



WIRE ROPES FOR OFFSHORE ENERGY APPLICATIONS







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USHA MARTIN GROUP

Usha Martin is one of the world's leading manufacturers of wire ropes, specializing in the production of high-performance wire ropes, LRPC strands, wires, pre-stressing accessories, machinery, and cables.

Our state-of-the-art facilities are equipped with advanced machinery to produce world-class products and deliver value-added services for critical applications across various sectors, including infrastructure, ports, mining, offshore energy, offshore wind, elevators, fishing, ropeways, telecommunications, automobiles, and other industrial sectors.

At Usha Martin, we ensure that our products undergo stringent quality testing at every stage of production, adhering to the highest safety and quality standards. Our commitment to excellence is evident in our global operations, with manufacturing facilities in United Kingdom, India, Thailand and UAE, along with distribution centres across continents. We also have a Global Development Centre in Italy and service centres in the Netherlands, Scotland, Singapore, India, Dubai and Saudi Arabia. Through our strategically positioned distribution, sales, and service networks, we offer customized solutions to meet the unique needs of our clients worldwide.

As a global leader in rope solutions, we are dedicated to driving our customers' success by reshaping industries and pushing the boundaries of what's possible through our pursuit of engineering excellence. With over six decades of experience and a presence in more than 70 countries, Usha Martin is a trusted name in wire rope manufacturing worldwide. Our service-focused model has evolved Usha Martin from a wire rope supplier into a one-stop solution provider, built on close collaboration with our customers.



SOCIAL & ENVIRONMENTAL COMMITMENT

ENVIRONMENTAL COMPLIANCE

On the environmental front, we are focused on energy and water efficiency, transitioning to cleaner fuels, biodiversity conservation, and circular waste management. Initiatives like solar energy adoption, composting canteen waste, greenbelt plantations, and real-time water monitoring are helping us reduce our ecological footprint and move toward a greener industrial ecosystem.

We have begun mobilizing the installation of rooftop solar panels across our facilities to reduce dependence on grid electricity and lower carbon emissions. This step marks our transition toward clean, renewable energy and reinforces our commitment to sustainable manufacturing.

Our social efforts prioritize employee health and safety, inclusive hiring, community upliftment, and human rights.

SOCIAL PROGRESS

Through the Usha Martin Foundation, we run transformative programs in healthcare, entrepreneurship, and rural infrastructure. Internally, we foster a diverse, skilled, and engaged workforce supported by wellness initiatives and structured development programs.

We also extend our social responsibility across the value chain by engaging with our suppliers through ESG assessments, training sessions, and compliance with our Supplier Code of Conduct. This ensures responsible sourcing, promotes fair labor practices, and strengthens sustainability performance throughout our supply chain.

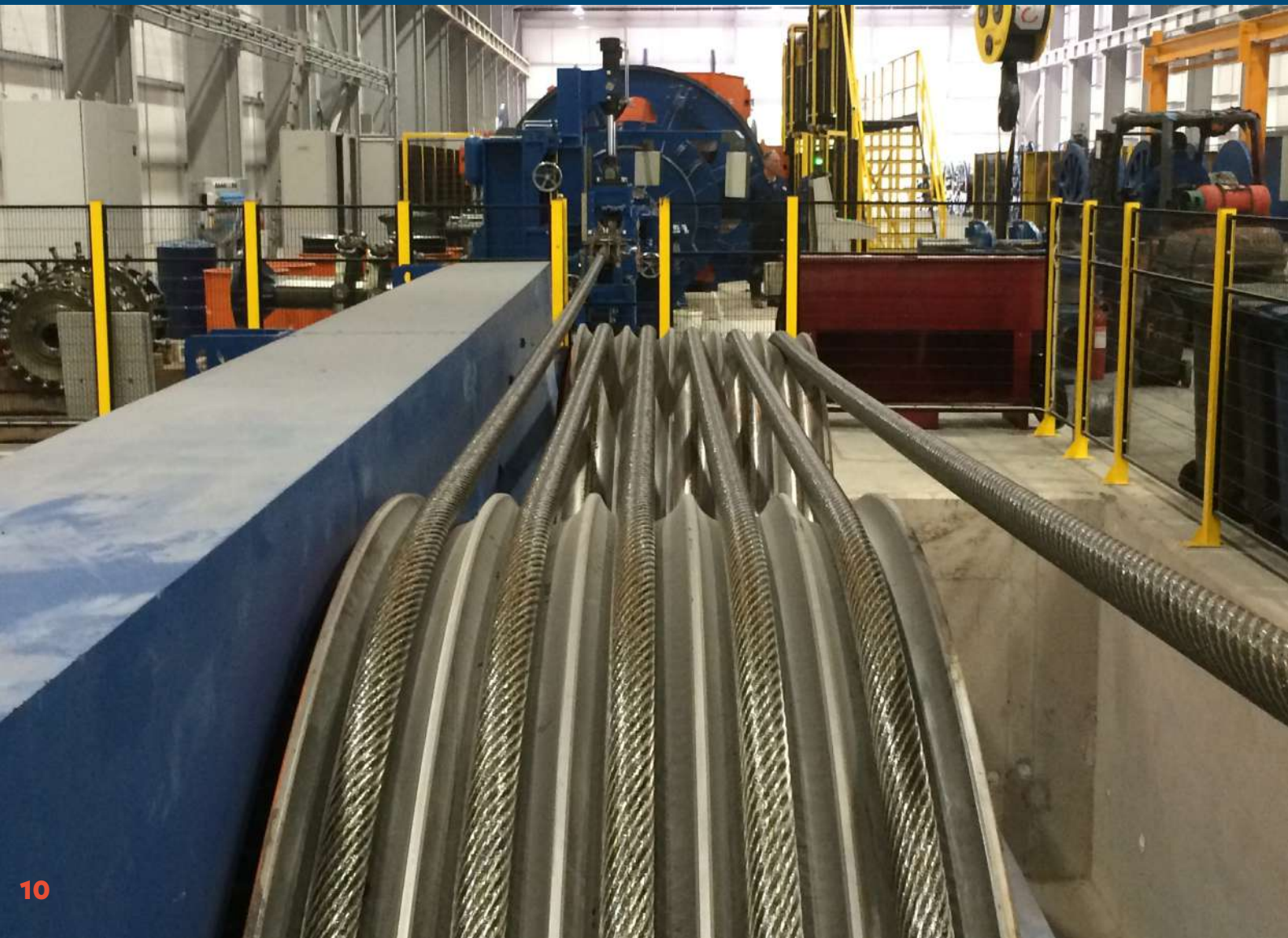
In terms of governance, we operate with integrity, transparency, and accountability. Our strong Board structure, comprehensive policies, and supplier code of conduct reflect our ethical foundations. We continuously engage our value chain partners to embed sustainability principles and encourage responsible sourcing.

Together, these actions reflect our belief that sustainability is not a choice but a responsibility. As we progress, we remain committed to integrating ESG into every aspect of our operations, ensuring long-term value creation for all.

MANUFACTURING SITES

With over 130 years of wire rope experience, Brunton Shaw is our key manufacturing facility for our range of OCEANMAX wire ropes. Our state-of-the-art and dedicated OCEANMAX production line is capable of producing 6-, 8-, multistrand and non-rotating wire ropes up to 160mm in size and 400T single gross weight. Since 2012, Brunton Shaw has developed into one of the preferred suppliers of heavy duty, high-tech, high-performance wire ropes to the key OEMs and contractors active in the offshore energy and offshore wind markets.

Depending upon the final location/destination and to mainly effectively serve our globally-oriented customer base within the Southeast Asian and Middle East regions, a selection of our OCEANMAX range can be produced within our main Usha Martin manufacturing facility, based in India. Under the strict guidance, quality assurance and project management of Brunton Shaw and our Global Development Centre, we have been supplying our range of OCEANMAX wire ropes, guaranteed of high-quality, sustainability, safety and superior performance.



SERVICE CENTRES

Our Usha Martin service centres are a natural and fully integrated extension to our manufacturing facilities. Our service facilities are considered value-added centres, aimed at providing one-stop-shop wire rope solutions. All our service centres hold readily available inventory positions of wire rope, ranging from 3mm up to 127mm and in 6, 8, 9, 10 strands and non-rotating constructions. In addition, we can provide turn-key service solutions, such as wire rope installation, proof load and break tests (up to 2000T), visual and NDT inspection services.

Our wire rope installation division is equipped with multiple mobile spoolers, ranging from 2T up to 180T. And effectively combined with traction winches of 40T CT for appropriate spooling under desired back-tension.

In addition to the vast inventory of steel wire rope, our facilities function as dedicated rigging shops. All our entities are equipped with numerous overhead cranes and presses from 100T up to 4.000T, enabling the assembly of steel wire rope slings up to 127mm.



WE ARE CONVENIENTLY LOCATED IN THE KEY AREAS FOR OFFSHORE & WIND ENERGY INDUSTRY:

EMM CORP
in Aberdeen, Dyce
(United Kingdom)

**DE RUITER
STAALKABEL**
on Dordrecht quayside
(The Netherlands)

EMM CORP
(Saudi Arabia)

**BRUNTON
WIRE ROPE**
in Jebel Ali Free Zone
(Dubai)

**USHA MARTIN
SINGAPORE**
at Tuas Bay



GLOBAL DEVELOPMENT CENTRE

Usha Martin Global Development Centre is set in Italy and it has the task to support the divisions of the Group in the development of high-tech ropes.

With decades of experience in wire rope design and applications, this team ensures a uniform and reliable process throughout the manufacturing divisions and takes care of:

- Wire rope design, manufacturing and quality control specifications
- Application engineering and reeving assessment
- Installation procedures and inspection criteria
- Technical assistance and troubleshooting
- Post retirement analysis and custom R&D activities

The internal laboratory of Global Development Centre is equipped with the most modern devices, such as:

- Scanning Electron Microscope for metallurgical analysis
- Digital microscope for surface analysis
- 3 rotary fatigue test beds, up to 100 mm rope diameter
- Multipurpose test bed for axial stiffness, radial stiffness and torsion tests
- Cross-over crushing test bed
- Wire break, elongation and torsion test beds
- Chemistry area for grease compatibility checks



GUIDANCE TO WIRE ROPE SELECTION

When selecting and ordering a wire rope, its main characteristics shall be clearly identified to optimize the performance in service.

DIAMETER AND LENGTH

The default oversize for Oceanmax ropes is +2%/+4%, which complies with the typical grooved drums. Shifted or narrowed tolerances can be made on demand.

CONSTRUCTION

Based on the application, a non rotating rope, multistrand or six strand rope can be selected (see pages 18-34).

LAY TYPE

Lang's lay ensures better resistance to side wear (crushing) and it is typical up to 40 mm rope diameter.

Regular lay is more effective against cross-over crushing and it is typically recommended for ropes larger than 40 mm, used for high lifting heights or deep sea.

MINIMUM BREAKING LOAD

MBL is specifically designed for each project to get the required result whilst using the lowest possible strength to increase service life and avoid the risk of strain ageing.

WIRE FINISHING

Oceanmax ropes are made by default of galvanized class B wires, other types of coating can be provided on demand.

LUBRICATION MODE AND TYPE

This feature is essential to increase rope service life and efficiency. Oceanmax ropes can also be equipped with Sealube, a special retention system which greatly impacts the duration of lubricant (see page 16-17).

REEL AND PACKAGING

Ropes can be wound on standard transportation reels or reinforced reels with enhanced backtension capability. The dimensions can be customized.

INSPECTION AND CERTIFICATES

Oceanmax ropes can be issued with mill or Class Society certificates. A variety of specific checks can be provided on demand, such as dimensional inspection at specific loads or Magnetic Rope Testing.

ANTI-CRUSHING WIRE ROPE DESIGN

Wire ropes used in the Offshore & Wind Energy industry are subjected to challenging operating conditions, which bring them beyond the limits of the conventional operational modes.

The peculiarities of these special systems can cause remarkable mechanical damages and consequent premature rope replacement.

In particular, cross-over crushing on multi-layer winches has been highlighted by the crane makers and end users as one of the most common failure modes, particularly for boom hoist ropes used repeatedly on the monopiles installation cranes, which are typical in the renewables field.

When dealing with such operational conditions, it is essential to select a type of rope which can withstand radial pressure and reduce cross-over crushing damage.

Global Development Centre has developed an extensive testing campaign to assess the effect of different rope parameters on this type of issues.



The tests outcomes proved that the most effective design features and manufacturing strategies are:

- **USING ROPES WITH ROUND SURFACE,**
for example multistrand and non rotating constructions rather than 6 strand ropes.
- **INCREASING THE NUMBER OF OUTER STRANDS,**
which makes the rope's surface smoother, strongly reducing the gearing phenomenon between adjacent wraps and layers and the consequent damage of the individual strands and wires
- **USING ROPES WITH HIGH FILL FACTOR AND RADIAL STIFFNESS**
to reduce the ovalization of the rope due to layers pressure.

