



PNEUMATIC FENDERS IN THE SPOTLIGHT

PNEUMATIC FENDERS

A GUIDE TO PRIME-QUALITY
PNEUMATIC FENDER MANUFACTURING

SHIBATAFENDERTeam

▶ on the safe side

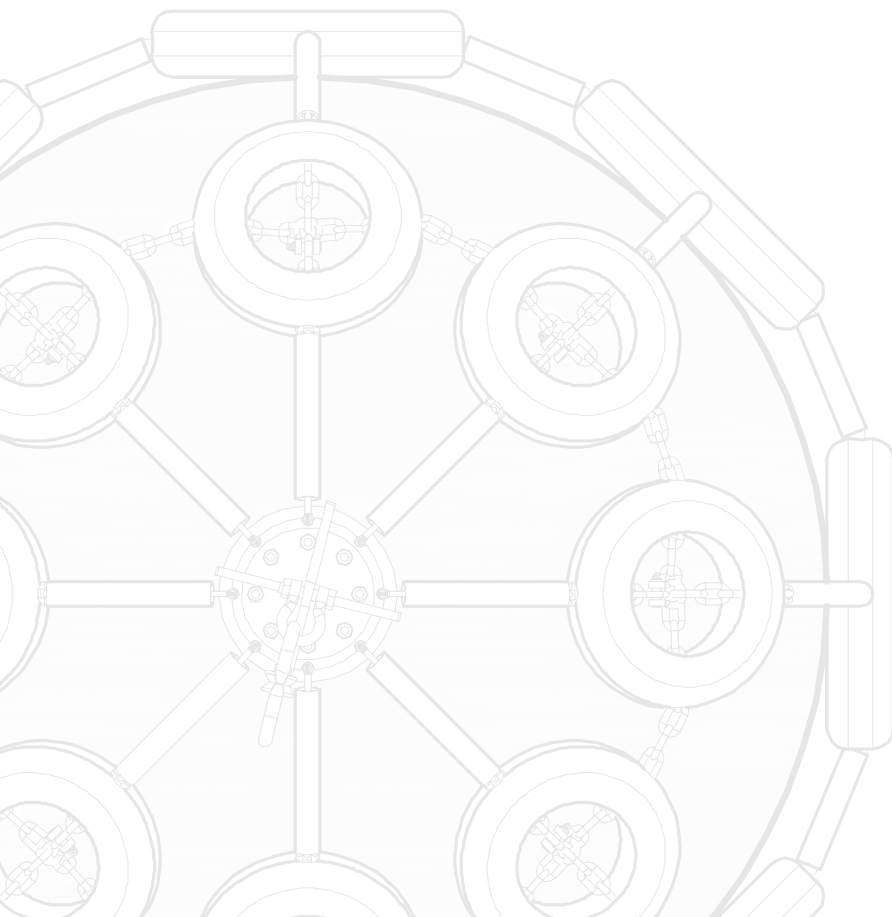
INTRODUCTION

Fenders are an integral element in marine safety and the protection of people, port infrastructures, and vessels. Quality and performance of all fender types are vitally important. Yet there are no rules dictating how to manufacture safe, reliable and durable marine fenders. International guidelines and standards such as PIANC2002 and BS6349 exclusively refer to the physical properties of the finished fender.

For this reason, the ShibataFenderTeam Group has developed a holistic approach to the complexity of the manufacturing processes and the varying requirements for different fender types – which is built on decades of practical knowledge and experience.

Pneumatic fenders – also commonly known as Yokohama or floating fenders – are an adequate and effective solution for ports with extreme tidal variations, ship-to-ship operations (liquid cargo vessels, FSRU) or temporary berthing. They are deployed to withstand harsh weather conditions and tremendous berthing forces.

This fender type consists of reinforced, abrasion resistant rubber layers and is being filled with air. This combination creates its unique proportional increase of energy and reaction, low hull pressure and the possibility to be stored on deck if deflated. Pneumatic fenders are designed according to ISO 17357-1:2014, an international standard providing guidelines on essential pneumatic fender criteria such as material, performance, dimensions, guaranteed energy absorption (GEA), as well as test and inspecting procedures.



