses it has greater resistance to bending fatigue

Unless otherwise requested all ropes are supplied preformed.

NON-PREFORMED ROPE

In PREFORMED rope the wires and strands are given the helix they take up in the completed rope

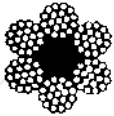


PREFORMED rope may be cut without servings although care must always be taken

COMMON STEEL WIRE ROPE CROSS SECTIONS

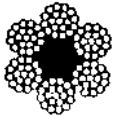
ROUND STRAND

6 x 19 (9/9/1)
'SEALE'



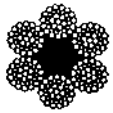
6 x 19 (12/6/1)

6 x19 (6 and 6/6/1)
'WARRINGTON'

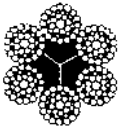


6 x 19 (12/6+6F/1)
'FILLER'

6 x 36 (14/7 and 7/7/1)
'WARRINGTON'



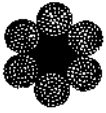
6 x 37 (15/15/61/1)
'SEALE'



6 x 41 (16/8 and 8/8/1)
'WARRINGTON'

6 x 37
(18/12/6/1)

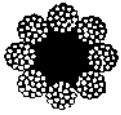
6 x 46 (18/9+9F/9/1)
'FILLER'



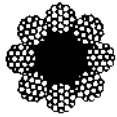
6 x 61
(24/18/12/6/1)

6 x 91
(30/24/18/12/6/1)

8 x19 (9/9/1)
'SEALE'



8 x19 (12/6+6F/1)
'FILLER'



8 x 19 (6 and 6/6/1)
'WARRINGTON'

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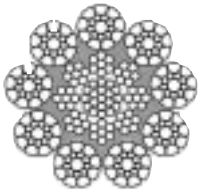
HIGH PERFORMANCE CRANE ROPES

9 STRAND

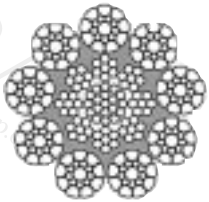
9 compacted strands with parallel steel core. Suitable for use on:
Boom Hoist, Main Hoist, Auxiliary Hoist, Trolley Rope

Available in Ordinary and Lang's Lay (RH and LH).
Galvanised.
2160N/mm2 grade

- A 9 Compacted construction with a double parallel steel core:
  - Extra High breaking load.
  - Excellent stability in diameter.
  - Very low elongation.
  - High resistance to crushing and excellent perfomance in multi-layer spooling.
  - Very good resistance to fatigue.



- Available with plastic full impregnation
  - Ideal for corrosive environments
  - Additional resistance to fatigue
  - High resistance to fleet angles
  - High resistance to dynamic loads and shock loading



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HIGH PERFORMANCE ROTATION RESISTANT CRANE ROPES

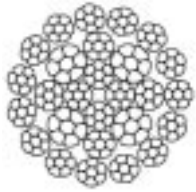
IPERPACK

Iperpack is a 27 compacted strands rope (15 outer strands) suitable for industrial hoist especially for tower and mobile cranes.

Galvanised

1960N/mm2 wire grade

- Good wear resistance thanks to compacted strands and Lang's lay
- Good rotation resistance
- Good resistance to crushing (thanks to compacted strands)
- Good load capacity



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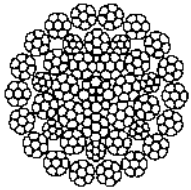
HIGH PERFORMANCE ROTATION RESISTANT CRANE ROPES

39 STRAND

A 39 strand construction designed to achieve a very low torque factor with 18 compacted outer strands suitable for use on: hoist, main hoist with plastic

18 outer compacted strands
Lang's Lay
Galvanised
2160 N/mm^2 wire grade

- Plastic corecover
- Very good fatigue performance
- 18 compacted outer strands in Lang's Lay
- Core construction designed to obtain high mechanical performance
- Suitable for high hoisting
- May be used with swivel
- Suitable for the equipment which require multi-layer reeving system



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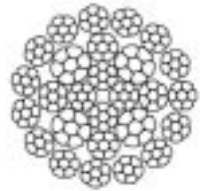
HIGH PERFORMANCE ROTATION RESISTANT CRANE ROPES

39 STRAND

4.12

A 39 compacted strand construction designed to achieve the lowest rotation. Suitable for use on: hoist, auxiliary hoist, main hoist.

39 compacted strands
Lang's Lay
Galvanised
2160 N/mm² grade



- The construction designed to achieve the lowest rotation:
  - Extra high breaking load
  - Ideal for hoists applications with one part line
  - the best rotation resistance properties
  - Very flexible construction
  - High resistance to contact pressures thanks to Lang's Lay
- Excellent performance on equipment with multi-layer reeving system and high demand of flexibility
- Available with plastic protected core, achieving all the benefits of core protection and construction stability (recommended for subsea operations)

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MARINE WIRE ROPES FOR SHIPPING AND FISHING PURPOSES

High resistance to the corrosive effect of salt water is accomplished by the use of specially galvanised steel wires and by impregnating the fibre core with special lubricant.

RUNNING RIGGING

Ropes used as running rigging require to be flexible, and 6 x 12 fibre cores or 6 x 19 in the small sizes is usually preferred.

WIRE HAWSERS

6 x 12 and 6 x 24 constructions, both having 7 fibre cores, are used, 6 x 12 for sizes up to about 16mm dia (2 in circ) and 6 x 24 for sizes up to about 28mm dia (31/2 in circ). For larger diameters, the more flexible 6 x 37 rope is recommended.

MOORING LINES AND TOWING LINES

6 x 36, 6 x 41 and 6 x 47 are all used and suitable for this application.

ROTARY DRILLING LINES

Rotary drilling lines are used for controlling the position of the drill string.

The construction is normally a 6 x 19 (9.9.1) IWRC rope right hand ordinary lay in extra improved plow steel bright finish, however a flattened strand rope may be more preferable for drilling rig with a construction 6 x 28 offering a higher breaking load.

RISER TENSIONER LINES

The high concentration of bending stresses combined with heavy abrasive wear on the outer surface of the rope can cause premature failure of the rope unless the correct rope is chosen.

Either a 6 x 41 IWRC or 6 x 49 IWRC right hand Langs Lay, bright finish could be used.

ANCHOR LINES

Anchor lines are supplied in Right Hand (Ordinary) Lay in drawn galvanised finish with independent wire rope core in either 6 x 36, 6 x 41 or 6 x 49 construction dependent upon the diameter.

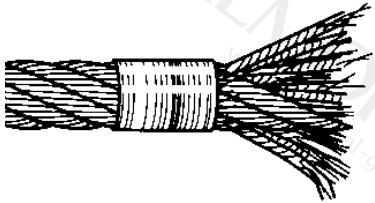
STRANDED ROPE SERVINGS

When cutting non-preformed rope, adequate servings should first be applied to both sides of the point where the cut is to be made, to prevent the rope from untwisting. Even with Preformed rope, it is recommended that one serving be applied at each side of the cutting point to prevent distortion of the rope ends by the pressure applied during cutting.

Soft annealed single wire or marlin should be used. Where wire is used the table below is given as a guide to size of wire, length and number of servings recommended, for Stranded Ropes.

Rope diameter	Serving wire diameter
Less than 22mm	1.32mm
22mm to 38mm	1.57mm
Larger than 38mm	1.83mm

At least two servings each of a length six times the diameter of the rope should be employed.



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METHOD OF APPLYING BULLDOG GRIPS

The bulldog grip should be fitted to wire rope as shown in Fig 1, and not as shown in Fig 2. The bridge of the grip should invariably be fitted on the working part of the rope, and the U-bolt on the rope tail or dead end of the rope. Grips should not alternate in position on the rope.

As a safety measure and to secure best results it is important to re-tighten all grips after a short period in operation, for, due to the compression of the rope under load, there will be a tendency for the grips to loosen. Refer to the manufacturers instructions for quantity of grips recommended.

Fig 1 Correct method of fitting bulldog grips

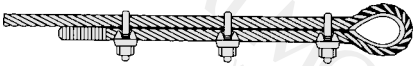
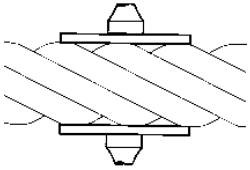


Fig 2 Incorrect method of fitting bulldog grips

HOW TO MEASURE

The actual diameter is measured with a suitable caliper fitted with jaws broad enough to cover not less than two adjacent strands.



The measurements are taken at two points at least 1 metre apart and at each point the two diameters at right angles are measured. The average of these four measurements is the actual diameter of the rope.

BULLDOG CLIP WIRE ROPE REQUIREMENTS

Rope Size (mm)	Minimum No. of Clips	Amount of Rope to Turn Back in (mm)	*Torque in Nm
3-4	2	85	6.1
5	2	95	10.2
6-7	2	120	20.3
8	2	133	40.7
9-10	2	165	61.0
11-12	2	178	88
13	3	292	88
14-15	3	305	129
16	3	305	129
18-20	4	460	176
22	4	480	305
24-25	5	660	305
28-30	6	860	305
32-34	7	1120	488
36	7	1120	488
38-40	8	1370	488
41-42	8	1470	583
44-46	8	1550	800
48-52	8	1800	1017
56-58	8	1850	1017
62-65	9	2130	1017
68-72	10	2540	1017
75-78	10	2690	1627
85-90	12	3780	1627

All dimensions are approximate

NOTES

If a greater number of clips are used than shown in the table, the amount of turnback should be increased proportionately.

*The tightening torque values shown are based upon the threads being clean, dry, and free of lubrication.

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DRUMS AND PULLEYS

GENERAL PURPOSE WIRE ROPE

The diameter of a drum or pulley should not be less than 500 times the diameter of the outside wire of the rope. The groove radius of a pulley should be within the range 5% to 15% larger than D/2 with the optimum radius 10% greater than D/2. The recommended radius of a drum groove is 6% greater than D/2 - where D is the nominal rope diameter. The bottom of the grooves should be arcs of circles equal in length to one-third of the circumference of the rope. The depth of a groove in a pully should be at least equal to one and a half times the rope diameter and the groove in a drum should not be less than one-third of the rope diameter.

The angle of flare between the sides of the sheaves should be approximately 52° but should be greater if the fleet angle exceeds 1.5°.

The clearance between neighbouring turns of rope on a drum should not be less than:

- 1.6mm for ropes up to 13mm diameter
- 2.4mm for ropes over 13mm and up to 28mm diameter
- 3.2mm for ropes over 28mm and up to 38mm diameter

In terms of rope diameters the sizes of drums and pulleys would be:

Rope construction round strand	**Minimum pulley diameter**
6 x 19 (9/9/1)	40 x D
6 x 19 (12/6+6F/1)	33 x D
6 x 36 (14/7&7/7/1)	29 x D
Multi-Strand	
17 x 7	18D
34 x 7	18D

Always refer to the wire rope manufacturers own recommendations.

WIRE ROPE

TREAD PRESSURE

Too great a radial pressure between sheave and rope will cause excess wear of the sheave grooves and will result in reduced rope life.

The radial pressure may be determined from $P = \frac{T1 + T2}{Dd}$

Where: P = the tread pressure kgf/cm2 (lbsf/in2)
T = tension on each side of the sheave kgf (lbsf)
D = diameter of the sheave cm (in)
d = diameter of the rope cm (in)

Recommended maximum tread pressures to minimise sheave wear:

Rope construction	Cast iron		Cast steel		11% to 13% Manganese steel	
	(kgf/cm²)	lbsf/in²	(kgf/cm²)	lbsf/in²	(kgf/cm²)	lbsf/in²
6 x 7	21	300	39	550	105	1500
6 x 19	35	500	63	900	175	2500
6 x 37	42	600	76	1075	210	3000
8 x 19	42	600	76	1075	210	3000

All dimensions are approximate

The above values are for Ordinary Lay ropes; for Lang's Lay ropes these values may be increased by 15%.

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ROPE STRETCH

The stretch of a wire rope under load consists of permanent constructional stretch and elastic stretch.

Permanent constructional stretch is due to the settling of the wires in the strand and the compression of the central core. This stretch is irrecoverable and most of it occurs during the early part of the rope's life. The following figures of percentage constructional stretch will give results within acceptable practical limits.

	Light loads		Heavy loads
Six-Strand ropes			
With Fibre Core	0.50	to	1.00% of length
With Steel Wire Core	0.25	to	0.50% of length
Eight-Strand ropes			
With Fibre Core	0.75	to	1.00% of length

Elastic stretch is the capacity of the individual wires to elongate, under load, due to their elastic properties. Providing the rope is not loaded beyond its elastic limit, it will return to its original length after removal of the load.

The elastic stretch may be calculated from the expression:-

$$\frac{WL}{AE} \text{ mm}$$

Where: W	is the load on the rope	kgf
L	is the length of the rope	mm
A	is the area of rope	mm^2
and E	is the modulus of elasticity of the rope	kgf/mm^2

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WIRE ROPE

MODULUS OF ELASTICITY

6 x 7 Group	12,000 kgf/mm^2
6 x 19 Group	10,500 kgf/mm^2
6 x 37 Group	9,800 kgf/mm^2

For six stranded ropes with an IWRC these figures should be increased by 10%.

17/7 and 34/7 9,800 kgf/mm^2

According to the number of wires in the strand.

METALLIC AREA

Metallic area = Xd^2

Where: d is the rope diameter and X is the factor.

Rope construction	Factor (X)	Rope construction	Factor (X)
6 x 7 (6/1)	0.369	8 x 19 (9/9/1)	0.342
6 x 19 (9/9/1)	0.385	8 x 19 (12/6 + 6f/1) 8 x 19 (6 and 6/6/1)	0.350
6 x 19 (12/6 + 6f/1) 6 x 19 (6 and 6/6/1) 6 x 21 (10/5 + 5f/1)	0.393	6 x 12 (12/FC)	0.232
6 x 19 (12/6/1)	0.357	6 x 24 (15/9/FC) 17 x 7 (6/1)	0.322 0.408
6 x 26 (10/5 and 5/5/1) 6 x 31 (12/6 and 6/6/1) 6 x 36 (14/7 and 7/7/1) 6 x 41 (16/8 and 8/8/1)	0.393	34 x 7 (6/1)	0.416

All dimensions are approximate

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OUTSIDE WIRE DIAMETER

The approximate diameter of the outer wires of a six stranded round strand rope may be found from the formulae:

$$d = \frac{D}{N + 3.5}$$

For an eight strand round strand rope from

$$d = \frac{D}{N + 6.5}$$

Where D is the rope diameter and N is the number of outer wires in a strand.

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FACTORS OF SAFETY

General purpose wire ropes

A uniform factor of safety cannot be given for all engineering applications. Where a rope is used on equipment, the factor of safety of which is not specified, the minimum factor of safety shall not be less than 5 to 1. After termination losses of 10% are considered.

WIRE ROPE WORKING LOADS

The load to which a rope is subjected in service includes forces due to acceleration, bending and shock in addition to static force.

The load due to acceleration maybe determined from:

$$F = 0.102 \times W \times a$$

Where F = Load due to acceleration (kgf)
W = The static load (kg)
a = The acceleration (m/S^2)

The load due to bending may be determined from:

$$F = \frac{Ed}{D} A$$

Where F = Load due to bending (kg)
E = Modulus of elasticity on the rope (kgf/mm^2)
d = Outside wire diameter (mm)
D = Drum or sheave diameter (mm)
A = Metallic area of the rope (mm^2)

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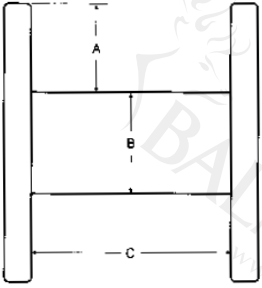
Under conditions of repeated bending the fatigue strength of rope wire is approximately 25% of its strength in simple tension.

The load due to shock is dependant upon the magnitude of the static load and the speed of load application. Every effort should be made to avoid "slack rope" when load is applied.

CAPACITY OF DRUM OR REEL



The undernoted formula may be used in computing the rope capacity of any size of drum or reel. While it will give results that are very nearly correct for wire rope evenly spooled, when the rope is not spooled evenly the drum capacity is slightly reduced. Remember to take account of large end terminations which could hamper spooling.

Formula: $\frac{A}{d} \times \frac{C}{d} \times \pi (A+B) = \text{capacity}$

Where d = Rope diameter

* Do not use fractions

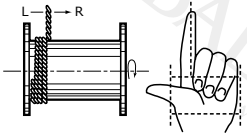
NB - The flange (A) will extend beyond the outer layer of rope. The dimension (A) should be taken to the outside of the rope only, and not to the outside of the flange.

CORRECT SPOOLING OF ROPE ON DRUM

The sketch shown below may be used to determine the proper direction of rope lay for spooling or winding on flat or smooth face drums.

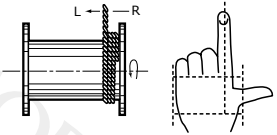
When a rope is wound on to a drum any tendency of the rope to twist when tension is released will be in a direction which would untwist the rope at the free end.

The advantage of spooling in the correct directions is that when any load is slackened off the laps on the drum will hug together and maintain an even layer. With incorrect spooling the laps will move apart on removal of load and when the load is reapplied the rope may criss-cross and overlap, and flattening and crushing of the rope will result. The correct spooling direction for right and left hand lay ropes is shown in the sketch below. This applies to both ordinary and Lang's lay ropes.



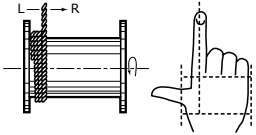
Underwind left to right
Use left lay rope

Left lay
Underwind



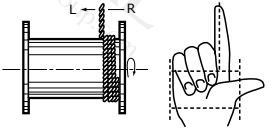
Overwind left to right
Use left lay rope

Left lay
Overwind



Overwind left to right
Use right lay rope

Right lay
Overwind



Underwind left to right
Use right lay rope

Right lay
Underwind

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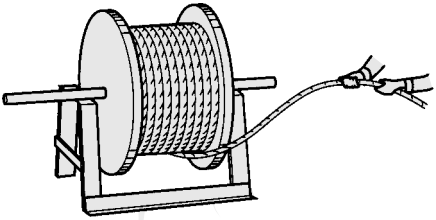
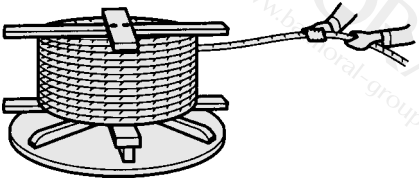
UNREELING AND UNCOILING

UNREELING



Pass a shaft through the centre of the reel and jack it up to allow the reel to revolve freely. Pull the rope straight ahead keeping it taut to prevent it from loosening up on the reel.

UNCOILING

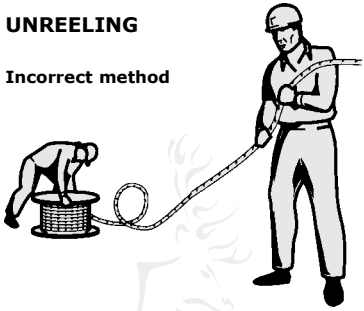


Heavy coils should be placed on a turntable and two crosspieces placed on top of the coil to prevent laps springing out of place and kinking. Light Flexible Ropes may be rolled along the ground so that the rope lies straight.

WIRE ROPE

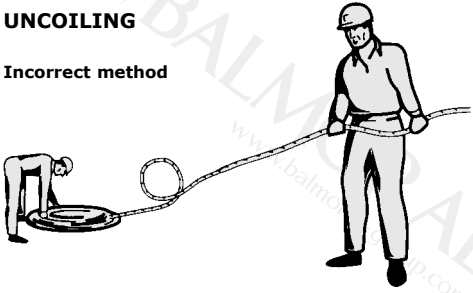
UNREELING

Incorrect method

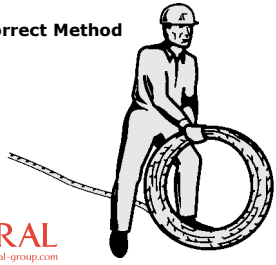


UNCOILING

Incorrect method



Correct Method



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A GUIDE TO WIRE ROPE DAMAGE

The life of a rope depends on many factors and includes:

a The integrity of rope records and certification
b Wear and tear of rope contact points
c Operator skills

The technical characteristics of a wire rope can be easily determined of the beginning of its life cycle whilst monitoring high contact areas can also be effectively managed. Operator skills, however, are more difficult to monitor.

Typical reasons for a wire rope to be withdrawn from service are listed below:

a Unsuitable rope composition, diameter and quality for purpose
b Ropes wound over or across each other
c Lack of regular and correct lubrication
d Use of incorrect reels and drums
e Use of misaligned reels and drums
f Use of reels and drums with unsuitable grooves and/or flanges
g Damage caused by ropes protruding from reels and/or drums
h Ropes being affected by humidity, chemicals or heat
i Use of unsuitable rope joints
j Looped ropes
k Excessive loads
l Damaged rope particles penetrating the internal structure

The following conditions should be noted when examining a rope:

a Decrease in diameter
b General wear and tear
c Lay length changes
d Traces of shock and stretch
e Corrosion
f Broken wires and their position in the rope structure

In examination, if possible, all the records should be analysed and inappropriate points should be eliminated. Some of the hints to help in finding possible cause for these failings are given below.

Possible causes of rope damage

Failure	Symptoms	Possible causes
Fatigue	Traversal wire breaks on strands	a bends on small dimensioned reels b Vibration and shock loads c Unsuitable rope compositions d Corrosion e Unsuitable joints at terminals
Breaking under excessive load	Conical and plastic type of breaks at rope wires	a Excessive load b Wrong rope diameter and construction c Unsuitable joints at terminals
Wear	Wear on external wires	a Changes in rope or reel diameters b Changes on load c Big fleet angle d Unsuitable reels e Abrasives in the rope f Unsuitable groove dimensions
Corrosion	Pittings on wire surfaces and breaks on wires caused by corrosion	a Insufficient lubrication b Unsuitable storing conditions c Corrosive atmospheric effects

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GROOVES IN SHEAVES

Apart from the sheave diameter, the lifetime of a rope also depends on the design and dimensions of the groove. If the groove is too narrow, the rope gets wedged in it, the strands and wires cannot move as is required for bending, and this condition is detrimental to the life cycle of the rope. On the other hand, too wide a groove also has an adverse effect on rope life due to the high surface pressure between rope and sheave.

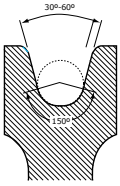
The graph below clearly shows that a radius 5% larger than half the rope diameter will give the longest service life of the rope.

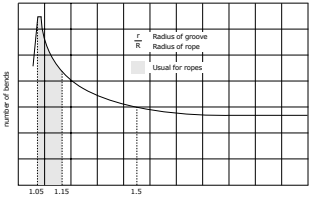
For traction sheaves the radius of the groove is usually adapted as closely as possible to the radius of the rope to obtain maximum traction.

The rope is supported in the best possible manner if the arc of contact with the groove contour can be 150 deg. This corresponds to a throat angle of 30 degrees. However, with a large fleet angle or with oscillating loads, the throat angle should be larger (up to 60 degrees) to avoid undue wear of the rope and sheave flanges.

The height of the flanges should be at least 1.5 times the rope diameter to prevent the rope running off the sheave.

The rope and groove are inevitably subject to wear during operation. Since the diameter of a rope becomes smaller due to abrasion and stretch, it will wear out the groove to the smaller diameter of the worn rope. If a new rope is laid in such a worn groove, it will get wedged in the narrow groove and this will have a very adverse effect on its life. It is also possible that the rope cuts its profile into the groove. Therefore the grooves should be inspected before installing a new rope and if necessary they must be re-machined, preferably with a profile cutting tool. If a groove shows excessive wear, this may be an indication that the sheave material is too soft. In this case a sheave of a harder grade steel must be used which better resists the abrasive effect of the rope, or a larger diameter sheave should be taken.



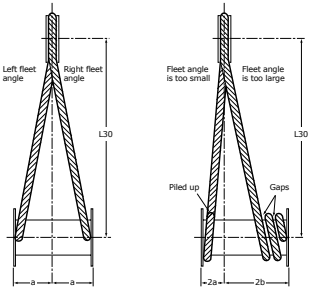


FLEET ANGLE

When ropes are wound on drums, attention must be paid to the fleet angle, that is the included angle between the rope running to or from the extreme left or right of the drum and an imaginary line drawn from the centre of the sheave normal to the axis of the drum. When this angle is too large, the rope in this extreme position will be pressed with great force against the flange of the sheave which causes undue friction and wear of both the rope and the sheave. With a plain faced drum a large fleet angle will, in addition, cause the rope to travel too fast from the side to the centre of the drum thereby leaving gaps between the wraps. When winding a second layer, the rope is forced into these gaps which results in serious deterioration. When, on the other hand, the rope is wound past the centre of the drum, a too large fleet angle will cause the next wrap to scrub against the preceding wrap as the rope runs more towards the side of the drum.

If the fleet angle is too small, the rope does not travel fast enough towards the centre of the drum and, apart from scrubbing, at a certain moment the wraps will pile up ie the next wrap is laid on top of the preceding one and is then pressed to the side of the preceding wrap with great force. This has a detrimental effect on the rope and the equipment on which it is used (shock loads).

For plain faced drums a minimum fleet angle of 1/2 deg. and a maximum fleet angle of 1 1/2 deg. is recommended. For groove drums these figures are 1/2 deg. minimum and 2 deg. maximum. In terms of length these figures correspond to a minimum distance between sheave and drum of 40 x ‘a’ (a=half the drum width) and a maximum distance of 115 x ‘a’ for plain faced drums, and minimum 30 x ‘a’ and maximum 115 x ‘a’ for grooved drums (approximate values).



Hence for a grooved drum 1 metre in width the distance between sheave and drum should be 30 x ‘a’ = 15 metres minimum, or conversely, if the distance between drum and sheave is 7 metres, the maximum drum width should be (7:30)x2 = approx. 47 cm.

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SHEAVES AND DRUMS(D)

Recommended diameter for Sheaves and Drums on cranes according to FEM 1001-4

Machine group	Drums	Pulleys	Compensating pulleys
M1	11.2 x d	12.5 x d	11.2 x d
M2	12.5 x d	14 x d	12.5 x d
M3	14 x d	16 x d	12.5 x d
M4	16 x d	28 x d	14 x d
M5	18 x d	20 x d	14 x d
M6	20 x d	22.4 x d	16 x d
M7	22.4 x d	25 x d	16 x d
M8	25 x d	28 x d	18 x d

SAFETY FACTORS

Recommended safety factors for wire rope on cranes according to FEM 1001-4

Machine group	Running ropes	Static ropes
M1	3.15	2.5
M2	3.35	2.5
M3	3.55	3
M4	4	3.5
M5	4.5	4
M6	5.6	4.5
M7	7.1	5
M8	9	5

All dimensions are approximate

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DRUMS

INSTALLATION FROM REEL TO DRUM

Installation of a wire rope on a plain (smooth) face drum requires a great deal of care. The starting position should be at the correct drum flange so that each wrap of the rope will wind tightly against the preceding wrap. See illustration on p 4.44. Here too, close supervision should be maintained throughout installation. This will help ensure:

1 the rope is properly attached to the drum
2 appropriate tension on the rope is maintained as it is wound on the drum
3 each wrap is guided as close to the preceding wrap as possible, so that there are no gaps between turns
4 there are at least two dead wraps on the drum when the rope is fully unwound during normal operating cycles

Loose and uneven winding on a plain (smooth) faced drum, can and usually does create excessive wear, crushing and distortion of the rope. The results of such abuse are lower operating performance and a reduction in the rope's effective strength. Also, for an operation that is sensitive in terms of moving and spotting a load, the operator will encounter control difficulties as the rope will pile up, pull into the pile and fall from the pile to the drum surface. The ensuing shock can break or otherwise damage the rope.

The proper direction of winding the first layer on a smooth drum can be determined by standing behind the drum and looking along the path the rope travels, and then following one of the procedures illustrated on page 4.33. The diagrams show: the correct relationship that should be maintained between the direction of lay of the rope (right or left), the direction of rotation of the drum (overwind or underwind), winding from left to right or right to left.

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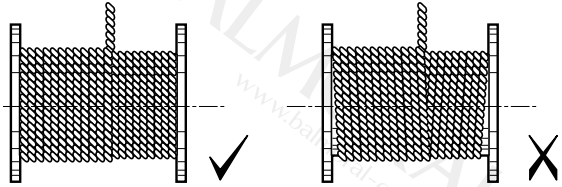
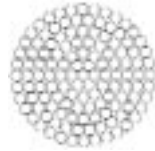
CORRECT/INCORRECT LAYERING

When working with long lengths of wire it is essential that the wires are spooled onto the winches correctly. Wires should be installed using spooling machines that can apply back tension to the winch. It is also important to check whether the winch is over or under wound, for left or for right stranded wire rope. See page 4.24.

The application of tension and the employment of correct spooling techniques will ensure that the wraps of wire will nestle neatly and tightly when spooled onto a winch. If wire is spooled slackly, or incorrectly placed on the winch, it will result in damaged wire. If an outer layer is pulled through the inner wraps towards the core of the drum it can result in the wire being cut.