All Oceanmax ropes are made of large size wires and highly compacted strands both in the core and in the outer layer.

Special strands constructions and manufacturing processes are also available to further increase the radial stiffness.

WIRE ROPE TECHNOLOGY SEALUBE

Demanding deep-sea and off-shore wind installations, A&R operations and rope usage in harsh marine environments cause grease to wash out from the rope impacting on the operational performance, which leads to additional maintenance damaging the marine environment.

Brunton Shaw is at the forefront of designing and producing high-performing wire ropes with a low ecological footprint, while in service. As a result, we have designed and developed SEALUBE, an environmentally-friendly, but high performing system to minimize appearance of internal corrosion and unnecessary lubrication leakage during wire rope usage.

SEA



SEALUBE has been successfully used for several years and has been proven to be extremely effective: even after many years of utilization, further extending the service life of the wire ropes.

WHAT IS IT? HOW DOES IT WORK?

SEALUBE is a high grade membrane with specific engineering features that protect the core of our tailored marine wire ropes by retaining the lube.

SEALUBE innovative solution from Usha Martin is a result of intensive R&D testing, consisting of:

SEALUBE provides an enhanced solution compared to traditional extruded core options.

- Zero degradation during temperature increase in operation.
- Maintains and ensures the highest rope flexibility in the market.
- Available in different textures and densities to suit the application.
- Rope fatigue tests.
- Core lubricant drop and leakage testing under stress.
- Measurement of lubricant washout in subsea operations.
- Higher rope endurance is achieved through the increased volume of grease applied and retained during core closing without extrusion.
- Excellent rope stability due to SEALUBE engineered thickness.
- Marginal impact on rope geometry during operation.
- Achieves stable rope spooling across rope lifetime.
- Environmentally friendly solution, with no measurable microplastic emission.

LUBE

WHY?

BENEFITS DURING ROPE LIFE, FROM CRADLE TO GRAVE.

SEALUBE is a cost effective and green solution from Usha Martin dedicated to high performance marine and offshore hoisting, lifting, and mooring applications.

- Relubrication made easier, focus is on outer strands.
- No wasted grease from washout.
- Minimal discharge of polluting media into the seawater.
- Rope core level temperature constraints removed for heave compensators.
- Opportunity to use differing lubricants during individual rope-closing operations.



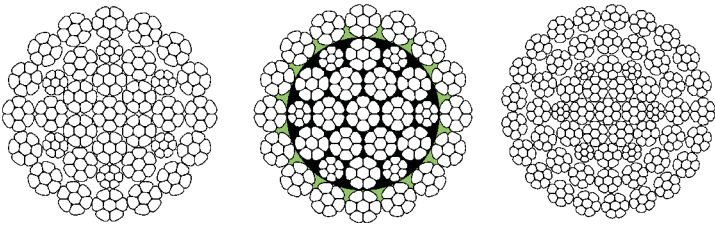
Oceanmax 35 is Brunton Shaw's state-of-the-art non rotating rope.

It is specifically designed for all the applications where rotational stability and radial stiffness are required, such as single fall operations, abandonment & recovery, operations in deep water or with significant lifting heights.

Oceanmax35 is offered with:

- **HEAVILY COMPACTED STRANDS**
Made of large size wires, which improve load capacity, diameter stability and resistance against wear and corrosion
- **CONTROLLED WIRE STRENGTH**
Which extends fatigue life and avoids the risk of strain ageing (1770 and 1960 typical grades for large size ropes)
- **SEALUBE TECHNOLOGY**
Which greatly extends lubrication effectiveness and duration
- **REGULAR LAY TYPE**
With special strand lay angle, which gives low torque and rotation factor and at the same time high resistance to side and cross-over crushing
- **FINE-TUNED COMPACTING LEVELS**
Which allows for the optimization of raw material procurement and rope performance

PRODUCTTABLE
OCEANMAX 35



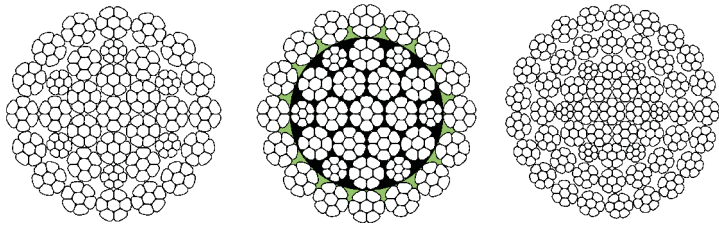
NOMINAL DIAMETER		MASS				MINIMUM BREAKING			
METRIC	IMPERIAL	METRIC		IMPERIAL		FORCE		LOAD	
		AIR	WATER	AIR	WATER	1960	2160	1960	2160
mm	Inches	kg/m	kg/m	Lb/ft	Lb/ft	kN	kN	Tonnes	Tonnes
26	1	3.16	2.69	2.13	1.81	600	645	61.2	65.7
		3.31	2.82	2.23	1.90	629	676	64.1	68.9
		3.84	3.27	2.59	2.20	729	784	74.3	79.9
30	1 1/8	4.00	3.40	2.69	2.29	759	817	77.4	83.3
	1 1/4	4.41	3.75	2.97	2.52	837	900	85.3	91.7
		4.94	4.20	3.33	2.83	937	1010	95.5	103
32	1 3/8	5.02	4.26	3.38	2.87	952	1020	97.0	104
34		5.66	4.81	3.81	3.24	1080	1160	110	118
35		5.98	5.08	4.02	3.42	1130	1220	115	124
36	1 1/2	6.35	5.40	4.28	3.63	1210	1300	123	133
38		7.08	6.01	4.76	4.05	1340	1440	137	147
40		7.84	6.66	5.28	4.49	1490	1590	152	162
41	1 5/8	8.35	7.10	5.62	4.78	1580	1670	161	170
42		8.64	7.35	5.82	4.95	1640	1730	167	176
44		9.49	8.06	6.39	5.43	1800	1900	183	194
46	1 3/4	9.68	8.23	6.52	5.54	1840	1920	188	196
48	1 7/8	10.4	8.81	6.98	5.93	1970	2050	201	209
50		11.3	9.60	7.60	6.46	2140	2230	218	227
52	2	12.3	10.4	8.25	7.01	2330	2400	238	245
54		12.6	10.7	8.51	7.24	2400	2480	245	253
56	2 1/8	13.2	11.3	8.92	7.58	2510	2570	256	262
58		14.3	12.1	9.62	8.18	2710	2770	276	282
56	2 1/4	15.4	13.1	10.3	8.79	2920	2980	298	304
58		16.5	14.0	11.1	9.43	3130	3200	319	326

These figures are for guidance only. Other features, such as MBF, dimensions, lay type and plastic fill can be designed on request.

OCEANMAX 35

35xK7 – 55xK7-WSC

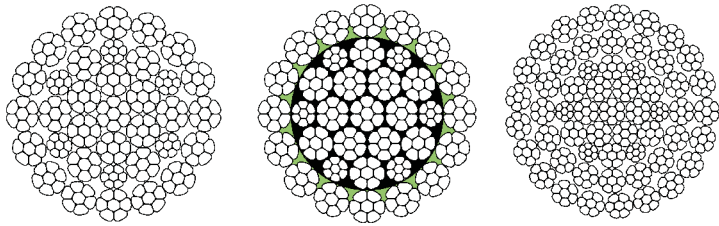
PRODUCTTABLE
OCEANMAX 35



NOMINAL DIAMETER		MASS				MINIMUM BREAKING			
METRIC	IMPERIAL	METRIC		IMPERIAL		FORCE		LOAD	
		AIR	WATER	AIR	WATER	1770	1960	1770	1960
mm	Inches	kg/m	kg/m	Lb/Ft	Lb/Ft	kN	kN	Tonnes	Tonnes
60	2 3⁄8	17.8	15.2	12.0	10.2	3130	3380	319	345
62		18.8	16.0	12.7	10.8	3310	3570	337	364
64	2 1⁄2	20.1	17.1	13.5	11.5	3520	3810	359	388
66		21.3	18.1	14.4	12.2	3750	4050	382	413
	2 5⁄8	21.8	18.5	14.7	12.5	3820	4130	389	421
68		22.7	19.3	15.3	13.0	3980	4300	406	439
70	2 3⁄4	24.0	20.4	16.2	13.7	4210	4560	429	465
72		25.4	21.6	17.1	14.5	4460	4820	455	491
73	2 7⁄8	26.1	22.2	17.6	15.0	4590	4960	468	506
74		26.8	22.8	18.1	15.4	4710	5090	480	519
76		28.3	24.1	19.1	16.2	4970	5370	507	547
	3	28.5	24.2	19.2	16.3	4990	5400	509	550
77		29.1	24.7	19.6	16.6	5100	5510	520	562
80	3 1⁄8	31.4	26.7	21.1	17.9	5500	5950	561	607
82	3 1⁄4	33.4	28.4	22.5	19.1	5860	6270	597	639
84		34.6	29.4	23.3	19.8	6070	6490	619	662
86	3 3⁄8	36.2	30.8	24.4	20.7	6360	6800	648	693
88		37.9	32.3	25.5	21.7	6600	7050	679	719
90	3 1⁄2	39.7	33.7	26.7	22.7	6970	7290	710	743
92	3 5⁄8	41.5	35.3	28.0	23.8	7290	7630	743	778
94		43.3	36.8	29.2	24.8	7600	7860	775	801
95	3 3⁄4	44.5	37.8	29.9	25.4	7800	7980	795	813
96		45.2	38.4	30.4	25.8	7930	8110	808	827
98	3 7⁄8	47.5	40.3	32.0	27.2	8330	8430	849	859
100		49.0	41.7	33.0	28.0	8600	8700	877	887
102	4	51.0	43.3	34.3	29.2	8950	9050	912	923
104		53.0	45.0	35.7	30.3	9300	9410	948	959
105	4 1⁄8	54.0	45.9	36.4	30.9	9480	9590	966	978
106		55.1	46.8	37.1	31.5	9660	9780	985	997
108	4 1⁄4	57.2	48.6	38.5	32.7	10000		1020	
109		58.2	49.5	39.2	33.3	10200		1040	

These figures are for guidance only. Other features, such as MBF, dimensions, lay type and plastic fill can be designed on request.

PRODUCTTABLE
OCEANMAX 35



NOMINAL DIAMETER		MASS				MINIMUM BREAKING			
METRIC	IMPERIAL	METRIC		IMPERIAL		FORCE		LOAD	
		AIR	WATER	AIR	WATER	1770	1960	1770	1960
mm	Inches	kg/m	kg/m	Lb/Ft	Lb/Ft	kN	kN	Tonnes	Tonnes
110		59.3	50.4	39.9	33.9	10300		1050	
112	4 3⁄8	61.5	52.5	41.4	35.2	10700		1090	
114	4 1⁄2	64.0	54.4	43.1	36.6	11100		1130	
115		64.8	55.1	43.6	37.1	11200		1140	
117	4 5⁄8	67.6	57.5	45.5	38.7	11700		1190	
119		69.4	59.0	46.7	39.7	12000		1220	
120	4 3⁄4	71.3	60.6	48.0	40.8	12400		1260	
122		72.9	62.0	49.1	41.7	12500		1270	
124	4 7⁄8	75.3	64.0	50.7	43.1	12900		1310	
125		76.6	65.1	51.5	43.8	13100		1340	
126		77.8	66.1	52.4	44.5	13300		1360	
127	5	79.0	67.2	53.2	45.2	13500		1380	
128		80.3	68.2	54.1	45.9	13800		1410	
130	5 1⁄8	83.0	70.6	55.9	47.5	14100		1440	
132		85.4	72.6	57.5	48.9	14500		1480	
134	5 1⁄4	88.0	74.8	59.2	50.4	14900		1520	
135		89.3	75.9	60.1	51.1	15100		1540	
136	5 3⁄8	91.3	77.6	61.5	52.3	15500		1580	
138		93.3	79.3	62.8	53.4	15800		1610	
139		94.7	80.5	63.7	54.2	16000		1630	
140	5 1⁄2	96.0	81.6	64.7	55.0	16300		1660	
142	5 5⁄8	100	85.0	67.3	57.2	16900		1720	
144		102	86.4	68.4	58.1	17200		1750	
146	5 3⁄4	105	88.8	70.4	59.8	17700		1800	
148		107	91.2	72.3	61.4	18200		1860	
150	5 7⁄8	110	93.7	74.2	63.1	18700		1910	
152	6	114	96.7	76.6	65.1	19300		1970	
154		116	98.8	78.2	66.5	19700		2010	
156	6 1⁄8	119	101	80.3	68.2	20200		2060	
158	6 1⁄4	123	105	83.1	70.7	20900		2130	
160		125	107	84.5	71.8	21200		2160	

These figures are for guidance only. Other features, such as MBF, dimensions, lay type and plastic fill can be designed on request.



