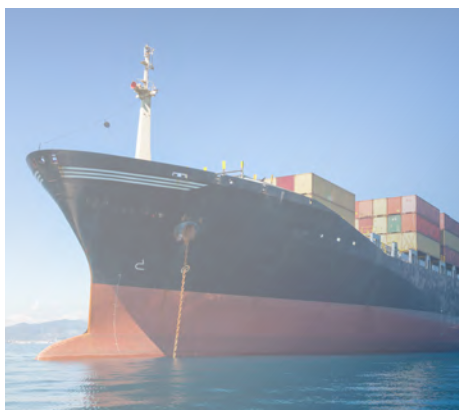




# MAINTAINING ASSET INTEGRITY IN THE MARINE INDUSTRY

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Belzona Protective Coatings and Repair Composites

## OUR HISTORY

Established in 1952, Belzona has pioneered innovative polymer technology that has revolutionised industrial repair and maintenance procedures. Today, Belzona is the world leader in the supply of polymer repair composites and industrial protective coatings and is continuously developing solutions to meet the ever increasing market demand.



*Durable coatings for corrosion, erosion and cavitation protection*



*Cold applied composites for bonding, forming and rebuilding*



*100% solids chocking compounds for installation of equipment*



*High performance polyurethanes for flexible repairs*

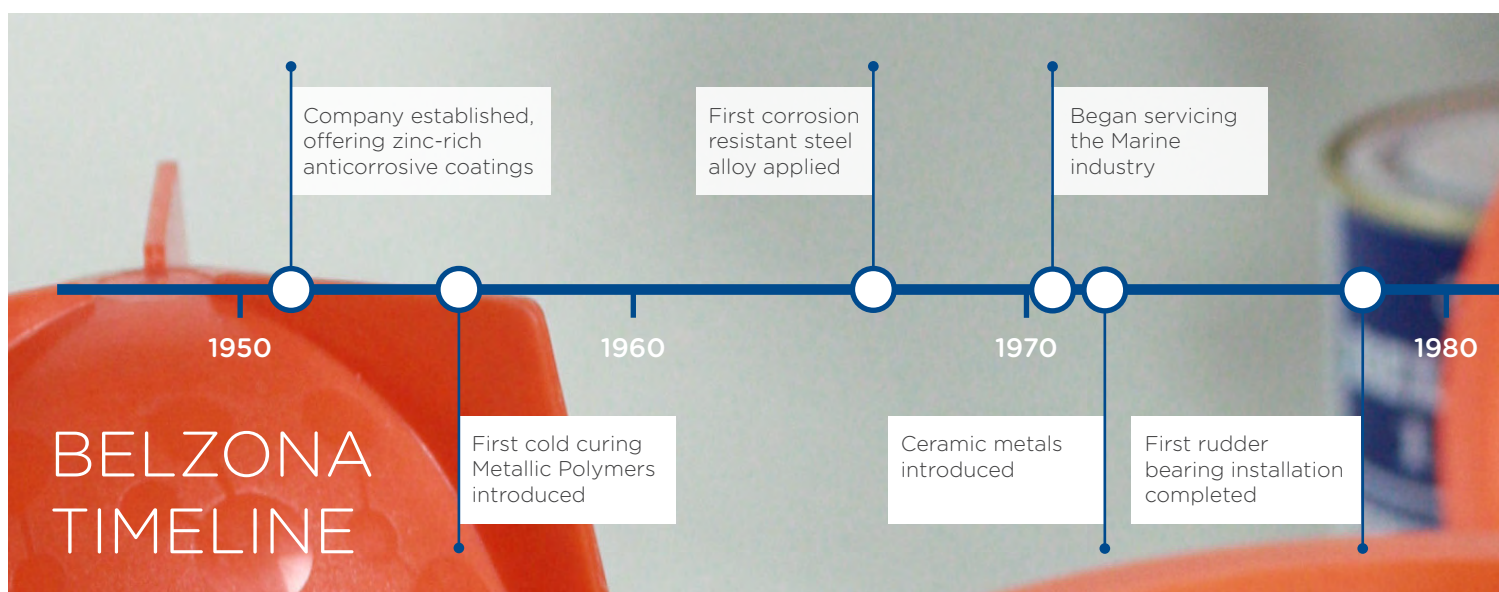
## VERSATILE SOLUTIONS TO FIT SPECIFIC NEEDS

