

# BRIDON

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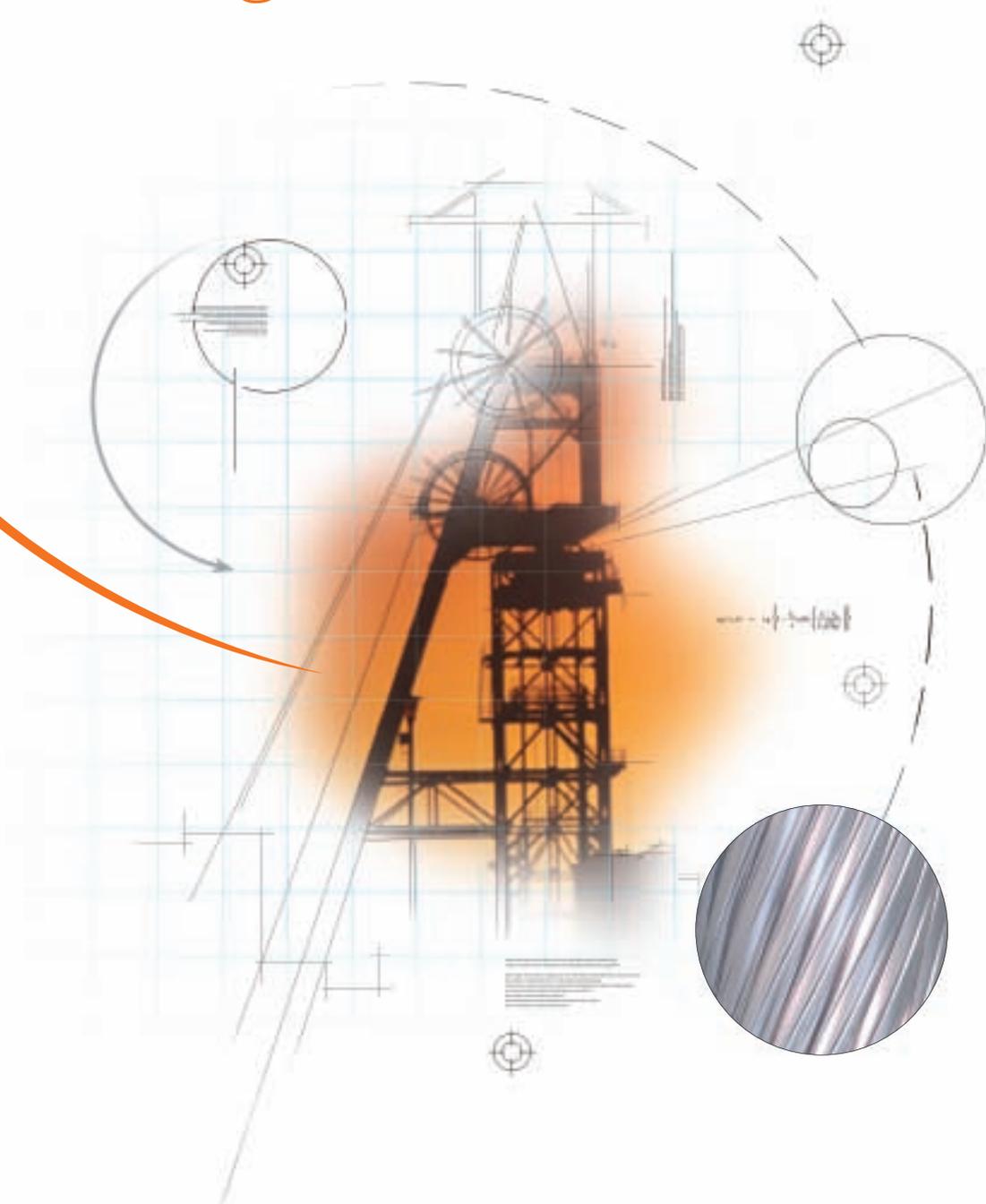
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High quality steel wire ropes for mining applications

# Mining



**BRIDON**



**Bridon - the world's leading specialist in the manufacture of wire and rope solutions for the most demanding applications, delivering reassurance through unrivalled experience.**

## High quality steel wire ropes for **mining** applications

Drawing from a background of long standing experience and technology, Bridon is an acknowledged world leader in the design, manufacture, development and supply of rope to meet the needs of the mining industry.



High performance ropes for Hoist, Balance, Guide, Haulage, Rope Driven Conveyor and General Engineering Applications.



**The *Difference* is  
BRIDON**

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Bridon's products are manufactured under controls that conform to quality management system ISO 9001:2000.



All statements, technical information and recommendations contained herein are believed to be reliable, but no guarantee is given as to their accuracy and/or completeness. The user must determine the suitability of the product for his own particular purpose, either alone or in combination with other products and shall assume all risk and liability in connection therewith.

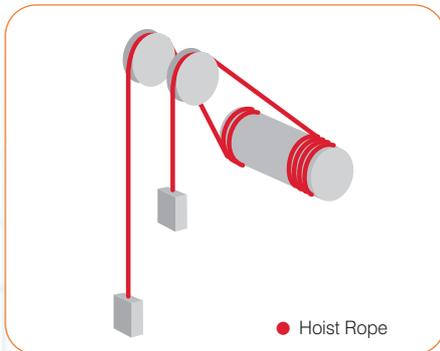
Whilst every attempt has been made to ensure accuracy in the content of the tables, the information contained in this catalogue does not form part of any contract.

## ISO 14001

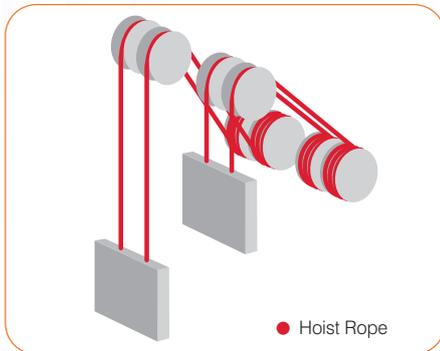
Bridon operates environmental management systems which, where required by legislation or risk, comply with the requirements of EN ISO 14001:2004 and are assessed and registered by accredited certification bodies.



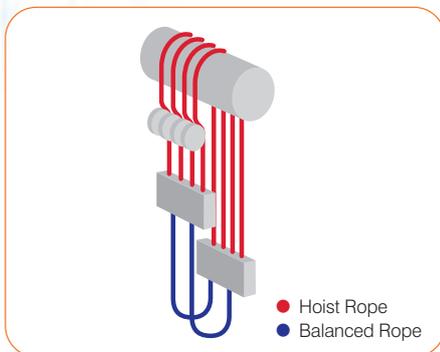
## Hoist and Balance Ropes



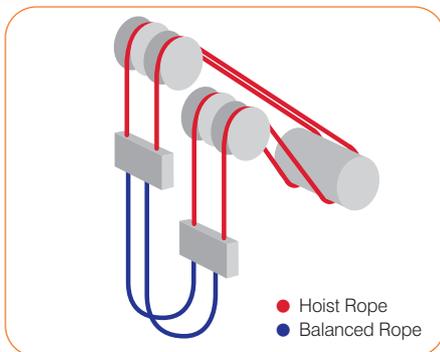
Parallel Drum Hoist



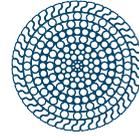
Blair Hoist



Tower Mounted Friction Hoist with Deflectors



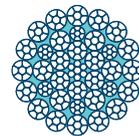
Ground Mounted Friction Hoist



### Tiger FL ●

- High strength
- Manufactured virtually non-rotating.
- Reduced stretch
- Can be prestretched
- Reduced internal cross-cutting
- Operate under higher radial pressure
- Reduced tread pressures
- Maximum retention of manufacturing lubricant
- Good resistance to wear and corrosion

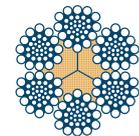
See page 22



### Tiger DYFORM® 34LR/PI Class ●

- Higher strength
- Good resistance to rotation.
- Reduced internal torsional stresses
- Excellent resistance to fatigue
- Improved flexibility
- Excellent resistance to wear
- Optional plastic impregnation

See page 16

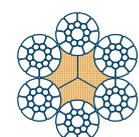


### Tiger 6T Compound ●

**6x22(9/12/Brangle), 6x23(10/12/Brangle)  
6x25(12/12/Brangle), 6x26(13/12/Brangle)  
6x27(14/12/Brangle), 6x28(15/12/Brangle)**

- Improved resistance to wear
- Reduced sheave and liner wear
- High strength
- Effective diameter control

See pages 12-13



### Tiger DYFORM® 6R ●

**6x19(S), 6x36(WS)**

- High quality
- Readily available
- Consistent performance
- Good resistance to wear
- Improved resistance to fatigue.
- Reduced interference in multi-layer coiling applications

See pages 9 & 11

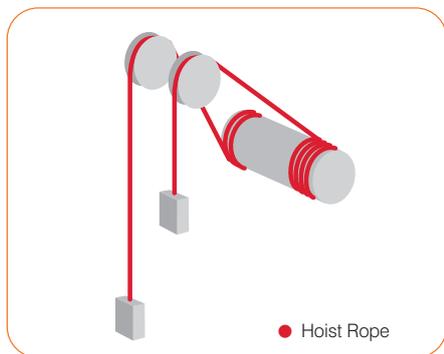


### Tiger DYFORM® 18M/PI Class ●●

- Higher strength
- Good resistance to rotation
- Reduced internal torsional stresses
- Excellent resistance to fatigue
- Improved flexibility
- Excellent resistance to wear
- Optional plastic impregnation

See page 14

## Hoist and Balance Ropes



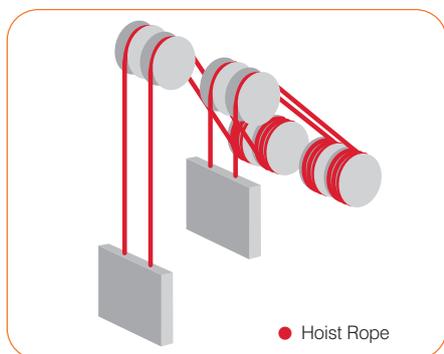
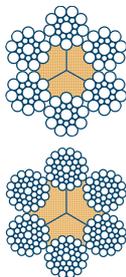
Parallel Drum Hoist



### Tiger 6R 6x19(S), 6x36(WS) ●

- High quality
- Readily available
- Consistent performance

See pages 8 & 10



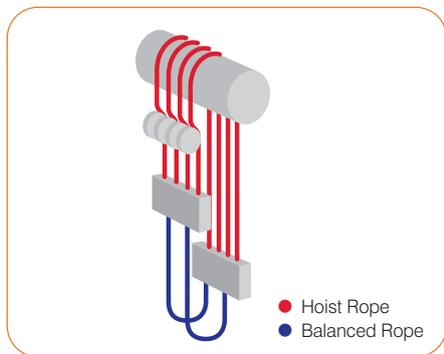
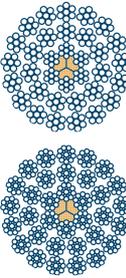
Blair Hoist



### Tiger 34M Class ●●

- Good resistance to rotation
- Reduced internal torsional stress
- Improved flexibility

See pages 15



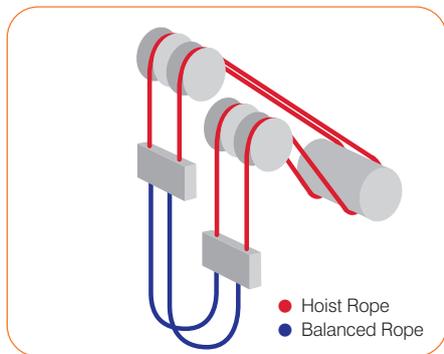
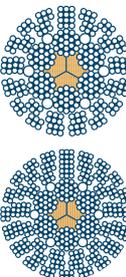
Tower Mounted Friction Hoist with Deflectors



### Tiger Superflex 17x6, 20x6 ●

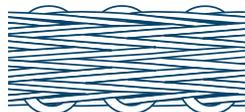
- Maximum Flexibility
- Maximum Resistance to wear

See page 17



Ground Mounted Friction Hoist

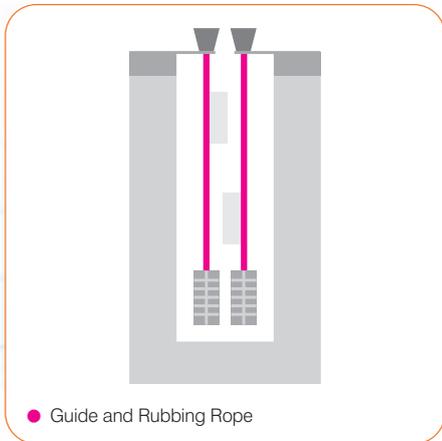
### Flat ropes 8x4x7, 6x4x12, 8x4x12, 8x4x14, 8x4x19 ●



- Maximum flexibility
- Good rotational characteristics

See page 18

## Guide and Rubbing Ropes

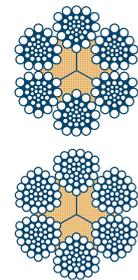
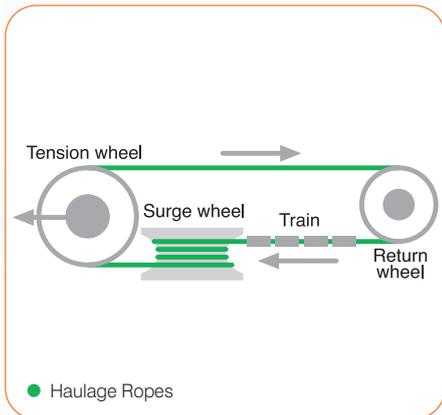


### Tiger HL ●

- High strength
- Good resistance to wear and corrosion
- Reduced stretch
- Can be prestretched
- Reduced internal cross-cutting

See page 23

## Haulage Ropes

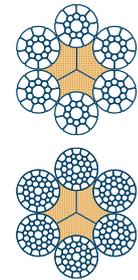
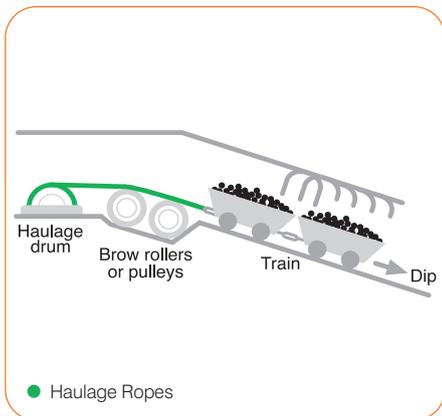


### Tiger 6T Compound ●

- 6x22(9/12/Brangle), 6x23(10/12/Brangle)
- 6x25(12/12/Brangle), 6x26(13/12/Brangle)
- 6x27(14/12/Brangle), 6x28(15/12/Brangle)

- Good resistance to wear
- Reduced sheave and liner wear
- High strength
- Effective diameter control
- Good fatigue resistance

See pages 12-13

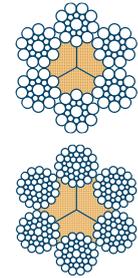


### Tiger DYFORM® 6R ●

6x19(S), 6x36(WS)

- High quality
- Excellent fatigue resistance
- Readily available
- Consistent performance
- Excellent resistance to wear

See pages 9 & 11

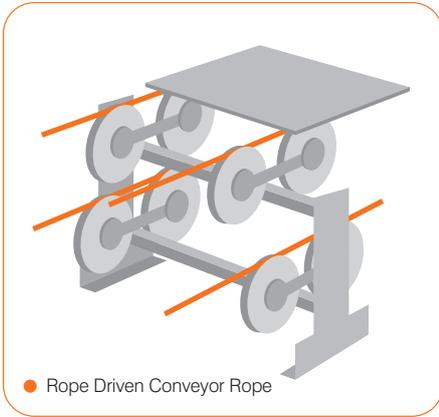


### Tiger 6R 6x19(S), 6x36(WS) ●

- High quality
- Readily available
- Consistent performance
- Good resistance to wear

See pages 8 & 10

## Rope Driven Conveyor Ropes



**Zebra**



**6x19(S), 6x26(WS), 6x31(WS)** ●

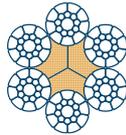
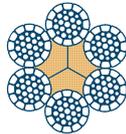
- Increased fatigue life
- High strength
- Reduced stretch
- Effective diameter control
- Reduced tread pressures
- Good resistance to wear and corrosion
- Reduced vibration and noise
- Extended rope life
- Extended splice life
- Minimal line stand and terminal pulley maintenance

*See page 19*



**Tiger DYFORM® 6CDR** ●

**6x19(S), 6x31(WS)**



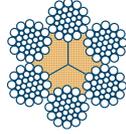
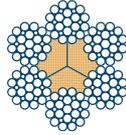
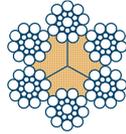
- Superior quality drive rope
- Special preformation for long splicing
- Special tensile grades
- High density and high tolerance cores
- Bespoke lubrication
- Superior breaking load
- Excellent fatigue life
- Reduced line stand pulley maintenance

*See page 21*



**Tiger 6CDR** ●

**6x19(S)(9/9/1), 6x25(F)(12/6+6F/1)**



- High performance conventional rope
- Special preformation for long splicing
- Special tensile grades
- High density and high tolerance cores
- Bespoke lubrication

*See page 20*



The "Powercheck" symbol means that BRIDON has carried out a destruction test on a sample of rope from each production length.



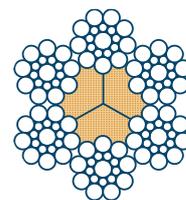
BRIDON has an active program to determine the rotational properties of its range of Rotation Resistant and low Rotation ropes. BRIDON has developed its own torque turn testing machine and has adopted a "Twistcheck" testing program for each product and is able to provide actual properties for any rope.



BRIDON has an active program to determine fatigue properties and specifies material of specific dimensions and properties, which will enhance fatigue performance. BRIDON design and manufactures its ropes with fatigue in mind and has machines for fatigue testing mining ropes.



## Tiger 6R 6x19(S) Class



Lay Type		Lay Direction		Finish		Core		
Ord	Langs	Right Hand	Left Hand	Bright	Galv	FC	FFC	IWRC
•	•	•	•	•	•	•	•	•

Available as standard. IWRC values available on request

Diameter	Approx Mass	Aggregate Breaking Force			Minimum Breaking Force		
		1570 N/mm <sup>2</sup>	1770 N/mm <sup>2</sup>	1960 N/mm <sup>2</sup>	1570 N/mm <sup>2</sup>	1770 N/mm <sup>2</sup>	1960 N/mm <sup>2</sup>
mm	kg/m	kN	kN	kN	kN	kN	kN
16	0.923	155	175	193	133	150	166
17	1.04	175	197	218	150	169	188
18	1.17	196	221	245	168	190	210
19	1.30	218	246	272	188	212	234
20	1.44	242	273	302	208	234	260
21	1.59	267	301	333	229	259	286
22	1.74	293	330	365	252	284	314
23	1.91	320	361	399	275	310	343
24	2.08	348	393	435	300	338	374
25	2.25	378	426	472	325	366	406
26	2.44	409	461	510	352	396	439
27	2.63	441	497	550	379	427	473
28	2.83	474	534	592	408	460	509
29	3.03	508	573	635	437	493	546
30	3.24	544	613	679	468	528	584
31	3.46	581	655	725	500	563	624
32	3.69	619	698	773	532	600	665
33	3.93	658	742	822	566	638	707
34	4.17	699	788	873	601	678	750
35	4.42	741	835	925	637	718	795
36	4.67	784	883	978	674	760	841
37	4.94	828	933	1030	712	803	889
38	5.21	873	984	1090	751	847	937
39	5.48	920	1040	1150	791	892	987
40	5.77	967	1090	1210	832	938	1040
41	6.06	1020	1150	1270	874	985	1090
42	6.36	1070	1200	1330	917	1030	1150

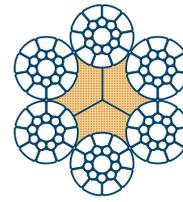
The nominal length mass values are for fully lubricated ropes. This table is for guidance purposes only.

Read pages 42-54 Product Safety Instructions and Warnings on the use of steel wire rope before selecting or using this product.





## Tiger DYFORM® 6R 6x19(S) Class



Lay Type		Lay Direction		Finish		Core		
Ord	Langs	Right Hand	Left Hand	Bright	Galv	FC	FFC	IWRC
•	•	•	•	•	•	•	•	•

Available as standard. IWRC values available on request

Diameter	Approx Mass	Aggregate Breaking Force			Minimum Breaking Force		
		1570 N/mm <sup>2</sup>	1770 N/mm <sup>2</sup>	1960 N/mm <sup>2</sup>	1570 N/mm <sup>2</sup>	1770 N/mm <sup>2</sup>	1960 N/mm <sup>2</sup>
mm	kg/m	kN	kN	kN	kN	kN	kN
25	2.51	428	483	534	360	405	449
26	2.72	463	522	578	389	438	485
27	2.93	499	563	623	419	473	524
28	3.15	537	605	670	451	508	563
29	3.38	576	649	719	484	545	604
30	3.62	616	695	769	518	584	646
31	3.86	658	742	822	553	623	690
32	4.12	701	791	875	589	664	735
33	4.38	746	841	931	626	706	782
34	4.65	792	892	988	665	750	830
35	4.93	839	946	1050	705	794	880
36	5.21	888	1000	1110	746	840	931
37	5.51	938	1060	1170	788	888	983
38	5.81	989	1110	1230	831	936	1040
39	6.12	1040	1170	1300	875	986	1090
40	6.43	1100	1240	1370	920	1040	1150
41	6.76	1150	1300	1440	967	1090	1210
42	7.09	1210	1360	1510	1010	1140	1270

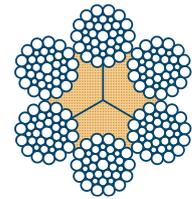
The nominal length mass values are for fully lubricated ropes.  
This table is for guidance purposes only.

Read pages 42-54 Product Safety Instructions and Warnings on the use of steel wire rope before selecting or using this product.





