

**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.

## Disclaimer

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# TJDA-B Arch Fender

TJDA-B Arch Fenders are single piece rubber moldings with an integral vulcanized UHMW-PE low friction face pad in black, and other color options. The low-friction properties of the TJDA-B fender make it ideal for locations where shear forces must be minimized.

Arch fenders are used wherever simplicity and toughness are essential, such as general-purpose berths and exposed sites. They are easy to install horizontally or vertically and need little maintenance.

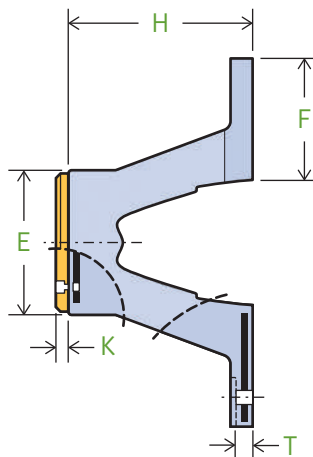
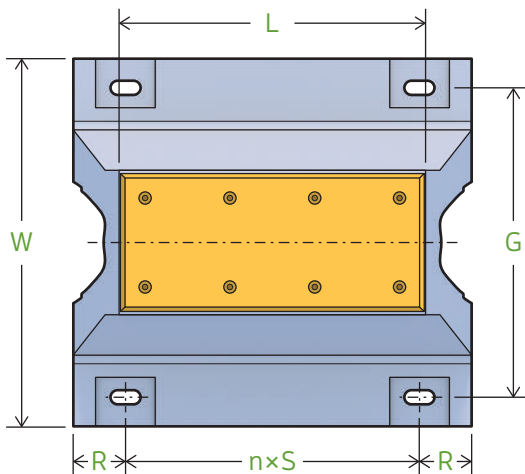


## Dimensions

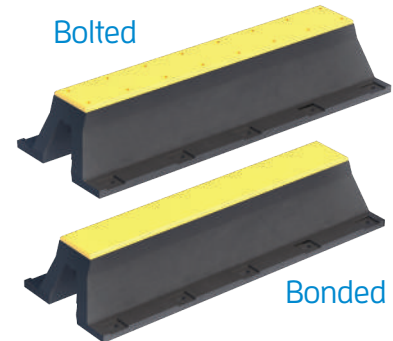
| Model      | Height |      | W    |      | E   |      | F   |      | G    |      | T  |     | Slot size |           | Bolt | Weight |      |
|------------|--------|------|------|------|-----|------|-----|------|------|------|----|-----|-----------|-----------|------|--------|------|
|            | mm     | in   | mm   | in   | mm  | in   | mm  | in   | mm   | in   | mm | in  | mm        | in        |      | mm     | kg   |
| TJDA-B250  | 250    | 9.8  | 500  | 19.7 | 164 | 6.5  | 160 | 6.3  | 410  | 16.1 | 21 | 0.8 | 32 × 64   | 1.3 × 2.5 | M24  | 85     | 187  |
| TJDA-B300  | 300    | 11.8 | 600  | 23.6 | 225 | 8.9  | 195 | 7.7  | 490  | 19.3 | 24 | 0.9 | 35 × 70   | 1.4 × 2.8 | M30  | 125    | 276  |
| TJDA-B400  | 400    | 15.7 | 800  | 31.5 | 300 | 11.8 | 260 | 10.2 | 670  | 26.4 | 30 | 1.2 | 41 × 82   | 1.6 × 3.2 | M36  | 205    | 452  |
| TJDA-B500  | 500    | 19.7 | 1000 | 39.4 | 375 | 14.8 | 325 | 12.8 | 840  | 33.1 | 33 | 1.3 | 47 × 94   | 1.9 × 3.7 | M42  | 325    | 717  |
| TJDA-B600  | 600    | 23.6 | 1200 | 47.2 | 450 | 17.7 | 390 | 15.4 | 1010 | 39.8 | 36 | 1.4 | 50 × 100  | 2.0 × 3.9 | M48  | 480    | 1058 |
| TJDA-B800  | 800    | 31.5 | 1600 | 63.0 | 600 | 23.6 | 520 | 20.5 | 1340 | 52.8 | 45 | 1.8 | 68 × 136  | 2.7 × 5.4 | M56  | 875    | 1929 |
| TJDA-B1000 | 1000   | 39.4 | 2000 | 78.7 | 750 | 29.5 | 650 | 25.6 | 1680 | 66.1 | 60 | 2.4 | 68 × 136  | 2.7 × 5.4 | M56  | 1400   | 3086 |

Values are for single units, L= 1m.