Marine vessels routinely face varied and severe operating conditions. Due to many metallic components being exposed to weather, salt water and galvanic effects, being able to deal with the effects of, or even prevent corrosion, is critical. Marine equipment also suffers from cavitation, impingement and entrainment, which can lead to performance failure of conventional coatings and lead to further corrosion.

For either new construction or maintenance and repair, Belzona offers long-term protection and repair solutions proven by years of successful experience with ships and offshore structures. Our unique solutions are designed to fit each client's specific needs, helping them to:

- Reduce capital expenditure
- Lower maintenance costs
- Improve efficiency and safety
- Reduce dry docking time
- Simplify maintenance procedures
- Extend equipment and asset life

Our range of coatings and composites has been carefully formulated to address the various issues faced by the Marine industry. We take pride in the quality of our materials as well as the comprehensive training and field support we provide to ensure the highest possible application standards.



# GLOBAL PRESENCE - LOCAL SUPPORT

Belzona have over 140 Distributors in more than 120 countries ensuring not only the availability of Belzona materials, but also specification support, project management, application and supervision services. Distributorships and their teams are supported by Belzona Corporate offices in Europe, North America and Asia.

To find your local Belzona representative visit [www.belzona.com/find](http://www.belzona.com/find)

## ● CORPORATE OFFICES

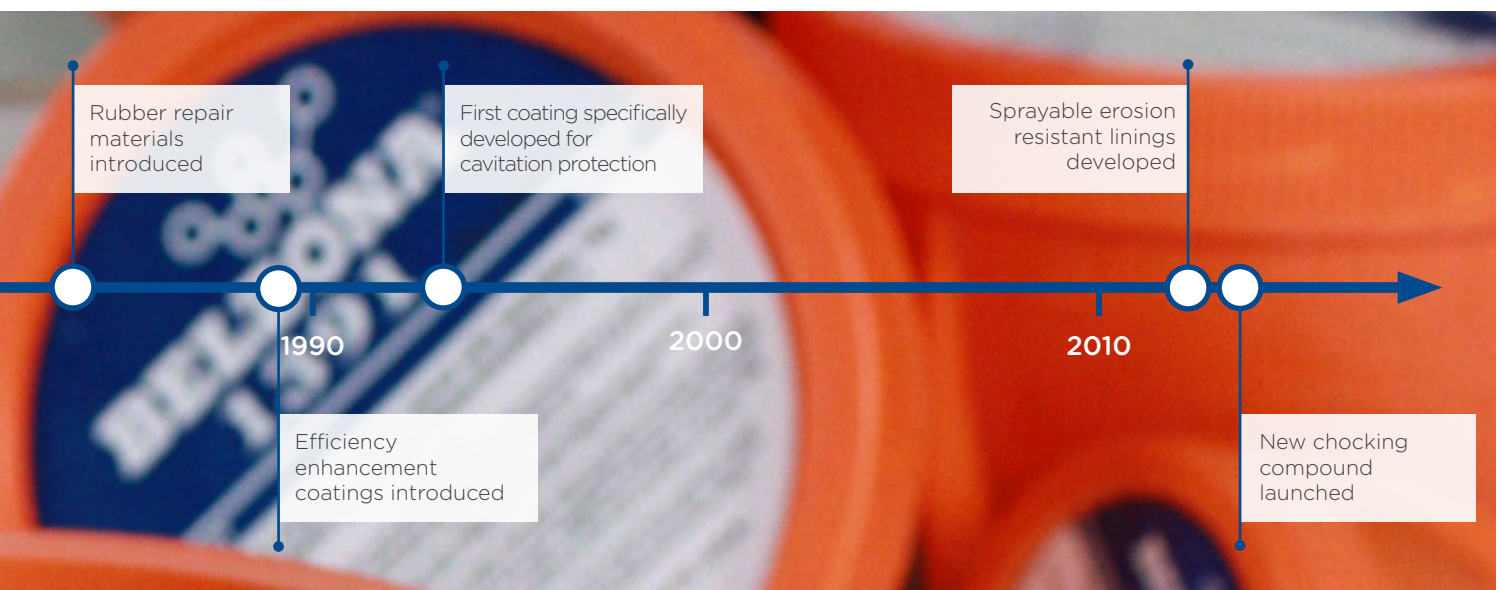
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Our expert Technical Consultants with years of field experience and advanced training are available to assist you every step of the way to: diagnose the problem, discuss material selection options, recommend a solution and provide on-site application support.



