



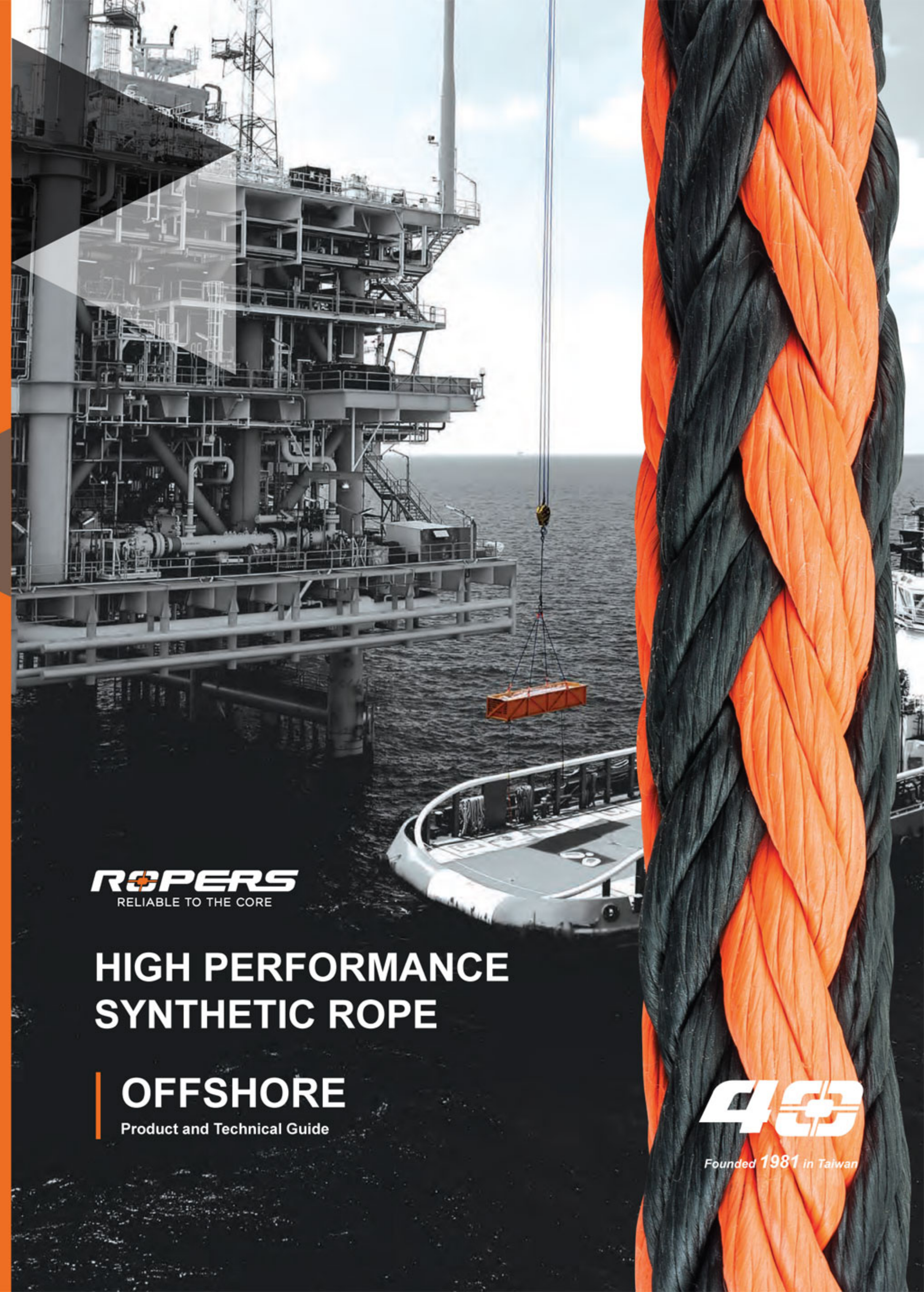
ROPERS
RELIABLE TO THE CORE

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ROPERS
RELIABLE TO THE CORE

HIGH PERFORMANCE SYNTHETIC ROPE

OFFSHORE

Product and Technical Guide

43

Founded 1981 in Taiwan



Company Introduction

- Founded in 1981 in Taiwan
- Manufacturing in Kaohsiung & Xiamen
- Meet the ISO 9001 Standards
- Certified by ABS, DNV, CE, Lloyd's and others
- Working with customers to better understand the problems encountered in critical applications
- Partnering with fiber and coating suppliers to determine how best to exploit their achievements in developing new products to overcome traditional limitations



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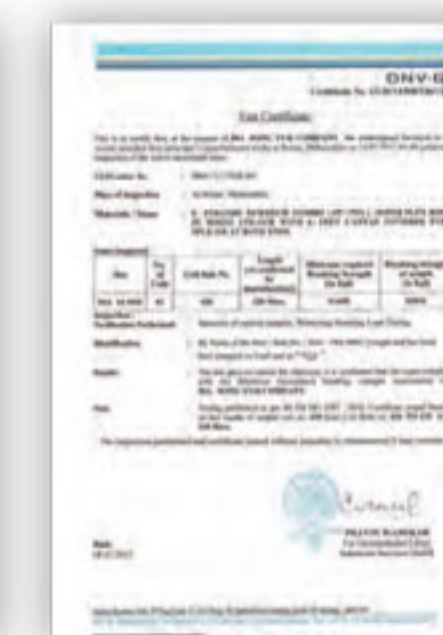
ISO



ISO



CERTIFICATE OF LIABILITY INSURANCE



Factory Certificate



Research & Development Capability



- **Industry leading R&D team**
 - Active project cooperation with universities and institutes
 - Self-developed specialty coatings
- **Advanced testing equipment**
 - Tensile testers up to 400 MT capacity
 - Abrasion testers - wet & dry (up to 10 MT tension)
 - CBOS tester
 - Winch strength tester

Manufacturing Capability

- **All types of rope constructions**
 - Single braid 12 strand, 8 strand, double braid, jacketed rope (24s, 32s, 48s), and 3D braiding
- **Experience with all types of fiber**
 - Nylon, Polyester, Polypropylene, HMPE, LCP, Aramid, and PBO fiber
- **Long length availability** (specified splicing technology - zero strength reduction)
- **Microwave drying process** - super uniformity
- **Fabrication capabilities**



High-Performance Synthetic Rope Offshore Line Advantages

Virtually weightless in seawater → smaller equipment footprint on crowded decks and lighter overall equipment loads. Easy to handle, inspect, repair, and safer operations. Anti-corrosion.