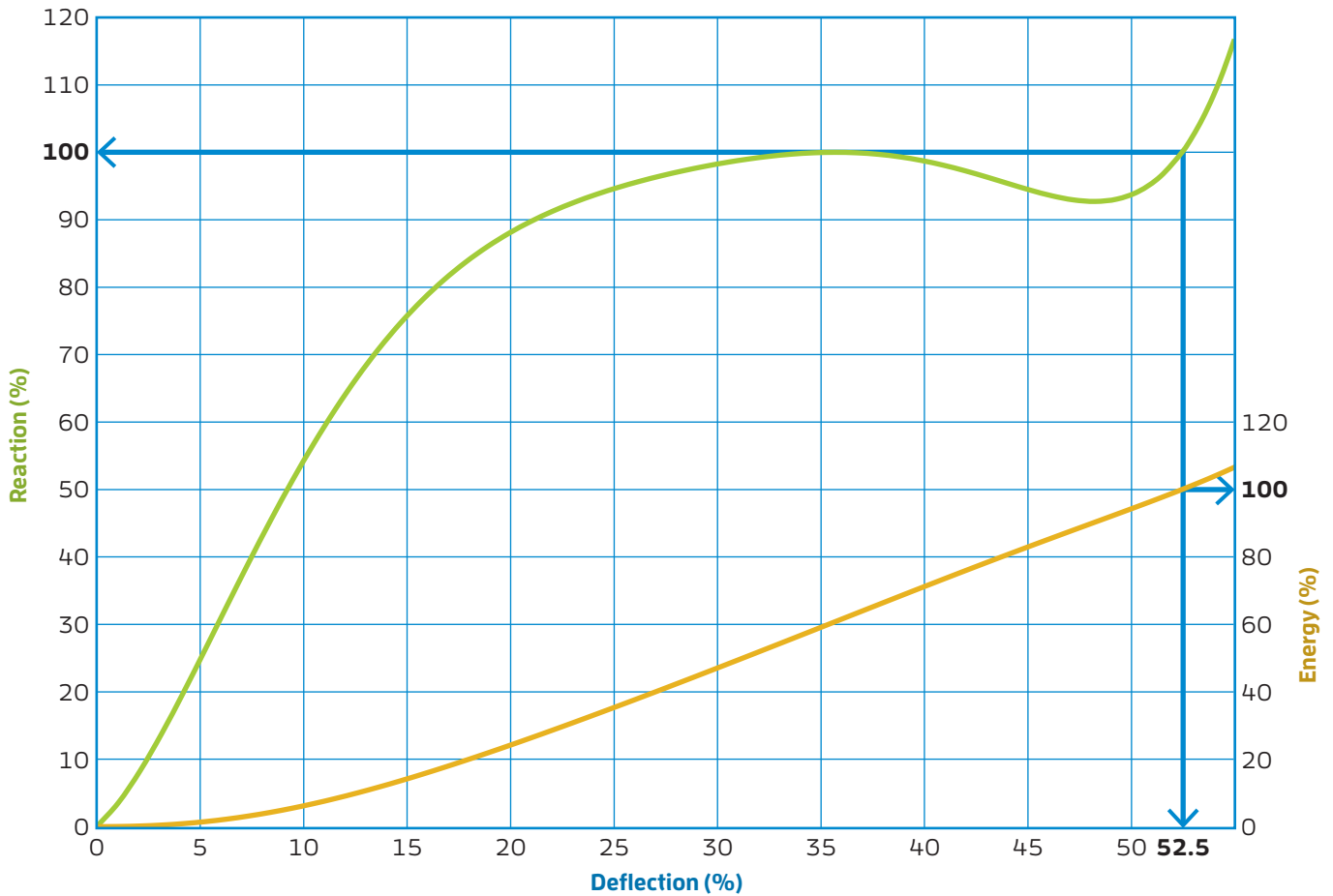
| Model      | 1m (3.28ft), n=1 |     |      |      | 1.5m (4.92ft), n=2 |     |     |      | 2m (6.56ft), n=3 |     |     |      | 2.5m (8.2ft), n=3 |     |     |      | 3m (9.84ft), n=4 |     |     |      | 3.5m (11.48ft), n=5 |     |     |      |
|------------|------------------|-----|------|------|--------------------|-----|-----|------|------------------|-----|-----|------|-------------------|-----|-----|------|------------------|-----|-----|------|---------------------|-----|-----|------|
|            | P                |     | Q    |      | P                  |     | Q   |      | P                |     | Q   |      | P                 |     | Q   |      | P                |     | Q   |      | P                   |     | Q   |      |
|            | mm               | in  | mm   | in   | mm                 | in  | mm  | in   | mm               | in  | mm  | in   | mm                | in  | mm  | in   | mm               | in  | mm  | in   | mm                  | in  | mm  | in   |
| TJDA-B250  | 130              | 5.1 | 865  | 34.1 | 135                | 5.3 | 680 | 26.8 | 135              | 5.3 | 620 | 24.4 | 130               | 5.1 | 790 | 31.1 | 135              | 5.3 | 715 | 28.1 | 120                 | 4.7 | 673 | 26.5 |
| TJDA-B300  | 140              | 5.5 | 870  | 34.3 | 140                | 5.5 | 685 | 27.0 | 140              | 5.5 | 625 | 24.6 | 140               | 5.5 | 790 | 31.1 | 145              | 5.7 | 715 | 28.1 | 140                 | 5.5 | 674 | 26.5 |
| TJDA-B400  | 150              | 5.9 | 900  | 35.4 | 150                | 5.9 | 700 | 27.6 | 150              | 5.9 | 635 | 25.0 | 150               | 5.9 | 800 | 31.5 | 150              | 5.9 | 725 | 28.5 | 150                 | 5.9 | 680 | 26.8 |
| TJDA-B500  | 160              | 6.3 | 930  | 36.6 | 160                | 6.3 | 715 | 28.1 | 160              | 6.3 | 645 | 25.4 | 160               | 6.3 | 810 | 31.9 | 165              | 6.5 | 730 | 28.7 | 160                 | 6.3 | 686 | 27.0 |
| TJDA-B600  | 170              | 6.7 | 960  | 37.8 | 170                | 6.7 | 730 | 28.7 | 170              | 6.7 | 655 | 25.8 | 170               | 6.7 | 820 | 32.3 | 170              | 6.7 | 740 | 29.1 | 170                 | 6.7 | 692 | 27.2 |
| TJDA-B800  | 180              | 7.1 | 1040 | 40.9 | 180                | 7.1 | 770 | 30.3 | 180              | 7.1 | 680 | 26.8 | 185               | 7.3 | 845 | 33.3 | 180              | 7.1 | 760 | 29.9 |                     |     |     |      |
| TJDA-B1000 | 200              | 7.9 | 1100 | 43.3 | 200                | 7.9 | 800 | 31.5 | 200              | 7.9 | 700 | 27.6 |                   |     |     |      |                  |     |     |      |                     |     |     |      |