## Tiger 6R 6x36(WS) Class



Lay Type		Lay Direction		Finish		Core		
Ord	Langs	Right Hand	Left Hand	Bright	Galv	FC	FFC	IWRC
•	•	•	•	•	•	•	•	•

Available as standard. IWRC values available on request

Diameter	Approx Mass	Aggregate Breaking Force			Minimum Breaking Force		
		1570 N/mm <sup>2</sup>	1770 N/mm <sup>2</sup>	1960 N/mm <sup>2</sup>	1570 N/mm <sup>2</sup>	1770 N/mm <sup>2</sup>	1960 N/mm <sup>2</sup>
mm	kg/m	kN	kN	kN	kN	kN	kN
16	0.98	156	176	195	133	150	166
17	1.11	176	199	220	150	169	187
18	1.24	197	223	247	168	189	210
19	1.38	220	248	275	187	211	233
20	1.53	244	275	304	207	234	259
21	1.69	269	303	336	228	258	285
22	1.85	295	333	368	251	283	313
23	2.03	322	364	403	274	309	342
24	2.21	351	396	438	298	336	373
25	2.39	381	429	476	324	365	404
26	2.59	412	465	514	350	395	437
27	2.79	444	501	555	378	426	472
28	3.00	478	539	597	406	458	507
29	3.22	513	578	640	436	491	544
30	3.45	549	618	685	466	526	582
31	3.68	586	660	731	498	561	622
32	3.92	624	704	779	531	598	662
33	4.17	664	748	829	564	636	704
34	4.43	705	794	880	599	675	748
35	4.69	747	842	932	635	716	792
36	4.96	790	891	986	671	757	838
37	5.24	834	941	1040	709	800	885
38	5.53	880	992	1100	748	843	934
39	5.83	927	1050	1160	788	888	984
40	6.13	975	1100	1220	829	935	1030
41	6.44	1020	1160	1280	871	982	1090
42	6.76	1080	1210	1340	914	1030	1140
43	7.08	1130	1270	1410	958	1080	1200
44	7.41	1180	1330	1470	1000	1130	1250
45	7.76	1230	1390	1540	1050	1180	1310
46	8.10	1290	1450	1610	1100	1240	1370
47	8.46	1350	1520	1680	1140	1290	1430
48	8.82	1400	1580	1750	1190	1350	1490
49	9.20	1460	1650	1830	1240	1400	1550
50	9.58	1520	1720	1900	1300	1460	1620

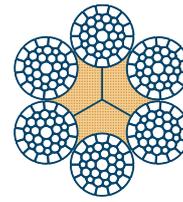
The nominal length mass values are for fully lubricated ropes.  
This table is for guidance purposes only.

Read pages 42-54 Product Safety Instructions and Warnings on the use of steel wire rope before selecting or using this product.





## Tiger DYFORM® 6R 6x36(WS) Class



Lay Type		Lay Direction		Finish		Core		
Ord	Langs	Right Hand	Left Hand	Bright	Galv	FC	FFC	IWRC
•	•	•	•	•	•	•	•	•

Available as standard. IWRC values available on request

Diameter	Approx Mass	Aggregate Breaking Force			Minimum Breaking Force		
		1570 N/mm <sup>2</sup>	1770 N/mm <sup>2</sup>	1960 N/mm <sup>2</sup>	1570 N/mm <sup>2</sup>	1770 N/mm <sup>2</sup>	1960 N/mm <sup>2</sup>
mm	kg/m	kN	kN	kN	kN	kN	kN
25	2.59	432	488	540	363	410	453
26	2.81	468	527	584	393	443	491
27	3.03	504	569	630	424	478	529
28	3.25	542	612	677	456	514	569
29	3.49	582	656	726	489	551	610
30	3.74	623	702	777	523	590	653
31	3.99	665	750	830	559	630	697
32	4.25	709	799	885	595	671	743
33	4.52	754	849	941	633	714	790
34	4.80	800	902	999	672	757	839
35	5.09	848	956	1060	712	803	889
36	5.38	897	1010	1120	753	849	940
37	5.68	947	1070	1180	796	897	993
38	5.99	999	1130	1250	839	946	1050
39	6.31	1050	1190	1310	884	997	1100
40	6.64	1110	1250	1380	930	1050	1160
41	6.98	1160	1310	1450	977	1100	1220
42	7.32	1220	1380	1520	1030	1160	1280
43	7.68	1280	1440	1600	1070	1210	1340
44	8.04	1340	1510	1670	1130	1270	1400
45	8.41	1400	1580	1750	1180	1330	1470
46	8.78	1460	1650	1830	1230	1390	1540
47	9.17	1530	1720	1910	1280	1450	1600
48	9.56	1590	1800	1990	1340	1510	1670
49	9.97	1660	1870	2070	1400	1570	1740
50	10.4	1730	1950	2160	1450	1640	1810
51	10.8	1800	2030	2250	1510	1700	1890
52	11.2	1870	2110	2340	1570	1770	1960
53	11.7	1940	2190	2430	1630	1840	2040
54	12.1	2020	2270	2520	1690	1910	2120
55	12.6	2090	2360	2610	1760	1980	2190
56	13.0	2170	2450	2710	1820	2050	2280
57	13.5	2250	2530	2810	1890	2130	2360
58	14.0	2330	2620	2910	1960	2200	2440
59	14.5	2410	2720	3010	2020	2280	2530
60	14.9	2490	2810	3110	2090	2360	2610
61	15.4	2570	2900	3210	2160	2440	2700
62	16.0	2660	3000	3320	2230	2520	2790
63	16.5	2750	3100	3430	2310	2600	2880
64	17.0	2830	3200	3540	2380	2680	2970
65	17.5	2920	3300	3650	2460	2770	3070
66	18.1	3010	3400	3760	2530	2850	3160

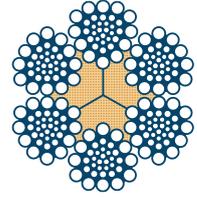
The nominal length mass values are for fully lubricated ropes.  
This table is for guidance purposes only.

Read pages 42-54 Product Safety Instructions and Warnings on the use of steel wire rope before selecting or using this product.





## Tiger 6T Compound Layer 6x22(9/12/Brangle), 6x23(10/12/Brangle), 6x25(12/12/Brangle)



Lay Type		Lay Direction		Finish		Core		
Ord	Langs	Right Hand	Left Hand	Bright	Galv	FC	FFC	IWRC
	•	•	•	•	•	•	•	

Diameter	Approx Mass	Aggregate Breaking Force			Minimum Breaking Force		
		1570 N/mm <sup>2</sup>	1770 N/mm <sup>2</sup>	1960 N/mm <sup>2</sup>	1570 N/mm <sup>2</sup>	1770 N/mm <sup>2</sup>	1960 N/mm <sup>2</sup>
mm	kg/m	kN	kN	kN	kN	kN	kN
16	1.08	184	205	225	157	174	192
17	1.22	208	232	255	177	197	216
18	1.37	233	260	285	198	221	243
19	1.52	260	289	318	221	246	270
20	1.69	288	321	352	245	273	299
21	1.86	318	354	388	270	301	330
22	2.04	349	388	426	296	330	362
23	2.23	381	424	466	324	360	396
24	2.43	415	462	507	353	393	431
25	2.64	450	501	551	383	426	468
26	2.85	487	542	595	414	461	506
27	3.08	525	584	642	446	497	546
28	3.31	565	629	691	480	534	587
29	3.55	606	674	741	515	573	630
30	3.80	648	722	793	551	613	674
31	4.06	692	770	846	588	655	720
32	4.32	738	821	902	627	698	767
33	4.60	784	873	959	667	742	815
34	4.88	833	927	1020	708	788	866
35	5.17	882	982	1080	750	835	917
36	5.47	934	1040	1140	794	883	970
37	5.78	986	1100	1210	838	933	1020
38	6.09	1040	1160	1270	884	984	1080
39	6.42	1100	1220	1340	931	1040	1140
40	6.75	1150	1280	1410	980	1090	1200
41	7.09	1210	1350	1480	1030	1150	1260
42	7.44	1270	1410	1550	1080	1200	1320
43	7.80	1330	1480	1630	1130	1260	1380
44	8.17	1390	1550	1710	1190	1320	1450
45	8.55	1460	1620	1780	1240	1380	1520
46	8.93	1520	1700	1860	1300	1440	1580
47	9.32	1590	1770	1950	1350	1510	1650
48	9.72	1660	1850	2030	1410	1570	1730
49	10.1	1730	1920	2110	1470	1640	1800
50	10.6	1800	2000	2200	1530	1700	1870

The nominal length mass values are for fully lubricated ropes.

This table is for guidance purposes only.

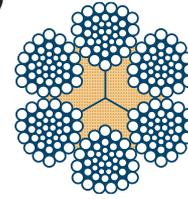
Ropes for friction winding application will weigh approximately 2% less than the above quoted weights.

Read pages 42-54 Product Safety Instructions and Warnings on the use of steel wire rope before selecting or using this product.





## Tiger 6T Compound Layer 6x26(13/12/Brangle) 6x27(14/12/Brangle), 6x28(15/12/Brangle)



Lay Type		Lay Direction		Finish		Core		
Ord	Langs	Right Hand	Left Hand	Bright	Galv	FC	FFC	IWRC
	•	•	•	•	•	•	•	

Diameter	Approx Mass	Aggregate Breaking Force			Minimum Breaking Force		
		1570 N/mm <sup>2</sup>	1770 N/mm <sup>2</sup>	1960 N/mm <sup>2</sup>	1570 N/mm <sup>2</sup>	1770 N/mm <sup>2</sup>	1960 N/mm <sup>2</sup>
mm	kg/m	kN	kN	kN	kN	kN	kN
28	3.32	565	629	691	480	534	587
29	3.56	606	674	741	515	573	630
30	3.81	648	722	793	551	613	674
31	4.06	692	770	846	588	655	720
32	4.33	738	821	902	627	698	767
33	4.60	784	873	959	667	742	815
34	4.89	833	927	1020	708	788	866
35	5.18	882	982	1080	750	835	917
36	5.48	934	1040	1140	794	883	970
37	5.79	986	1100	1210	838	933	1020
38	6.11	1040	1160	1270	884	984	1080
39	6.43	1100	1220	1340	931	1040	1140
40	6.77	1150	1280	1410	980	1090	1200
41	7.11	1210	1350	1480	1030	1150	1260
42	7.46	1270	1410	1550	1080	1200	1320
43	7.82	1330	1480	1630	1130	1260	1380
44	8.19	1390	1550	1710	1190	1320	1450
45	8.56	1460	1620	1780	1240	1380	1520
46	8.95	1520	1700	1860	1300	1440	1580
47	9.34	1590	1770	1950	1350	1510	1650
48	9.74	1660	1850	2030	1410	1570	1730
49	10.2	1730	1920	2110	1470	1640	1800
50	10.6	1800	2000	2200	1530	1700	1870
51	11.0	1870	2090		1590	1770	
52	11.4	1950	2170		1660	1840	
53	11.9	2020	2250		1720	1910	
54	12.3	2100	2340		1790	1990	
55	12.8	2180	2430		1850	2060	
56	13.3	2260	2510		1920	2140	
57	13.7	2340	2600		1990	2210	
58	14.2	2420	2700		2060	2290	
59	14.7	2510	2790		2130	2370	
60	15.2	2590	2890		2200	2450	
61	15.7	2680	2980		2280	2540	
62	16.3	2770	3080		2350	2620	
63	16.8	2860	3180		2430	2700	
64	17.3	2950	3280		2510	2790	
65	17.9	3040	3390		2590	2880	

The nominal length mass values are for fully lubricated ropes.

This table is for guidance purposes only.

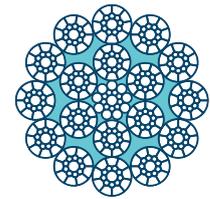
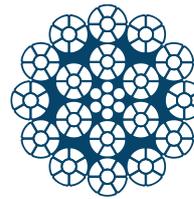
Ropes for friction winding application will weigh approximately 2% less than the above quoted weights.

Read pages 42-54 Product Safety Instructions and Warnings on the use of steel wire rope before selecting or using this product.





## Tiger DYFORM® 18M/PI Class



Lay Type		Lay Direction		Finish		Core		
Ord	Langs	Right Hand	Left Hand	Bright	Galv	FC	FFC	WSC
•	•	•	•	•	•	•	•	•

Available as standard. WSC values available on request

Diameter	Approx Mass	Aggregate Breaking Force			Minimum Breaking Force		
		1570 N/mm <sup>2</sup>	1770 N/mm <sup>2</sup>	1960 N/mm <sup>2</sup>	1570 N/mm <sup>2</sup>	1770 N/mm <sup>2</sup>	1960 N/mm <sup>2</sup>
mm	kg/m	kN	kN	kN	kN	kN	kN
16	1.27	217	244	270	162	183	203
17	1.44	244	276	305	183	207	229
18	1.61	274	309	342	206	232	257
19	1.79	305	344	381	229	258	286
20	1.99	338	381	422	254	286	317
21	2.19	373	421	466	280	315	349
22	2.41	409	462	511	307	346	383
23	2.63	447	504	559	336	378	419
24	2.86	487	549	608	365	412	456
25	3.11	529	596	660	397	447	495
26	3.36	572	645	714	429	483	535
27	3.62	617	695	770	462	521	577
28	3.90	663	748	828	497	561	621
29	4.18	711	802	888	534	602	666
30	4.47	761	858	950	571	644	713
32	5.09	866	977	1080	650	732	811
34	5.75	978	1100	1220	733	827	916
35	6.09	1040	1170	1290	777	876	970
36	6.44	1100	1240	1370	822	927	1030
38	7.18	1220	1370	1520	916	1030	1140
40	7.95	1360	1520	1690	1020	1140	1270
42	8.77	1490	1680	1870	1120	1260	1400
44	9.62	1640	1840	2040	1230	1380	1530
44.5	9.82	1670	1880	2080	1250	1410	1560
46	10.5	1790	2010	2240	1340	1510	1680
47.6	11.3	1920	2160	2390	1440	1620	1790
48	11.5	1950	2200	2430	1460	1650	1820
50	12.4	2120	2390	2640	1590	1790	1980
50.8	12.8	2190	2470	2720	1640	1850	2040
52	13.4	2290	2570	2850	1720	1930	2140
54	14.5	2470	2790	3080	1850	2090	2310

The nominal length mass values are for fully lubricated ropes.  
This table is for guidance purposes only.

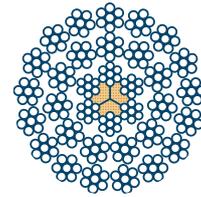
Read pages 42-54 Product Safety Instructions and Warnings on the use of steel wire rope before selecting or using this product.

Read page 54 cautionary notice - Restrictions on the use of large diameter multistrand ropes.





## Tiger 34M Class



Lay Type		Lay Direction		Finish		Core		
Ord	Langs	Right Hand	Left Hand	Bright	Galv	FC	FFC	WSC
●	●	●	●	●	●	●	●	●

Available as standard. WSC values available on request

Diameter	Approx Mass	Aggregate Breaking Force			Minimum Breaking Force		
		1570 N/mm <sup>2</sup>	1770 N/mm <sup>2</sup>	High Tensile	1570 N/mm <sup>2</sup>	1770 N/mm <sup>2</sup>	High Tensile
mm	kg/m	kN	kN	kN	kN	kN	kN
16	1.01	169	190	211	127	143	158
17	1.14	191	215	238	143	161	179
18	1.28	214	241	267	160	181	200
19	1.42	238	269	297	179	201	223
20	1.58	264	298	330	198	223	247
21	1.74	291	328	363	218	246	273
22	1.91	319	360	399	240	270	299
23	2.08	349	394	436	262	295	327
24	2.27	380	429	475	285	321	356
25	2.46	413	465	515	309	349	386
26	2.66	446	503	557	335	377	418
27	2.87	481	542	601	361	407	451
28	3.09	517	583	646	388	438	485
29	3.31	555	626	693	416	469	520
30	3.55	594	670	742	446	502	556
31	3.79	634	715	792	476	536	594
32	4.03	676	762	844	507	571	633
33	4.29	719	810	897	539	608	673
34	4.55	763	860	953	572	645	714
35	4.83	809	912	1010	606	684	757
36	5.10	855	964	1070	642	723	801
37	5.39	904	1020	1130	678	764	846
38	5.69	953	1070	1190	715	806	892
39	5.99	1000	1130	1250	753	849	940
40	6.30	1060	1190	1320	792	893	989
41	6.62	1110	1250	1390	832	938	1040
42	6.95	1160	1310	1450	873	984	1090
43	7.28	1220	1380	1520	915	1030	1140
44	7.63	1280	1440	1600	958	1080	1200
45	7.98	1340	1510	1670	1000	1130	1250
46	8.33	1400	1570	1740	1050	1180	1310
47	8.70	1460	1640	1820	1090	1230	1370
48	9.08	1520	1710	1900	1140	1290	1420
49	9.46	1580	1790	1980	1190	1340	1480
50	9.85	1650	1860	2060	1240	1400	1540
52	10.7	1780	2010	2230	1340	1510	1670
54	11.5	1920	2170	2400	1440	1630	1800
56	12.4	2070	2330	2580	1550	1750	1940
58	13.3	2220	2500	2770	1670	1880	2080
60	14.2	2380	2680	2970	1780	2010	2220
62	15.1	2540	2860	3170	1900	2150	2380
64	16.1	2700	3050	3380	2030	2290	2530
66	17.2	2880	3240	3590	2160	2430	2690
68	18.2	3050	3440	3810	2290	2580	2860
70	19.3	3230	3650	4040	2430	2730	3030

The nominal length mass values are for fully lubricated ropes.  
 This table is for guidance purposes only. Balance ropes are normally designed to achieve a desired weight.  
 Ropes with the required weight and strength will be designed to meet particular shaft requirements.

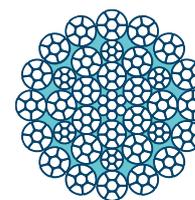
Read pages 42-54 Product Safety Instructions and Warnings on the use of steel wire rope before selecting or using this product.

Read page 54 cautionary notice - Restrictions on the use of large diameter multistrand ropes.





## Tiger DYFORM® 34LR/PI Class



Lay Type		Lay Direction		Finish		Core		
Ord	Langs	Right Hand	Left Hand	Bright	Galv	FC	FFC	WSC
•	•	•	•	•	•	•	•	•

Diameter	Approx Mass	Aggregate Breaking Force			Minimum Breaking Force			
		1570 N/mm <sup>2</sup>	1770 N/mm <sup>2</sup>	1960 N/mm <sup>2</sup>	1570 N/mm <sup>2</sup>	1770 N/mm <sup>2</sup>	1960 N/mm <sup>2</sup>	2160 N/mm <sup>2</sup>
mm	kg/m	kN	kN	kN	kN	kN	kN	kN
19	1.81	322	363	403	258	291	322	362
20	2.00	357	403	447	286	322	357	401
21	2.21	394	444	492	315	355	394	442
22	2.42	432	487	540	346	390	432	485
23	2.65	472	533	591	378	426	472	530
24	2.88	514	580	643	411	464	514	577
25	3.13	558	629	698	446	503	558	626
26	3.38	604	681	755	483	544	604	678
27	3.65	651	734	814	521	587	651	731
28	3.92	700	789	875	560	631	700	786
29	4.21	751	847	939	601	677	751	843
30	4.50	804	906	1000	643	725	804	902
32	5.12	919	1040	1140	707	797	879	989
34	5.78	1040	1170	1290	799	900	992	
35	6.13	1100	1240	1370	846	954	1050	
36	6.48	1160	1310	1440	895	1010	1110	
38	7.22	1300	1460	1610	998	1120	1240	
40	8.00	1440	1620	1780	1110	1250	1370	
42	8.82	1580	1780	1970	1220	1370	1510	
44	9.68	1740	1960	2160	1340	1510	1660	
44.5	9.88	1770	2000	2200	1360	1540	1700	
46	10.6	1900	2140	2360	1460	1650	1820	
47.6	11.3	2030	2290	2530	1570	1760	1950	
48	11.5	2070	2330	2570	1590	1790	1980	
50	12.5	2240	2530	2790	1730	1950	2150	
50.8	12.9	2320	2610	2880	1780	2010	2220	
52	13.5	2430	2730	3010	1870	2110	2320	
54	14.6	2620	2950	3250	2010	2270	2500	
56	15.7	2810	3170	3500	2170	2440	2690	
57.2	16.3	2930	3300	3640	2260	2540	2800	
58	16.8	3020	3400	3750	2320	2620	2890	
60	18.0	3230	3640	4010	2490	2800	3090	
62	19.2	3450	3890	4290	2660	2990	3300	
63.5	20.2	3620	4080	4500	2790	3140	3460	
64	20.5	3670	4140	4570	2830	3190	3520	
66	21.8	3910	4410	4860	3010	3390	3740	

The nominal length mass values are for fully lubricated ropes.  
This table is for guidance purposes only.

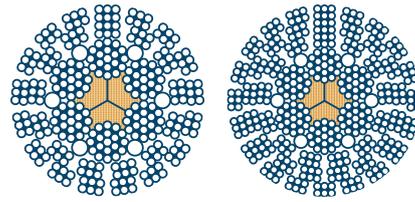
Read pages 42-54 Product Safety Instructions and Warnings on the use of steel wire rope before selecting or using this product.

Read page 54 cautionary notice - Restrictions on the use of large diameter multistrand ropes.





## Tiger Superflex 17x6, 20x6



Lay Type		Lay Direction		Finish		Core		
Ord	Langs	Right Hand	Left Hand	Bright	Galv	FC	FFC	WSC
	•	•	•	•	•	•	•	

Available as standard.

Nominal Diameter	Nominal Length Mass	Calculated Aggregate Breaking Force				Calculated Minimum Breaking Force			
		1080 N/mm <sup>2</sup>	1270 N/mm <sup>2</sup>	1370 N/mm <sup>2</sup>	1570 N/mm <sup>2</sup>	1080 N/mm <sup>2</sup>	1270 N/mm <sup>2</sup>	1370 N/mm <sup>2</sup>	1570 N/mm <sup>2</sup>
mm	kg/m	kN	kN	kN	kN	kN	kN	kN	kN
<b>17x6</b>									
44	7.31	856	1007	1086	1244	706	830	896	1026
46	7.63	917	1078	1163	1333	757	890	960	1100
47	7.96	930	1094	1180	1352	767	902	973	1115
48	8.29	962	1131	1220	1398	794	934	1007	1154
49	8.92	1020	1199	1294	1483	842	990	1068	1224
51	9.33	1083	1274	1374	1574	894	1051	1134	1300
54	10.83	1239	1457	1572	1801	1022	1202	1296	1486
57	11.95	1356	1595	1720	1971	1119	1316	1419	1627
<b>20x6</b>									
48	8.58	981	1154	1244	1426	809	951	1026	1176
51	9.75	1150	1325	1459	1672	949	1116	1204	1380
54	11.12	1308	1538	1659	1901	1079	1269	1369	1569
57	12.05	1408	1656	1786	2047	1162	1366	1474	1689
60	13.04	1524	1792	1933	2215	1257	1478	1595	1827
64	15.10	1767	2078	2241	2569	1458	1715	1850	2120
67	16.79	1963	2308	2490	2854	1620	1905	2055	2355
70	17.33	2028	2385	2573	2948	1674	1969	2124	2434
73	19.59	2247	2642	2850	3266	1854	2180	2352	2695

The nominal length mass values are for fully lubricated ropes.  
 This table is for guidance purposes only. Balance ropes are normally designed to achieve a desired weight.  
 Ropes with the required weight and strength will be designed to meet particular shaft requirements.

Read pages 42-54 Product Safety Instructions and Warnings on the use of steel wire rope before selecting or using this product.

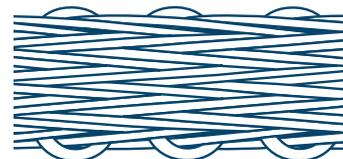
Read page 54 cautionary notice - Restrictions on the use of large diameter multistrand ropes.



