TEKMARINE

# Marine Fenders

# About TekMarine

From its base in the United States, TekMarine Systems LLC designs and supplies advanced marine fendering and mooring systems to ports, harbors and waterways across the world.

We bring a wealth of engineering and market experience to each project. Our fender solutions range from simple modules to the most sophisticated engineered systems. We supply every type of berth, including passenger terminals, bulk and RoRo ports, Oil and Gas installations and naval facilities.

We offer full support at each step from early concept discussions through to design and detailing, material selection, construction, testing, shipping, and installation. A full after-care service helps keep your investment working safely and reliably for many years after commission.

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## Copyright

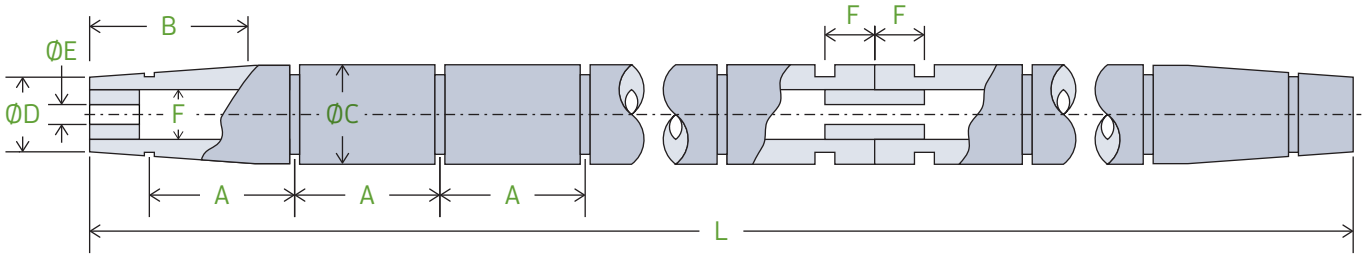
# TJTB Tug Cylindrical Fenders

Modern tugs frequently use large cylindrical fenders as their main pushing fenders to bow and stern. The rounded section maintains a constant contact against flared vessel hulls, and work just as well with straight-sided vessels.

The fender is attached by a chain running along the fender's central bore, and straps or chains in special grooves around the fender circumference. Fender ends may be tapered.

TJTB Tug Cylindrical Fenders are available in diameters up to 1000mm (3′ 3″) and continuous or jointed lengths.

## Dimensions

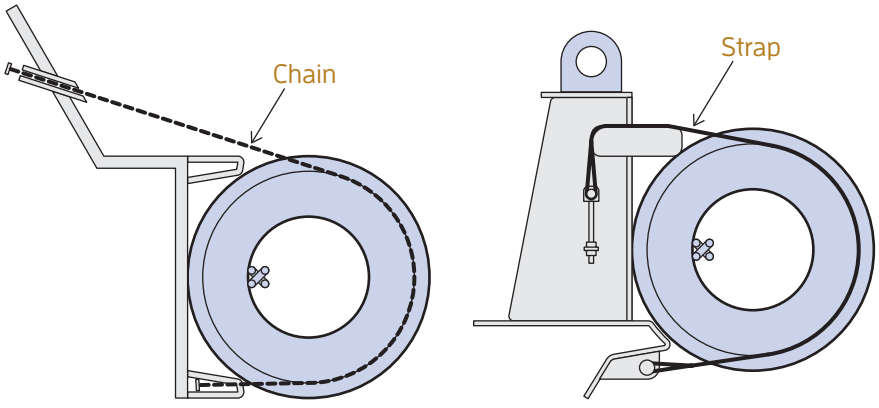



| A | | B | | ØC | | ØD | | ØE | | F | | Weight | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| mm | in | mm | in | mm | in | mm | in | mm | in | mm | in | kg | lb |
| 570 | 22.4 | 500 | 19.7 | 250 | 9.8 | 190 | 7.5 | 75 | 3.0 | 125 | 4.9 | 46 | 101 |
| 600 | 23.6 | 700 | 27.6 | 300 | 11.8 | 225 | 8.9 | 75 | 3.0 | 150 | 5.9 | 65 | 143 |
| 650 | 25.6 | 800 | 31.5 | 380 | 15.0 | 280 | 11.0 | 100 | 3.9 | 190 | 7.5 | 105 | 231 |
| 670 | 26.4 | 800 | 31.5 | 400 | 15.7 | 300 | 11.8 | 100 | 3.9 | 200 | 7.9 | 116 | 256 |
| 700 | 27.6 | 850 | 33.5 | 450 | 17.7 | 350 | 13.8 | 100 | 3.9 | 225 | 8.9 | 147 | 324 |
| 730 | 28.7 | 900 | 35.4 | 500 | 19.7 | 375 | 14.8 | 100 | 3.9 | 250 | 9.8 | 181 | 399 |
| 800 | 31.5 | 900 | 35.4 | 600 | 23.6 | 450 | 17.7 | 125 | 4.9 | 300 | 11.8 | 255 | 562 |
| 930 | 36.6 | 1000 | 39.4 | 800 | 31.5 | 600 | 23.6 | 125 | 4.9 | 400 | 15.7 | 453 | 999 |
| 1000 | 39.4 | 1100 | 43.3 | 900 | 35.4 | 675 | 26.6 | 150 | 5.9 | 450 | 17.7 | 573 | 1263 |
| 1060 | 41.7 | 1200 | 47.2 | 1000 | 39.4 | 750 | 29.5 | 150 | 5.9 | 500 | 19.7 | 707 | 1559 |

Values are for single units, L = 1m.

## Attachment

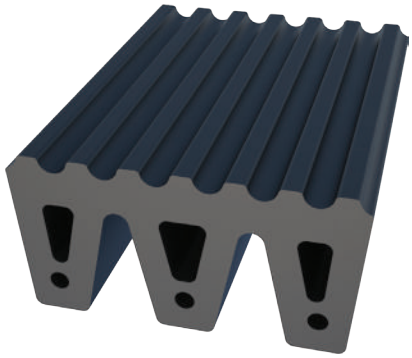
A chain is run through the longitudinal bore of the cylindrical fender, attached to the hull at either end and tensioned using turnbuckles. Larger fenders are secured via chains or straps running around the grooves in the fender surface.



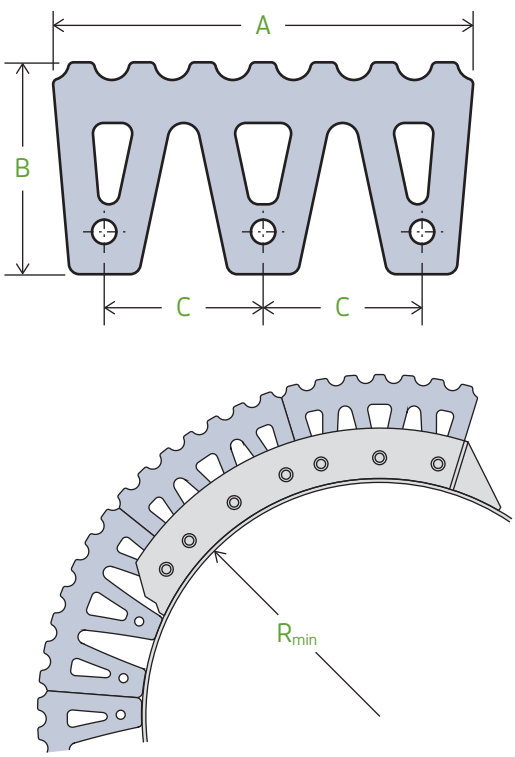
# M Fenders

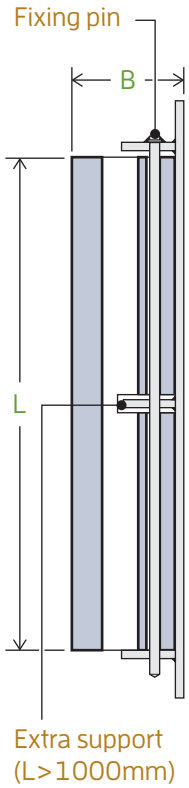
The large, flexible faces of M-Fenders exert low hull pressures when pushing vessels. They are grooved for a soft and flexible contact face, which firmly grips the vessel's hull. The M-Fender attaches securely to the tug via fixing pins running through each of its three legs.