### Facing options



# TJDA-B Performance



## Intermediate values

| Deflection  | Reaction   | Energy     |
|-------------|------------|------------|
| %           | %          | %          |
| 5           | 25         | 1          |
| 10          | 54         | 6          |
| 15          | 76         | 14         |
| 20          | 88         | 25         |
| 25          | 95         | 35         |
| 30          | 98         | 47         |
| 35          | 100        | 59         |
| 40          | 99         | 71         |
| 45          | 95         | 83         |
| 50          | 94         | 94         |
| <b>52.5</b> | <b>100</b> | <b>100</b> |
| 55          | 116        | 106        |

## Angle factor

| Angle (°) | $\gamma_A$  |             |
|-----------|-------------|-------------|
|           | Energy      | Reaction    |
| <b>0</b>  | <b>1.00</b> | <b>1.00</b> |
| 3         | 0.97        | 1.00        |
| 5         | 0.95        | 1.00        |
| 8         | 0.91        | 1.00        |
| 10        | 0.88        | 1.00        |
| 15        | 0.80        | 1.00        |
| 20        | 0.73        | 1.00        |

## Velocity factors

| Time (s) | $\gamma_V$ |
|----------|------------|
| 1        | 1.19       |
| 2        | 1.08       |
| 3        | 1.04       |
| 4        | 1.03       |
| 5        | 1.02       |
| 6        | 1.01       |
| 7        | 1.01       |
| 8        | 1.00       |
| 9        | 1.00       |
| ≥10      | 1.00       |

## Temperature factor

| Temperature |           | $\gamma_T$  |
|-------------|-----------|-------------|
| (°C)        | (°F)      |             |
| 50          | 122       | 0.90        |
| 40          | 104       | 0.94        |
| 30          | 86        | 0.98        |
| <b>23</b>   | <b>73</b> | <b>1.00</b> |
| 10          | 50        | 1.06        |
| 0           | 32        | 1.10        |
| -10         | 14        | 1.14        |
| -20         | -4        | 1.19        |
| -30         | -22       | 1.24        |

Values are for single units, L=1m. Standard tolerance ±10%. Please ask TekMarine if t < 4 seconds or for any other performance data.