## Flat Balance Rope 8x4x7, 6x4x12, 8x4x12, 8x4x14, 8x4x19

Construction			Finish	
Single Stitched	Double Stitched	Clamped	Bright	Galv
•	•	•	•	•

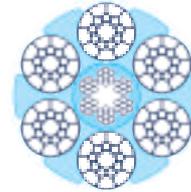
Available as standard.



Nominal Dimensions Width x b x Thickness s		Nominal Diameter of the Load Carrying Wires	Sum of the Nominal Cross-Sectional Areas of the Load Carrying Wires	Calculated Mass Per Unit Length of the Lubricated Rope			Nominal Aggregate Breaking Load at a Tensile Grade of the Wires of	
Twice Stitched (d)	Single Stitched (e) or Clamped (k)			Twice Stitched (d)	Single Stitched (e)	Clamped (k)	1370 N/mm <sup>2</sup>	1570 N/mm <sup>2</sup>
mm	mm	mm	mm <sup>2</sup>	kg/m	kg/m	kg/m	kN	kN
<b>Rope Construction 8 x 4 x 7 = 8 Legs with 4 Strands each having 1+6 Wires = 224 wires</b>								
110 x 20	110 x 18	1.9	635	642	616	604	870	997
113 x 20	113 x 18	1.95	669	676	649	636	917	1050
116 x 21	116 x 19	2.0	704	711	683	669	964	1105
119 x 21	119 x 19	2.05	739	747	717	702	1010	1160
122 x 22	122 x 20	2.1	776	784	753	738	1060	1220
125 x 22	125 x 20	2.15	813	822	789	773	1110	1280
128 x 23	128 x 21	2.2	851	860	826	809	1170	1340
<b>Rope Construction 6 x 4 x 12 = 6 Legs with 4 Strands each having 3+9 Wires = 288 wires</b>								
112 x 26	112 x 23	1.9	817	826	793	768	1120	1280
115 x 25	115 x 23	1.95	860	869	835	809	1180	1350
118 x 27	118 x 24	2.0	905	914	878	851	1240	1420
121 x 27	121 x 24	2.05	951	961	923	894	1300	1490
124 x 28	124 x 25	2.1	998	1010	968	939	1370	1570
127 x 28	127 x 25	2.15	1046	1060	1020	984	1430	1640
130 x 29	130 x 26	2.2	1095	1110	1070	1030	1500	1720
<b>Rope Construction 8 x 4 x 12 K = 8 Legs with 4 Strands each having 3+9 Wires = 384 wires</b>								
146 x 25	146 x 23	1.9	1089	1100	1060	1030	1490	1710
149 x 26	149 x 23	1.95	1147	1160	1120	1080	1570	1800
154 x 27	154 x 24	2.0	1206	1220	1170	1140	1650	1890
157 x 27	157 x 24	2.05	1267	1280	1230	1190	1740	1990
160 x 28	160 x 25	2.1	1330	1350	1290	1250	1820	2090
165 x 28	165 x 25	2.15	1394	1410	1360	1310	1910	2190
168 x 29	168 x 26	2.2	1460	1480	1420	1380	2000	2290
<b>Rope Construction 8 x 4 x 14 K = 8 Legs with 4 Strands each having 4+10 Wires = 448 wires</b>								
168 x 28	168 x 25	2.0	1407	1430	1370	1330	1930	2210
172 x 29	172 x 26	2.05	1479	1500	1440	1390	2030	2320
176 x 29	176 x 26	2.1	1552	1570	1510	1460	2130	2440
180 x 30	180 x 27	2.15	1626	1650	1580	1530	2230	2550
184 x 30	184 x 27	2.2	1703	1720	1660	1600	2330	2670
<b>Rope Construction 8 x 4 x 19 K = 8 Legs with 4 Strands each having 1+6+12 Wires = 608 wires</b>								
186 x 31	186 x 28	1.9	1724	1750	1680	1620	2360	2710
190 x 32	190 x 29	1.95	1816	1840	1780	1700	2490	2850
194 x 33	194 x 30	2.0	1910	1930	1860	1800	2620	3000
200 x 34	200 x 31	2.05	2007	2030	1950	1890	2750	3150
204 x 34	204 x 31	2.1	2106	2130	2040	1980	2890	3310
210 x 36	210 x 32	2.15	2207	2230	2140	2080	3020	3460
216 x 37	216 x 33	2.2	2311	2330	2240	2180	3170	3630

The nominal length mass values are for fully lubricated ropes.  
This table is for guidance purposes only.

Read pages 42-54 Product Safety Instructions and Warnings on the use of steel wire rope before selecting or using this product.



Lay Type		Lay Direction		Finish		Core		
Ord	Langs	Right Hand	Left Hand	Bright	Galv	FC	FFC	Modified Core
	•	•		•	•			•

Nominal Diameter	Nominal Length Mass	Calculated Minimum Breaking Load			
		Grade 1670 N/mm <sup>2</sup>	Grade 1670 N/mm <sup>2</sup>	Grade 1820 N/mm <sup>2</sup>	Grade 1820 N/mm <sup>2</sup>
mm	kg/m	tonnes	kN	tonnes	kN
<b>6x19S</b>					
32	3.94	59.51	584	64.40	632
33	4.19	63.28	621	68.48	672
34	4.45	67.18	659	72.70	713
35	4.71	71.19	698	77.04	756
36	4.99	75.31	739	81.50	800
37	5.27	79.56	780	86.09	845
38	5.56	83.91	823	90.81	891
39	5.85	88.39	867	95.65	938
40	6.16	92.98	912	100.62	987
41	6.47	97.69	958	105.71	1037
<b>6x26WS</b>					
41	6.51	98.25	964	106.33	1043
42	6.83	103.10	1011	111.58	1095
43	7.16	108.07	1060	116.95	1147
44	7.49	113.16	1110	122.46	1201
45	7.84	118.36	1161	128.09	1257
46	8.53	127.20	1248	137.65	1350
47	8.91	132.79	1303	143.70	1410
48	9.29	138.50	1359	149.88	1470
49	9.68	144.33	1416	156.19	1532
50	10.08	150.28	1474	162.63	1595
51	10.49	156.35	1534	169.20	1660
52	10.90	162.54	1595	175.90	1726
<b>6x31WS</b>					
41	6.69	100.97	991	109.28	1072
42	7.02	105.95	1039	114.68	1125
43	7.36	111.06	1089	120.21	1179
44	7.70	116.28	1141	125.86	1235
45	8.06	121.63	1193	131.65	1291
46	8.77	130.71	1282	141.48	1388
47	9.15	136.45	1339	147.70	1449
48	9.55	142.32	1396	154.05	1511
49	9.95	148.32	1455	160.54	1575
50	10.36	154.43	1515	167.15	1640
51	10.78	160.67	1576	173.91	1706
52	11.21	167.03	1639	180.79	1774
53	11.64	173.52	1702	187.82	1843
54	12.08	180.13	1767	194.97	1913
55	12.54	186.86	1833	202.26	1984
56	13.00	193.72	1900	209.68	2057
57	13.46	200.80	1969	217.23	2131
58	13.94	207.80	2039	224.92	2206
59	14.43	215.03	2109	232.75	2283
60	13.88	222.38	2182	240.70	2361

The nominal length mass values are for fully lubricated ropes.  
This table is for guidance purposes only.

Read pages 42-54 Product Safety Instructions and Warnings on the use of steel wire rope before selecting or using this product.

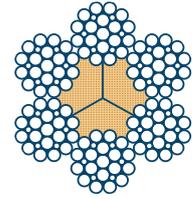
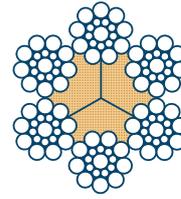




## Tiger 6CDR

Lay Type		Lay Direction		Finish		Core		
Ord	Langs	Right Hand	Left Hand	Bright	Galv	FC	FFC	Bristar
	•	•		•	•	•	•	•

Available as standard. Bristar values available on request



Nominal Diameter	Nominal Length Mass	Calculated Minimum Breaking Force	
		Grade 1670 N/mm <sup>2</sup>	Grade 1820 N/mm <sup>2</sup>
mm	kg/m	kN	kN
<b>6x19S</b>			
32	3.79	550	600
33	3.95	560	610
35	4.61	666	726
37	5.11	740	806
38	5.42	788	858
41	5.66	894	974
43	6.51	965	1052
<b>6x25F</b>			
41	6.21	898	978
45	7.43	1069	1165
48	8.78	1265	1379
51	9.94	1432	1561
54	10.93	1589	1732
57	12.91	1771	1930
60	13.61	1972	2149

The nominal length mass values are for fully lubricated ropes. This table is for guidance purposes only.

Read pages 42-54 Product Safety Instructions and Warnings on the use of steel wire rope before selecting or using this product.

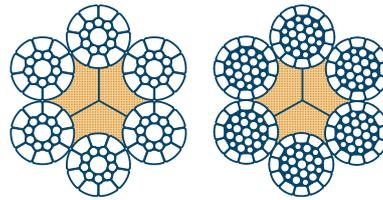




## Tiger DYFORM® 6CDR

Lay Type		Lay Direction		Finish		Core		
Ord	Langs	Right Hand	Left Hand	Bright	Galv	FC	FFC	Bristar
	•	•		•	•	•	•	•

Available as standard. Bristar values available on request



Nominal Diameter	Nominal Length Mass	Calculated Minimum Breaking Force	
		Grade 1670 N/mm <sup>2</sup>	Grade 1820 N/mm <sup>2</sup>
mm	kg/m	kN	kN
<b>6x19S</b>			
32	4.02	592	645
33	4.19	602	656
35	4.89	716	780
37	5.42	796	867
38	5.75	847	923
41	6.69	960	1047
43	6.90	1040	1133
<b>6x31WS</b>			
41	6.58	965	1051
45	7.88	1148	1251
48	9.31	1364	1486
51	10.54	1540	1679
54	11.59	1708	1862
57	13.68	1904	2075
60	14.43	2119	2309

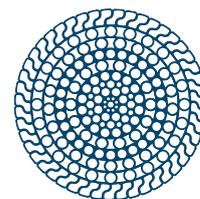
The nominal length mass values are for fully lubricated ropes. This table is for guidance purposes only.

Read pages 42-54 Product Safety Instructions and Warnings on the use of steel wire rope before selecting or using this product.





## Tiger FL



Lay Type		Lay Direction		Finish		Core		
Ord	Langs	Right Hand	Left Hand	Bright	Galv	FC	FFC	WSC
		●	●	●	●			

Available as standard. Variable Torque and Turn characteristics available by design

Nominal Diameter	Nominal Length Mass	Calculated Aggregate Breaking Force		Calculated Minimum Breaking Force	
		Standard Grade	Higher Grade	Standard Grade	Higher Grade
mm	kg/m	kN	kN	kN	kN
16	1.44	261	281	218	234
17	1.63	261	281	218	234
18	1.83	331	355	276	297
19	2.04	368	395	307	330
21	2.49	449	483	375	403
21.5	2.60	465	500	388	417
22	2.73	493	530	412	443
24	3.25	587	631	490	527
26	3.81	689	740	575	618
27	4.11	743	798	620	667
29	4.74	856	921	715	769
30	5.08	916	985	765	822
31	5.42	928	998	775	833
32	5.78	1043	1121	871	936
33	6.14	1109	1192	926	995
35	6.91	1246	1339	1040	1118
37	7.72	1398	1502	1167	1255
37.5	7.93	1422	1528	1187	1276
38	8.14	1468	1578	1226	1318
40	9.02	1634	1756	1364	1466
40.5	9.25	1668	1793	1393	1497
41	9.48	1715	1844	1432	1539
42	9.95	1798	1932	1501	1614
43	10.40	1880	2021	1570	1688
44	10.90	1974	2122	1648	1772
45	11.40	2068	2223	1727	1857
46	11.90	2162	2324	1805	1940
47	12.50	2244	2413	1874	2015
48	13.00	2350	2526	1962	2109
49	13.50	2443	2626	2040	2193
51	14.70	2655	2854	2217	2383
52	15.00	2738	2943	2286	2457
53	15.80	2867	3082	2394	2574
54	16.40	2972	3195	2482	2668
55	17.00	3055	3284	2551	2742
56	17.70	3195	3435	2668	2868
57	18.30	3313	3561	2766	2973
59	19.60	3501	3763	2923	3142
60	20.30	3630	3902	3031	3258
62	21.70	3865	4155	3227	3469
64	23.10	4123	4433	3443	3701
65	23.80	4253	4572	3551	3817

The nominal length mass values are for fully lubricated ropes.  
This table is for guidance purposes only.

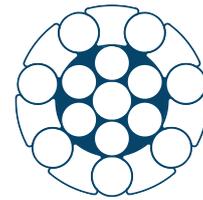
 Read pages 42-54 Product Safety Instructions and Warnings on the use of steel wire rope before selecting or using this product.





## Tiger HL

Lay Type		Lay Direction		Finish		Core		
Ord	Langs	Right Hand	Left Hand	Bright	Galv	FC	FFC	WSC
		•	•	•	•			



Nominal Diameter	Nominal Length Mass	Calculated Aggregate Breaking Force		Calculated Minimum Breaking Force	
		Standard Grade	Higher Grade	Standard Grade	Higher Grade
mm	kg/m	kN	kN	kN	kN
29	4.63	455	546	421	505
32	5.63	554	665	512	614
35	6.74	663	796	613	736
38	7.94	781	937	722	866
41	9.25	909	1091	841	1009
45	11.10	1092	1310	1010	1212
48	12.70	1241	1489	1148	1378
51	14.30	1411	1693	1305	1566
52	14.95	1704	1942	1576	1796
54	1634	1845	2110	1707	1952

The nominal length mass values are for fully lubricated ropes.  
This table is for guidance purposes only.

 Read pages 42-54 Product Safety Instructions and Warnings on the use of steel wire rope before selecting or using this product.



## 1. Hoist Ropes

Various constructions of ropes may be used for hoisting, the final choice usually being decided upon economic grounds. What may be a satisfactory life on a shallow high frequency hoist, may be completely uneconomic on a deep low frequency installation, and therefore the rope designs as well as their sizes must be considered.

### 1.1 Drum Hoists

**6 Stranded Ropes** – both round and triangular strand – are satisfactory for all depths of shafts, although perhaps best suited for those up to 1000m in depth with fixed guides. They are not suitable for shafts deeper than 600m with rope guides, as their natural tendency to twist causes the conveyance to turn.

As a rough guide to the construction of the rope, the ratio of drum or sheave diameter to outer wire diameter should be between 1000 and 1500:1, although if abrasion is severe this can be reduced slightly at the expense of a lower fatigue life.

For maximum resistance to wear and crossover damage the use of Lang's lay is recommended.

**Multi-Strand Rotation Resistant Ropes** – are now used on permanent drum hoist installations, except where multi layer coiling is employed, due to their relatively low resistance to compressive forces. Certain constructions are suitable for sinking purposes.

Multi-strand ropes with Dyformed (compacted) strands have increased resistance to crushing over ropes with conventional strands.

**Locked Coil Ropes** – have gained in popularity and are extensively used throughout the UK. They can be used to advantage on any depth of shaft with either fixed or rope guides. As they are virtually non-rotating under normal loading conditions they are considered to be the best rope to operate in shafts deeper than 700 metres equipped with rope guides.

The cross section is extremely compact and as a result such ropes can withstand very high radial and compressive forces. This property coupled with their smooth outer surface enables them to be used to advantage on multi layer coiling installations.

Because of their compact cross section, it is desirable

that the drum or sheave diameter to rope diameter ratio should be in the region of 100 to 120:1 for satisfactory service life on main shaft winders. Ratios as low as 50:1 can be tolerated on small ropes in shallow shafts, staple shafts and sinking stage winders.

### 1.2 Friction or Koepe Hoists

**6 Stranded Ropes** – are suitable to depths of 1000 metres. Beyond that the torque in these ropes can result in premature torsional fatigue of the wires. Triangular strands are more usual due to the lower contact pressures on the friction linings although Lang's lay equal laid round strand ropes are quite suitable for shallow shafts. Round strand ropes with Dyformed (compacted) strands are becoming more popular as they offer higher breaking loads, increased fatigue life and reduced contact pressures over ropes with conventional strands.

With rope guided shafts, alternate left and right hand lay ropes are employed to prevent conveyance twist.

Tread pressures with stranded ropes are limited to 17.5 kgf/cm<sup>2</sup> (1.72Mpa) to avoid excessive wear of the friction linings.

**Multi-Strand Rotation Resistant Ropes** – can be usefully employed at all depths of shaft and generally satisfactory lives are obtained. Earlier designs of the ropes were subject to severe internal cross-cutting, although modern designs incorporating Dyformed (compacted) strands and plastic enhancement coupled with modern design and manufacturing techniques most of these problems have been eliminated.

Tread pressure limits are similar to those of 6 stranded ropes.

**Locked Coil Ropes** – are widely used on this type of hoist particularly in the UK. The advantages offered by ropes of this construction make them particularly suited for this type of hoist especially if rope guides are employed.

Due to the large smooth surface area of locked coil ropes, tread pressures of up to 28.0 kgf/cm<sup>2</sup> (2.75Mpa) can be tolerated. The limit is used to minimise friction liner wear, the rope being able to withstand much higher pressures.

## 2. Sinking Ropes

### 1.3 Recommended Rope Construction for various winder applications

Type of winder application	Rope Construction
Small drum hoist operation at less than 2.5m/s in a vertical shaft with fixed guides	6x19(9/9/) FC Langs Lay Full Locked Coil
Small Drum hoist operating in a vertical shaft with rope guides	Multi-strand Rotation Resistant Full Locked Coil
Large drum hoist operating in a vertical shaft with fixed guides	Compound Triangular Strand Langs Lay Full Locked Coil Dyform 6R Ordinary/Langs Lay
Large drum hoist operating in a vertical shaft with rope guides	Multi-strand Rotation Resistant Full Locked Coil
Blair multi-rope hoist	Compound Triangular Strand Langs Lay Full Locked Coil
Friction hoist operating to a depth of 500m	6 strand Ordinary/Langs Lay Compound Triangular Strand Langs Lay Multi-strand Rotation Resistant Full Locked Coil Dyform 6R Ordinary/Langs Lay
Friction hoist operating to a depth between 500m and 1000m	6 Strand Ordinary/Langs Lay Compound Triangular Strand Langs Lay Multi-strand Rotation Resistant Full Locked Coil Dyform 6R Ordinary/Langs Lay
Friction Hoists above 1000m	Locked Coil Winding Ropes Multi Strand Rotation Resistant Dyform 6R Ordinary/Langs Lay Compound Triangular Strand Langs Lay
Sinking stage winder	Multi-strand Rotation Resistant Full Locked Coil Alternate Lay Triangular Strand Langs Lay
Kibble winder	Multi-strand Rotation Resistant Full Locked Coil
Tail/Balance rope	Multi-strand Rotation Resistant Superflex Flat rope

**Kibble Ropes** – Ropes used for these duties must be rotation resistant, to prevent excessive spin of the kibble or bucket in the shaft.

Providing the hoist equipment is suitable, flexible full locked coil ropes meet these requirements admirably, and have been used successfully for many years. Where very small diameter sinking drums and sheaves are employed, or where a sheave is fitted above the kibble to enable two parts of rope to support the load, multi-strand rotation resistant ropes are suitable.

Bridon's dedicated Mining Department will be pleased to discuss and recommend the best ropes construction for optimum performance on your kibble winder.

**Stage Ropes** – There are several methods of suspending the sinking stage or platform and this can govern the choice of rope construction.

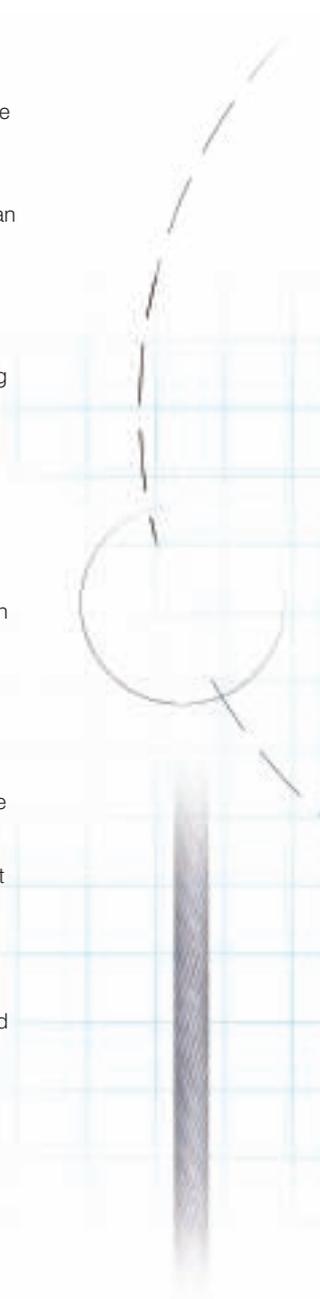
Stage ropes are normally required to act as guide ropes for the kibble so resistance to wear is a necessary characteristic. In addition a good resistance to crushing on the multi-layer drum coiling is required.

Full locked coil ropes offer excellent performance on the correct design of equipment.

Where smaller drums and sheaves are employed multi-strand rotation resistant ropes with relatively large outer wires or triangular strands with equal numbers of left and right hand lay can be used. With triangular strand ropes however, problems can be experienced with controlling the turn if slack rope conditions occur.

Bridon's dedicated Mining Department will be pleased to discuss and recommend the best ropes construction for optimum performance on your stage winder.

Under normal circumstances it is recommended that ropes for both applications, but in particular stage ropes, should be manufactured from galvanised material. However, where higher tensile grades of wire are required galvanised material is not always available. In these cases it is strongly recommended that the ropes are regularly cleaned and re-lubricated with emphasis on the evaluation of corrosion during examination.



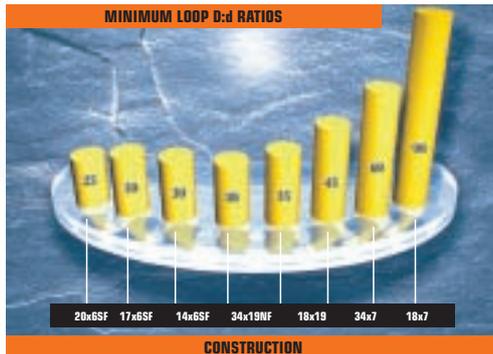
## 3. Balance Ropes

Generally balance ropes are required to have the flexibility to suit the particular cage centres, adequate rotation resistant properties combined with good resistance to wear and corrosion. Bridon's range of multi-strand rotation resistant ropes has the capability to meet the needs for all balance rope applications.

Bridon's Superflex balance ropes were developed for installations where maximum flexibility is required combined with optimum resistance to wear and corrosion. The range of ropes is almost completely non-rotating. As a result there is no torsional effect either at the terminal ends or at the loop and therefore the onset of fatigue at these points is almost entirely eliminated.

Where maximum flexibility is not required alternative constructions are available to best suit the specific winding conditions and give optimum economic service life.

The graph below gives the minimum recommended loop diameter to rope diameter ratio for various constructions.



For advice on the best rope for your installations contact Bridon's dedicated Mining Department.