Comparison of Weight and Diameter at the Same Strength

Product	Diameter (mm)	Weight (kg/100m)	MBS (T)
HMPE	40	97	124
Aramid	48	211	126
Nylon double braid	72	321	124
Polyester	66	311	124
Steel 6X36WS	40	771	124

With the same breaking strength, HMPE rope has the lowest weight among all offshore lines, and comparable size to steel rope.

Synthetic Fiber Comparison & Selection

Abrasion Resistance

HMPE > Polyester > LCP > Aramid

Application:

Dynamic

Dynamic

Semi-Dynamic

Static

Creep Life

Aramid > DM20 > Low Creep HMPE > Regular HMPE

Application:

Continued Tension

Continued Tension

Continued Tension

Intermittent tension

Heat Resistance

Aramid > LCP > HMPE

Critical Temperature:

520°F / 271°C

300°F / 149°C

150°F / 66°C

Specific Gravity (g/cm³)

(Float)

HMPE (0.98) > Polypropylene (0.91)

(Sink)

LCP (1.4) > Aramid (1.39) > Polyester (1.38) > Nylon (1.14)

Water Level



Deep Water Mooring



Vessel Mooring & Tugging



Lifting Sling



Seismic



Deep Water Installation

We work with you on SOLUTION not just rope.

“

- Specialty products designed for the offshore oil, gas, and wind energy exploration.
- On-site technical training and support on installation, splicing, inspection, repair, and retirement.
- Accurate and reliable specifications based on internal and independent testing.

”

Offshore Products

	Lifting Sling	Vessel Mooring	Tugging	Seismic	Semi-Permanent Mooring	Permanent Mooring	Deep Water Installation	Construction	Fiber (core/cover)
AlphaSteel® - 12	✓	✓	✓				✓	12S	HMPE
AlphaSteel® - 8		✓	✓				✓	8S	HMPE
OmegaSteel® I		✓	✓					CD*	HMPE/PET
OmegaSteel® II		✓	✓					CD	HMPE
Polaris® - 12							✓	12S	High Performance Fibers Combination
Optima® - 12				✓	✓			12S	Low Creep HMPE
Optima® - X20				✓	✓	✓		12S	Super Low Creep HMPE
Optima® - Ar				✓	✓	✓		12S	Aramid

*CD: core dependent

AlphaSteel® Offshore Lifting Sling

Features

- Different color yarns used for outside and inner layers – indicator of critical abrasion damage.
- Specialty coating – to improve internal and external abrasion resistance, extend usage life from lab test and field trial.
- Torque – free & anti – twist pattern (4% strength reduction with every 1 twist)
 - Convenient inspection – single braid.
 - 100% dyed yarn – Permanent color fastness.

AlphaSteel® -12 Single-Leg Sling

If $D/d \geq 25:1$, please refer to table 1. Otherwise, please multiply the retained strength factor (E) in table 2.