## CAVITATION PROTECTION

Cavitation resistant coatings - avoid hot work repairs and costly replacement

*When tested to ASTM standards, Belzona Elastomer coatings for cavitation protection show minimum volume loss.*

In the Marine industry, cavitation usually occurs on foils in rudders, vanes in pumps and also on propulsion systems. Cavitation damage can lead to severe erosion-corrosion problems and render equipment useless if left untreated.

Millions are spent every year on replacing equipment damaged by cavitation. This is not only expensive and time consuming, but the like for like replacement solution will not solve the problem. Repair methods involving welding will not stop the problem from reoccurring either, and the heat introduced can cause HAZ (Heat Affected Zones) and stress corrosion cracking.

Cavitation damage can be repaired without the need for hot work with a Belzona paste grade material. Belzona offers a combination of ceramic epoxy coatings and resilient polyurethane coatings that provides outstanding corrosion and cavitation protection. Our ceramic coatings have a proven track record of increasing efficiency in fluid flow situations, as well as stopping corrosion and significantly slowing down erosion, while the polyurethane coatings are designed to absorb and disperse the cavitation energy, resisting its effects.



*Cavitated propeller areas*



*Propeller areas rebuilt and protected*



*Cavitation damage on jet tube*



*Completed application*



*Cavitation protection coating applied to jet tube area on super yacht*

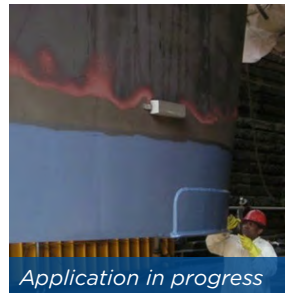


## RUDDER AREAS

Cavitation damage to rudders causes erosion, pitting and sometimes complete failure. Existing pitted areas can be filled using a Belzona repair composite with a cavitation resistant coating, slowing down reoccurrence. This coating can also be applied on new constructions to mitigate cavitation damage and provide a long-term protection.



Surface preparation



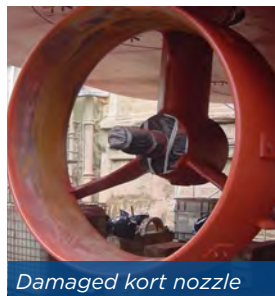
Application in progress



Cavitation protection

## PROPULSION SYSTEMS

Marine propulsion systems vary depending on the type of vessel, but they all suffer from cavitation problems. Belzona offers metal rebuilding and resurfacing composites to reclaim the lost substrate, as well as erosion, corrosion and cavitation resistant coatings to protect kort nozzles, bow thrusters, jet tubes and propellers from future attack.