## 4. Guide and Rubbing Ropes

Bridon's Tiger Brand range of guide and rubbing ropes are normally constructed of central king wire, covered by one or two layers of round wires which are closed in a final layer of half lock and round wires. The precise construction depending upon the diameter and the tensile grade of wires used to meet the breaking force requirement. Bridon's CAD rope design system ensures that the largest possible outer half lock and round wires are used to give maximum resistance to wear and corrosion.

The choice of size and breaking load depends upon the local regulations for factor of safety and the tensioning required. A typical arrangement is a factor of safety of 5:1 at the point of suspension with the

guides tensioned on the basis of 3000kg plus 500kg for each 100m of shaft depth. The tensions are normally varied in the range plus or minus 10% to limit harmonic vibration.

In wet and corrosive shafts the use of galvanised material is recommended.

Types of tensioning arrangement, terminations and methods of installation are many and varied and Bridon's dedicated Mining Department will be pleased to give advice on these aspects along with types of layouts, methods of lubrication, inspection procedures and maintenance.

## 5. Haulage Ropes

The modern rope haulage system is an integral part of the system for both the transportation of men and the supply of materials to the mine face.

Haulage systems fall into 3 main categories

Endless

Direct

Main and Tail

Bridon's Tiger Brand range has the rope to suit your system.

In general, haulage ropes are required to have excellent resistance to wear and in some instances corrosion. To achieve this they tend to be of the more simple construction with fewer larger outer wires. These can be single layer round strand construction or triangular strand construction. On the majority of systems where the length of travel is high and the frequency of cycle is small, fatigue is generally not a critical deteriorating factor.

### 5.1 Single Construction

#### Round Strand

6x7(6/1) Fibre Core Langs lay is recommended to maximise the resistance to wear.

#### Triangular Strand

6x8TS, 6x9TS, 6x10TS.

However, when travel distances become shorter and the cycle frequency is higher then fatigue can become a factor dictating rope removal, particularly when drive wheels, drums and sheaves are smaller. To combat this more complex (compound constructions) with smaller outer wires can be used.

### 5.2 Compound Construction

#### Round Strand

6x19S, 6x26WS, 6x25F, 6x36WS.

#### Triangular Strand

6x22TS, 6x23TS, 6x25TS, 6x28TS.

Where wet and corrosive conditions exist the use of galvanised ropes, man made fibre cores or a combination of both is recommended.

On certain installations where resistance to crushing is required then the use of ropes with steel IWRC cores should be considered.

On endless systems ropes with special preforming are supplied to facilitate long splicing.

The performance of round strand ropes can be enhanced by the use of Dyformed strands. Dyform ropes offer the following improvements:-

- Higher breaking loads
- Improved fatigue life
- Increased resistance to crushing
- Reduced interference on drums and Clifton (surge) wheels

Bristar Cores offer the following improvements:-

- Reduced stretch
- Increased fatigue life
- Increased dimension stability (diameter retention)

Contact our dedicated Mining Department for advise on the best construction for your haulage application.

## 6. Conveyor Drive Ropes

Bridon has had a close working relationship with the O.E.M. of cable driven conveyors for many years. This has resulted in Bridon being the major supplier of cable belt driving ropes world wide. Extensive research and development has resulted in Bridon's Tiger Brand range of driving ropes such that Bridon can offer rope solutions to give optimum lowest cost conveying of material.

The Tiger Brand range offers the following rope options:-

### Conventional Driving Ropes

6x19S, 6x26WS, 6x25F, 6x31WS, 6x36WS.

The type of construction used depends upon the diameter, stress levels, the type of conveyor and it's layout.

### Dyform Driving Ropes

6x19S Dyform, 6x26WS Dyform, 6x31WS Dyform, 6x36WS Dyform.

Dyform Driving Ropes offer the following advantages:-

- Higher breaking forces
- Increased fatigue life
- Increased resistance to wear
- Reduced line stand pulley wear during the early part of service life

Driving ropes are generally supplied in galvanised material although ropes manufactured from bright wire are available. They are produced under the highest quality system from high specification wire and cores specially designed and manufactured for use on rope driven conveyors. All ropes have specific strand preformation to facilitate long splicing and maximisation of splice life.

In both conventional and Dyform drive ropes alternative cores and manufacturing lubrication are available to best suit your conveyor conditions to ensure maximum economic operating performance. These include the following:-

- Man made fibre cores for use in wet conditions
- Bristar cores offering lower stretch, increased fatigue life and improve diameter retention
- Special lubrication, both manufacturing and service, to ensure maximum life in severe corrosive conditions

### Zebra Drive Ropes

Joint development with rope driven conveyor manufacturers and operators has resulted in Bridon's Zebra range of conveyor drive ropes.

Extensive laboratory and on site testing has shown the following advantages of Zebra over conventional and Dyform drive ropes:

- Increased fatigue life. In excess of 10 times conventional cables in laboratory tests
- Equivalent or increased breaking loads
- Reduced stretch both constructional and elastic
- Superior diameter retention
- Smooth outer surface
- Reduced tread pressures
- Superior resistance to internal corrosion

These improvements in physical properties have realised the following proven cost saving advantages:

- Zebra can be retro fitted to existing conveyors at minimal cost
- Reduced line pulley wear
- Reduced steel terminal pulley and surge/Koepe lining maintenance
- Reduced vibration and noise
- Extended rope life
- Extended splice life

For an assessment of potential cost saving on your conveyor contact Bridon's directly.

Bridon's commitment to lowest cost conveying doesn't stop there. On long conveyors splicing and splice maintenance can be both inconvenient and costly. Bridon's unique Service Department can provide expert engineers to install, splice, inspect and maintain your drive cables. Driving ropes are a major cost component part of the conveyor. **LOOK AFTER THEM !**

In addition Bridon recognised the implications in down time and cost for splicing on long conveyors with numerous splices. To minimise splicing and splice repairs Bridon increased their production capacity from piece weights of 60 tons to piece weights of approximately 135 tons. If you think longer ropes can assist in reducing operating costs please contact our Mining Department who will be pleased to discuss the possibilities.



## 7. Properties of Extension of Steel Wire Ropes

Any assembly of steel wires spun into a helical formation, either as a strand or wire rope, when subjected to a tensile load, can extend in three separate phases, depending on the magnitude of the applied load.

There are also other factors which produce rope extension which are very small and can normally be ignored.

### Phase 1 - Initial or Permanent Constructional Extension

At the commencement of loading a new rope, extension is created by the bedding down of the assembled wires with a corresponding reduction in overall diameter. This reduction in diameter creates an excess length of wire which is accommodated by a lengthening of the helical lay. When sufficiently large bearing areas have been generated on adjacent wires to withstand the circumferential compressive loads, this mechanically created extension ceases and the extension in Phase 2 commences. The Initial Extension of any rope cannot be accurately determined by calculation and has no elastic properties.

The practical value of this characteristic depends upon many factors, the most important being the type and construction of rope, the range of loads and the number and frequency of the cycles of operation. It is not possible to quote exact values for the various constructions of rope in use, but the following approximate values may be employed to give reasonably accurate results.

	% of rope length	
	Fibre Core	Steel Core
Lightly loaded Factor of safety about 8:1	0.25	0.125
Normally loaded Factor of safety about 5:1	0.50	0.25
Heavily loaded Factor of safety about 3:1	0.75	0.50
Heavily loaded with many bends and/or deflections	Up to 2.00	Up to 1.00

The above figures are for guidance purposes. More precise figures are available upon request.

### Locked Coil Hoist Ropes

Immediate permanent extension	0.08
Additional initial extension	0.08
Gradual permanent extension	0.08
Total extension approx.	0.25

### Phase 2 - Elastic Extension

Following Phase 1, the rope extends in a manner which complies approximately with Hookes Law (stress is proportional to strain) until the Limit of Proportionality or Elastic Limit is reached.

It is important to note that wire ropes do not possess a Young's Modulus of Elasticity, but an 'apparent' Modulus of Elasticity can be determined between two fixed loads.

The Modulus of Elasticity also varies with different rope constructions, but generally increases as the cross-sectional area of steel increases. By using the values given, it is possible to make a reasonable estimate of elastic extension, but if greater accuracy is required it is advisable to carry out a modulus test on an actual sample of the rope. As rope users will find it difficult to calculate the actual metallic steel area, the values normally quoted are based on the circumscribed rope area (area of a circle, related to the nominal diameter of the rope).

$$\text{Elastic Extension} = \frac{WL}{EA} \text{ (mm)}$$

$W$  = load applied (kgs)

$L$  = rope length (mm)

$E$  = elastic modulus (kg/mm<sup>2</sup>)

$A$  = circumscribed rope area (mm<sup>2</sup>)

### Phase 3 - Permanent Extension

The permanent, non-elastic extension of the steel caused by tensile loads exceeding the yield point of the material.

If the load exceeds the Limit of Proportionality, the rate of extension will accelerate as the load is increased, until a loading is reached at which continuous extension will commence, causing the wire rope to fracture without any further increase of load.

### Thermal Expansion and Contraction

The coefficient of linear expansion ( $\alpha$ ) of steel wire rope is 0.0000125 = (12.5 x 10<sup>-6</sup>) per °C and therefore the change in length of 1 metre of rope produced by a temperature change of  $t$  °C would be;

Change in length  $\Delta l = \alpha l t$  where

$\alpha$  = coefficient of linear expansion

$l$  = original length of rope (m)

$t$  = temperature change (°C)

The change will be an increase in length if the temperature rises and a decrease in length if the temperature falls.

### Extension due to Rotation

The elongation caused by a free rope end being allowed to rotate.

### Extension due to Wear

The elongation due to inter-wire wear which reduces the cross-sectional area of steel and produces extra constructional extension.

*Example:* What will be the total elongation of a 200 metre length of 28mm diameter Tiger 6R wire rope at a tension of 10 tonnesf (tf) and with an increase in temperature of 20°C.

Permanent Constructional Extension = 0.25% of rope length = 500mm

$$\text{Elastic Extension} = \frac{WL}{EA} = \frac{10000 \times 200 \ 000}{6000 \times 615.8} = 540\text{mm}$$

Thermal Expansion =  $\Delta l = \alpha l a t = 0.0000125 \times 200,000 \times 20 = 50\text{mm}$

Therefore total extension = 500 + 540 + 50 = 1090mm

## 8. Pressures between Ropes and Sheaves or Drums

In addition to bending stresses experienced by wire ropes operating over sheaves or pulleys, ropes are also subjected to radial pressure as they make contact with the sheave. This pressure sets up shearing stresses in the wires, distorts the rope's structure and affects the rate of wear of the sheave grooves. When a rope passes over a sheave, the load on the sheave results from the tension in the rope and the angle of rope contact. It is independent of the diameter of the sheave.

$$\text{Load on bearing} = \frac{2T \sin \theta}{2}$$

Assuming that the rope is supported in a well fitting groove, then the pressure between the rope and the groove is dependent upon the rope tension and diameter but is independent of the arc of contact.

$$\text{Pressure, } P = \frac{2T}{Dd}$$

$P$  = pressure (kg/cm<sup>2</sup>)

$T$  = rope tension (kg)

$D$  = diameter of sheave or drum (cm)

$d$  = diameter of rope (cm)

### Maximum Permissible Pressures

Number of outer wires in strands	Groove material		
	Cast iron kgf/cm <sup>2</sup>	Low carbon cast steel kgf/cm <sup>2</sup>	11 to 13% Mn steel or equivalent alloy steels kgf/cm <sup>2</sup>
5 - 8 Ordinary lay	20	40	105
5 - 8 Lang's lay	25	45	120
9 - 13 Ordinary lay	35	60	175
9 - 13 Lang's lay	40	70	200
14 - 18 Ordinary lay	42	75	210
14 - 18 Lang's lay	47	85	240
Triangular strand	55	100	280

It should be emphasised that this method of estimation of pressure assumes that the area of contact of the rope in the groove is on the full rope diameter, whereas in fact only the crowns of the outer wires are actually in contact with the groove. The local pressures at these contact points may be as high as 5 times those calculated and therefore the values given above cannot be related to the compressive strength of the groove material.

If the pressure is high, the compressive strength of the material in the groove may be insufficient to prevent excessive wear and indentation and this in turn will damage the outer wires of the rope and effect its working life. As with bending stresses, stresses due to radial pressure increase as the diameter of the sheave decreases. Although high bending stresses generally call for the use of flexible rope constructions having relatively small diameter outer wires, these have less ability to withstand heavy pressures than do the larger wires in the less flexible constructions. If the calculated pressures are too high for the particular material chosen for the sheaves or drums or indentations are being experienced, consideration should be given to an increase in sheave or drum diameter. Such a modification would not only reduce the groove pressure, but would also improve the fatigue life of the rope.

The pressure of the rope against the sheave also cause distortion and flattening of the rope structure. This can be controlled by using sheaves with the correct groove profile which, for general purposes, suggests an optimum groove radius of nominal rope radius + 10%. The profile at the bottom of the groove should be circular over an angle of approximately 120°, and the angle of flare between the sides of the sheave should be approximately 52°.

### Hardness of Rope Wire

Rope grade	Approximate Equivalent	Approximate Hardness	
		Brinell	Rockwell 'C'
Min. Tensile Strength	API 9A Grade		
2160N / mm <sup>2</sup>	EEIPS	480 / 500	52
1960N / mm <sup>2</sup>	EIPS	470 / 480	51
1770N / mm <sup>2</sup>	IPS	445 / 470	49
1570N / mm <sup>2</sup>	PS	405 / 425	45

Suggested pulley hardness: 250-300 Brinell for Mn steel or equivalent alloy steel.

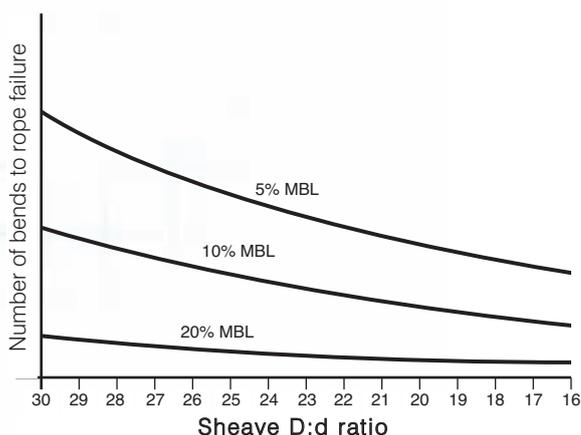
If the calculated pressure is too high for the particular material chosen for the pulley or drum, consideration should be given to increase in pulley or drum diameter. Such a modification would not only reduce the groove pressure, but would also improve the fatigue life of the rope by reducing the bending stresses imposed.

## 9. Bend Fatigue

Bend fatigue testing of ropes usually consists of cycling a length of rope over a sheave while the rope is under a constant tension and as part of its ongoing development programme Bridon has tested literally thousands of ropes in this manner over the years on its in-house own design bend testing equipment.

Through this work, Bridon has been able to compare the effects of rope construction, tensile strength, lay direction, sheave size, groove profile and tensile loading on bend fatigue performance under ideal operating conditions. At the same time it has been possible to compare rope life to discard criteria (e.g. as laid down in ISO 4309) with that to complete failure of the rope, i.e. to the point where the rope has been unable to sustain the load any longer. As part of the exercise, it has also been possible to establish the residual breaking strength of the rope at discard level of deterioration.

### Effects of D:d Ratio and loading on fatigue life - Typical example Dyform 6

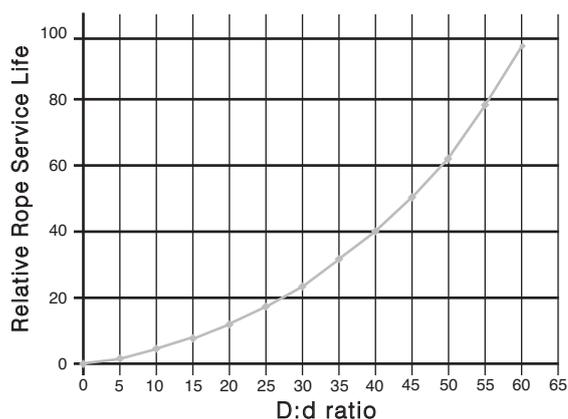


What needs to be recognised, however, is that very few ropes operate under these controlled operating conditions, making it very difficult to use this base information when attempting to predict rope life under other conditions. Other influencing factors, such as dynamic loading, differential loads in the cycle, fleet angle, reeving arrangement, type of coiling on the drum, change in rope direction, sheave alignment, sheave size and groove profile, can have an equally dramatic effect on rope performance.

However, the benefit of such testing can be particularly helpful to the rope manufacturer when developing new or improving existing products.

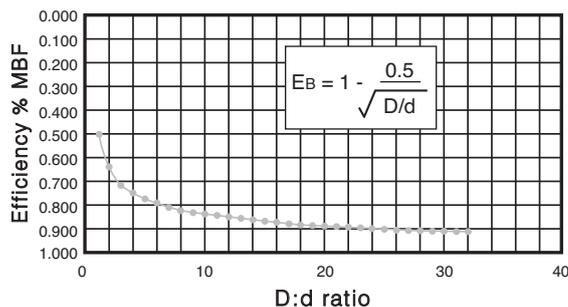
If designers or operators of equipment are seeking optimum rope performance or regard bending fatigue life as a key factor in the operation of equipment, such information can be provided by Bridon for guidance purposes.

### Service life curve for various D:d ratios



When considering the use of a steel wire rope around a minimum D:d ratio, it is generally accepted that at below 4:1 the effect on the strength of the rope needs to be considered. Permanent distortions within the rope will occur when using ratios of 10:1 and less and that a minimum ratio of 16:1 be used for a rope operating around sheaves.

### Approximate loss in breaking strength due to bending

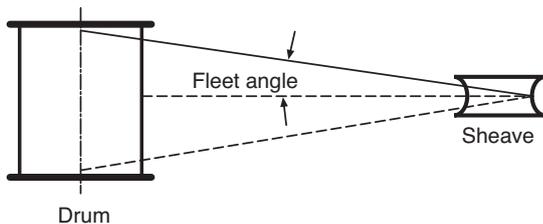


## 10. Fleet Angle

Of all the factors which have some influence on the winding of a rope on a smooth drum, the fleet angle, arguably, has the greatest effect.

Fleet angle is usually defined as the included angle between two lines, one which extends from a fixed sheave to the flange of a drum and the other which extends from the same fixed sheave to the drum in a line perpendicular to the axis of the drum. (See illustration).

### Illustration of Fleet Angle



If the drum incorporates helical grooving, the helix angle of the groove needs to be added or subtracted from the fleet angle as described above to determine the actual fleet angle experienced by the rope.

### At the drum

When spooling rope onto a drum it is generally recommended that the fleet angle is limited to between  $0.5^\circ$  and  $2.5^\circ$ . If the fleet angle is too small, i.e. less than  $0.5^\circ$ , the rope will tend to pile up at the drum flange and fail to return across the drum. In this situation, the problem may be alleviated by introducing a 'kicker' device or by increasing the fleet angle through the introduction of a sheave or spooling mechanism.

If the rope is allowed to pile up it will eventually roll away from the flange creating a shock load in both the rope and the structure of the mechanism, an undesirable and unsafe operating condition.

Excessively high fleet angles will return the rope across the drum prematurely, creating gaps between wraps of rope close to the flanges as well as increasing the pressure on the rope at the cross-over positions.

Even where helical grooving is provided, large fleet angles will inevitably result in localised areas of mechanical damage as the wires 'pluck' against each other. This is often referred to as 'interference' but the amount can be reduced by selecting a Langs lay rope if the reeving allows. The "interference" effect can also be reduced by employing a Dyform rope which offers a much smoother exterior surface than conventional rope constructions.

Floating sheaves or specially designed fleet angle compensating devices may also be employed to reduce the fleet angle effect.

### At the sheave

Where a fleet angle exists as the rope enters a sheave, it initially makes contact with the sheave flange. As the rope continues to pass through the sheave it moves down the flange until it sits in the bottom of the groove. In doing so, even when under tension, the rope will actually roll as well as slide. As a result of the rolling action the rope is twisted, i.e. turn is induced into or out of the rope, either shortening or lengthening the lay length of the outer layer of strands. As the fleet angle increases so does the amount of twist.

To reduce the amount of twist to an acceptable level the fleet angle should be limited to  $2.5^\circ$  for grooved drums and  $1.5^\circ$  for plain drums and when using rotation-resistant low rotation and parallel-closed ropes the fleet angle should be limited to  $1.5^\circ$ .

However, for some applications it is recognised that for practical reasons it is not always possible to comply with these general recommendations, in which case the rope life could be affected.

## 11. Rope Torque

The problem of torsional instability in hoist ropes would not exist if the ropes could be perfectly torque balanced under load. The torque generated in a wire rope under load is usually directly related to the applied load by a constant 'torque factor'. For a given rope construction the torque factor can be expressed as a proportion of the rope diameter and this has been done below..

Variation with rope construction is relatively small and hence the scope for dramatically changing the stability of a hoisting system is limited. Nevertheless the choice of the correct rope can have a deciding influence, especially in systems which are operating close to the critical limit. It should be noted that the rope torque referred to here is purely that due to tensile loading. No account is taken of the possible residual torque due, for example, to rope manufacture or installation procedures.

### Torsional Stability

The torque factors quoted on page 34 are approximate maximum values for the particular constructions. To calculate the torque value for a particular rope size multiply by the nominal rope diameter. Example: for 20mm dia. Tiger 34LR 34x7 Class at 20% of minimum breaking force:-

Torque value = torque factor x rope dia.  
 =  $0.8\% \times 20\text{mm}$   
 = 0.16mm



## Rope Torque

To calculate the torque generated in a particular rope when subjected to a tensile load, multiply the load by the torque value and combine the units.

Example: for 20mm dia. Tiger 34LR 34x7 Class at 6000 kg f load

$$\begin{aligned} \text{Torque generated} &= \text{torque value} \times \text{load} \\ &= 0.16 \cdot 6000 \\ &= 960 \text{ kgf.m} \end{aligned}$$

### Bending Loads

As the rope is bent over the headsheave or drum, an additional force is induced into the steel which must be added to the static and dynamic tensions to obtain the total force imposed. There are many methods of calculation for this bending force, although the one most commonly used is:

$$\text{Bending force} = \frac{EdA}{D}$$

where E = Elastic Modulus as given under 'Elongation of Wire Rope' – kgf/mm<sup>2</sup>  
 d = diameter of outer wire in rope – mm  
 A = Area in rope – mm<sup>2</sup>  
 D = Diameter of sheave or drum – mm

### Size of Outer Wires in Rope

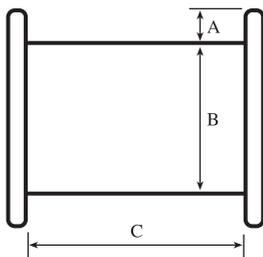
It is sometimes useful to know the size of the outer wires in ropes i.e. when estimating the amount of external wear or calculating bending stress. These can be calculated with reasonable accuracy for all constructions of 6 strand ropes using the following formula.

$$\text{Diameter of outer wires} = \frac{\text{Nominal diameter or rope}}{\text{No. of outer wires per strand} + 3}$$

Example:  
 26mm diameter 6 x 36 (14/7 and 7/7/1)  
 round strand  
 No. of outer wires per strand = 14  
 Diameter of =  $\frac{26}{14+3} = 1.5\text{mm}$   
 outer wire

### Calculations of Drum Capacity

The following formula gives an approximate indication regarding length of rope of a given diameter (d) which can be installed onto a winch/drum.