M-Fenders have a low weight per contact area. They can be fitted around very tight curves, fixed with pins that run through central bore holes. An intermediate support is recommended where length is over 1000mm (3′ 3″).

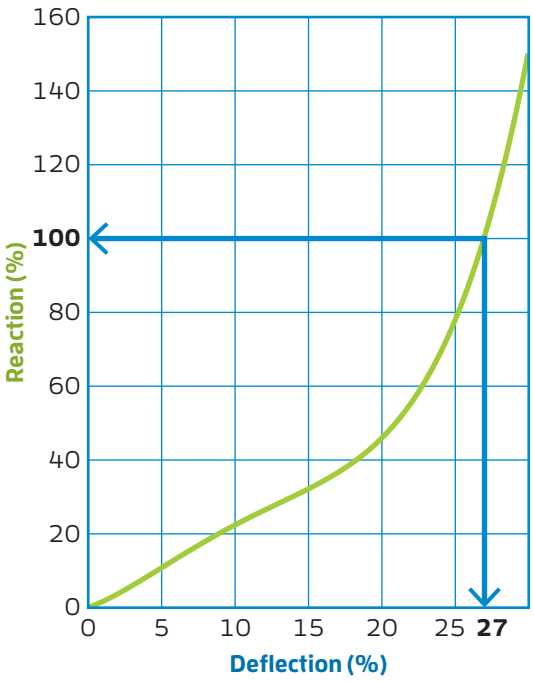


## Dimensions and Fixings




## Performance




| A | | B | | C | | $L_{max}$ | | Weight | |
|---|---|---|---|---|---|---|---|---|---|
| mm | in | mm | in | mm | in | mm | in | kg | lb |
| 400 | 15.7 | 200 | 7.9 | 150 | 5.9 | 2000 | 78.7 | 56 | 123 |
| 500 | 19.7 | 250 | 9.8 | 190 | 7.5 | 2000 | 78.7 | 89 | 196 |
| 600 | 23.6 | 300 | 11.8 | 230 | 9.1 | 2000 | 78.7 | 132 | 291 |
| 800 | 31.5 | 400 | 15.7 | 305 | 12.0 | 2100 | 82.7 | 235 | 518 |

| Pin dia. | | Flat bar | | $R_{min}$ | |
|---|---|---|---|---|---|
| mm | in | mm | in | mm | in |
| 20 | 0.8 | 100 × 15 | 1.0 × 0.2 | 450 | 17.7 |
| 24 | 0.9 | 125 × 20 | 1.3 × 0.2 | 550 | 21.7 |
| 30 | 1.2 | 150 × 20 | 1.5 × 0.2 | 650 | 25.6 |
| 40 | 1.6 | 150 × 20 | 1.5 × 0.2 | 900 | 35.4 |

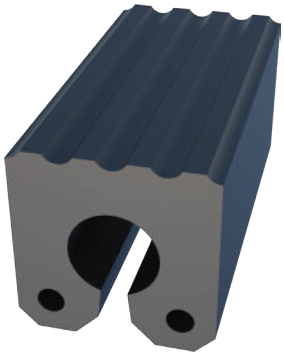
Values are for single units, L = 1m.

# Block Fenders

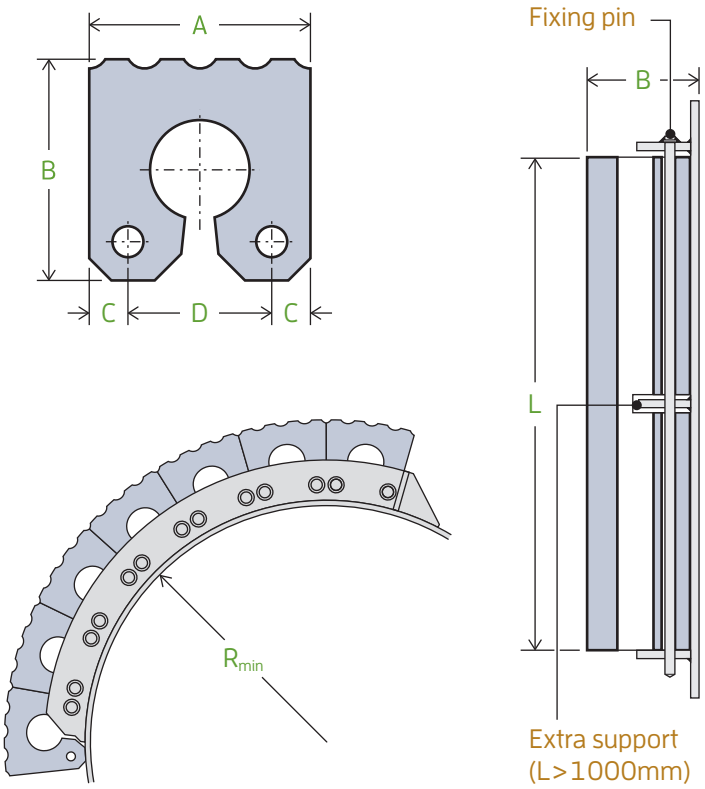
The Block Fender's instantly recognizable 'keyhole' section handles the most demanding tug operations. Block Fenders have optional smooth or grooved faces to suit different friction requirements, and can be fitted with low-friction UHMW-PE facings for heavy seas.

As well as tugs, Block Fenders are commonly fitted to pilings and similar structures to form a simple, reliable protective face.

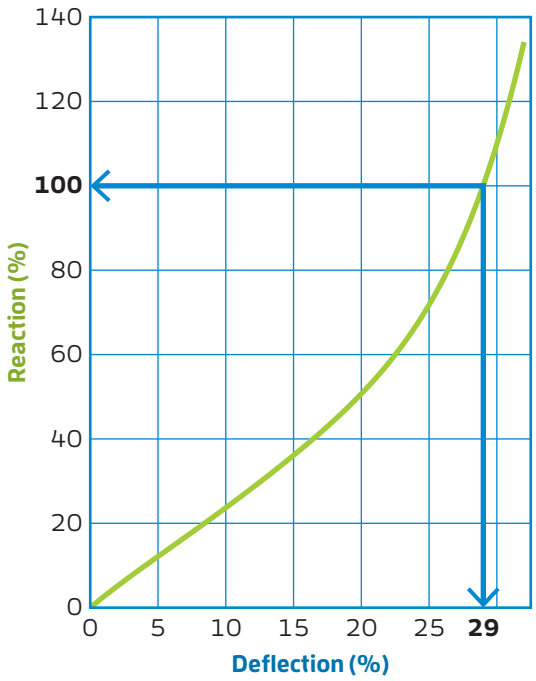
An intermediate support is recommended for fenders over 1000mm (3′ 3″) long.