FENDER TYPES

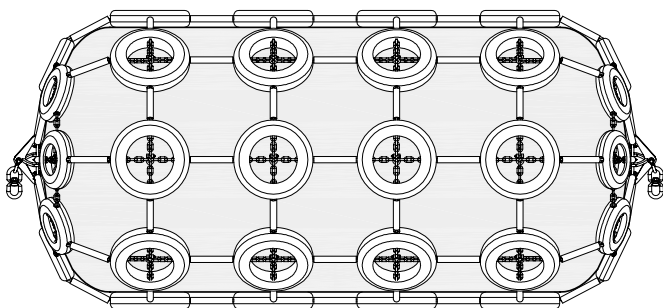
There are two different types of pneumatic fenders: net-type (equipped with a chain & tire net) and sling-type.

They are available in diameters ranging from 300 mm to 4,500 mm and lengths ranging from 500 mm to 9,000 mm. Depending on the energy absorption (EA) mandatory for the respective project, diameters can be individually altered to suit.

According to ISO 17357, high pressure pneumatic fenders have an initial pressure of 50 kPa or 80 kPa to provide the prescribed GEA for each fender size and grade.



Sling-Type



Net-Type

THE AIRBAG PARADOX

It is a common misconception in the maritime industry that launching airbags are similar to pneumatic fenders.

In fact, the two marine products serve entirely different purposes. Technology, structure, and production method of airbags cannot be compared to the specifications of pneumatic fenders:

Pneumatic Fenders

- ▶ Have to fulfil high quality requirements regulated by ISO 17357
- ▶ Protect berthing structures and vessels in ports and during ship-to-ship operations
- ▶ The quality and the performance of every single fender is of utmost importance

Airbags

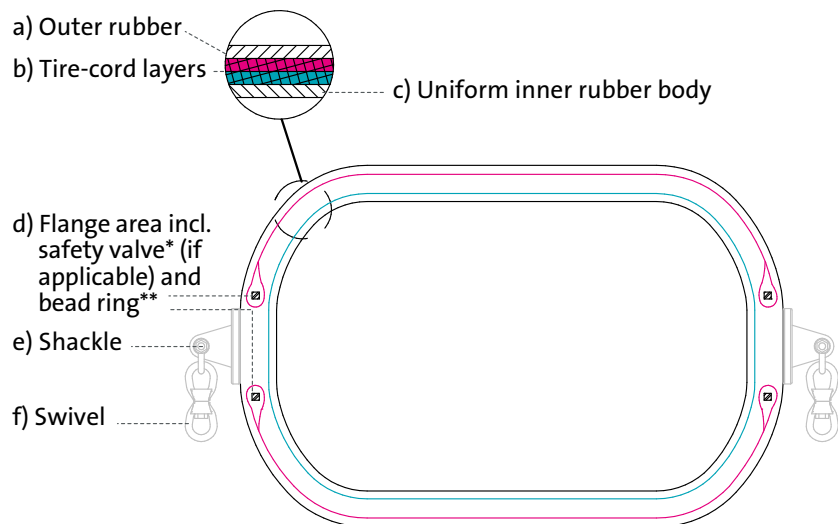
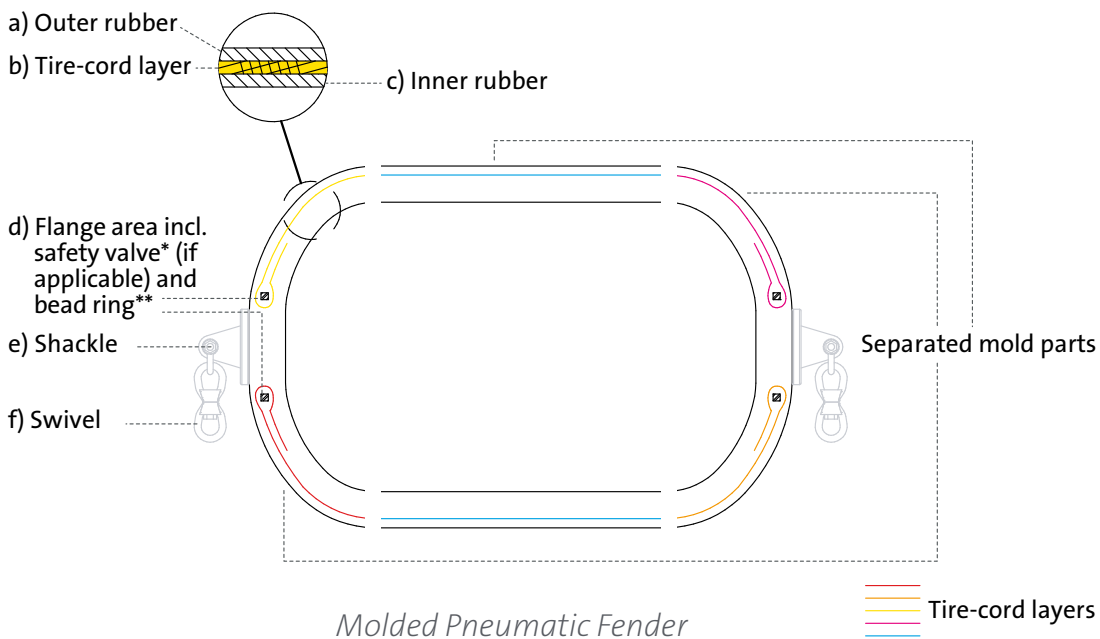
- ▶ The quality requirements are regulated by ISO 14409
- ▶ Facilitates ship-launching operations
- ▶ Work in groups, which reflects in a simpler manufacturing method