ROPE SPECIFICATIONS



SPIRAL STRAND

- Designed to improve service life
- Surface finish: hot dip galvanised
- Sheathing: HDPE yellow colour with longitudal dark stripe
- Tensile grades of wire optimised to improve wire ductility
- Rope, size, mass and MBF may be customised according to project design requirements
- Supply includes: Quality plan - Fatigue design calculations Wear design calculation - Corrosion design calculation

Wire rope dia		Mass (unsheathed)		Mass (sheathed)		Metallic Area	MBF	Stiffness	Torque 25% MBF	Turns 25% MBF
Uncoated mm	Sheathed mm	Air kg/m	Sea water kg/m	Air kg/m	Sea water kg/m	mm²	kN	MN	Nm	Nm
77	91	29	25	32	25	3440	5480	525	750	0.5
83	99	34	29	37	29	4000	6370	610	950	0.5
89	105	39	33	42	33	4600	7330	700	1200	0.4
96	114	46	38	49	38	5350	8530	820	1500	0.4
102	122	51	43	55	43	6040	9360	925	1750	0.4
108	128	58	49	61	48	6770	10490	1035	2100	0.4
115	137	65	55	69	54	7680	11760	1175	2500	0.3
121	145	72	61	76	60	8500	12720	1300	2850	0.3
127	151	80	67	84	66	9370	13930	1435	3300	0.3
134	160	89	75	93	73	10430	15510	1595	3850	0.3
140	168	97	82	101	79	11390	16930	1740	4400	0.3
147	175	107	90	112	88	12550	18660	1920	5100	0.3

All dimensions are approximate

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ROPE SPECIFICATIONS

Iperflex
27x7/36x7/39x7

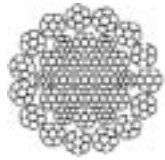
Iperplast
27x7/36x7/39x7
Compact
Plastic impregnated

ROTATION RESISTANT WIRE ROPE
Lay: Lang or regular

Size Nominal Diameter mm	Iperflex			Iperplast		
		Min. breaking force Kn			Min. breaking force Kn	
	Mass kg/m	2160 ung	2160 gal	Mass kg/m	2160 ung	2160 gal
8	0.27	49.9	49.9			
9	0.35	63.2	63.2			
10	0.43	78.0	78.0	0.48	90.4	90.4
11	0.52	94.4	94.4	0.59	109	109
12	0.61	112	112	0.70	130	130
13	0.72	132	132	0.82	153	153
14	0.83	153	153	0.95	177	177
15	0.96	176	176	1.09	203	203
16	1.09	200	200	1.24	231	231
17	1.23	225	225	1.40	261	261
18	1.38	253	253	1.57	293	293
19	1.54	282	282	1.75	326	326
20	1.70	312	312	1.94	362	362
21	1.88	344	344	2.14	399	399
22	2.06	378	378	2.35	438	438
23	2.25	413	413	2.57	478	478
24	2.45	449	449	2.79	521	521
25	2.75	481	481	3.03	565	551
26	2.97	520	520	3.28	611	596
27	3.21	561	561	3.54	659	643
28	3.45	603	603	3.80	709	691
29	3.70	647	647	4.08	760	741
30	3.96	692	692	4.37	814	793
31	4.23	739	721	4.66	869	847
32	4.51	787	768	4.97	926	903
33	4.79	837	817	5.28	984	960
34	5.09	889	867	5.61	1050	1020
35	5.39	942	918	6.00	1110	1080
36	5.70	997	972	6.53	1170	1140
38	6.35	1110	1080	6.71	1240	1210
40	7.05	1230	1200	7.84	1450	1410
42	7.76	1340	1310			
44	8.52	1470	1430			

All dimensions are approximate

ROPE SPECIFICATIONS



FLEXPACK NON ROTATING

- Use: winch riser wires, towing wires, off-shore deploy winch wires
- Designed to improve breaking force and minimise torque and rotation
- Tensile grades of wires optimised to improve wire ductility
- Rope size, mass and MBF may be customised according to project design requirements

Wire rope diameter mm	Mass		Metallic Area mm²	MBF kN	Torque 25% MBF Nm	Turns 25% MBF deg/m
	Air kg/m	Sea Water kg/m				
51	13	11	1460	2270	430	2.0
58	16	14	1890	2930	630	1.7
64	20	17	2300	3570	850	1.6
70	24	20	2760	4280	1120	1.4
77	29	24	3340	5170	1490	1.3
83	34	28	3880	6010	1870	1.2
89	39	33	4460	6920	2300	1.1
92	41	34.7	4920	6300		
96	44.6	37.7	5360	6860		
100	48.4	40.9	5810	8000		

All dimensions are approximate

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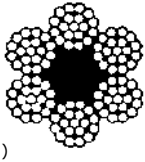
ROPE SPECIFICATIONS



6 X 19 AND 6 X 37 CONSTRUCTION GROUPS WITH FIBRE OR STEEL CORE

Typical Construction

6 x 19 Group
6 x 19 (9/9/1)
6 x 19 12/6 + F/1
6 x 26 (10/5 and 5/5/1)
6 x 31 (12/6 and 6/6/1)

6 x 37 Group
6 x 36 (14/7 and 7/7/1)
6 x 41 (16/8 and 8/8/1)
6 x 49 (16/8 and 8/8/8/1)

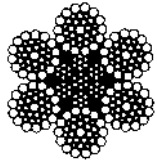
These ropes are in accordance with BS302 parts 1, 2: 1987 for corresponding sizes.

Nominal Diameter mm	Approx Equivalent Diameter ins	Fibre Core		IWRC	
		Approx Mass kg/100m	Min Breaking Load at 1770N/mm² (180kgf/mm²) tonnes	Mass kg/100m	Min Breaking Load at 1770N/mm² (180kgf/mm²) tonnes
9	3/8	29.2	4.82	32.2	5.20
10	3/8	36.1	5.95	39.8	6.42
11	7/16	43.7	7.21	48.2	7.77
12	7/16	52.0	8.57	57.3	9.25
13	1/2	61.0	10.1	67.3	10.8
14	9/16	70.8	11.6	78.0	12.6
16	5/8	92.4	15.3	102	16.4
18	11/16	117	19.3	129	20.8
19	3/4	130	21.5	144	23.1
20	13/16	144	23.9	159	25.7
22	7/8	175	28.8	193	31.1
24	15/16	208	34.3	229	37.0
26	1	244	40.3	269	43.4
28	1 1/8	283	46.7	312	50.4
32	1 1/4	370	61.0	408	65.7
35	1 3/8	442	73.0	488	78.7
36	1 3/8	468	77.2	516	83.3
38	1 1/2	521	85.9	575	92.8
40	1 5/8	578	95.3	637	103
44	1 3/4	699	115	771	124
48	1 7/8	832	137	917	148
52	2	976	161	1076	174
54	2 1/8	1053	174	1161	187
56	2 1/4	1132	187	1248	201
60	2 3/8	1300	214	1433	231

All dimensions are approximate

ROPE SPECIFICATIONS

6 X 37 CONSTRUCTION GROUPS WITH STEEL CORE



Typical Constructions
6 x 37 Group
6 x 36 (14/7 and 7/7/1)
6 x 49 (16/8 and 8/8/1)

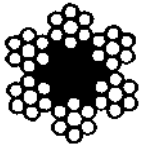
These ropes are in accordance with BS302 part 7: 1987 for corresponding sizes.

Nominal Diameter mm	Approx equivalent Diameter ins	Approx Mass kg/100m	Min Breaking Load tonnes
64	2 1/2	1700	274
67	2 5/8	1860	299
71	2 3/4	2090	333
74	2 7/8	2270	361
77	3	2460	389
80	3 1/8	2660	417
83	3 1/4	2860	447
87	3 7/16	3140	487
90	3 1/2	3360	519
96	3 3/4	3820	585
103	4	4400	665
109	4 1/4	4930	728
115	4 1/2	5490	805
122	4 3/4	6180	896
128	5	6800	979

All dimensions are approximate

ROPE SPECIFICATIONS

Round Strand with Fibre Main Core
6 x 7 classification



These ropes are in accordance with API Standard 9A-Table 3.4. (Bright (uncoated) or Drawn Galvanised Wire).

Nominal Diameter ins	Approx Mass lbs per ft	Plow Steel		Improved Plow Steel	
		tonnes	lbs	tonnes	lbs
3/8	0.21	4.63	10,200	5.32	11,720
7/16	0.29	6.26	13,800	7.20	15,860
1/2	0.38	5.13	17,920	9.35	20,600
9/16	0.48	10.3	22,600	11.8	26,000
5/8	0.59	12.6	27,800	14.4	31,800
3/4	0.84	18.0	39,600	20.6	45,400
7/8	1.15	24.2	53,400	27.9	61,400
1	1.50	31.3	69,000	36.0	79,400

All dimensions are approximate

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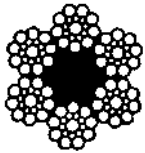
ROPE SPECIFICATIONS

ROUND STRAND WITH FIBRE MAIN CORE
6 X 19 CLASSIFICATION



This table is applicable to:
6 x 19 (9/9/1)
6 x 21 (10/5 + 5F/1)
6 x 25 (12/6 + 6F/1)

These ropes are in accordance with API Standard 9A - Table 3.5.
(Bright (uncoated) or Drawn Galvanised Wire).

Nominal Diameter ins	Approx Mass lbs per ft	Plow Steel		Improved Plow Steel	
		tonnes	lbs	tonnes	lbs
1/2	0.42	8.48	18,700	9.71	21,400
9/16	0.53	10.7	23,600	12.2	27,000
5/8	0.66	13.2	29,000	15.1	33,400
3/4	0.95	18.8	41,400	21.6	47,600
7/8	1.29	25.4	56,000	29.2	64,400
1	1.68	33.0	72,800	37.9	83,600
1 1/8	2.13	41.5	91,400	47.7	105,200
1 1/4	2.63	51.0	112,400	58.6	129,200
1 3/8	3.18	-	-	70.5	155,400
1 1/2	3.78	-	-	83.5	184,000
1 5/8	4.44	-	-	97.1	214,000
1 3/4	5.15	-	-	112	248,000
1 7/8	5.91	-	-	128	282,000
2	6.72	-	-	145	320,000

All dimensions are approximate

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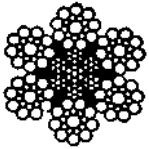
ROPE SPECIFICATIONS

ROUND STRAND WITH STEEL MAIN CORE
6 X 19 CLASSIFICATION



This table is applicable to:
6 x 19 (9/9/1)
6 x 25 (12/6 + 6F/1)
6 x 26 (10/5 and 5/5/1)

These ropes are in accordance with API Standard 9A - Table 3.6
(Bright (uncoated) or Drawn Galvanised Wire).

Nominal Diameter ins	Approx Mass lbs per ft	Improved Plow Steel		Extra Improved Plow Steel	
		tonnes	lbs	tonnes	lbs
1/2	0.46	10.4	23,000	12.1	26,600
9/16	0.59	13.2	29,000	15.2	33,600
5/8	0.72	16.2	35,800	18.7	41,200
3/4	1.04	23.2	51,200	26.7	58,800
7/8	1.42	31.4	69,200	36.1	79,600
1	1.85	40.7	89,800	46.9	103,400
1 1/8	2.34	51.3	113,000	59.0	130,000
1 1/4	2.89	63.0	138,000	72.5	159,800
1 3/8	3.50	75.7	167,000	87.1	192,000
1 1/2	4.16	89.7	197,800	103	228,000
1 5/8	4.88	104	230,000	120	264,000
1 3/4	5.67	121	266,000	139	306,000
1 7/8	6.50	138	304,000	158	348,000
2	7.39	156	334,000	180	396,000

All dimensions are approximate

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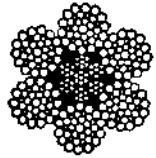
ROPE SPECIFICATIONS

ROUND STRAND WITH STEEL MAIN CORE
6 X 19 CLASSIFICATION



This table is applicable to:
6 x 19 (9/9/1)
6 x 25 (12/6 + 6F/1)
6 x 26 (10/5 and 5/5/1)

These ropes are in accordance with API Standard 9A - Table 3.6 (Bright (uncoated) or Drawn Galvanised Wire).

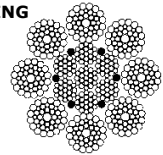
Nominal Diameter mm	Approx Mass lbs per ft	Improved Plow Steel		Extra Improved Plow Steel	
		lbs	tonnes	lbs	tonnes
13	0.46	23,000	10.4	26,600	12.1
14.5	0.59	29,000	13.2	33,600	15.2
16	0.72	35,800	16.2	41,200	18.7
19	1.04	51,200	23.2	58,800	26.7
22	1.42	69,200	31.4	79,600	36.1
26	1.85	89,800	40.7	103,400	46.9
29	2.34	113,000	51.3	130,000	59.0
32	2.89	138,000	63.0	159,800	72.5
35	3.50	167,000	75.7	192,000	87.1
38	4.16	197,800	89.7	228,000	103
42	4.88	230,000	104	264,000	120
45	5.67	266,000	121	306,000	139
48	6.50	304,000	138	348,000	158
52	7.39	344,000	156	396,000	180
54	8.35	384,000	174	442,000	200
58	9.36	430,000	195	494,000	224
60	10.44	478,000	217	548,000	249
64	11.65	524,000	238	604,000	274
67	12.85	576,000	261	658,000	299
71	14.06	628,000	285	736,000	333
74	15.36	682,000	309	796,000	361
77	16.67	740,000	336	856,000	389
80	18.07	798,000	362	920,000	417
83	19.58	858,000	389	984,000	447
87	21.09	918,000	416	1,074,00	1020.0
90	22.79	981,200	445	1,144,000	519
96	26.0	1,114,000	505	1,129,000	585
103	29.6	1,254,000	569	1,466,600	665

All dimensions are approximate

ROPE SPECIFICATIONS

HIGH PERFORMANCE WIRE ROPES FOR MOORING

8x41WS-IWRC (6x19W-1x19W) + zinc anodes



- Surface finish: hot dip galvanised
- Designed to improve service life in comparison with 6-strands ropes
- Improved flexibility
- Reduced external wear
- Rope size, mass and MBF may be customised according to project design requirements
- Supply includes: Quality plan - Fatigue design calculations Wear design calculation - Corrosion design calculation

Wire rope Diameter mm	Mass		Metallic Area mm²	MBF	Stiffness	Torque 25% MBF	Turns 25% MBF
	Air kg/m	Sea water kg/m		kN	MN	Nm	deg/m
77	27	22	3040	4000	335	6650	17
83	31	26	3540	4640	390	8350	16
89	35	30	4070	5340	450	10300	14
96	41	35	4730	6220	525	12900	13
102	47	39	5340	7020	595	15500	13
108	52	44	5990	7870	665	18400	12
115	59	50	6790	8920	755	22200	11
121	66	55	7520	9880	835	25850	11
127	72	61	8290	10880	920	29900	10

All dimensions are approximate

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NON ROTATING HI TECH CRANE ROPES

	Pack 1			Flexpack			Pack 2		
									
Rope Dia (mm)	Mass kg/m	Min. breaking force Bright kN	Galv. kN	Mass kg/m	Min. breaking force Bright kN	Galv. kN	Mass kg/m	Min. breaking force Bright kN	Galv. kN
8	-	-	-	-		-	0.32	66.6	63.2
9	-	-	-	-	-	-	0.41	84.2	80.0
10	0.45	91.1	91.1	0.48		95.4	0.50	104	98.8
11	0.54	110	110	0.58	115	115	0.61	126	120
12	0.65	131	131	0.69		137	0.72	150	142
13	0.76	154	154	0.81	161	161	0.85	176	167
14	0.88	179	179	0.95		195	0.98	204	194
15	1.01	205	205	1.09	224	224	1.13	234	222
16	1.15	233	233	1.24		255	1.28	266	253
17	1.30	263	263	1.40	288	288	1.45	301	286
18	1.46	295	295	1.57		323	1.62	337	320
19	-	-	-	1.75	360	360	1.81	375	357
20	1.80	364	364	1.94		398	2.00	416	395
21	-	-	-	2.13	439	439	2.21	459	436
22	2.18	441	441	2.34		482	2.42	503	478
23	-	-	-	2.56	527	527	2.65	550	523
24	2.59	525	525	2.79		574	2.89	599	569
25	-	-	-	3.02	596	588	3.13	650	618
26	3.04	616	616	3.27		635	3.48	696	661
27	-	-	-	3.53	695	685	-	-	-
28	3.53	698	663	3.79		737	4.04	808	767
30	4.05	801	761	4.36	859	816	4.63	927	881
32	4.61	911	866	4.96		928	5.27	1050	1000
34	5.20	1030	977	5.60	1100	1050	5.95	1190	1130
36	5.83	1150	1100	6.27		1170	6.67	1330	1270
38	6.50	1290	1220	6.99	1380	1310	7.44	1490	1410
40	7.20	1420	1350	7.74	1530	1450	8.24	1650	1570
42	7.94	1530	1430	8.54	1620	1550	8.84	1820	1730
44	8.71	1680	1570	9.37	1780	1710	9.70	1990	1890

All dimensions are approximate

NON ROTATING HI TECH CRANE ROPES

	Pack 1			Flexpack			Pack 2		
									
Rope Dia (mm)	Mass kg/m	Min. breaking force Bright kN	Galv. kN	Mass kg/m	Min. breaking force Bright kN	Galv. kN	Mass kg/m	Min. breaking force Bright kN	Galv. kN
46	9.52	1840	1710	10.2	1950	1860	10.6	2180	2070
48	10.4	2000	1860	11.2	2120	2030	11.5	2370	2250
50	11.3	2180	2020	12.1	2300	2200	12.5	2580	2450
52	12.2	2350	2190	13.1	2490	2380	13.5	2790	2650
54	13.1	2540	2360	14.1	2600	2410	14.6	2950	2800
56	14.1	2730	2540	-	-	-	15.7	3170	3010
58	15.1	2930	2720	16.3	2990	2780	16.9	3400	3230
60	16.2	3130	2910	-	-	-	18.0	3640	3450
62	17.3	3340	3110	18.6	3420	3180	19.3	3770	3500
64	18.4	3560	3310	-	-	-	20.5	4010	3730
66	19.6	3790	3520	21.1	3880	3610	21.8	4270	3970
68	20.8	4020	3740	-	-	-	23.2	4440	4130
70	22.0	4260	3960	23.7	4360	4060	24.5	4700	4370
72	23.3	4510	4190	-	-	-	-	-	-
74	24.6	4760	4430	26.5	4870	4530	-	-	-
76	26.0	5030	4670	28.0	4970	4620	-	-	-
80	-	-	-	31.0	5500	5120	-	-	-
84	-	-	-	34.2	5930	5510	-	-	-
88	-	-	-	37.5	6500	6050	-	-	-
92	-	-	-	41.0	6770	6300	-	-	-
96	-	-	-	44.6	7370	6860	-	-	-
100	-	-	-	48.4	8000	7440	-	-	-

All dimensions are approximate

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SIX STRAND ROPES

In accordance to API 9 A Standards

Nominal Diameter		Approx Weight		Nominal Strength				
mm	inches	kg/m	lb/ft	Classification	API - EIPS	API - EEIPS	Neptune 220	Neptune 240
52	2	11.0	7.39	6x37	180	197	226	240
54	2 1/8	12.4	8.35	6x37	200	221	250	265
58	2 1/4	13.9	9.36	6x37	224	247	275	292
60	2 3/8	15.5	10.4	6x37	249	274	306	321
64	2 1/2	17.3	11.6	6x37	274	301	336	353
67	2 5/8	19.0	12.8	6x37	299	330	370	389
71	2 3/4	20.8	14.0	6x37	333	360	409	429
74	2 7/8	22.8	15.3	6x37	361	392	447	469
77	3	24.7	16.6	6x37	389	425	491	511
80	3 1/8	26.8	18.0	6x37	417	458	522	543
83	3 1/4	29.0	19.5	6x37	447	493	557	579
87	3 3/8	31.3	21.0	6x37	487	528	607	631
90	3 1/2	33.8	22.7	6x37	519	563	659	679
96	3 3/4	38.7	26.0	6x37	585	640	714	735
103	4	44.0	29.6	6x37	665	720	796	820
109	4 1/4	49.7	33.4	6x61	725	N/A	845	870
115	4 1/2	55.7	37.4	6x61	806	N/A	939	967
122	4 3/4	62.1	41.7	6x61	890	N/A	1036	1067
128	5	68.8	46.2	6x61	978	N/A	1138	1161
135	5 1/4	74.1	49.8	6x91	1016	N/A	1184	1208
141	5 1/2	81.1	54.5	6x91	1106	N/A	1288	1314
148	5 3/4	88.7	59.6	6x91	1198	N/A	1396	1424
154	6	96.7	65.0	6x91	1294	N/A	1508	1538

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Section 5
WIRE FITTINGS

Introduction

There are many different types of wire rope fittings. Most fittings are applied directly onto the wire rope to enable it to be used. These fittings are likely to be thimbles with either aluminium or steel ferrules or sockets. This section shows sockets as used within the offshore industry. Sockets generally exceed than the MBL of the wire rope whereby thimbles and ferrules reduce the MBL of the wire.

Other fittings used with wire rope are Carpenter Stoppers, Multi-Angle Fairleads and Swivel Head Fairleads. These units assist in protecting the wire during arduous use.

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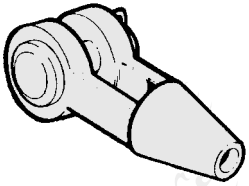
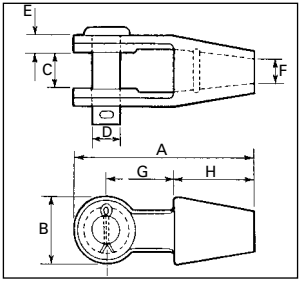
OPEN TYPE GALVANISED STEEL SPELTER SOCKETS





Rope Dia mm	A mm	B mm	C mm	D mm	E mm	F mm	G mm	H mm	Weight kg
18-19	203	67	38	35	16	22	76	89	2.7
20-22	235	79	44	41	19	25	89	102	4.5
24-26	270	95	51	51	22	29	102	114	7.0
28-30	302	105	57	57	25	32	114	127	10.9
32-35	336	121	64	64	29	38	127	140	14.5
38	384	137	76	70	32	41	162	152	20.9
40-42	413	146	76	76	35	44	165	165	25.0
44-48	464	165	89	89	41	51	178	191	38.5
50-54	546	178	102	95	48	57	229	216	56.8
56-60	597	197	114	108	54	64	254	229	74.9
64-67	648	216	127	121	60	73	273	248	113.6
75-80	737	241	146	133	76	86	286	305	172.7

All dimensions are approximate

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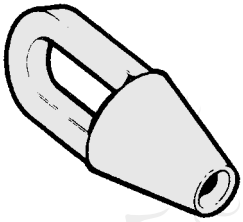
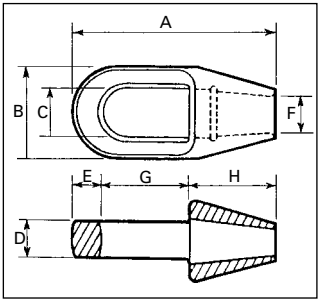
CLOSED TYPE GALVANISED STEEL SPELTER SOCKETS





Rope Dia mm	A mm	B mm	C mm	D mm	E mm	F mm	G mm	H mm	Weight kg
18-19	194	76	41	32	28	22	79	89	2.3
20-22	225	92	48	38	32	25	92	102	3.5
24-26	254	105	57	44	35	29	105	114	5.4
28-29	283	114	64	51	38	32	117	127	7.3
32-35	314	127	70	57	42	38	130	140	10.4
38	359	137	79	64	51	41	156	152	12.7
40-42	391	146	83	70	54	44	171	165	16.3
44-48	445	171	89	76	57	51	200	191	26.3
50-54	502	194	98	83	64	57	225	216	36.3
56-60	549	216	102	92	67	64	241	229	47.6
64-67	597	241	140	102	79	73	270	248	63.6
75-80	686	292	171	133	83	86	298	305	125.5

All dimensions are approximate

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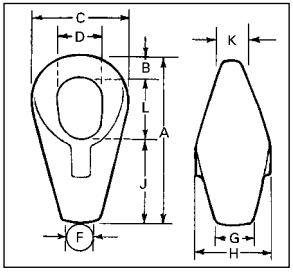
"PEE WEE" ANCHOR PENDANT SOCKETS

"PEE WEE" anchor pendant socket illustrates perfectly the principle of the design that allows the socket to slide easily over the tail board and the wire rope, to lie flat against it, and re-wound around drum hoist easier than a traditional standard type socket. They can be attached together by detachable chain connecting links or shackles, proven by major offshore drilling contractors on semi-submersible offshore drilling rigs and offshore anchor handling boats.



	Wire Rope Dia	Dimensions in inches										Weight Pounds Each Galv
		A	B	C	D	F	G	H	J	K	L	
*	2 - 2 1/8	15 1/2	2	8	4 5/16	2 1/4	3 3/4	6 1/2	8 1/4	2 1/10	5 1/4	63
*	2 1/4 - 2 3/8	17 1/4	2 3/8	8 5/8	5 1/4	2 1/2	4 1/16	7	9	2 3/8	5 7/8	73
*	2 1/2 - 2 5/8	20	2 3/4	11	5 3/4	2 3/4	4 3/4	9 3/4	10 1/8	2 3/4	7 1/4	156
*	3 - 3 1/8	22 5/8	3 1/8	13 1/8	6 7/8	3 3/8	5 3/8	10 7/8	11 1/4	3 1/8	8 3/4	245
**	2 3/4 - 2 7/8	21	3	12	6 3/4	3 1/8	5 1/8	10 1/2	11	3 1/8	7	200
**	3 - 3 1/8	22 7/8	3 1/8	13 1/8	6 3/4	3 3/8	5 3/8	10 7/8	11	3 3/8	8 3/4	230
**	3 1/4 - 3 1/2	28 3/4	3 15/16	14 1/4	8 1/4	3 7/8	6 1/8	11 3/4	15	4	10	350
**	3 3/4 - 4	28 3/4	3 15/16	16 1/2	9	4 3/8	7 3/8	14	15	4	10	482
**	4 1/4 - 4 1/2	31 1/2	4 1/2	19	10	4 5/8	7 3/4	16	15 1/2	5 1/16	11 1/2	600
**	4 3/4 - 5	34 1/4	5	19 1/2	12	5 3/8	8 3/16	16 1/2	17	5 1/4	12 1/4	700

All dimensions are approximate

- Within standard foundry practice dimensions are subject to change without notice

Made in the USA

*NB - * FORGED SOCKETS ** ALLOY CAST STEEL*

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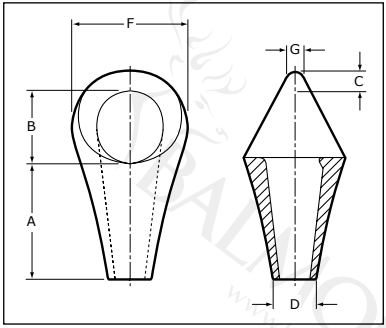
CR-SOCKETS

Material:	Cast steel
Safety:	5 times
Finish:	Painted/galvanised
Certificates:	Proofload
	Manufacturer certificate
On request:	MPI & UT inspection



Wire Dia mm	SWL tons	MBL tons	A mm	B mm	C mm	D mm	E mm	F mm	G mm	Weight kgs
49 - 54	50	250	215	125	55	57	115	200	50	27
55 - 60	60	300	230	145	65	63	135	220	57	41
61 - 68	80	400	250	160	75	73	150	270	65	56
69 - 75	100	500	280	175	80	79	165	300	70	78
76 - 80	120	600	310	190	85	86	175	325	75	100
81 - 86	140	700	340	205	100	92	200	350	90	128
87 - 93	160	800	360	220	105	99	205	360	95	145
94 - 102	180	900	380	240	110	108	225	380	100	188
108 - 115	200	1000	450	260	125	120	240	420	112	243

All dimensions are approximate

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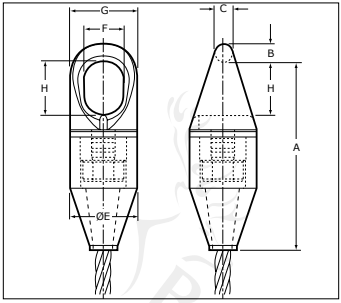
CR-ROPE SWIVEL



Rope Dia mm	MBL tons	PL tons	A mm	B mm	C mm	D mm	E mm	F mm	G mm	H mm
22 - 26	75	30	340	40	40	28	110	47	110	90
28 - 34	125	50	440	45	45	36	140	60	140	105
35 - 39	200	80	540	50	48	42	160	80	160	130
40 - 54	250	100	625	55	50	57	200	115	200	165
55 - 60	300	120	690	65	57	63	225	135	230	195
61 - 72	400	160	720	75	65	73	250	150	270	205
73 - 84	600	240	835	85	75	86	300	175	342	240
85 - 93	800	320	965	105	95	99	330	205	360	285
94 - 105	900	360	1055	110	100	108	360	225	380	320

Tolerence 5%

All dimensions are approximate

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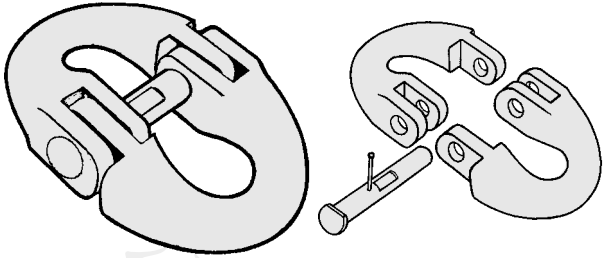
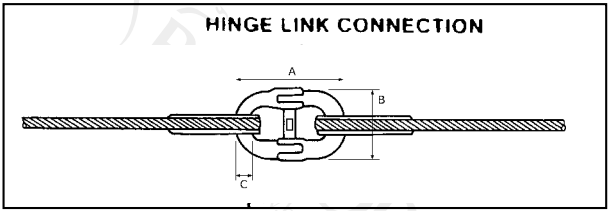
HINGE LINK





Size mm	A (mm)	B (mm)	C (mm)	SWL. tonnes	Weight kg
76	560	360	76	110	75
108	787	508	108	240	130

All dimensions are approximate

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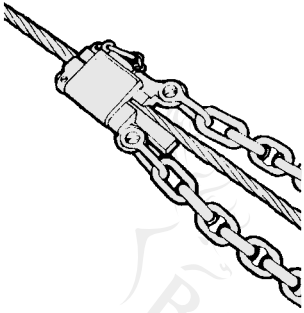
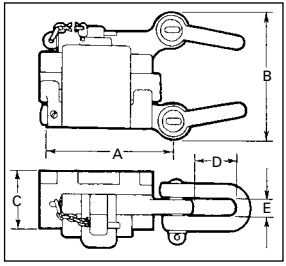
WIRE ROPE CARPENTER STOPPERS