## Dimensions and Fixings




## Performance




| A | | B | | C | | $L_{max}$ | | Weight | |
|---|---|---|---|---|---|---|---|---|---|
| mm | in | mm | in | mm | in | mm | in | kg | lb |
| 200 | 7.9 | 200 | 7.9 | 35 | 1.4 | 2000 | 78.7 | 33 | 73 |
| 250 | 9.8 | 250 | 9.8 | 50 | 2.0 | 2000 | 78.7 | 54 | 119 |
| 300 | 11.8 | 300 | 11.8 | 60 | 2.4 | 1750 | 68.9 | 80 | 176 |
| 350 | 13.8 | 350 | 13.8 | 70 | 2.8 | 2000 | 78.7 | 114 | 251 |

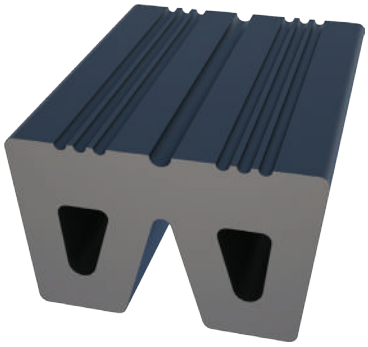
| Pin dia. | | Flat bar | | $R_{min}$ | |
|---|---|---|---|---|---|
| mm | in | mm | in | mm | in |
| 20 | 0.8 | 100 × 15 | 3.9 × 0.2 | 450 | 17.7 |
| 24 | 0.9 | 125 × 20 | 4.9 × 0.2 | 600 | 23.6 |
| 30 | 1.2 | 150 × 20 | 5.9 × 0.2 | 800 | 31.5 |
| 40 | 1.6 | 175 × 25 | 6.9 × 0.2 | 1000 | 39.4 |

Values are for single units, L = 1m.

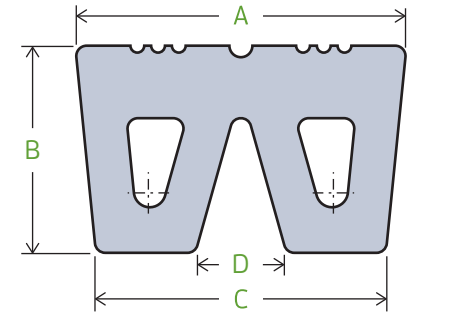
# W Fenders

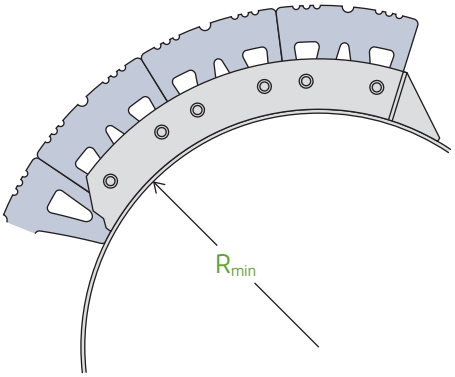
One of the world's most popular tug fender designs, the W-Fender is built for extreme conditions. Its open-bore profile makes installation simple around almost any hull shape.

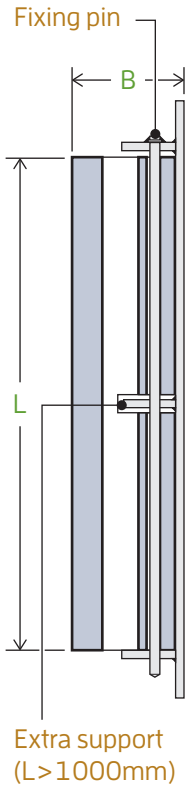
W-Fenders are fitted using pins that run through central bore holes. An intermediate support is recommended for fenders over 1000mm (3′ 3″) long.



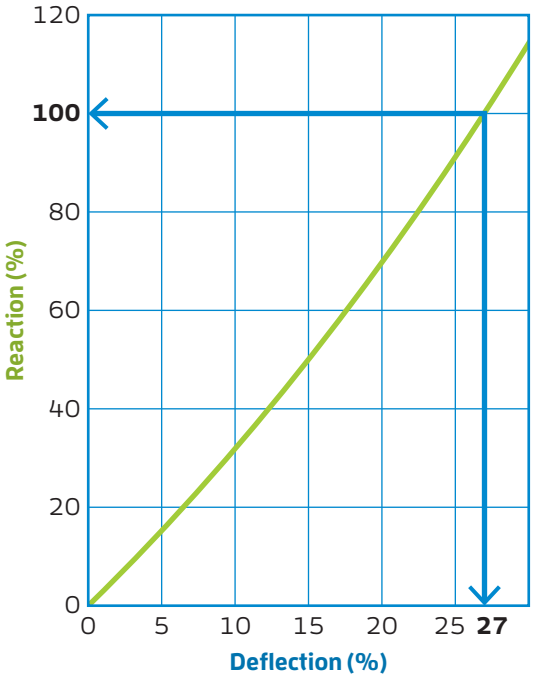
## Dimensions and Fixings




## Performance




| A | | B | | C | | D | | $L_{max}$ | | Weight | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| mm | in | mm | in | mm | in | mm | in | mm | in | kg | lb |
| 320 | 12.6 | 200 | 7.9 | 280 | 11.0 | 100 | 3.9 | 2000 | 78.7 | 51 | 112 |
| 400 | 15.7 | 250 | 9.8 | 350 | 13.8 | 110 | 4.3 | 2000 | 78.7 | 81 | 179 |
| 480 | 17.7 | 300 | 11.8 | 426 | 16.8 | 135 | 5.3 | 2000 | 78.7 | 120 | 265 |
| 500 | 19.7 | 450 | 17.7 | 420 | 16.5 | 90 | 3.5 | 2000 | 78.7 | 180 | 397 |

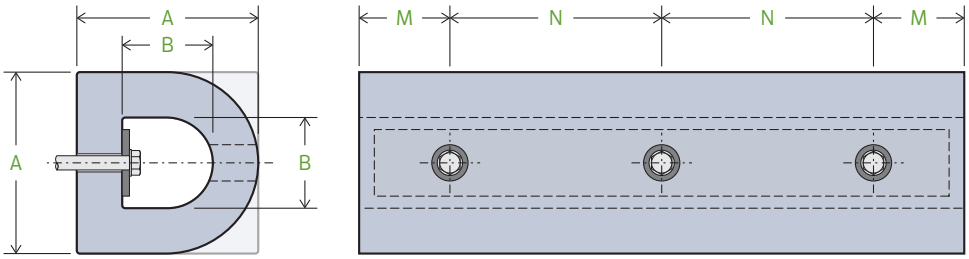
| Pin dia. | | Flat bar | | $R_{min}$ | |
|---|---|---|---|---|---|
| mm | in | mm | in | mm | in |
| 25 | 1.0 | 100 × 20 | 3.9 x 0.2 | 600 | 23.6 |
| 30 | 1.2 | 120 × 20 | 4.7 x 0.2 | 800 | 31.5 |
| 40 | 1.6 | 140 × 20 | 5.5 x 0.2 | 900 | 35.4 |
| 40 | 1.6 | 150 × 20 | 5.9 x 0.2 | 1000 | 39.4 |

Values are for single units, L = 1m.

# Profile Fenders

**Profile** Fenders are used for smaller vessels and lighter applications. They are usually bolted to the structure, either through the top or sides of the fender. Available in various sections including D and square, they can be supplied in almost any length then cut and drilled as needed.

