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### ZHEJIANG FOUR BROTHERS ROPE CO., LTD

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# HEAVY LIFTING





### INTRODUCTION

Zhejiang Four Brothers Rope Co.,Ltd (FBR) offers various types of High-Modulus Polyethylene (HMPE) fiber heavy-lift slings. At the same size, it is stronger than conventional steel wire, yet only weights 1/7 of steel wire. FBR HMPE heavy-lift slings are more flexible and much easier to handle. They also have a much better fatigue life compared to steel wires, whilst retaining similar elastic elongation properties.

FBR's R&D department has conducted comprehensive tests on our heavy-lift slings in different configurations, to be sure the slings are at their best efficiency for the required lifting capacities:

- Working load limit (WLL)
- D/d ratio
- Optimal lift configuration
- Splicing
- Length tolerances

FBR has a wide range of advanced R&D and testing equipment, including 2500-ton, 500-ton, 300-ton, 100-ton, and 50-ton testing machines, and other special testers, to simulate a broad range of working environments – such as fatigue, creep, wear, aging, etc. With professional R&D equipment, FBR is able to design, test and produce customized heavy-lift slings for engineer lifting, meeting all complex loading and handling requirements for specific lifting projects.

FBR have been instrumental in successfully implementing heavy lift projects for major offshore contractors with our customized solutions, which are built to conquer the toughest environments and conditions where our customers operate.

The FBR products have obtained the certifications of DNV, ABS, CCS, BV, LR, NK and other international first-class classification societies, with stable and reliable performance.

### FBR Heavy-Lift Slings KEY BENEFITS

#### Light & easy handling

Quick & easy rigging
 Safer operations

Torque neutral

- Increased lift capacity
  Time saving from faster handling
- Soft contact surfaces
  Not affected by fresh or salt water

### **Product List**

Product	Rope Slings		Round Slings	
Performance	LIFTMAX <sup>®</sup> Sling	LIFTMAX <sup>®</sup> Sling With Jacket	LIFTMAX <sup>®</sup> Plus Sling (Braided Jacket)	LIFTMAX <sup>®</sup> Plus Sling (Sleeve Jacket)
Product diagram				
Typical MBL (mT)	49-2500	49-2500	460-6200	460-6200
Typical sling lengths (m)	> 5	> 5	> 6	>2
Abrasion resistance	Good	Excellent	Excellent	Good
UV resistance	Good	Excellent	Excellent	Excellent
CUT resistance	Good	Excellent	Excellent	Excellent
Chemical resistance	Excellent	Excellent	Excellent	Excellent

With the 2500-ton in-house testing capabilities, slings can be proof loaded before delivery to guarantee adequate operation under the designed WLL, per ISO 18264 or other testing standards per request.





- No fish hooks
- Extremely low length tolerances
- Very low elongation after multiple lifts
- No damages to goods









# LIFTMAX<sup>®</sup> Sling



LIFTMAX<sup>®</sup> Sling is a rope sling made of 12-strand braided HMPE fiber rope, with a very high strength to weight ratio. At the same size, it is stronger than conventional steel wire, yet weights just 1/7 of steel wire. This provides LIFTMAX<sup>®</sup> Sling more flexibility in design and operation, safer and easier handling, and minimized installation time.



#### **Product Features**

- High specific strength (strength to weight ratio)
- Torque neutral
- Light weight and easy handling
- Easy splicing
- Good cut and abrasion resistance
- Paired slings easily matched
- No fish hooks

#### **Technical Specifications**

- Material: HMPE/Dyneema® fiber
- Construction: 12-strand braided
- Specific gravity: 0.97 (floating)
- Water absorption: 0%
- Maximum working temperature: 70°C
- Length tolerances: ±1% nominal length or less

#### **Applications**

- Heavy lifting
- Onshore and offshore installation
- Subsea installation
- Renewable energy installation
- Salvage and rescue