Wire Dia Range		A	B	C	D	E	Stopper Weight	Bridle Weight	SWL
Wedge B mm	Wedge A mm	mm	mm	mm	mm	mm	kg	kg	tonnes
8-10	11-13	85	90	40	31	16	1	1.2	2.5
14-18	19-20	149	134	66	38	22	5	2.5	5
22-24	26-28	198	183	93	55	32	15	5.9	10
30-32	35-36	264	235	121	73	38	35	19.5	17
38-40	44	313	294	147	88	48	65	29.6	25
48	52	371	333	173	114	60	100	62.0	35
54	56	584	498	210	140	82	300	62.0	40
60	64	584	498	210	140	82	300	74.0	55
68	72-76	584	498	210	140	82	300	96.5	75

All dimensions are approximate

Safety factor 5/1

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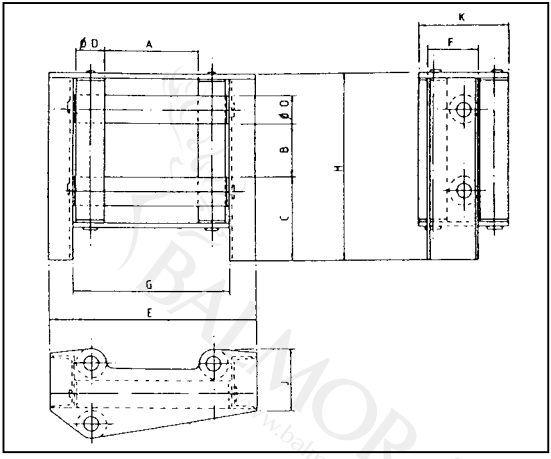
MULTI-ANGLE FAIRLEADS



Type	Part no.	SWL (tonnes)	Ø Wire rope	A	B	C	D	E	F	G	H	J
114	A2-606	5	-10	254	152	309	114	686	203	534	645	248
140	A2-609	8	-16	254	152	335	140	756	254	578	697	300
168	A2-611	12	-20	254	152	363	168	812	305	634	753	356
194	A1-613	20	-28	324	200	389	194	966	381	762	853	408
273	A1-615	24	-32	324	200	543	273	1124	432	920	1111	566

All dimensions are approximate

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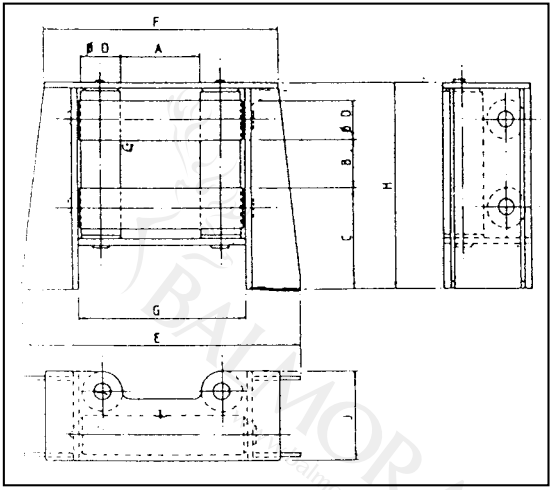
MULTI-ANGLE FAIRLEADS



Type	Part no.	SWL (tonnes)	Ø Wire rope	A	B	C	D	E	F	G	H	J
114	A2-562	8	10-15	254	152	309	114	800	666	534	645	280
140	A2-525x	12	16-20	254	152	335	140	898	724	578	697	356
168	A2-551x	16	21-26	254	152	363	168	970	778	634	753	400
194	A1-556	25	27-34	324	200	389	194	1258	1016	762	853	457
273	A1-511	38	35-40	324	200	543	273	1492	1168	920	1111	682
324	A1-563	45	41-44	324	200	624	324	1652	1290	1022	1223	698
356	A1-564			508	254	706	356	1950	1550	1270	1441	764
406	A1-565			508	254	756	406	2390	1300	1420	1541	914

All dimensions are approximate

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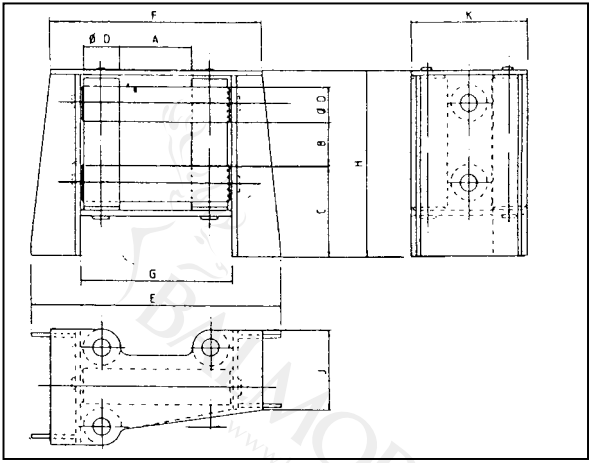
MULTI-ANGLE FAIRLEADS



Type	SWL (tonnes)	SWL (tonnes)	Ø Wire rope	A	B	C	D	E	F	G	H	J	K
114	A2-567	8	10-15	254	152	309	114	800	666	534	645	280	362
140	A2-527	12	16-20	254	152	335	140	898	724	578	697	356	440
168	A2-553	16	21-26	254	152	363	168	970	778	634	753	400	524
194	A1-558	25	27-34	324	200	389	194	1258	1016	762	853	457	602
273	A1-513	38	35-40	324	200	543	273	1492	1168	920	1111	682	838
324	A1-570	45	41-44	324	200	624	324	1652	1290	1022	1223	698	992
356	A1-571			508	254	706	356	1950	1550	1270	1441	764	1088
406	A1-572			508	254	756	406	2390	1800	1420	1541	914	1270

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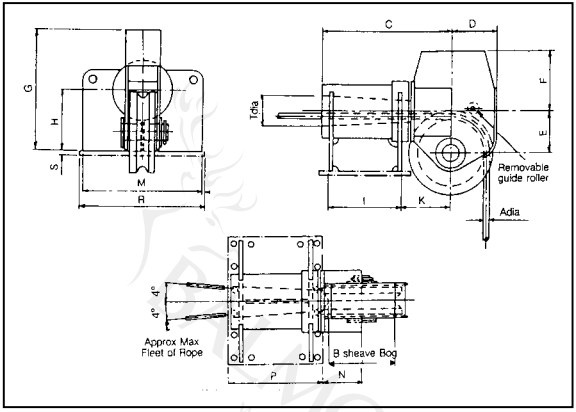
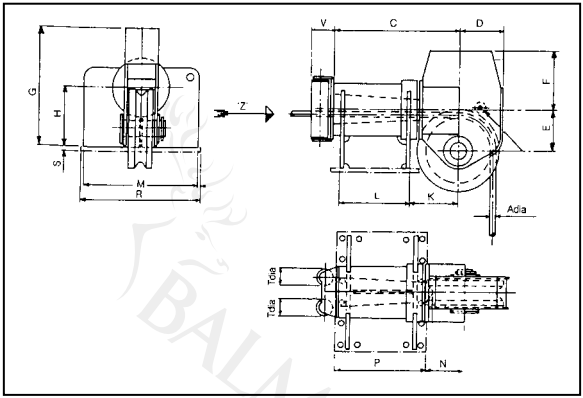
SWIVEL FAIRLEAD WITHOUT BASE PLATES



Type & max. breaking strain of wire (tonnes)	20	35	55	70	85	100	140	180	220	270	320	380	430	500
A max rope dia	18	22	28	32	36	38	46	54	60	64	70	76	84	90
B sheave B.O.G.	325	396	504	578	578	560	616	560	700	700	840	836	924	990
C	575	700	815	920	975	1028	1104	1153	1296	1363	1425	1613	1700	1800
D	210	250	320	357	360	362	394	388	474	477	550	567	610	660
E	197.5	236	299	340	340	331	377	370	428	432	530	550	595	640
F	315	360	430	473	525	576	549	568	625	630	730	770	810	860
G	635	730	850	951	1021	1091	1099	1138	1225	1280	1460	1510	1610	1700
H	320	370	420	478	496	515	550	570	600	650	730	740	800	840
K	255	290	350	381.5	405	430	439	468	514.5	521.5	660	624	710	750
L	260	350	400	485	500	250	590	590	690	750	700	910	900	960
M	500	600	680	750	800	850	1000	1016	1180	1250	1350	1500	1600	1700
N	195	230	285	314	325	340	359	373	448	450	510	540	620	660
P	380	470	530	620	660	700	770	780	848	913	1000	1073	1080	1140
R	560	660	740	810	850	900	1050	1130	1230	1300	1400	1550	1650	1750
S	30	30	30	30	35	35	50	50	50	60	70	70	80	80
T max shank bore	130	150	170	190	220	250	250	280	340	350	420	450	480	510

All dimensions are approximate

SWIVEL FAIRLEAD WITH EXTRA TAIL ROLLERS



Type & max. breaking strain of wire (tonnes)	20	35	55	70	85	100	140	180	220	270	320	380	430	500
A max rope dia	18	22	28	32	36	38	46	54	60	64	70	76	84	90
B sheave B.O.G.	325	396	504	578	578	560	616	560	700	700	840	836	924	990
C	575	700	815	920	975	1028	1104	1153	1296	1363	1425	1613	1700	1800
D	210	250	320	357	360	362	394	388	474	477	550	567	610	660
E	197.5	236	299	340	340	331	377	370	428	432	530	550	595	640
F	315	360	430	473	525	576	549	568	625	630	730	770	810	860
G	635	730	850	951	1021	1091	1099	1138	1225	1280	1460	1510	1610	1700
H	320	370	420	478	496	515	550	570	600	650	730	740	800	840
K	255	290	350	381.5	405	430	439	468	514.5	521.5	660	624	710	750
L	260	350	400	485	500	520	590	590	690	750	700	910	900	960
M	500	600	680	750	800	850	1000	1016	1180	1250	1350	1500	1600	1700
N	195	230	285	314	325	340	359	373	448	450	510	540	620	660
P	380	470	530	620	660	700	770	780	848	913	1000	1073	1080	1140
R	560	660	740	810	850	900	1050	1130	1230	1300	1400	1550	1650	1750
S	30	30	30	30	35	35	50	50	50	60	70	70	80	80
T	89	140	140	168	168	194	194	194	194	194	194	194	194	194
V	120	172	172	200	200	235	235	235	235	235	235	235	235	235

All dimensions are approximate

SOCKETING RESIN

Wire Rope/ Strand Size in	in³	Socketfast Req for Rope Fittings grams	cc
1/4	0.5	15	9
5/16	1.1	30	17
3/8	1.1	30	17
7/16	2.1	60	35
1/2	2.1	60	35
9/16	3.2	90	52
5/8	3.2	90	52
3/4	5.3	150	86
7/8	7.5	215	125
1	9.7	275	160
1 1/8	13	365	210
1 1/4	21.5	610	350
1 3/8	21.5	610	350
1 1/2	26	735	420
1 5/8	30	860	495
1 3/4	43	1220	700
1 7/8	43	1220	700
2	78	2200	1265
2 1/8	78	2200	1265
2 1/4	86	2450	1410
2 3/8	86	2450	1410
2 1/2	112	3180	1830
2 5/8	112	3180	1830
2 3/4	137	3910	2250
3	193	5500	3160
3 1/4	232	6600	3795
3 1/2	300	8560	4920
3 3/4	365	10400	5980
4	472	13450	7730
Wire Rope/ Strand Size in	**in³**	**Socketfast Req for Elevator Shackles grams**	**cc**
3/8	1.1	32	19
1/2	2.1	60	35
9/16	2.1	60	35
5/8	3.5	100	58
11/16	4.6	130	75
3/4	5.1	145	84

All dimensions are approximate

Compound for wire rope assemblies

This is usually a two-part liquid polyester resin compound for socketing wire rope assemblies in industrial, marine and commercial applications.

When properly applied, socketing resin will withstand 100% of the rated rope strength and offers maximum resistance to shock and fatigue.

Socketing resin is reliable at operating temperatures from +200˚F to -65˚F and is not affected by electrolysis or by immersion in most corrosive fluids.

Socketing resin is usually packaged in cases of convenient pre-measured kits.

- 300 grams (10.5 cu. in. - 173 cc) 20 kits per case
- 1000 grams (35.1 cu. in. - 575 cc) 12 kits per case
- 4000 grams (140.3 cu. in. - 2299 cc) 4 kits per case

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Section 6
SPOOLING MACHINES

Introduction

Balmoral Marine operates a wide range of versatile spooling machines, drill line stands and coilers capable of handling up to 200 tonnes of wire on a single reel.

The spooling machines have been developed over a number of years to ensure the equipment is safe to operate and provides the necessary back tension and speed control. The spoolers can handle wire rope products such as pendants, tow-wires, work wires, extension wires and anchor lines as well as umbilicals and electrical cable.

All equipment is fully tested for offshore use and is operated by fully trained experienced personnel.

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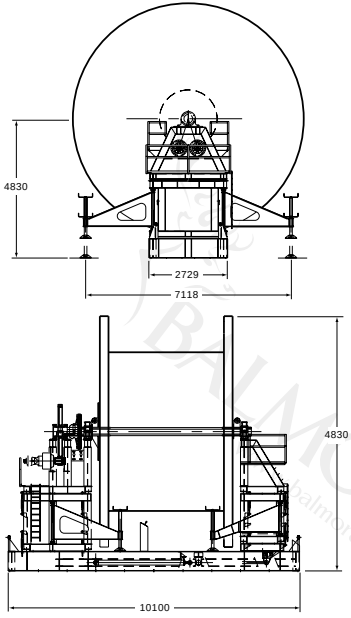
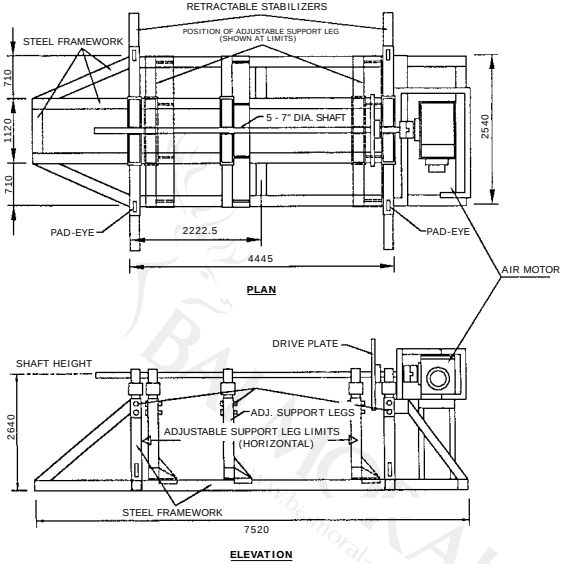
200T SPOOLING MACHINE



- Not to Scale
- All Dimensions in mm
- Maximum Reel Weight - 200T
- Maximum Reel Diameter - 8m
- Maximum Reel Width - 4.5m
- Line Pull Capacity - 16T at 2m Radius - 8T at 4m Radius
- Brake Hold Capacity - 20T at 2m Radius - 10T at 4m Radius
- Back Tensioning - 8T at 4m Radius - 16T at 2m Radius
- Complete with 200T Spreader Bar
- Modular Design

ADJUSTABLE SPOOLING MACHINE



- Not to Scale
- All dimensions in mm
- All steel framework constructed of 180mm box beam
- Max capacity: 80 Tonnes

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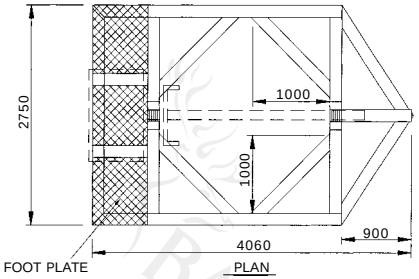
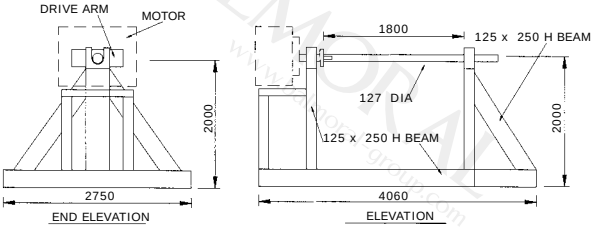
POWER SPOOLING MACHINE - 20 TONNES





- Not to scale
- All dimensions in mm
- SWL 20 Tonnes
- Drum 1.8m wide X 3.5m diameter (Maximum)

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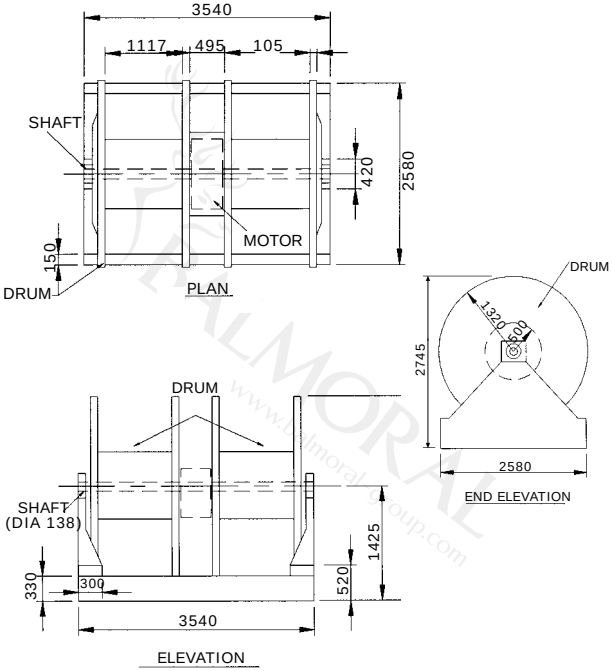
DOUBLE DRUM SPOOLING MACHINE (AIR DRIVEN)



- Not to scale
- All dimensions in mm
- SWL 40 Tonnes
- Each drum capacity: 1200m x 64mm diameter wire rope

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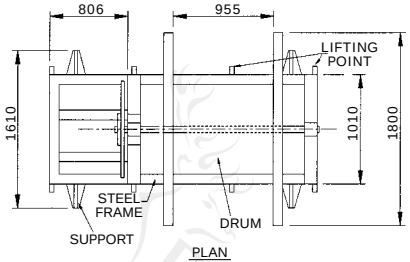
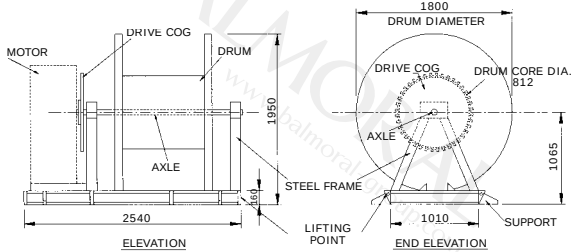
PNEUMATIC SPOOLING MACHINE



PLAN



- Not to scale
- All dimensions in mm
- SWL 7 Tonnes
- Drum capacity - 76mm x 320m

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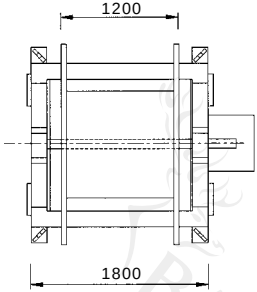
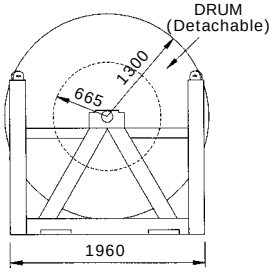
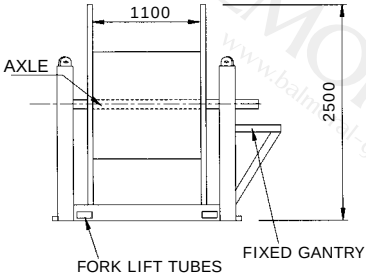
PNEUMATIC SPOOLING MACHINE



PLAN



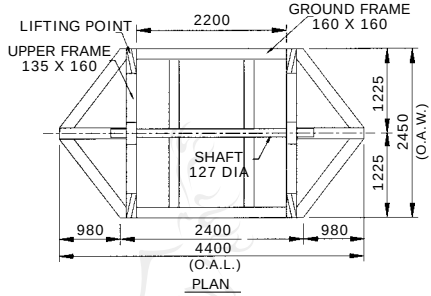
END ELEVATION

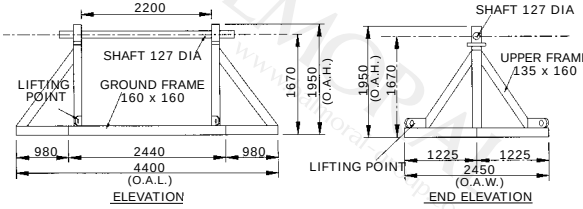


ELEVATION

- Not to scale
- All dimensions in mm
- Detachable reel
- Drum capacity: 1100ft X 2 3/4" wire rope
- Air or pneumatic motor is detachable
- SWL 8 Tonnes

DRILL LINE STAND





- Not to scale
- All dimensions in mm
- Weight in air: 2.25 Tonnes
- SWL 22.25 Tonnes
- Drum 2m wide X 3m diameter (maximum)

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Section 7
SYNTHETIC ROPE

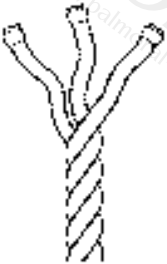
Introduction

While natural fibre ropes such as hemp, manila and sisal are still in use they have in large been replaced by man-made fibre ropes using synthetic materials. Synthetic ropes are generally manufactured from nylon, polypropylene, polyester or a combination. The ropes are constructed in either a three strand hawser, eight strand plaited or braided. There are other constructions but these three are the main ones used.

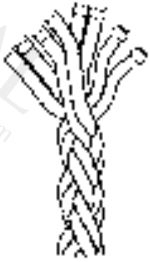
Fibre lines are much more flexible than wire rope but not as high in strength. Three strand hawser laid rope is a multi-purpose rope used for many different types of tasks. Eight strand plaited rope is generally used as vessel mooring and winch ropes. More modern materials such as Kevlar, Arimid and Dyneema threads can be added to the above ropes to provide different charactersitics such as high strength operations. Should you require information on special mooring ropes please do not hesitate to contact Balmoral Marine.

Circumference is often used to express the size of a rope and standard coils of rope are 220 metres long.

Braided Construction



3 Strand Hawser Laid



8 Strand Plaited

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SYNTHETIC ROPE

POLYESTER MOORING ROPES

Nominal Circ. (inches)	Nominal Diameter (mm)	Minimum Break Load (tonnes)	Mass (kg/100m)
2	16	6	19
2 1/4	18	8	22.5
-	21	11	39
3	24	15	50
3 1/2	28	18.5	68
4	32	25	88.5
4 1/2	36	29	112
5	40	35	122
5 1/2	44	40.5	147
6	48	50	176
6 1/2	52	56	205
7	56	64	238
7 1/2	60	77	274
8	64	84	312
9	72	108	395
10	80	133	487
11	88	158	591
12	96	182	702
13	104	209	825
14	112	240	956
15	120	275	1100
16	128	299	1250
17	136	337	1410
18	144	378	1580
19	152	421	1760
20	160	467	1950
21	168	513	2150
22	176	563	2360
23	184	615	2580
24	192	670	2810
27	216	848	3560
30	240	1047	4390

All dimensions are approximate

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SPECIAL POLYMER

Diameter		Standard coils - 220m	
mm	Inc C	Weight (kg)	MB L Kg
6	3/4	3.74	770
8	1	6.6	1360
10	1 1/4	9.9	2035
12	1 1/2	14.3	2900
14	1 3/4	19.8	3905
16	2	25.3	4910
18	2 1/4	32.56	6305
20	2 1/2	39.6	7600
22	2 3/4	48.4	8905
24	3	57.2	10490
26	3 1/4	67.1	12320
28	3 1/2	78.1	13910
30	3 3/4	89.1	16070
32	4	101.2	17540
36	4 1/2	128.7	22080
40	5	158.4	26860
44	5 1/2	193.6	31780
48	6	228.6	37180
52	6 1/2	268.4	43195
56	7	312.4	49380
60	7 1/2	358.6	56680
64	8	407	64140
68	8 1/2	460.9	76062
72	9	514.8	80225
80	10	638	99050

All dimensions are approximate

Available as: Mooring Ropes, Twisted Ropes, Pot Ropes.

This new polymer, is light, strong - a tenacity of more than 9g/Den for the filament of 1500 Den - and with a good abrasion resistance.

Other Information

Density: 0.94
Melting Point: 185°C
Stretch: low elongation
Chemical resistance: Resistant to most acids, alkalis and oils.
Not affected by water.

POLYPROPYLENE

Diameter		Standard coils - 220m	
mm	Inc C	Weight (kg)	MB L Kg
6	3/4	3.7	550
8	1	6.6	960
10	1 1/4	10	1425
12	1 1/2	14.5	2030
14	1 3/4	20	2790
16	2	25.5	3500
18	2 1/4	32.5	4450
20	2 1/2	40	5370
22	2 3/4	48.5	6500
24	3	57	7600
26	3 1/4	67	8850
28	3 1/2	78	10100
30	3 3/4	90	11500
32	4	101	12800
36	4 1/2	129	16100
40	5	158	19400
44	5 1/2	194	23400
48	6	229	27200
52	6 1/2	268	31500
56	7	312	36000
60	7 1/2	359	41200
64	8	407	46600
68	8 1/2	460	52600
72	9	515	58500
80	10	638	72000

All dimensions are approximate

PP Ropes available as: PP Mono, PP Split Film, PP Multifilament, PP Staple Spun.

Construction for PP ropes: Twisted 3 or 4 strand
Plated 8 strand

Other Information

Density: 0.91
Melts at: 330°F
Stretch: low elongation
Chemical resistance: Resistant to most acids, alkalis and oils.
Not affected by water.

SYNTHETIC ROPE

POLYETHYLENE

Diameter		Standard coils - 220m	
mm	Inc C	Weight (kg)	MB L Kg
6	3/4	4	400
8	1	7	700
10	1 1/4	11	1090
12	1 1/2	16	1540
14	1 3/4	21	2090
16	2	28	2800
18	2 1/4	35	3500
20	2 1/2	44	4300
22	2 3/4	53	5100
24	3	65	6100
26	3 1/4	75	7000
28	3 1/2	86	8000
30	3 3/4	100	9150
32	4	115	10400
36	4 1/2	145	13000
40	5	175	15600
44	5 1/2	209	18800
48	6	253	22400
52	6 1/2	295	26200
56	7	348	30200
60	7 1/2	396	34200
64	8	449	38600
68	8 1/2	506	43500
72	9	572	48500
80	10	702	59700

All dimensions are approximate

Construction for PE Mono:
Twisted 3 or 4 strand ropes
Plated 8 strand ropes

Very popular for commercial fishing and marine applications.

Other Information

Density: 0.95
Melts at: 285°F
Stretch: low elongation
Chemical resistance: Resistant to most acids, and alkalis.
Very good abrasion resistance. Not as strong as Polypropylene.
Does not absorb water.

NYLON

Diameter		Standard coils - 220m	
mm	Inc C	Weight (kg)	MB L Kg
6	3/4	5.2	750
8	1	9.3	1350
10	1 1/4	14.3	2080
12	1 1/2	20.6	3000
14	1 3/4	28	4100
16	2	36.5	5300
18	2 1/4	46	6700
20	2 1/2	57	8300
22	2 3/4	69	10000
24	3	82	12000
26	3 1/4	97	13900
28	3 1/2	112	15800
30	3 3/4	129	17900
32	4	146	20000
36	4 1/2	184	24800
40	5	228	30000
44	5 1/2	276	35800
48	6	330	42000
52	6 1/2	384	48800
56	7	446	56000
60	7 1/2	512	63800
64	8	582	72000
68	8 1/2	660	81000
72	9	738	90000
80	10	911	110000

All dimensions are approximate

Nylon ropes available:
Twisted 3 or 4 strand
Plates 8 strand

Other Information

Density: 1.14
Melts at: 480°F
Stretch: High elasticity. This means that a large amount of energy is stored within the rope.

Precautions must be taken.
Chemical resistance: At normal temperatures good resistance to alkalis. Limited resistance to acids.

WINCHLINE

Splicing instructions

The tools you will need:

sharp knife, tape, marker pen and ruler (tape measure), nylon seizing thread (hollow braid), 5mm diameter for ropes up to 5” circ, 6mm dia for larger sizes, large needle.

Description

- This splice is made in a 7-strand rope with a cover-braided jacket
- The jacket has to be removed in two places
- Start with marking the rope. The first mark should be placed at the end of the rope measuring back upwards for 45 times the diameter, place a mark here
- Then mark the length of the eye, this part wil stay on, and finally mark the splicing area, which should cover a length of 35 times the diameter of the rope
- Make sure the core is not damaged when removing the jacket
- Strip the jacket of the first marked area of the outer cover (length approx. 45 times rope diameter) to expose the 7 strand core
- Tape each of the 7 strands to keep yarns together
- The part of the jacket covering the eye should remain intact.
- Now strip the jacket of the splicing area (length approx 35 times the rope diameter)
- Bend the rope to form the eye and use tape or a whipping to keep the two rope parts together at the start point of the splice

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SYNTHETIC ROPE

STARTING THE SPLICE

First strand tuck

For the first tuck use strand 1, being closed to the running part and which does not disturb the rope construction. Tuck this strand under 3 strands (A,B,C) WITH the lay of the rope (Right Hand Lay).

Second strand tuck

Use strand no 2 and tuck this one under two strands (A and B) WITH the lay of the rope.

Third strand tuck

Strand no 3 has to be tucked under strand (A) WITH the lay of the rope. The core is now released.

Fourth strand tuck

Strand no 4 together with the core is tucked under one strand (F) WITH the lay of the rope.