# TJDA-B Performance (metric units)

| Model      | E = kNm, R=kN |      |      |      |      |      |      |      |      |      |      |      |      |      |
|------------|---------------|------|------|------|------|------|------|------|------|------|------|------|------|------|
|            | T07           | T08  | T09  | T10  | T11  | T12  | T13  | T14  | T15  | T16  | T17  | T18  | T19  |      |
| TJDA-B250  | E             | 10.6 | 12.2 | 13.7 | 15.2 | 15.8 | 16.5 | 17.1 | 17.7 | 18.4 | 19.0 | 19.6 | 20.3 | 20.9 |
|            | R             | 102  | 117  | 132  | 146  | 152  | 158  | 164  | 170  | 176  | 182  | 188  | 194  | 200  |
| TJDA-B300  | E             | 15.3 | 17.5 | 19.7 | 21.9 | 22.8 | 23.7 | 24.6 | 25.5 | 26.4 | 27.4 | 28.3 | 29.2 | 30.1 |
|            | R             | 123  | 140  | 158  | 175  | 183  | 190  | 197  | 204  | 211  | 218  | 225  | 232  | 240  |
| TJDA-B400  | E             | 27.2 | 31.1 | 35.0 | 38.9 | 40.5 | 42.2 | 43.8 | 45.4 | 47.0 | 48.6 | 50.2 | 51.9 | 53.5 |
|            | R             | 164  | 187  | 210  | 234  | 243  | 253  | 262  | 272  | 281  | 291  | 300  | 310  | 319  |
| TJDA-B500  | E             | 42.6 | 48.7 | 54.7 | 60.8 | 63.3 | 65.9 | 68.4 | 70.9 | 73.5 | 76.0 | 78.5 | 81.0 | 83.6 |
|            | R             | 205  | 234  | 263  | 292  | 304  | 316  | 328  | 340  | 352  | 364  | 375  | 387  | 399  |
| TJDA-B600  | E             | 61.3 | 70.1 | 78.8 | 87.6 | 91.2 | 94.9 | 98.5 | 102  | 106  | 109  | 113  | 117  | 120  |
|            | R             | 246  | 281  | 316  | 351  | 365  | 379  | 394  | 408  | 422  | 436  | 451  | 465  | 479  |
| TJDA-B800  | E             | 109  | 125  | 140  | 156  | 162  | 169  | 175  | 182  | 188  | 195  | 201  | 207  | 214  |
|            | R             | 327  | 374  | 421  | 468  | 487  | 506  | 525  | 544  | 563  | 582  | 601  | 620  | 639  |
| TJDA-B1000 | E             | 170  | 195  | 219  | 243  | 253  | 263  | 274  | 284  | 294  | 304  | 314  | 324  | 334  |
|            | R             | 409  | 468  | 526  | 585  | 608  | 632  | 656  | 680  | 703  | 727  | 751  | 775  | 798  |

Values are for single units, L= 1m (3.28ft) . Other sizes and intermediate performances are available on request. Please ask TekMarine for details.

# TJDA-B Performance (US units)

| Model      | E = ft.kip, R=kips |      |      |      |      |      |      |      |      |      |      |      |      |      |
|------------|--------------------|------|------|------|------|------|------|------|------|------|------|------|------|------|
|            | T07                | T08  | T09  | T10  | T11  | T12  | T13  | T14  | T15  | T16  | T17  | T18  | T19  |      |
| TJDA-B250  | E                  | 7.9  | 9.0  | 10.1 | 11.2 | 11.7 | 12.1 | 12.6 | 13.1 | 13.5 | 14.0 | 14.5 | 14.9 | 15.4 |
|            | R                  | 23.0 | 26.3 | 29.6 | 32.9 | 34.2 | 35.5 | 36.9 | 38.2 | 39.5 | 40.9 | 42.2 | 43.5 | 44.9 |
| TJDA-B300  | E                  | 11.3 | 12.9 | 14.5 | 16.2 | 16.8 | 17.5 | 18.2 | 18.8 | 19.5 | 20.2 | 20.8 | 21.5 | 22.2 |
|            | R                  | 27.6 | 31.5 | 35.5 | 39.4 | 41.0 | 42.6 | 44.2 | 45.8 | 47.4 | 49.0 | 50.6 | 52.2 | 53.8 |
| TJDA-B400  | E                  | 20.1 | 23.0 | 25.8 | 28.7 | 29.9 | 31.1 | 32.3 | 33.5 | 34.7 | 35.9 | 37.1 | 38.3 | 39.4 |
|            | R                  | 36.8 | 42.1 | 47.3 | 52.6 | 54.7 | 56.8 | 59.0 | 61.1 | 63.3 | 65.4 | 67.5 | 69.7 | 71.8 |
| TJDA-B500  | E                  | 31.4 | 35.9 | 40.4 | 44.9 | 46.7 | 48.6 | 50.5 | 52.3 | 54.2 | 56.0 | 57.9 | 59.8 | 61.6 |
|            | R                  | 46.0 | 52.6 | 59.1 | 65.7 | 68.4 | 71.1 | 73.7 | 76.4 | 79.1 | 81.7 | 84.4 | 87.1 | 89.7 |
| TJDA-B600  | E                  | 45.2 | 51.7 | 58.1 | 64.6 | 67.3 | 70.0 | 72.7 | 75.3 | 78.0 | 80.7 | 83.4 | 86.1 | 88.7 |
|            | R                  | 55.2 | 63.1 | 71.0 | 78.9 | 82.1 | 85.3 | 88.5 | 91.7 | 94.9 | 98.1 | 101  | 104  | 108  |
| TJDA-B800  | E                  | 80.4 | 91.9 | 103  | 115  | 120  | 124  | 129  | 134  | 139  | 143  | 148  | 153  | 158  |
|            | R                  | 73.6 | 84.1 | 94.6 | 105  | 109  | 114  | 118  | 122  | 127  | 131  | 135  | 139  | 144  |
| TJDA-B1000 | E                  | 126  | 144  | 162  | 179  | 187  | 194  | 202  | 209  | 217  | 224  | 232  | 239  | 247  |
|            | R                  | 92.0 | 105  | 118  | 131  | 137  | 142  | 147  | 153  | 158  | 163  | 169  | 174  | 179  |