OCEANMAX10S

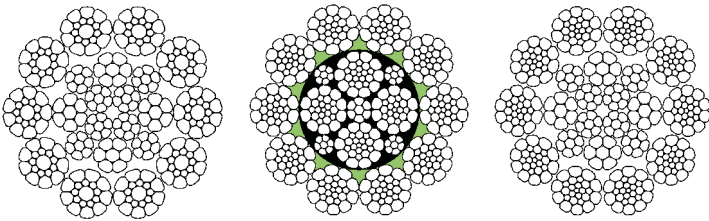
10xK19 IWRC, 10xK26 IWRC

OCEANMAX 10S is a spin resistant rope, consisting of 10 outer strands closed over a core laid in the opposite direction and it is typically provided in regular lay construction.

This is an intermediate solution between a non rotating and a conventional multistrand rope, which gives medium level torque and rotation factor and can be useful for some specific hoist configurations, like for example pipe handlers, piper elevators or boom hoist requiring enhanced torsional stability.

- Oceanmax10S is offered with:
- **COMPACTED CORE AND OUTER STRANDS**
to ensure load capacity, diameter stability and radial stiffness
 - **REGULAR LAY TYPE**
to minimize torque and rotation factor
 - **OPTIONAL SEALUBE TECHNOLOGY**
which greatly extends lubrication effectiveness and duration
 - **HEAVILY COMPACTED STRANDS**
which ensure excellent spooling capability and crushing resistance
 - **CONTROLLED WIRE STRENGTH**
which extends fatigue life and avoids the risk of strain ageing
 - **OPTIONAL PLASTIC IMPREGNATED CORE**
for enhanced resistance to fleet angles

PRODUCTTABLE OCEANMAX 10S



NOMINAL DIAMETER		MASS				MINIMUM BREAKING			
METRIC	IMPERIAL	METRIC		IMPERIAL		FORCE		LOAD	
		AIR	WATER	AIR	WATER	1960	2160	1960	2160
mm	Inches	kg/m	kg/m	Lb/ft	Lb/ft	kN	kN	Tonnes	Tonnes
26	1	3.03	2.58	2.04	1.74	561	613	57.2	62.5
		3.18	2.70	2.14	1.82	588	642	59.9	65.4
		3.68	3.13	2.48	2.11	682	745	69.5	75.9
30	1⅝	3.84	3.26	2.58	2.20	710	776	72.4	79.1
	1¼	4.23	3.60	2.85	2.42	783	855	79.8	87.2
		4.74	4.03	3.19	2.71	877	958	89.4	97.7
32	1⅜	4.81	4.09	3.24	2.75	891	973	90.8	99.2
34		5.43	4.62	3.66	3.11	1010	1100	103	112
35		5.73	4.87	3.86	3.28	1060	1160	108	118
36	1½	6.09	5.18	4.10	3.49	1130	1230	115	125
38		6.79	5.77	4.57	3.88	1260	1370	128	140
40		7.52	6.39	5.06	4.30	1390	1520	142	155
41	1⅝	8.01	6.81	5.39	4.58	1480	1600	151	163
42		8.29	7.05	5.58	4.74	1530	1660	156	169
44		9.10	7.73	6.13	5.21	1680	1820	171	186
46	1¾	9.29	7.89	6.25	5.31	1720	1860	175	190
	1⅞	9.95	8.45	6.70	5.69	1840	1990	188	203
48		10.8	9.20	7.29	6.20	2000	2140	204	218
50	2	11.8	10.0	7.91	6.72	2180	2330	222	238
52		12.1	10.3	8.17	6.94	2250	2400	229	245
		12.7	10.8	8.56	7.27	2350	2510	240	256
54	2⅙	13.7	11.6	9.23	7.84	2540	2710	259	276
56		14.7	12.5	9.92	8.44	2730	2920	278	298
58	2¼	15.8	13.4	10.6	9.05	2930	3090	299	315
60	2⅝	17.1	14.5	11.5	9.79	3170	3350	323	341
62		18.1	15.4	12.2	10.3	3340	3540	340	361
64	2½	19.3	16.4	13.0	11.0	3560	3770	363	384
66	2⅝	20.5	17.4	13.8	11.7	3790	4010	386	409
68		20.9	17.8	14.1	12.0	3870	4090	394	417
		21.7	18.5	14.6	12.4	4020	4250	410	433
70	2¾	23.0	19.6	15.5	13.2	4260	4510	434	460
72		24.4	20.7	16.4	13.9	4510	4770	460	486

These figures are for guidance only. Other features, such as MBF, dimensions, lay type and plastic fill can be designed on request.

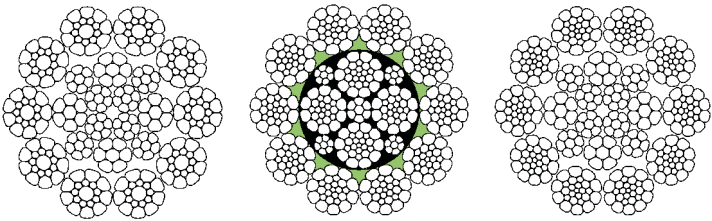


OCEANMAX10 is a 10 strand IWRC rope, which can be provided both in regular and lang's lay, depending on customer requirements.

Its peculiar construction results in a higher fill factor and more surface roundness compared to 8 strand and 6 strand ropes, giving higher breaking force and better spooling capacity.

- OCEANMAX10 is offered with:
- **COMPACTED CORE AND OUTER STRANDS**
to ensure load capacity, diameter stability and radial stiffness
 - **OPTIONAL SEALUBE TECHNOLOGY**
which greatly extends lubrication effectiveness and duration
 - **HEAVILY COMPACTED STRANDS**
which ensure excellent spooling capability and crushing resistance
 - **CONTROLLED WIRE STRENGTH**
which extends fatigue life and avoids the risk of strain ageing
 - **OPTIONAL PLASTIC IMPREGNATED CORE**
for enhanced resistance to fleet angles

PRODUCTTABLE
OCEANMAX 10



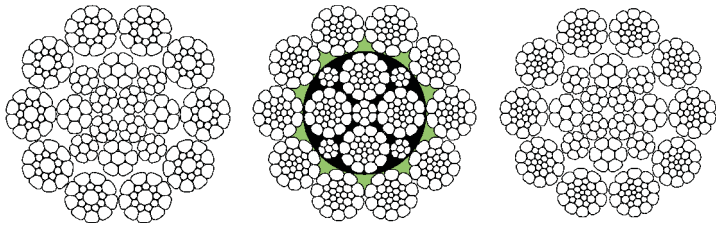
NOMINAL DIAMETER		MASS				MINIMUM BREAKING			
METRIC	IMPERIAL	METRIC		IMPERIAL		FORCE		LOAD	
		AIR	WATER	AIR	WATER	1960	2160	1960	2160
mm	Inches	kg/m	kg/m	Lb/ft	Lb/ft	kN	kN	Tonnes	Tonnes
26	1	3.03	2.58	2.04	1.74	568	619	57.9	63.1
		3.18	2.70	2.14	1.82	595	649	60.7	66.2
		3.68	3.13	2.48	2.11	690	753	70.3	76.8
30	1 1/8	3.84	3.26	2.58	2.20	719	784	73.3	79.9
	1 1/4	4.23	3.60	2.85	2.42	792	864	80.7	88.1
		4.74	4.03	3.19	2.71	887	968	90.4	98.7
32	1 3/8	4.81	4.09	3.24	2.75	901	983	91.8	100
34		5.43	4.62	3.66	3.11	1020	1110	104	113
35		5.73	4.87	3.86	3.28	1070	1170	109	119
36	1 1/2	6.09	5.18	4.10	3.49	1140	1240	116	126
38		6.79	5.77	4.57	3.88	1270	1390	129	142
40		7.52	6.39	5.06	4.30	1410	1540	144	157
41	1 5/8	8.01	6.81	5.39	4.58	1500	1620	153	165
42		8.29	7.05	5.58	4.74	1550	1680	158	171
44		9.10	7.73	6.13	5.21	1700	1840	173	188
46	1 3/4	9.29	7.89	6.25	5.31	1740	1880	177	192
	1 7/8	9.95	8.45	6.70	5.69	1860	2010	190	205
48		10.8	9.20	7.29	6.20	2030	2170	207	221
50		11.8	10.0	7.91	6.72	2200	2350	224	240
52	2	12.1	10.3	8.17	6.94	2270	2430	231	248
	2 1/8	12.7	10.8	8.56	7.27	2380	2540	243	259
54		13.7	11.6	9.23	7.84	2570	2740	262	279
56		14.7	12.5	9.92	8.44	2760	2950	281	301
58	2 1/4	15.8	13.4	10.6	9.05	2960	3130	302	319
60	2 3/8	17.1	14.5	11.5	9.79	3200	3380	326	345

These figures are for guidance only. Other features, such as MBF, dimensions, lay type and plastic fill can be designed on request.

OCEANMAX 10

10xK19 IWRC, 10xK26 IWRC

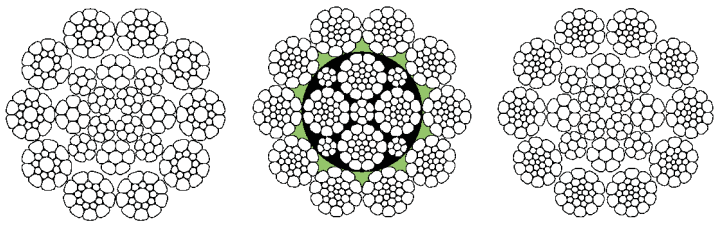
PRODUCTTABLE
OCEANMAX 10



NOMINAL DIAMETER		MASS				MINIMUM BREAKING			
METRIC	IMPERIAL	METRIC		IMPERIAL		FORCE		LOAD	
		AIR	WATER	AIR	WATER	1770	1960	1770	1960
mm	Inches	kg/m	kg/m	Lb/ft	Lb/ft	kN	kN	Tonnes	Tonnes
62	2 ½	18.1	15.4	12.2	10.3	3150	3570	321	364
64		19.3	16.4	13.0	11.0	3360	3810	343	388
66		20.5	17.4	13.8	11.7	3570	4050	364	413
68	2 ⅝	20.9	17.8	14.1	12.0	3650	4130	372	421
		21.7	18.5	14.6	12.4	3790	4300	386	438
70	2 ¾	23.0	19.6	15.5	13.2	4020	4560	410	465
72	2 ⅞	24.4	20.7	16.4	13.9	4250	4770	433	486
73		25.1	21.3	16.9	14.3	4370	4910	445	501
74		25.7	21.9	17.3	14.7	4490	5040	458	514
76	3	27.1	23.1	18.3	15.5	4740	5310	483	541
		27.3	23.2	18.4	15.6	4760	5340	485	544
77		27.9	23.7	18.8	15.9	4860	5450	495	556
80	3 ⅙	30.1	25.6	20.3	17.2	5250	5890	535	600
82	3 ¼	32.0	27.2	21.6	18.3	5590	6270	570	639
84		33.2	28.2	22.3	19.0	5790	6490	590	662
86	3 ⅓	34.8	29.5	23.4	19.9	6060	6800	618	693
88	3 ½	36.4	30.9	24.5	20.8	6350	7050	647	719
90		38.1	32.4	25.6	21.8	6640	7370	677	751
92	3 ⅝	39.8	33.9	26.8	22.8	6950	7710	708	786
94	3 ¾	41.5	35.3	28.0	23.8	7250	8040	739	820
95		42.6	36.2	28.7	24.4	7440	8170	758	833
96		43.3	36.8	29.2	24.8	7560	8290	771	845

These figures are for guidance only. Other features, such as MBF, dimensions, lay type and plastic fill can be designed on request.

PRODUCTTABLE
OCEANMAX 10



NOMINAL DIAMETER		MASS				MINIMUM BREAKING			
METRIC	IMPERIAL	METRIC		IMPERIAL		FORCE		LOAD	
		AIR	WATER	AIR	WATER	1770	1960	1770	1960
mm	Inches	kg/m	kg/m	Lb/ft	Lb/ft	kN	kN	Tonnes	Tonnes
98	3 ⅞	45.5	38.7	30.7	26.1	7940	8620	809	879
100	4	47.0	40.0	31.6	26.9	8200	8900	836	907
102		48.9	41.6	32.9	28.0	8530	9260	870	944
104		50.8	43.2	34.2	29.1	8870	9410	904	959
105	4 ⅛	51.8	44.0	34.9	29.7	9040	9590	922	978
		52.8	44.9	35.6	30.2	9210	9780	939	997
106									
108	4 ¼	54.8	46.6	36.9	31.4	9560	10000	975	1020
109		55.8	47.5	37.6	32.0	9740	10200	993	1040
110		56.9	48.3	38.3	32.5	9920	10400	1010	1060
112	4 ⅜	59.0	50.1	39.7	33.7	10300	10700	1050	1090
114	4 ½	61.4	52.2	41.3	35.1	10700	11000	1090	1120
115		62.2	52.8	41.8	35.6	10800	11100	1100	1130
117	4 ⅝	64.9	55.1	43.7	37.1	11300	11600	1150	1180
119		66.6	56.6	44.8	38.1	11600	11900	1180	1210
120		68.4	58.2	46.1	39.2	11900	12100	1210	1230
122	4 ¾	70.0	59.5	47.1	40.0	12200	12400	1240	1260
124		72.3	61.4	48.7	41.4	12600	12800	1280	1300
125		73.4	62.4	49.4	42.0	12800	13000	1300	1330
126	5	74.6	63.4	50.2	42.7	13000		1330	
127		75.8	64.4	51.0	43.4	13200		1350	
128		77.0	65.5	51.8	44.1	13400		1370	
130	5 ⅙	79.6	67.7	53.6	45.6	13900		1420	

These figures are for guidance only. Other features, such as MBF, dimensions, lay type and plastic fill can be designed on request.