Fifth strand tuck

Strand no 5 is tucked under the following strand of the rope (E), WITH the lay of the cable.

Sixth strand tuck

Strand no 6 is tucked under the remaining strand (D) WITH the lay of the cable.

Second till eighth series of tucks

Every strand (starting with strand 1) is tucked over one strand AGAINST the lay and under two strands WITH the lay of the cable. The core is cut after the third tuck.

NOW THE SPLICE IS COMPLETED.

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COVERING THE SPLICE

- First start with securing the jacket to the core. Stitch a large needle with thread through the jacket and core
- The ends of the thread must be tucked back into the splice. Do this at both ends of the formed eye as well as at the start of the jacket after the splice
- Ensure that at least 3 full tucks are made
- Now cover the splicing area with a whipping. Sometimes its easier to first cover the splicing area with tape before starting with the whipping

THE ROPE IS NOW READY FOR USE.

Splicing instructions

The tools you will need: sharp knife, tape and a spike

Description: this splice is suitable for 12 strand ropes, braided one over one

START:

- Start with measuring the length of the tail. It should at least be 12 full braiding pitches long. Wrap a tape around rope at the start point of the splice
- Tape the individual ends to keep yarns together. Then unlay the tail for the full 12 braiding pitches
- Bend the rope to form the eye and add eye protection if required. A seizing or whipping may be used to keep two rope parts together at the start point of the splice
- Divide the 12 strands into 6 pairs. 3 pairs of left hand lay and 3 pairs of right hand lay strands

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SPLICING

NB - always tuck right hand lay strands under right hand lay strands and left under left

- Tuck from the first pair (1R right red), the 1e strand under 6 strands (2 right, 2 left, 2 right) of the body
- Tuck the 2e right hand strand from this pair under 5 strands
- Continue tucking these strands under the same 5e and 6e right hand strand of the body. (over one, under one, over one)
- Both strands are tucked in the same way 3 times in total. Only with the second strand a fourth tuck is made over one under two
- The second pair of strands (2L, left, grey), are tucked under the 4th and 3rd strand of the body. Continue here as well with tucking these strands over and under the same 4th and 3rd strand of the body. Again, only the second strand is tucked for a fourth time over one, under 2
- The third pair (3R, right, yellow), are tucked under the 2nd and 1st strand of the body. Then follow the same procedure as described before
- The fourth pair (4L, left, black), go under the 1st and 2nd strands of the body (calculated from the tucks made at F). Then follow same procedure.
- The 5th set (5R, right, white), are both tucked under one strand, then follow same procedure
- The last pair (6L, left, blue) are tucked under 2 and 3 strands, then follow the same procedure
- The splice is now finished. Tape the two most close laying ends together (if the procedure has been followed correctly then such pair will consist out of a left and right hand laid strand) and cut off the over length

THE CABLE IS NOW READY FOR USE.

7.8

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Splicing instructions 8 Strand Plaited Ropes

Determining splice length:

5 full braid length are required for the splice.

Form the eye and seize the end of the rope to the main body of the 6th full braid length.

Final Preparation

An 8 strand rope consists out of 4 left hand lay(S) and 4 right hand lay(Z) strands. Always keep the left(S) and right hand lay(Z) strands apart(S) by (S) and (Z) by (Z). Tape each individual strand at the end in order to avoid untwisting. Then unlay the strands up to the point where the eye is formed and where the seizing is placed.

STARTING THE SPLICE

- Tuck two S-lay strands under two Z-lay strands of the body of the splice
- Tuck the first Z-lay strand under the two preceding Z-lay strands of the body. Tuck the second Z-lay strand only under the first Z-lay strand
- Tuck the third S-lay strand under the first S-lay strand of the body and tuck the 4th S-lay strand under the next S-lay strand of the body
- The third Z-lay strand is tucked under the out Z-lay strand of the body and the fourth Z-lay strand is tucked under the inner Z-lay strand of the body
- We're back to the first 2 S-lay strands (A). Tuck the first S-lay strand under the outer S-lay strand of the body and tuck the second S-lay strand under the inner S-lay strand of the body
- All strands have now been tucked into the right position. Make sure that S-lay strands are tucked under S-lay strands of the body and that Z-lay strands are tucked under the Z-lay strands of the body
- Continue with tucking two S-lay strands under S-lay strands and two Z-lay strands under the Z-lay strands of the body
- Turn the rope and continue by tucking two S Under S and two Z under Z. Repeat steps G and H, and all strands are tucked 3 times
- To finalise; tuck the first S-lay strand under first S-lay strand of the body and the second S-lay strand under the second S-lay strand of the body
- Do the same with the first two Z-lay strands
- Turn the rope and repeat steps J and K with the remaining strands
- Seize the out sticking strands in pairs and cut off the over length

THE SPLICE IS NOW COMPLETE.

ROPE INFORMATION

Weight, length and diameter are measured in accordance with EN 919. The Breaking force of new, unused synthetic ropes, both standard and high performance, are in accordance with EN 919. Phillystran ropes are in accordance with manufacturers standard test methods.
All data in this brochure is provided for technical reference and guidance only, it does not constitute a guarantee. Balmoral Marine reserves the right to amend details of their specifications in line with technical developments. For calculation purposes customers should consult Lankhorst sales staff for in-depth and up to date technical details.

It can be expected that a rope's strength will decrease as soon as taken into service. Avoid using rope that shows signs of wear and abrasions. If in doubt contact the manufacturer or take the rope out of use.

Joints and knots can cause loss of strength, in extreme cases up to 50%. When ropes are running over pulleys or sheaves, one also should take care of proper D/d ratio's as well as grooves. If in doubt about any of the mentioned actions please contact our sales staff for details.

CONSTRUCTIONS

3 and 4 strand

3 and 4 strand hawser laid constructions are easy to splice and have an excellent abrasion resistance.

8 strand plaited

A 100% torque balanced rope due to the 4 left and 4 right hand lay constructed strands. This construction does not kink, is easy to terminate and has a great abrasion resistance.

Cover braids

Cover braided constructions can be offered with a variety of cores. In most cases the jacket (cover) does not contribute to the ropes strength. The non load bearing jacket provides a protection to the rope's core, this being the strength member. If the jacket is damaged this does not automatically mean loss of strength. The larger sizes of cover braids especially, will retain their breaking strength even if the jacket is completely abraded. Our cover braids offer maximum strength at a minimal diameter and thus weight.

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Extruded jackets

Extruded jackets can be provided upon request depending upon the application. However for certain application they are provided as standard, like for instance our tower guys (HPTG). In order to provide a die-electric strength member the rope core is surrounded by an abrasion and UV resistant, water proof jacket. Extruded jackets (PP, PE, PA, PUR) normally provide a more abrasion resistant cover but restrain the rope's use due to less flexibility (higher stiffness).

Specialities

Many varieties on above constructions can be provided. Plaited cores with braided jackets as well as extruded jackets can be supplied if the application demands a special design.

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Section 8
LIFTING EQUIPMENT

Introduction

Balmoral produces a wide range of slings to meet the requirements of today's market. These can be categorised into the following groups:

- Single Leg Wire Rope Slings
- Multi-Leg Wire Rope Slings
- Endless Grommet Slings and Cable Laid Slings
- Polyester Webbing Slings
- Polyester Round Slings

Standard wire rope slings are available from stock and specialist orders can normally be manufactured within 24 hours.

Please refer to the following section for specific details on our wire rope sling range and application.

For details on the information required to order/design slings along with working loads, please see the section at the back of the book.

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International Standards

The preparation of standards for a comprehensive range of materials and components of lifting tackle has facilitated the general adoption of designs giving a satisfactory margin of safety in use. All persons who are concerned with the design or technical selection of lifting tackle are strongly recommended to have copies of these standards, a list of which is given below.

Chain

Short link chain for lifting purposes Safety. General Conditions of Acceptance.	-	EN818-1:1996
Short link chain for lifting purposes Safety. Medium tolerance chain for chain slings. Grade 8.	-	EN818-2:1997
Short link chain for lifting purposes Safety. Medium tolerance chain for chain slings. Grade 4.	-	EN818-3:1999
Short link chain for lifting purposes Safety. Chain slings. Grade 8	-	EN818-4:1997
Short link chain for lifting purposes Safety. Chain slings. Grade 4	-	EN818-5: 1999
Short link chain for lifting purposes Safety. Chain slings. Specification for information for use and maintenance to be provided by the manufacturer.	-	EN818-6:2000
Short link chain for lifting purposes Safety. Fine tolerance hoist chain Grade T (types T, DAT and DT)	-	EN818-7:2002
Guide for proper use and maintenance of calibrated round steel link lifting chains	-	BS 6521:1984

Fibre ropes

Fibre ropes for general service. Manila and sisal.	-	EN698:1995
Fibre ropes for general service. General specification.	-	EN701:1995
Fibre ropes for general service. Hemp	-	EN1261:1995
Fibre ropes for general service. Polyamide	-	EN696:1995
Fibre ropes for general service. Polyester	-	EN697:1995
Fibre ropes for general service. Polypropylene	-	EN699:1995
Fibre ropes for general service. Polyethylene	-	EN700:1995
Glossary of terms relating to fibre ropes and cordage	-	BS3724:1991
Glossary of generic names for man-made fibres	-	BS4815:1972

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LIFTING EQUIPMENT

Slings

Lifting slings, methods of rating	–	BS6166-1:1996
Lifting slings, specification for marking	–	BS6166-2:1986
Lifting slings, guide to the selection and safe use of lifting slings for multi-purposes	–	BS6166-3:1988
Steel wire ropes slings – Safety. Part 1. Slings for general lifting service	–	EN13414-1:2003
Steel wire rope slings – Safety. Part 2. Specification for information for use and maintenance to be provided by the manufacturer	–	EN13414-2:2003
Textile slings – Safety. Flat woven webbing slings made of man-made fibres for general purpose use	–	EN1492-1:2000
Textile slings – Safety. Roundslings made of man-made fibres for general purpose use	–	EN1492-2:2000

Pulley Blocks

Gin Blocks	-	BS1692:1998
Pulley blocks for use with wire rope for a maximum lift of 25 tons in combination	-	BS4018:1966
Pulley blocks for use with synthetic fibre ropes (M)	-	BS4344:1968
Heavy duty pulley blocks for use with wire ropes	-	BS4536:1970
Hand operated chain pulley blocks	-	BS3243:1990
Chain lever hoists	-	BS4898:1973

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LIFTING EQUIPMENT

Shipping

Code of practice for the design and operation of ships' derrick rigs	-	MA48:1976
Code of practice for ships cargo blocks	-	MA47:1977

Materials

Wrought steels	-	BS970:1996 Part 1
Iron and steel colliery haulage and winding equipment, wrought steels	-	BS2772:1989 Part 2
Steel castings for general engineering purposes	-	BS3100:1991

Wire ropes

General requirements for steel wire ropes	-	EN12385-1:2002
Stranded ropes for general lifting purposes	-	EN12385-4:2002
Zinc coated ropes for ships	-	BS302:1987 Part 3
Stranded ropes for lifts	-	EN12385-5:2002
Ropes for haulage purposes	-	BS302:1987 Part 5
Ropes for mine hoisting	-	BS302:1987 Part 6
Large diameter ropes	-	BS302:1989 Part 7
Higher breaking load ropes for general purposes	-	BS302:1989 Part 8

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LIFTING EQUIPMENT

International Standards

The selection, care and maintenance of steel wire ropes	-	BS6570:1986

Terminal attachments for chain, fibre ropes & wire ropes

Higher tensile steel hooks - Grade 4	-	EN1677-5:2001
Eyebolts for lifting purposes (M)	-	BS4278:1984
Thimbles for natural fibre ropes	-	BS3226:1960
Bordeaux connections	-	BS7167:1990
Sockets for wire ropes, inch units	-	BS463:1958 Part 1
Sockets for wire ropes, metric	-	BS463:1970 Part 2
Code of practice for socketing, metal and resin	-	EN13411-4:2002
Thimbles for wire ropes	-	EN13411-1:2002
Rigging screws and turnbuckles	-	BS4429:1987
Wedge and socket anchorages for wire ropes	-	BS7166:1989
Forged steel shackles for general lifting purposes. Dee shackles and bow shackles - Grade 6	-	EN13889:2003
Shackles, forged	-	Federal Specification RR-C-271D
Alloy steel shackles	-	BS3551:1962
Terminations for steel wire ropes, ferrules and ferrule securing	-	EN13411-3

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Miscellaneous

The design and testing of steel overhead runway beams	-	BS2853:1957
Steel links and strap assemblies for lifting attachments for packing cases	-	BS2837:1988
Hand operated plate sided winches	-	BS3701:1964
Power driven overhead travelling Cranes Semi-Goliath and Goliath cranes for general use	-	BS466:1984
Rules for the design of cranes structures	-	BS2573:1983 Part 1
Rules for the design of cranes mechanisms	-	BS2573:1980 Part 2
Code of practice for safe use of cranes	-	BS7121:1989
Power driven mobile cranes	-	BS1757:1986

These are correct at time of printing. Correct standards should always be checked by users.

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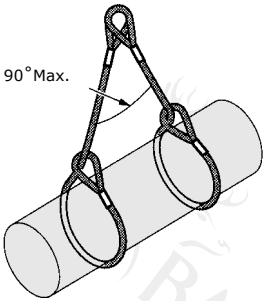
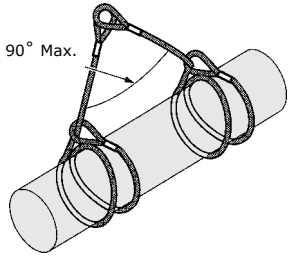
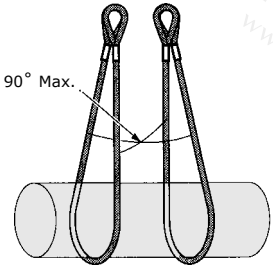
TWO SINGLE LEGS USED TOGETHER



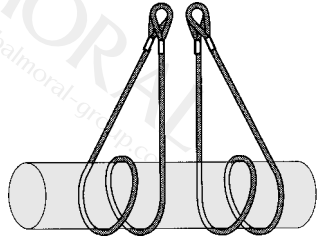
Chock Hitch
SWL = 1.4 x SWL of Sling



Double Wrap Chock Hitch
SWL = 1.4 x SWL of Sling



Basket Hitch
SWL = 2.1 x SWL of Sling



Double Wrap Basket Hitch
SWL = 2.1x SWL of Sling

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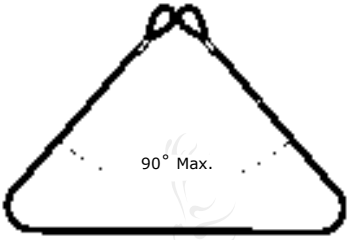
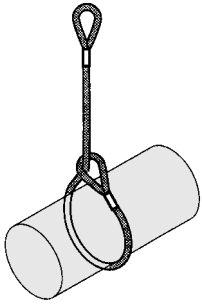
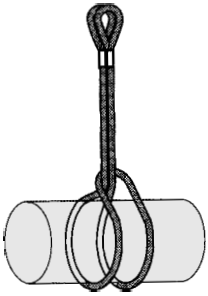
USED SINGLY



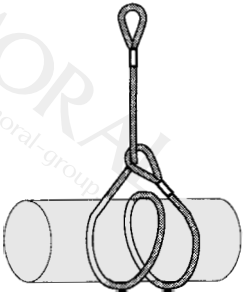
Basket Hitch
SWL = 1.4 x SWL of Sling



Simple Choke Hitch
SWL = SWL of Sling



Double and Choked
SWL = 2 x SWL of Sling



Choke Hitch Double Wrapper
SWL = SWL of Sling

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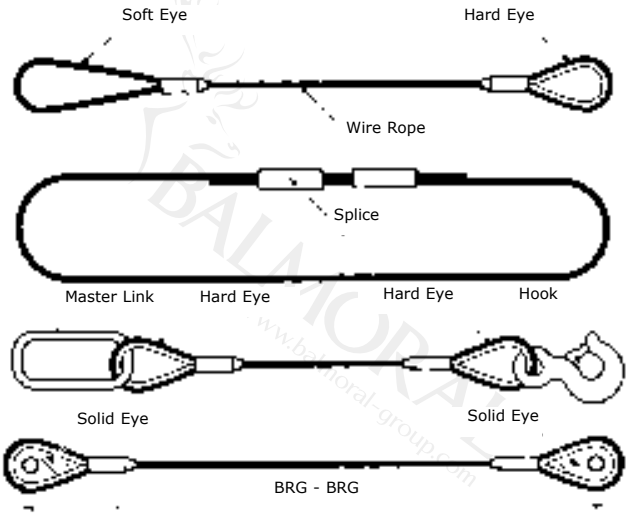
METHOD OF DETERMINING NOMINAL LENGTH OF SLING LEGS

(Bearing to Bearing)



Tapered Ferrules available upon request

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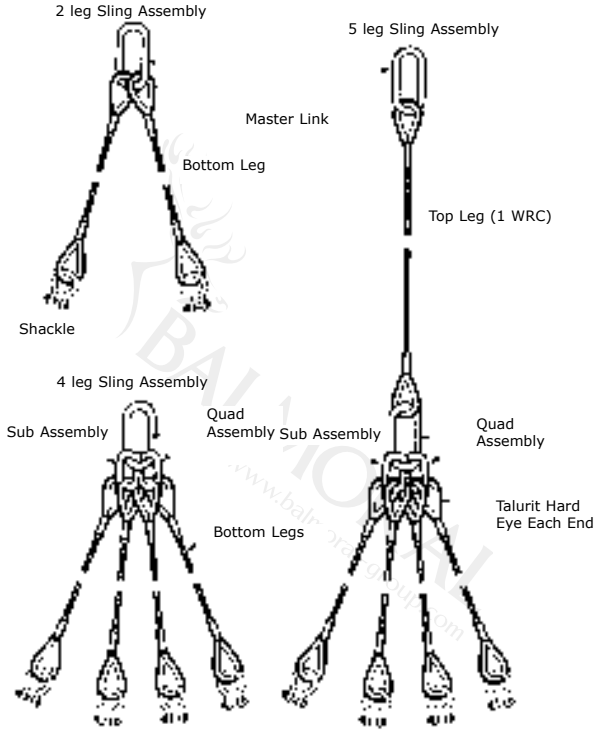
MULTIPLE LEG SLING ASSEMBLY



Tapered Ferrules available upon request

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CABLE LAID SLINGS

Cable laid slings and grommets shown in the table are designed in accordance to the PM 20 (the guidance note of the Health and Safety Executive).

The CALCULATED ROPE BREAKING LOAD (or MBL) of the cable laid rope is the sum of the individual breaking force of the component ropes multiplied by a spinning loss coefficient of 0.85.

For slings this result is multiplied by a TERMINATION EFFICIENCY (ET), which for hand splice is 0.75 (now CSBL).

For slings and grommets the SAFE WORKING LOAD is the maximum mass that a sling may raise, lower or suspend under specific working conditions as certified by a competent authority. In making its assessment this competent person considers at least the following factors:-

- the angular displacement of the sling legs
- the length tolerance legs
- dynamic loading effects
- the position of the centre of gravity of the load
- the rigidity of the load

The minimum radius over which the slings (when doubled) and grommets are bent. For calculating the BENDING EFFICIENCY (EB) see PM 20.

NB- the D/d ratio should never be smaller than 1/1 (acc. PM 20). Our experience has taught that D/d ratio of 2/1 is better

The WORKING LOAD LIMIT (WLL) is defined.

NB - Slings and/or grommets with different lay directions should never be connected

Cable Laid Slings				Cable Laid Grommets	
Diameter mm	Weight kg/m	CRBL mtf	CSBL = CGBL	Weight kg/m	Diameter mm
120	1.43	600	450	21	78
142	63	900	675	32	96
164	87	1.200	900	45	114
188	115	1.500	1.125	55	126
212	147	1.800	1.350	65	138
224	166	2.100	1.575	78	150
240	187	2.400	1.800	79	156
262	218	2.700	2.025	89	162
270	264	3.000	2.250	96	168
288	270	3.300	2.475	100	171
300	290	3.600	2.700	111	180
314	320	3.900	2.925	124	192
328	356	4.200	3.150	137	201
337	380	4.500	3.375	143	204
352	412	4.800	3.600	160	216
361	432	5.100	3.825	170	222
376	465	5.400	4.050	179	228
382	474	5.700	4.275	193	240
398	514	6.000	4.500	209	249
406	523	6.300	4.725	210	252
424	579	6.600	4.950	225	258
434	605	6.900	5.175	242	267
440	632	7.200	5.400	259	276
453	672	7.500	5.625	265	282
460	696	7.800	5.850	277	288
470	705	8.100	6.075	296	294
			6.763	315	306
			6.865	342	312
			7.446	369	324
			7.803	396	336
			8.211	413	342
			8.843	448	360
			9.874	502	381
			10.812	553	399
			12.852	668	438

All dimensions are approximate

NB - a 25% TERMINATION EFFICIENCY (TE) loss has been accounted for in the CSBL (CALCULATED SLING BREAKING LOAD)

For the CGBL (CALCULATED GROMMET BREAKING LOAD), no loss has been calculated for the D/d ratio at the lifting points.

SLING CHART

6 x 19/6 x 36 Groups Fibre Core

	One leg sling	Two leg sling		Three and four leg sling		Endless sling
Angle to the vertical	0°	0° to 45°	over 45° to 60°	0° to 45°	over 45° to 60°	0° –
						
	Direct	Direct	Direct	Direct	Direct	Choke hitch
Nominal Rope Dia (mm)	Working Load Limits (tonnes)					
8	0.700	0.950	0.700	1.50	1.05	1.10
9	0.850	1.20	0.850	1.80	1.30	1.40
10	1.05	1.50	1.05	2.25	1.60	1.70
11	1.30	1.80	1.30	2.70	1.95	2.12
12	1.55	2.12	1.55	3.30	2.30	2.50
13	1.80	2.50	1.80	3.85	2.70	2.90
14	2.12	3.00	2.12	4.35	3.15	3.30
16	2.70	3.85	2.70	5.65	4.20	4.35
18	3.40	4.80	3.40	7.20	5.20	5.65
20	4.35	6.00	4.35	9.00	6.50	6.90
22	5.20	7.20	5.20	11.0	7.80	8.40
24	6.30	8.80	6.30	13.5	9.40	10.0
26	7.20	10.0	7.20	15.0	11.0	11.8
28	8.40	11.8	8.40	18.0	12.5	13.5
32	11.0	15.0	11.0	23.5	16.5	18.0
36	14.0	19.0	14.0	29.0	21.0	22.5
40	17.0	23.5	17.0	36.0	26.0	28.0
44	21.0	29.0	21.0	44.0	31.5	33.5
48	25.0	35.0	25.0	52.0	37.0	40.0
52	29.0	40.0	29.0	62.0	44.0	47.0
56	33.5	47.0	33.5	71.0	50.0	54.0
60	39.0	54.0	39.0	81.0	58.0	63.0
Leg factor (K_t)	1	1.4	1	2.1	1.5	1.6

All dimensions are approximate

These tables are compiled in compliance with EN 13414-1:2003, uniform load method calculation used entirely.

SLING CHART

6 x 19 & 6 x 36 Groups Steel Core

	One leg sling	Two leg sling		Three and four leg sling		Endless sling
Angle to the vertical	0°	0° to 45°	over 45° to 60°	0° to 45°	over 45° to 60°	0° –
						
	Direct	Direct	Direct	Direct	Direct	Choke hitch
Nominal Rope Dia (mm)	Working Load Limits (tonnes)					
8	0.750	1.05	0.750	1.55	1.10	1.20
9	0.950	1.30	0.950	2.00	1.40	1.50
10	1.15	1.60	1.15	2.40	1.70	1.85
11	1.40	2.00	1.40	3.00	2.12	2.25
12	1.70	2.30	1.70	3.55	2.50	2.70
13	2.00	2.80	2.00	4.15	3.00	3.15
14	2.25	3.15	2.25	4.80	3.40	3.70
16	3.00	4.20	3.00	6.30	4.50	4.80
18	3.70	5.20	3.70	7.80	5.65	6.00
20	4.60	6.50	4.60	9.80	6.90	7.35
22	5.65	7.80	5.65	11.8	8.40	9.00
24	6.70	9.40	6.70	14.0	10.0	10.6
26	7.80	11.0	7.80	16.5	11.5	12.5
28	9.00	12.5	9.00	19.0	13.5	14.5
32	11.8	16.5	11.8	25.0	17.5	19.0
36	15.0	21.0	15.0	31.5	22.5	23.5
40	18.5	26.0	18.5	39.0	28.0	30.0
44	22.5	31.5	22.5	47.0	33.5	36.0
48	26.0	37.0	26.0	55.0	40.0	42.0
52	31.5	44.0	31.5	66.0	47.0	50.0
56	36.0	50.0	36.0	76.0	54.0	58.0
60	42.0	58.0	42.0	88.0	63.0	67.0
Leg factor (K_c)	1	1.4	1	2.1	1.5	1.6

All dimensions are approximate

These tables are compiled in compliance with EN 13414-1:2003, uniform load method calculation used entirely.

POLYESTER LIFTING SLINGS

Polyester webbing slings and round slings have many advantages over conventional chain or steel wire rope slings, particularly where the item to be lifted is in danger of being marked or damaged in the lifting process. The synthetic sling then comes into its own. The slings flexibility and ease of handling are appreciated by those involved in the lifting process and the wide load-bearing surface aids safer lifting.

The round slings load bearing core is produced from high tenacity polyester yarn wound continuously to provide maximum strength with minimum weight. The outer cover is also manufactured from high tenacity polyester yarn for maximum abrasion resistance.

All flat webbing slings are woven from high strength polyester yarn incorporating good shock absorption properties with a high strength to weight ratio. Wear sleeves are available as an optional extra.

All slings are colour coded for increased safety.

All slings are manufactured in accordance with the current international standards.

STRONG FLEXIBLE LIGHTWEIGHT

Polyester slings are suitable for use in temperature range - 40°C to 100°C and are resistant to moderate strength acids. Do not use in alkali conditions. Seek the advice of Balmoral if exposure to chemicals is likely. Instructions on the care and safety use of textile lifting slings are available on request and issued with each consignment.

Load resistant systems are also available with a wide range of end liftings to suit every requirement.

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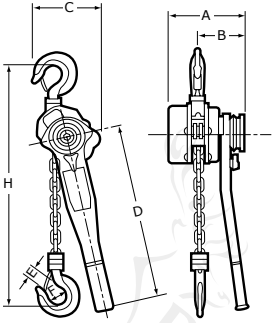
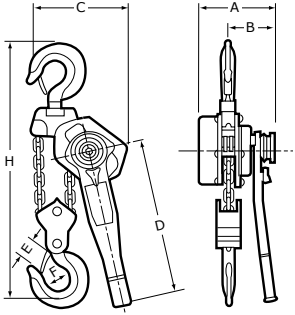
LEVER HOISTS



MODELS 500/750/1500/3000Kg



MODEL 5000Kg

Capacity kg	No of falls of chain	Effort of lift max load kg	Weight kg	Chain Diameter mm	Dimensions mm						
					A	B	C	D	E	F	H mini
500	1	33	5	5 x 15	110	80	122	290	21	34	303
750	1	20	7	6 x 18	139	84	153	290	23	37	303
1500	1	21	11	7 x 21	174	108	160	410	30	45	365
3000	1	33	20	10 x 30	200	115	185	410	38	55	485
5000	2	35	30	10 x 30	200	115	230	410	40	65	600

Standard Lift - 1.50m

All dimensions are approximate

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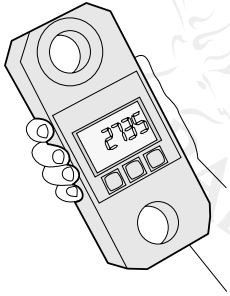
LOAD INDICATING DEVICE

The modern range of load indicating devices are highly accurate instruments for measuring tensile forces, suitable for many applications: transport and construction industries; testing and safety organisations; monitoring lifting equipment and load-checking goods in and out. The operating principle is the movement of a material within its elastic limit, using bonded strain gauges to give an electrical signal under strain, relative to the load applied, which is instantly displayed on the LCD.



Capacity t	Test load t	Accuracy (±0.2%) ±kg	Smallest Load kg	Max dynamic overload t	Max display	Dimensions mm	Weight kg
0.25	0.5	0.5	0.1	0.5	250.0	190 x 83 x 56	1.1
0.50	1	1	0.2	1	500.0	190 x 83 x 56	1.1
1.25	2.5	2.5	0.5	2.5	1250.0	190 x 83 x 56	1.1
2.5	5	5	1	5	2500	214 x 83 x 56	1.4
5	10	10	2	10	5000	226 x 90 x 56	1.9
12.5	25	25	5	25	12500	310 x 110 x 58	3.8
25	50	50	10	50	25000	360 x 104 x 68	6.6
50	85	100	20	100	50000	440 x 164 x 98	15.1
100	145	200	50	200	100.00	660 x 260 x 118	46.0

All dimensions are approximate

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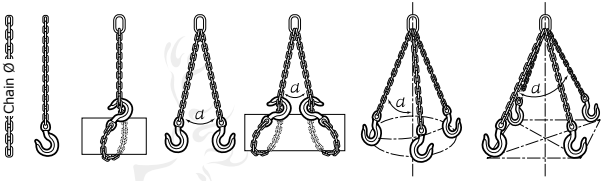
SYSTEM 80 CHAIN SLINGS

ALLOY - GRADE 80 CHAIN SLING WORKING LOAD CHART



	Multiply single leg	WORKING LOAD LIMIT IN TONNES					
Angle	Factor	7mm	10mm	13mm	16mm	20mm	22mm
0°	1	1.50	3.20	5.40	8.00	12.50	15.50
0°	0.8	1.20	2.56	4.32	6.40	10.00	12.40
0° - 90°	1.4	2.10	4.48	7.56	11.20	17.50	21.70
90° - 120°	1	1.50	3.20	5.40	8.00	12.50	15.50
0° - 90°	1.1	1.65	3.52	5.94	8.80	13.75	17.05
90° - 120°	0.8	1.20	2.56	4.32	6.40	10.00	12.40
0° - 45°	2.1	3.15	6.72	11.34	16.80	26.25	32.55
45° - 60°	1.5	2.25	4.80	8.10	12.00	18.75	23.25
0° - 90°	2.1	3.15	6.72	11.34	16.80	26.25	32.55
90° - 120°	1.5	2.25	4.80	8.10	12.00	18.75	23.75

All dimensions are approximate

All figures in accordance with DIN-5688 and B.S.6166. "Uniform Load Method" of rating.