Values are for single units, L= 1m (3.28ft) . Other sizes and intermediate performances are available on request. Please ask TekMarine for details.

# TJDA-B Performance (metric units)

| Model      | E = kNm, R=kN |      |      |      |      |      |      |      |      |      |      |      |      |      |
|------------|---------------|------|------|------|------|------|------|------|------|------|------|------|------|------|
|            | T20           | T21  | T22  | T23  | T24  | T25  | T26  | T27  | T28  | T29  | T30  | T31  | T32  |      |
| TJDA-B250  | E             | 21.5 | 22.2 | 22.8 | 23.4 | 24.0 | 24.7 | 25.3 | 25.9 | 26.6 | 27.2 | 27.8 | 29.2 | 30.6 |
|            | R             | 206  | 211  | 217  | 223  | 229  | 235  | 241  | 247  | 253  | 259  | 265  | 278  | 291  |
| TJDA-B300  | E             | 31.0 | 31.9 | 32.8 | 33.7 | 34.6 | 35.5 | 36.4 | 37.4 | 38.3 | 39.2 | 40.1 | 42.1 | 44.1 |
|            | R             | 247  | 254  | 261  | 268  | 275  | 282  | 289  | 296  | 304  | 311  | 318  | 334  | 350  |
| TJDA-B400  | E             | 55.1 | 56.7 | 58.3 | 59.9 | 61.6 | 63.2 | 64.8 | 66.4 | 68.0 | 69.6 | 71.3 | 74.8 | 78.4 |
|            | R             | 329  | 338  | 348  | 357  | 367  | 376  | 386  | 395  | 405  | 414  | 424  | 445  | 466  |
| TJDA-B500  | E             | 86.1 | 88.6 | 91.1 | 93.7 | 96.2 | 98.7 | 101  | 104  | 106  | 109  | 111  | 117  | 122  |
|            | R             | 411  | 423  | 435  | 447  | 459  | 470  | 482  | 494  | 506  | 518  | 530  | 556  | 583  |
| TJDA-B600  | E             | 124  | 128  | 131  | 135  | 139  | 142  | 146  | 149  | 153  | 157  | 160  | 168  | 176  |
|            | R             | 493  | 507  | 522  | 536  | 550  | 564  | 579  | 593  | 607  | 621  | 636  | 667  | 699  |
| TJDA-B800  | E             | 220  | 227  | 233  | 240  | 246  | 253  | 259  | 266  | 272  | 279  | 285  | 299  | 314  |
|            | R             | 658  | 677  | 696  | 715  | 734  | 753  | 772  | 791  | 810  | 829  | 848  | 890  | 932  |
| TJDA-B1000 | E             | 344  | 354  | 365  | 375  | 385  | 395  | 405  | 415  | 425  | 435  | 445  | 468  | 490  |
|            | R             | 822  | 846  | 870  | 893  | 917  | 941  | 965  | 988  | 1012 | 1036 | 1059 | 1112 | 1165 |

Values are for single units, L= 1m (3.28ft) . Other sizes and intermediate performances are available on request. Please ask TekMarine for details.

