Fender System Front Panel General Information

1. Purpose of Fender Panels

At forefront of today's marine fender technology are the buckling column rubber fenders, namely the cone fenders, element fenders, and super cell fenders. These fenders offer relatively higher energy absorption capacity while yielding relatively lower reaction force than earlier generation fenders at comparable standoff and cost. Most buckling column fenders require a front panel to form a system. This panel serves as a controlled contact surface between the rubber fender components and the ship's hull. The main purposes of the panels are:

- Provide a barrier high enough, low enough, far enough, and strong enough, to prevent all docking vessels from intruding into minimum standoff space from the pier
- Provide a large enough area to spread fender reaction force and limit the pressure on the vessel hull to allowable extent under worst design impact
- Reduces lateral / shear strains to the fender system, in the plane perpendicular to the direction of fender design compression with low friction contact surface
- Suit ship hull features such as flare angle and belt to minimize impact
- Allow installation of digital fender monitoring system (See BIM Berthing Impact Monitoring System literature)

Specialized in fendering since 1991, Zalda Technology has extensive experience in designing and manufacturing fender panels according to design criterions and beyond.

2. Panel Features

- Design:

Fender panel design is integral part of the fender system design process. Panel outer dimension designs are based on consideration of vessel hull pressure limit / draft range / bow radius / flare angle / belting / navigation limits, against fender characteristics, pier conditions and environmental conditions. Panel internal structure and material are engineered based on fender system internal dynamics. Connections to other system components such as fender elements, PE pads, chains, hinges and VTLMs / HTLMs are added to ensure system integrity with details down to material specifications / geometry / tolerance / adjustment range etc.. Corrosion protection design, such surface treatment and cathodic protection design, is added based on panel types / base materials, and environmental factors.
By default, Zalda panel structures are mostly based on proven design templates and then fine-tuned by traditional hand calculations with FEM proof analysis. Structural design safety factor is 3+ over worst-case scenario impact. All designs are checked by at least three engineers, against project requirements and fender system parameters, before they are released to customer for confirmation. Upon customer confirmation, final design will be checked once again before released for production.

Standard and some common optional fender panel features are listed in the table below.

### Panel Feature Table

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<th>Features</th>
<th>Standard</th>
<th>Common Options</th>
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<td>Panel Type</td>
<td>Closed Box</td>
<td>Open Rack</td>
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<td></td>
<td></td>
<td>Air Tight</td>
</tr>
<tr>
<td>Edge Finish</td>
<td>Top and Sides 45 Deg</td>
<td>4 Sides 45 Deg</td>
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<tr>
<td></td>
<td></td>
<td>4 Sides Round</td>
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<td></td>
<td></td>
<td>Bottom Deflector</td>
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<tr>
<td>Panel Structure</td>
<td>ASTM A36 10mm</td>
<td>ASTM A572</td>
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<tr>
<td>PE</td>
<td>Virgin UHMW PE 32mm</td>
<td>Reprocessed UHMW PE</td>
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<td></td>
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<td>HD PE</td>
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<tr>
<td>Bolt Connection</td>
<td>Galv. ASTM A307-A563</td>
<td>Galv. A449</td>
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<tr>
<td></td>
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<td>AISI SS304</td>
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<tr>
<td></td>
<td></td>
<td>AISI SS316</td>
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<tr>
<td>U Ring</td>
<td>ASTM A36 50mm</td>
<td></td>
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<tr>
<td>Lifting Ring</td>
<td>ASTM A36 ( x2 )</td>
<td></td>
</tr>
<tr>
<td>Coating</td>
<td>Coal Tar Epoxy 300 um</td>
<td>Polyurethane</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Polyamide</td>
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<tr>
<td></td>
<td></td>
<td>+ Zn Galv. / AL Metalizing</td>
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<tr>
<td>Sacrificial Anodes</td>
<td>Aluminum Alloy ( x2 )</td>
<td>Zinc Alloy</td>
</tr>
</tbody>
</table>

** Other options such as reflective strip, cathodic system, and built in mooring devices / safety devices available. Contact us for details. We also built to customer requirements.

** Panel Type

Open rack design are relatively easier to make but will suffer from corrosion on both sides of the steel plate in most instances. Therefore special considerations need to be given on corrosion allowance and anti corrosion measures.

Airtight design is a box made to be air and waterproof. It is relatively costly due to higher welding standard and cap nut - stud connection to PE pads and rubber fender elements. Every airtight panel needs to pass pressurized tests under relevant test standards.

Close box design is the most common design because it offers a balance between cost and performance. Nuts are welded into the plates to allow bolt on connection with PE pad and rubber fender element. Close box design is not waterproof but corrosion is deterred.
Other Features

Zalda Technology panels are equipment with 2 standard lifting rings, which enables the panel alone or panel – fender assembly to be lifted vertically with a crane during transportation, assembly, or installation. Each panel is also equipped with two standard sacrificial anodes, which slows down the corrosion process and extends panel service life. Panel contact face can be curved or chamfered to suit hull features. Panel edge finish should be selected according to the hull features and relative elevation range of the various vessels to be considered in fender system design process. A reflective strip can be added to the panel surface that will illuminate to serve as navigational aids at night. Mooring rings and cleats for parking of small / service crafts can be built into the panel. Safety access ladder can be built into the panel to make water escape easier.