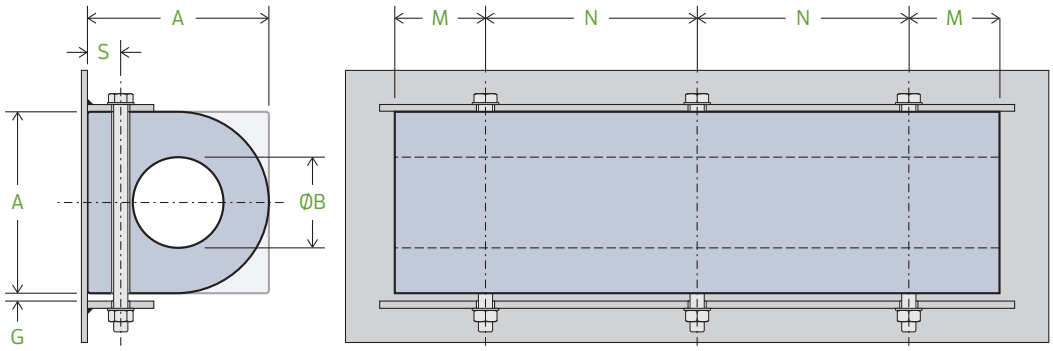
## TJDD
## TJSD




| A | | B | | M | | N | | Bolt | Weight | | | | Performance | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | TJDD | | TJSD | | TJDD Energy | | TJDD Reaction | | TJSD Energy | | TJSD Reaction | |
| mm | in | mm | in | mm | in | mm | in | | kg | lb | kg | lb | kNm | ft.kip | kN | kip | kNm | ft.kip | kN | kip |
| 100 | 3.9 | 50 | 2.0 | 90–130 | 3.7–5.3 | 200–300 | 8.2–12.2 | M12 | 8.0 | 17.6 | 9.3 | 20.5 | 1.4 | 1.0 | 76 | 17.0 | 2.6 | 1.9 | 137 | 30.8 |
| 150 | 5.9 | 75 | 3.0 | 110–150 | 4.5–6.1 | 250–350 | 10.2–14.3 | M16 | 18.1 | 39.9 | 21.0 | 46.3 | 3.1 | 2.3 | 114 | 25.6 | 6.5 | 4.8 | 205 | 46.1 |
| 200 | 7.9 | 100 | 3.9 | 130–180 | 5.3–7.3 | 300–400 | 12.2–16.3 | M20 | 32.1 | 70.8 | 37.3 | 82.2 | 5.6 | 4.1 | 152 | 34.2 | 11.3 | 8.3 | 273 | 61.4 |
| 250 | 9.8 | 125 | 4.9 | 140–200 | 5.7–8.2 | 350–450 | 14.3–18.4 | M24 | 50.2 | 111 | 58.3 | 129 | 8.9 | 6.6 | 190 | 42.7 | 17.6 | 13.0 | 345 | 77.6 |
| 300 | 11.8 | 150 | 5.9 | 140–200 | 5.7–8.2 | 350–450 | 14.3–18.4 | M24 | 72.3 | 159 | 83.9 | 185 | 12.8 | 9.4 | 232 | 52.2 | 25.3 | 18.7 | 413 | 92.8 |
| 350 | 13.8 | 175 | 6.9 | 140–200 | 5.7–8.2 | 350–450 | 14.3–18.4 | M30 | 98.4 | 217 | 114 | 251 | 17.6 | 13.0 | 270 | 60.7 | 34.3 | 25.3 | 504 | 113 |
| 400 | 15.7 | 200 | 7.9 | 140–200 | 5.7–8.2 | 350–450 | 14.3–18.4 | M30 | 129 | 284 | 149 | 328 | 23.2 | 17.1 | 305 | 68.6 | 45.1 | 33.3 | 590 | 133 |
| 500 | 19.7 | 250 | 9.8 | 140–200 | 5.7–8.2 | 350–450 | 14.3–18.4 | M36 | 201 | 443 | 233 | 514 | 36.0 | 26.6 | 384 | 86.3 | 70.3 | 51.9 | 737 | 166 |

Values are for single units, L = 1m.

## TJDO
## TJSO




| A | | ØB | | G | | S | | M | | N | | Bolt | Weight | | | | Performance | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | | TJDO | | TJSO | | TJDO Energy | | TJDO Reaction | | TJSO Energy | | TJSO Reaction | |
| mm | in | mm | in | mm | in | mm | in | mm | in | mm | in | | kg | lb | kg | lb | kNm | ft.kip | kN | kip | kNm | ft.kip | kN | kip |
| 100 | 3.9 | 50 | 2.0 | 10 | 0.4 | 25 | 1.0 | 90–130 | 3.7–5.3 | 200–300 | 8.2–12.2 | M12 | 9.9 | 21.8 | 11.1 | 24.5 | 1.9 | 1.4 | 154 | 34.7 | 2.8 | 2.1 | 173 | 38.9 |
| 150 | 5.9 | 75 | 3.0 | 12 | 0.5 | 30 | 1.2 | 110–150 | 4.5–6.1 | 250–350 | 10.2–14.3 | M16 | 20.0 | 44.1 | 22.9 | 50.5 | 4.2 | 3.1 | 233 | 52.4 | 6.4 | 4.7 | 260 | 58.5 |
| 200 | 7.9 | 100 | 3.9 | 15 | 0.6 | 45 | 1.8 | 130–180 | 5.3–7.3 | 300–400 | 12.2–16.3 | M20 | 37.4 | 82.5 | 42.6 | 93.9 | 7.5 | 5.5 | 315 | 70.8 | 11.2 | 8.3 | 343 | 77.1 |
| 250 | 9.8 | 125 | 4.9 | 20 | 0.8 | 50 | 2.0 | 140–200 | 5.7–8.2 | 350–450 | 14.3–18.4 | M24 | 57.2 | 126 | 65.3 | 144 | 11.8 | 8.7 | 390 | 87.7 | 17.6 | 13.0 | 435 | 97.8 |
| 300 | 11.8 | 150 | 5.9 | 25 | 1.0 | 60 | 2.4 | 140–200 | 5.7–8.2 | 350–450 | 14.3–18.4 | M24 | 81.3 | 179 | 92.9 | 205 | 16.9 | 12.5 | 474 | 107 | 25.3 | 18.7 | 520 | 117 |
| 350 | 13.8 | 175 | 6.9 | 25 | 1.0 | 70 | 2.8 | 140–200 | 5.7–8.2 | 350–450 | 14.3–18.4 | M30 | 110 | 241 | 118 | 259 | 23.0 | 17.0 | 545 | 123 | 34.2 | 25.2 | 605 | 136 |
| 400 | 15.7 | 200 | 7.9 | 30 | 1.2 | 80 | 3.1 | 140–200 | 5.7–8.2 | 350–450 | 14.3–18.4 | M30 | 142 | 313 | 154 | 339 | 29.3 | 21.6 | 625 | 141 | 45.0 | 33.2 | 688 | 155 |
| 500 | 19.7 | 250 | 9.8 | 40 | 1.6 | 90 | 3.5 | 140–200 | 5.7–8.2 | 350–450 | 14.3–18.4 | M36 | 208 | 459 | 240 | 529 | 46.5 | 34.3 | 790 | 178 | 70.2 | 51.8 | 865 | 194 |

Values are for single units, L = 1m.