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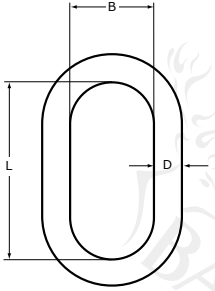
SYSTEM 80 MASTER LINKS

Master Links

Safety Factor 4:1

Minimum Breaking load = 4 x SWL at 0°



D (mm)	B (mm)	L (mm)	SWL kgs	Weight kgs
11	40	83	2400	0.2
13	54	86	2900	0.3
13	60	115	2700	0.4
16	70	120	4300	0.6
16	100	190	3200	0.9
20	80	134	7200	1.1
20	90	170	6500	1.3
22	90	170	8600	1.6
22	110	210	7200	1.9
25	100	190	11300	2.3
28	110	210	14300	3.2
28	140	270	11800	4.0
32	140	270	17100	5.3
38	140	270	28100	7.6
38	220	420	19100	11.0
45	170	320	38300	12.5
45	250	470	27600	17.5
50	200	380	45000	18.0
60	220	420	65300	29.0
70	250	470	84400	43.2

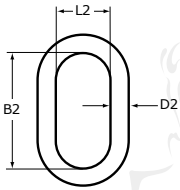
All dimensions are approximate

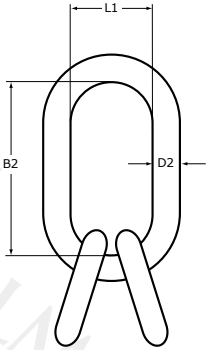
SYSTEM 80 MASTER LINKS

Sub Assemblies

Safety Factor 4:1

Minimum Breaking load = 4 x SWL at 0°





D1 (mm)	L1 (mm)	B1 (mm)	D2 (mm)	L2 (mm)	B2 (mm)	SWL kgs	Weight kgs
16	120	70	13	86	54	4200	1.2
20	170	90	16	120	70	6000	2.5
22	170	90	20	134	80	8600	2.8
25	190	100	20	134	80	10200	4.9
28	210	110	22	170	90	12000	6.4
32	270	140	25	190	100	16000	10.0
38	270	140	32	270	140	24200	18.2
45	320	170	38	270	140	38300	27.7
50	380	200	38	270	140	39800	33.2
60	420	220	50	380	200	63600	54.0
70	470	250	50	380	200	63600	101.2

All dimensions are approximate

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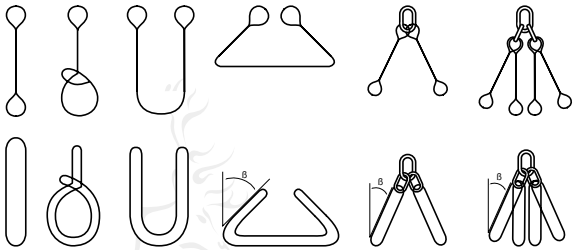
SEWN WEBBING



WLL of sewn webbing component	Colour of sewn webbing component	Working load limits in tonnes								
		Straight lift	Choked lift	Basket hitch			Two leg sling		Three and four leg slings	
				Parallel	β= 0-45°	β= 45°-60°	β= 0-45°	β= 45°-60°	β= 0-45°	β= 45°-60°
		M=1	M=0,8	M=2	M=1,4	M=1	M=1,4	M=1	M=2,1	M=1,5
1,0	Violet	1,0	0,8	2,0	1,4	1,0	1,4	1,0	2,1	1,5
2,0	Green	2,0	1,6	4,0	2,8	2,0	2,8	2,0	4,2	3,0
3,0	Yellow	3,0	2,4	6,0	4,2	3,0	4,2	3,0	6,3	4,5
4,0	Grey	4,0	3,2	8,0	5,6	4,0	5,6	4,0	8,4	6,0
5,0	Red	5,0	4,0	10,0	7,0	5,0	7,0	5,0	10,5	7,5
6,0	Brown	6,0	4,8	12,0	8,4	6,0	8,4	6,0	12,6	9,0
8,0	Blue	8,0	6,4	16,0	11,2	8,0	11,2	8,0	16,8	12,0
10,0	Orange	10,0	8,0	20,0	14,0	10,0	14,0	10,0	21	15,0
Over 10,0	Orange	-	-	-	-	-	-	-	-	-

All dimensions are approximate

M = Mode factor for symmetrical loading. Handling tolerance for slings or parts of slings indicated as vertical = 6°.

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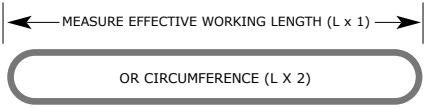
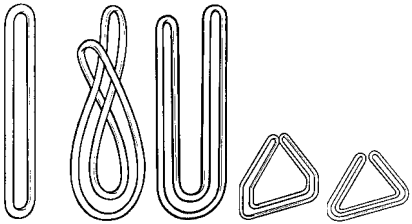
POLYESTER ENDLESS SLINGS



Flat Woven Webbing



Safety Factor 7:1

Colour Code	Length mm	Straight x1 WLL kg	Choked x0.8 WLL kg	Basket x2 WLL kg	45°Basket x1.8 WLL kg	90°Basket x1.4 WLL kg
VIOLET	25	1000	800	2000	1800	1400
GREEN	50	2000	1600	4000	3600	2800
YELLOW	75	3000	2400	6000	5400	4200
GREY	100	4000	3200	8000	7200	5600
RED	125	5000	4000	10000	9000	7000
BROWN	150	6000	4800	12000	10800	8400
BLUE	200	8000	6400	16000	14400	11200
ORANGE	250	10000	8000	20000	18000	14000
ORANGE	300	12000	9600	24000	21600	16800

All dimensions are approximate

Manufactured and tested in accordance with BS 3481 Part 2 1983

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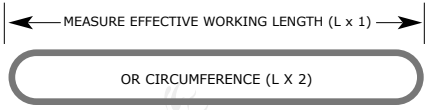
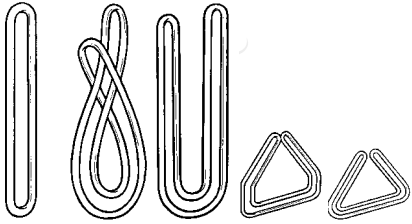
LIFTING EQUIPMENT

ROUNDSLING





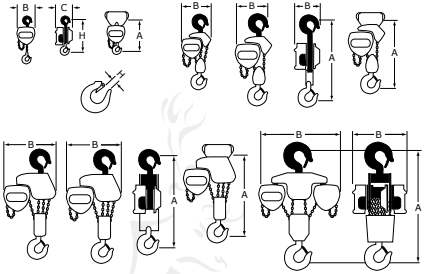
WLL of roundsling in straight lift	Colour of roundsling cover	Working load limits in tonnes								
		Straight lift	Choked lift	Basket hitch			Two leg sling		Three and four leg slings	
				Parallel	β= 0-45°	β= 45°-60°	β= 0-45°	β= 45°-60°	β= 0-45°	β= 45°-60°
		M=1	M=0,8	M=2	M=1,4	M=1	M=1,4	M=1	M=2,1	M=1,5
1,0	Violet	1,0	0,8	2,0	1,4	1,0	1,4	1,0	2,1	1,5
2,0	Green	2,0	1,6	4,0	2,8	2,0	2,8	2,0	4,2	3,0
3,0	Yellow	3,0	2,4	6,0	4,2	3,0	4,2	3,0	6,3	4,5
4,0	Grey	4,0	3,2	8,0	5,6	4,0	5,6	4,0	8,4	6,0
5,0	Red	5,0	4,0	10,0	7,0	5,0	7,0	5,0	10,5	7,5
6,0	Brown	6,0	4,8	12,0	8,4	6,0	8,4	6,0	12,6	9,0
8,0	Blue	8,0	6,4	16,0	11,2	8,0	11,2	8,0	16,8	12,0
10,0	Orange	10,0	8,0	20,0	14,0	10,0	14,0	10,0	21	15,0
Over 10,0	Orange	-	-	-	-	-	-	-	-	-

All dimensions are approximate

M = Mode factor for symmetrical loading.
Handling tolerance for slings or parts of slings indicated as vertical = 6°.

HAND CHAIN HOISTS

Dimensions, weights and performance data

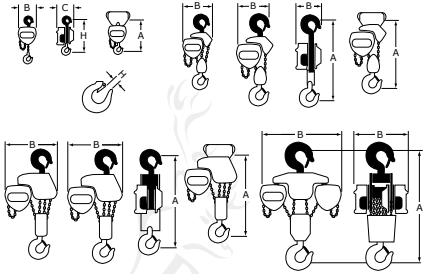


Capacity - safe working load		500kg	1t	1.5t	2t	2.5t	3t
Number of falls of load chain		1	1	1	1	1	3
Dimensions mm							
A	hook suspension	295	360	360	450	450	530
	hung-in (164 trolley, ranges 1 &2)	365	430	430	530	530	650
	hung-in (164 trolley, range 3)	405	470	470	575	575	715
	close-lift (ranges 1 &2)	300	345	345	425	425	500
	close-lift (range 3)	340	385	385	470	470	565
B		155	180	180	238	238	268
C		144	153	153	209	209	153
H Gap		27	32	32	38	38	37
Hung-in and close-fit units							
Track widths	range 1	76-140	76-140	76-140	90-153	90-153	126-166
	range 2	140-210	140-210	140-210	153-216	153-216	166-210
	range 3	210-305	210-305	210-305	216-305	216-305	210-305
Minimum clear depth of track		127	127	127	152	152	203
Minimum radius of track curve		1.5	1.5	1.5	1.5	1.5	1.8
Weight: hook suspension unit chain for standard 3m hook to hook kg		10	13	13	29	29	27
Additional weight for extra of lift, per metre kg		1.4	1.8	1.8	3.5	3.5	3.6
Effort on hand chain to raise working load kg		23	26	39	33	41	31
Velocity ratio (movement of chain relative to load chain)		27:1	45:1	45:1	78:1	78:1	135:1
Safety factor		5:1	5:1	4:1	5:1	4:1	5:1

All dimensions are approximate

HAND CHAIN HOISTS CONTINUED

Dimensions, weights and performance data



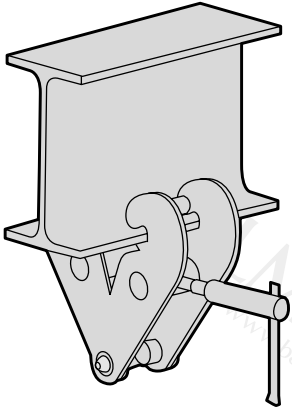
Capacity - safe working load		5t	8t	10t	16t	20t
Number of falls of load chain		2	3	4	6	8
Dimensions mm						
A	hook suspension	720	810	840	1065	1120
	hung-in (164 trolley, ranges 1 &2)	840	970	1000	1285	1340
	hung-in (164 trolley, range 3)	905	1060	1090	1285	1340
	close-lift (ranges 1 &2)	660	775	800	-	-
	close-lift (range 3)	725	775	800	-	-
B		280	420	470	600	920
C		209	220	220	220	220
H Gap		38	55	60	75	85
Hung-in and close-fit units						
Track widths	range 1	126-166	154-192	154-192	154-192	154-192
	range 2	166-210	192-229	192-229	192-229	192-229
	range 3	210-305	229-305	229-305	229-305	229-305
Minimum clear depth of track		203	203	203	203	203
Minimum radius of track curve		1.8	3.0	3.0	-	-
Weight: hook suspension unit chain for standard 3m hook to hook kg		55	67	99	178	220
Additional weight for extra of lift, per metre kg		5.7	7.9	10.1	14.5	20.2
Effort on hand chain to raise working load kg		41	46	40	40	46 x 2
Velocity ratio (movement of chain relative to load chain)		156:1	234:1	312:1	468:1	624:1
Safety factor		4:1	4:1	4:1	4:1	4:1

All dimensions are approximate

BEAM CLAMPS

Beam clamps are designed for attachment to the lower flange of Structural Steel Beams, to provide a semi-permanent lifting point.

Beam Clamp



Model	WLL ton	Flange width mm	Weight kg
SC1	1	75-230	3.8
SC2	2	75-230	4.6
SC3	3	80-320	9.2
SC5	5	90-310	11.0
SC10	10	90-320	17.2

Model	WLL ton	Flange width mm	Weight kg
SC921	1	75-210	5
SC922	2	75-210	6
SC923	3	100-270	8
SC923/L	3	75-305	9
SC925	5	100-270	10
SC925/L	5	75-305	12
SC9210	10	75-305	16

Model	WLL ton	Weight kg
SC921T	1	11
SC922T	2	13
SC923T	3	16
SC923/L/T	3	20
SC925T	5	23
SC925/L/T	5	27
SC9210T	10	37

All dimensions are approximate

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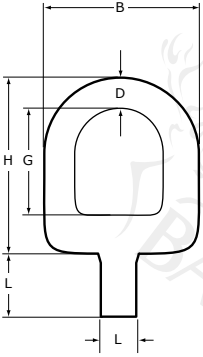
EYE LIFTING POINT, Grade 8

Suitable for 1 - legged slings.
Approved BG 005161



Dimension in mm						
B	D	G	H	L	M	Weight
72	16	42	56	24	M16	0,4
72	16	42	58	30	M20	0,5
88	19	48	69	36	M24	0,9
106	22	60	84	45	M30	1,4
127	26	72	100	54	M36	2,3

All dimensions are approximate

NB - Threaded depths need to be at least 1xM for steel, 1,25xM for cast iron and 2xM for aluminium alloy

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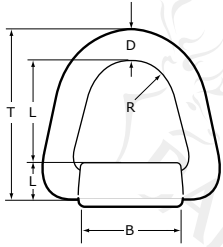
WELDABLE LIFTING POINT, Grade 8

Weld-on lifting point for towing, lashing and lifting applications. Suitable electrodes are ISO 2560, DIN EN 499, BS EN 499 or equivalent.
Approved BG 955102



Dimension in mm						Weight
B	D	G	L	R	T	
50	14	28	53	24	105	0,6
58	17	32	48	29	111	0,9
64	22	41	73	33	150	1,7

All dimensions are approximate

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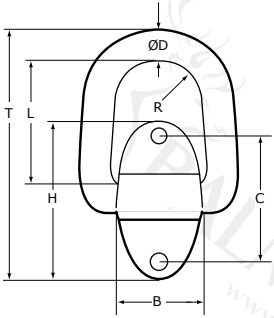
SCREW-ON LIFTING POINTS, Grade 8

To be used in applications where welding is not possible.
Approved BG 955102



Dimension in mm								Weight
B	C	D	H	L	M	T	R	
50	72	14	98	55	M14	139	24	0,9
58	84	17	114	50	M16	144	29	1,4
64	116	22	160	74	M20	203	33	2,9

All dimensions are approximate

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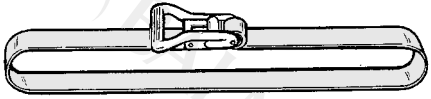
LASHING EQUIPMENT

HEAVY DUTY RATCHET LOADBINDER ASSEMBLIES
Webbing Width 50mm

TYPE RL1 RATCHET LOADBINDER fitted with DELTA LINKS

TYPE RL2 RATCHET LOADBINDER fitted with CLAW HOOKS



TYPE RL3 RATCHET LOADBINDER fitted with ENDLESS BELT

TYPE RL4 RATCHET LOADBINDER fitted with OPEN RAVE HOOK

TYPE RL5 RATCHET LOADBINDER with SNAP HOOK also available with twisted SNAP HOOK

Manufactured in 4000kg and 5000kg capacity.
Other systems available on request.

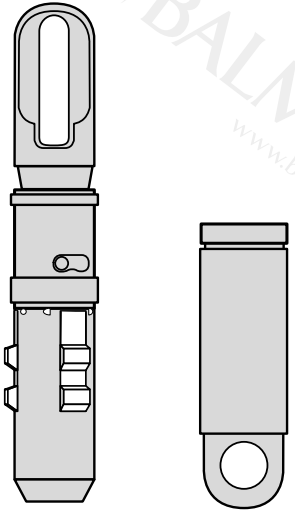
All HEAVY DUTY RATCHET LOADBINDERS are also available with wear sleeves.

MULTIDOG™

A multifunctional deployment and recovery tool for subsea operations

The MultiDog combines state-of-the-art material technology with rugged lightweight construction to save time and money during subsea installation and recovery opertions.

The MultiDog tool offers a variety of actuation options and is fully field configurable. This makes the MultiDog suitable for most deployment and recovery strategies.
The tool provides secondary actuation giving added piece of mind against primary failure.



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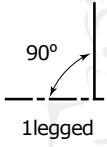
CHAIN SLINGS

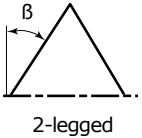
Recommended master links for use with chain slings acc to EN 818-4:1996

1 - legged



Chain dim (mm)	WLL (tonnes)	Master link M/MF*	
6	1.12	6-8	
7	1.5	86-8	
8	2.0	86-8	
10	3.15	108-8	
13	5.3	1310-8	13-8
16	8.0	1613-8	
19	11.2	2016-8	19-8
22	15.0	2220-8	
26	21.2	2622-8	
32	31.5	3226-8	32-8
36	40.0	3632-8	
45	63.0	4536-8	

2 - legged



Chain dim (mm)	WLL (tonnes) β 0-45° α 0-90°	WLL (tonnes) β 45-60° α 90-120°	Master link M/MF*
6	1.6	1.12	86-8
7	2.12	1.5	108-8
8	2.8	2.0	108-8
10	4.25	3.15	1310-8
13	7.5	5.3	1613-8
16	11.2	8.0	2016-8
19	16.0	11.2	2220-8
22	21.2	15.0	2622-8
26	30.0	21.2	3226-8
32	45.0	31.5	3632-8
36	56.0	40.0	4536-8
45	90.0	63.0	-

All dimensions are approximate

* Grey areas available with flattened section for use with BL.

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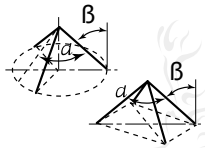
CHAIN SLINGS

Recommended master links for use with chain slings acc to EN818-4:1996

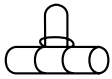
3 - legged & 4 - legged



3-legged & 4-legged

Chain dim (mm)	WLL (tonnes) β 0-45° α 0-90°	WLL (tonnes) β 45-60° α 90-120°	Master link MT*/MTC*
6	2.36	1.7	6-8
7	3.15	2.24	8-8
8	4.25	3.0	8-8
10	6.7	4.75	10-8
13	11.2	8.0	13-8
16	17.0	11.8	16-8
19	23.6	17.0	20-8
22	31.5	22.4	22-8
26	45.0	31.5	26-8
32	67.0	47.5	32-8
36	85.0	60.0	-
45	132.0	95.0	-

Choked endless sling



Choked endless sling

Chain dim (mm)	WLL (tonnes)
6	1.8
7	2.5
8	3.15
10	5.0
13	8.5
16	12.5
19	18.0
22	23.6
26	33.5
32	50.0
36	63.0
45	100.0

All dimensions are approximate

* Grey areas available with flattened section for use with BL.

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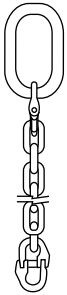
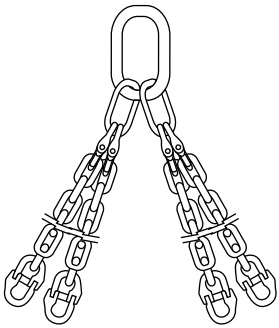
COUPLING LINK

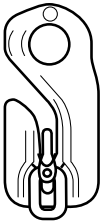
The coupling link is a universal fitting. It can be used on chain, master links, hooks and other lifting components.



Master Link
For connection to chain with coupling links. For single or double-leg slings.



Master Link
For connection to chain with coupling links. For 3-leg or 4-leg slings.



Shortening Hook
No reduction in Working Load Limit because of its perfect support of the shortened chain leg.

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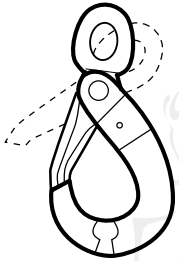
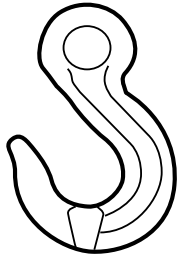
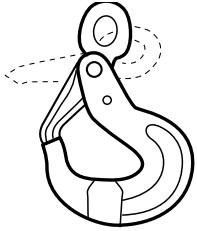
HOOKS



Safety Hook
The safest of hooks. It retains the load in the hook and will not easily snag during lifting. Very easy to handle.



Sling Hook
The standard, traditional sling hook.



Safety Hook for Webslings
The wide, flat bowl is designed to allow a webbing sling to lay flat within the hook. Can also be used with chain or wire rope slings.

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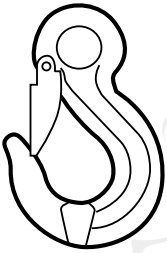
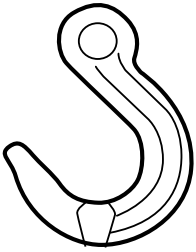
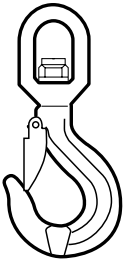
HOOKS



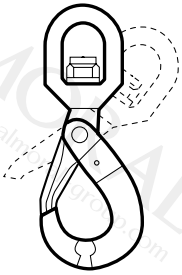
Latch Hook
Sling hook equipped with a latch.



Foundry Hook
The wide admittance gives this hook more uses than just foundry work.



Swivel Latch Hook
The swivel permits the load to be rotated.



Swivel Safety Hook
The swivel permits the load to be rotated.

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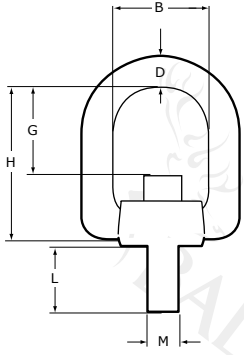
LIFTING POINTS

Approved BG 005147



Dimension in mm						Weight
B	D	G	H	L	M	
42	12	35	60	15	M8	0,3
42	12	34	60	20	M10	0,3
57	19	46,5	85	19	M12	0,9
57	19	44	85	24	M16	0,9
83	28	56	111	32	M20	2,8
83	28	53	111	37	M24	2,8

All dimensions are approximate

NB -Threaded depths need to be at least 1xM for steel, 1,25xM for cast iron and 2xM for aluminium alloy.

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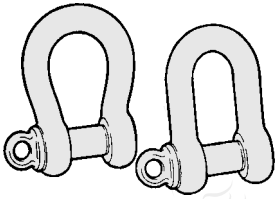
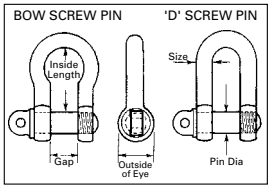
SHACKLES

Bow and 'D' screw pin shackles up to 120 tonne SWL





SWL tonnes	Size (mm)	Pin dia (mm)	Gap (mm)	O/dia eye (mm)	Inside length (mm)	Weight safety (kg)	Weight screw pin (kg)
2	13	16	19	32	48	0.36	0.36
3.25	16	19	26	41	61	0.72	0.68
4.75	19	22	32	48	70	1.3	1
6.5	22	25	35	54	83	1.8	1.5
8.5	25	29	42	60	95	2.6	2.4
9.5	29	32	45	67	108	3.6	3.4
12	32	35	51	76	118	5.1	3.9
13.5	35	38	57	85	133	6.9	5.9
17	38	41	60	92	149	9	7.9
25	44	51	73	111	178	14.2	12.7
35	51	57	83	127	197	21	18.7
55	64	70	105	152	267	43	38
85	76	83	127	165	330	66	59
120	89	95	140	203	381	114	102

All dimensions are approximate

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SHACKLES

Bow and 'D' safety pin shackles up to 100 tonne SWL

SWL tonnes	Size (mm)	Pin dia (mm)	Gap (mm)	O/dia eye (mm)	Inside length (mm)	Weight safety (kg)	Weight screw pin (kg)
2	13	16	19	32	41	0.36	0.3
3.25	16	19	26	41	51	0.67	0.55
4.75	19	22	32	48	60	0.72	0.6
6.5	22	25	35	54	70	1.7	1.4
8.5	25	29	42	60	80	2.4	2.1
9.5	29	32	45	67	89	3.3	3
12	32	35	51	76	99	4.7	4.1
13.5	35	38	57	85	111	6.1	5.5
17	38	41	60	92	124	8.4	7.4
25	44	51	73	111	149	13	16
35	51	57	83	127	171	19	16.5
50-55	64	70	105	152	203	38	33.7
75-85	76	83	127	165	229	56	49
100	89	95	149	203	267	99	86

All dimensions are approximate

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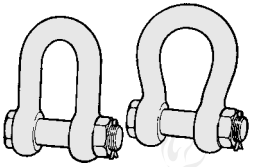
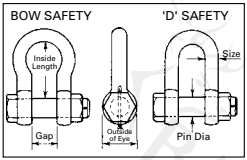
SHACKLES, BOW & 'D' SAFETY





Green pin

SWL tonnes	Size (mm)	Pin dia (mm)	Gap (mm)	Inside length (mm)	Weight safety (kg)
120	89	95	146	381	120
150	102	108	165	400	160
200	120	130	175	500	235
250	125	140	200	540	285
300	135	150	200	600	340
400	165	175	225	650	560
500	175	185	250	700	685
600	195	205	275	700	880
700	205	215	300	700	980
800	210	220	300	700	1100
900	220	230	320	700	1280
1000	230	240	340	700	1460

Crosby

SWL tonnes	Size (mm)	Pin dia (mm)	Gap (mm)	Inside length (mm)	O/dia eye (mm)	Weight safety (kg)
120	89	95	133	371	203	120
150	102	108	140	368	229	153
200	108	121	184	394	268	204
250	121	127	216	508	305	272
300	130	152	216	495	305	352
400	149	178	210	571	356	499
500	155	190	219	641	381	704
600	178	210	235	810	432	863

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Section 9
BUOYS

Introduction

Anchor pendant and support buoy sizes are normally expressed in terms of the reserve buoyancy rather than the physical dimensions. The reserve buoyancy is equal to the weight of water displaced by the buoy when fully immersed less the buoy's weight in air. A buoy with 6 Tonnes reserve buoyancy would be fully immersed if required to support 6 Tonne. In practice, as the buoy would be fully submerged it would be very difficult to locate. Therefore standard practice is to use only about half the reserve buoyancy of the buoy so that approximately half the buoy is showing above the water.

The above does not apply to mooring buoys as they need to resist being pulled under the water when high loads are being applied to the mooring hawsers. Mooring analysis is generally required to ensure that buoys used in the mooring of vessels are of the correct size and that the structural steel within through the buoy is of a sufficient strength.

Navigational buoys are selected on the basis of sea conditions and signal range requirements. Their buoyancy is required to support the moorings and give sufficient freeboard and height for the signals (light and day-marks etc) to be effective. Navigational buoys are also ballasted to aid stability.

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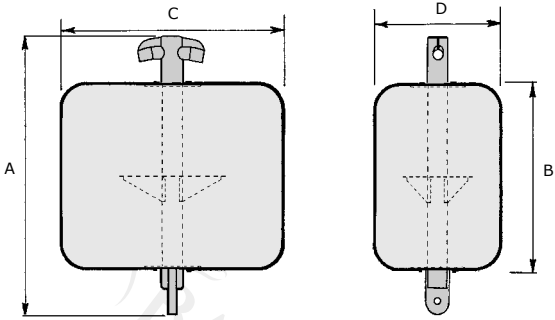
BALMORAL ANCHOR PENDANT BUOYS



Balmoral elastomer anchor pendant buoys type EP										
Buoy Type	Nominal weight kg	Nominal dimensions mm				Net reserve buoyancy kg	Nominal reserve buoyancy kg	Max length in metres of various dia of wire rope		
		A	B	C	D			56mm	64mm	70mm
EP1	310	1490	1100	1270	1100	1234	1000	90	70	60
EP2	560	2280	1770	1770	1270	3126	2000	185	130	120
EP4	1160	2880	1770	2600	1500	5499	4000	370	270	230
EP6	1330	3380	2200	2600	1500	7298	6000	550	400	350
EP8	1580	3605	2400	2600	1800	9702	8000	740	530	460
EP10	1770	3805	2600	2800	1800	11392	10000	920	660	580
EP12	2050	4210	2800	3200	1800	14150	12000	1100	800	690
EP14	2260	4210	2800	3300	2000	16303	14000	1290	930	810
EP16	2450	4210	3000	3400	2000	18042	16000	1480	1060	930
EP18	2660	4210	3000	3700	2000	19640	18000	1660	1200	1040
EP20	2860	4210	3000	3700	2200	21670	20000	1840	1330	1160
EP22	3070	4210	3000	3700	2400	23690	22000	2030	1460	1270
EP24	3270	4210	3000	3700	2600	25720	24000	2210	1600	1390
EP26	2480	4210	3000	3700	2800	27740	26000	2400	1730	1500

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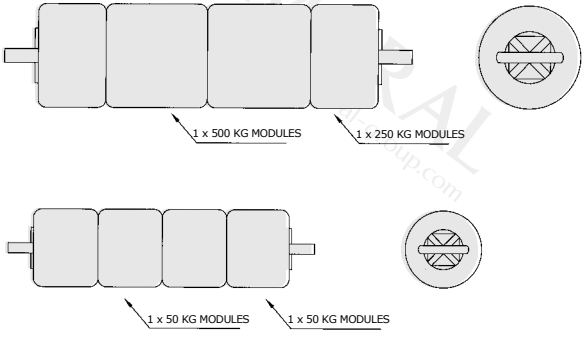
SUBSURFACE BUOYANCY

In certain circumstances, such as anchor line suspensions, it can be preferable to avoid the use of very large surface support buoys. In such situations, special subsurface buoyancy is required. Unlike the surface buoys which are impact absorbent, this is manufactured from a dense closed cell material which does not compress under pressure. This feature makes it possible to submerse these subsurface buoys without distortion or damage, thus the physical properties of surface and subsurface buoys are very different.