Other special features we offer include but not limited to special panel / bolt / surface pad materials, special standoff compensators, built in walkways, built in electronic devices, built in anti fouling & anti oil devices, built in safety devices, special coatings, special sacrificial anodes, special wire / pile / wale connections etc.. Please contact us with your custom requirements.

3. Fabrication / Surface Preparation / QC

Zalda Technology front panels are fabricated from plates with certified materials with best workmanship available in the fender industry. All materials are tested / checked against mill certificates before admitted. Panel members are cut according to computer programs and manually measured before welding. Manual welding by certified welder is only performed when automatic welding is not possible. All welds are checked against welding procedures visually. Selected welds at predetermined and randomly chosen locations are checked by non-destructive method such as ultrasonic and magnetic particle inspection. Panel structure geometry is carefully measured after welding and all heat deformations are properly corrected. All panels are serialized according to production order and are clearly marked on the inside and outside by QC personnel after proper check points. All airtight panels need to pass pressurized testing at set pressure level for set duration.

All panels are blasted to SSPC-10 or Sa 2 1/2 before surface preparation. Designated coating is then applied via professional equipments, such as airless stray, at proper temperature / humidity and left for cure for sufficient amount of time according to proper coating procedures. Upon completion of each coat, DFT readings are checked with redundant thickness gauges at various predetermined or randomly selected locations on each panel to determine if the design thickness is reached. Upon completion of the coating system, further tests are carried out to determine the overall adequacy of the coating system.
Proper ID plates are attached to each panel when it passes all relevant QC procedures. As a part of Zalda’s ISO certified quality assurance system, all our QC records, including production - test records, photo – video records, and other pertinent work procedure records throughout the manufacturing process are permanently kept for possible future investigation.

For orders with 3rd party authority certification requirements, 3rd party inspector will be grant access to our plant at any time during the manufacturing process. Our complete production schedule will be presented to the 3rd party representative for him to determine the necessary visits and durations when our assistance is needed. A written inspection plan involving cooperation from our side will be drafted to both parties’ agreement and can be modified with further agreement. Full cooperation will be provided to the 3rd party representative according to the inspection plan. Our internal QC procedures will be unaffected for any project with 3rd inspection requirements.

4. Shipping

Zalda Technology fender system front panels are designed to withstand impacts of large marine vessels and are heavily constructed with steel plates covered with anti-corrosion metal or chemical / paint coating. Plastic low friction pads are attached to each panel on the vessel contact side while connection devices such as U rings stick out from the other. In order to protect the panel coating and especially the UHMW PE pads, all panels are bundled in groups of two if possible, with each panel’s vessel contact side facing each other. All panels are wrapped in proper material to protect coating finish. Panels are loaded into containers on steel frames and restrained to the container floor / wall to prevent cargo shifting during long distance transportation. All packages are properly marked with items such as packing lists, shipping marks, package numbers and reference numbers, according to Zalda standard or project requirements. Sufficient amount of touch up coating is provided with all shipments contain fender panels. Photo and video records of the state of shipment are permanent kept for possible future investigation.

5. Handling & Unloading

Heavy equipment is required to unload the panels in most cases. Loading docks are preferred when unloading panels from standard containers. Extreme caution is advised when opening the containers and moving the panels. Read packing list and other provided documents for information on package weight and determine the equipment needed prior to unloading containers.

To unload the panels from container, follow these instructions:

- Use caution in the entire process. Stand clear of the panels at any time.
- Carefully open the container, watch for possible fallouts.
- Locate the front panels, cut and remove all fastening devices such as wood blocks, steel wires, tires, air bags that keeps the panel bundles and the steel frame in place.
In case of unloading from standard containers:

- Containers cannot be unloaded on chassis. Level floor inside and outside of the opening of the container is needed for safe unloading. Unload containers on a loading dock or a temporary sliding platform, or lift the containers to place them on level ground before unloading.
- Locate and attach wire ropes to eyes on both sides of the shipping and secure the other end of the steel rope to available heavy machinery such as a forklift, a truck or a crane.
- Horizontally pull the frame and slide it very slowly out of the container. Steel pipes, plates, plywood, and similar devices can be used to smooth the process. Repeat until all frames are pulled out of the container.

In case of unloading from open top containers:

- Carefully remove canvas on top of the container.
- Locate and attach wire rope to all lift eyes on the bottom of the frame and lift the frame very slowly out of the container. Repeat until all frames are lifted out of the container.

Use the following cautions for storage before installation:

- Read packing list and other provided documents for information on package weight and determine the equipment needed prior to unloading containers.
- Lift all two-panel bundles off the frames with the U rings or lifting pad eyes on both panels and place the bundles on the ground.
- Loosen bolt and cut wire ropes so the two panels can be separated for all two-panel bundles.
- Lift the panel on top of each two-panel bundle and turn it during the lifting until it can sit on its U ring side. (All panels should be sitting on the U ring side with the UHMW PE side facing up before final assembly and installation.
- Avoid scratching the UHMW PE pads and coating as much as possible and keep them out of contact from sharp or hard objects during the entire process.
- Install fender systems according to installation instructions as soon as they were received to reduce the chance of incidental damage.
- TOUCH UP ALL COATING DAMAGE BEFORE STORAGE AND AFTER FENDER SYSTEM INSTALLATION

6. Maintenance

Maintenance procedures might differ with different panel designs. Refer to recommended maintenance procedure documents provided with shipment.

7. Contact us

Feel free to contact our local representative or Zalda directly with any questions, suggestions, comments and requirements.

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