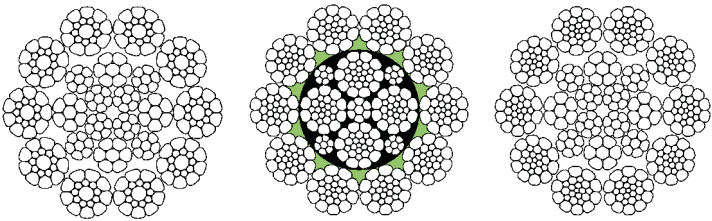
OCEANMAX8 is an 8 strand IWRC rope, which can be provided both in regular and langs lay, depending on customer requirements.

Together with OCEANMAX35, this is one of Brunton Shaw's best sellers and it is very popular for boom hoist and also for multifall main hoist, provided that the reeving geometry and the lifting height do not require a low torque factor to ensure the block stability, particularly in offshore wind installation cranes.

OCEANMAX8 is offered with:

- **COMPACTED CORE AND OUTER STRANDS**
to ensure load capacity, diameter stability and radial stiffness
- **OPTIONAL SEALUBE TECHNOLOGY**
which greatly extends lubrication effectiveness and duration
- **HEAVILY COMPACTED STRANDS**
which ensure excellent spooling capability and crushing resistance
- **CONTROLLED WIRE STRENGTH**
which extends fatigue life and avoids the risk of strain ageing
- **OPTIONAL PLASTIC IMPREGNATED CORE**
for enhanced resistance to fleet angles

PRODUCTTABLE
OCEANMAX 8

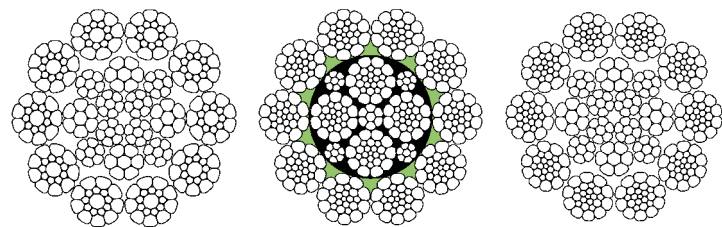


NOMINAL DIAMETER		MASS				MINIMUM BREAKING			
METRIC	IMPERIAL	METRIC		IMPERIAL		FORCE		LOAD	
		AIR	WATER	AIR	WATER	1960	2160	1960	2160
mm	Inches	kg/m	kg/m	Lb/ft	Lb/ft	kN	kN	Tonnes	Tonnes
26 28	1	2.97	2.52	2.00	1.70	568	613	57.9	62.5
		3.11	2.64	2.09	1.78	595	642	60.7	65.4
		3.61	3.07	2.43	2.06	690	745	70.3	75.9
30	1 1/8	3.76	3.19	2.53	2.15	719	776	73.3	79.1
	1 1/4	4.14	3.52	2.79	2.37	792	855	80.7	87.2
		4.64	3.94	3.12	2.65	887	958	90.4	97.7
32	1 3/8	4.71	4.00	3.17	2.70	901	973	91.8	99.2
34		5.32	4.52	3.58	3.04	1020	1100	104	112
35		5.61	4.77	3.78	3.21	1070	1160	109	118
36	1 1/2	5.96	5.07	4.01	3.41	1140	1220	116	124
38		6.64	5.65	4.47	3.80	1270	1360	129	139
40		7.36	6.26	4.96	4.21	1410	1500	144	153
41	1 5/8	7.84	6.66	5.28	4.48	1500	1600	153	163
42		8.11	6.90	5.46	4.64	1550	1660	158	169
44		8.91	7.57	6.00	5.10	1700	1820	173	186
46	1 3/4	9.09	7.73	6.12	5.20	1740	1860	177	190
	1 7/8	9.73	8.27	6.55	5.57	1860	1990	190	203
48		10.6	9.01	7.14	6.07	2030	2140	207	218
50		11.5	9.78	7.74	6.58	2200	2330	224	238
52	2	11.9	10.1	7.99	6.79	2270	2400	231	245
		12.4	10.6	8.37	7.12	2380	2510	243	256

These figures are for guidance only. Other features, such as MBF, dimensions, lay type and plastic fill can be designed on request.

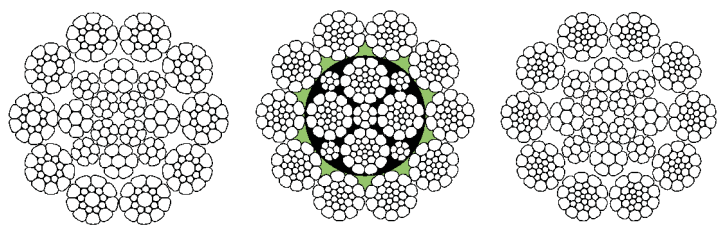
OCEANMAX 8

8xK26 IWRC, 8xK31 IWRC



NOMINAL DIAMETER		MASS				MINIMUM BREAKING			
METRIC	IMPERIAL	METRIC		IMPERIAL		FORCE		LOAD	
		AIR	WATER	AIR	WATER	1960	2160	1960	2160
mm	Inches	kg/m	kg/m	Lb/ft	Lb/ft	kN	kN	Tonnes	Tonnes
54	2 1/8	13.4	11.4	9.03	7.68	2570	2710	262	276
56		14.4	12.3	9.71	8.26	2760	2890	281	295
58	2 1/4	15.5	13.2	10.4	8.86	2960	3090	302	315
60	2 3/8	16.7	14.2	11.3	9.58	3200	3350	326	341
62		17.7	15.0	11.9	10.1	3380	3540	345	361
64	2 1/2	18.8	16.0	12.7	10.8	3600	3770	367	384
66	2 5/8	20.0	17.0	13.5	11.5	3830	4010	390	409
		20.4	17.4	13.8	11.7	3910	4050	399	413
68		21.3	18.1	14.3	12.2	4070	4210	415	429
70	2 3/4	22.5	19.2	15.2	12.9	4310	4460	439	455
72		23.8	20.3	16.1	13.6	4560	4720	465	481
73	2 7/8	24.5	20.9	16.5	14.0	4690	4800	478	489
74	3	25.2	21.4	17.0	14.4	4820	4930	491	503
76		26.6	22.6	17.9	15.2	5080	5200	518	530
		26.7	22.7	18.0	15.3	5110	5230	521	533
77	3 1/8	27.3	23.2	18.4	15.6	5220	5280	532	538
80		29.4	25.0	19.8	16.8	5630	5700	574	581

These figures are for guidance only. Other features, such as MBF, dimensions, lay type and plastic fill can be designed on request.



NOMINAL DIAMETER		MASS				MINIMUM BREAKING			
METRIC	IMPERIAL	METRIC		IMPERIAL		FORCE		LOAD	
		AIR	WATER	AIR	WATER	1770	1960	1770	1960
mm	Inches	kg/m	kg/m	Lb/ft	Lb/ft	kN	kN	Tonnes	Tonnes
82	3 1/4	31.3	26.6	21.1	17.9	5520	5930	563	604
84		32.5	27.6	21.9	18.6	5720	6140	583	626
86	3 3/8	34.0	28.9	22.9	19.5	5990	6360	611	648
88	3 1/2	35.6	30.3	24.0	20.4	6270	6580	639	671
90		37.3	31.7	25.1	21.3	6560	6890	669	702
92	3 5/8	39.0	33.1	26.3	22.3	6870	7210	700	735
94	3 3/4	40.6	34.5	27.4	23.3	7160	7420	730	756
95		41.7	35.5	28.1	23.9	7350	7620	749	777
96		42.4	36.0	28.5	24.3	7460	7650	760	780
98	3 7/8	44.6	37.9	30.0	25.5	7850	8040	800	820
100	4	46.0	39.1	31.0	26.3	8100	8300	826	846
102		47.9	40.7	32.2	27.4	8430	8530	859	870
104	4 1/8	49.8	42.3	33.5	28.5	8760	8870	893	904
105		50.7	43.1	34.1	29.0	8930	9040	910	922
106		51.7	43.9	34.8	29.6	9100		928	
108	4 1/4	53.7	45.6	36.1	30.7	9450		963	
109		54.7	46.5	36.8	31.3	9620		981	
110		55.7	47.3	37.5	31.9	9800		999	
112	4 3/8	57.7	49.0	38.9	33.0	10000		1020	

These figures are for guidance only. Other features, such as MBF, dimensions, lay type and plastic fill can be designed on request.



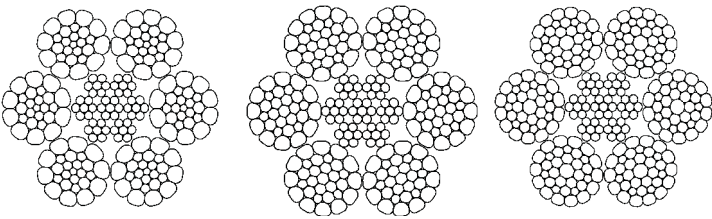
OCEANMAX6 is a 6 strand, IWRC rope, which can be provided both in regular and langs lay, depending on customer requirements.

This is the most traditional rope construction and it is commonly used both for standard applications, which do not require highly specialized products, as well as for some specific fields, such as risers tensioners or drilling lines.

OCEANMAX6 is offered with:

- **COMPACTED CORE AND OUTER STRANDS**
to ensure diameter stability
- **OPTIONAL SEALUBE TECHNOLOGY**
which greatly extends lubrication effectiveness and duration
- **CONTROLLED WIRE STRENGTH**
which extends fatigue life and avoids the risk of strain ageing

PRODUCTTABLE
OCEANMAX 6



NOMINAL DIAMETER		MASS				MINIMUM BREAKING			
METRIC	IMPERIAL	METRIC		IMPERIAL		FORCE		LOAD	
		AIR	WATER	AIR	WATER	1960	2160	1960	2160
mm	Inches	kg/m	kg/m	Lb/ft	Lb/ft	kN	kN	Tonnes	Tonnes
26	1	2.90	2.47	1.95	1.66	548	594	55.9	60.6
		3.04	2.59	2.05	1.74	575	622	58.6	63.4
		3.53	3.00	2.38	2.02	666	721	67.9	73.5
30	1 ⅛	3.67	3.12	2.47	2.10	694	751	70.7	76.6
	1 ¼	4.05	3.44	2.73	2.32	765	819	78.0	83.5
		4.54	3.86	3.05	2.60	857	917	87.4	93.5
32	1 ⅜	4.61	3.92	3.10	2.64	870	932	88.7	95.0
34		5.20	4.42	3.50	2.98	983	1050	100	107
35		5.49	4.67	3.70	3.14	1040	1110	106	113
36	1 ½	5.83	4.96	3.93	3.34	1100	1170	112	119
38		6.50	5.52	4.38	3.72	1230	1300	125	133
40		7.20	6.12	4.85	4.12	1360	1440	139	147
41	1 ⅝	7.67	6.52	5.16	4.39	1450	1530	148	156
42		7.94	6.75	5.34	4.54	1500	1590	153	162
44		8.71	7.41	5.87	4.99	1650	1740	168	177
46	1 ¾	8.89	7.56	5.99	5.09	1680	1780	171	181
	1 ⅞	9.52	8.09	6.41	5.45	1800	1900	183	194
48		10.4	8.81	6.98	5.93	1960	2070	200	211
50	2	11.3	9.56	7.57	6.44	2130	2250	217	229
52		11.6	9.87	7.82	6.65	2190	2320	223	236
		12.2	10.3	8.19	6.96	2300	2430	234	248
54	2 ⅛	13.1	11.2	8.83	7.51	2480	2620	253	267
56	2 ¼	14.1	12.0	9.50	8.08	2670	2820	272	287
58		15.1	12.9	10.2	8.66	2860	3030	292	309
60		16.4	13.9	11.0	9.37	3090	3280	315	334
62	2 ⅝	17.3	14.7	11.6	9.90	3270	3460	333	353
64	2 ½	18.4	15.7	12.4	10.5	3480	3690	355	376
66	2 ⅞	19.6	16.7	13.2	11.2	3700	3920	377	400
68		20.0	17.0	13.5	11.4	3780	4000	385	408
		20.8	17.7	14.0	11.9	3930	4160	401	424
70	2 ¾	22.1	18.7	14.8	12.6	4170	4410	425	450
72	2 ⅞	23.3	19.8	15.7	13.4	4410	4670	450	476
73		24.0	20.4	16.2	13.7	4530	4800	462	489
74		24.6	20.9	16.6	14.1	4650	4930	474	503
76		26.0	22.1	17.5	14.9	4910	5200	501	530

These figures are for guidance only. Other features, such as MBF, dimensions, lay type and plastic fill can be designed on request.