### Imperial

$$\text{Rope length (ft)} = \frac{(A + B) \times A \times C \times \pi}{12d^2}$$

where A, B, C and d are quoted in inches.

### Metric

$$\text{Rope length (m)} = \frac{(A + B) \times A \times C \times \pi \times 10^6}{d^2}$$

where A, B and C are quoted in metres and d quoted in mm.

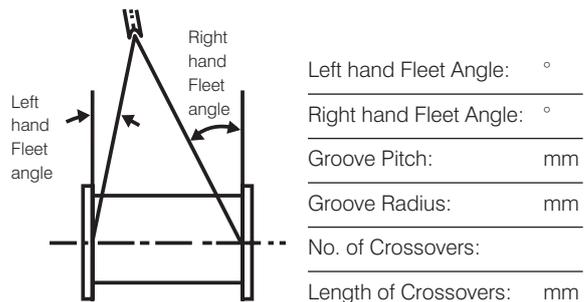
NOTE: Ropes are normally manufactured to a maximum oversize tolerance of 4%. Therefore the actual diameter 'd' could be nominal diameter + 4%.

### WARNING

**Wire rope will fail if worn-out, shock loaded, overloaded, misused, damaged, improperly maintained or abused.**

- Always inspect wire rope for wear, damage or abuse before use
- Never use wire rope which is worn-out, damaged or abused
- Never overload or shock load a wire rope
- Inform yourself: Read and understand the guidance on product safety given in this catalogue; also read and understand the machinery manufacturer's handbook
- Refer to applicable directives, regulations, standards and codes concerning inspection, examination and rope removal criteria

**Protect yourself and others - failure of wire rope may cause serious injury or death!**



### Rope Oscillation

Drum hoists operating with multiple layers of rope often experience severe oscillation of the rope between the headgear sheave and the hoist drum during some part of the hoisting cycle. Advice should be sought from BRIDON'S Mining Division.

## How to order hoist ropes

Customer information				
<b>I. Particulars of shaft:</b>				
1. Suspended Hoist Rope (From Lowest level to Headgear pulley)				
2. Type of ventilation (upcast/downcast)				
3. Shaft water inflow				
4. PH value				
5. Availability of chloride content				
6. Range of temperature variation				
7. Other conditions affecting the rope				
<b>II. Particulars of hoisting:</b>				
1. Type of hoisting	One Rope		Multirope	
	Cage	Skip	Kibble	Counterweight
2. Application	Mineral			
	Mineral & Manriding			
3. Speed of lifting, m/sec				
4. Acceleration of lifting, m/sec <sup>2</sup>				
5. Preventative deceleration, m/sec <sup>2</sup>				
6. Guides	If Available			
	Rope			
	Rigid:	Wood	Steel	Rollers Shoe
<b>III. Particulars of the winder:</b>				
1. Type	Drum Winder	Friction Winder-tower or Ground Mounted Drum		
2. Drum diameter				
3. Drum width				
4. Diameter of Headgear pulley, (mm)				
5. Width of Headgear Pulley				
6. Diameter tolerance taking into account the bottom of the pulley				
7. Type of lining				
8. Diameter of deflector sheave (Tower mounted Friction winding only)				
9. Number of hoist ropes				
10. Number of balance ropes				
11. Type of balance ropes				
12. Weight of 1 m of balance ropes				
13. Loop radius of balance ropes				
<b>IV. Particulars of the hoist conveyance:</b>				
1. Mass of empty conveyance with suspension gear of hoist and balance ropes				
2. Mass of conveyance (2) or counterweight with suspension gear				
3. Mass of payload, t				
4. Number of cycles per day/month				
<b>V. Particulars of the rope:</b>				
1. Rope Specification				
2. Nominal diameter, mm				
3. Construction				
4. Lay Direction				
5. Type of core				
6. Weight of 1 m				
7. Length of the rope, m				
8. Number of individual lengths				
9. Preferred Lubrication				
10. Galvanised/Ungalvanised				
11. Rope Tensile				
12. Minimum Breaking Load, kgf				
13. Nominal Breaking Load, kgf				
14. Aggr. Breaking Load of all wires				
15. Lubrication	Core:	Strands	Rope:	
16. Safety factor: ratio of ABL of all wires to the end load	Without Mass of Ropes, min.			
	With Mass of Ropes, min.			
18. Causes of rope failure during operation				
19. Notes:				



## Summary Technical Information (For guidance purposes only)

Bridon supply a range of 'Tiger' High Performance steel wire ropes specifically designed and manufactured to meet the needs of today's mine winder specifications and the demanding applications to which they are exposed. High performance ropes are normally selected by customers when they require the specific characteristics of improved performance, high strength, low extension or low rotation.

Rope Construction	Rope Modules at 20% of MBF kN/mm <sup>2</sup>	Torque Factor at 20% of MBF	
		%	
		Ordinary	Langs
TIGER 6R F 6 x 7 Class	61.80	8.1	12.0
TIGER 6R F 6 x 19 Class	54.00	8.1	12.0
TIGER 6R F 6 x 36 Class	50.80	8.1	12.0
TIGER Dyform 6R F 6 x 7 Class	66.90	8.1	12.0
TIGER Dyform 6R F 6 x 19 Class	54.20	8.1	12.0
TIGER Dyform 6R F 6 x 36 Class	50.30	8.1	12.0
TIGER 6T F 6 x 8 Class Single layer	68.70	n/a	13.4
TIGER 6T F 6 x 25 Class Compound layer	61.80	n/a	13.4
TIGER 18M F 18 x 7 Class	42.30	n/a	6.6
TIGER 18M F 18 x 19 Class	41.80	n/a	5.6
TIGER Dyform 18 18 x 7 Class	65.70	n/a	4.5
TIGER Dyform 18 18 x 19 Class	65.70	n/a	3.8
TIGER 34M F 34 x 7 Class	41.20	n/a	4.1
TIGER 34M F 34 x 19 Class	40.70	n/a	5.1
TIGER 34LR 34 x 7 Class	72.60	n/a	0.8
TIGER 34LR 34 x 19 Class	72.60	n/a	1.8
TIGER Superflex 14 x 6	40.20	n/a	3.9
TIGER Superflex 17 x 6	38.30	n/a	2.6
TIGER Superflex 20 x 6	36.30	n/a	1.3
TIGER 6R CDR 6 x 19 Class	50.00	n/a	12.0
TIGER 6R CDR 6 x 25 Class	46.40	n/a	12.0
TIGER 6R CDR 6 x 31 Class	46.40	n/a	12.0
TIGER Dyform 6R CDR 6 x 19 Class	54.20	n/a	12.0
TIGER Dyform 6R CDR 6 x 26 Class	50.30	n/a	12.0
TIGER Dyform 6R CDR 6 x 31 Class	50.30	n/a	12.0
TIGER Zebra CDR 6 x 19	63.90	n/a	9.6
TIGER Zebra CDR 6 x 26	59.30	n/a	9.6
TIGER Zebra CDR 6 x 31	59.30	n/a	9.6
TIGER FL Hoist Class	98.10	Variable	
TIGER FL Aerial Track Class	110.00	Variable	
TIGER HL Guide Class	117.00	Variable	

## Guide to Examination

The continued safe operation of lifting equipment, lifting accessories (e.g. slings) and other systems employing wire rope depends to a large extent on the operation of well programmed periodic rope examinations and the assessment by the competent person of the fitness of the rope for further service.

Examination and discard of ropes by the competent person should be in accordance with the instructions given in the original equipment manufacturer's handbook. In addition, account should be taken of any local or application specific Regulations.

The competent person should also be familiar, as appropriate, with the latest versions of related International, European or National standards such as ISO 4309 "Cranes - Wire ropes - code of practice for examination.

**Particular attention must be paid to those sections of rope which experience has shown to be liable to deterioration. Excessive wear, broken wires, distortions and corrosion are the more common visible signs of deterioration.**

*Note: This publication has been prepared as an aid for rope examination and should not be regarded as a substitute for the competent person.*

**Wear** is a normal feature of rope service and the use of the correct rope construction ensures that it remains a secondary aspect of deterioration. Lubrication may help to reduce wear.

**Broken wires** are a normal feature of rope service towards the end of the rope's life, resulting from bending fatigue and wear. The local break up of wires may indicate some mechanical fault in the equipment. Correct lubrication in service will increase fatigue performance.

**Distortions** are usually as a result of mechanical damage, and if severe, can considerably affect rope strength.

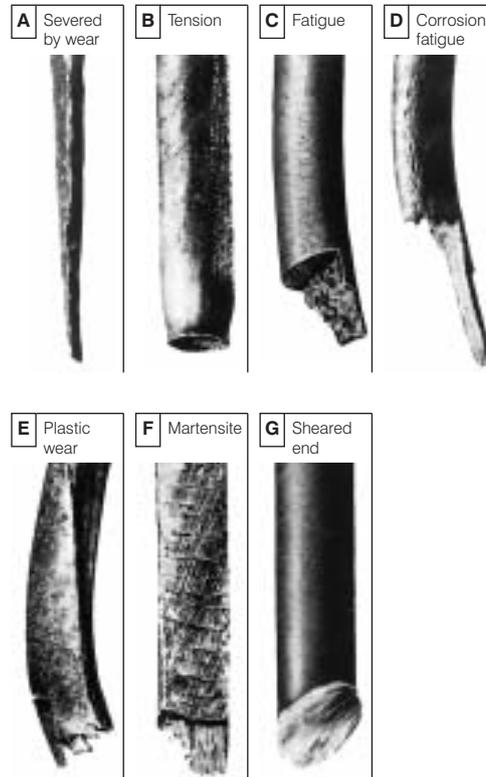
Visible rusting indicates a lack of suitable lubrication, resulting in **corrosion**. Pitting of external wire surfaces becomes evident in some circumstances. Broken wires ultimately result.

**Internal corrosion** occurs in some environments when lubrication is inadequate or of an unsuitable type. Reduction in rope diameter will frequently guide the observer to this condition. Confirmation can only be made by opening the rope with clamps or the correct use of spike and needle to facilitate internal inspection.

*Note: Non-destructive testing (NDT) using electromagnetic means may also be used to detect broken wires and/or loss in metallic area. This method complements the visual examination but does not replace it.*

*Pictures courtesy of S.M.R.E. Crown Copyright 1966*

### Some of the More Common Types of Wire Fractures Can Include:



## Factors Affecting Rope Performance

**Multi-coiling** of the rope on the drum can result in severe distortion in the underlying layers.

**Bad coiling** (due to excessive fleet angles or slack winding) can result in mechanical damage, shown as severe crushing, and may cause shock loading during operation.

**Small diameter sheaves** can result in permanent set of the rope, and will certainly lead to early wire breaks due to fatigue.

**Oversize grooves** offer insufficient support to the rope leading to increased localised pressure, flattening of the rope and premature wire fractures. Grooves are deemed to be oversize when the groove diameter exceeds the nominal rope diameter by more than 15% steel, 20% polyurethane liners.

**Undersize grooves** in sheaves will crush and deform the rope, often leading to two clear patterns of wear and associated wire breaks.

**Excessive angle of fleet** can result in severe wear of the rope due to scrubbing against adjacent laps on the drum. Rope deterioration at the Termination may be exhibited in the form of broken wires. An excessive angle of fleet can also induce rotation causing torsional imbalance.



## Troubleshooting Guide

### Typical examples of Wire Rope deterioration

**1** Mechanical damage due to rope movement over sharp edge projection whilst under load.



**2** Localised wear due to abrasion on supporting structure.



**3** Narrow path of wear resulting in fatigue fractures, caused by working in a grossly oversize groove, or over small support rollers.



**4** Two parallel paths of broken wires indicative of bending through an undersize groove in the sheave.



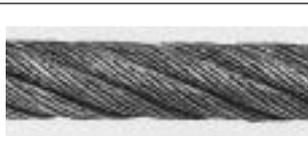
**5** Severe wear, associated with high tread pressure.



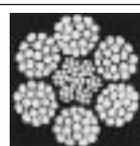
**6** Severe wear in Langs Lay, caused by abrasion.



**7** Severe corrosion.



**8** Internal corrosion whilst external surface shows little evidence of deterioration.



**9** Typical wire fractures as a result of bend fatigue.



**10** Wire fractures at the strand, or core interface, as distinct from 'crown' fractures.



**11** Break up of IWRC resulting from high stress application.



**12** Looped wires as a result of torsional imbalance and/or shock loading.



**13** Typical example of localised wear and deformation.



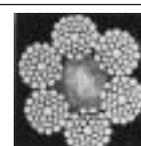
**14** Multi strand rope 'bird caged' due to torsional imbalance.



**15** Protrusion of rope centre resulting from build up of turn.



**16** Substantial wear and severe internal corrosion.



## Troubleshooting Guide

The following is a simplified guide to common wire rope problems. More detailed advice can be obtained from any Bridon distributor. In the event of no other standard being applicable, Bridon recommends that ropes are inspected/examined in accordance with ISO 4309.

Problem	Cause/Action
<p>Mechanical damage caused by the rope contacting the structure of the installation on which it is operating or an external structure - usually of a localised nature.</p>	<ul style="list-style-type: none"> <li>• Generally results from operational conditions.</li> <li>• Check sheave guards and support/guide sheaves to ensure that the rope has not "jumped out" of the intended reeving system.</li> <li>• Review operating conditions.</li> </ul>
<p>Opening of strands in rotation resistant, low rotation and parallel closed ropes - in extreme circumstances the rope may develop a "birdcage distortion" or protrusion of inner strands.</p> <p><b>Note - rotation resistant and low rotation ropes are designed with a specific strand gap which may be apparent on delivery in an off tension condition. These gaps will close under load and will have no effect on the operational performance of the rope.</b></p>	<ul style="list-style-type: none"> <li>• Check sheave and drum groove radii using sheave gauge to ensure that they are no smaller than nominal rope radius +5% - Bridon recommends that the sheave and drum groove radii are checked prior to any rope installation.</li> <li>• Repair or replace drum/sheaves if necessary.</li> <li>• Check fleet angles in the reeving system - a fleet angle in excess of 1.5 degrees may cause distortion (see page 31).</li> <li>• Check installation method - turn induced during installation can cause excessive rope rotation resulting in distortion (See pages 42 - 54).</li> <li>• Check if the rope has been cut "on site " prior to installation or cut to remove a damaged portion from the end of the rope. If so, was the correct cutting procedure used? Incorrect cutting of rotation resistant, low rotation and parallel closed ropes can cause distortion in operation (See page 46).</li> <li>• Rope may have experienced a shock load.</li> </ul>
<p>Broken wires or crushed or flattened rope on lower layers at crossover points in multi - layer coiling situations.</p> <p>Wire breaks usually resulting from crushing or abrasion.</p>	<ul style="list-style-type: none"> <li>• Check tension on underlying layers. Bridon recommends an installation tension of between 2% and 10% of the minimum breaking force of the wire rope. Care should be taken to ensure that tension is retained in service. Insufficient tension will result in these lower layers being more prone to crushing damage.</li> <li>• Review wire rope construction. Dyform wire ropes are more resistant to crushing on underlying layers than conventional rope constructions.</li> <li>• Do not use more rope than necessary.</li> <li>• Check drum diameter. Insufficient bending ratio increases tread pressure.</li> </ul>

Continued on next page

## Troubleshooting Guide

Problem	Cause/Action
Wires looping from strands.	<ul style="list-style-type: none"> <li>• Insufficient service dressing.</li> <li>• Consider alternative rope construction.</li> <li>• If wires are looping out of the rope underneath a crossover point, there may be insufficient tension on the lower wraps on the drum.</li> <li>• Check for areas of rope crushing or distortion.</li> </ul>
"Pigtail" or severe spiralling in rope.	<ul style="list-style-type: none"> <li>• Check that the sheave and drum diameter is large enough - Bridon recommends a minimum ratio of the drum/sheave to nominal rope diameter of 18:1.</li> <li>• Indicates that the rope has run over a small radius or sharp edge.</li> <li>• Check to see if the rope has "jumped off" a sheave and has run over a shaft.</li> </ul>
Two single axial lines of broken wires running along the length of the rope approximately 120 degrees apart indicating that the rope is being "nipped" in a tight sheave.	<ul style="list-style-type: none"> <li>• Check sheave and drum groove radii using sheave gauge to ensure that they are no smaller than nominal rope radius + 5% - Bridon would recommend that the sheave/drum groove radii are checked prior to any rope installation.</li> <li>• Repair or replace drum/sheaves if necessary.</li> </ul>
One line of broken wires running along the length of the rope indicating insufficient support for the rope, generally caused by oversize sheave or drum grooving.	<ul style="list-style-type: none"> <li>• Check to see if the groove diameter is no greater than 15% greater than the nominal rope diameter.</li> <li>• Repair or replace drum/sheaves if necessary.</li> <li>• Check for contact damage.</li> </ul>
<p>Short rope life resulting from evenly/randomly distributed bend fatigue wire breaks caused by bending through the reeving system.</p> <p>Fatigue induced wire breaks are characterised by flat ends on the broken wires.</p>	<ul style="list-style-type: none"> <li>• Bending fatigue is accelerated as the load increases and as the bending radius decreases (see page 30). Consider whether either factor can be improved.</li> <li>• Check wire rope construction - Dyform ropes are capable of doubling the bending fatigue life of a conventional steel wire rope.</li> </ul>

## Troubleshooting Guide

Problem	Cause/Action
<p>Short rope life resulting from localised bend fatigue wire breaks.</p> <p>Fatigue induced wire breaks are characterised by flat ends on the broken wires.</p>	<ul style="list-style-type: none"> <li>Bending fatigue is accelerated as the load increases and as the bending radius decreases (see page 30). Consider whether either factor can be improved.</li> <li>Check wire rope construction - Dyform ropes are capable of doubling the bending fatigue life of a conventional steel wire rope.</li> <li>Localised fatigue breaks indicate continuous repetitive bends over a short length. Consider whether it is economic to periodically shorten the rope in order to move the rope through the system and progressively expose fresh rope to the severe bending zone. In order to facilitate this procedure it may be necessary to begin operating with a slightly longer length of rope.</li> </ul>
<p>Broken rope - ropes are likely to break when subjected to substantial overload or misuse particularly when a rope has already been subjected to mechanical damage.</p> <p>Corrosion of the rope both internally and/or externally can also result in a significant loss in metallic area. The rope strength is reduced to a level where it is unable to sustain the normal working load.</p>	<ul style="list-style-type: none"> <li>Review operating conditions.</li> </ul>
<p>Wave or corkscrew deformations normally associated with multistrand ropes.</p>	<ul style="list-style-type: none"> <li>Check sheave and drum groove radii using sheave gauge to ensure that they are no smaller than nominal rope radius +5% - Bridon recommends that the sheave/drum groove radii are checked prior to any rope installation.</li> <li>Repair or replace drum/sheaves if necessary.</li> <li>Check fleet angles in the reeving system - a fleet angle in excess of 1.5 degrees may cause distortion (see page 31).</li> <li>Check that rope end has been secured in accordance with manufacturers instructions (see page 46).</li> <li>Check operating conditions for induced turn.</li> </ul>
<p>Rotation of the load in a single fall system.</p>	<ul style="list-style-type: none"> <li>Review rope selection.</li> <li>Consider use of rotation resistant or low rotation rope.</li> </ul>
<p>Rotation of the load in a multi - fall system resulting in "cabling" of the rope falls.</p> <p>Possibly due to induced turn during installation or operation.</p>	<ul style="list-style-type: none"> <li>Review rope selection.</li> <li>Consider use of rotation resistant or low rotation rope.</li> <li>Review installation procedure (See pages 42 - 54) or operating procedures.</li> </ul>
<p>Core protrusion or broken core in single layer six or eight strand rope.</p>	<ul style="list-style-type: none"> <li>Caused by repetitive shock loading - review operating conditions.</li> </ul>

Continued on next page

## Troubleshooting Guide



Problem	Cause/Action
Rope accumulating or “stacking” at drum flange - due to insufficient fleet angle.	<ul style="list-style-type: none"> <li>• Review drum design with original equipment manufacturer - consider adding rope kicker, fleeting sheave etc.</li> </ul>
Sunken wraps of rope on the drum normally associated with insufficient support from lower layers of rope or grooving.	<ul style="list-style-type: none"> <li>• Check correct rope diameter.</li> <li>• If grooved drum check groove pitch.</li> <li>• Check tension on underlying layers - Bridon recommend an installation tension of between 2% and 10% of the minimum breaking force of the wire rope - Care should be taken to ensure that tension is retained in service. Insufficient tension will result in these lower layers being more prone to crushing damage.</li> <li>• Make sure that the correct rope length is being used. Too much rope (which may not be necessary) may aggravate the problem.</li> </ul>
Short rope life induced by excessive wear and abrasion.	<ul style="list-style-type: none"> <li>• Check fleet angle to drum.</li> <li>• Check general alignment of sheaves in the reeving system.</li> <li>• Check that all sheaves are free to rotate.</li> <li>• Review rope selection. The smooth surface of Dyform wire ropes gives better contact with drum and sheaves and offers improved resistance to “interference” between adjacent laps of rope.</li> </ul>
External corrosion.	<ul style="list-style-type: none"> <li>• Consider selection of galvanised rope.</li> <li>• Review level and type of service dressing.</li> </ul>
Internal corrosion.	<ul style="list-style-type: none"> <li>• Consider selection of galvanised rope.</li> <li>• Review frequency amount and type of service dressing.</li> <li>• Consider selection of plastic impregnated (PI) wire rope.</li> </ul>

## Services



Bridon Services comprises the most highly trained professionals in the industry. Our expertise in inspection has won international recognition and has proved to be one of many cost effective services provided by Bridon customers world-wide.

24 hours a day, 365 days a year, underground trained engineers and technicians are dispatched across the globe to execute complex operations, our teams are prepared whatever the problem, wherever the location. With resources and support services unavailable elsewhere in the industry, BRIDON provides the only specialist service in wire rope.

### Repair and Maintenance

Repair and maintenance can be carried out in many forms. All types of ropes including haulage, multi-strand rope, Lock Coil mining rope and Spiral Strand are catered for, from a broken wire to a total re-splice.

### Installation & Replacement Services

The service life and safety of a wire rope can depend as much upon the quality of the installation as upon the quality of the product itself. To protect your investment, take advantage of our installation and replacement service - expert international support covering virtually all types of equipment which uses or incorporates wire rope. Typical installations include: aerial ropeways, mining applications, elevators, excavators and cranes. Bridon Services has a range of specialised installation equipment including back tension winches, spoolers, hydraulic tensioners, etc, to carry out installations of wire rope on all applications.

### Inspection & Statutory Examination Services

Bridon's expertise in the Inspection and Statutory Examination of wire rope has won international recognition - especially through the quality of our client training courses and field inspection services which cover many needs. The regular inspection of systems and components through a comprehensive inspection service has proved to be very cost effective for our customers.