# TJDA-B Performance (US units)

| Model      | E = ft.kip, R=kips |      |      |      |      |      |      |      |      |      |      |      |      |      |
|------------|--------------------|------|------|------|------|------|------|------|------|------|------|------|------|------|
|            | T20                | T21  | T22  | T23  | T24  | T25  | T26  | T27  | T28  | T29  | T30  | T31  | T32  |      |
| TJDA-B250  | E                  | 15.9 | 16.3 | 16.8 | 17.3 | 17.7 | 18.2 | 18.7 | 19.1 | 19.6 | 20.1 | 20.5 | 21.6 | 22.6 |
|            | R                  | 46.2 | 47.5 | 48.9 | 50.2 | 51.5 | 52.9 | 54.2 | 55.5 | 56.9 | 58.2 | 59.5 | 62.5 | 65.5 |
| TJDA-B300  | E                  | 22.9 | 23.5 | 24.2 | 24.9 | 25.5 | 26.2 | 26.9 | 27.6 | 28.2 | 28.9 | 29.6 | 31.0 | 32.5 |
|            | R                  | 55.4 | 57.0 | 58.6 | 60.2 | 61.8 | 63.4 | 65.0 | 66.7 | 68.3 | 69.9 | 71.5 | 75.0 | 78.6 |
| TJDA-B400  | E                  | 40.6 | 41.8 | 43.0 | 44.2 | 45.4 | 46.6 | 47.8 | 49.0 | 50.2 | 51.4 | 52.6 | 55.2 | 57.8 |
|            | R                  | 73.9 | 76.1 | 78.2 | 80.3 | 82.5 | 84.6 | 86.7 | 88.9 | 91.0 | 93.1 | 95.3 | 100  | 105  |
| TJDA-B500  | E                  | 63.5 | 65.4 | 67.2 | 69.1 | 70.9 | 72.8 | 74.7 | 76.5 | 78.4 | 80.3 | 82.1 | 86.2 | 90.3 |
|            | R                  | 92.4 | 95.1 | 97.7 | 100  | 103  | 106  | 108  | 111  | 114  | 116  | 119  | 125  | 131  |
| TJDA-B600  | E                  | 91.4 | 94.1 | 96.8 | 99.5 | 102  | 105  | 108  | 110  | 113  | 116  | 118  | 124  | 130  |
|            | R                  | 111  | 114  | 117  | 120  | 124  | 127  | 130  | 133  | 137  | 140  | 143  | 150  | 157  |
| TJDA-B800  | E                  | 163  | 167  | 172  | 177  | 182  | 186  | 191  | 196  | 201  | 205  | 210  | 221  | 231  |
|            | R                  | 148  | 152  | 156  | 161  | 165  | 169  | 173  | 178  | 182  | 186  | 191  | 200  | 210  |
| TJDA-B1000 | E                  | 254  | 261  | 269  | 276  | 284  | 291  | 299  | 306  | 314  | 321  | 329  | 345  | 361  |
|            | R                  | 185  | 190  | 195  | 201  | 206  | 211  | 217  | 222  | 228  | 233  | 238  | 250  | 262  |

Values are for single units, L= 1m (3.28ft) . Other sizes and intermediate performances are available on request. Please ask TekMarine for details.



# UHMW-PE Facings

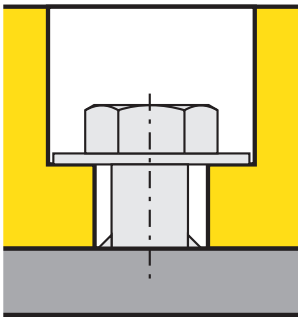
TekMarine protects every fender panel with top quality UHMW-PE (Ultra High Molecular Weight Polyethylene) facings. Impact resistant and very low in friction, UHMW-PE allows vessels to move smoothly past a fender system without snagging or abrasion. It is also popular for heavy duty impact protection where fenders are not required.

Easy to machine and install, UHMW-PE comes in many colors and several quality grades.

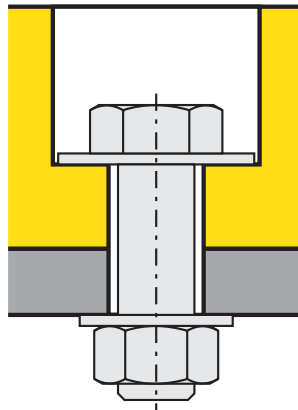
UHMW-PE does not rot, split or decay and does not suffer from UV or ozone damage. It is fully recyclable.