d = rope diameter D = smallest diameter in loaded contact with the sling

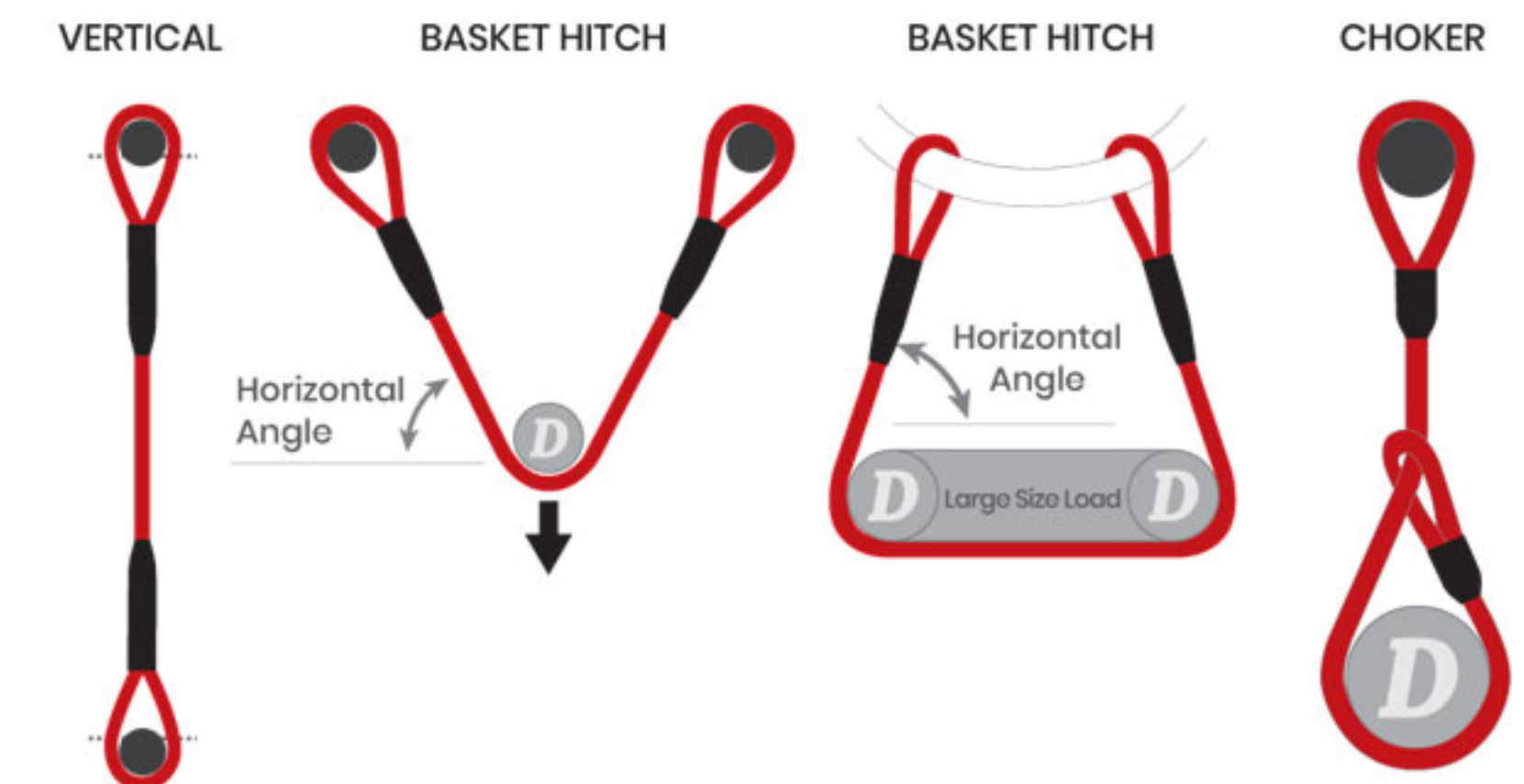


Table 1: AlphaSteel® -12 Single-Leg Sling Configuration

Diameter	Minimum Strength	Vertical (SF=5:1)		Basket Hitch (SF* =5:1)								Choker (SF=5:1)	
		WLL		$\geq 90^\circ$ (WLL x 2)		60° (WLL x 1.7)		45° (WLL x 1.4)		30° (WLL x 1)		WLL x 0.7	
(inch)	(mm)	(MT)	(lb)	(MT)	(lb)	(MT)	(lb)	(MT)	(lb)	(MT)	(lb)	(MT)	(lb)
2 1/16	50	177	389,455	35.3	77,891	70.7	155,782	61.2	134,911	50.0	110,155	35.3	77,891
2 1/8	52	192	423,321	38.4	84,664	76.8	169,328	66.5	146,643	54.3	119,733	38.4	84,664
2 1/4	56	214	471,865	42.8	94,373	85.6	188,746	74.1	163,459	60.5	133,463	42.8	94,373
2 1/2	60	250	551,062	50.0	110,212	100	220,425	86.6	190,894	70.7	155,864	50.0	110,212
2 5/8	64	291	640,769	58.1	128,154	116	256,308	101	221,969	82.2	181,237	58.1	128,154
2 3/4	68	309	681,295	61.8	136,259	124	272,518	107	236,008	87.4	192,699	61.8	136,259
3	72	343	756,602	68.6	151,320	137	302,641	119	262,094	97.1	213,999	68.6	151,320
3 1/8	76	347	764,189	69.3	152,838	139	305,676	120	264,723	98.0	216,145	69.3	152,838
3 1/4	80	400	881,458	80.0	176,292	160	352,583	139	305,346	113	249,314	80.0	176,292

*SF= SF: safety factor

Table 2: Single-Leg Sling Retained Strength Factor

D/d	20	10	5	2	1
E	95%	85%	75%	60%	50%

AlphaSteel® Offshore Lifting Sling

AlphaSteel® - 12
AlphaSteel® - 8

100% HMPE Single Braid –
a direct replacement for wire ropes
proven to reduce lifting assist and costs.

AlphaSteel® -12
50mm actual size

AlphaSteel® - 8
50mm actual size

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AlphaSteel® Offshore Lifting Sling

AlphaSteel® -12 Grommet Sling

If $D/d \geq 25:1$, please refer to table 3. Otherwise, please multiply the retained strength factor (E) in table 4.