Damaged kort nozzle



Surface rebuilt



Coating applied

## ENGINE BLOCKS

Marine engines are often affected by severe cavitation on the cylinder blocks and liners. Belzona high temperature repair composites and coatings are used to reclaim and protect the damaged areas, extending the engine life.



Engine block



Damaged cylinder liner



Cavitation repaired

## COLD BONDING AND CHOCKING SOLUTIONS

Applied at ambient temperatures, 100% solids Belzona materials create high performance adhesives and chocking compounds.

Bonding with Belzona composites and coatings was first used in the late 1950s to attach equipment ID tags. Over the years, our materials were enhanced to resist higher pressures and temperatures as well as demonstrate comparably high adhesion and compressive strength. Design and maintenance scenarios that would historically involve hot work can be completed with the use of polymeric cold bonding materials.

Cold bonding with Belzona provides repairs with equivalent or greater strength than welding and also offers a larger contact surface, reducing point loading. This technology is applied and cures at ambient temperatures, thus improving safety and reducing downtime.

### BEARING INSTALLATION

The critical requirement with rudder bearings relates to the bush retention in the housing. Corrosion and impact wear can result in the development of annular gaps between the housing and the bearing bush, resulting in a malfunctioning rudder and, consequently, costly repairs and loss of sea time.

The use of Belzona materials for installation of rudder bearings began in 1977 as a collaboration between Belzona and Germanischer Lloyd. The project investigated the use of Belzona materials to eliminate the problem of galvanic corrosion between steel housings and rudder bushes, pintle cones and liners. Nowadays, our polymeric composites and coatings are widely used in the Marine industry for the reseating or installation of new rudder bearings and pintle housing liners. Our materials allow thickness from 0.1mm to 25mm and demonstrate high adhesion and compressive strength, providing a long-term solution.

### RESTORING STRUCTURAL INTEGRITY WITH PLATE BONDING

Corroded equipment and structures can be repaired with Belzona's pioneering injection bonding technology, helping to restore their structural integrity. This technique has been successfully utilised for deck and hull renovation as well as equipment repairs such as cracked engine casings. Our deck strengthening technology has been extensively tested for bend, impact, flexural strength, drag and shear adhesion, which provides a durable solution.



Rudder bearing bonding - top view



Rudder bearing bonding - bottom view



Anchor pocket bonding in progress



Anchor pocket bonding completed

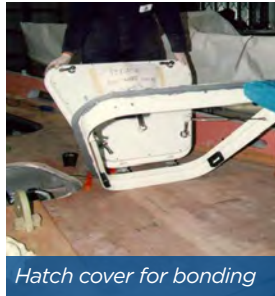


Completed application



## BONDING OF EQUIPMENT

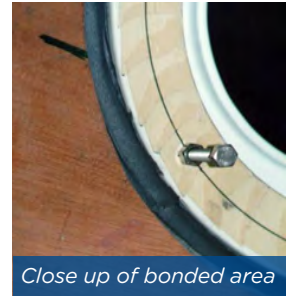
Cold bonding of equipment eliminates the need for hot work and facilitates rapid installation. With tensile shear adhesion of up to 2,960 psi (20.4MPa), pull off adhesion of up to 3,240 psi (22.3MPa) and flexural strength of up to 14,300 psi (98.6MPa), equipment such as brackets and supports can be bonded permanently and safely. Belzona cold bonding materials are also recommended to rapidly reinstall deck-mounted and other equipment after hull repair, minimising dry docking times.



Hatch cover for bonding



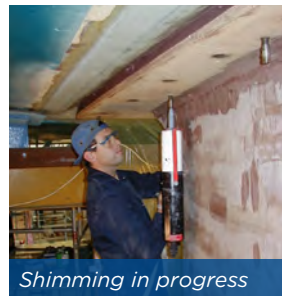
Installation completed



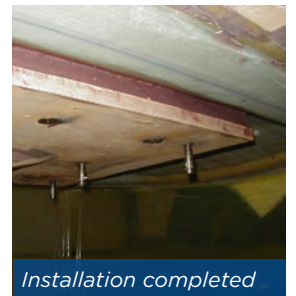
Close up of bonded area



Keel ready for shimming



Shimming in progress



Installation completed

## INSTALLING, ALIGNING AND LEVELLING MARINE EQUIPMENT

Traditional cast iron or steel chocks have been conventionally used in shipbuilding. As a result of the high rigidity of these metal chocks, even minimal inaccuracies in their fitting can lead to uneven loading.