OCEANMAX 6

6xK26 IWRC, 6xK31 IWRC, 6xK36 IWRC

ROPE PROPERTIES

	FILL FACTOR (F)	MBF FACTOR (K)	MASS FACTOR (Km)		E MODULUS* (E) [KN/mm²]	TORQUE FACTOR* (t)		REF. LAY FACTOR	ROTATION FACTOR* (R) [°/LAY]	
			IN AIR	IN WATER		LANG	REG		LANG	REG
OCEANMAX 35	0.725	0.861	0.0049	0.0042	127	0.012	0.007	7	1	0
OCEANMAX 35 - 55XK7	0.725	0.830.86	0.0049	0.0042	127	0.007	0.001	7	0.5	0
OCEANMAX 10S	0.695	0.810.95	0.0047	0.0040	125	0.055	0.045	7	12	4
OCEANMAX 10	0.695	0.820.96	0.0047	0.0040	127	0.125	0.09	6.5	120	70
OCEANMAX 8	0.68	0.800.95	0.0046	0.0039	125	0.11	0.085	6.5	100	60
OCEANMAX 6	0.67	0.790.92	0.0045	0.0038	122	0.11	0.078	6.5	90	60

Nominal value at 20% MBL after training*

ROPE CALCULATOR

MBF [kN] = K • d² (d = nominal diameter [mm])

Mass [kg/m] = Km • d²

Metallic area (A) [mm²] = 0.785 • f • d²

Axial stiffness (EA) [MN] = E • 0.785 • f • d²/1000

Elastic elongation [ΔL] = Load [kN] / (EA • 1000)

Rope torque [Nm] = t • d • load [kN]

DISCARD CRITERIA FOR VISIBLE BROKEN WIRES

		ROPE CATEGORY NUMBER (RCN)	NUMBER OF OUTER WIRES	SECTIONS OF ROPE WORKING IN STEEL SHEAVES AND/OR SPOOLING ON SINGLE LAYER DRUM (wire breaks randomly distributed)				SECTION OF ROPE SPOOLING ON A MULTILAYER DRUM	
				ORDINARY		LANGS		ORDINARY OR LANGS	
				6d	30d	6d	30d	6d	30d
OCEANMAX 35	35xK7	23-2	112	3	5	3	5	5	10
	56xK7	23-3	126	3	5	3	5	6	11
OCEANMAX 10S	10xK19	6	190	6	13	3	6	12	26
	10xK26	11	260	10	21	5	10	20	38
	10xK31	-	310	12	25	6	12	25	50
OCEANMAX 10	10xK19	6	190	6	13	3	6	12	26
	10xK26	11	260	10	21	5	10	20	38
	10xK31	-	310	12	25	6	12	25	50
OCEANMAX 8	8xK26	9	208	9	18	4	9	18	36
	8xK31	11	248	10	21	5	10	20	38
	8xK36	13	288	12	24	6	12	24	48
OCEANMAX 6	6xK26	6	156	6	13	3	6	12	26
	6xK31	8	186	8	16	4	8	16	32
	6xK36	9	216	9	18	4	9	18	36

REFERENCE REGULATIONS

EN 12385-1

Steel wire ropes – Safety Part 1: General requirements

EN 12385-2

Steel wire ropes – Safety Part 2: Definitions, designation and classification

EN 12385-3

Steel wire ropes – Safety Part 3: Information for use and maintenance

EN 12385-4

Steel wire ropes – Safety Part 4: Stranded ropes for general lifting applications

EN 10244-2

Steel wire and wire products – Non ferrous metallic coatings on steel wire – Zinc or zinc alloy coatings

EN 10264-1

Steel wire and wire products – Steel wire for ropes – General requirements

EN 10264-2

Steel wire and wire products – Steel wire for ropes – Cold drawn non-alloyed steel wire for ropes for general applications

ISO 17558

Steel wire ropes – Socketing procedures – Molten metal and resin socketing

EN 13411-4

Terminations for steel wire ropes – Safety Part 4: metal and resin socketing

ISO 4309

Cranes – Wire ropes – Care and maintenance, inspection and discard

IMCA M171

Crane specification document

IMCA M179

Code of practice on the manufacture and safe use of cable-laid slings and grommets

IMCA M187

Guidelines for lifting operations

IMCA M194

Recommended practice on wire rope integrity management for vessels in the offshore industry

IMCA M197

Recommended practice for the examination of steel wire rope through magnetic rope testing (MRT)

ISO 10425

Steel wire ropes for the petroleum and natural gas industries – Minimum requirements and terms of acceptance

API RP 9B

American Petroleum Institute recommended practice for application, care and use of wire rope for oilfield services

WIRE ROPE TECHNICAL BOARD

Wire rope user’s manual 5th edition

DIAMETER AND OVERSIZE

Rope nominal diameter and oversize should be selected depending on the application, on the configuration of the system and on the applicable regulations.

According to EN12385-1, ISO and API standards, diameter measurement shall be taken on a straight portion of the rope, either under no tension or a tension not exceeding 5% of the minimum breaking force, at two positions spaced at least one meter apart. At each position two measurements, at right angles, of the circumscribed circle diameter shall be taken.

The most suitable measuring equipment is a plate gauge, capable of covering at least two strands.

Diameter should be measured and recorded immediately after receiving the rope, as this value should be used as a baseline for subsequent inspections.

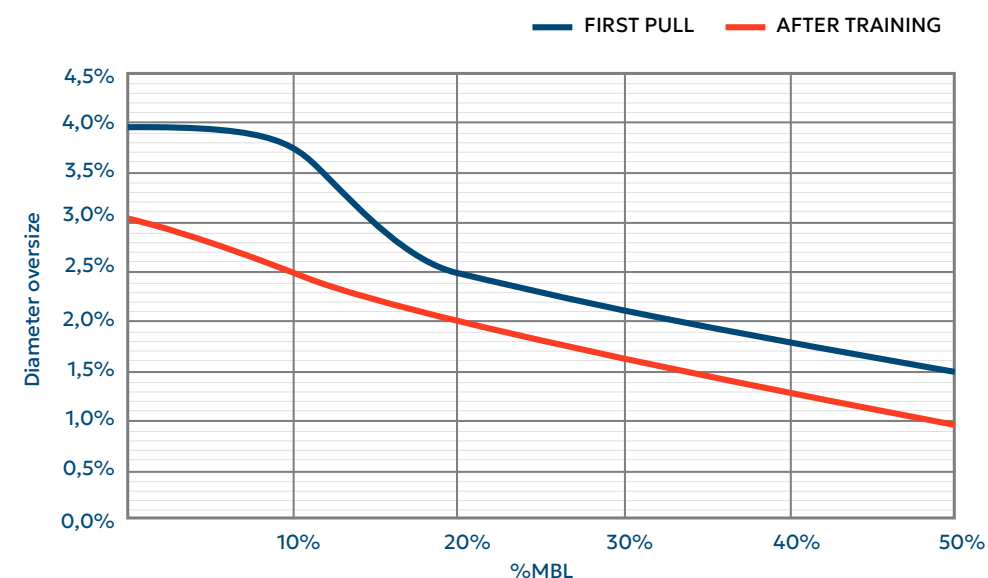
The actual diameter of the rope changes over time due to the initial stabilization, to the effect of the working tension and to the wear generated by the passage over the components of the reeving system.

The permanent diameter reduction after the first pull varies from 0.5% to 3% depending on rope and core construction (see below graph, showing the diameter vs load correlation for a new and trained rope).

Diameter measurement is an essential tool which can give an immediate and simple evaluation of the overall condition of the rope.

For example, a localized diameter variation can indicate undesired phenomena like geometrical deformation, core distortion or presence of heavy corrosion, while a distributed diameter reduction can be associated to wear due to intensive use.

Ovalization is also a marker of possible rope issues, which have to be properly addressed.



LAYTYPE AND LENGTH

Lay direction is normally selected taking into consideration the natural tendency of the rope to twist to get a tight contact between adjacent wraps, especially on the first layer.

In case of plain drum, a right hand or left hand rope should be selected to match the drum's type and direction, as shown in the figure.

These indications are not strictly required for grooved drums, where the rope is already guided by the grooves themselves: in these cases, lay direction can be selected to facilitate the spooling of the first layer or considering the rope layer that will be more frequently used during operations.

The choice of a Lang or regular lay rope is based on rope use and desired performance.

Regular lay ropes ensure improved rotation stability and therefore they are recommended for relevant lifting heights, deep water deployment and high capacity cranes. They also offer a higher resistance to cross-over crushing compared to regular lay ropes.

Lang lay ropes can give better resistance to side crushing, particularly for lightly or not compacted ropes, and they are particularly common for 40 mm size ropes used on deck cranes or small winches.

For heavily compacted ropes, the difference in terms of crushing resistance is not so relevant, as compaction intrinsically creates smoother contacts and avoids the gearing effect between adjacent wraps.

Lay length affects rope's elasticity and performance under load:

- Longer lay length → Higher MBL capability and stiffer construction
- Shorter lay length → More resistance to shock loading and better handling capability

Lay length shall be periodically measured during rope usage, as variations can be an indication of rope issues, like forced rotation during installation, unlay due to excessive lifting height, misalignment of the reeving components.

An excessive lay length variation can seriously affect the structural stability of the rope, with risk of waviness, birdcage or kink generation.



STRENGTH AND BREAKING FORCE

Rope breaking force derives from the combination of

- metallic area, which depends on geometrical construction, diameter oversize and compacting level
- strength, which is dependent on the characteristics of the individual wires
- spinning factor, which indicates the capabilities of the rope maker

Although this is one of the major characteristics of steel wire ropes, high breaking force shall not be confused with increased safety: safe working conditions are ensured if rope damages are visible, reliably detectable and progressive.

This can be achieved if the rope is made of ductile wires, which gradually break over the rope's service life and allow for safely assessing the rope's conditions.

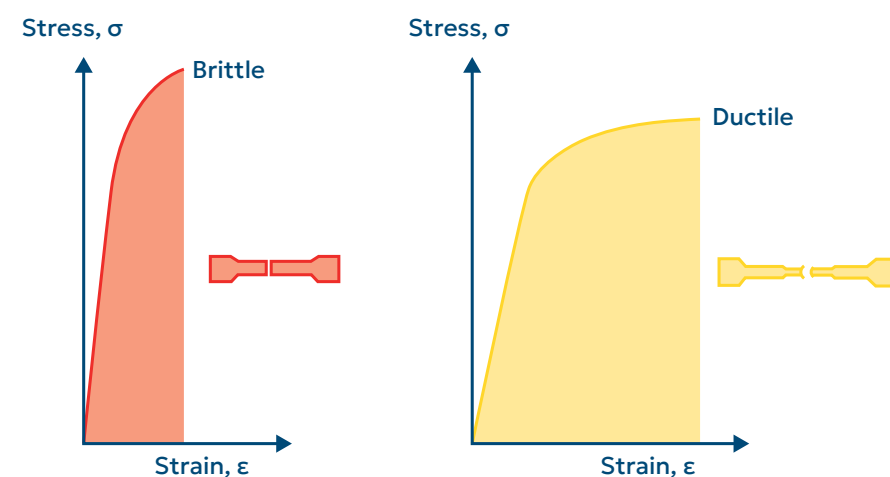
For this reason, the usage of the lowest possible grade and high ductility wires to achieve the required MBL is always preferable, as this allows to avoid premature fatigue or other unexpected phenomena.

According to Standards, the level of breaking force of a rope is indicated by the grade, which is just a "label" and it is not associated to any unit, i.e. "1960" and not "1960 N/mm²".

Considering the values indicated in EN12385-4, a rope with 1960 grade can have wires with 1770 N/mm², 1960 N/mm² or 2160 N/mm² grade.

This shall be kept in mind when selecting a rope, as some suppliers work on the lower part of the allowed strength interval while others tend to use higher strength to compensate for manufacturing bottlenecks or design shortcomings.

The graph below compares the behavior of wires with different strengths: the first figure represents a brittle trend typical of high strength steel (over 2160 N/mm²). The second figure represents the typical trend of lower strength steel (1770 and 1960 N/mm²).



BREAKING LOAD TEST

Breaking load tests shall be performed using suitable equipment and procedures in order to get a reliable output.