Balmoral does not produce a standard size range in this product as each application differs. Unlike with surface buoys, excess buoyancy can create problems. In order to avoid such problems and offer maximum versatility, Balmoral can provide modular subsurface units which can be built up to provide the exact buoyancy and depth rating required on different projects.

Typical examples of Modular Subsurface Buoys are shown below.

MODULAR SUBSURFACE BUOYS
DEPTH RATED DOWN TO A MAX OF 2200 METRES



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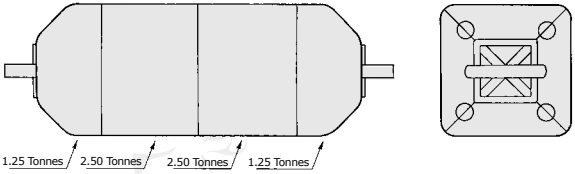
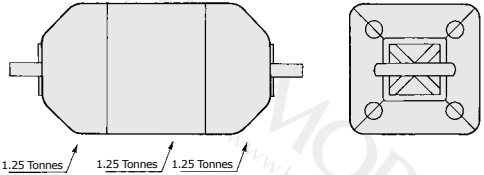
MODULAR SUBSURFACE BUOYS DEPTH RATED FROM 250 TO 2200 METRES





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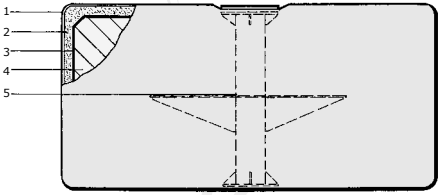
MOORING BUOYS
ELASTOMER MBE BUOYS

Balmoral provides standard buoys with net reserve buoyancies from 500 kg to 35 tonne. Purpose designed or specials are available to suit client's requirements.

1 PU elastomer skin
2 PE memory foam
3 GRP membrane
4 PU foam core
5 Through steel hawser



MBE Mooring Buoys						
Buoy Type	Admiralty Class	Length mm	Dia mm	Hawser Dia mm	Weight kg	Buoyancy kg
MBE 5	-	1600	800	156	290	534
MBE 10	6	1800	1100	156	440	1313
MBE 15	5	2100	1200	209	566	1868
MBE 20	-	2400	1200	209	627	2155
MBE 30	-	2600	1400	304	831	3271
MBE 40	-	2800	1500	304	945	4127
MBE 50	4	3000	1600	304	1067	5116
MBE 60	-	3200	1700	336	1214	6231
MBE 85	3	3500	1900	336	1465	8707
MBE 100	2	4000	2200	437	1975	13611
MBE 150	1	4500	2400	437	2377	18489
MBE 250	X	5000	2800	437	3051	28506
MBE 300	M	5500	2900	437	3425	33812

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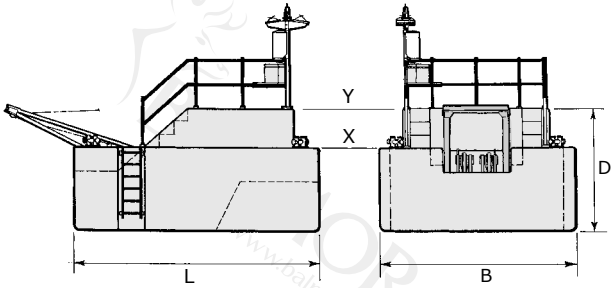
MBS BUOYS

An effective design of mooring buoy has been developed by Balmoral Nav-Aids to complement the already well known MBE buoys.
Constructed from a PU foam core surrounded by a GRP membrane, then PE memory foam and a final protective coating of either elastomer or GRP, making the buoys impact energy absorbent and abrasive resistant.
These buoys are especially suited to tanker loading and offloading operations. The release mechanism is by lanyard which can be operated from the tanker.



Elastomer foam MBS buoys						
	Dimensions mm			Weight kg	Nominal Reserve buoyancy kg	
Type	Length	Breadth	Depth		Level x	Level y
MBS 3000	4000	3000	2000	4100	10600	16500
MBS 4000	4000	4000	2000	4800	14850	22700
MBS 5000	5000	4000	2500	6900	26400	32700
MBS 6000	6000	5000	3000	10000	55000	61300

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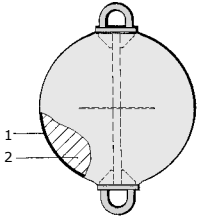
SUPPORT BUOYS

Support Buoys - Cylindrical Section					
Type	Extreme Length mm	Length over body mm	Diameter mm	Weight kg	Buoyancy kg
BSB5C	1750	1300	800	135	535
BSB10C	2150	1700	1000	260	1110
BSB15C	2150	1700	1200	350	1620
BSB20C	1850	1400	1520	420	2185
BSB25C	2230	1780	1520	485	2825
BSB30C	2230	1780	1600	520	3150
BSB40C	2250	1800	1850	640	4315
BSB50C	2650	2200	1850	740	5320
BSB60C	2650	2200	2000	820	6260

Support Buoys - Square Section					
Type	Extreme Length mm	Length over body mm	Width mm	Weight kg	Buoyancy kg
BSB5S	1650	1200	800	150	640
BSB10S	1950	1500	950	260	1125
BSB15S	2150	1600	1100	355	1625
BSB20S	2050	1750	1200	430	2155
BSB25S	2200	1900	1300	495	2795
BSB30S	2450	2000	1400	560	3455
BSB40S	2550	2100	1500	640	4205
BSB50S	2750	2300	1600	740	5290
BSB60S	3000	2550	1650	835	6280

PICK-UP BUOY



1 PU elastomer skin
2 PE memory foam core

Elastometer foam pick-up buoys			
Type	Diameter mm	Weight kg	Buoyancy kg
PU 6	600	28	90
PU 10	1000	110	455
PU 12	1200	195	770
PU 16	1650	300	2175

All dimensions are approximate

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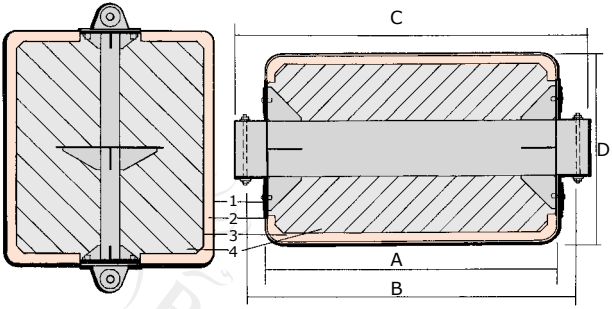
BUOYS

SUPPORT BUOY CHAIN SUPPORT BUOY



1 PU elastomer skin
2 PE memory foam
3 GRP membrane
4 PU foam core

Nb- B can be altered for various chain sizes.

Chain Support Buoys										
Buoy Type	Nominal dimensions mm				Weight kg	Net reserve buoyancy kg	Hawsepipe ID mm	Hawsepipe 0D mm	Max Chain size mm
	A	B	C	D					
BCSB12S	2000	2432	2632	1000	590	1250	331	356	76
BCSB24S	2000	2432	2632	1300	700	2520	331	356	76
BCSB36S	2500	2880	3080	1400	910	3720	381	406	90
BCSB48S	2500	2880	3080	1580	1010	4970	381	406	90
BCSB60S	2800	3264	3400	1660	1220	6120	432	457	102
BCSB12C	2000	2432	2632	1100	590	1200	331	356	76
BCSB24C	2000	2432	2632	1450	690	2520	331	356	76
BCSB36C	2500	2880	3080	1550	890	3650	381	406	90
BCSB48C	2500	2880	3080	1750	980	4880	381	406	90
BCSB60C	2800	3264	3400	1850	1190	6100	432	457	102

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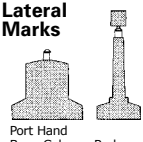
MARKER BUOYS

The approved system of buoyage in Europe, Africa, India, Australia and most of Asia is the International Association of Lighthouse Authorities (IALA) System A which is a combined cardinal and lateral system. The rules of System A ensure that the information provided by any mark is easily interpreted.
The lateral marks of the system utilise Red can shape to denote the port side of channels and Green conical shape to denote the starboard side from the normal direction of approach to a harbour, river or other waterway from seaward.
Cardinal marks indicate that the deepest water in the area lies to the named side of the mark and also to indicate the safe side on which to pass a danger.
The particular purpose of any buoy is therefore defined by a combination of its shape, colour, day marks, lighting colour and signal characteristic. Additional considerations when selecting a buoy are the power source (electric, solar or wave power) the light range and the buoy's reserve buoyancy.

I.A.L.A. BUOYAGE SYSTEM 'A'

Lateral Marks



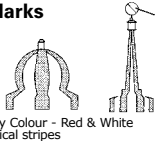
Port Hand
Buoy Colour - Red
Light Colour - Red
Rhythm - Any

Starboard Hand
Buoy Colour - Green
Light Colour - Green
Rhythm - Any

Isolated Danger Marks

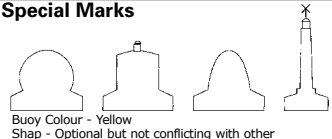
Buoy Colour - Black & Red
Light Colour - White
Rhythm - Group flashing 2

Safe Water Marks



Buoy Colour - Red & White vertical stripes
Light Colour - White
Rhythm - Isophase, occulting or one long flash every 10 seconds

Special Marks



Buoy Colour - Yellow
Shap - Optional but not conflicting with other navigational marks in the area
Light Colour - Yellow
Rhythm - Any not used for other buoys
Topmark (if any) - Yellow cross

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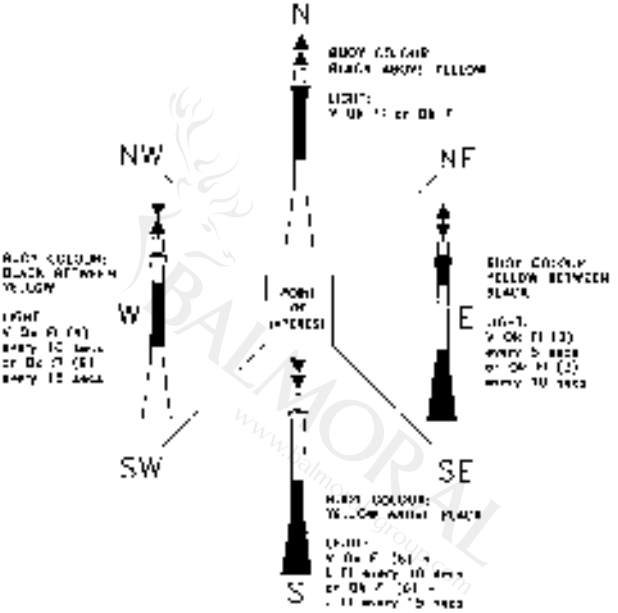
CARDINAL MARKS



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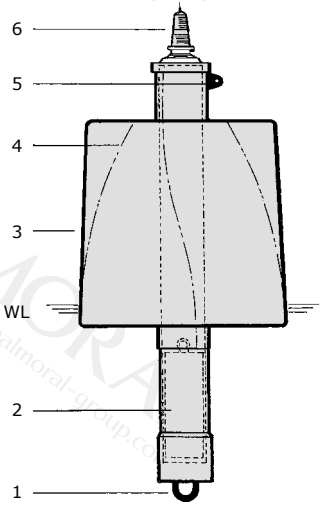
EF120L MARKER BUOY

The EF120L buoy is constructed from PE memory foam coated with a highly abrasive-resistant PU elastomer.

The materials used by Balmoral in the construction make the buoys impact resistant, virtually unsinkable and ensure a long maintenance free life. This buoy is widely used by fish farmers, small ports and marinas.

The EF120L standard buoy is equipped with the following fittings:

1 Single mooring eye
2 Balmoral DB3 battery
3 Can daymark
4 Conical daymark
5 Single lifting eye
6 Balmoral B85 beacon
WL Waterline



The buoy will be coloured to suit IALA recommendations and can be fitted with topmarks if required.

General Particulars

Diameter	1200 mm
Focal plane	1500 mm
Draught	1050 mm
Freeboard	N/A
Weight	175 kg
Max mooring weight	200 kg
Overall height	2790 mm

Balmoral's design and technical department can incorporate any special requirements as necessary.

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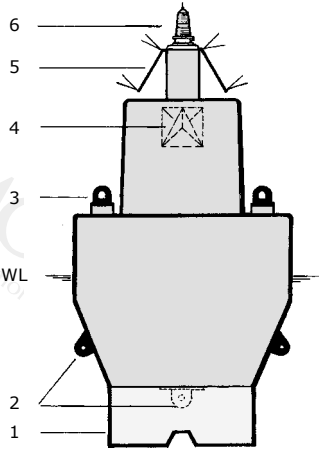
EF15L CLASS V BUOY

Balmoral Marine elastomer buoys are constructed from an inner core of PU foam covered with a layer of memory foam and then hot sprayed with PU elastomer to give an abrasive resistant skin.

The materials used by Balmoral in the construction make the buoys impact resistant, virtually unsinkable and ensure a long maintenance free life. This buoy is ideal for use in small ports.

The EF15L standard buoy is equipped with the following fittings:

1 Ballast skirt
2 Single or bridle mooring eyes
3 Lifting eyes - 2 in number
4 Radar reflector
5 Balmoral solargen pack
6 Balmoral B85 beacon
WL Waterline



The buoy will be shaped and coloured to suit IALA recommendations.

General Particulars

Diameter	1500 mm
Focal plane	1750 mm
Draught	1180 mm
Freeboard	420 mm
Weight	800 kg
Max mooring weight	300 kg
Overall height	3080 mm

Balmoral's design and technical department can incorporate any special requirements as necessary.

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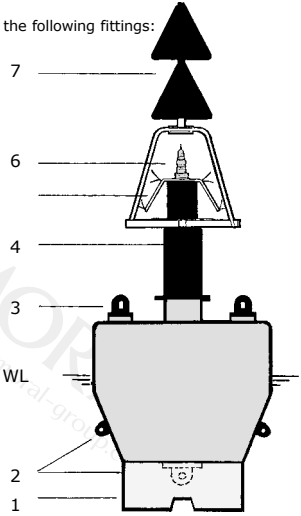
EF15P CLASS V BUOY

Balmoral Marine elastomer buoys are constructed from an inner core of PU foam covered with a layer of memory foam and then hot sprayed with PU elastomer to give an abrasive resistant skin.

The materials used by Balmoral in the construction make the buoys impact resistant, virtually unsinkable and ensure a long maintenance free life. Suitable for use in small ports.

The EF15P standard buoy is equipped with the following fittings:

1 Ballast skirt
2 Single or bridle mooring eyes
3 Lifting eyes 2 in number
4 Radar reflector (within pillar)
5 Balmoral solargen pack
6 Balmoral B85 beacon
7 Top marks to suit relevant IALA recommendations
WL Waterline



The buoy will be coloured to suit IALA recommendations.

General Particulars

Diameter	1500 mm
Focal plane	1800 mm
Draught	1180 mm
Freeboard	420 mm
Weight	800 kg
Max mooring weight	300 kg
Overall height	4400 mm (dependent on topmarks)

Balmoral's design and technical department can incorporate any special requirements as necessary.

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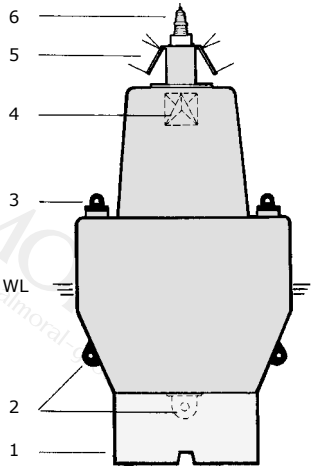
EF18L CLASS IV BUOY

Balmoral Marine elastomer buoys are constructed from an inner core of PU foam covered with a layer of memory foam and then hot sprayed with PU elastomer to give an abrasive resistant skin.

The materials used by Balmoral in the construction make the buoys impact resistant, virtually unsinkable and ensure a long maintenance free life.

The EF18L standard buoy is equipped with the following fittings:

1 Ballast skirt
2 Single or bridle mooring eyes
3 Lifting eyes - 2 in number
4 Radar reflector
5 Balmoral solargen pack
6 Balmoral B85 beacon
WL Waterline



The buoy will be shaped and coloured to suit IALA recommendations.

General Particulars

Diameter	1800 mm
Focal plane	2300 mm
Draught	1520 mm
Freeboard	580 mm
Weight	1370 kg
Max mooring weight	500 kg
Overall height	4000 mm

Balmoral's design and technical department can incorporate any special requirements as necessary.

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EF18P CLASS IV BUOY

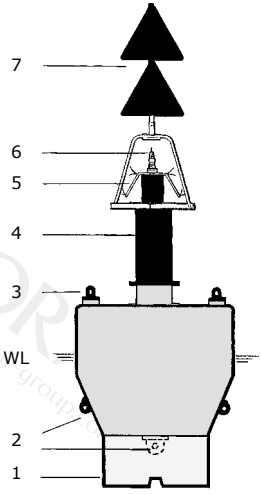
Balmoral marine elastomer buoys are constructed from an inner core of PU foam covered with a layer of memory foam and then hot sprayed with PU elastomer to give an abrasive resistant skin.

The materials used by Balmoral in the construction make the buoys impact resistant, virtually unsinkable and ensure a long maintenance free life.

The EF18P standard buoy is equipped with the following fittings:

1 Ballast skirt
2 Single or bridle mooring eyes
3 Lifting eyes - 2 in number
4 Radar reflector (within pillar)
5 Balmoral solargen pack
6 Balmoral B85 beacon
7 Top marks to suit relevant IALA recommendations
WL Waterline

The buoy will be coloured to suit IALA recommendations.



General Particulars

Diameter	1800 mm
Focal plane	2300 mm
Draught	1530 mm
Freeboard	570 mm
Weight	1400 kg
Max mooring weight	500 kg
Overall height	5570 mm (dependent on topmarks)

Balmoral's design and technical department can incorporate any special requirements as necessary.

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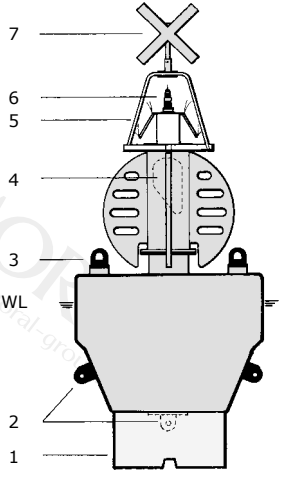
EF20L

Balmoral Marine elastomer buoys are constructed from an inner core of PU foam covered with a layer of memory foam and then hot sprayed with PU elastomer to give an abrasive resistant skin.

The materials used by Balmoral in the construction make the buoys impact resistant, virtually unsinkable and ensure a long maintenance free life.

The EF20L standard buoy is equipped with the following fittings:

1 Ballast skirt
2 Single or bridle mooring eyes
3 Lifting eyes - 2 in number
4 Radar reflector
5 Balmoral solargen pack
6 Balmoral B85 beacon
7 Top marks if applicable
WL Waterline



The buoy will be shaped and coloured to suit IALA recommendations.

9.16

General Particulars

Diameter	2000 mm
Focal plane	2550 mm
Draught	1560 mm
Freeboard	540 mm
Weight	1650 kg
Max mooring weight	500 kg
Overall height	4070 mm (excluding topmark)

Balmoral's design and technical department can incorporate any special requirements as necessary.

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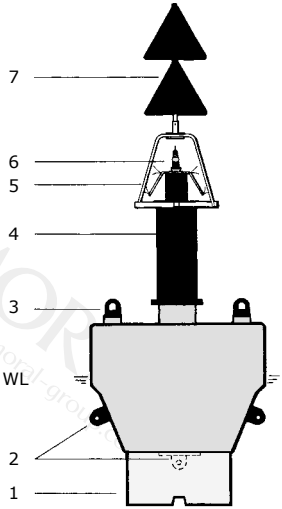
EF20P

Balmoral Marine elastomer buoys are constructed from an inner core of PU foam covered with a layer of memory foam and then hot sprayed with PU elastomer to give an abrasive resistant skin.

The materials used by Balmoral in the construction make the buoys impact resistant, virtually unsinkable and ensure a long maintenance free life.

The EF20P standard buoy is equipped with the following fittings:

1 Ballast skirt
2 Single or bridle mooring eyes
3 Lifting eyes - 2 in number
4 Radar reflector (within pillar)
5 Balmoral solargen pack
6 Balmoral B85 beacon
7 Top marks to suit IALA requirements
WL Waterline



The buoy will be coloured to suit IALA recommendations.

General Particulars

Diameter	2000 mm
Focal plane	2550 mm
Draught	1560 mm
Freeboard	540 mm
Weight	1650 kg
Max mooring weight	500 kg
Overall height	5600 mm (dependent on topmark)

Balmoral's design and technical department can incorporate any special requirements as necessary.

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E marine@balmoral.co.uk
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www.balmoralmarine.com

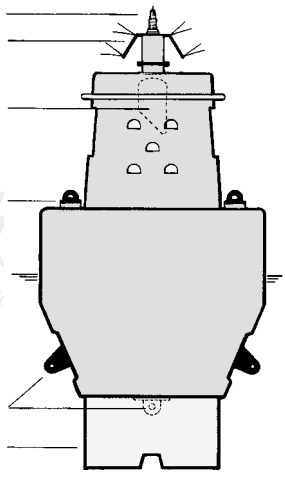
EF25L CLASS III BUOY

Balmoral Marine elastomer buoys are constructed from an inner core of PU foam covered with a layer of memory foam and then hot sprayed with PU elastomer to give an abrasive resistant skin.

The materials used by Balmoral in the construction make the buoys impact resistant, virtually unsinkable and ensure a long maintenance free life. This buoy is utilised by both the offshore oil industry and large port authorities.

The EF25L standard buoy is equipped with the following fittings:

1 Ballast skirt
2 Single or bridle mooring eyes
3 Lifting eyes - 2 in number
4 Radar reflector
5 Balmoral solargen pack
6 Balmoral B85 beacon
WL Waterline



The buoy will be shaped and coloured to suit IALA recommendations.

General Particulars

Diameter	2500 mm
Focal plane	3000 mm
Draught	2150 mm
Freeboard	750 mm
Weight	3800 kg
Max mooring weight	1000 kg
Overall height	5020 mm

Balmoral's design and technical department can incorporate any special requirements as necessary.

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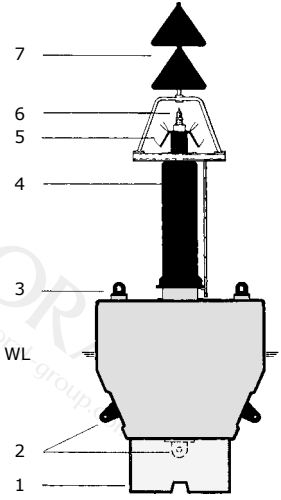
EF25P CLASS III BUOY

Balmoral Marine elastomer buoys are constructed from an inner core of PU foam covered with a layer of memory foam and then hot sprayed with PU elastomer to give an abrasive resistant skin.

The materials used by Balmoral in the construction make the buoys impact resistant, virtually unsinkable and ensure a long maintenance free life. This buoy is utilised by both the offshore oil industry and large Port Authorities.

The EF25P standard buoy is equipped with the following fittings:

1 Ballast skirt
2 Single or bridle mooring eyes
3 Lifting eyes - 2 in number
4 Radar reflector (within pillar)
5 Balmoral solargen pack
6 Balmoral B85 beacon
7 Top marks to suit relevant IALA recommendations
WL Waterline



The buoy will be coloured to suit IALA recommendations.

General Particulars

Diameter	2500 mm
Focal plane	3500 mm
Draught	2100 mm
Freeboard	800 mm
Weight	3700 kg
Max mooring weight	1000 kg
Overall height	7560 mm (dependant on topmark)

Balmoral's design and technical department can incorporate any special requirements as necessary.

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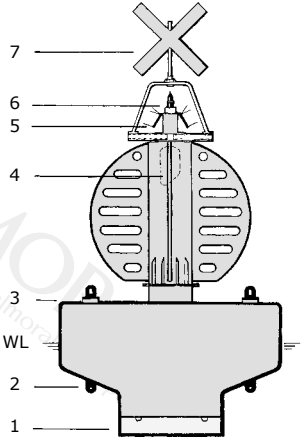
EF30L CLASS II BUOY

Balmoral Marine elastomer buoys are constructed from an inner core of PU foam covered with a layer of memory foam and then hot sprayed with PU elastomer to give an abrasive resistant skin.

The materials used by Balmoral in the construction make the buoys impact resistant, virtually unsinkable and ensure a long maintenance free life.

The EF30L standard buoy is equipped with the following fittings:

1 Ballast skirt
2 Bridle mooring eyes
3 Lifting eyes - 2 in number
4 Radar reflector
5 Balmoral solargen pack
6 Balmoral B85 beacon
7 Top marks if applicable
WL Waterline



The buoy will be shaped and coloured to suit IALA recommendations.

General Particulars

Diameter	3000 mm
Focal plane	2800 mm
Draught	2670 mm
Freeboard	700 mm
Weight	4950 kg
Max. mooring weight	1200 kg
Overall height	5610 mm (excluding topmarks)

Balmoral's design and technical department can incorporate any special requirements as necessary.

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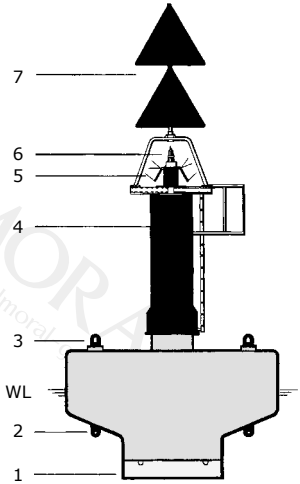
EF30P CLASS II BUOY

Balmoral Marine elastomer buoys are constructed from an inner core of PU foam covered with a layer of memory foam and then hot sprayed with PU elastomer to give an abrasive resistant skin.

The materials used by Balmoral in the construction make the buoys impact resistant, virtually unsinkable and ensure a long maintenance free life. This buoy is utilised by both the offshore oil industry and large port authorities.

The EF30P standard buoy is equipped with the following fittings:

1 Ballast skirt
2 Bridle mooring eyes
3 Lifting eyes - 2 in number
4 Radar reflector (within pillar)
5 Balmoral solargen pack
6 Balmoral B85 beacon
7 Top marks to suit relevant IALA requirements
WL Waterline



The buoy will be coloured to suit IALA recommendations.

General Particulars

Diameter	3000 mm
Focal plane	3400 mm
Draught	2670 mm
Freeboard	700 mm
Weight	4500 kg
Max mooring weight	1650 kg
Overall height	8160 mm (dependent on topmark)

Balmoral's design and technical department can incorporate any special requirements as necessary.

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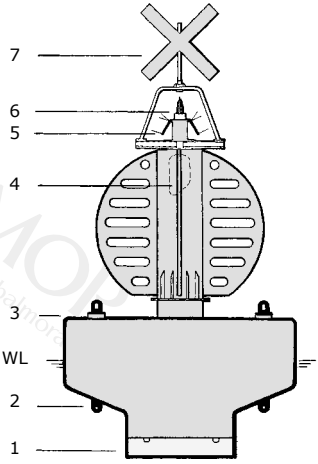
EF36L CLASS I BUOY

Balmoral Marine elastomer buoys are constructed from an inner core of PU foam covered with a layer of memory foam and then hot sprayed with PU elastomer to give an abrasive resistant skin.

The materials used by Balmoral in the construction make the buoys impact resistant, virtually unsinkable and ensure a long maintenance free life.

The EF36L standard buoy is equipped with the following fittings:

1 Ballast skirt
2 Bridle mooring eye
3 Lifting eyes - 2 in number
4 Radar reflector
5 Balmoral solargen pack
6 Balmoral B85 beacon
7 Top marks if applicable
WL Waterline



The buoy will be shaped and coloured to suit IALA recommendations.

9.22

General Particulars

Diameter	3600 mm
Focal plane	4000 mm
Draught	1500 mm
Freeboard	700 mm
Weight	5600 kg
Max mooring weight	2000 kg
Overall height	5600 mm (excluding topmarks)

Balmoral's design and technical department can incorporate any special requirements as necessary.

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EF36P CLASS I BUOY

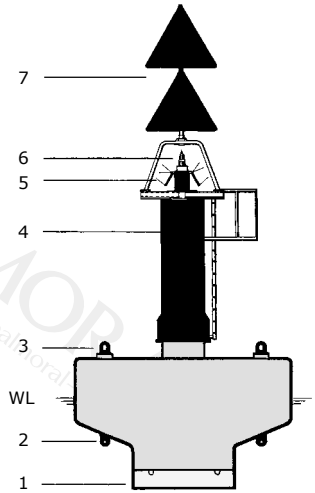
Balmoral Marine elastomer buoys are constructed from an inner core of PU foam covered with a layer of memory foam and then hot sprayed with PU elastomer to give an abrasive resistant skin.

The materials used by Balmoral in the construction make the buoys impact resistant, virtually unsinkable and ensure a long maintenance free life.