d = rope diameter D = smallest diameter in loaded contact with the sling

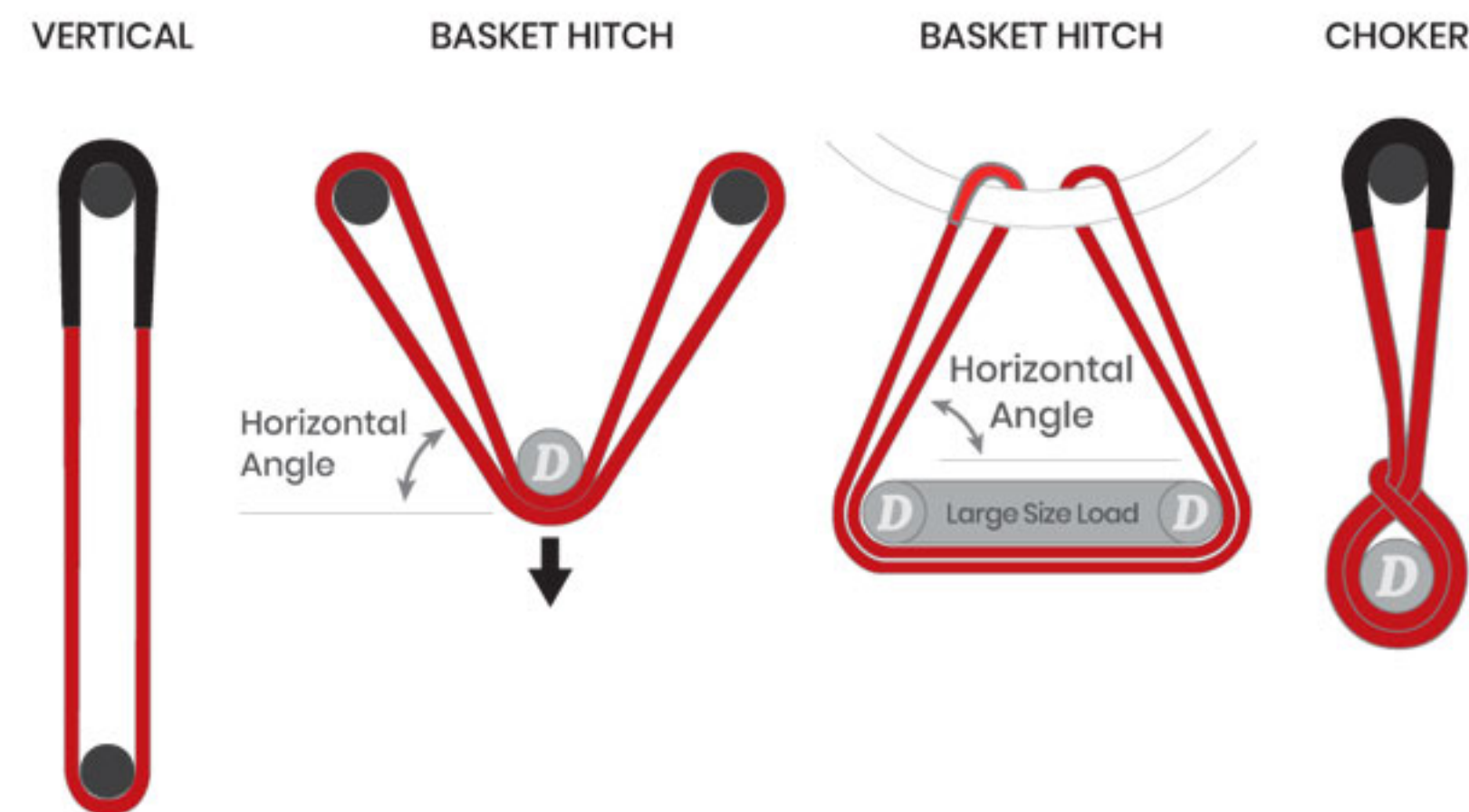


Table 3: AlphaSteel® -12 Grommet Sling Configuration

Diameter		Minimum Strength		Vertical (SF=5:1)		Basket Hitch (SF=5:1)								Choker (SF=5:1)	
				WLL		$\geq 90^\circ$ (WLL x 2)		60° (WLL x 1.7)		45° (WLL x 1.4)		30° (WLL x 1)		WLL x 0.7	
(inch)	(mm)	(MT)	(lb)	(MT)	(lb)	(MT)	(lb)	(MT)	(lb)	(MT)	(lb)	(MT)	(lb)	(MT)	(lb)
2 1/16	50	282.6	623,128	56.5	124,626	113	249,251	98	215,858	79.9	176,247	56.5	124,626	39.6	87,238
2 1/8	52	307.2	677,313	61.4	135,463	123	270,925	106	234,628	86.9	191,573	61.4	135,463	43.0	94,824
2 1/4	56	342.5	754,983	68.5	150,997	137	301,993	119	261,534	96.9	213,542	68.5	150,997	47.9	105,698
2 1/2	60	399.9	881,700	80.0	176,340	160	352,680	139	305,430	113.1	249,382	80.0	176,340	56.0	123,438
2 5/8	64	465.0	1,025,230	93.0	205,046	186	410,092	161	355,150	131.5	289,979	93.0	205,046	65.1	143,532
2 3/4	68	494.4	1,090,072	98.9	218,014	198	436,029	171	377,612	139.9	308,319	98.9	218,014	69.2	152,610
3	72	549.1	1,210,562	109.8	242,112	220	484,225	190	419,351	155.3	342,399	109.8	242,112	76.9	169,479
3 1/8	76	554.6	1,222,703	110.9	244,541	222	489,081	192	423,557	156.9	345,833	110.9	244,541	77.6	171,178
3 1/4	80	639.7	1,410,333	127.9	282,067	256	564,133	222	488,554	181	398,903	127.9	282,067	89.6	197,447

SF= SF: safety factor

Table 4: Table 4: Grommet Retained Strength Factor

D/d	5	2	1
E	94%	75%	63%

OmegaSteel® Vessel Mooring & Tugging

OmegaSteel® I HMPE Core / PET Jacket

OmegaSteel® II HMPE Core / HMPE Jacket

Core-Dependent Jacket Rope –
Additional surface protection along the whole rope, though about 15% less strength than 12s single braid rope of the same size, and not convenient for internal inspection.

OmegaSteel®

OmegaSteel® I HMPE Core / PET Jacket

OmegaSteel® II HMPE Core / HMPE Jacket

Features

- Firm as wire – super cut and abrasion resistance
- Specialty coating for both core and cover
- The same strength for both products: core dependent (strength only provided by the HMPE core)
 - HMPE jacket: better abrasion resistance
 - PET jacket: less cost option

OmegaSteel® I
24mm actual size

OmegaSteel® II
24mm actual size

Super Armor®

Super Armor® Chafe Guard

Features

- Unique fiber and construction design
 - Minimize abrasion damage against the main rope inside
 - Fixed on rough surfaces, not moving with the main rope
- Specialty coating
- HMPE or PET options



Selection of Super Armor®

Model	Fits Rope Dia	Covers Splice Dia
Size-S	24-44 mm	18-24 mm
Size-M	45-56 mm	28-34 mm
Size-L	57-80 mm	36-44 mm

Abrasion (external & internal):

the biggest culprits of mooring line and tug line destruction.

Example:
external abrasion against chock, roller, or other rough surface.
Internal fiber-to-fiber abrasion also exist due to shearing.