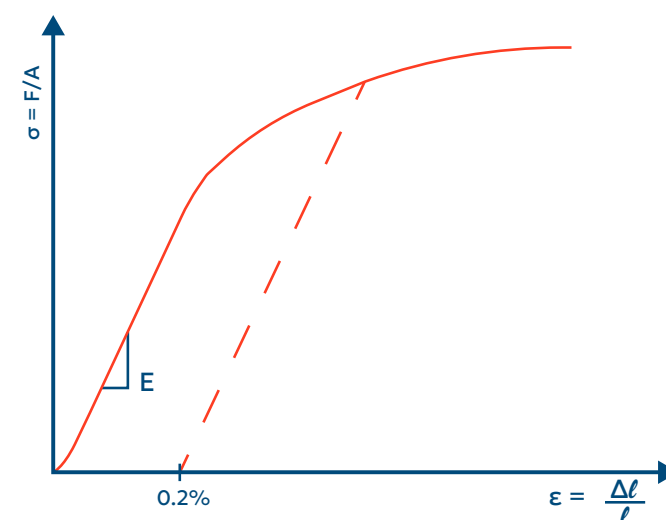
The test should be smooth enough to allow force distribution within the rope during all its duration, which should be around 3 to 5 minutes.

When possible, it is recommended to carry out the test on a bed which is capable to provide a load vs displacement curve (see example below), as this allows to gather additional rope knowledge.

The first phase of the test is not linear due to the initial rope stabilization, then the trend is basically linear up to the yield point and with a slope corresponding to E modulus. Finally, permanent plastic deformation takes place, until the load reaches the actual breaking force. Ropes with good performance will normally have an elongation at break of about 4 to 5% and yield point at about 70 to 75% MBL. These values strongly depend on the test bed arrangement and on the rigidity of the connections between the sample and the test bed itself.

A failure in achieving the Minimum Breaking Load can be typically due to one of the following reasons:

- bad samples handling, socketing or seizing
- inadequate test procedure, such as excessive speed, issues with the test bed, socket cones misalignment
- quality issues of the rope due to inadequate manufacturing process
- metallurgical reasons, such as strain ageing. This is typically associated to a relevant loss of breaking force (around 20%), which is detectable even a few weeks after rope manufacturing
- presence of corrosion altering the integrity of the rope
- presence of distributed damages (e.g. fatigue, wear, indentations)
- presence of other mechanical damages (e.g. rope distortion, squeezing, localized breaks)



WIRE DRAWING AND SURFACE COATING

Wire used for Oceanmax ropes is obtained by high carbon patented galvanized rod, which allows to achieve the required wires characteristic in terms of ductility and breaking force.

Although Regulations allow carbon content between 0.6 and 1, Oceanmax ropes are usually made using values between 0.82 and 0.88.

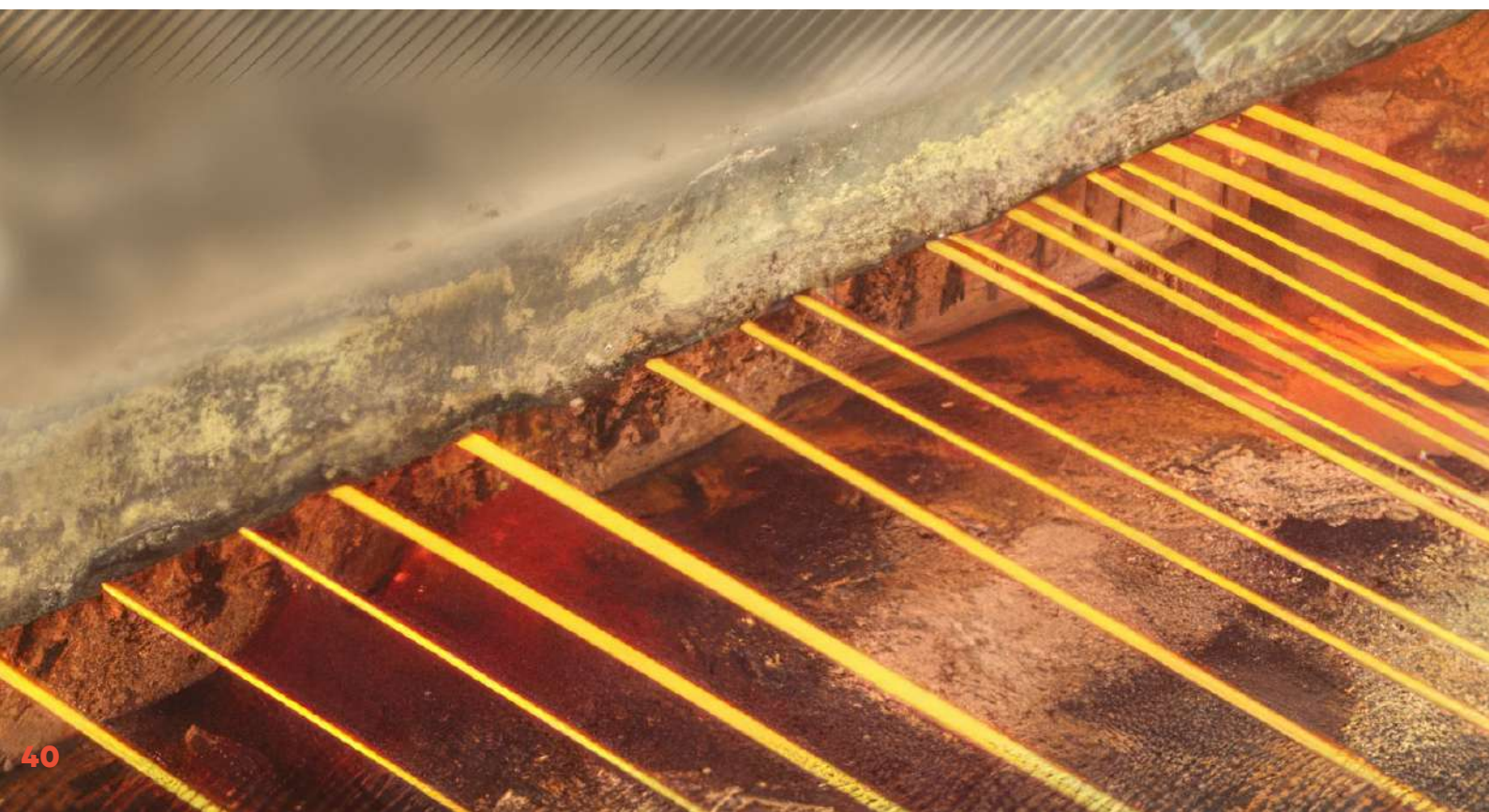
Rod is subjected to hot dip galvanization, during which a tight connection between zinc and steel is established, virtually alloying them in one unique entity and avoiding hydrogen embrittlement issues.

The quantity of zinc which has to be applied to wires is regulated by EN10264-2 – Steel wire and wire products – Non ferrous metallic coatings on steel wire – Zinc or zinc alloy coatings.

For ropes used in the oil and energy industry, the typical zinc thickness is approximately 20 to 25 microns, which complies to class B.

In some peculiar cases, galvanization can be replaced by zinc alloys processes, while bright ropes, which are still in use for some applications, have a very limited use in oil and energy field.

After coating, the rod is subjected to a drawing process, which consists of a number of passages through a series of tungsten carbide dies with gradual diameter reduction. During this process, the metallurgical structure of the rod changes from a very thin perlite pattern to well aligned fibers with high tenacity and strength.



ROTATIONAL PROPERTIES

Being composed by helically laid elements, each rope has the natural tendency to twist when subjected to axial loads.

The level of twist is dependent on the geometrical arrangement and can be reduced by compensating the core tendency to rotate in one direction with an opposite tendency of the outer layer, as typically applied to spin resistant and non rotating ropes.

The torsional stability is related to the torque factor, which is used in the calculations when both ends of the rope are fixed, and rotation factor (expressed in degrees/lay), which is used when one end is free to rotate.

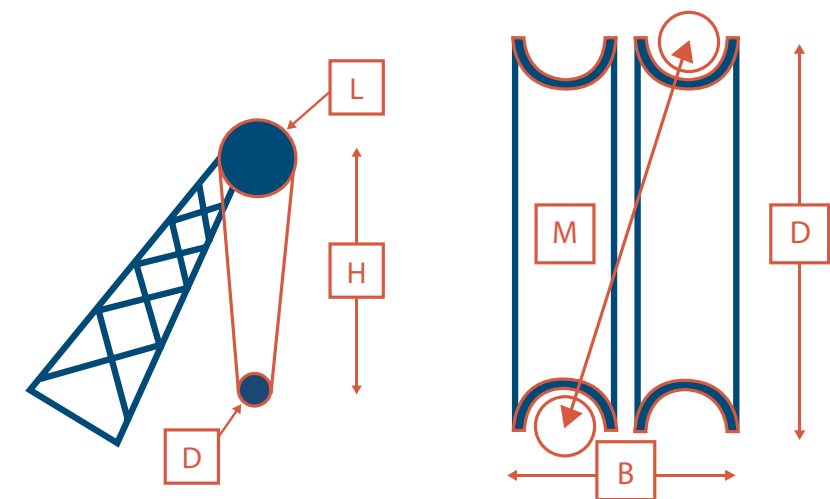
Both torque factor and rotation factor strongly decrease after rope stabilization and are negligible if the rope is always used at the same working load and lifting height.

In case of single fall lifting, non rotating ropes are typically recommended, while in case of multi-part reeving arrangement, the rope type shall be selected depending on the height of lift, block configuration and loading in order to avoid cabling issues.

It has to be noted that block stability depends on the geometry of the reeving and on the type of rope only and it is not affected by the rope tension.

Block stability verification can be carried out using the following formulas, where H is the lifting height, L is the distance at top, D is the distance at bottom, d is the nominal rope diameter and t is the torque factor. In case of number of falls higher than 2, the second formula can be used (see second sketch).

$$H = \frac{L \cdot D}{4 \cdot d \cdot t} \quad H = \frac{L \cdot M}{4 \cdot d \cdot t} \quad \text{where } M = \sqrt{(B^2 + D^2)}$$



TORSIONAL AND BENDING STIFFNESS

Torsional stiffness is related to the capability of the rope to resist torque: this will be low in case of 6 strand ropes, which will easily unlay when forced to rotate, while it will be high for non rotating ropes, which will oppose a much greater force.

The torsion induced by the system shall be kept under strict control, as these may cause permanent rope deformations, i.e. kink, birdcage, waviness and lead to premature discard.

When selecting a rope, it is essential to be aware of the maximum allowed turns which can be considered. As an example, Oceanmax 35 can typically withstand up to 8° /lay.

In any case, when torsions occur, it is always essential not to concentrate them in a single rope portion, but spread them over the longest possible length. This can be made, for example, by moving the hook during operations causing torque generation (e.g. mast crane slewing).

Bending stiffness is related to the capability of the rope to be put in a U shape or in a loop with a certain load or unloaded and without getting permanent deformation.

Although heavily compacted, Oceanmax ropes require a relatively low tension to be bent in a loop and can withstand very small loop diameters with no permanent deformation, as the gap between the strands is accurately set.

Bending stiffness is also relevant when a rope has to be wound on a relatively small reel for transportation: in case of Oceanmax35, the typical drum to rope ratio is 16.

The bending force to bend an Oceanmax35 rope over a certain D/d ratio can be calculated using the following empirical formula:

$$\text{Bending force [N]} = f \cdot d^2$$

where $f \text{ [N/mm}^2\text{]} = 10 \cdot (D/d)^{-1.6}$

D/d= bending ratio



LUBRICATION AND RELUBRICATION

Proper lubrication is essential to maintain rope performance in use, protect it against corrosion and preserve its service life.

To be effective, the lubricant shall have high adherence to steel in order to withstand the passage over the reeving system, light colour which will not obstruct the detection of possible rope damage and high compatibility with other products.

The lubricant drop point must be high enough to tolerate rope storage and operation in warm environment, but with a safety borderline that is sufficient to detect rope overheating during the use of special devices such as heave compensators in offshore applications, which can cause permanent deterioration to the rope steel. As steel deterioration starts at approximately 80°, the grease drop point shall be in a similar range.

Oceanmax ropes are generally equipped with VGP compliant grease, which does not create a film or sheens on water surface and which is not considered to be harmful towards the marine environment.

Upon customer request, it is also possible to apply biodegradable greases for enhanced environmental protection. In this case, the end user shall be made aware of the peculiarities of these products, in particular the different duration of the corrosion protection and the associated relubrication rate in service.

Lubricant is applied during different manufacturing phases: stranding, core closing and final closing.

When applied during stranding, the lubricant is firmly engaged between the individual wires and reduces internal friction. If applied during core closing it creates a barrier against external elements penetration and if applied during final closing it further increases protection against corrosion.

If insufficient lubricant is applied, the rope will not be adequately protected, however an excess of lubricant may be squeezed out of the rope during installation and use, thereby creating environmental and safety issues.

This has to be carefully considered in case of boom hoist ropes operating on offshore vessels, which run over reeving systems composed of a large number of sheaves.