We also offer customers a statutory examination services

as required under law, which subjects wire rope and lifting equipment to stringent testing and examination procedures.

### Non destructive testing (NDT)

The primary cause of wire rope failure is internal degradation through corrosion and fatigue. We provide a comprehensive non-destructive testing service operating to the most meticulous standards. This process detects the presence of defects such as broken wires on the surface and within the rope, loss of metallic cross-sectional area and distortions, and records the information progressively from the head on a magnetic recording to a notebook/laptop as the wire rope passes through the head.

### Splicing

- for rope ranges of up to 70mm on long splices and 95mm on eye splices.

All types of on-site splices can be carried out by our teams including: rope driven conveyors, aerial haulages, funiculars, tile conveyors etc. Types of splices include: long splices and eye splices including multi-strand and bordeaux connection. All splices are carried out to internationally recognised standards, including passenger carrying ropes. All splicing materials can be provided.

## Training

Bridon has established a reputation for running quality training which is second to none. Our courses never stand still and are directly relevant to trading conditions of today. In an increasing competitive world, costs must be continually reduced without compromising safety. There is no better way to prepare for this challenge than through a Bridon Industry-standard course.

For further information on training courses and practical workshop based wire rope splicing and socketing courses to suit your individual needs contact BRIDON.

## Product Safety: Instructions & Warnings on the use of steel wire rope

The following Instructions and Warnings combine to provide guidance on Product Safety and are intended for use by those already having a working knowledge of wire ropes, as well as the new user. They should be read, followed and passed on to others.

Failure to read, understand and follow these instructions could result in harmful and damaging consequences.

A 'Warning' statement indicates a potential hazardous situation which could result in a significant reduction in rope performance and/or put at risk, either directly or indirectly, the safety or health of those persons within the danger zone of the rope and its associated equipment.

*Note: As a result of the creation of the single European market and the 'New Approach' Directives which set out 'essential requirements' (e.g. for safety) designers, manufacturers, suppliers, specifiers and users need to keep themselves abreast of any changes to the appropriate Regulations and national standards.*

### 1. Storage

**1.1** Unwrap the rope and examine the rope immediately after delivery to check its identification and condition and verify that it is in accordance with the details on the Certificates and/or other relevant documents.

*Note: The rope should not be used for lifting purposes without the user having a valid Certificate in his possession.*

Check the rope diameter and examine any rope terminations to ensure that they are compatible with the equipment or machinery to which they are to be fitted. (See Fig. 1)



Fig 1

**1.2** Select a clean, well ventilated, dry, undercover location. Cover with waterproof material if the delivery site conditions preclude inside storage.

Rotate the reel periodically during long periods of storage, particularly in warm environments, to prevent migration of the lubricant from the rope.

#### **⚠ WARNING**

**Never store wire rope in areas subject to elevated temperatures as this may seriously affect its future performance. In extreme cases its original as-manufactured strength may be severely reduced rendering it unfit for safe use.**

Ensure that the rope does not make any direct contact with the floor and that there is a flow of air under the reel.

#### **⚠ WARNING**

**Failure to do so may result in the rope becoming contaminated with foreign matter and start the onset of corrosion before the rope is even put to work.**

Support the reel on a simple A-frame or cradle, located on ground which is capable of supporting the total mass of rope and reel. (See Fig. 2) Ensure that the rope is stored where it is not likely to be affected by chemical fumes, steam or other corrosive agents.

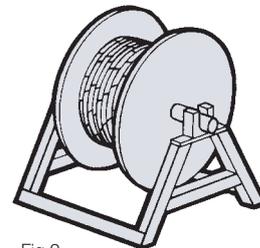


Fig 2

#### **⚠ WARNING**

**Failure to do so may seriously affect its condition rendering it unfit for safe use.**

**1.3** Examine ropes in storage periodically and, when necessary, apply a suitable dressing which is compatible with the manufacturing lubricant. Contact the rope supplier, Bridon or original equipment manufacturer's (OEM) manual for guidance on types of dressings available, methods of application and equipment for the various types of ropes and applications.

Re-wrap the rope unless it is obvious that this will be detrimental to rope preservation. (Refer to the relevant Product Data sheets on rope dressings for more detailed information.)

#### **⚠ WARNING**

**Failure to apply the correct dressing may render the original manufacturing lubricant ineffective and rope performance may be significantly affected.**

Ensure that the rope is stored and protected in such a manner that it will not be exposed to any accidental damage either during the storage period or when placing the rope in, or taking it out of storage.

## Product Safety: Instructions & Warnings on the use of steel wire rope

### ⚠ WARNING

**Failure to carry out or pay attention to any of the above could result in a loss of strength and/or a reduction in performance. In extreme cases the rope may be unfit for safe use.**

### 2. Certification and Marking

Make sure that the relevant Certificate has been obtained before taking the rope into use for a lifting operation. (Refer to statutory requirements)

Check to verify that the marking on the rope or its package matches the relevant Certificate.

*Note: The rating of a component part of a machine or lifting accessory is the responsibility of the designer of the machine or accessory. Any re-rating of a lifting accessory must be approved by a competent person.*

Retain the Certificate in a safe place for identification of the rope when carrying out subsequent periodic statutory examinations in service. (Refer to statutory requirements)

### 3. Handling and Installation

- 3.1** Handling and installation of the rope should be carried out in accordance with a detailed plan and should be supervised by a competent person.

### ⚠ WARNING

**Incorrectly supervised handling and installation procedures may result in serious injury to persons in the vicinity of the operation as well as those persons directly involved in the handling and installation.**

- 3.2** Wear suitable protective clothing such as overalls, industrial gloves, helmet, eye protectors and safety footwear (and respirator, particularly where the emission of fumes due to heat is likely).

### ⚠ WARNING

**Failure to wear suitable protective clothing and equipment may result in skin problems from over exposure to certain types of rope lubricants and dressings; burns from sparks, rope ends, molten lubricants and metals when cutting ropes or preparing sockets for re-use; respiratory or other internal problems from the inhalation of fumes when cutting ropes or preparing sockets for re-use; eye injuries from sparks when cutting ropes; lacerations to the body from wire and rope ends; bruising of the body and damage to limbs due to rope recoil, backlash and any sudden deviation from the line of path of rope.**

- 3.3** Ensure that the correct rope has been supplied by checking to see that the description on the Certificate is in accordance with that specified in the purchaser's order.

- 3.4** Check by measurement that the nominal diameter of the new rope conforms to the nominal size stated on the Certificate.

For verification purposes, measure the diameter by using a suitable rope vernier fitted with jaws broad enough to cover not less than two adjacent strands. Take two sets of measurements spaced at least 1 metre apart, ensuring that they are taken at the largest cross-sectional dimension of the rope. At each point take measurements at right angles to each other.

The average of these four measurements should be within the tolerances specified in the appropriate Standard or Specification.

For a more general assessment of rope diameter use a rope calliper. (See Fig 1)

- 3.5** Examine the rope visually to ensure that no damage or obvious signs of deterioration have taken place during storage or transportation to the installation site.
- 3.6** Check the working area around the equipment for any potential hazards which may affect the safe installation of the rope.
- 3.7** Check the condition of the rope-related equipment in accordance with the OEM's instructions. Include the following -

#### Sheave and Drum Sizes

Regulations throughout the world quote various minimum D:d ratios for differing rope constructions and these must be considered when selecting a suitable hoist rope. However as guidance the following D:d ratios are recommended.

6 Stranded ropes 80:1

Multi Stranded ropes 80:1

Locked coil ropes 100-120:1 depending upon rope diameter.

(In addition the drum to outer wire ratio should be between 1000 and 1500:1)

Factors such as speed can necessitate an increase in the D:d ratio and in certain circumstances a D:d ratio below the recommended value can be tolerated but some reduction in rope life should be expected.

BRIDON's Mining Division will be pleased to advise on this subject.

#### Sheave Grooves

Groove diameters should be such that they can accommodate a new rope taking into account the relevant oversize tolerance and the fleet angles involved to provide adequate circumferential support.

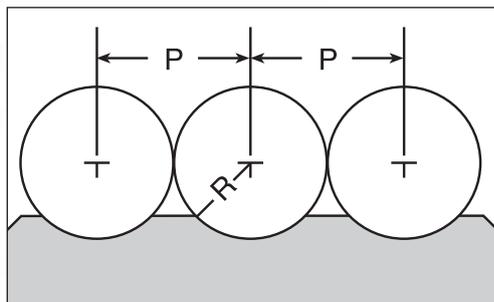
## Product Safety: Instructions & Warnings on the use of steel wire rope

A groove diameter of 7.5% greater than the nominal rope diameter is normally acceptable. However in certain cases experience has shown that clearances between 10 and 12.5% are required to obtain optimum performance.

Before installing a new rope all sheave grooves should be checked to ensure they provide the recommended clearance.

### Drum Grooves

On single layer drum hoists spiral grooving is recommended. Where multilayer coiling is necessary then parallel grooves or one of the patterned coiling systems should be used. In all cases correct pitch, clearance and groove depth are essential to obtain good rope performance.



Dimensions for grooving of drums

General recommendations for stranded ropes

$P = \text{nominal diameter} + 5\%$

$R = \text{nominal radius} + 7.5\%$

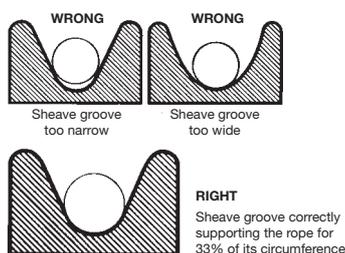
A gap between the last turn on the bottom layer of rope on the drum and the flange can be corrected by fitting a packing (or false cheek) of suitable thickness on the inside of the flange.

### **WARNING**

**Failure to carry out any of the above could result in unsatisfactory and unsafe rope performance.**

*Note: Grooves must have clearance for the rope and provide adequate circumferential support to allow for free movement of the strands and facilitate bending. When grooves become worn and the rope is pinched at the sides, strand and wire movement is restricted and the ability of the rope to bend is reduced. (See Fig. 4)*

Fig 4



When a new rope is fitted a variation in size compared with the old worn rope will be apparent. The new rope may not fit correctly into the previously worn groove profile and unnecessary wear and rope distortion is likely to occur. This may be remedied by machining out the grooves before the new rope is installed. Before carrying out such action the sheaves or drum should be examined to ensure that there will be sufficient strength remaining in the underlying material to safely support the rope.

The competent person should be familiar with the requirements of the appropriate application/machinery standard.

*Note: General guidance to users is given in ISO 4309 Code of practice for the selection, care and maintenance of steel wire rope.*

Transfer the wire rope carefully from the storage area to the installation site.

### Coils

Place the coil on the ground and roll it out straight ensuring that it does not become contaminated with dust/grit, moisture or any other harmful material. (See Fig. 5)

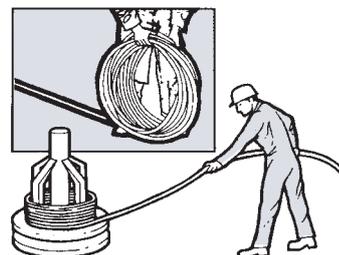


Fig 5

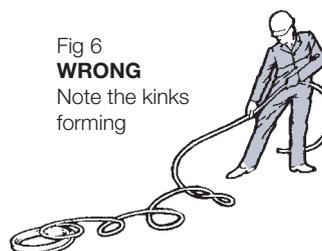
If the coil is too large to physically handle it may be placed on a 'swift' turntable and the outside end of the rope pulled out allowing the coil to rotate. (See Fig. 5)

### **WARNING**

**Never pull a rope away from a stationary coil as this will induce turn into the rope and kinks will form. These will adversely affect rope performance. (See Fig. 6)**

Fig 6

**WRONG**  
Note the kinks forming



## Product Safety: Instructions & Warnings on the use of steel wire rope

### Reels

Pass a shaft through the reel and place the reel in a suitable stand which allows it to rotate and be braked to avoid overrun during installation. Where multi-layer coiling is involved it may be necessary for the reel to be placed in equipment which has the capability of providing a back tension in the rope as it is being transferred from reel to drum. This is to ensure that the underlying (and subsequent) laps are wound tightly on the drum. (See Fig. 7)

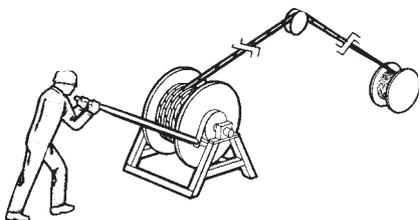


Fig 7

Position the reel and stand such that the fleet angle during installation is limited to 1.5 degrees. (See Fig. 8)

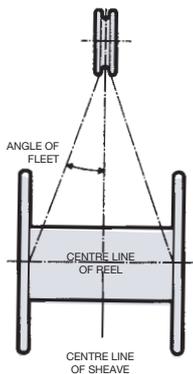


Fig 8

If a loop forms in the rope ensure that it does not tighten to form a kink.

### **WARNING**

**A kink can severely affect the strength of a six strand rope and can result in distortion of a rotation-resistant or low rotation rope leading to its immediate discard.**

Ensure that the reel stand is mounted so as not to create a reverse bend during reeving (i.e. for a winch drum with an overlap rope, take the rope off the top of the reel). (See Fig. 7)

- 3.9** Ensure that any equipment or machinery to be roped is correctly and safely positioned and isolated from normal usage before installation commences. Refer to the OEM's instruction manual and the relevant 'Code of Practice'.
- 3.10** When releasing the outboard end of the rope from a reel or coil, ensure that this is done in a controlled manner. On release of the bindings and servings used for packaging, the rope will want to straighten itself from its previously bent position. Unless controlled, this could be a violent action. Stand clear.

### **WARNING**

**Failure to control could result in injury.**

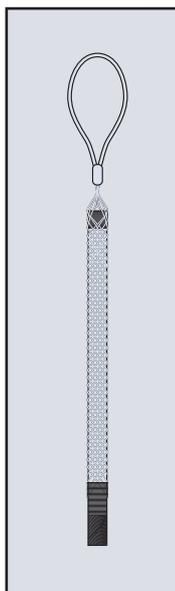
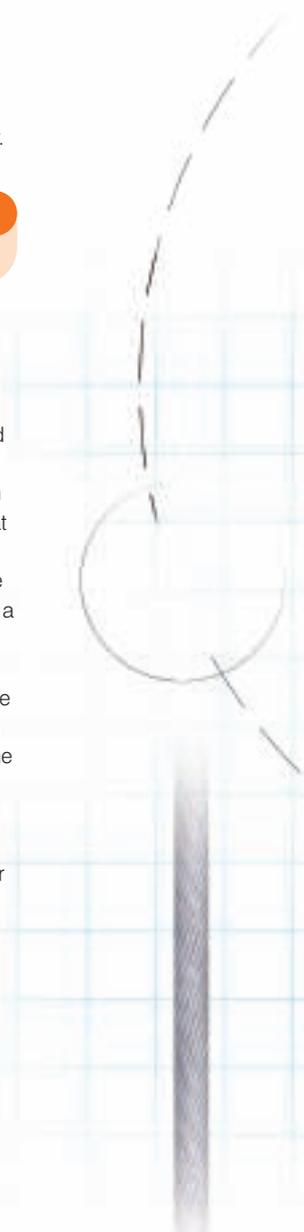


Fig 9

Ensure that the as-manufactured condition of the rope is maintained during installation.

If installing the new rope with the aid of an old one, one method is to fit a wire rope sock (or stocking) to each of the rope ends. Always ensure that the open end of the sock (or stocking) is securely attached to the rope by a serving or alternatively by a clip (See Fig. 9). Connect the two ends via a length of fibre rope of adequate strength in order to avoid turn being transmitted from the old rope into the new rope. Alternatively a length of fibre or steel rope of adequate strength may be reeved into the system for use as a pilot/messenger line. Do not use a swivel during the installation of the rope.



## Product Safety: Instructions & Warnings on the use of steel wire rope

- 3.11** Monitor the rope carefully as it is being pulled into the system and make sure that it is not obstructed by any part of the structure or mechanism which may cause the rope to come free.

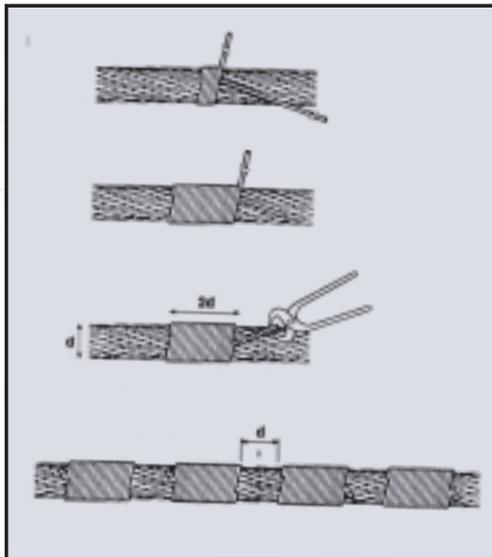


Fig 10

### **WARNING**

**Failure to monitor during this operation could result in injury.**

This entire operation should be carried out carefully and slowly under the supervision of a competent person.

- 3.12** Take particular care and note the manufacturer's instructions when the rope is required to be cut. Apply secure servings on both sides of the cut mark. (See Fig. 10 for typical method of applying a serving to a multi-layer rope.)

Ensure that the length of serving is at least equal to two rope diameters. (Note: Special servings are required for spiral ropes, i.e. spiral strand and locked coil.)

### **Length of serving for locked coil winding ropes and half locked coil guide ropes**

The length of rope to be served depends on the object of the serving and on the size and type of the rope. If the serving is to restrain the cut end of a rope it must be longer than one intended to restrain the end of a short sample to be cut from a rope. A rope of the stranded type exerts only a moderate bursting force on a serving but a large locked coil rope exerts a considerable bursting force and, should the serving burst, the rope will unlay itself violently over a long length. Thus, for the cut end of a stranded rope, two servings each of a length at least six times the rope diameter should be used and kept in place until the rope end is otherwise secured. For the cut end of a large locked coil rope a serving or servings each a length of twenty times the rope diameter is advisable, and such servings should be backed up by a minimum of six two-bolt clamps set clear of the served length until the rope end is otherwise secured. Servings should be left permanently on locked coil winding ropes so that there is one about 0.6m (2ft) clear of the capel to allow proper examination of the rope at this point and another between the capel and the nearest pulley or driving sheave in the head frame. This is to localise any unlaying of the rope end, or of broken wires, in the event of some incident.

One serving either side of the cut is normally sufficient for preformed ropes. For non-preformed ropes, multi-layer (i.e. rotation-resistant and low rotation ropes) and parallel closed ropes (i.e. DSC ropes) a minimum of two servings each side of the cut will be necessary (See Fig. 10).

Arrange and position the rope in such a manner that at the completion of the cutting operation the rope ends will remain in position, thus avoiding any backlash or any other undesirable movement.

Cut the rope with a high speed abrasive disc cutter. Other suitable mechanical or hydraulic shearing equipment may be used although not recommended when a rope end is required to be welded or brazed.

For serving instructions for FL and HL ropes refer to Bridon.

## Product Safety: Instructions & Warnings on the use of steel wire rope

### ⚠ WARNING

**When using a disc cutter be aware of the danger from sparks, disc fragmentation and fumes. (Refer 3.2.)**

Ensure adequate ventilation to avoid any build-up of fumes from the rope and its constituent parts including any fibre core (natural or synthetic) any rope lubricant(s) and any synthetic filling and/or covering material.

### ⚠ WARNING

**Some special ropes contain synthetic material which, when heated to a temperature higher than normal production processing temperatures, will decompose and may give off toxic fumes.**

### ⚠ WARNING

**Rope produced from carbon steel wires in the form shipped is not considered a health hazard. During subsequent processing (e.g. cutting, welding, grinding, cleaning) dust and fumes may be produced which contain elements which may affect exposed workers.**

The products used in the manufacture of steel wire ropes for lubrication and protection present minimal hazard to the user in the form shipped. The user must however, take reasonable care to minimise skin and eye contact and also avoid breathing their vapour and mist.

After cutting, the rope cross-sections of non-preformed ropes, multi-layer ropes and parallel closed ropes must be welded, brazed or fused and tapered such that all wires and strands in the rope are completely secured.

### ⚠ WARNING

**Failure to correctly secure the rope end is likely to lead to slackness, distortions, premature removal from service and a reduction in the breaking force of the rope.**

**3.13** Ensure that any fittings such as clamps or fixtures are clean and undamaged before securing rope ends.

Make sure that all fittings are secure in accordance with the OEM's instruction manual or manufacturer's instructions and take particular note of any specific safety requirements e.g. torque values (and frequency of any re-application of torque).

When terminating a rope end with a wedge socket, ensure that the rope tail cannot withdraw through the socket by securing a clamp to the tail or by following the manufacturer's instructions.

(See Fig. 11 for two recommended methods of securing the rope tail of a wedge socket termination).

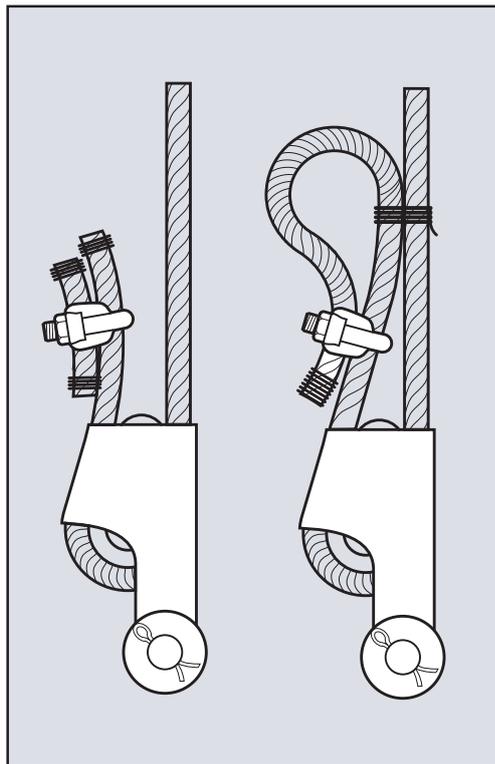


Fig 11

The loop back method uses a rope grip and the loop should be lashed to the live part of rope by a soft wire serving or tape to prevent flexing of the rope in service.

The method of looping back should not be used if there is a possibility of interference of the loop with the mechanism or structure.

### ⚠ WARNING

**Failure to secure in accordance with instructions could lead to loss of the rope and/or injury.**

**3.14** When coiling a rope on a plain (or smooth) barrel drum ensure that each lap lies tightly against the preceding lap. The application of tension in the rope greatly assists in the coiling of the rope.

## Product Safety: Instructions & Warnings on the use of steel wire rope

### **⚠ WARNING**

**Any looseness or uneven winding will result in excessive wear, crushing and distortion of the rope.**

With plain barrel drums it is difficult to achieve satisfactory multi-layer coiling beyond three layers.

The direction of coiling of the rope on the drum is important, particularly when using plain barrel drums, and should be related to the direction of lay of the rope in order to induce close coiling.

(See Fig. 12 for proper method of locating rope anchorage point on a plain drum.)