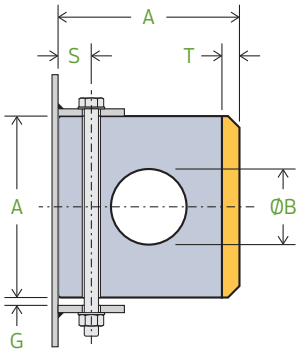
# Composite Fenders

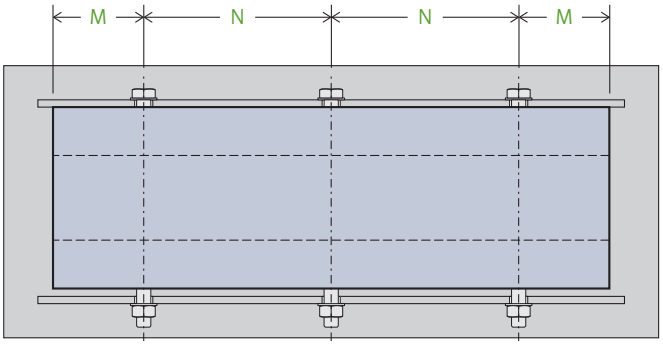
Composite Fenders combine a rubber body permanently bonded to a low-friction UHMW-PE face pad. The rubber body absorbs berthing energy while the facing reduces shear forces.

## TJCA

Hollow ◘

Solid ■



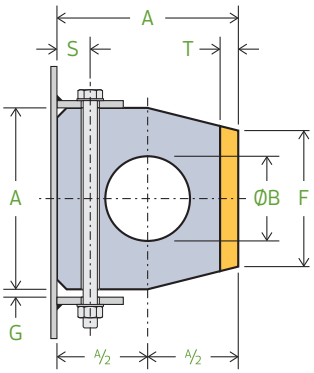

| A | | ØB* | | G | | S | | T | | M | | N | | Standard length | | Flat bar | | Bolt | Weight | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | | | | | | | | Hollow ◘ | | Solid ■ | |
| mm | in | mm | in | mm | in | mm | in | mm | in | mm | in | mm | in | mm | in | mm | in | | kg | lb | kg | lb |
| 100 | 3.9 | 30 | 1.2 | 10 | 0.4 | 25 | 1.0 | 20 | 0.8 | 90–130 | 3.5–5.1 | 200–300 | 7.9–11.8 | 3000 | 118 | 50 × 6 | 2.0 × 0.2 | M12 | 10.3 | 22.7 | 11.1 | 24.5 |
| 150 | 5.9 | 65 | 2.6 | 12 | 0.5 | 30 | 1.2 | 20 | 0.8 | 110–150 | 4.3–5.9 | 250–350 | 9.8–13.8 | 3000 | 118 | 60 × 8 | 2.4 × 0.3 | M16 | 21.5 | 47.4 | 27.0 | 59.5 |
| 200 | 7.9 | 75 | 3.0 | 20 | 0.8 | 45 | 1.8 | 25 | 1.0 | 130–180 | 5.1–7.1 | 300–400 | 11.8–15.7 | 3000 | 118 | 80 × 10 | 3.1 × 0.4 | M20 | 40.2 | 88.6 | 48.0 | 106 |
| 250 | 9.8 | 100 | 3.9 | 25 | 1.0 | 50 | 2.0 | 30 | 1.2 | 140–200 | 5.5–7.9 | 350–450 | 13.8–17.7 | 2000 | 79 | 100 × 6 | 3.9 × 0.2 | M24 | 60.2 | 133 | 75.0 | 165 |
| 300 | 11.8 | 125 | 4.9 | 30 | 1.2 | 60 | 2.4 | 30 | 1.2 | 140–200 | 5.5–7.9 | 350–450 | 13.8–17.7 | 3700 | 146 | 110 × 12 | 4.3 × 0.5 | M24 | 92.1 | 203 | 108 | 238 |

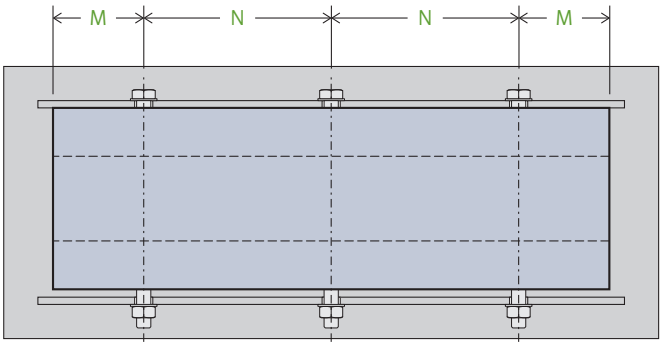
Values are for single units, L = 1m. *Dimension applies to hollow fenders only.

## TJCB

Hollow ◘

Solid ■




| A | | ØB* | | F | | G | | S | | T | | M | | N | | Standard length | | Flat bar | | Bolt | Weight | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | | | | | | | | | | Hollow ◘ | | Solid ■ | |
| mm | in | mm | in | mm | in | mm | in | mm | in | mm | in | mm | in | mm | in | mm | in | mm | in | | kg | lb | kg | lb |
| 80 | 3.1 | 42 | 1.7 | 60 | 2.4 | 6 | 0.2 | 25 | 1.0 | 10 | 0.4 | 90–130 | 3.5–5.1 | 200–300 | 7.9–11.8 | 2000 | 79 | 45 × 6 | 1.8 × 0.2 | M12 | 5.4 | 11.9 | 7.0 | 15.4 |
| 100 | 3.9 | 45 | 1.8 | 74 | 2.9 | 8 | 0.3 | 25 | 1.0 | 10 | 0.4 | 90–130 | 3.5–5.1 | 200–300 | 7.9–11.8 | 2000 | 79 | 45 × 6 | 1.8 × 0.2 | M12 | 8.4 | 18.5 | 11.0 | 24.3 |
| 120 | 4.7 | 65 | 2.6 | 88 | 3.5 | 10 | 0.4 | 30 | 1.2 | 12 | 0.5 | 110–150 | 4.3–5.9 | 250–350 | 9.8–13.8 | 2000 | 79 | 60 × 8 | 2.4 × 0.3 | M16 | 12.2 | 26.9 | 15.8 | 34.8 |
| 150 | 5.9 | 73 | 2.9 | 110 | 4.3 | 12 | 0.5 | 30 | 1.2 | 15 | 0.6 | 110–150 | 4.3–5.9 | 250–350 | 9.8–13.8 | 3000 | 118 | 60 × 8 | 2.4 × 0.3 | M16 | 19.7 | 43.4 | 24.8 | 54.7 |

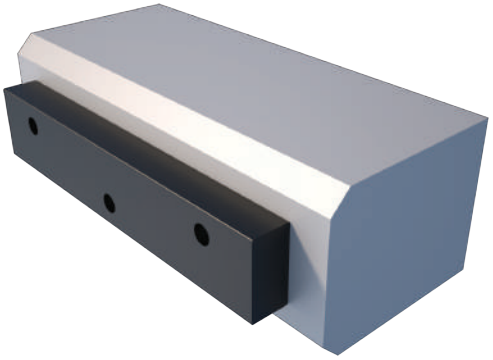
Values are for single units, L = 1m. *Dimension applies to hollow fenders only.

# HD-PE Sliding Fenders

TekMarine HD-PE Fenders are durable, low friction strips that wear better and last longer than traditional timbers. HD-PE does not rot, split or suffer from marine borer infestation.