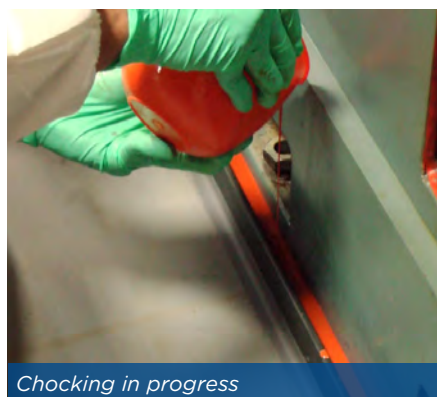
Cast compound chocks offer an alternative to conventional metal chocks. Belzona's 100% solids Marine chocking compound has been designed for the installation of Marine engines and other equipment, providing precise equipment alignment due to non-shrinking properties whilst its high impact and compressive strength provides high load bearing capabilities. This self-levelling material is easy to use, shortening installation time and offering a durable non-corroding solution for installation of ship propulsion systems and other heavy equipment where alignment and anchorage is essential.



Staysail track shimming with paste grade



Staysail track installed



Chocking in progress



Installed equipment



Video: Chocking compound

# INTERNAL SURFACE PROTECTION FROM FLOWING CORROSIVE MEDIA

Protective linings and repair composites for erosion-corrosion environments

## HEAT EXCHANGER REPAIR AND PROTECTION

When exposed to an electrolytic solution, galvanic corrosion occurs at the interface of the tube and the tube sheet. Belzona composites and coatings have been used for heat exchanger repair and protection since the 1970s, with known applications in service for over three decades. The Belzona solution eliminates the need for part replacement, therefore significantly reducing maintenance expenses, and offers excellent adhesion as well as erosion and chemical resistance. In order to prevent galvanic corrosion, new heat exchangers can be designed and coated with Belzona.

For more information visit: [www.belzona.com/hex](http://www.belzona.com/hex)

## PUMP EFFICIENCY ENHANCEMENT

Pump deterioration leads to decreased pumping efficiency and eventually costly part replacement. Pitting, worn wear ring clearances as well as casing damage can be rebuilt using Belzona's composites specifically designed for erosion-corrosion resistance under immersion. Pumping efficiency is restored and enhanced with the use of a hydrophobic smooth lining, which also protects from erosion and corrosion. Once the pump has been protected with Belzona, it can remain maintenance-free for many years with applications still in service decades later.

Due to over 30 years' experience in repairing and restoring pumps, Belzona's linings are now specified to protect new pumps, significantly extending the lifetime of the assets and subsequent maintenance-free periods. Belzona linings have become a first choice in protecting pumps from erosion-corrosion and cavitation damage.