Diameter	Weight	Minimum Break Load (Single leg)		Minimum I (Gron	Break Load nmet)
mm	kg/m	kN	mT	kN	mT
24	0.32	480	49.0	768	78.4
28	0.44	634	64.7	1014	103.5
32	0.59	826	84.3	1322	134.9
36	0.72	994	101.4	1590	162.3
40	0.88	1196	122.0	1914	195.3
46	1.17	1528	155.9	2445	249.5
50	1.39	1774	181.0	2838	289.6
54	1.64	2070	211.2	3312	338.0
60	2.01	2500	255.1	4000	408.2
64	2.26	2783	284.0	4453	454.4
70	2.75	3327	339.5	5323	543.2
76	3.22	3837	391.5	6139	626.4
80	3.53	4165	425.0	6664	680.0
86	4.06	4730	482.7	7568	772.2
90	4.43	5110	521.4	8176	834.3
96	4.99	5690	580.6	9104	929.0
100	5.52	6297	642.6	10075	1028.1
120	7.98	8870	905.1	14192	1448.2
130	9.21	10521	1073.5	16833	1717.7
140	10.67	12149	1239.7	19439	1983.6
150	12.22	13896	1417.9	22233	2268.7
160	13.88	15759	1608.1	25215	2573.0

#### **REMARKS:**

- Other sizes are available upon request.
- Single leg sling strengths @D/d ≥2.
- Grommet sling strengths @ D/d  $\geq$ 3.

# LIFTMAX<sup>®</sup> Sling With Jacket

Additionally, jacket may be applied to LIFTMAX<sup>®</sup> Sling for extra protection. We offer protective jackets in polyester or HMPE fiber. The jacket itself does not carry load but is to prevent the core from wearing which may lead to a loss of strength.





# LIFTMAX<sup>®</sup> Plus Sling

LIFTMAX<sup>®</sup> Plus Sling from FBR provides a more reliable, safer, lighter weight and cost-effective alternative to heavy chains and wire rope slings. In addition, it has a longer service life and is more versatile.

Our innovative endless loop construction, encased in a durable braided jacket or sleeve, enables LIFTMAX<sup>®</sup> Plus Sling to have very low elongations under load. These highly visible protective jackets and sleeves can also be tailored to your specific needs for specific environmental and usage considerations. With customized jackets and sleeves, LIFTMAX<sup>®</sup> Plus Sling offers the most durable solution against aggressive abuses, such as cutting, piercing, scratching, abrasion and UV.



LIFTMAX<sup>®</sup> Plus Sling with Braided Jacket



LIFTMAX<sup>®</sup> Plus Sling with Sleeve Jacket

#### **Product Features**

- High specific strength (strength to weight ratio)
- Load-bearing core protected by jacket, not subject to external wear
- Torque neutral
- Light weight
- Excellent cut and abrasion resistance
- Paired slings easily matched
- No damage to painted surfaces or sensitive equipment
- Construction stability
- Soft contact surfaces

#### **Technical Specifications**

- Material: load bearing core HMPE/Dyneema® fiber; jacket/sleeve - HMPE or Polyester
- Construction: parallel braided cores with a jacket
- Specific gravity: depending on construction, 0.97 for the HMPE core and 1.38 for the Polyester jacket
- Water absorption: 0%
- Maximum working temperature: 70°C
- Length tolerances: ±1% nominal length or less

#### **Applications**

- Heavy lifting
- Onshore and offshore installation
- Subsea installation
- Renewable energy installation
- Salvage and rescue



LIFTMAX<sup>®</sup> Plus Sling is our latest innovation in sling applications, optimizing a high MBL with a low EWL. For LIFTMAX<sup>®</sup> Plus Sling would be the best option for its ease of operation and light weight.

Diameter	Core Weight		
mm	kg/m		
72	2.32		
76	2.64		
94	3.89		
100	4.40		
110	5.46		
114	5.88		
132	7.76		
142	9.23		
152	10.60		
162	12.20		
174	13.93		
182	15.34		
184	15.70		
200	18.76		
206	19.56		
212	20.80		
216	21.65		
226	23.84		
246	28.53		
258	31.03		
268	33.64		
278	36.35		
288	39.16		

#### **REMARKS**:

- Other sizes are available upon request.
- Grommet sling strengths @ D/d  $\geq$  3.

example, when the MBL needs to be over 1000-ton for a heavy lifting, with a confined length of 6 meters,

Minimum Break Load (Grommet)					
kN	mT				
4538	463.0				
5174	527.9				
7619	777.5				
8615	879.0				
10694	1091.2				
11523	1175.8				
15202	1551.2				
17592	1788.7				
18831	1921.5				
21538	2197.7				
23639	2412.2				
26002	2653.3				
26610	2715.3				
31729	3237.7				
33079	3375.4				
35156	3587.4				
36576	3732.2				
38906	3970.0				
44907	4582.3				
48822	4981.9				
52900	5397.9				
57139	5830.6				
61541	6279.7				

### **FLAT WEBBING SLINGS**

Flat webbing slings are sewed from double-layer high-tenacity polyester fibers webbing, which feature in excellent strength to weight ratio, easy handling, no fishhooks, extended service life and superb cost effectiveness.