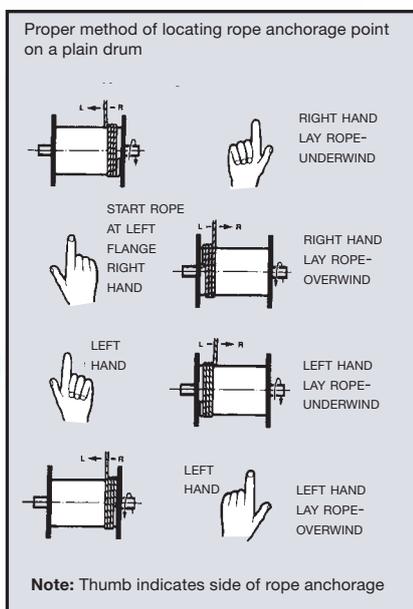


Fig 12

When multi layer coiling has to be used it should be realised that after the first layer is wound on a drum, the rope has to cross the underlying rope in order to advance across the drum in the second layer. The points at which the turns in the upper layer cross those of the lower layer are known as the cross-over points and the rope in these areas is susceptible to increased abrasion and crushing. Care should be taken when installing a rope on a drum and when operating a machine to ensure that the rope is coiled and layered correctly.

- 3.15** Check the state of re-usable rope end terminations for size, strength, defects and cleanliness before use. Non-destructive testing may be required depending on the material and circumstances of use. Ensure that

the termination is fitted in accordance with the OEM's instruction manual or manufacturer's instructions.

When re-using a socket and depending on its type and dimensions, the existing cone should be pressed out. Otherwise, heat may be necessary.

### **⚠ WARNING**

**When melting out sockets which have previously been filled with hot metal, the emission of toxic fumes is likely. Note that white metal contains a high proportion of lead.**

Correctly locate and secure any connection pins and fittings when assembling end terminations to fixtures. Refer to manufacturer's instructions.

### **⚠ WARNING**

**Failure to pay attention to any of the above could result in unsafe operation and potential injury.**

- 3.16** Limit switches, if fitted, must be checked and re-adjusted, if necessary, after the rope has been installed.
- 3.17** Record the following details on the Certificate after installation has been completed: type of equipment, location, plant reference number, duty and date of installation and any re-rating information/signature of competent person. Then safely file the Certificate.
- 3.18** 'Run in' the new rope by operating the equipment slowly, preferably with a low load, for several cycles. This permits the new rope to adjust itself gradually to working conditions.

*Note: Unless otherwise required by a certifying authority, the rope should be in this condition before any proof test of the equipment or machinery is carried out.*

Check that the new rope is spooling correctly on the drum and that no slack or cross laps develop.

If necessary, apply as much tension as possible to ensure tight and even coiling, especially on the first layer.

Where multi-layer coiling is unavoidable, succeeding layers should coil evenly on the preceding layers of rope.

## Product Safety: Instructions & Warnings on the use of steel wire rope

### ⚠ WARNING

**Irregular coiling usually results in severe surface wear and rope malformation, which in turn is likely to cause premature rope failure.**

- 3.19 Ensure that the as-manufactured condition of the rope is maintained throughout the whole of the handling and installation operation.
- 3.20 If samples are required to be taken from the rope for subsequent testing and/or evaluation, it is essential that the condition of the rope is not disturbed. Refer to the instructions given in 3.12 and, depending on the rope type and construction, any other special manufacturer's instructions.

#### 4. In Service

- 4.1 Inspect the rope and related equipment at the beginning of every work period and particularly following any incident which could have damaged the rope or installation.

The entire length of rope should be inspected and particular attention paid to those sections that experience has proven to be the main areas of deterioration. Excessive wear, broken wires, distortion and corrosion are the usual signs of deterioration. For a more detailed examination special tools are necessary (see Fig. 13) which will also facilitate internal inspection (see Fig. 14.)

Fig 13

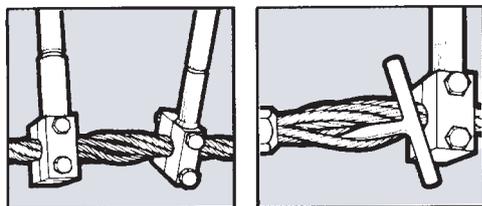
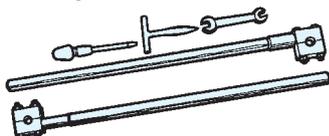


Fig 14

In the case of ropes working over drums or sheaves it is particularly necessary to examine those areas entering or leaving the grooves when maximum loads (i.e. shock loads) are experienced, or those areas which remain for long periods in exposed places such as over a head gear pulleys.

On some running ropes, but particularly relevant to standing ropes (e.g. guide ropes) the areas adjacent to terminations should be given special attention (see Fig. 14).

*Note: Shortening the rope re-positions the areas of maximum deterioration in the system. Where conditions permit, begin operating with a rope which has a slightly longer length than necessary in order to allow for periodic shortening.*

When a non-preformed rope, multi-layer rope or parallel closed rope is used with a wedge socket and is required to be shortened, it is essential that the end of the rope is secured by welding or brazing before the rope is pulled through the main body of the socket to its new position. Slacken the wedge in the socket. Pass the rope through the socket by an amount equivalent to the crop length or sample required. Note that the original bent portion of the rope must not be retained within the wedge socket. Replace the wedge and pull up the socket. Prepare and cut in accordance with section 3.12. Ensure that the rope tail cannot withdraw through the socket, see section 3.13.

### ⚠ WARNING

**Failure to observe this instruction will result in a significant deterioration in the performance of the rope and could render the rope completely unfit for further service.**

In cases where severe rope wear takes place at one end of a wire rope, the life of the rope may be extended by changing round the drum end with the load end, i.e. turning the rope 'end for end' before deterioration becomes excessive.

- 4.2 Remove broken wires as they occur by bending backwards and forwards using a pair of pliers until they break deep in the valley between two outer strands (see Fig. 15). Wear protective clothing such as overalls, industrial gloves, helmet, eye protectors and safety footwear during this operation.

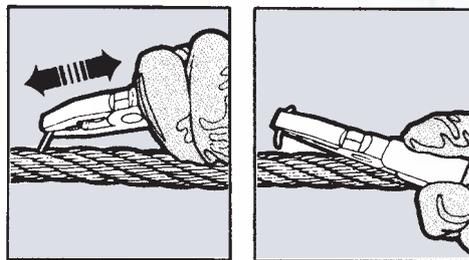


Fig 15

### ⚠ WARNING

**Do not shear off the ends of broken wires with pliers as this will leave an exposed jagged edge which is likely to damage other wires in the rope and lead to premature removal of the rope from service. Failure to wear adequate protective clothing could result in injury.**

## Product Safety: Instructions & Warnings on the use of steel wire rope

*Note: Broken wires are a normal feature of service, more so towards the end of the rope's life, resulting from bending fatigue and wear. The local break up of wires may indicate some mechanical fault in the equipment.*

Record the number and position in the rope of any removed broken wires.

- 4.3 Do not operate an appliance if for any reason (e.g. rope diameter, certified breaking force, rope construction, length or strength and type of rope termination) the wire rope and its termination is considered unsuitable for the required duty.
- 4.4 Do not operate an appliance if the wire rope fitted has become distorted, been damaged or has deteriorated to a level such that discard criteria has been reached or is likely to be reached prior to normal expected life based on historical performance data.

### **WARNING**

**Rope distortion is usually a result of mechanical damage and can significantly reduce rope strength.**

- 4.5 An authorised competent person must examine the rope in accordance with the appropriate Regulations.
- 4.6 Do not carry out any inspection, examination, dressing/lubrication, adjustment or any other maintenance of the rope whilst it is suspending a load, unless otherwise stated in the OEM's instruction manual or other relevant documents.  
  
Do not carry out any inspection or maintenance of the rope if the appliance controls are unattended unless the surrounding area has been isolated or sufficient warning signs have been posted within the immediate vicinity.  
  
If the appliance controls are attended, the authorised person must be able to communicate effectively with the driver or controller of the appliance during the inspection process.
- 4.7 Never clean the wire rope without recognising the potential hazards associated with working on a moving rope.

### **WARNING**

**Failure to pay attention or take adequate precaution could result in injury.**

If cleaning by cloth/waste, the material can be snagged on damaged surfaces and/or broken wires. If cleaning by brush, eye protectors must be worn. If using fluids it should be recognised that some products are highly inflammable. A respirator should be worn if cleaning by a pressurised spray system.

### **WARNING**

**Failure to take adequate precaution could result in injury or damage to health.**

Only use compatible cleaning fluids which will not impair the original rope lubricant nor affect the rope associated equipment.

### **WARNING**

**The use of cleaning fluids (particularly solvent based) is likely to 'cut back' the existing rope lubricant leading to a greater quantity of lubricant accumulating on the surface of the rope. This may create a hazard in appliances and machinery which rely on friction between the rope and the drive sheave (e.g. lifts, friction winders and cableways).**

- 4.8 Lubricants selected for in-service dressing must be compatible with the rope manufacturing lubricant and should be referenced in the OEM's instruction manual or other documents approved by the owner of the appliance.  
  
If in doubt contact the rope supplier or Bridon.
- 4.9 Take particular care when applying any in-service lubricant/dressing. Application systems which involve pressure should only be operated by trained and authorised persons and the operation carried out strictly in accordance with the manufacturer's instructions.  
  
Most wire ropes should be lubricated as soon as they are put into service and at regular intervals thereafter (including cleaning) in order to extend safe performance.

### **WARNING**

**A 'dry' rope unaffected by corrosion but subject to bend fatigue, is likely to achieve only 30% of that normally attained by a 'lubricated' rope.**

Do not dress/lubricate the rope if the application required it to remain dry. (Refer OEM's instruction manual.)

Reduce the period between examinations when ropes are not subjected to any in-service dressing and when they must remain dry.

*Note: The authorised person carrying out a rope inspection must be capable of recognising the potential loss of safe performance of such a rope in comparison with lubricated rope.*

Clean the rope before applying a fresh dressing/lubricant if it is heavily loaded with foreign matter e.g. sand, dust.

## Product Safety: Instructions & Warnings on the use of steel wire rope

**4.10** The authorised person responsible for carrying out wire rope maintenance must ensure that the ends of the rope are secure. At the drum end this will involve checking the integrity of the anchorage and ensuring that there are at least two and a half dead laps tightly coiled. At the outboard end the integrity of the termination must be checked to ensure that it is in accordance with the OEM's manual or other documents approved by the owner of the appliance.

Adjust the lengths of ropes in multi-rope systems in order that equal forces (within approved limits) are evident.

If a wire rope needs cutting refer to 3.12.

When securing rope ends refer to 3.13.

When re-usable end terminations are used refer to 3.15.

When re-connecting any end terminations to fixtures refer to 3.15.

**4.11**

### **⚠ WARNING**

**Damage to, or removal of component parts (mechanical or structural) caused by abnormal contact with wire rope can be hazardous to the safety of the appliance and/or the performance of the rope (e.g. damage to the drum grooving, such that coiling is erratic and/or the rope is 'pulled down' into underlying layers, which might cause a dangerous condition or, alternatively, cause localised rope damage at 'cross-over' positions, which might then radically affect performance; loss/removal of wear plates protecting the structure leading to major structural damage by cutting and/or failure of the wire rope due to mechanical severance).**

**4.12** Following any periodic statutory examination or routine or special inspection where any corrective action is taken the Certificate should be updated and a record made of the defects found, the extent of the changes and the condition of the rope.

**4.13** Apply the following procedures for the selection and preparation of samples, from new and used lengths of rope, for the purpose of examination and testing to destruction.

Check that the rope end, from which the sample will be taken, is secured by welding or brazing. If not, select the sample length further away from the rope end and prepare new servings (see 3.12).

Handle the rope in accordance with the instructions given in section 3. Serve the rope, using the buried wire technique (see Fig. 10) and apply a rope clamp or grip as close to the cut mark as practically possible. Do not use solder to secure the servings.

Ensure that the sample is kept straight throughout the whole procedure and ensure that the minimum sample length is 3 metres for ropes up to and including 40mm diameter and 12 metres for larger diameter ropes.

The rope should be cut with a high speed abrasive disc cutter or an oxyacetylene torch. Weld the rope ends of the sample as described in section 3.12, after which the clamp or grip can be removed.

The identification of the rope must be established and the sample suitably marked and packed. It is recommended that the 3 metre sample is retained straight and secured to a wood batten for transportation. For a 12 metre sample, coil to a diameter as large as practically possible and never less than 2 metres.

*Note: Samples taken for destruction testing are required to be terminated in accordance with a recognised resin socketing standard (e.g. BS EN 13411-4 or ISO 7596).*

### **⚠ WARNING**

**Failure to comply with these procedures will result in measured breaking force values which are not truly representative of the actual strength of the rope.**

### **5. Wire Rope Discard**

**5.1** Discard the wire rope in accordance with current Regulations and in accordance with the OEM's instruction manual.

**5.2** If a wire rope is removed from service at a level of performance substantially different to historically established performance data and without any obvious reason(s), contact Bridon or Bridon's distributor for further guidance.

**5.3** Only qualified and experienced personnel, taking the appropriate safety precautions and wearing the appropriate protective clothing, should be responsible for removing the wire rope.

### **⚠ WARNING**

**Take particular care when removing ropes with mechanical damage as they may fail abruptly during the change-out procedure.**

## Product Safety: Instructions & Warnings on the use of steel wire rope

Take the utmost care when removing 'exhausted/failed' ropes from drums and sheaves as they may be grossly distorted, lively and tightly coiled.

### **⚠ WARNING**

**Failure to take adequate precautions could result in injury.**

- 5.4 Store discarded rope in a safe and secure location or compound and ensure that it is suitably marked to identify it as rope which has been removed from service and not to be used again.

### **⚠ WARNING**

**Discarded rope can be a danger (e.g. protruding broken wires, excessive grease/lubricant and rope mass) to personnel and equipment if not handled correctly and safely during disposal.**

- 5.5 Record the date and reason for discard on the Certificate before filing for future reference.
- 5.6 Pay attention to any Regulations affecting the safe disposal of steel wire rope.

### **6. Rope Selection Criteria**

Ensure that the correct type of wire rope is selected for the equipment by referring to the OEM's instruction manual or other relevant documents. If in doubt contact Bridon or Bridon's distributor for guidance.

#### **6.1 Rope Strength**

If necessary, refer to the appropriate Regulations and/or application standards and calculate the maximum force to which the rope will be subjected.

The calculation may take into account the mass to be lifted or moved, any shock loading, effects of high speed, acceleration, any sudden starts or stops, frequency of operation and sheave bearing friction.

By applying the relevant coefficient of utilisation (safety factor) and, where applicable, the efficiency of the rope termination, the required minimum breaking load or force of the rope will be determined, the values of which are available from the relevant National, European or International standards or from specific Product Data literature.

If in doubt ask for advice from Bridon or Bridon's distributor.

#### **6.2 Bending fatigue**

The size and number of sheaves in the system will influence the performance of the rope.

### **⚠ WARNING**

**Wire rope which bends around sheaves, rollers or drums will deteriorate through 'bending fatigue'. Reverse bending and high speed will accelerate the process. Therefore, under such conditions select a rope with high bending fatigue resistance. Refer to Product Data Information, and if in doubt ask for advice.**

#### **6.3 Abrasion**

Wire rope which is subject to abrasion will become progressively weaker as a result of:

Externally - dragging it through overburden, sand or other abrasive materials and passing around a sheave, roller or drum.

Internally - being loaded or bent.

### **⚠ WARNING**

**Abrasion weakens the rope by removing metal from both the inner and outer wires. Therefore, a rope with large outer wires should normally be selected.**

#### **6.4 Vibration**

Vibration in wire rope will cause deterioration. This may become apparent in the form of wire fractures where the vibration is absorbed.

### **⚠ WARNING**

**These fractures may be internal only and will not be visually identified.**

#### **6.5 Distortion**

Wire rope can be distorted due to high pressure against a sheave, improperly sized grooves or as a result of multi-layer coiling on a drum.

Rope with a steel core is more resistant to crushing and distortion.

#### **6.6 Corrosion**

Rope with a large number of small wires is more susceptible to corrosion than rope with a small number of large wires. Therefore, if corrosion is expected to have a significant effect on rope performance select a galvanised rope with as large an outer wire size as possible bearing in mind the other conditions (e.g. bending and abrasion) under which the rope will be operating.

## Product Safety: Instructions & Warnings on the use of steel wire rope

### 6.7 Connecting Ropes

In the event that it is necessary to connect one rope to another (in series) it is essential that they have the required strength, are of the same type and both have the same lay direction (i.e. connect 'right' lay to 'right' lay).

#### **⚠ WARNING**

**Failure to heed this warning could result in catastrophic failure particularly at a termination which is capable of being pulled apart (i.e. splice) due to unlaying.**

### 6.8 Rope Length

Rope length and /or difference in length between two or more ropes used in a set may be a critical factor and must be considered along with rope selection.

#### **⚠ WARNING**

**Wire rope will elongate under load. Other factors such as temperature, rope rotation and internal wear will also have an effect. These factors should also be considered during rope selection.**

### 6.9 Preformed and Non-preformed Ropes

Single layer round strand rope is normally supplied preformed. However, if a non-preformed rope is selected then personnel responsible for its installation and/or maintenance need to take particular care when handling such rope, especially when cutting. For the purposes of this instruction, multi-layer, parallel closed and spiral ropes should be regarded as non-preformed ropes.

### 6.10 Operating Temperatures

Wire rope with a steel core should be selected if there is any evidence to suggest that a fibre core will not provide adequate support to the outer strands and/or if the temperature of the working environment may be expected to exceed 100°C.

For operating temperatures above 100°C de-rating of the minimum breaking force of the rope is necessary (e.g. between 100°C and 200°C reduce by 10%; between 200°C and 300°C reduce by 25%; between 300°C and 400°C reduce by 35%).

Do not use ropes with high carbon wires above 400°C.

#### **⚠ WARNING**

**Failure to observe this general guidance could result in failure of the ropes to support the load.**

For temperatures over 400°C, other materials such as stainless steel or other special alloys should be considered.

#### **⚠ WARNING**

**Rope lubricants and any synthetic filling and/or covering materials may become ineffective at certain low or high operating temperature levels.**

Certain types of rope end terminations also have limiting operating temperatures and the manufacturer or Bridon should be consulted where there is any doubt. Ropes with aluminium ferrules must not be used at temperatures in excess of 150°C.

## Product Safety: Instructions & Warnings on the use of steel wire rope

### WARNING

#### CAUTIONARY NOTICE – RESTRICTIONS ON THE USE OF LARGE DIAMETER MULTISTRAND ROPES.

All wire ropes are prone to damage if they are not properly supported when used at high loads. Larger Multistrand ropes are particularly susceptible to this form of abuse, due to their rigid construction and the relatively fine wire sizes involved in their manufacture/construction. Instances have been recorded of ropes being heavily worked over plain drums and failing "prematurely", despite the nominal tension being

being in the region of half the breaking strength of the rope.

The best way of preventing difficulties of this sort is to avoid conditions that are likely to generate damagingly high contact stresses. A simple method of assessing the severity of the contact conditions is to firstly calculate the tread pressure based on the projected nominal area and then apply a factor (of say 10\*) to allow for the highly localised and intermittent nature of the actual wire contacts, as indicated below :-

Type of contact	Close-fitting U-groove	Oversize U-groove	Plain drum
Level of support	Good	Fair	Poor
Tread path width	100% of rope dia.	50% of rope dia.	20% of rope dia.
Tread pressure =	2T/Dd	4T/Dd	10T/Dd
Contact stress =	20T/Dd	40T/Dd	100T/Dd

*Note: Contact stresses which exceed 10% of the wire UTS should be considered a cause for concern, especially if the rope is operating at a low factor of safety.*

*[\* This is because the true contact area is very much less than the projected nominal area.]*

#### Worked example:

Consider case of a 50mm Multistrand rope (MBL=2100kN) operating at a 3:1 factor of safety. Then, for the Contact stress < 200 Mpa say, the following minimum bending diameters are indicated:

*Close-fitting groove – 1400mm*

*Oversize U-groove - 2800mm*

*Un-grooved drum - 7000mm*

## Material Safety Data

### Introduction

Steel wire rope is a composite material and dependent upon its type may contain a number of discrete materials. The following provides full details of all the individual materials which may form part of the finished wire rope.

The description and/or designation of the wire rope stated on the delivery note and/or invoice (or certificate, when applicable) will enable identification of the component parts.

The main component of a steel wire rope is the wire, which may be carbon steel, coated (zinc or Zn95/A15) steel or stainless steel.

The other three components are (i) the core, which may be of steel of the same type as used in the main strands or alternatively fibre (either natural or synthetic), (ii) the rope lubricant and, where applicable, (iii) any internal filling or

external covering. No Occupational Exposure Limits (OEL's) exist for steel wire rope and the values provided in this publication relate to component elements and compounds. The actual figures quoted in relation to the component parts are taken from the latest edition of EH40.

Rope produced from carbon, coated or stainless steel wires in the as-supplied condition is not considered a health hazard. However during any subsequent processing such as cutting, welding, grinding and cleaning, dust and fumes may be produced which contain elements that may affect exposed workers.

The following indicates the order in which specific information is provided:-

Carbon steel wire, Coated steel wire, Stainless steel wire, Manufacturing rope lubricants, Fibre cores, Filling and covering materials, General information

### Carbon Steel Wire - Hazardous Ingredients

Component	% Weight (Max)	Long term exposure limit (8-hour TWA reference period) mg/m <sup>3</sup>	Short term exposure limit (10-minute reference period) mg/m <sup>3</sup>
<b>BASE METAL</b>			
Aluminium	0.3	10	20
Carbon	1.0	None Listed	
Chromium	0.4	0.5	
Cobalt	0.3	0.1	
Copper	0.5	0.2	
Iron	Balance	5	10
Manganese	1.0	5	5
Molybdenum	0.1	5	10
Nickel	0.5	1	
Phosphorus	0.1	0.1	0.3
Silicon	0.5	10	
Sulphur	0.5	None Listed	
Vanadium	0.25	0.5	
Boron	0.1	10	20
Titanium	0.1	10	
Nitrogen	0.01	5	9
Lead	0.1	0.15	
Arsenic	0.01	0.2	
Zirconium	0.05	5	10
<b>COATED</b>			
Sodium	0.5	None Listed	
Calcium	0.5	2	
Boron	1.0	10	20
Phosphorus	1.0	0.1	0.3
Iron	1.0	5	10
Zinc	1.0	5	10
Oil may be applied	5.0	5	10

### Physical Data

Specific Gravity:	7.5 - 8.5	Vapour Pressure:	N/A
Melting Point:	1350 - 1500 °C	Vapour Density:	N/A
Appearance & Odour:	Solid. Odourless Metal	Evaporation:	N/A
Solubility in water:	Insoluble	% Volatiles:	N/A
Flash Point:	None	Boiling Point:	> 2800 °C

## Material Safety Data

### Coated (Zinc and ZN95/A 15) Steel Wire - Hazardous Ingredients

Component	% Weight (Max)	Long term exposure limit (8-hour TWA reference period) mg/m <sup>3</sup>	Short term exposure limit (10-minute reference period) mg/m <sup>3</sup>
<b>BASE METAL</b>			
Aluminium	0.3	10	20
Carbon	1.0	None Listed	
Chromium	0.4	0.5	
Cobalt	0.3	0.1	
Copper	0.5	0.2	
Iron	Balance	5	10
Manganese	1.0	5	5
Molybdenum	0.1	5	10
Nickel	0.5	1	
Phosphorus	0.1	0.1	0.3
Silicon	0.5	10	
Sulphur	0.5	None Listed	
Vanadium	0.25	0.5	
Boron	0.1	10	20
Titanium	0.1	10	
Nitrogen	0.01	5	9
Lead	0.1	0.15	
Arsenic	0.01	0.2	
Zirconium	0.05	5	10
<b>COATED</b>			
Zinc	10.0	5	10
Aluminium	1.5	10	20
Iron	5.0	5	10
Sodium	0.5	None Listed	
Calcium	0.5	2	
Boron	1.0	100	20
Phosphorus	1.0	0.1	0.3
Sulphur	0.5	None Listed	
Oil may be applied	5.0	5	10
Wax may be applied	5.0	2	6

### Physical Data

Specific Gravity:	7.5 - 8.5	Vapour Pressure:	N/A
Melting Point:	1350 - 1500 °C	Vapour Density:	N/A
Appearance & Odour:	Solid. Odourless Metal	Evaporation:	N/A
Solubility in water:	Insoluble	% Volatiles:	N/A
Flash Point:	None	Boiling Point:	> 2800 °C

## Material Safety Data

### Manufacturing Rope Lubricants

The products used in the manufacture of steel wire ropes for lubrication and protection present minimal hazard to the user in the as-supplied condition. The user must, however, take reasonable care to minimise skin and eye contact and also avoid breathing their vapours and mists.