THE DETAILS

The two manufacturing methods for pneumatic fenders that are commonly performed in the fender industry are wrapping and molding, both complying with the ISO standard. The manufacturers decide which approach is the most workable for achieving the quality standards with their factory set-up.

Pneumatic fenders consist of

- a) an outer rubber,
- b) a synthetic tire-cord layer,
- c) an air-tight inner rubber body,
- d) a flange area including safety valve* (if applicable) and bead ring**,
- e) a shackle,
- f) a swivel.

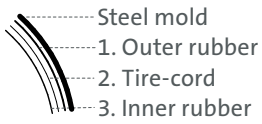
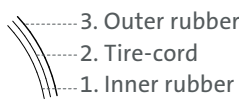
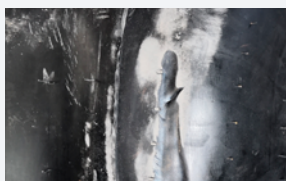
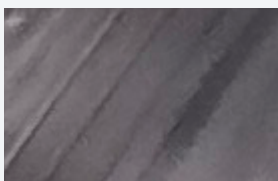


* Flange area and safety valve not shown for clarity.

** Bead ring only required for sling-type according to ISO 17357, section 6.1.6.

WRAPPING VS. MOLDING

Both wrapping and molding are proven methods to manufacture a prime-quality pneumatic fender, although there are several significant differences. We, the ShibataFenderTeam Group, have subsequently compiled the most striking differences between the two processes in pneumatic fender manufacturing.

	Molded Pneumatic Fenders	Wrapped Pneumatic Fenders	Commentary
Production order of layers	 <p>Steel mold 1. Outer rubber 2. Tire-cord 3. Inner rubber</p>	 <p>3. Outer rubber 2. Tire-cord 1. Inner rubber</p>	<ul style="list-style-type: none"> ▶ The different order of layer production has several implications on the subsequent aspects
Integrity of individual layers	Layers of separated mold parts need to be stitched together	Uniform inner rubber body No stitching needed for tire-cord and outer rubber body as wrapping is done in one flow for entire fender	<ul style="list-style-type: none"> ▶ Stitched layers due to separated mold parts are potentially vulnerable to failing ▶ Wrapped fenders provide even strength ▶ Molds limit the variation of dimensions by their given size ▶ Higher flexibility using wrapping method
Angle of tire-cord layers	45-60°	50-65°	<ul style="list-style-type: none"> ▶ Cord layers can be laid at the ideal angle of 60° with both methods
Release of trapped air between layers	From inside of the fender through tiny holes in the tire-cord and the inner rubber	From outside of the fender through tiny holes in the tire-cord and the outer rubber	<ul style="list-style-type: none"> ▶ Because of the mold, workers need to enter the inside of the fender, leaving footprints on the inner rubber layer and the cord layers (may compromise the integrity of the inner layers) ▶ Holes in the inner rubber layer are more likely to cause air leakage than holes in the outer rubber layer ▶ Holes in the outer layer are compliant with ISO 17357
Inner rubber air-tightness	Cannot be ensured	Is tested for 72 hours before application of the tire-cord layer	<ul style="list-style-type: none"> ▶ Only production of the inner rubber layer prior to the outer rubber layer allows for proper checking of air leakage
Finishing process of fender surface	Necessary to smoothen out the stitched overlapping areas resulting from separated mold parts 	Not necessary because there are no stitched areas 	<ul style="list-style-type: none"> ▶ Slightly uneven but consistent surface created by wrapping method does not have any impact on the quality of the fender ▶ Repairing and polishing of molded fenders can potentially impact the integrity of the fenders
Flange area	Needs to grant access for workers to release trapped air and check for air-tightness from the inside	Can be bonded with the inner rubber layer for a tight fit as entering the inside of the fender is not necessary	<ul style="list-style-type: none"> ▶ A flange that is bonded with the inner rubber layer ensures a more durable fender and more safety in cases of bursting fenders, if overcompressed