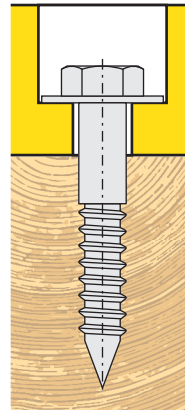
Steel panel with welded stud



Open steel structure



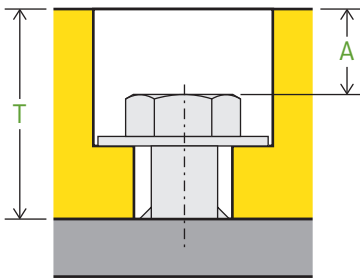
Timber structure



The fixing type depends on the underlying structure. Welded studs or stronger 'blind boss' fixings are used for steel panels. Oversize washers are recommended when bolting through open steel structures.

Fixings are available in various steel grades and finishes: please ask TekMarine for more details.

## Wear Allowances



| T   | A  |
|-----|----|
| 30  | 5  |
| 40  | 10 |
| 50  | 15 |
| 70  | 25 |
| 100 | 40 |

A small increase in the thickness of UHMW-PE can dramatically improve the working life of the facing, protecting the fender and structure for longer.

# Physical Properties

| Property                     | Test method   | Metric            |                        |                        | US Units              |                        |                        |
|------------------------------|---------------|-------------------|------------------------|------------------------|-----------------------|------------------------|------------------------|
|                              |               | Unit              | Virgin                 | Recycled               | Unit                  | Virgin                 | Recycled               |
| Density                      | ASTM D-792    | kg/m <sup>3</sup> | 930                    | 945                    | lb/ft <sup>3</sup>    | 58.01                  | 58.9                   |
| Molecular Weight             | Viscosimetric | g/mol             | 4.2 × 10 <sup>6</sup>  | 4.2 × 10 <sup>6</sup>  | g/mol                 | 4.2 × 10 <sup>6</sup>  | 4.2 × 10 <sup>6</sup>  |
| Yield Strength               | ASTM D-638    | MPa               | 21                     | 20                     | psi                   | 3050                   | 2900                   |
| Ultimate Strength            | ASTM D-638    | MPa               | 40                     | 34.3                   | psi                   | 5800                   | 4974                   |
| Elongation at Break          | ASTM D-638    | %                 | 250                    | 218                    | %                     | 250                    | 218                    |
| Impact Strength              | ASTM D-4020   | kJ/m <sup>2</sup> | 70                     | 50                     | ft-lb/in <sup>2</sup> | 34                     | 24                     |
| Tensile Impact               | DIN 53448     | kJ/m <sup>2</sup> | 2200                   | 1600                   | ft-lb/in <sup>2</sup> | 1050                   | 762                    |
| Abrasion Index (Sand Slurry) | ASTM 965      | AR-01 Steel=100   | 90                     | 116                    | AR-01 Steel=100       | 90                     | 116                    |
| Hardness                     | ASTM D-2240   | Type D            | 68                     | 70                     | Type D                | 68                     | 70                     |
| Static Friction              | ASTM D-1894   | -                 | 0.15                   | 0.15-0.20              | -                     | 0.15                   | 0.15-0.20              |
| Dynamic Friction             | ASTM D-1894   | -                 | 0.12                   | 0.14-0.16              | -                     | 0.12                   | 0.14-0.16              |
| Operating Temperature        |               | °C                | -80 to +80             | -80 to +80             | °F                    | -112 to 176            | -112 to 176            |
| Thermal Expansion            | ASTM D-696    | K <sup>-1</sup>   | 2.0 × 10 <sup>-4</sup> | 1.8 × 10 <sup>-4</sup> | °F <sup>-1</sup>      | 1.1 × 10 <sup>-4</sup> | 1.1 × 10 <sup>-4</sup> |
| Melting Point                | ASTM D-3417   | °C                | 137-143                | 137-143                | °F                    | 278-289                | 278                    |
| Water Absorption             | ASTM D-570    | %                 | 0                      | 0                      | %                     | 0                      | 0                      |

## Friction comparisons

| Material       | Coefficient of friction against steel (μ) |
|----------------|---|
| <b>UHMW-PE</b> | <b>0.15-0.2</b>                           |
| HD-PE          | 0.3                                       |
| Nylon          | 0.2                                       |
| Rubber         | 0.6-0.7                                   |
| Timber         | 0.4                                       |
| Steel          | 0.5                                       |

The coefficient of friction of UHMW-PE varies according to the material grade and the pressure applied to the panel's surface.

These coefficients of friction only apply to smooth contact surfaces.