Abrasion external

Abrasion internal

Suggestion

- Repair all rope contact point to a smooth surface.
- To use AlphaSteel® + Super Armor® Guard
- To use OmegaSteel® Jacketed Rope

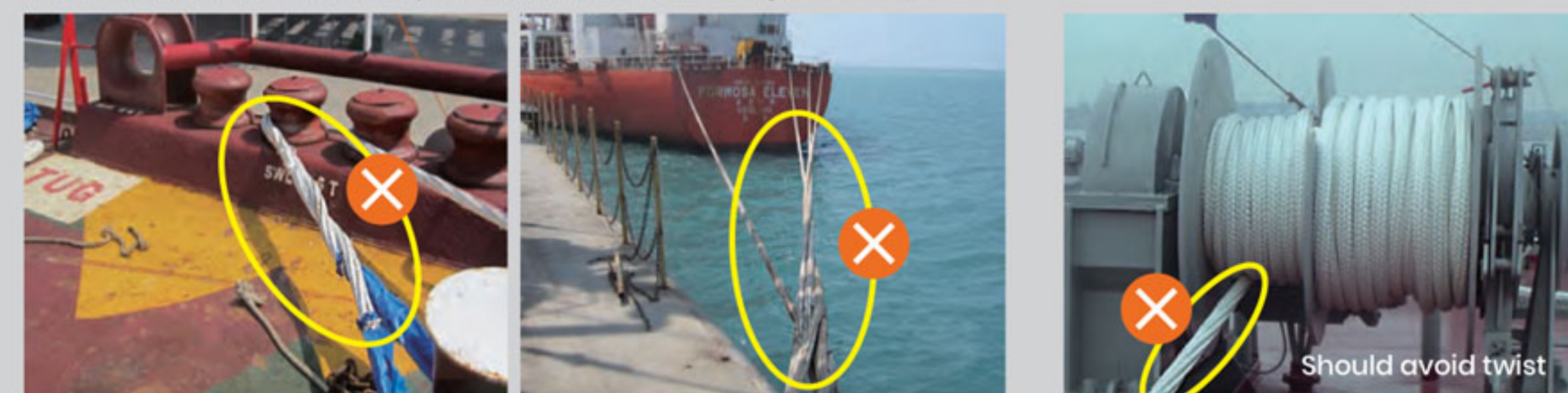


Other Important Factors:

A. Make sure rope come out of winch from the bottom, not the top, to avoid hurting operators in accident.



B. Twist is often overlooked (every 1 twist would cause 4% strength reduction)



C. Installation – need closely packed to minimize gap where the outside layer rope may "dive" into the dinner layer.

D. Leave 8-10 wraps, but never exceed one layer on the tension side of split-drum.

Vessel Mooring & Tug Line Selection

Jacketed

Advantages

- Core is completely protected
- Firm, round profile

Disadvantages

- Impossible to inspect the core (strength member)
- Difficult to repair or splice

Single braid

Advantages

- Higher strength
- Easy to inspect, repair, and splice

Disadvantages

- Need proper handling to avoid accidental

Jacketed

OmegaSteel® II
24mm actual size

Single braid

AlphaSteel® - 12
80mm actual size

Diameter (mm)		OmegaSteel® Jacketed Rope						AlphaSteel® -12 Single Braid					
		Average Strength		Minimum Strength		Weight		Average Strength		Minimum Strength		Weight	
(inch)	(mm)	(MT)	(lb)	(MT)	(lb)	(kg/100m)	(lb/100ft)	(MT)	(lb)	(MT)	(lb)	(kg/100m)	(lb/100ft)
1	24	41.5	91,488	37.3	82,340	37.9	25.5	49.7	109,625	44.8	98,662	32.4	21.8
1 1/4	30	71.7	158,142	64.6	142,328	59.5	40.0	75.8	167,195	68.3	150,475	53.9	36.2
1 1/2	36	96.3	212,365	86.7	191,128	88.5	59.5	101	223,699	91.3	201,329	76.9	51.7
1 5/8	40	113	249,396	102	224,457	99.7	67.0	131	289,833	118	260,850	97.0	65.2
1 3/4	44	130	287,071	117	258,364	127	85.3	165	364,074	149	327,667	117	78.6
2	48	160	352,817	144	317,536	147	98.8	177	390,406	159	351,365	129	86.7
2 1/8	52	183	402,780	164	362,502	164	110	213	470,357	192	423,321	162	109
2 1/4	56	204	449,081	183	404,173	187	126	238	524,294	214	471,865	173	116
2 1/2	60	256	563,712	230	507,341	232	156	278	612,291	250	551,062	220	148
2 5/8	64	269	592,300	242	533,070	247	166	323	711,965	291	640,769	248	167
2 3/4	68	277	611,417	250	550,275	275	185	343	756,995	309	681,295	278	187
3	72	321	708,673	289	637,806	324	218	381	840,668	343	756,602	307	206
3 1/4	80	359	791,513	323	712,362	308	207	444	979,398	400	881,458	357	240

Optima® Low Creep Options

Optima® - 12

100% modified low creep HMPE to meet MODU semi-permanent mooring requirement of <10% elongation in 5 years continuous loads.

Optima® - X20

100% modified super low creep HMPE to meet permanent mooring requirement of <0.5% elongation in 25 years continuous loads.

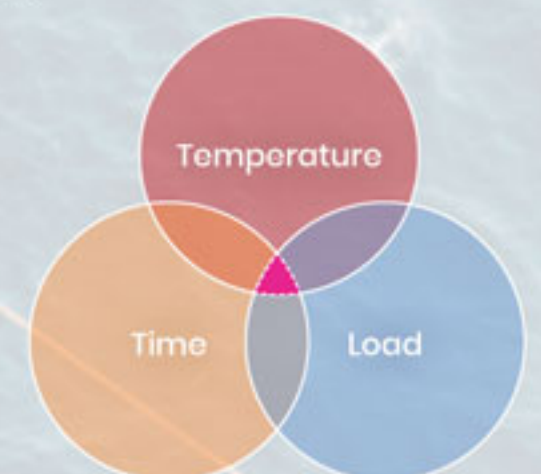
Optima® - Ar

100% aramid fiber rope -
Another Option for Low Creep.