Flat webbing slings are widely used in applications such as offshore installations, and emergency rescues, etc.





Product ID	SWL	Width mm		Minimum length	Spliced eye length
	kg	5:1 or 6:1	7:1	m	mm
F01	1000	25	30	1.1	350
F02	2000	50	60	1.2	400
F03	3000	75	90	1.3	450
F04	4000	100	120	1.4	500
F05	5000	125	150	2.0	550
F06	6000	150	180	2.0	600
F08	8000	200	240	2.0	700
F10	10000	250	300	3.0	800
F12	12000	300	300	3.0	900

#### **REMARKS:**

• Other sizes are available upon request.

■ 5:1, 6:1 and 7:1 are safety factors.

### **FIBER ROUND SLINGS**

Fiber round slings are made with wrapped-around polyester fibers. Fiber round slings consist of two parts, a load-bearing core and a protective braided jacket. The jacket can protect the core from abrasion and deformation, and itself doesn't contribute to the sling strength. Therefore, slight wear damages to the jacket don't affect the sling strength.

Fiber round slings are widely used in applications such as offshore installations, and emergency rescues, etc.





Diameter	SWL	Minimum length	Maximum length
mm	mT	m	m
19	1.0	0.5	80
25	2.0	0.5	80
28	3.0	0.5	80
32	4.0	0.5	80
36	5.0	0.5	80
38	6.0	1.0	80
43	8.0	1.0	80
48	10.0	2.0	80
53	12.0	2.0	80
60	15.0	2.0	80
70	20.0	2.0	80
86	30.0	2.0	80
119	50.0	2.0	80
140	100.0	2.0	80

#### **REMARK:**



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	 	 $\rightarrow$



<sup>•</sup> Other sizes are available upon request.



## **SLING CONFIGURATIONS**

Proper selection of sling configurations and sizes is critical for successful lifting projects. FBR offers tailor-made sling products and configurations to customers with specific individual need.

#### **Bending efficiency**

Theoretically, a sling used in a basket configuration could have twice the working load as a sling in a vertical configuration as two ropes are now holding the load instead of one. However, because the sling is bent, one should rate the sling strength properly with a bending reduction factor.

The common way to describe bending is the ratio of the bending diameter ( $D_{\mu\nu\nu}$ ) to the rope diameter ( $d_{ensel}$ ),  $D_{\mu\nu\nu}$  $/d_{POPE}$  or  $D_{LW}$ :  $d_{POPE}$ . A higher  $D_{LW}/d_{POPE}$  means a gentler bend. As the  $D_{LW}/d_{POPE}$  ratio goes down, the bending is more severe, leading to a lower strength rating of the sling. FBR has done extensive tests to understand the bending reduction factor under different  $D_{HW}/d_{ROPE}$  ratios in both grommet and basket configurations.

The table below gives an overview bending reduction efficiency of slings in different configurations.

#### SLING BENDING EFFICIENCY IN DIFFERENCE CONFIGURATION



### Sling length Effective Working Length (EWL)

The correct Effective Working Length (EWL) is a critical factor in lifting operations, especially if a multi-sling arrangement is being used. The EWLs of FBR slings are tested per ISO 18264.

The typical EWL tolerance of FBR sling products is ±1%. Please note that EWL tolerance is highly dependent on sling's length and structure. We can achieve tighter tolerance as needed. Please contact FBR for specific length tolerances for your projects.

Constructional elongation (bedding-in) is the elongation of a loaded sling as the result of compacted sling construction and better alignment among the fibers and strands. Such constructional elongation is permanent, and the sling structure will not return to its original length when relaxed.

Usually after the slings are proof-loaded, the constructional elongation is removed.

#### Elastic elongation

Elastic elongation is a result of the elasticity of the fibers in the sling. Different fibers have different elasticity values. We can provide specific detailed data as needed.

#### ELONGATION CHARACTERISTICS OF A SLING



#### SLING ELONGATION PROPERTIES CURVE



L<sub>1</sub>: Elongation due to loading

L<sub>2</sub>: Immediate recovery once unloading

L<sub>3</sub>: Elastic hysteresis over several hours

L<sub>4</sub>: Unrecoverable constructional elongation