FENDER FACTS

- ▶ If low-quality raw material is used, the fender cannot pass the physical properties defined by the ISO standard regardless of the manufacturing method.
- ▶ The weight of a fender depends merely on the materials used in the rubber compound and is not affected by the manufacturing method.
- ▶ ISO 17357 does not specify properties like thickness and density of the rubber, the chemical composition of the rubber, or the bonding strength between the layers. All of these characteristics depend merely on the material quality and the process control of the manufacturer.
- ▶ The tire-cord properties of density and tensile strength are defined in the ISO. The results depend exclusively on the quality of the raw materials.



SFT'S TRUSTED OPINION



- ▶ A molded pneumatic fender with footprints on the inner rubber layer and without an ensured inner rubber air-tightness may be a potential safety risk for the operation. Therefore, SFT recommends clarifying these details with your supplier.
- ▶ When trapped air is released through the inner rubber body from molded fenders, the mandatory air-tightness is at risk.
- ▶ End fittings should be made of one solid piece with a thick guy chain attached, instead of being built up by several thin chains. Multiple thin chains can tangle and make the fender less reliable and safe.
- ▶ In contrast to wrapped pneumatic fenders, the inner flange of molded fenders is not bonded with the inner rubber layer. In the unlikely event of a fender blasting, the whole flange could shoot away like a “cannonball”, which poses a serious safety hazard.

In general: *The quality of all fender types should be judged by the fender's physical properties and according to standard-compliance test results.* These results of physical properties testing are the only reliable indicator of a high-quality fender while the manufacturing method and how to achieve the required properties is entirely at the discretion of the manufacturer.

CONCLUSION

There are many factors that determine the final quality of a pneumatic fender such as the raw material, the design, the process control, the trained operators and many more – the decision for one or the other manufacturing method is entirely based on the manufacturer's pool of experience.

Since ISO 17357 only specifies the physical properties for pneumatic fenders, and as other industry standards and guidelines do for other fender types, a holistic view that goes beyond the mere production is all the more important.

A proven track record, a corresponding number of references, and a product liability insurance are vital aspects to look for in a trusted fender supplier.

With 50+ years of experience, over 100,000 fenders in service, and 90+ years of experience in the production of rubber products, the ShibataFenderTeam Group is the leading international fender manufacturer with a unique and holistic approach to high-quality fender manufacturing.

REFERENCES



Pneumatic Fenders with chain & tire nets
Ferry Terminal Ponto Colombo T7
Genova, Italy (2016)

More information



Pneumatic Fenders with chain & tire nets
Cruise Terminal
Rostock, Germany (2016)

More information



Pneumatic Fenders with chain & tire nets
Cruise Terminal
Montreal, QC, Canada (2016)

More information



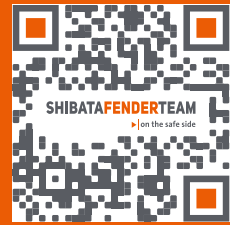
Grey sling type Pneumatic Fenders
Navy
Karlskrona, Sweden (2009)

More information

For comprehensive information on rubber compounding, mixing, manufacturing, curing and testing, download our **SFT Whitepaper Series**. The Whitepaper Series is also available in Spanish and French on our **website**.



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