As indicated at page 16 and 17, lubricant performance can be greatly improved by using Sealube technology.



END TERMINATIONS

TEMPORARY

BECKET LOOP



TAPERED



BOLTED EYE



CHINESE FINGER



Ropes can be equipped with different end terminations depending on customer requirements. Special sockets or connections can be supplied on demand.

Temporary end connections shall be used only for rewind-ing or installation, while permanent end connections can also be used for actual operations.

Permanent connections allow the Safe Working Load to be maintained and are characterized by a specific efficien-cy depending on the connection type, which varies from 100% for resin sockets to 80% for wedge sockets (see also EN13411).

When socketing is required, this shall be performed by trained personnel using proper procedures and equipment and following the applicable Regulations (e.g. EN12927, EN13411-4 and ISO17558) and internal procedures.

Temporary end connections shall not be used as lifting devices, as they are not designed to ensure Safe Working Load but only to allow the rope to be moved from the stor-age reel to another reel or to the winch drum.

In case pulling tension is applied to a “peeled off” core, the allowed value can be roughly estimated considering the square of ratio between core and rope diameter and the reduced efficiency due to dismantling and reassembling by manual operation. This efficiency could be assumed as 0.75, similarly to slings.

As an example, in case of 96mm rope with peeled off core of 47mm the resultant value is

$$\frac{d_{\text{core}}^2}{d_{\text{rope}}^2} \cdot 0.75 = \frac{47^2}{96^2} \cdot 0.75 = 18\% \text{ of the MBL of the rope}$$

PERMANENT

OPEN SPELTER SOCKET



CLOSED SPELTER SOCKET



CYLINDRICAL SOCKET



WEDGE SOCKET



PACKAGING, HANDLING AND STORAGE

As a default, Oceanmax ropes are wound on transportation steel reels capable to withstand a limited pay out tension, which is typically 3 times the reel diameter with double brakes (e.g. 1.5 meter reel can bear up to 4.5 tons).

In order to match customer’s spooling equipment and procedures, reels can be customized in terms of geometry, pins position and socket compartment and they can also have reinforced drums in case the rope shall be directly spooled on the winch with high installation tension.

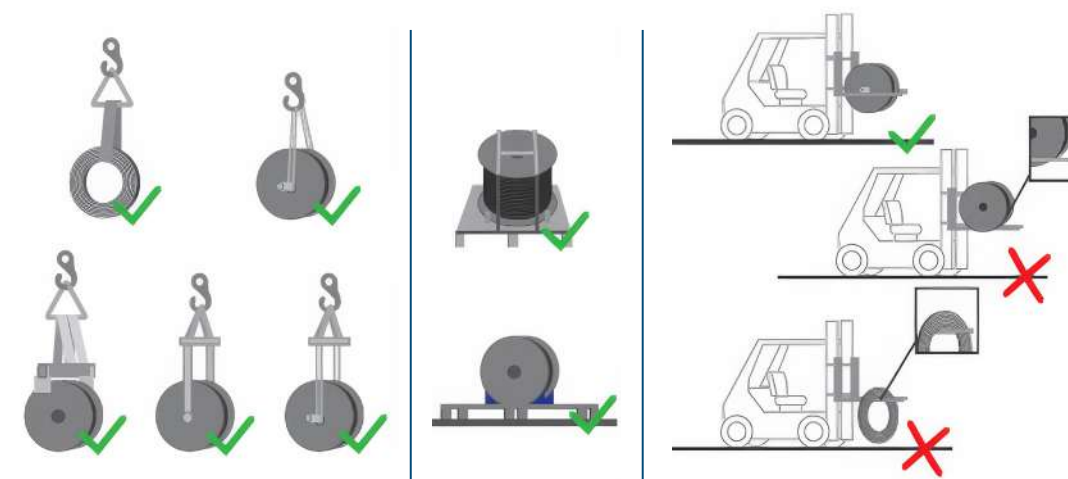
For long term or overseas transportation, the rope is wound with a protective layer and the reel is usually equipped with steel cradles to ensure proper contact with the ground or the transportation surfaces. The assembly is finally covered with tarpaulin for contamination protection.

Storage and transfer of empty reels after the installation of a large size rope is often challenging: for this reason, Oceanmax reels can also be provided in a demountable configuration. This special layout allows to disassemble the reel into its primary components, pack them in a very compact way and fit them into a container or in a reduced storage area.

After reel receipt, storage conditions are essential to prevent rope damage; it should be avoided to keep the rope in very warm or humid environment, as this could break down the effectiveness of native lubri-cation and accelerate the deterioration process.

The rope should not be stored in places which could be affected by chemical agents, corrosive matters or accidental damages; if stored outside, the reel should be positioned in order to avoid direct contact with the ground and covered with waterproof material.

During loading, transferring and unloading operations, rope reels or coils should be properly handled using slings or lifting beams (see drawing for typical recommendations).



INSTALLATION AND TRAINING



INSTALLATION

Rope installation and training shall be performed carefully and following the rope and winch manufacturer guidelines.

Before starting the installation phase, it is recommended to check the rope and the associated certificate, to inspect the equipment which will be used during this operation and also the components of the reeving (e.g. capstan, sheaves, rollers, drum) to confirm that they are correctly dimensioned and maintained.

The diameter of the rope shall be measured in a straight section following EN12385 instructions and the value should be recorded and used as a baseline for the following inspections.

The lay direction of the rope and of the messenger line shall be the same and the diameter shall be as similar as possible, otherwise birdcage and permanent damage will easily occur. This is valid for all the sizes and constructions.

During paying in, the rope should be prevented from running on the ground, it should not be subjected to high deflection angles and, in general, to induced rotations.

The first layer on the drum should be tight and smooth and it should be wound with a tension equal to 2% rope MBF or 10% rope SWL: this tension can be easily achieved for relatively small size ropes, while for large size ropes it is typical to wind the rope using the maximum available backtension and finalize this step afterwards.

It is important to clearly identify the safety wraps (usually, at least three) which shall never be used during operations. In case of plain drums, the first layer usually works as a bedding for the other layers; therefore, it should not be used and it should be clearly identified as well (e.g. by red paint).

TRAINING

Once rope installation is completed, it is essential to perform rope training to stabilize its structure, diameter, constructional stretch, torque and rotation factor.

The typical procedure consists of deploying the full rope length (excluding the safety wraps) with any available payload for at least three times: the own weight of the rope will automatically generate proper backtension.

If properly installed and trained, the rope will show tight wraps and uniform arrangement also in the cross-overzone and up to the last layers.

This will reduce the risk of crushing, cut-in and early formation of broken wires and, together with proper maintenance and inspection procedures, will maximize the service life.

This procedure can have some practical limitations, particularly in case of large size ropes with relevant length.

When these ropes are installed on systems composed by traction and storage winch, a simplified procedure can be adopted, as the installation is normally done through the traction winch, which automatically provides a sort of “training” given by the combination of tension, tension increase and bending.

This allows the rope to achieve an adequate structural stabilization and to reach the storage winch with a reasonably settled diameter. Moreover, since the rope tension between the storage winch and the traction winch is generally relatively low, the risk of cut in is limited.

The final stabilization of the rope can then be performed gradually during rope use, depending on the type of job which has to be performed.



ROPE INTERACTION WITH THE REEVING SYSTEM



In order to ensure smooth operational conditions and satisfactory rope performance, all the components of the reeving system shall be properly designed and located.

Some peculiarities of the reeving, like reverse bending, fleet angle, groove oversize and material, shall be carefully controlled, as they can significantly affect the rope's service life.

All the components shall be periodically checked during operations, as inadequate maintenance conditions (i.e. stuck or misaligned sheaves, worn grooves) can cause premature and fast rope failure.

Reverse bending can induce permanent rope damage, as the strands are stretched and compressed between adjacent sheaves and they are forced to modify their relative position.

If the reverse bending sheaves are too close, the strands do not have room enough to recover their right position, therefore the rope can be permanently damaged or suffer from early fatigue.

In case of full reverse bending, it is recommended to maintain a minimum distance between the adjacent sheaves equal to 100 times the rope diameter. This value can be mitigated in case of partial reverse bending.

Fleet angle can induce forced rotation and consequent permanent rope damages, like waviness and birdcage, and it shall be kept as low as possible, both during the initial installation and during the rope usage.

The typical maximum value for extensive usage is 2°, which can be increased up to 4° in case of plastic impregnated core ropes. Higher values might be accepted for limited rate of utilization and tension.



Grooves diameter and oversize should be designed to consider the rope diameter and the possible effect of fleet angle: the base value with no fleet angle is 1.06 times the nominal rope diameter, while the most typical value is 1.08d. In case of relevant fleet angle (up to 4°), it is recommended to increase the oversize up to 1.1d to allow the rope to properly sit in the groove.

In order to maintain a smooth contact surface, the rope should be in touch with the sheave for at least 1.5 times its lay length, which corresponds approximately to 60° winding angle for a sheave having a bending ratio of 20.

In case of very small winding values, the stress induced in the rope is not very relevant, while in the intermediate range, from 10° to 45°, significant damage can occur, especially if the component is located in the high tension side of the reeving.

In case of rollers or sheaves with reduced bending ratio (up to 10 D/d), it is recommended to adopt a minimum bending ratio equal to the winding angle (e.g. 2 D/d minimum in case of 2° winding angle).

Rope bending over sheaves generates certain pressure, which shall be considered when selecting the material of the sheaves: steel sheaves should be hardened to achieve approximately 300 HB hardness, while synthetic sheaves should have a yield point higher than the working pressure.

The nominal average pressure can be calculated using the following formula.

$$P = \frac{2T}{Dd}$$

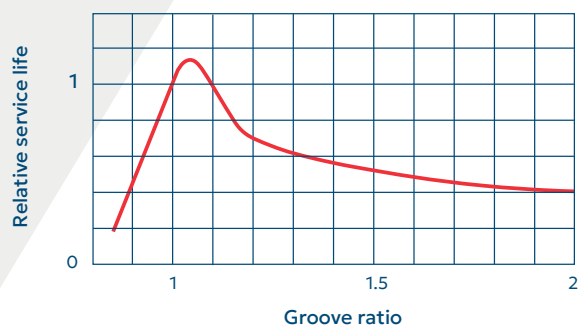
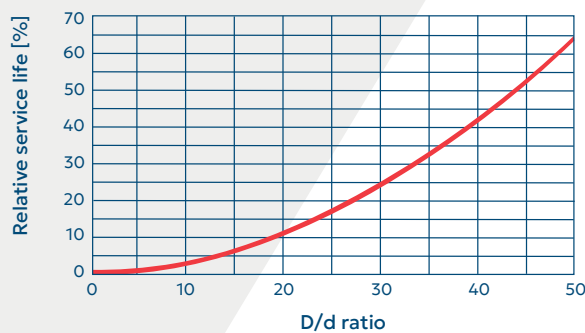
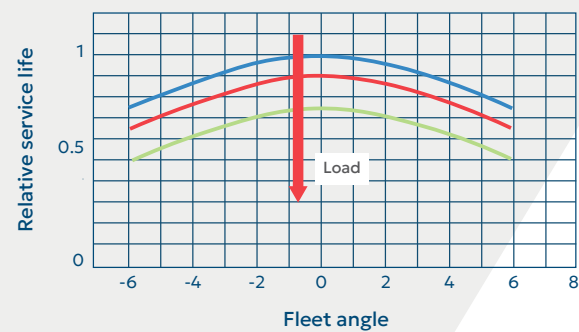
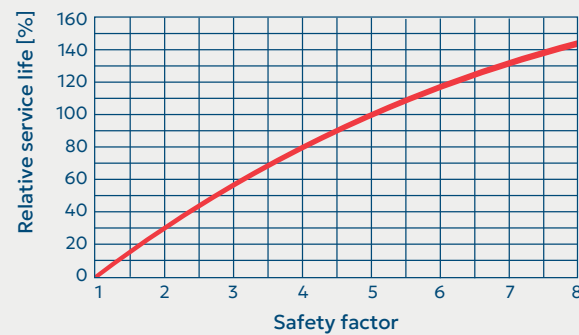
P = pressure [N/mm²]

T = rope tension [N]

D = diameter of sheave or drum [mm]

d = diameter of rope [mm]

BENDING FATIGUE



Fatigue damage is caused by repeated bending, tension and rotational stresses: since the working life of wire ropes generally involves several passages over drum and sheaves, this damage has to be carefully considered during operations.

Fatigue damage occurs gradually and becomes evident when it reaches a point where it has caused a remarkable number of broken wires and consequent wire elongation, which quickly evolves until the rope reaches the discard criteria.

Being an inherent phenomenon, it can only be mitigated by working on the rope and on the system.

From a rope perspective, the most effective tool is a careful raw material selection, avoiding the usage of extra high strength wires.

From a system perspective, the most typical items are safety factor, bending ratio, fleet angle and groove ratio. The theoretical relative service life associated to each parameter is shown in the following graphs.