HD-PE Fenders are ideal for workboat berths, waterways and lock entrances and as components in larger fender installations.

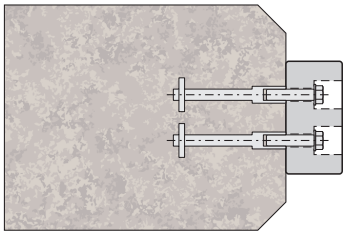
HD-PE is easy to machine and install onto concrete, steel or timber substrates. Better still, HD-PE is fully recyclable after its working life, and is a cost-effective alternative to tropical hardwoods.



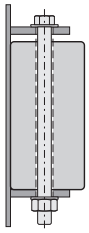
## Fixing

HD-PE Fenders are equally at home mounted on concrete, steel plate or beam structures, or as a timber facing. Please ask TekMarine about the most suitable drilling diameters and fixings for your project.

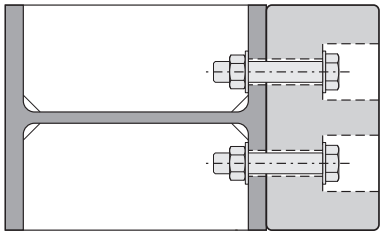
Concrete



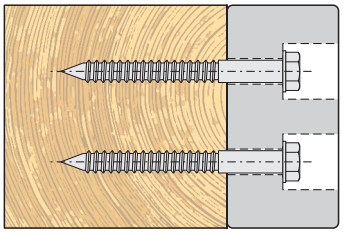
Plate



Beam



Timber



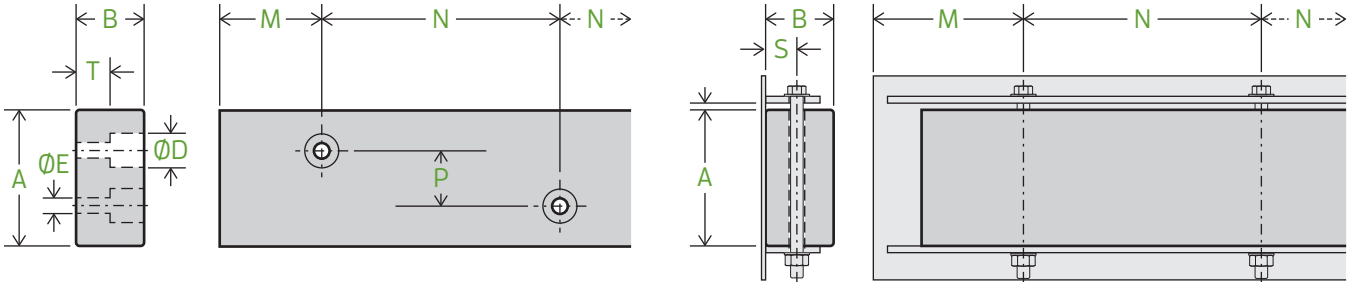
## Physical Properties

| Property | Test method | Typical results | Unit |
|---|---|---|---|
| Abrasion index (sand slurry) | ISO DIS 15527 | ~400 | – |
| Density | ISO 1183-1 | 0.91–0.94 | g/cm³ |
| Dynamic friction (wet plastic) | ISO 8295 | 0.20–0.25 | – |
| Molecular weight | Light diffusion method ASTM D6474 | ~200,000 $>4 \times 10^{-6}$ | g/mol |
| Operating temperature | Not applicable | –20 to +70 | °C |
| Shore hardness | DIN 53505/ISO 868 | 48–50 | Shore D |
| Thermal expansion | DIN 53752/ ISO 3146 | $2 \times 10^{-4}$ | $K^{-1}$ |
| Yield strength | DIN 53504/ISO 527 | 10–15 | MPa |

Typical results are for virgin HD-PE. Actual values for Sliding Fenders can differ due to the proportion of recycled materials used in their manufacture.

For a comparison of the friction properties of various materials, please refer to p51.