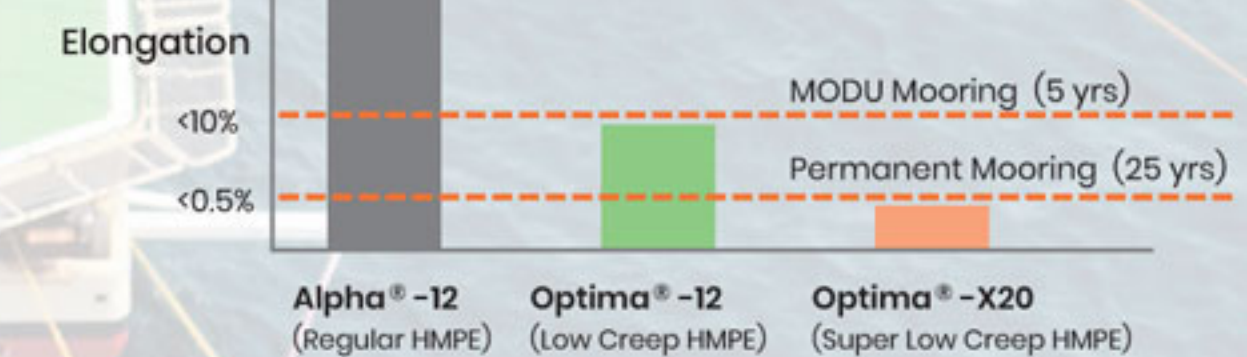
? What is CREEP?

! Normal HMPE fibers are sensitive to long-term static loads (continuous loads), and will irreversibly elongate proportionally with time - this phenomenon is known as CREEP.

Three Important Factors



Elongation Requirements and Rope Options for Deep Water Mooring

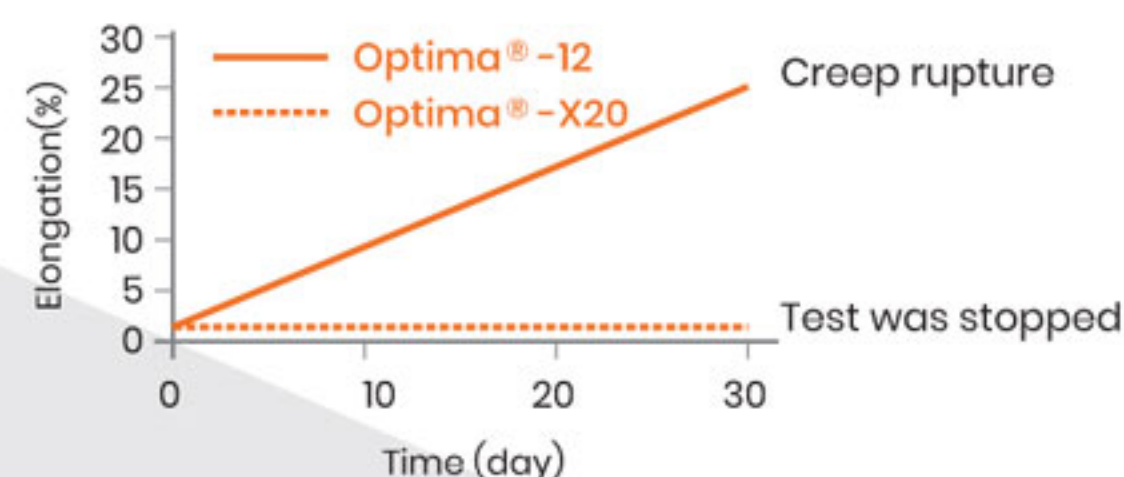


The "Modified HMPE" ropes have shown a longer fatigue life compared to polyester ropes, and are not vulnerable to axial compression fatigue compared to aramid fiber rope.

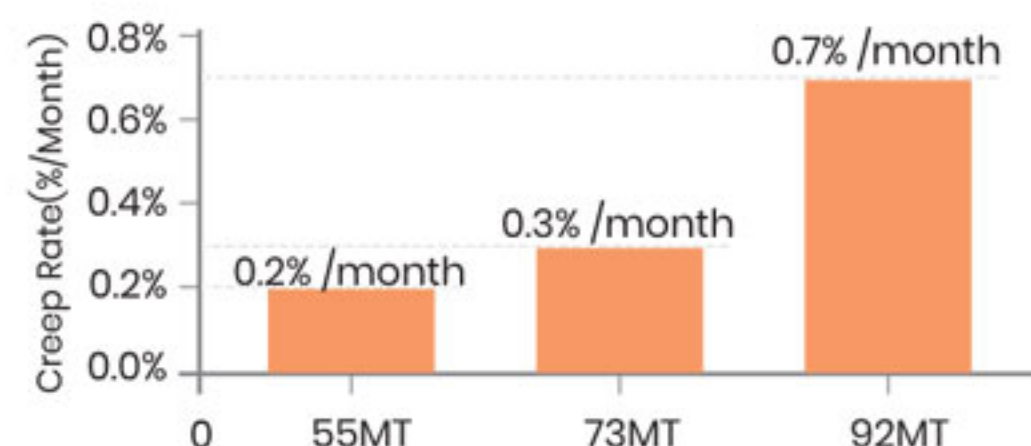
Optima® Low Creep Options

Optima Low Creep is also the best option for Seismic Rope.