The EF36P standard buoy is equipped with the following fittings:

1 Ballast skirt
2 Bridle mooring eyes
3 Lifting eyes - 2 in number
4 Radar reflector (within pillar)
5 Balmoral solargen pack
6 Balmoral B85 beacon
7 Top marks to suit relevant IALA recommendations
WL Waterline

The buoy will be coloured to suit IALA recommendations.



General Particulars

Diameter	3600 mm
Focal plane	4000 mm
Draught	1500 mm
Freeboard	700 mm
Weight	5500 kg
Max mooring weight	2000 kg
Overall height	8100 mm (dependent on topmarks)

Balmoral's design and technical department can incorporate any special requirements as necessary.

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EMB28 WELLHEAD MARKER BUOY

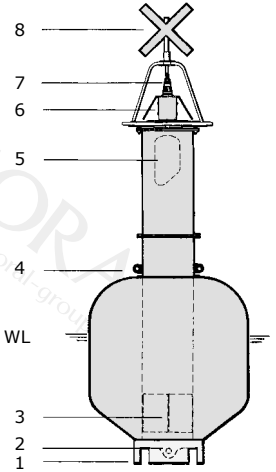
Balmoral Marine elastomer buoys are constructed from an inner core of PU foam covered with a layer of memory foam and then hot sprayed with PU elastomer to give an abrasive resistant skin.

The materials used by Balmoral in the construction make the buoys impact resistant, virtually unsinkable and ensure a long maintenance free life.

This buoy is specifically designed and built for the offshore industry to allow ease of handling from the back of an anchor handling vessel.

The EMB28 standard buoy is equipped with the following fittings:

1 Ballast skirt
2 Single mooring eye
3 Balmoral DB9 battery - 2 in no (optional)
4 Lifting eyes - 2 in no
5 Radar reflector
6 Balmoral solargen pack
7 Balmoral B85 beacon
8 Top yellow cross
(optional IALA marks are available)
WL Waterline



The buoy will be coloured to suit IALA recommendations.

General Particulars

Width	2060 mm
Width over diagonal	2800 mm
Focal Plane	3300 mm
Draught	1660 mm
Freeboard	770 mm
Weight	2500 kg
Max mooring weight	2180 kg
Overall height	6060 mm (including topmark)

Balmoral's design and technical department can incorporate any special requirements as necessary.

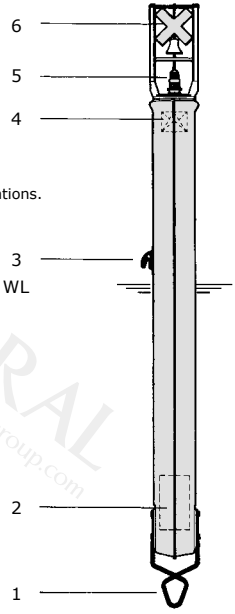
SPAR BUOYS

The SG2 and SG7 spar buoys are constructed using a GRP/PU foam sandwich.

The hexagonal cross section eliminates rolling and allows for stacking. Rubber fenders are built into the length to protect the buoy during launch and recovery.

The standard buoys come equipped with the following:

1 Single mooring eye
2 Balmoral DB9 battery
3 Recovery hook
4 Radar reflector
5 Balmoral B85 beacon
6 Topmark
WL Waterline



The buoy will be coloured to suit IALA recommendations.
A solar powered version is available on request.

General Particulars

	SG2	SG7
Width across flats mm	400	400
Focal plane mm	2000	1700
Draught mm	3350	2750
Freeboard mm	1800	1500
Weight kg	280	235
Overall length mm	6100	5100
Required mooring weight	127kg	80kg

Balmoral's design and technical department can incorporate any special requirements as necessary.

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950 SERIES GRP MARKER BUOY

The Balmoral 950 series of GRP buoys are an economical lit or unlit buoy constructed from Baltec foam filled glass reinforced plastic protected by a rubber fender. Solid can or conical daymarks are available.

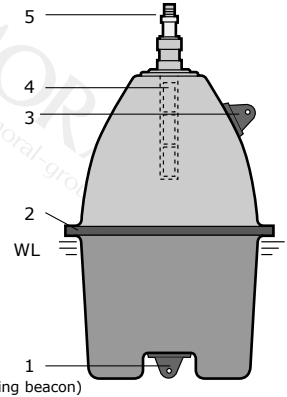
Ideal for fish farms, marinas, small ports and temporary markers.

The materials used by Balmoral in the construction make the buoys impact resistant, virtually unsinkable and ensure a long maintenance free life.

The internal ballast can be reduced during manufacture to increase the allowable amount of moorings to suit individual site conditions.

The 950 series marker buoy is equipped with the following fittings:

1 Single mooring eye
2 Rubber fender
3 Lifting eye - 1 in no
4 Battery
5 Beacon
WL Waterline



The buoy will be coloured to suit IALA recommendations.

General Particulars

Diameter	950 mm
Focal Plane	1000 mm
Draught	670 mm
Freeboard	30 mm
Weight	200 kg
Max mooring weight	80 kg
Overall height	1765 mm (including beacon)

Balmoral's design and technical department can incorporate any special requirements as necessary.

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E marine@balmoral.co.uk
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L11 GRP BUOY

Balmoral L11 GRP buoys are constructed from a Baltec foam filled glass reinforced plastic body protected by a marine grade rubber fender. Can, conical, or spherical bolt on solid daymarks are available.

The materials used by Balmoral in the construction make the buoys impact resistant, virtually unsinkable and ensure a long maintenance free life.

The standard L11 buoy is equipped with the following fittings:

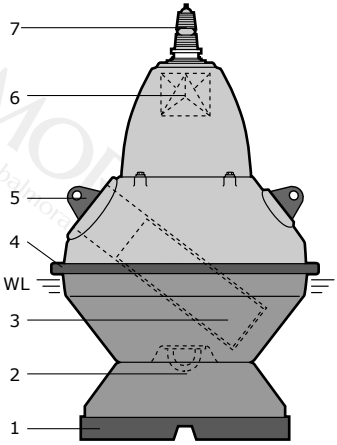
1 Ballast skirt
2 Single mooring eye
3 Battery
4 Rubber fender
5 Lifting eyes - 2 in no
6 Radar reflector
7 Beacon
WL Waterline

The buoy will be coloured to suit IALA recommendations.

The buoy is also available with a bridle mooring if required

A solar powered version is

also available



General Particulars

Diameter	1100 mm
Focal Plane	1100 mm
Draught	750 mm
Freeboard	450 mm
Weight	230 kg
Max mooring weight	80 kg
Overall height	2055 mm (including beacon)

Balmoral's design and technical department can incorporate any special requirements as necessary.

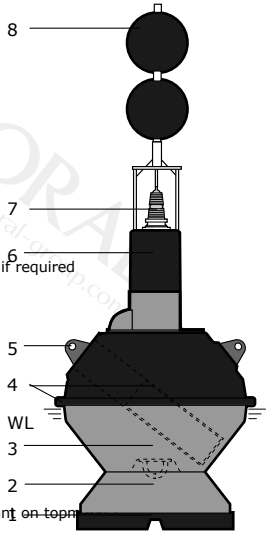
P11 GRP BUOY

Balmoral P11 GRP buoys are constructed from Baltec foam filled glass reinforced plastic protected by a marine grade rubber fender. The bolt on pillar can be fitted with any IALA recommended topmarks.

The materials used by Balmoral in the construction make the buoys impact resistant, virtually unsinkable and ensure a long maintenance free life.

The standard P11 GRP buoy is equipped with the following fittings:

1 Ballast skirt
2 Single mooring eye
3 Battery
4 Rubber fender
5 Lifting eyes - 2 in no
6 Radar reflector (within pillar)
7 Beacon
8 Topmarks
WL Waterline



The buoy will be coloured to suit IALA recommendations.

The buoy can be supplied with bridle mooring if required

A solar powered version is also available

General Particulars

Diameter	1100 mm
Focal Plane	1250 mm
Draught	750 mm
Freeboard	450 mm
Weight	210 kg
Max mooring weight	70 kg
Overall height	3185 mm (dependant on topm

Balmoral's design and technical department can incorporate any special requirements as necessary.

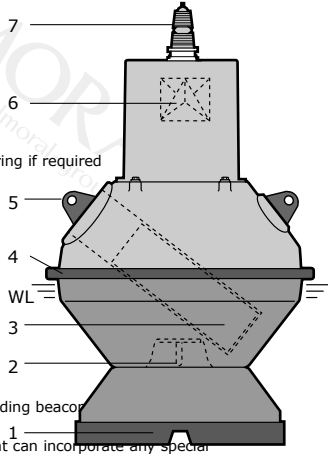
L16 GRP BUOY

Balmoral L16 GRP buoys are constructed from Baltec foam filled glass reinforced plastic protected by a marine grade rubber fender. Can, conical, or spherical bolt on solid daymarks are available.

The materials used by Balmoral in the construction make the buoys impact resistant, virtually unsinkable and ensure a long maintenance free life.

The standard L16 GRP buoy is equipped with the following fittings:

1 Ballast skirt
2 Single mooring eye
3 Battery
4 Rubber fender
5 Lifting eyes - 2 in no
6 Radar reflector
7 Beacon
WL Waterline



The buoy will be coloured to suit IALA recommendations.

The buoy can be supplied with bridle mooring if required

A solar powered version is also available

General Particulars

Diameter	1600 mm
Focal Plane	1600 mm
Draught	1060 mm
Freeboard	690 mm
Weight	450 kg
Max mooring weight	350 kg
Overall height	2805 mm (including beacon)

Balmoral's design and technical department can incorporate any special requirements as necessary.

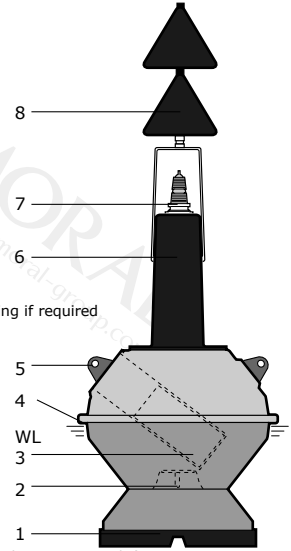
P16 GRP BUOY

Balmoral P16 GRP buoys are constructed from Baltec foam filled glass reinforced plastic protected by a marine grade rubber fender. The bolt on pillar can be fitted with any IALA recommended topmarks.

The materials used by Balmoral in the construction make the buoys impact resistant, virtually unsinkable and ensure a long maintenance free life.

The standard P16 GRP buoy is equipped with the following fittings:

1 Ballast skirt
2 Single mooring eye
3 Battery
4 Rubber fender
5 Lifting eyes - 2 in no
6 Radar reflector (within pillar)
7 Beacon
8 Topmarks
WL Waterline



The buoy will be coloured to suit IALA recommendations.

The buoy can be supplied with bridle mooring if required

A solar powered version is also available

General Particulars

Diameter	1600 mm
Focal Plane	2000 mm
Draught	1060 mm
Freeboard	700 mm
Weight	500 kg
Max mooring weight	300 kg
Overall height	3920 mm (dependant on topmarks)

Balmoral's design and technical department can incorporate any special requirements as necessary.

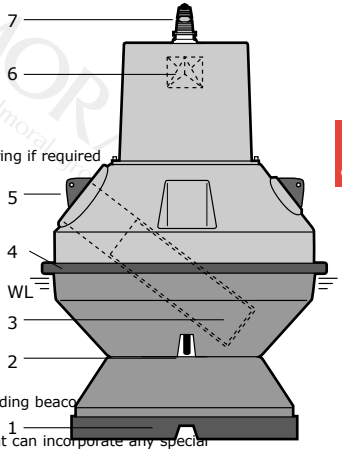
L21 GRP BUOY

Balmoral L21 GRP buoys are constructed from Baltec foam filled glass reinforced plastic protected by a marine grade rubber fender. Can, conical, or spherical bolt on solid daymarks are available.

The materials used by Balmoral in the construction make the buoys impact resistant, virtually unsinkable and ensure a long maintenance free life.

The standard L21 GRP buoy is equipped with the following fittings:

1 Ballast skirt
2 Single mooring eye
3 Battery (if fitted)
4 Rubber fender
5 Lifting eyes - 2 in no
6 Radar reflector
7 Beacon
WL Waterline



The buoy will be coloured to suit IALA recommendations.

The buoy can be supplied with bridle mooring if required

A solar powered version is also available

General Particulars

Diameter	2100 mm
Focal Plane	2100 mm
Draught	1400 mm
Freeboard	825 mm
Weight	1200 kg
Max mooring weight	600 kg
Overall height	3700 mm (including beaco

Balmoral's design and technical department can incorporate any special requirements as necessary.

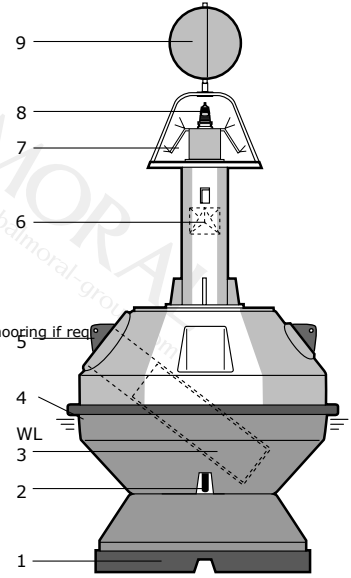
P21 GRP BUOY

Balmoral P21 GRP buoys are constructed from Baltec foam filled glass reinforced plastic protected by a marine grade rubber fender. The bolt on pillar can be fitted with any IALA recommended topmarks.

The materials used by Balmoral in the construction make the buoys impact resistant, virtually unsinkable and ensure a long maintenance free life.

The standard P21 GRP buoy is equipped with the following fittings:

1 Ballast skirt
2 Single mooring eye
3 Battery (if fitted)
4 Rubber fender
5 Lifting eyes - 2 in no
6 Radar reflector
7 Balmoral solargen pack
8 Beacon
9 Topmark
WL Waterline



The buoy will be coloured to suit IALA recommendations.

The buoy can be supplied with bridle mooring if required.

The option of a solargen pack has been depicted

General Particulars

Diameter	2100 mm
Focal Plane	2750 mm
Draught	1400 mm
Freeboard	825 mm
Weight	1250 kg
Max mooring weight	550 kg
Overall height	5325 mm (dependant on topmarks)

Balmoral's design and technical department can incorporate any special requirements as necessary.

L30 GRP BUOY

Balmoral L30 GRP buoys are constructed from Baltec foam filled glass reinforced plastic protected by a marine grade rubber fender. The batwing type daymarks bolt together to form the platform for the beacon and topmarks if required.

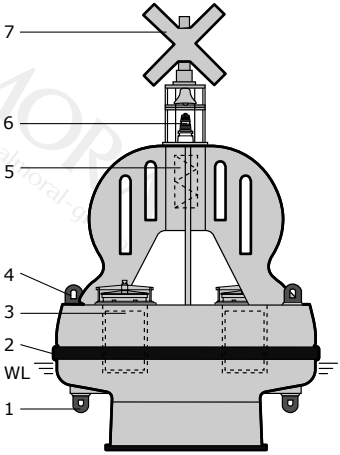
The materials used by Balmoral in the construction make the buoys impact resistant, virtually unsinkable and ensure a long maintenance free life.

The standard L30 GRP buoy is equipped with the following fittings:

1 Bridle mooring eyes
2 Rubber fender
3 Batteries - 2 in no
4 Lifting eyes - 2 in no
5 Radar reflector
6 Beacon
7 Topmarks
WL Waterline

The buoy will be coloured to suit IALA recommendations.

A solar powered version is also available



General Particulars

Diameter	3000 mm
Focal Plane	2800 mm
Draught	1000 mm
Freeboard	650 mm
Weight	1500 kg
Max mooring weight	850 kg
Overall height (dependant on topmarks)	3900 mm

Balmoral's design and technical department can incorporate any special requirements as necessary.

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P30 GRP BUOY

Balmoral P30 GRP buoys are constructed from Baltec foam filled glass reinforced plastic protected by a marine grade rubber fender. The bolt on pillar can be fitted with any IALA recommended topmarks.

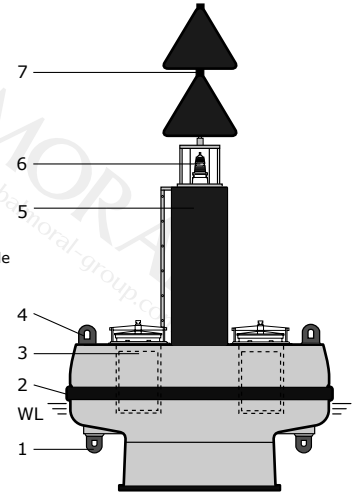
The materials used by Balmoral in the construction make the buoys impact resistant, virtually unsinkable and ensure a long maintenance free life.

The standard P30 GRP buoy is equipped with the following fittings:

1 Bridle mooring eyes
2 Rubber fender
3 Battery
4 Lifting eyes - 2 in no
5 Radar reflector (within pillar)
6 Beacon
7 Topmarks
WL Waterline

The buoy will be coloured to suit IALA recommendations.

A solar powered version is also available



General Particulars

Diameter	3000 mm
Focal Plane	2800 mm
Draught	1000 mm
Freeboard	650 mm
Weight	1500 kg
Max mooring weight	850 kg
Overall height (dependant on topmarks)	5600 mm

Balmoral's design and technical department can incorporate any special requirements as necessary.

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L40 GRP BUOY

Balmoral L40 GRP buoys are constructed from Baltec foam filled glass reinforced plastic protected by a marine grade rubber fender. The batwing type daymarks bolt together to form the platform for the beacon and topmarks if required.

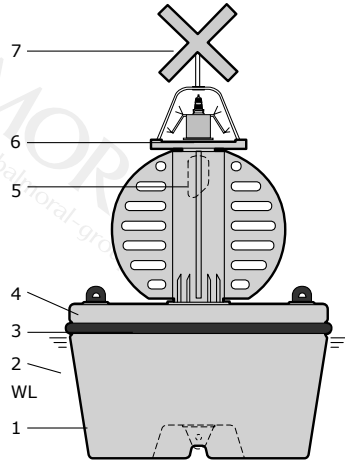
The materials used by Balmoral in the construction make the buoys impact resistant, virtually unsinkable and ensure a long maintenance free life.

The standard L40 GRP buoy is equipped with the following fittings:

1 Single mooring eye
2 Rubber fender
3 Lifting eyes - 2 in no
4 Radar reflector
5 Balmoral solargen pack
6 Beacon
7 Topmarks
WL Waterline

The buoy will be coloured to suit IALA recommendations.

A solar powered version is depicted



General Particulars

Diameter	4000 mm
Focal Plane	3800 mm
Draught	1650 mm
Freeboard	1200 mm
Weight	7000 kg
Max mooring weight	3500 kg
Overall height (dependant on topmarks)	5600 mm

Balmoral's design and technical department can incorporate any special requirements as necessary.

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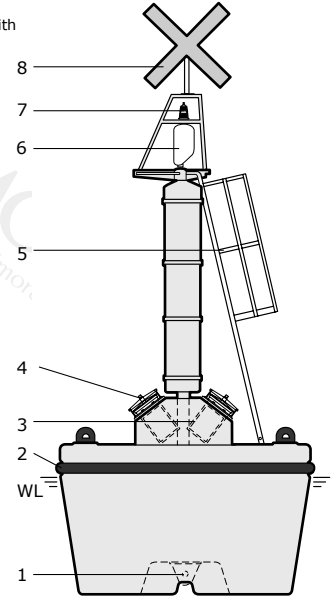
P40 GRP BUOY

Balmoral P40 GRP buoys are constructed from Baltec foam filled glass reinforced plastic protected by a marine grade rubber fender. The bolt on pillar can be fitted with any IALA recommended topmarks.

The materials used by Balmoral in the construction make the buoys impact resistant, virtually unsinkable and ensure a long maintenance free life.

The standard P40 GRP buoy is equipped with the following fittings:

1 Single mooring eye
2 Rubber fender
3 Lifting eyes - 2 in no
4 Battery
5 Ladder
6 Radar reflector
7 Beacon
8 Topmarks
WL Waterline



The buoy will be coloured to suit IALA recommendations.

A solar powered version is also available

General Particulars

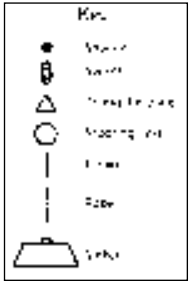
Diameter	4000 mm
Focal Plane	6500 mm
Draught	1650 mm
Freeboard	1200 mm
Weight	7500 kg
Max mooring weight	3000 kg
Overall height (dependant on topmarks)	9050 mm

Balmoral's design and technical department can incorporate any special requirements as necessary.

MOORING SYSTEMS

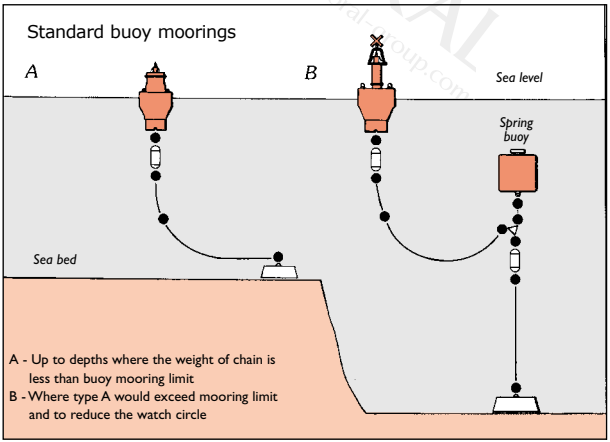
The choice of mooring system required is dependent on the size of buoy and the conditions in which it shall operate.

The diagrams depicted here are indicative of the type of mooring systems which can be used in various locations. Balmoral Marine can design the optimum system for each application.

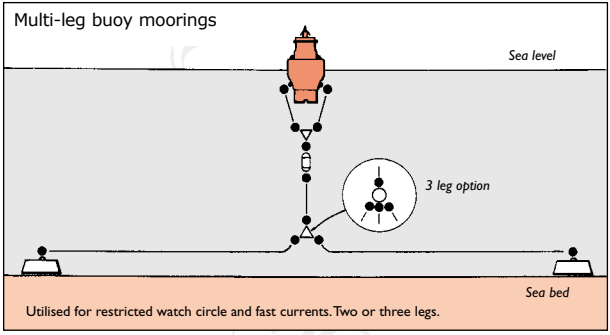


To achieve this the following information is required:

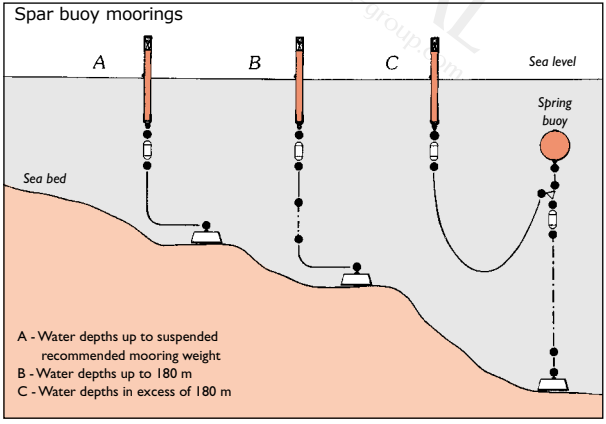
1 Location
2 Water depth
3 Tidal range
4 Current velocity
5 Wave heights and periods (if known)
6 Wind speeds
7 Maximum watch circle required (if applicable)
8 Sea bed conditions (if known)



MULTI-LEG BUOY MOORINGS



SPAR BUOY MOORINGS



Section 10
FENDERS

Pneumatic Fenders and Elastomer Foam Floating Fenders

Balmoral's ten sizes of fender cater for ships dead-weight ranging from 250-350,000 tonne. Elastomer foam fenders are constructed with a central steel through-pipe with polyethylene foam core forming the resilient part of the fender. The rugged, tear-resistant skin is formed using high tensile fibre reinforced polyethylene elastomer. Tyre and chain nets are optional.

This combination of materials enables extremely high compressive stresses to be absorbed, coupled with low reaction forces.

Fenders are unsinkable. In the event of rupture of the outer skin, the closed cell property of the Baltec memory flexible foam seals off water ingress. The outer skin can be repaired quickly and economically.

The fenders are lightweight with high reserve buoyancy and always maintain the correct level in varying tidal waters.

Suitable for dock protection, all ship-to-shore operations and for ship-to-ship protection at sea. Balmoral can advise on type of fender on receipt of specific details of operation.

Balmoral also stocks a large range of fenders for hire.

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Fender Selection

Fender selection needs to take into account various factors.
Is the fender required to give standoff between the vessel and quayside or between two vessels side by side?
Is the fender being used to absorb energy of a vessel berthing?
Is the fender to protect the berthing vessel or the quayside or both?
Reaction force of a selected fender is also important as this is the load being imposed on the vessel hull during berthing operations. High reaction forces may damage vessel hulls.

Balmoral fenders are designed to give a reasonable standoff, protect both vessels and quaysides, and give high energy absorption and low reaction forces.

To ensure you have the correct size of fender we have set out the information required and a calculation for energy absorption. If there is doubt then please contact Balmoral Marine. Contact lists are on the rear cover.

Information required:
Displacement Tonnage of vessel/vessels berthing
Draft: Operational or maximum
Length of vessel
Berthing speed if known otherwise a speed of 0.15 metres a second will be used for medium to large vessels

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ENERGY ABSORPTION

(1)

$$E = \frac{MV^2 C_B}{2g}$$

where: E = Kinetic energy
M = Ship mass (= M_b + M_a)
V = Relative approach velocity
G = Acceleration of gravity (9.8 m/sec^2 or 32.2 ft/sec^2)
CB = Berthing coefficient

The mass, in the case of a ship, is the sum of the ship body mass, M_b and the added mass caused by the acceleration of the sea water surrounding the ship M_a, which may be estimated as follows:

(2)

$$M_a = \frac{\pi}{4} \rho D^2 L$$

where: ρ = Sea water density
D = Ship draft
L = Ship length

For ship-to-ship transfers involving two ships of different sizes, Equation (1) should be used with the mass, M, computed as:

(3)

$$M = \frac{M_1 M_2}{M_1 + M_2}$$

Where subscripts 1 and 2 represent the masses (body plus added) of the two ships. This expression results from the different equation of motion (essentially a two-mass spring systems) for the ship and fenders.

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Examples...

Sample energy absorption calculations are given to illustrate calculation procedures.

Ship-to-Quay Example

For this example a fully-laden 105,000 displacement bulk carrier is required to unload alongside a quay.
Characteristics of the vessel are given below.

M_b, Displacement Tonnage = 105,000 Tons
D, Draft = 12m
L, Length = 245m
M_a, Added Mass = $\frac{\pi}{4} \rho D^2 L = \frac{\pi}{4} \times 1.028 \times (12)^2 (245)$

M_a = 28,488 tons
$M = M_a + M_b$ = 28,488 + 105,000
M = 133, 488 tons

A berthing velocity of 0.15 m/sec is/has been assumed for this example. The energy absorption requirement is calculated as follows, assuming a berthing coefficient of 0.5:

$$E = \frac{MV^2}{2g} - C_B$$

$$E = \frac{(133{,}488)\ (0.15)^2 (0.5)}{2 \times 9.8}$$

E = 76.6 ton-m

The energy value is then used for selecting a fender having an energy absorption capacity of 76.6 ton-m at 60% compression.

Worksheets have also been provided for ease in performing the energy absorption calculations.

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Ship-to-Ship Example

For this example, a fully-laden 70,000 Displacement tanker that is berthing alongside a fully-laden 260,000 Displacement tanker.
Characteristics of the vessel are given below.

70,000 DWT Tanker
M_b, Displacement Tonnage = 70,000 Tons
D, Draft = 11.5m
L, Length = 230m
M_a, Added Mass = $\frac{\pi}{4} \rho D^2 L = \frac{\pi}{4} \times 1.028 \times (11.5)^2 (230)$

M_a = 24,562 tons
$M_1 = M_a + M_b$ = 24,562 + 70,000 = 94,562 tons

260,000 Displacement Tanker
M_b, Displacement Tonnage = 260,000 Tons
D, Draft = 18.5m
L, Length = 310m
M_a, Added Mass = $\frac{\pi}{4} \rho D^2 L = \frac{\pi}{4} \times 1.028 \times (18.5)^2 (310)$

M_a = 85,673 tons
$M_2 = M_a + M_b$ = 85,673 + 260,000 = 345,673 tons

The mass used in the energy equation is calculated from Equation (3):

$$M = \frac{M_1 M_2}{M_1 + M_2} = \frac{(94,562)\ (345,673)}{94,562 + 345,673}$$

M = 74, 248 tons

10.5

(cont. over)

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Ship-to-Ship Example continued

A berthing velocity of 0.20m/sec has been assumed for this example. The required energy to be absorbed is calculated as follows, assuming a berthing coefficient of 0.5:

$$E = \frac{MV^2}{2g} - C_B$$

$$E = \frac{(74{,}248)\ (0.20)^2(0.5)}{2 \times 9.8}$$

E = 75.76 ton-m

Having found the energy absorption figure choose the appropriate size of fender or slightly larger. Do not select one below the value that you require. A single fender has to be capable of absorbing the entire berthing energy.

The numbers of fenders required is dependant on the berthing area and the size of the berthing vessel. For medium to large vessel 4-5 units would generally be considered sufficient.

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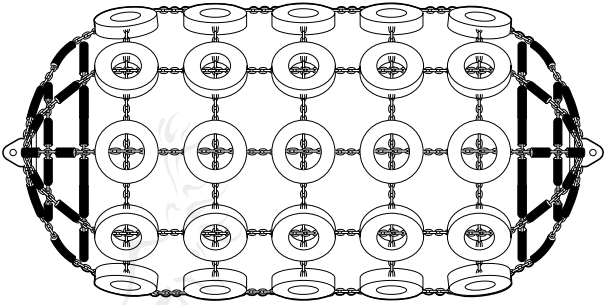
FOAM FILLED FENDERS



Foam Fender specifications			
	60% Deflection		
Nominal size Dia. x Length (metres)	Energy absorption (tonnes)	Reaction force (tonnes)	Weight with chain tyre net (kg)
1.0 x 1.5	4.1	19.5	365
1.2 x 2.0	8.2	32.25	490
1.5 x 2.5	16	50.5	565
1.5 x 2.5	20.2	63.5	950
2.0 x 3.0	33.1	78	1300
2.0 x 4.0	48.1	113.5	1650
2.5 x 5.5	93.5	200	3100
3.3 x 6.5	210	300	6950
3.5 x 8.0	300	405	9250

All dimensions are approximate

Reaction force and energy absorption figures above are indicative only.
Contact Balmoral Marine for actual figures in specific situations.