# HD-PE Dimensions




| A | | B | | ØD | | ØE | | L | | M | | N | | P | | S | | T | | Flat Bar | | Bolt | Weight | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| mm | in | mm | in | mm | in | mm | in | mm | in | mm | in | mm | in | mm | in | mm | in | mm | in | mm | in | | kg | lb |
| 50 | 2.0 | 50 | 2.0 | 32 | 1.3 | 16 | 0.6 | 5500 | 217 | 75–125 | 3–5 | 250–300 | 10–12 | 0 | 0 | 25 | 1.0 | - | - | - | - | M12 | 2.3 | 5.1 |
| 60 | 2.4 | 60 | 2.4 | 32 | 1.3 | 16 | 0.6 | 5500 | 217 | 75–125 | 3–5 | 250–300 | 10–12 | 0 | 0 | 30 | 1.2 | - | - | - | - | M12 | 3.3 | 7.3 |
| 70 | 2.8 | 50 | 2.0 | 32 | 1.3 | 16 | 0.6 | 2500 | 98 | 75–125 | 3–5 | 250–300 | 10–12 | 0 | 0 | 25 | 1.0 | - | - | - | - | M12 | 3.3 | 7.3 |
| 70 | 2.8 | 70 | 2.8 | 32 | 1.3 | 16 | 0.6 | 6500 | 256 | 75–125 | 3–5 | 250–300 | 10–12 | 0 | 0 | 35 | 1.4 | - | - | - | - | M12 | 4.5 | 9.9 |
| 80 | 3.1 | 60 | 2.4 | 32 | 1.3 | 16 | 0.6 | 5000 | 197 | 75–125 | 3–5 | 250–300 | 10–12 | 0 | 0 | 30 | 1.2 | - | - | - | - | M12 | 4.5 | 9.9 |
| 100 | 3.9 | 50 | 2.0 | 32 | 1.3 | 16 | 0.6 | 5500 | 217 | 75–125 | 3–5 | 250–300 | 10–12 | 0 | 0 | 25 | 1.0 | - | - | - | - | M12 | 4.7 | 10.4 |
| 100 | 3.9 | 65 | 2.6 | 32 | 1.3 | 16 | 0.6 | 5500 | 217 | 75–125 | 3–5 | 250–300 | 10–12 | 0 | 0 | 30 | 1.2 | - | - | - | - | M12 | 6.1 | 13.4 |
| 100 | 3.9 | 100 | 3.9 | 32 | 1.3 | 16 | 0.6 | 6000 | 236 | 75–125 | 3–5 | 250–300 | 10–12 | 0 | 0 | 50 | 2.0 | 32 | 1.3 | 50×6 | 2×0.25 | M12 | 9.3 | 20.5 |
| 120 | 4.7 | 80 | 3.1 | 40 | 1.6 | 20 | 0.8 | 5000 | 197 | 100–150 | 4–6 | 300–350 | 12–14 | 0 | 0 | 40 | 1.6 | - | - | - | - | M16 | 8.9 | 19.6 |
| 120 | 4.7 | 120 | 4.7 | 40 | 1.6 | 20 | 0.8 | 6000 | 236 | 100–150 | 4–6 | 300–350 | 12–14 | 0 | 0 | 60 | 2.4 | 40 | 1.6 | 65×10 | 2.5×0.4 | M16 | 13.4 | 29.5 |
| 140 | 5.5 | 70 | 2.8 | 40 | 1.6 | 20 | 0.8 | 5500 | 217 | 100–150 | 4–6 | 300–350 | 12–14 | 0–50 | 0–2.0 | 35 | 1.4 | - | - | - | - | M16 | 9.1 | 20.1 |
| 160 | 6.3 | 70 | 2.8 | 40 | 1.6 | 20 | 0.8 | 5000 | 197 | 100–150 | 4–6 | 300–350 | 12–14 | 0–70 | 0–2.8 | 35 | 1.4 | - | - | - | - | M16 | 10.4 | 22.9 |
| 160 | 6.3 | 160 | 6.3 | 40 | 1.6 | 20 | 0.8 | 6000 | 236 | 100–150 | 4–6 | 300–350 | 12–14 | 0–80 | 0–3.1 | 80 | 3.1 | 40 | 1.6 | 80×10 | 3.1×0.4 | M16 | 24.1 | 53.1 |
| 170 | 6.7 | 120 | 4.7 | 40 | 1.6 | 20 | 0.8 | 5500 | 217 | 100–150 | 4–6 | 300–350 | 12–14 | 0–80 | 0–3.1 | 60 | 2.4 | 40 | 1.6 | 65×10 | 2.5×0.4 | M16 | 19.0 | 41.9 |
| 175 | 6.9 | 150 | 5.9 | 50 | 2.0 | 23 | 0.9 | 4000 | 157 | 125–175 | 5–7 | 350–450 | 14–18 | 0–80 | 0–3.1 | 75 | 3.0 | 40 | 1.6 | 80×10 | 3.1×0.4 | M20 | 24.2 | 53.4 |
| 180 | 7.1 | 70 | 2.8 | 50 | 2.0 | 23 | 0.9 | 5000 | 197 | 125–175 | 5–7 | 350–450 | 14–18 | 0–80 | 0–3.1 | 35 | 1.4 | - | - | - | - | M20 | 11.7 | 25.8 |
| 180 | 7.1 | 180 | 7.1 | 50 | 2.0 | 23 | 0.9 | 6000 | 236 | 125–175 | 5–7 | 350–450 | 14–18 | 0–80 | 0–3.1 | 90 | 3.5 | 46 | 1.8 | 80×10 | 3.1×0.4 | M20 | 30.2 | 66.6 |
| 190 | 7.5 | 110 | 4.3 | 50 | 2.0 | 23 | 0.9 | 5000 | 197 | 125–175 | 5–7 | 350–450 | 14–18 | 0–90 | 0–3.5 | 55 | 2.2 | 46 | 1.8 | 80×10 | 3.1×0.4 | M20 | 19.4 | 42.8 |
| 200 | 7.9 | 75 | 3.0 | 50 | 2.0 | 23 | 0.9 | 5000 | 197 | 125–175 | 5–7 | 350–450 | 14–18 | 0–100 | 0–3.9 | 35 | 1.4 | 46 | 1.8 | - | - | M20 | 14.0 | 30.9 |
| 200 | 7.9 | 100 | 3.9 | 50 | 2.0 | 23 | 0.9 | 6000 | 236 | 125–175 | 5–7 | 350–450 | 14–18 | 0–100 | 0–3.9 | 50 | 2.0 | 46 | 1.8 | 80×10 | 3.1×0.4 | M20 | 18.6 | 41.0 |
| 200 | 7.9 | 150 | 5.9 | 50 | 2.0 | 23 | 0.9 | 5500 | 217 | 125–175 | 5–7 | 350–450 | 14–18 | 0–100 | 0–3.9 | 75 | 3.0 | 46 | 1.8 | 80×10 | 3.1×0.4 | M20 | 27.9 | 61.5 |
| 200 | 7.9 | 200 | 7.9 | 50 | 2.0 | 23 | 0.9 | 6000 | 236 | 125–175 | 5–7 | 350–450 | 14–18 | 0–100 | 0–3.9 | 100 | 3.9 | 46 | 1.8 | 80×10 | 3.1×0.4 | M20 | 37.6 | 82.9 |
| 210 | 8.3 | 165 | 6.5 | 50 | 2.0 | 23 | 0.9 | 2000 | 79 | 150–200 | 6–8 | 450–550 | 18–22 | 0–130 | 0–5.1 | 80 | 3.1 | 46 | 1.8 | 80×10 | 3.1×0.4 | M20 | 31.9 | 70.3 |
| 250 | 9.8 | 150 | 5.9 | 65 | 2.6 | 28 | 1.1 | 6500 | 256 | 150–200 | 6–8 | 450–550 | 18–22 | 0–130 | 0–5.1 | 75 | 3.0 | 46 | 1.8 | 80×10 | 3.1×0.4 | M24 | 34.8 | 76.7 |
| 250 | 9.8 | 160 | 6.3 | 65 | 2.6 | 28 | 1.1 | 5000 | 197 | 150–200 | 6–8 | 450–550 | 18–22 | 0–130 | 0–5.1 | 80 | 3.1 | 46 | 1.8 | 80×10 | 3.1×0.4 | M24 | 37.2 | 82.0 |
| 250 | 9.8 | 250 | 9.8 | 65 | 2.6 | 28 | 1.1 | 5000 | 197 | 150–200 | 6–8 | 450–550 | 18–22 | 0–130 | 0–5.1 | 125 | 4.9 | 56 | 2.2 | 100×10 | 3.9×0.4 | M24 | 58.1 | 128 |
| 300 | 11.8 | 100 | 3.9 | 65 | 2.6 | 28 | 1.1 | 5500 | 217 | 150–200 | 6–8 | 450–550 | 18–22 | 0–160 | 0–6.3 | 50 | 2.0 | - | - | - | - | M24 | 27.9 | 61.5 |
| 300 | 11.8 | 210 | 8.3 | 70 | 2.8 | 36 | 1.4 | 5000 | 197 | 175–225 | 7–9 | 500–600 | 20–24 | 0–160 | 0–6.3 | 105 | 4.1 | 56 | 2.2 | 100×12 | 3.9×0.5 | M30 | 58.6 | 129 |
| 300 | 11.8 | 300 | 11.8 | 70 | 2.8 | 36 | 1.4 | 5000 | 197 | 175–225 | 7–9 | 500–600 | 20–24 | 0–160 | 0–6.3 | 105 | 4.1 | 72 | 2.8 | 100×12 | 3.9×0.5 | M30 | 84.6 | 187 |
| 440 | 17.3 | 160 | 6.3 | 70 | 2.8 | 36 | 1.4 | 2000 | 79 | 175–225 | 7–9 | 500–600 | 20–24 | 0–160 | 0–6.3 | 80 | 3.1 | - | - | - | - | M30 | 66.8 | 147 |

Values are for single units, L = 1m.

# Rubber Properties

Every TekMarine rubber fender unit uses the highest quality Natural Rubber (NR) and/or Styrene-butadiene (SBR) based compounds. These meet or exceed the performance requirements of the main international fender specifications such as PIANC and EAU-E 62 "Acceptance Requirements for Fender Elastomers". The table below shows typical specifications for laboratory prepared and tested specimens.

Please consult TekMarine about other fender compounds such as EPDM, Butyl, Neoprene and Polyurethane.