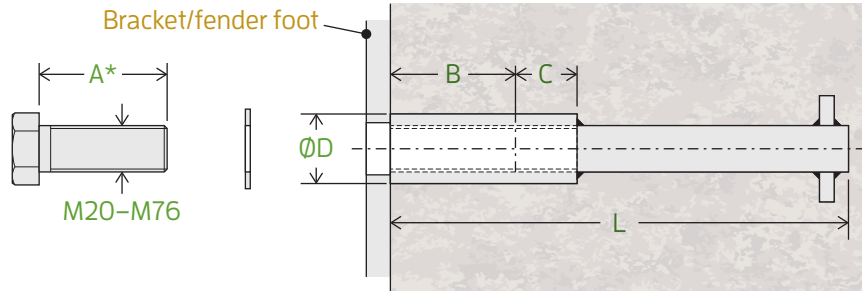
Source: BS 6349-4:2014

For more information please consult TekMarine.



# Anchors

Anchors are available in galvanized or stainless steel finishes, in various strength grades and in metric or inch sizes. Ask TekMarine for details if the required specification is not listed.



## Cast-in type

Cast-in anchors are preferred for new concrete structures. The threaded anchor links via a long tail to an anchor plate, for even load distribution.

\* Dimension A varies according to the thickness of the bracket or fender foot and should always be calculated.

| Anchor | B   | C  | ØD  | L   | Weight |
|--------|-----|----|-----|-----|--------|
| mm     | mm  | mm | mm  | mm  | kg     |
| M20    | 50  | 20 | 30  | 214 | 0.9    |
| M24    | 60  | 25 | 35  | 258 | 1.5    |
| M30    | 70  | 30 | 45  | 318 | 2.7    |
| M36    | 80  | 40 | 55  | 328 | 4.2    |
| M42    | 85  | 45 | 65  | 416 | 6.9    |
| M48    | 100 | 50 | 75  | 431 | 10.2   |
| M56    | 105 | 60 | 85  | 436 | 14.0   |
| M64    | 128 | 80 | 100 | 600 | 29.8   |
| M76    | 152 | 90 | 114 | 700 | 46.1   |

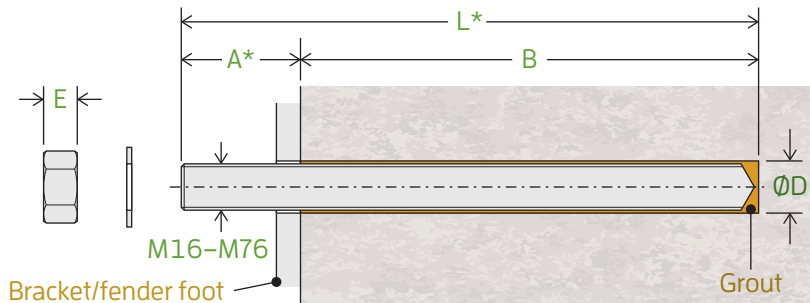
## Chemical type

Chemical anchors are used for existing concrete structures.

Please ask about glass grout capsules and other grouting systems.

For an accurately drilled hole, allow for grout wastage of 10%–30%, depending on grout type.

\* Dimensions A and L depend on the bracket/fender foot thickness and the concrete grade, and should always be calculated.



| Anchor | B   | ØD | E  | Grout |
|--------|-----|----|----|-------|
| mm     | mm  | mm | mm | ml    |
| M16    | 140 | 20 | 13 | 16    |
| M20    | 170 | 24 | 16 | 23    |
| M24    | 210 | 28 | 19 | 34    |
| M30    | 280 | 35 | 24 | 71    |
| M36    | 360 | 42 | 29 | 132   |
| M42    | 420 | 50 | 34 | 243   |
| M48    | 460 | 54 | 38 | 221   |
| M56    | 500 | 64 | 45 | 377   |
| M64    | 560 | 72 | 51 | 479   |
| M76    | 670 | 84 | 61 | 674   |



# 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<sup>1</sup> and wrapped cylindrical<sup>2</sup> fenders is conducted in-house, with an option for third party witnessing, using full size fenders in accordance with the PIANC 2002<sup>3</sup> 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  $\pm$  8cm/min.
- The test specimen is temperature stabilized to 23°C  $\pm$  5°C.<sup>4</sup>
- Reaction force<sup>5</sup> is recorded at intervals to at least a deflection at which the permitted<sup>6</sup> minimum energy absorption is achieved.
- Energy absorption<sup>5</sup> is determined as the integral of reaction and deflection, calculated using Simpson's Rule. The results of a pre-compression cycle<sup>6</sup> and subsequent 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<sup>7</sup> reaction force and more than the minimum permitted<sup>7</sup> energy absorption.<sup>8</sup>
- Sampling is 10% of fenders (rounded up to a unit).<sup>9</sup>
- 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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