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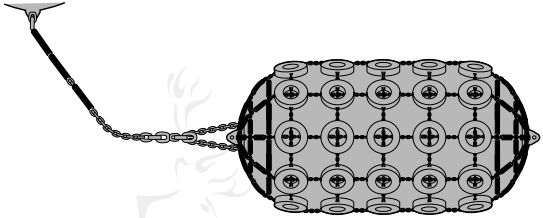
PNEUMATIC FENDER

The wall of the fender body is reinforced by a tightly woven nylon reinforced rubber layer between an internal and an extra thick external rubber layer.



Pneumatic Fender specifications					
Nominal size Dia. x Length (metres)	Initial Pressure 0.05kg/cm²		Weight		Total weight (kg)
	Reaction force (tonnes)	Energy absorption (tonnes)	Fender body (kg)	Chain & tyre net (kg)	
0.5 x 1.0	6.50	0.60	24	—	24
0.7 x 1.5	13.80	1.70	84	148	232
1.0 x 1.5	18.30	3.20	97	160	257
1.0 x 2.0	26.00	4.60	158	171	329
1.2 x 2.0	30.00	6.30	170	286	456
1.35 x 2.5	43.10	10.20	220	340	560
1.5 x 3.0	58.50	15.40	340	513	853
1.7 x 3.0	64.50	19.30	480	980	1460
2.0 x 3.5	88.40	31.00	550	990	1540
2.5 x 4.0	139.00	66.70	1040	1260	2300
2.5 x 5.5	204.00	95.00	1340	1680	3020
3.3 x 4.5	190.00	118.00	1980	2290	4270
3.3 x 6.5	304.00	183.00	2475	2735	5210

All dimensions are approximate

- "Guaranteed energy absorption" represents the guaranteed energy absorption at 60% deflection
- Tolerance of reaction force and deflection at guaranteed energy absorption are as follows: Reaction ± 10% • Deflection ± 10%
- Each reaction and energy absorption are measured under static condition
- Testing pressure rate indicates the testing pressure at factory
- Weight of fender body and net may vary by ± 10%
- Other sizes may be possible

Section 11
CHAIN INSPECTION

Introduction

Balmoral Marine operates a number of chain inspection and repair units on a worldwide basis. These specialist inspection and repair units provide an excellent working environment where inspection and repair work can take place on a continuous shift basis without interruption from bad weather.

All inspection and repair units comply with industry certification, are easily transportable and can be mobilised within 24 hours.

Balmoral Marine is approved by most certifying authorities to carry out chain inspection and carries a manufacturing survey arrangement (MSA) with DNV.

All procedures exceed industry standards and Balmoral Marine has an environmental policy in place.

Inspections carried out in accordance with API 2F and DNV Cert No. 2.9

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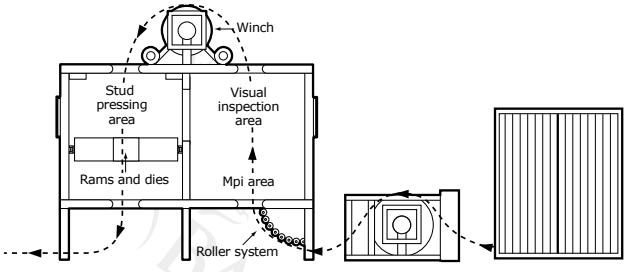
CHAIN INSPECTION UNIT



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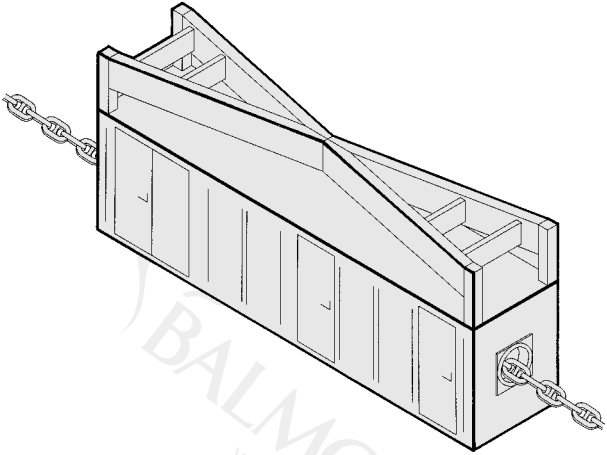
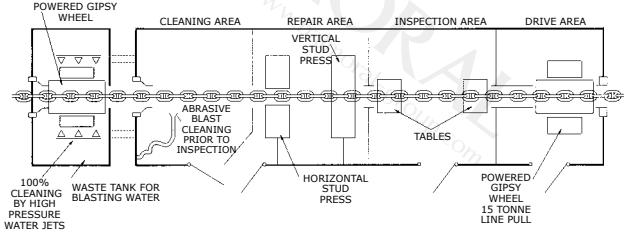
CHAIN INSPECTION UNIT





SCHEMATIC LAYOUT

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Section 12
LOAD TESTING

Introduction

The test house facilities comprise a range of load testing equipment. This test equipment is capable of proof loading and in some cases break testing a wide range of products. These products include slings, chain and fittings, anchors and many other types of offshore items.

Balmoral has one of the most comprehensive test units in the UK and serves many industries.

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LOAD TESTING

110 Tonne Sling Test Bed
This test bed has a working length of 10 metres and is primarily used for testing slings and other items that have a proof load test of 110 Tonnes or less. The working length can be adjustable to suit a wide range of sling lengths and other items. Ultimate proof load 110 Tonnes

155 Tonne Test Bed
This test bed has a short length and was designed for proof loading wire rope terminations after they have been applied. The test bed is also used to proof load shackles and other short items with a proof load of 155 tonnes or less. Ultimate proof load 155 Tonnes.

575 Tonne Test Bed
This bed was originally designed for testing of ship's chain to proof load. The bed is approximately 100 feet long and can accept a normal 27.5 metre length of ship's chain. It is also used to test a variety of other oilfield equipment such as bails, elevators, fabrications and marine jewellery. The bed has a limited capacity for break testing and has been used by verification companies.
Ultimate proof load 575 Tonnes.

Anchor Test Bed
The bed was originally designed for the testing of all types of anchors with a proof load up to a maximum of 250 Tonnes. The bed is adaptable for other testing operations. Ultimate proof load 250 Tonnes.

Anchor Test Rig
The rig was designed to test Stevpris high holding power anchors to NMD rules, which call for a higher proof load than more conventional anchors. The rig is portable and available for testing Stevpris anchors onsite. Ultimate proof load 450 Tonnes.
All the above test beds and rigs carry certification and are approved by most certifying authorities.

All testing can be witnessed by appropriate Classification Societies or other independent bodies if required.

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Section 13
MOORING SYSTEMS

Design Considerations

- Environmental conditions
- Seabed conditions
- Vessel or buoy shape and dimensions
- Vessel or buoy stability calculations at various load drafts
- Operational limitations imposed
- Limits of excursion
- Mooring location and number of mooring lines to be used if known
- Any data on submarine pipelines riser hoses etc that may be associated with the mooring system
- Installation and maintenance that may be required
- Design criteria such as storm data that the system would require to operate
- Classification society nominated
- Installation and methodology requirements

Calculations

Mooring analysis taking into consideration the effects of:

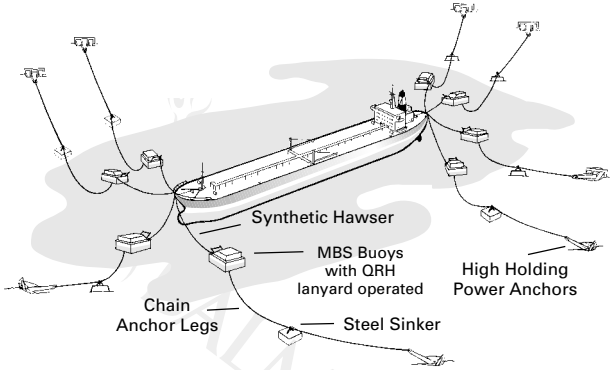
- Wind
- Current
- Wave and swell
- Predominant weather directions and patterns
- Hose analysis if part of the mooring system and the effect on them due to the vessel movements

Evaluation

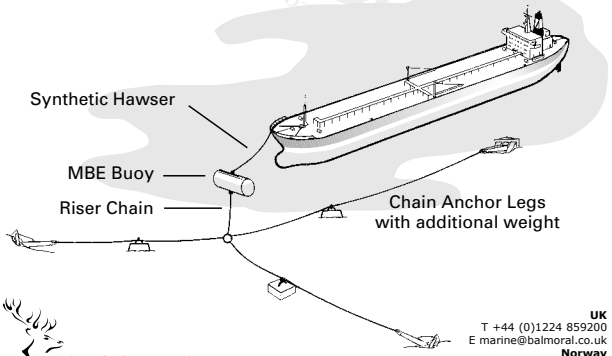
- Examine the options listing the different types of mooring systems that can be used
- Select the best option
- Select and submit a bill of materials
- Select a possible alternative system and submit a bill of materials
- Examine the technical and economical benefits of selected systems
- Select system and components

CBM SYSTEM

Using MBS Buoys with QR Hooks.
System varies with size of tanker
and location.



ADMIRALTY MOORING SYSTEM



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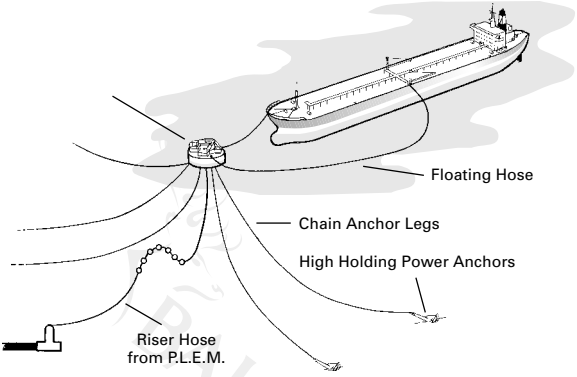
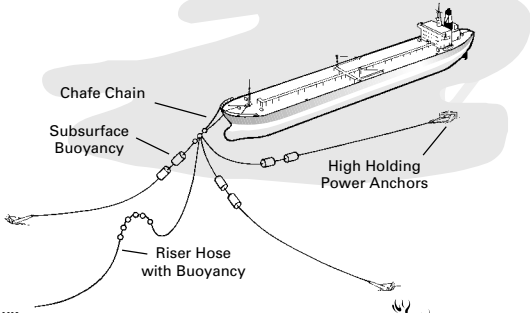
SINGLE POINT MOORING



TCMS (Tanker Weathering)



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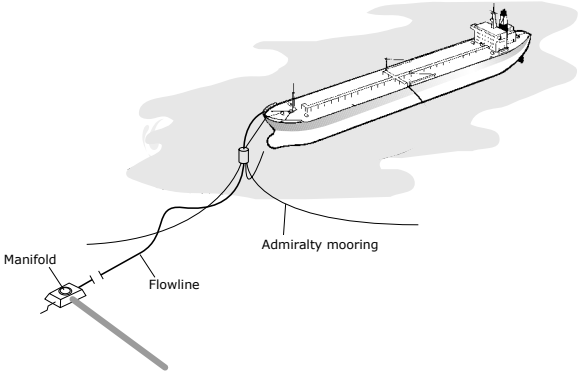
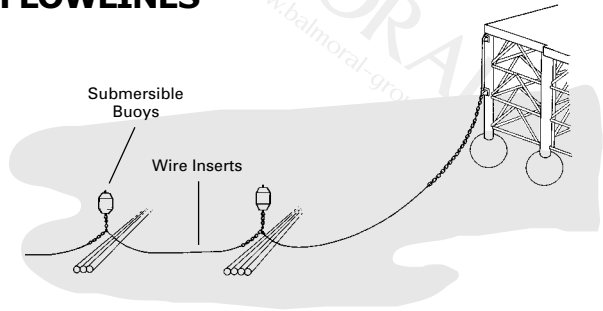
VAMS



SUSPENDED MOORINGS OVER FLOWLINES



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Section 14

SERVICE/SUPPLY INFORMATION REQUIREMENTS

Information required to assist in the design and supply of:

- **WIRE ROPE SLINGS**
- **SPOOLING MACHINES**
- **MARKER BUOYS AND MOORING SYSTEMS**
- **WIRE ROPE**
- **MOORING SYSTEMS**

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SINGLE LEG SLINGS

(Refer to Safe Working Load of Single Leg Slings by Usage)

1 Weight of each unit and number of units per lift

2 Number of slings per lift dependent on size and shape of equipment

3 Length of sling needed to provide a stable and secure lift with a maximum of 0-90° included angle (if 2 single leg slings are used)

4 Type of termination/end fitting (eg size of soft eye)

5 Specification identification, markings, colour coding if required

6 Bulldog grips for securing slings

7 Tywraps

MULTI-LEG SLING ASSEMBLIES

1 Number of legs required dependent on lifting points and height of container/equipment (height of containers will determine if a top leg is required), sling should be able to be fitted to crane hook without the operator leaving the deck

2 Maximum gross weight of unit

3 Distance between pad eyes to establish length of legs

4 Details of pad eyes to establish shackle size

5 Specific identification markings/colour coding if required

6 Type of fittings required on legs ie hooks, shackles etc

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SPOOLING EQUIPMENT

1 Overall dimensions of drum *ie*, overall width/diameter

2 Size of shaft aperture

3 Details of drive plate arrangements on reel

4 Overall length and diameter of cable to be spooled

5 Overall weight in air/water of cable

6 Minimum bending radius required

7 Amount of back tension required

MOORING SYSTEMS

- Vessel dimensions and type, *ie*, tanker LOA, Beam, Draft, Moulded height
- Location
- Water depth
- Seabed condition *ie*, geotechnical information
- Environmental conditions *ie*, current direction and speed, wind direction and speeds maximum
- Sheltered or open waters
- Vessel operational criteria, for vessels *ie*,

  In what environmental conditions will the vessel be moored? Does the vessel need to weather around the moorings? Will cargo transfer or lightening take place at the mooring? Will vessels be moored alongside or in tandem with moored vessel?

MOORING PIGGY BACK EQUIPMENT

1 Number of piggy back sets required

2 Water depth

3 Seabed conditions to establish type of anchor required

4 Type of current primary anchor, including crown fittings

5 Equipment required by anchor handling vessel ie work wires, chasers and grapnels

6 Type of connectors preferred (ie shackles or hinge-links)

7 Type of pigtail dressing required on buoys and anchors

8 The diameter of the wire rope pendants will normally be determined by the loads to be applied. The overall length required can however be achieved by a number of permutations such as 1 x 1000 ft or 5 x 200 ft depending on individual preference

9 If pendants over 600 ft long are required, these can be fitted on reelers which aid handling and reduce damage

10 Does the equipment require to be split between a number of anchor handling vessels?

MARKER BUOYS

1 Minimum and maximum water depth

2 Current speed

3 Environmental conditions (sheltered water or exposed locations)

4 Purpose of buoy

5 Light flash sequence, range and latitude required for solar calculations

6 Specific markings

7 Facilities for launching and handling buoys ie crane availability

8 Latitude for solar power

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WIRE ROPE

1 Length

2 Diameter

3 Construction and core or application

4 Safe working load required and safety factor

5 Grade of steel if applicable

6 Finish (galvanised or bright ungalvanised dependent on environment)

7 Type of lubrication required (dependent on application)

8 Type of end fittings (if any)

9 Wire rope can be supplied either on a drum or in a coil

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Section 15
CONVERSION CHARTS

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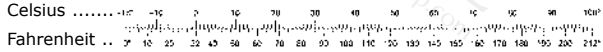
CONVERSION FORMULAE

Multiply by	To obtain To convert	From To	Multiply by
0.4536	lb	kg	2.2046
1016-05	ton	kg	0.000984
9.9676	ton f	kN	0.10033
25.4	in	mm	0.03937
0.3048	ft	m	3.280842
1.83	fathoms	m	0.546807
1.49	lb/ft	kg/m	0.671999
0.2480	lb/fathom	kg/m	4.031997
1.5748	ton f/sq in	kgf/sq mm	0.634997
15.444	ton f/sq in	N/sq mm (Mpa)	0.06475
0.000703	lb f/sq in	kgf/sq mm	1422.330
0.006895	lb f/sq in	N/sq mm (Mpa)	145.038
9.807	kgf/sq mm	N/sq mm (Mpa)	0.10194
10.0165	h bar	N/sq mm (Mpa)	0.09939
0.0305	oz/sq ft	g/sq cm	32.771

Temperature Conversion °C / °F

$$C = \frac{5}{9}(F-32) \qquad F = \frac{9}{5}C+32$$



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CONVERSION CHARTS

LENGTH centimetres (cm)	cm or inches	inches (in)
2.54	1	0.394
5.08	2	0.787
7.62	3	1.181
10.16	4	1.575
12.70	5	1.969
15.24	6	2.362
17.78	7	2.756
20.32	8	3.150
22.86	9	3.543
25.40	10	3.937
50.80	20	7.874
76.20	30	11.811
101.60	40	15.748
127.00	50	19.685
152.40	60	23.622
177.80	70	27.559
203.20	80	31.496
228.60	90	35.433
254.00	100	39.370

LENGTH kilometres	km or miles	miles
1.609	1	0.621
3.219	2	1.243
4.828	3	1.864
6.437	4	2.485
8.047	5	3.107
9.656	6	3.728
11.265	7	4.350
12.875	8	4.971
14.484	9	5.592
16.093	10	6.214
32.187	20	12.427
48.280	30	18.641
64.374	40	24.855
80.467	50	31.069
96.561	60	37.282
112.654	70	43.496
128.748	80	49.710
144.841	90	55.923
160.934	100	62.137

CONVERSION CHARTS

WEIGHT (MASS) kilograms (kg)	kg or lb	pounds (lb)
0.454	1	2.205
0.907	2	4.409
1.361	3	6.614
1.814	4	8.819
2.268	5	11.023
2.722	6	13.228
3.175	7	15.432
3.629	8	17.637
4.082	9	19.842
4.536	10	22.046
9.072	20	44.092
13.608	30	66.139
18.144	40	88.185
22.680	50	110.231
27.216	60	132.277
31.752	70	154.324
36.287	80	176.370
40.823	90	198.416
45.359	100	220.462

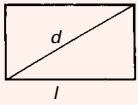
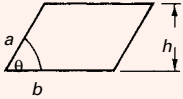
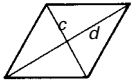
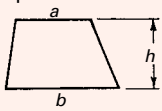
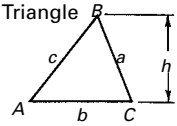
WEIGHT (MASS) tonnes (t)	tonnes or UK tons	UK tons
1.016	1	0.984
2.032	2	1.968
3.048	3	2.953
4.064	4	3.937
5.080	5	4.921
6.096	6	5.905
7.112	7	6.889
8.128	8	7.874
9.144	9	8.858
10.161	10	9.842
20.321	20	19.684
30.481	30	29.526
40.642	40	39.368
50.802	50	49.210
60.963	60	59.052
71.123	70	68.894
81.284	80	78.737
91.444	90	88.579
101.605	100	98.421

CONVERSION CHARTS

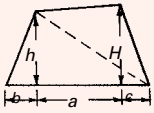
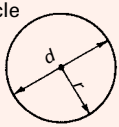
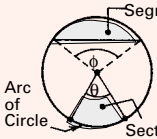
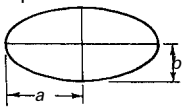
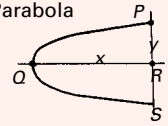
VOLUME litres	litres or UK gallons	UK gallons (UK gal)
4.546	1	0.220
9.092	2	0.440
13.638	3	0.660
18.184	4	0.880
22.730	5	1.100
27.276	6	1.320
31.822	7	1.540
36.368	8	1.760
40.914	9	1.980
45.460	10	2.200
90.919	20	4.399
136.379	30	6.599
181.839	40	8.799
227.298	50	10.998
272.758	60	13.198
318.217	70	15.398
363.677	80	17.598
409.137	90	19.797
454.596	100	21.997

AREA hectares (ha)	hectares or acres	acres
0.405	1	2.471
0.809	2	4.942
1.214	3	7.413
1.619	4	9.884
2.023	5	12.355
2.428	6	14.826
2.833	7	17.297
3.237	8	19.769
3.642	9	22.240
4.047	10	24.711
8.094	20	49.421
12.140	30	74.132
16.187	40	98.842
20.234	50	123.553
24.281	60	148.263
28.328	70	172.974
32.375	80	197.684
36.422	90	222.395
40.469	100	247.105

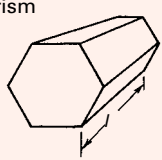
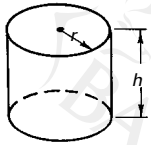
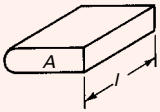
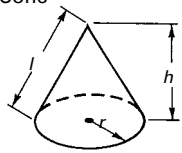
CONVERSION CHARTS

figure	area	perimeter
Rectangle 	$lb = b\sqrt{d^2 - b^2} = l\sqrt{d^2 - l^2}$	$2l + 2b$ (sum of sides)
Square 	$a^2 = \frac{1}{2}d^2$	$4a$ (sum of sides)
Parallelogram 	$bh = ab \sin \theta$	$2b + 2a$ (sum of sides)
Rhombus 	$\frac{1}{2}cd$ (c and d are the lengths of the diagonals)	(sum of sides)
Trapezium 	$\frac{1}{2}h(a + b)$	(sum of sides)
Triangle 	$\frac{1}{2}bh = \frac{1}{2}ab \sin C$ $= \sqrt{s(s-a)(s-b)(s-c)}$ where $s = \frac{a + b + c}{2}$	(sum of sides)

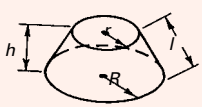
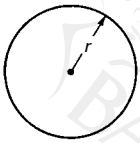
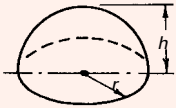
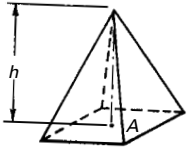
CONVERSION CHARTS

Figure	Area	Perimeter
Quadrilateral 	$\frac{a(H+h) + bh + cH}{2}$ Area also found by dividing the figure into two triangles as shown by the dotted line	(sum of sides)
Polygon (Regular) 	$\frac{1}{4} nl^2 cot \frac{180}{n}$ (n is the No of sides of length l)	$6l$ (sum of sides)
Circle 	$\pi r^2 = \frac{\pi d^2}{4}$	$\pi d = 2\pi r$
	Segment $\frac{1}{2} r^2(\phi - \sin\phi)$ (ϕ in radians) Sector $= \pi r^2 x \frac{\theta}{360}$ (θ in degrees) $= \frac{1}{2} r^2\theta$ (θ in radians) $= \frac{1}{2} rl$	Length of chord $= 2r \sin \frac{\phi}{2}$ Length of arc $= 2\pi r x \frac{\theta}{360}$ (θ in degrees) $= r\theta$ (θ in radians)
Ellipse 	πab	$2\pi\sqrt{\frac{1}{2}(a^2 + b^2)}$ approx
Parabola 	Area of sector PQRS $= \frac{4xy}{3}$	Length of arc PQS $= \frac{2\sqrt{y^2 x 4x^2}}{3}$ approx

CONVERSION CHARTS

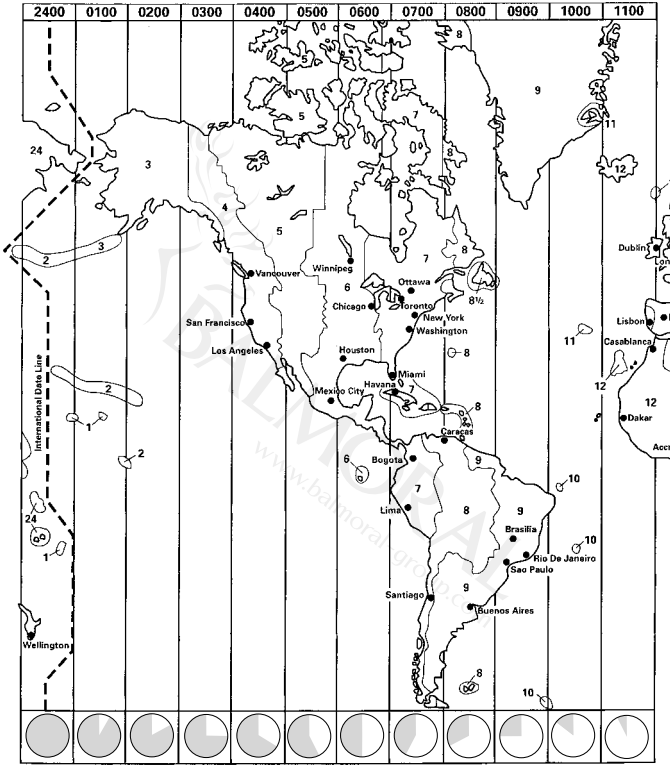
figure	area	perimeter
Prism 		Area of cross-section x length of prism
Cylinder 	Curved Surface $= 2\pi rh$ Total Surface Area $= 2\pi rh + 2\pi r^2$ $= 2\pi r(r + h)$	$\pi r^2 h$
Any solid having a regular cross - section  Area of ends = A	Curved Surface Area = perimeter of cross-section x length Total Surface Area = curved surface area + area of ends	Al
Cone 	Curved Surface Area $= \pi rl$ Total Surface Area $= \pi rl + \pi r^2$ *(h = vertical height)* *(l = slant height)*	$\frac{1}{3}\pi r^2 h$

CONVERSION CHARTS

figure	area	perimeter
Frustrum of a cone 	Curved Surface $= \pi(R+r)l$ Total Surface Area $= \pi(R+r)l + \pi R^2 + \pi r^2$	$\frac{1}{3}\pi h(R^2 + Rr + r^2)$
Sphere 	$4\pi r^2$	$\frac{4}{3}\pi r^3$
Segment of a sphere 	$2\pi rh$	$\frac{1}{3}\pi r^2 (3r-h)$ $= \frac{1}{6}\pi h(h^2+3a^2)$ a = radius of base of segment
Pyramid  Area of base = A		$\frac{1}{3}Ah$

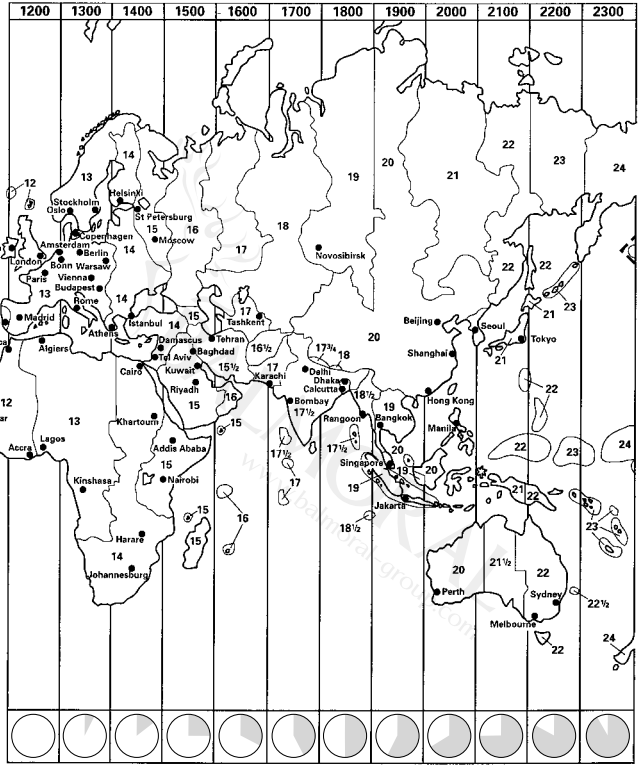
CONVERSION CHARTS

WORLD STANDARD TIMES



Standard times at 12 Noon Greenwich Mean Time

CONVERSION CHARTS



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CONVERSION CHARTS

BEAUFORT SCALE OF WIND VELOCITY

Beaufort Number	Wind Velocity (knots)	(MPH)	Seaman's Term	Sea Condition	Typical Wave Height Feet	Typical Condition Attainment Time
0	0-1	0-1.7	Calm	Glassy-smooth, mirror-like	Smooth	--
1	2-3	1.8-4.0	Light Air	Scale-like ripples	Ripples	1-10 min
2	4-6	4.1-7.4	Light Breeze	Small, short wavelets with glassy crests	1/3	5-15 min
3	7-10	7.5-12.0	Gentle Breeze	Large wavelets, crests begin to break, occasional form	1-2	5-20 min
4	11-16	12.1-18.9	Moderate Breeze	Small waves, some whitecaps, more frequent form	2-3	15-60 min
5	17-21	19.0-24.7	Fresh Breeze	Moderate longer waves, better formed, many whitecaps, much foam, some spray	3-4	15-60 min
6	22-27	24.8-31.6	Strong Breeze	Large waves form, many whitecaps, foam everywhere, more spray	4-5	1/4-2 hr.
7	28-33	31.7-38.5	Moderate Gale	Sea heaps up, streaks of foam spindrift begins	5-6	1/2-3 hr.
8	34-40	38.6-46.6	Fresh Gale	Moderately-high long waves, crests into spindrift, well-marked streaks of foam	6-7	1/2-3 hr.
9	41-47	46.7-53.9	Strong Gale	High waves, sea rolls, dense streaks, spray affects visibility	7-9	1/2-4 hr.

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