A wide range of compounds is used as lubricants in the manufacture of steel wire rope. These products, in the main, consist of mixtures of oils, waxes, bitumens, resins, gelling agents and fillers with minor concentrations of corrosion inhibitors, oxidation stabilizers and tackiness additives.

Most of them are solid at ambient temperatures and provided skin contact with the fluid types is avoided, none present a hazard in normal rope usage.

However, to assist in the assessment of the hazard caused by these products, the following table contains all the components which may be incorporated into a wire rope lubricant and which may be considered hazardous to health.

#### Hazardous Ingredients:

Component	Long term exposure limit (8-hour TWA reference period) mg/m <sup>3</sup>	Short term exposure limit (10-minute reference period) mg/m <sup>3</sup>
Oil mist	5	10
Paraffin wax fume	2	6
Bitumen	5	10
Silica, fused		
Total inhalable dust	0.3	
Respirable dust	0.1	
Aluminium flake	10	20
Zinc oxide, fume	5	10
Butane	1430	1780

There are no other known constituents of any wire rope lubricant used that are classified as hazardous in the current edition of EH40.

#### General advice on handling ropes with lubricants

To avoid the possibility of skin disorders, repeated or prolonged contact with mineral or synthetic hydrocarbons must be avoided and it is essential that all persons who come into contact with such products maintain high standards of personal hygiene.

#### The worker should:

- 1) use oil impermeable gloves, or if not available, suitable oil repellent type barrier creams,
- 2) avoid unnecessary contact with oil using protective clothing,
- 3) obtain first aid treatment for any injury, however slight,
- 4) wash hands thoroughly before meals, before using the toilet and after work,
- 5) use conditioning creams after washing, where provided.

#### The worker should not:

- 1) put oily rags or tools into pockets, especially trousers,
- 2) use dirty or spoiled rags for wiping oil from the skin,
- 3) wear oil soaked clothing,
- 4) use solvents such as paraffin, petrol etc., to remove oil from the skin.

Concentrations of oil mists, fumes and vapours in the working atmosphere must be kept as low as is reasonably practicable. Levels quoted in the current edition of HSE Guidance Note EH40 'Occupational Exposure Limits' must not be exceeded.

#### Health Hazards

Inhalation of oil mists or fumes from **heated** rope lubricants in high concentrations may result in dizziness, headache, respiratory irritation or unconsciousness. Eye contact may produce mild transient irritation to some users.

Fumes from **heated** rope lubricants in high concentrations may cause eye irritation.

If **heated** rope lubricants contacts skin, severe burns may result.

Prolonged or repeated skin contact may cause irritation, dermatitis or more serious skin disorders.

#### Fibre Cores

Being in the centre of a steel wire rope, the materials (natural or synthetic) from which fibre cores are produced do not present a health hazard during normal rope handling. Even when the outer core strands are removed (for example when the rope is required to be socketed) the core materials present virtually no hazard to the users, except, maybe, in the case of a used rope where, in the absence of any service dressing or as a result of heavy working causing internal abrasive wear of the core, the core may have decomposed into a fibre dust which might be inhaled, although this is considered extremely unlikely.

The principal area of hazard is through the inhalation of fumes generated by **heat**, for example when the rope is being cut by a disc cutter.

## Material Safety Data

Under these conditions, natural fibres are likely to yield carbon dioxide, water and ash, whereas synthetic materials are likely to yield toxic fumes.

The treatment of natural fibres, such as rotproofing, may also produce toxic fumes on burning.

The concentrations of toxic fumes from the cores, however, will be almost negligible compared with the products generated by heating from the other primary materials, e.g. wire and manufacturing lubricant in the rope.

The most common synthetic core material is polypropylene, although other polymers such as polyethylene and nylon may occasionally be used.

### Filling and Covering Materials

Filling and covering materials do not present a health hazard during handling of the rope in its as-supplied condition.

The principal area of hazard is by the inhalation of fumes generated by heat, for example when the rope is being cut by a disc cutter.

Under these conditions, fillings and coverings, which are generally polypropylene, polyethylene and polyamid (but in some cases may be of natural fibre) are likely to produce toxic fumes.

### General Information

#### Occupational protective measures

- 1) Respiratory protection** - Use general and local exhaust ventilation to keep airborne dust or fumes below established occupational exposure standards (OES's). Operators should wear approved dust and fume respirators if OES's are exceeded.  
(The OES for total dust is 10mg/m<sup>3</sup> and for respirable dust is 5mg/m<sup>3</sup>).
- 2) Protective equipment** - Protective equipment should be worn during operations creating eye hazards. A welding hood should be worn when welding or burning. Use gloves and other protective equipment when required.
- 3) Other** - Principles of good personal hygiene should be followed prior to changing into street clothing or eating. Food should not be consumed in the working environment.

#### Emergency medical procedures

- 1) Inhalation** - Remove to fresh air; get medical attention.
- 2) Skin** - Wash areas well with soap and water.
- 3) Eyes** - Flush well with running water to remove particulate; get medical attention.
- 4) Ingestion** - In the unlikely event that quantities of rope or any of its components are ingested, get medical attention.

### Safety Information

- 1) Fire and explosion** - In the solid state, steel components of the rope present no fire or explosion hazard. The organic elements present, i.e. lubricants, natural and synthetic fibres and other natural or synthetic filling and covering materials are capable of supporting fire.
- 2) Reactivity** - Stable under normal conditions.

### Spill or leak procedures

- 1) Spill or leak** - Not applicable to steel in the solid form.
- 2) Disposal** - Dispose of in accordance with local Regulations.

## Rope Terminology

### Wires

**Outer wires:** All wires positioned in the outer layer of wires in a spiral rope or in the outer layer of wires in the outer strands of a stranded rope.

**Inner wires:** All wires of intermediate layers positioned between the centre wire and outer layer of wires in a spiral rope or all other wires except centre, filler, core and outer wires of a stranded rope.

**Core wires:** All wires of the core of a stranded rope.

**Centre wires:** Wires positioned either at the centre of a spiral rope or at the centres of strands of a stranded rope.

**Layer of wires:** An assembly of wires having one pitch circle diameter. The exception is Warrington layer comprising alternately laid large and small wires where the smaller wires are positioned on a larger pitch circle diameter than the larger wires. The first layer is that which is laid immediately over the strand centre.

*Note: Filler wires do not constitute a separate layer.*

**Tensile strength grade of wires:** A level of requirement of tensile strength of a wire and its corresponding tensile strength range. It is designated by the value according to the lower limit of tensile strength and is used when specifying wire and when determining the calculated minimum breaking force or calculated minimum aggregate breaking force of a rope.

**Wire finish:** The condition of the surface finish of a wire, e.g. bright, zinc coated.

## Rope Terminology

### Strands

**Strand:** An element of rope usually consisting of an assembly of wires of appropriate shape and dimensions laid helically in the same direction in one or more layers around a centre.

*Note: Strands containing three or four wires in the first layer or certain shaped (e.g. ribbon) strands may not have a centre.*

**Round strand:** A strand with a cross-section which is approximately the shape of a circle.

**Triangular strand:** A strand with a cross-section which is approximately the shape of a triangle.

*Note: Triangular strands may have built-up centres (i.e. more than one wire forming a triangle).*

**Oval strand:** A strand with a cross-section which is approximately the shape of an oval

**Flat ribbon strand:** A strand without a centre wire with a cross-section which is approximately the shape of a rectangle.

**Compacted strand:** A strand which has been subjected to a compacting process such as drawing, rolling or swaging whereby the metallic cross-sectional area of the wires remains unaltered and the shape of the wires and the dimensions of the strand are modified.

*Note: Bridon's brands of Dyform rope contain strands which have been compacted.*

**Single lay strand:** Strand which contains only one layer of wires, e.g. 6-1.

**Parallel lay strand:** Strand which contains at least two layers of wires, all of which are laid in one operation (in the same direction), e.g. 9-9-1; 12-6F-6-1; 14-7+7-7-1. Each layer of wires lies in the interstices of the underlying layer such that they are parallel to one another, resulting in linear contact.

*Note: This is also referred to as equal lay. The lay length of all the wire layers are equal.*

**Seale:** Parallel lay strand construction with the same number of wires in each wire layer, each wire layer containing wires of the same size, e.g. 7-7-1; 8-8-1; 9-9-1.

**Warrington:** Parallel lay strand construction having an outer layer of wires containing alternately large and small wires, the number of wires in the outer layer being twice that in the underlying layer of wires, e.g. 6+6-6-1; 7+7-7-1.

**Filler:** Parallel lay strand construction having an outer layer of wires containing twice the number of wires than in the inner layer with filler wires laid in the intersticeswires of the underlying layer of wires, e.g. 12-6F-6-1; 14-7F-7-1.

**Combined parallel lay:** Parallel lay strand construction having three or more layers of wires, e.g. 14-7+7-7-1; 16-8+8-8-1; 14-14-7F-7-1; 16-16-8F+8-1.

*Note: The first two examples above are also referred to as Warrington-Seale construction. The latter two examples are also referred to as Seale-Filler construction.*

**Multiple operation lay strand:** Strand construction containing at least two layers of wires, at least one of which is laid in a separate operation. All of the wires are laid in the same direction.

**Cross-lay:** Multiple operation strand construction in which the wires of superimposed wire layers cross over one another and make point contact, e.g. 12/6-1.

**Compound lay:** Multiple operation strand which contains a minimum of three layers of wires, the outer layer of which is laid over a parallel lay centre, e.g. 16/6+6-6-1.

### Ropes

**Spiral Rope:** An assembly of two or more layers of shaped and/or round wires laid helically over a centre, usually a single round wire. There are three categories of spiral rope, viz. spiral strand, half-locked coil and full-locked coil.

**Spiral Strand:** An assembly of two or more layers of round wires laid helically over a centre, usually a single round wire.

**Half-locked Coil Rope:** A spiral rope type having an outer layer of wires containing alternate half lock and round wires.

**Full-locked Coil Rope:** A spiral rope type having an outer layer of full lock wires.

**Stranded Rope:** An assembly of several strands laid helically in one or more layers around a core or centre. There are three categories of stranded rope, viz. single layer, multi-layer and parallel-closed.

**Single Layer Rope:** Stranded rope consisting of one layer of strands laid helically over a core.

*Note: Stranded ropes consisting of three or four outer strands may, or may not, have a core. Some three and four strand single layer ropes are designed to generate torque levels equivalent to those generated by rotation-resistant and low rotation ropes.*

**Rotation-resistant Rope:** Stranded rope having no less than ten outer strands and comprising an assembly of at least two layers of strands laid over a centre, the direction of lay of the outer strands being opposite (i.e. contra - lay) to that of the underlying layer of strands.

**Low Rotation Rope:** Rotation resistant rope having at least fifteen outer strands and comprising an assembly of at least three layers of strands laid over a centre in two operations.

*Note: this category of rotation resistant rope is constructed in such a manner that it displays little or no tendency to rotate, or if guided,*



## Rope Terminology

*generates little or no torque when loaded.*

**Compacted Strand Rope:** Rope in which the outer strands, prior to closing of the rope, are subjected to a compacting process such as drawing, rolling or swaging.

*Note: Bridon's products containing compacted strands are identified by "Dyform".*

**Compacted Rope:** Rope which is subjected to a compacting process after closing, thus reducing its diameter.

**Solid Polymer Filled Rope:** Rope in which the free internal spaces are filled with a solid polymer. The polymer extends to, or slightly beyond, the outer circumference of the rope.

**Cushioned Rope:** Stranded rope in which the inner layers, inner strands or core strands are covered with solid polymers or fibres to form a cushion between adjacent strands or layers of strands.

**Cushion Core Rope:** Stranded rope in which the core is covered (coated) or filled and covered (coated) with a solid polymer.

**Solid Polymer Covered Rope:** Rope which is covered (coated) with a solid polymer.

**Solid Polymer Covered and Filled Rope:** Rope which is covered (coated) and filled with a solid polymer.

**Rope Grade (R<sub>t</sub>):** A number corresponding to a wire tensile strength grade on which the minimum breaking force of a rope is calculated.

*Note: It does not imply that the actual tensile strength grades of the wires in a rope are necessarily the same as the rope grade.*

**Preformed Rope:** Stranded rope in which the wires in the strands and the strands in the rope have their internal stresses reduced resulting in a rope in which, after removal of any serving, the wires and the strands will not spring out of the rope formation.

*Note: Multi-layer stranded ropes should be regarded as non-preformed rope even though the strands may have been partially (lightly) preformed during the closing process.*

**Rope Class:** A grouping of rope constructions where the number of outer strands and the number of wires and how they are laid up are within defined limits, resulting in ropes within the class having similar strength and rotational properties.

**Rope Construction:** System which denotes the arrangement of the strands and wires within a rope, e.g. 6x36WS, 6x19S.

*Note: K denotes compacted strands.*

**Cable-laid Rope:** An assembly of several (usually six) single layer stranded ropes (referred to as unit ropes) laid helically over a core (usually a seventh single layer stranded rope).

**Braided Rope:** An assembly of several round strands braided in pairs.

**Electro-mechanical Rope:** A stranded or spiral rope containing electrical conductors.

## Strand and Rope Lays

**Lay direction of strand:** The direction right (z) or left (s) corresponding to the direction of lay of the outer layer of wires in relation to the longitudinal axis of the strand.

**Lay direction of rope:** The direction right (Z) or left (S) corresponding to the direction of lay of the outer strands in relation to the longitudinal axis of a stranded rope or the direction of lay of the outer wires in relation to the longitudinal axis of a spiral rope.

**Ordinary lay:** Stranded rope in which the direction of lay of the wires in the outer strands is in the opposite direction to the lay of the outer strands in the rope. Right hand ordinary lay is designated sZ and left hand ordinary lay is designated zS.

*Note: This type of lay is sometimes referred to as 'regular' lay.*

**Lang's lay:** Stranded rope in which the direction of lay of the wires in the outer strands is the same as that of the outer strands in the rope. Right hand Lang's lay is designated zZ and left hand Lang's lay is designated sS.

**Alternate lay:** Stranded rope in which the lay of the outer strands is alternatively Lang's lay and ordinary lay. Right hand alternate lay is designated AZ and left hand alternate lay is designated AS.

**Contra-lay:** Rope in which at least one inner layer of wires in a spiral rope or one layer of strands in a stranded rope is laid in the opposite direction to the other layer(s) of wires or strands respectively.

*Note: Contra-lay is only possible in spiral ropes having more than one layer of wires and in multi-layer stranded ropes.*

**Rope lay length (Stranded Rope):** That distance parallel to the axis of the rope in which the outer strands make one complete turn (or helix) about the axis of the rope.

## Cores

**Core:** Central element, usually of fibre or steel, of a single layer stranded rope, around which are laid helically the outer strands of a stranded rope or the outer unit ropes of a cable-laid rope.

**Fibre core:** Core made from natural fibres (e.g. hemp, sisal) and designated by its diameter and runnage.

## Fibre Film Core

Core made from synthetic fibres (e.g. polypropylene) and designated by its diameter and runnage.

**Steel core:** Core produced either as an independent wire rope (IWRC)(e.g. 7x7) or wire strand (WSC)(e.g. 1x7).

**Solid polymer core:** Core produced as a single element of solid polymer having a round or grooved shape. It may also contain internal elements of wire or fibre.

**Insert:** Element of fibre or solid polymer so positioned as to separate adjacent strands or wires in the same or overlying layers and fill, or partly fill, some of the interstices in the rope. (see Zebra)

## Rope Characteristics and Properties

**Calculated Minimum aggregate Breaking Force:** Value of minimum aggregate breaking force is obtained by calculation from the sum of the products of the cross-sectional area (based on nominal wire diameter) and tensile strength grade of each wire in the rope, as given in the manufacturer's rope design.

**Calculated Minimum breaking Force:** Value of minimum breaking force based on the nominal wire sizes, wire tensile strength grades and spinning loss factor for the rope class or construction as given in the manufacturer's rope design.

**Fill factor:** The ratio between the sum of the nominal cross-sectional areas of all the load bearing wires in the rope and the circumscribed area of the rope based on its nominal diameter.

**Spinning loss factor (k):** The ratio between the calculated minimum breaking force of the rope and the calculated minimum aggregate breaking force of the rope.

**Breaking force factor (K):** An empirical factor used in the determination of minimum breaking force of a rope and obtained from the product of fill factor for the rope class or construction, spinning loss factor for the rope class or construction and the constant  $\pi/4$ .

**Minimum breaking force (Fmin):** Specified value, in kN, below which the measured breaking force is not allowed to fall in a prescribed test and, for ropes having a grade, obtained by calculation from the product of the square of the nominal diameter, the rope grade and the breaking force factor.

**Minimum aggregate breaking force (Fe,min):** Specified value, in kN, below which the measured aggregate breaking force is not allowed to fall in a prescribed test and, for ropes having a grade, obtained from the product of the square of the nominal rope diameter (d), the metallic cross-sectional area factor (C) and the rope grade (Rr).

**Norminal length mass:** The nominal mass values are for the fully lubricated ropes. For friction winder ropes, the values should be reduced by 2%. The nominal length mass values are subject to a tolerance of plus 2% to minus 5%.

**Rope torque:** Value, usually expressed in N.m, resulting from either test or calculation, relating to the torque generated when both ends of the rope are fixed and the rope is subjected to tensile loading.

**Rope turn:** Value, usually expressed in degrees per metre, resulting from either test or calculation, relating to the amount of rotation when one end of the rope is free to rotate and the rope is subjected to tensile loading.

**Initial extension:** Amount of extension which is attributed to the initial bedding down of the wires within the strands and the strands within the rope due to tensile loading.

*Note: This is sometimes referred to as constructional stretch.*

**Elastic extension:** Amount of extension which follows Hooke's Law within certain limits due to application of a tensile load.

**Permanent rope extension:** Non-elastic extension.



## Conversion Factors S.I. Units

Force				Mass			
1 kN	= 0.101 972 Mp	1 UK tonf	= 9964.02N	1 kg	= 2.204 62 lb	1 lb	= 0.453 592 kg
1 N	= 0.101 972 kgf	1 lbf	= 4.448 22N	1 tonne (t)	= 0.984 207 UK ton	1 UK ton	= 1.01605 tonnes (t)
1 kgf	= 9.806 65 N	1 lbf	= 0.453 592 kgf	1 kg/m	= 0.671 970 lb/ft	1 lb/ft	= 1.488 kg/m
1 kgf	= 1 kp	1 UK tonf	= 1.01605 tonne	1 kg	= 1000 g	1 kip (USA)	= 1000 lb
1 N	= 1.003 61 x 10 <sup>-6</sup> UK tonf	1 UK tonf	= 9.964 02 kN	1 Mp	= 1 x 10 <sup>6</sup> g		
1 N	= 0.2244 809 lbf	1 UK tonf	= 2240 lbf				
1 kgf	= 2.204 62 lbf	1 short tonf					
1 t	= 0.984 207 UK tonf	(USA)	= 2000 lbf	Length			
1 kN	= 0.100 361 UK tonf	1 kip (USA)	= 1000 lbf	1 m	= 3.280 84 ft	1 ft	= 0.304 8 m
		1 kip	= 453.592 37 kgf	1 km	= 0.621 371 miles	1 mile	= 1.609 344 km
Pressure/Stress				Area			
1 N/mm <sup>2</sup>	= 0.101972 kgf/mm <sup>2</sup>			1 mm <sup>2</sup>	= 0.001 55 in <sup>2</sup>	1 in <sup>2</sup>	= 645.16 mm <sup>2</sup>
1 kgf/mm <sup>2</sup>	= 9.806 65 N/mm <sup>2</sup>			1 m <sup>2</sup>	= 10.763 9ft <sup>2</sup>	1 ft <sup>2</sup>	= 0.092 903 0 m <sup>2</sup>
1 N/mm <sup>2</sup>	= 1 MPa						
1 kgf/mm <sup>2</sup>	= 1 422.33 lbf/in <sup>2</sup>	1 lbf/in <sup>2</sup>	= 7.030 x 10 <sup>2</sup> kgf/mm <sup>2</sup>				
1 kgf/mm <sup>2</sup>	= 0.634 969 tonf/in <sup>2</sup>	1 tonf/in <sup>2</sup>	= 1.574 88 kgf/mm <sup>2</sup>	Volume			
1 N/m <sup>2</sup>	= 1.450 38 x 10 <sup>3</sup> lbf/in <sup>2</sup>	1 lbf/in <sup>2</sup>	= 6.894 76 N/m <sup>2</sup>	1 cm <sup>3</sup>	= 0.061 023 7 in <sup>3</sup>	1 in <sup>3</sup>	= 16.387 1 cm <sup>3</sup>
1 N/m <sup>2</sup>	= 1 x 10 <sup>2</sup> N/mm <sup>2</sup>	1 tonf/in <sup>2</sup>	= 1.544 43 x 10 <sup>2</sup> dyn/cm <sup>2</sup>	1 litre (l)	= 61.025 5 in <sup>3</sup>	1 in <sup>3</sup>	= 16.386 6 ml
1 bar	= 14.503 8 lbf/in <sup>2</sup>			1 m <sup>3</sup>	= 6.102 37 x 104 in <sup>3</sup>	1 yd <sup>3</sup>	= 0.764 555 m <sup>3</sup>
1 hectobar	= 10N/mm <sup>2</sup>						
1 hectobar	= 10 <sup>2</sup> N/m <sup>2</sup>						

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