Creep Elongation
(29mm dia; 50%MBL Load; 30°C)



Optima-X20 Rope Creep Rate at Different Load (52mm dia; 23°C)



Optima® -12

22mm actual size

Optima® -X20

24mm actual size

Optima® -Ar

24mm actual size

Diameter (mm)		Optima® - 12						Optima® - X20						Optima® - Ar					
		Average Strength		Minimum Strength		Weight		Average Strength		Minimum Strength		Weight		Average Strength		Minimum Strength		Weight	
(inch)	(mm)	(MT)	(lb)	(MT)	(lb)	(kg/100m)	(lb/100ft)	(MT)	(lb)	(MT)	(lb)	(kg/100m)	(lb/100ft)	(MT)	(lb)	(MT)	(lb)	(kg/100m)	(lb/100ft)
1	24	49.7	109,625	44.8	98,662	32.4	21.8	49.7	109,625	44.8	98,662	32.4	21.8	46.7	103,047	42.1	92,742	46.0	30.9
1 1/4	30	75.8	167,195	68.3	150,475	53.9	36.2	75.8	167,195	68.3	150,475	53.9	36.2	71.3	157,163	64.2	141,447	76.5	51.4
1 1/2	36	101	223,699	91.3	201,329	76.9	51.7	101	223,699	91.3	201,329	76.9	51.7	95.4	210,277	85.8	189,249	109	73.3
1 5/8	40	131	289,833	118	260,850	97.0	65.2	131	289,833	118	260,850	97.0	65.2	124	272,443	111	245,199	138	92.5
1 3/4	44	165	364,074	149	327,667	117	78.6	165	364,074	149	327,667	117	78.6	155	342,230	140	308,007	166	112
2	48	177	390,406	159	351,365	129	86.7	177	390,406	159	351,365	129	86.7	166	366,982	150	330,284	183	123
2 1/8	52	213	470,357	192	423,321	162	109	213	470,357	192	423,321	162	109	201	442,135	180	397,922	230	154
2 1/4	56	238	524,294	214	471,865	173	116	238	524,294	214	471,865	173	116	224	492,836	201	443,553	245	165
2 1/2	60	278	612,291	250	551,062	220	148	278	612,291	250	551,062	220	148	261	575,554	235	517,999	312	210
2 5/8	64	323	711,965	291	640,769	248	167	323	711,965	291	640,769	248	167	304	669,247	273	602,323	352	236
2 3/4	68	343	756,995	309	681,295	278	187	343	756,995	309	681,295	278	187	323	711,575	290	640,418	394	265
3	72	381	840,668	343	756,602	307	206	381	840,668	343	756,602	307	206	358	790,228	323	711,205	435	293
3 1/4	80	444	979,398	400	881,458	357	240	444	979,398	400	881,458	357	240	418	920,634	376	828,571	506	340

Polaris® Deep Water Installation

Polaris®-12 Strand Solid Braid Rope

Polaris®-8 Strand Rope

Deep water exploration and production need higher capacity lifting and lowering with cranes and winches, with repetitive bending over sheaves, combines with high loads and increased depths.

Wire Rope

Advantages

- A long track history of performance, inspection, and retirement
- Good bend fatigue properties, heat resistance, and durability.

Disadvantages

- Need to support the package as well as their own weight
- Need for winches with large capacity, and increase structural support for the winch and load capacity, footprint size, etc.

Synthetic Rope

Advantages

- Buoyant or neutrally buoyant in sea water – offer a product of equal load capacity without additional weight that wire rope bring
- Decreases the required lifting capacity
- Smaller winch system, take up less deck space

Disadvantages

- Lack of performance history, inspection, and retirement standard
- Lower heat resistance which is a concern with heave compensation and Cyclic Bend-Over-Sheave (CBOS) performance

Therefore, improved CBOS products along with proper training on operation, inspection and retirement is the key to providing a viable alternative to wire rope.

Polaris® Deep Water Installation

Features

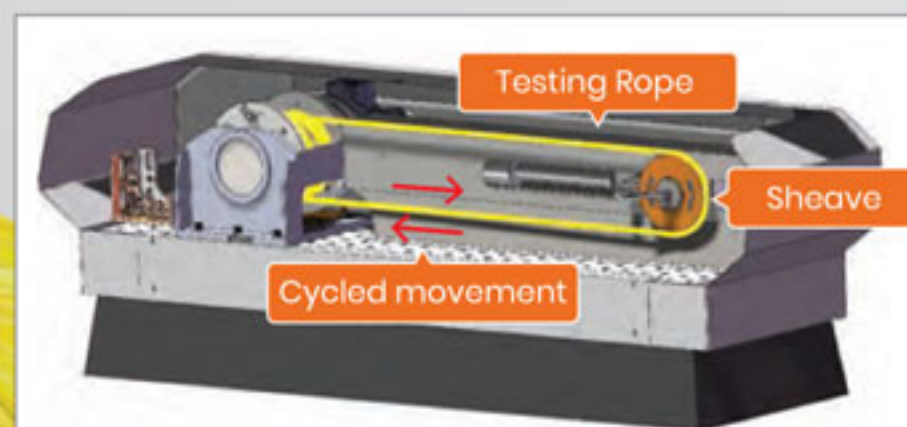
- Unique high performance fiber combinations
- Specialty coating further eliminates fiber-to-fiber internal abrasion
- Standard lab CBOS tests correlated with field trials

Polaris® -12 is 80% lighter than wire rope of the same size, the same strength, and longer bending fatigue life.

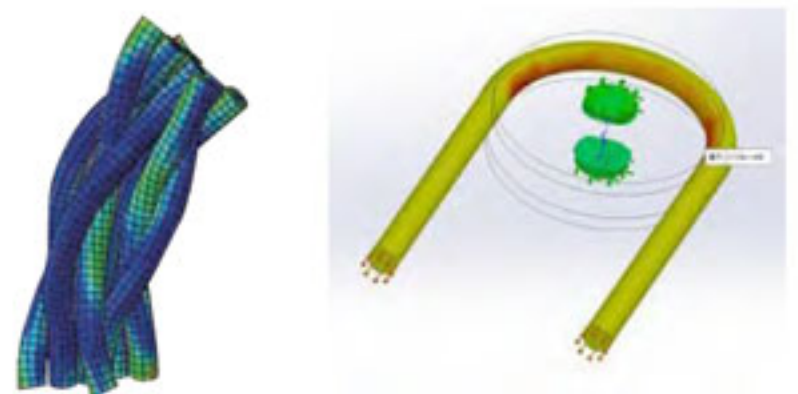
How to Evaluate CBOS Performance?