GUIDELINES FOR ROPE INSPECTION

Wire ropes shall be periodically inspected by a competent person to assess possible deterioration due to regular use or unexpected events and to ensure that safe working conditions are maintained.

Each rope shall be inspected along its entire length or, at the discretion of the competent person, along the working length plus at least five wraps on the drum. In this case, if a greater working length is subsequently foreseen to be used, that additional portion should also be inspected.

The frequency of inspections depends on regulations (e.g. ISO4309), type of crane and environment, results of previous examinations, load spectrum and experience related to similar ropes and systems.

The main modes of deterioration are: broken wires or strands, decrease in rope diameter, corrosion, deformation, mechanical or heat damage and change in elastic behavior of rope under load.

The following areas have to be inspected with particular care:

- drum anchorage and any section near the rope termination;
- in case of repetitive operations, any part of the rope that lies over a sheave during crane working;
- rope portion which lies over a compensating sheave;
- cross-over zones on multilayer drums;
- rope sections subjected to reverse bending over sheaves or rollers;
- section subjected to external damage, like abrasion or heat.

Terminations, clamps and securing ferrules should be also inspected with special care to detect possible looseness due to vibrations, cracks, distortion, wear or corrosion.

After each periodic inspection, the competent person shall provide a rope inspection record and state a maximum time interval that shall not be exceeded before the following inspection takes place.

DISCARD CRITERIA OVERVIEW

Discard criteria for visible broken wires depend on their nature, occurrence, location and on the rope construction.

The maximum allowed number takes into account the breaks due to regular use only, that indicate fatigue piling up and approaching of the end of rope safe life, while breaks due to improper handling may not be considered in this count if not affecting safety conditions.

Breaks protruding from the rope can be removed if there is the risk that they generate further damage to the equipment or to the rope itself.

If groups of broken wires are found in a section of rope which does not spool on and off the drum and if breaks are concentrated in adjacent strands, it might be necessary to discard the rope.

It shall be discarded as well if two or more wire breaks are found at a termination or concentrated in the valleys in a rope lay length, as this could indicate the beginning of fatigue phenomenon.

If breaks occur randomly in rope sections running through sheaves, spooled on and off a single layer drum or on cross-overpoints of a multilayer drum, the maximum amount is determined by specific regulations (e.g. ISO 4309). Some examples of maximum allowed breaks for Oceanmax ropes are shown on page 34.

The number of allowed breaks derives from correlation between fatigue progression, associated loss of metallic area and subsequent reduction of the rope breaking force, as well as on the assumption that outer wire breaks correspond to a certain number of inner wire breaks.

Typically, the number of inner broken wires due to use of a Lang lay rope is higher than the number of outer broken wires, therefore damage detection is harder and the number of outer allowed breaks is lower.

On the other hand, in ordinary lay ropes more breaks occur on the outer surface, therefore they are more detectable and the allowed number is higher than the Lang lay value.

For non rotating ropes this difference is not remarkable due to their geometrical structure, therefore there is no distinction due to lay direction.

Breaks distribution along the rope can indicate early stage fatigue, therefore the number of broken wires over a significant length (e.g. 30d) is not proportional to the number of localized broken wires in a specific portion (e.g. 6d), which could be due to other causes to be specifically investigated.

Diameter shall be periodically measured and compared to the initial reference value (i.e. recorded measurement taken immediately after receipt) to detect uniform or localized variations.

In case of uniform decrease, the maximum allowed value is 5% in respect to nominal diameter for non rotating ropes, 7.5% for other rope constructions with steel core, 10% for fiber core ropes.

A clear localized decrease indicates a severe failure of rope core and leads to immediate rope discard.

Also in case of the break of a complete strand, rope has to be immediately discarded.

Ropes showing deformations like basket, core or strand protrusion or distortion, kink or tightened loop shall be evaluated and can remain in service if the damaged portion can be removed and if the remaining part of rope is still suitable for use.

Other damages, like flattened portion or permanent bend, may not be cause of immediate discard, but they have to be inspected with higher frequency, as the affected portions are likely to deteriorate and show broken wires at faster rate than usual.

Waviness should be assessed using a straight bar and considering the gap between the rope and the cut surface: the maximum allowed gap is 1/3 the rope nominal diameter if the deformation affects a portion not running over sheaves or spooled on the drum, otherwise it has to be reduced to 1/10.

Corrosion should be evaluated after having wiped the rope to remove contaminating particles and should be assessed considering type and severity.

The rope should be discarded in case of heavy pitting and slack wires on the external surface, as well as in case of internal corrosion, indicated by the presence of debris extruding between the outer strands.

The rope should also be discarded in case of severe fretting corrosion, which manifests as a dry red powder and is caused by the continuous rubbing between dry wires and consequent particles oxidation.

ROPE DEFINITIONS

BREAKING FORCE

■ MINIMUM BREAKING FORCE (F_{min})

Specified value in kN, below which the measured breaking force (F_m) is not allowed to fall in a prescribed breaking force test and normally obtained by calculation from the product of the square of the nominal diameter (d), the rope grade (R_r) and the breaking force factor (K).

■ MINIMUM 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 (f) for the rope class or construction, spinning loss factor (k) for the rope class or construction and the constant $\pi/4$.

■ CALCULATED MINIMUM BREAKING FORCE ($F_{c.min}$)

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.

■ MINIMUM AGGREGATE BREAKING FORCE ($F_{e.min}$)

Specified value, in kN, below which the measured aggregate breaking force is not allowed to fall in a prescribed test and normally obtained by calculation from the product of the square of the rope diameter (d), the metallic cross sectional area factor (C) and the rope grade (R_r).

■ MEASURED AGGREGATE BREAKING FORCE ($F_{e.m}$)

The sum of the measured breaking forces of all the individual wires taken from the rope.

■ SPINNING LOSS FACTOR (k)

The ratio between either the calculated minimum aggregate breaking force ($F_{e.c.min}$) and the calculated minimum breaking force ($F_{c.min}$) of the rope or the specified minimum aggregate breaking force ($F_{e.min}$) and the specified minimum breaking force (F_{min}) of the rope, as determined from the ropemaker's design.

■ MEASURED TOTAL SPINNING LOSS FACTOR (k_m)

The ratio between the measured breaking force (F_m) of the rope and the measured aggregate breaking force of the rope, before rope making.

■ FINISH AND QUALITY OF COATING

The condition of the surface finish of the wire e.g. uncoated (bright), zinc coated, zinc alloy coated or other protective coating and the class of coating, e.g. class B zinc coating, defined by the minimum mass of coating and the adherence of the coating to the steel below.

■ MASS OF COATING:

The mass of coating (obtained by a prescribed method) per unit of surface area of the uncoated wire, expressed in g/m^2 .

■ CORE

Central element of a round rope around which are laid helically the strands of a stranded rope or the unit ropes of a cable laid rope.

■ FIBRE CORE (FC)

Core made from either natural fibres (NFC) or synthetic fibres (SFC) (Note - Fibre cores are normally produced in the sequence fibres to yarns, yarns to strands and strands to rope).

■ STEEL CORE (WC)

Core made from steel wires arranged as a wire strand (WSC) or as an independent wire rope (IWRC) (Note The steel core and/or its outer strands can also be covered with either fibre or solid polymer).

■ SOLID POLYMER CORE (SPC)

Core consisting of a solid polymer material having a round shape or a round shape with grooves. It may also contain an internal element of wire(s) or fibre.

COATING

CORE

CROSS-SECTIONAL AREA AND MASS

■ FILL FACTOR (f)

The ratio between the sum of the nominal metallic cross-sectional areas of all the wires in the rope and the circumscribed area of the rope based on its nominal diameter.

■ NOMINAL METALLIC CROSS-SECTIONAL AREA FACTOR (C)

Factor derived from fill factor and used in the calculation to determine the nominal metallic cross-sectional area of a rope (Note - This can be expressed as $C = f \pi/4$).

■ NOMINAL METALLIC CROSS-SECTIONAL AREA (A)

The product of the nominal metallic cross-sectional area factor (C) and the square of the nominal rope diameter.

■ ROPE LENGTH MASS FACTOR (W)

That factor which takes into account the mass of core and lubricant as well as the metallic elements.

■ NOMINAL ROPE LENGTH MASS (M)

Product of the length mass factor and the square of the nominal diameter.

DIMENSIONS

■ DIMENSION OF ROUND WIRE OR STRAND

The diameter of the perpendicular cross-section of the wire or strand.

■ DIMENSION OF ROUND ROPE

That diameter which circumscribes the rope cross-section.

■ OUTER WIRE FACTOR (A)

Factor used in the calculation of the approximate diameter of the outer wires of the outer strand layer.

■ OUTER WIRE DIAMETER (δA)

The value derived from the product of the outer wire factor and the nominal rope diameter.

GRADE AND STRENGTH

■ ROPE GRADE (R_r)

A level of requirement of breaking force which is designated by a number (e.g. 1770, 1960) (Note - It does not imply that the actual tensile strength grades of the wires in the rope are necessarily of this grade).

■ WIRE TENSILE STRENGTH GRADE (R)

A level of requirement of tensile strength of a wire and its corresponding 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, expressed in N/mm^2 .

■ WIRE TENSILE STRENGTH (R_m)

The ratio between the maximum force obtained in a tensile test and the nominal cross-sectional area of the test piece, expressed in N/mm^2 .

LAY

■ LAY LENGTH (h)

That distance (h) parallel to the longitudinal rope axis in which the outer wires of a spiral rope, the outer strands of a stranded rope or the unit ropes of a cable-laid rope make one complete turn (or helix) about the axis of the rope.

■ LAY DIRECTION OF ROPE

The direction right (Z) or left (S) corresponding to the direction of the outer strands in a stranded rope in relation to the longitudinal axis of the rope.

■ ORDINARY LAY (sZ OR zS)

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 (Note - The first letter denotes strand direction; the second letter denotes rope direction).

■ LANG LAY (zZ OR sS)

Stranded rope in which the lay direction of the wires in the outer strands is in the same lay direction as that of the outer strands in the rope (Note - The first letter denotes strand direction; the second letter denotes rope direction).

ROPE DEFINITIONS

■ ROPE CONSTRUCTION

The detail and arrangement of the various elements of the rope.

■ ROPE CLASS

A grouping of ropes of similar mechanical properties and physical characteristics.

■ STRANDED ROPE

an assembly of several strands laid helically in one or more layers around a core (single-layer rope) or centre (rotation-resistant or parallel-closed rope) (Note - Stranded ropes consisting of three or four outer strands can, or cannot, have a core).

■ SINGLE-LAYER ROPE

Stranded rope consisting of one layer of strands laid helically around a core.

■ ROTATION-RESISTANT ROPE

stranded rope designed to generate reduced levels of torque and rotation when loaded (Note - Rotation-resistant ropes generally comprise an assembly of at least two layers of strands laid helically around a centre, the direction of lay of the outer strands being opposite to that of the underlying layer. Ropes having three or four strands can also be designed to exhibit rotational-resistant properties).

■ PARALLEL-CLOSED ROPE

stranded rope consisting of at least two layers of strands laid helically in one closing operation around a strand or fibre centre.

■ COMPACTED STRAND ROPE

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

■ COMPACTED (SWAGED) ROPE

Rope which is subjected to a compacting (usually swaging) process after closing the rope, thus reducing its diameter.

■ CABLE-LAID ROPE

An assembly of several (usually six) round stranded ropes (referred to as unit ropes) closed helically around a core (usually a seventh rope).

■ TORQUE

Torsional characteristic, the value of which is usually expressed in Nm, at a stated tensile loading and determined by test when both rope ends are prevented from rotating (Note - Torsional characteristics can also be determined by calculation).

■ TURN

Rotational characteristic, the value of which is usually expressed in degrees or turns per unit length at a stated tensile loading and determined by test when one end of the rope is free to rotate.

■ FULLY PREFORMED ROPE

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

■ STRAND

An element of rope 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 strands (e.g. ribbon) cannot have a centre).

■ 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 whereas the shape of the wires and the dimensions of the strand are modified.

■ SEALE

Parallel lay strand construction with the same number of wires in both layers.

■ WARRINGTON

Parallel lay strand construction having an outer layer containing alternately large and small wires and twice the number of wires as the inner layer.

■ FILLER

Parallel lay strand construction having an outer layer containing twice the number of wires than the inner layer, with filler wires laid in the interstices between the layers.

■ OUTER WIRES

All wires positioned in the outer layer of 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 in a stranded rope.

■ FILLER WIRES

Wires used in filler constructions to fill up the interstices between wire layers.

■ CENTRE WIRES

Wires positioned either at the centre of a spiral rope or the centres of strands of a stranded rope.

■ CORE WIRES

All wires of the core of a stranded rope.

■ LOAD-BEARING WIRES

Those wires in a rope which are regarded as contributing towards the breaking force of the rope.

■ SERVING WIRE OR STRAND

Single wire or strand used for making a close-wound helical serving to retain the elements of a rope in their assembled position.

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