Material samples for laboratory test purposes are prepared differently to rubber fender units. Please ask TekMarine for details.

| Property | Test method | Conditions | Requirements | Unit |
|---|---|---|---|---|
| Tensile Strength | ASTM D412 Die C; AS 1180.2; BS 903.A2; ISO 37; JIS K6251 Item 3, Dumbell 3 | Original | ≥ 16.0 | MPa |
| | | Aged for 96 hours at 70°C | ≥ 12.8 | |
| Elongation at Break | ASTM D 412 Die C; AS 1180.2; BS 903.A2; ISO 37; JIS K 6251 Item 3, Dumbell 3 | Original | ≥ 400 | % |
| | | Aged for 96 hours at 70°C | ≥ 320 | |
| Hardness | ASTM D 2240; AS1683.15.2; BS 903.A6; ISO 815; JIS K 6301 Item 5A Tester | Original | ≤ 78° | Shore A |
| | | Aged for 96 hours at 70°C | original value +6° | |
| Compression Set | ASTM D 395; AS1683.13B; BS903. A6; ISO 815; JIS K6262 Item 10 | Aged for 22 hours at 70°C | ≤ 30 | % |
| | DIN 53517 | Aged for 24 hours at 70°C | ≤ 40 | |
| Tear Resistance | ASTM D624; AS1683.12; BS903. A3: ISO 34.1; JIS K6301 Item 9; Test Piece A | Die B | ≥ 70 | kN/m |
| Ozone Resistance | ASTM D1149; AS1683.24; BS903.43; DIN 53509; ISO 143/1 | 1ppm at 20% strain at 40°C for 100 hours | no visible cracking | n/a |
| Seawater Resistance (Hardness) | ASTM D 471; BS ISO 1817 | 28 days in artificial seawater at 95°C ±2°C | ≤ ±10° | Shore A |
| Seawater Resistance (Volume) | | | ≤ +10/-5 | % |
| Abrasion Resistance | BS 903.A9 | Method B | ≤ 0.5 | cc |
| Bond Strength (Steel to Rubber) | BS 903.A21 | Method B | ≥ 7 | N/mm |

# Tolerances

Standard manufacturing and performance tolerances apply to all TekMarine fenders. TekMarine may agree to smaller tolerances in special cases. Please ask TekMarine for tolerances of types not listed below.

| Fender Type | Property | | Tolerance |
|---|---|---|---|
| TJCO, TJSC, TJUE, TJDA-A and TJDA-B | All dimensions | | ±3% or ±2mm (whichever greater) |
| | Bolt hole spacing | | ±2mm |
| TJCY | Outside diameter | | ±4% |
| | Inside diameter | | ±4% |
| | Length | | ±40mm |
| TJDD, TJSD, TJDO and TJSO | Cross-section | | ±4% |
| | Length | | ±2% or ±10mm(whichever greater) |
| | Drilled hole centers | | ±4mm (non-cumulative) |
| | Counterbore depth | | ±4mm (under-head depth) |
| TJCA, TJCB | Cross-section | | ±3% or ±2mm (whichever greater) |
| | Length | | ±2% or ±25mm (whichever greater) |
| | Drilled hole centers | | ±4mm (non-cumulative) |
| | Counterbore depth | | ±4mm (under-head depth) |
| HD-PE fenders | Cross-section | | ±4% |
| | Length | | ±2% or ±20mm (whichever greater) |
| | Drilled hole centers | | ±4mm (non-cumulative) |
| | Counterbore depth | | ±4mm (under-head depth) |
| UHMW-PE panels | Length and width | (cut panels) | ±5mm (cut pads) |
| | | (uncut sheets) | ±20mm (uncut sheets) |
| | Planed thickness | ≤ 30mm | ±0.2mm |
| | | 31–100mm | ±0.3mm |
| | | ≥ 100mm | ±0.5mm |
| | Unplaned thickness | ≤ 30mm | ±2.5mm |
| | | 31–100mm | ±4.0mm |
| | | ≥ 100mm | ±6.0mm |
| | Drilled hole centers | | ±2mm (non-cumulative) |
| | Counterbore depth | | ±2mm (under-head depth) |
| M, W and Block fenders | Cross-section | | ±3% or ±2mm (whichever greater) |
| | Length | | ±3% or ±20mm (whichever greater) |
| | Fixing hole centers | | ±3mm |
| | Fixing hole diameter | | ±3mm |

## Performance

| Fender Type | Property | Tolerance |
|---|---|---|
| TJCO, TJSC, TJUE, TJDA-A and TJDA-B | Reaction, energy and deflection | ±10% |
| Cylindricals (wrapped) | Reaction, energy and deflection | ±10% |
| Cylindricals (extruded) | Reaction, energy and deflection | ±10% |
| Profile fenders | Reaction, energy and deflection | ±10% |
| Pneumatic fenders | Reaction and energy | ±10% |
| Foam fenders | Reaction and energy | ±15% |

Unless otherwise listed or agreed with TekMarine, tolerances are ±20%.

# Testing

Testing of molded[1] and wrapped cylindrical[2] fenders is conducted in-house, with an option for third party witnessing, using full size fenders in accordance with the PIANC 2002[3] guidelines below.

- All fender units have a unique serial number which can be traced back to manufacturing and testing records.
- Fenders are tested under direct (vertical) compression using the Constant Velocity (CV) method.
- The test specimen shall be broken-in by deflected three or more times to at least its rated deflection. After break-in cycles the fender specimen is allowed to recover for at least one hour.
- Axial compression test speed is 2 cm/min ± 8cm/min.
- The test specimen is temperature stabilized to 23°C ± 5°C.[4]
- Reaction force[5] is recorded at intervals to at least a deflection at which the permitted[6] minimum energy absorption is achieved.
- Energy absorption[5] is determined as the integral of reaction and deflection, calculated using Simpson's Rule. The results of a pre-compression cycle[6] and subsequence break-in compression cycle(s) are not recorded.
- The fender performance shall be determined from a single measured compression cycle and pass if the reaction force is less than the maximum permitted[7] reaction force and more than the minimum permitted[7] energy absorption.[8]
- Sampling is 10% of fenders (rounded up to a unit).[9]
- If any sample does not satisfy the specifications, sampling of the remainder is increased to 20% of fenders (rounded up to a unit), excluding non-compliant units.
- If any further sample does not satisfy the specifications, 100% of remaining samples will be tested. Only units which satisfy the specifications shall be passed for shipment. The non-compliant fenders will be rejected.

1 Molded fenders include TJCO, TJSC, TJUE, TJDA-A and TJDA-B fenders. TJCO, TJSC, TJDA-A and TJDA-B fenders are tested singly. TJUE fenders are tested in pairs.

2 Excluding TJTB tug cylindrical fenders.

3 Permanent International Association of Navigation Congress Report of the International Commission for Improving the Design of Fender Systems (Guidelines for the design of Fender systems: 2002, Appendix A).

4 Where the ambient temperature is outside this range, fenders shall be normalized to this temperature range in a conditioning room for a suitable period (according to fender size), or performance values may be adjusted according to the temperature correction factor tables.

5 Reaction forces (and the corresponding, calculated energy absorption) shall be the exact recorded value and not corrected or otherwise adjusted for speed, unless the project specifications require otherwise.

6 Pre-compression testing involves a single 'run in' cycle up to the catalogue rated deflection. The reaction force is not recorded.

7 Maximum permitted reaction force is the catalogue value plus the applicable manufacturing tolerance. Minimum permitted energy absorption is the catalogue value minus the applicable manufacturing tolerance.

8 The deflection at which the minimum permitted energy absorption is achieved may differ from the nominal 'rated' deflection indicated in the catalogue for the corresponding fender type. Actual deflection is not considered as a pass/fail criterion.

9 Testing to PIANC protocols is included within the fender price. Higher testing frequencies, third party witnessing and temperature stabilization costs shall be paid by the purchaser.

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**Presented by**

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