To compare CBOS fatigue life (cycles to fail) at the same Life Factor.

$$\text{Life Factor (LF)} = \frac{\text{SheaveDia}}{\text{Rope dia}} \times \frac{\text{RopeStrength}}{\text{TestLoad}}$$



Lab CBOS Tester



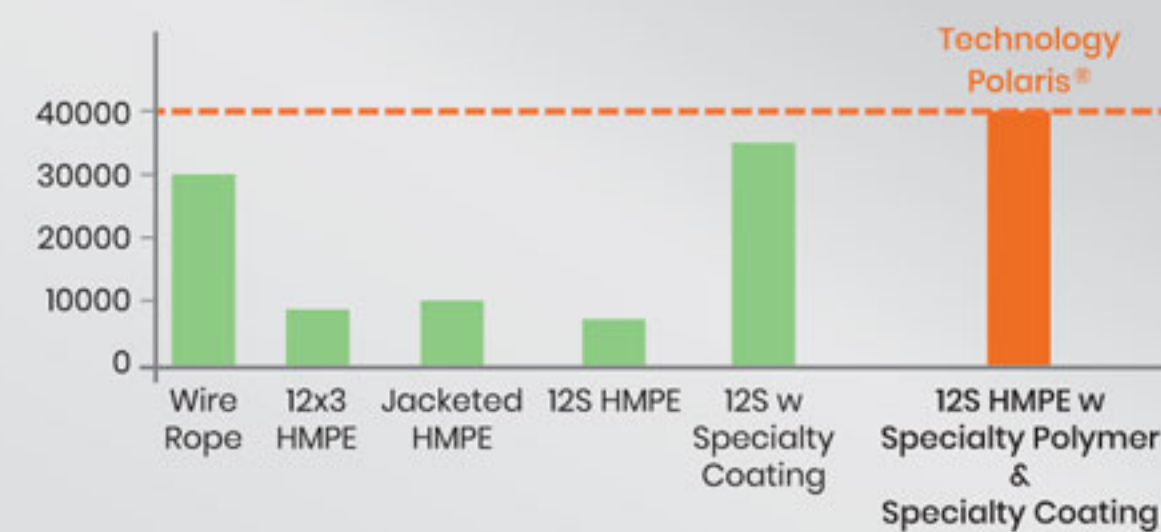
Stress and Temperature Analysis

Specification of Polaris® - 12:

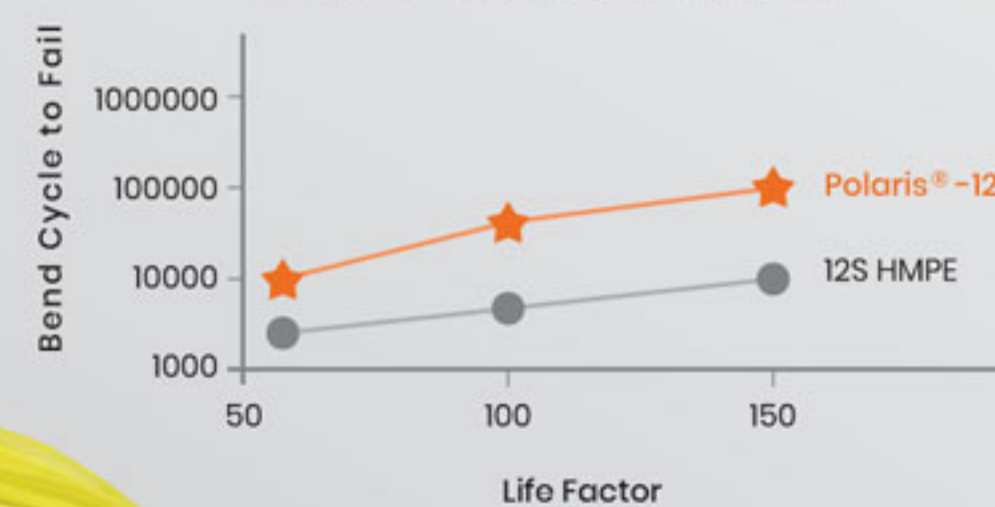
Diameter		Minimum Strength		Weight	
(inch)	(mm)	(MT)	(lb)	(kg/100m)	(lb/100ft)
1 5/8	40	115	253,024	103	69.4
1 3/4	44	144	317,837	125	83.7
2	48	155	340,825	137	92.3
2 1/8	52	186	410,621	172	116
2 1/4	56	208	457,709	184	124
2 1/2	60	242	534,530	234	157
2 5/8	64	282	621,546	264	177
2 3/4	68	300	660,856	296	199
3	72	333	733,903	327	220
3 1/4	80	388	855,015	380	255

CBOS life increases as Life Factor increases. With a fixed Life Factor, **Polaris® -12** shows the best CBOS performance.

CBOS Life Comparison (LF=100)



CBOS Life: 25mm dia. 12:1 D:d; f=10s



Polaris® - 12
42mm actual size

Offshore Products Feature Comparison

	Strength	Bending Fatigue (CBOS Life)	Abrasion Resistance	Creep (Less Elongation & Better Residual Strength)	Easy Inspection	Floatability
AlphaSteel® -12	★★	★	★		★	★
AlphaSteel® -8	★		★		★	★
OmegaSteel® I			★★★			★
OmegaSteel® II			★★★★			★
Polaris® -12	★	★★★★	★		★	★
Polaris® -8	★	★★★★	★		★	★
Optima® - 12	★	★	★	★	★	★
Optima® -X20	★	★★	★	★★★★	★	★
Optima® -Ar				★★★★	★	

Summary

As offshore exploration and production move into increasingly deeper water, the need for higher capacity lifting, lowering, and mooring becomes more prevalent. And that is why offshore experts have come to count on high performance synthetic ropes for safe and lightweight solutions, that increase winch efficiency and remote operated vehicles can easily manipulate.

Ropers have serious of innovations on products development for different offshore applications. And we provide unparalleled service package to the offshore oil and gas industry includes application knowledge, technical support, and product training and service.

**We Work With You on SOLUTIONS,
NOT JUST ROPE!**

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