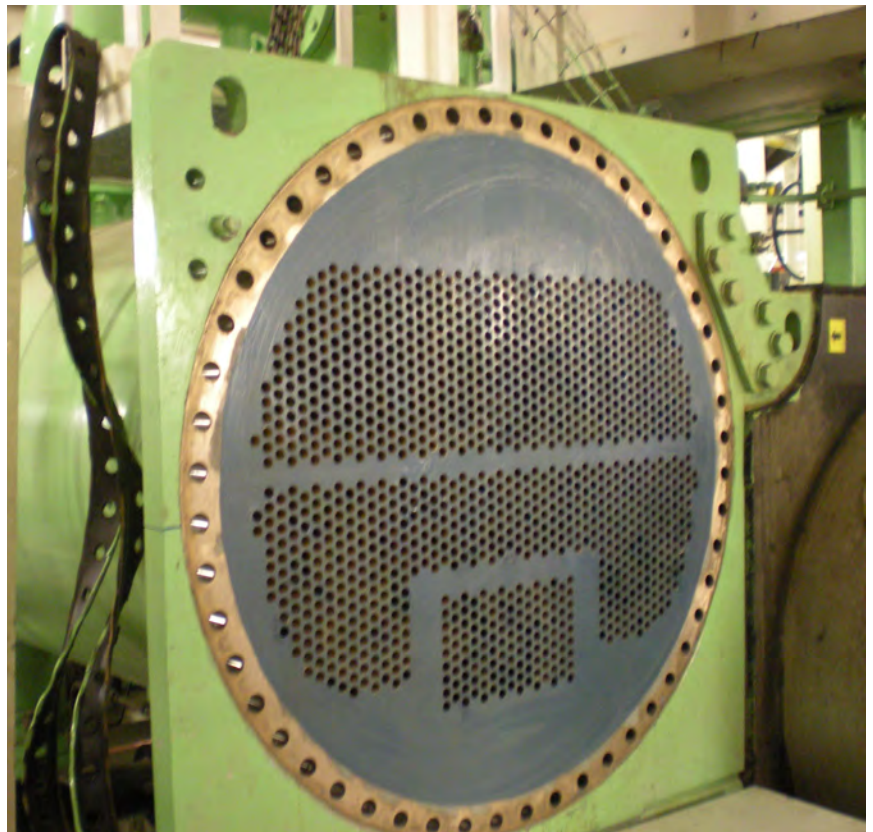
Video: Pump repair and protection



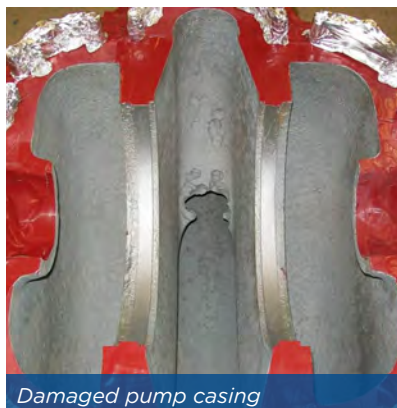
Severe pitting on division bar



Division bar repaired and protected



Heat exchanger full refurbishment carried out on board



Damaged pump casing



Casing rebuilt and coated

## WET SPACES

Spaces in constant contact or immersion in sea water such as stern tubes, ventilation trunks, elevator pits, MSD tanks and bilge pockets are continually exposed to highly corrosive and erosive environments. This can lead to critical corrosion rates of the metallic substrates if left unprotected. Sufficient long-term protection, which can be applied and maintained with minimal disruption to operations, is integral to the smooth running of the vessel.

Belzona's range of linings can protect equipment against corrosion and erosion and are designed to perform under constant immersion conditions. Sea strainers affected by galvanic corrosion and salt water contamination, causing deep pitting, can also be restored and protected using a lining system.

Where protection against aggressive chemical attack is required, a Belzona chemical resistant lining can be used, providing a long lasting solution with minimised downtime.

## PIPEWORK

Pipe and duct work can be protected from weathering and external corrosion with Belzona coatings and cladding protection materials. Belzona offers surface tolerant barrier coatings specifically designed for application to wet and oily substrates with minimum surface preparation.

Leisure boats with inboard engines often suffer from corrosion problems on the wet exhausts. The hot exhaust gas together with the salt water causes severe corrosion that can lead to critical loss of steel. High temperature resistant composite repair materials are used to recover the metal loss and rebuild the original surface profile of the water inlet and exhaust outlet. A high temperature lining can then be applied to provide long-term protection and eliminate future corrosion issues in the exhaust system.

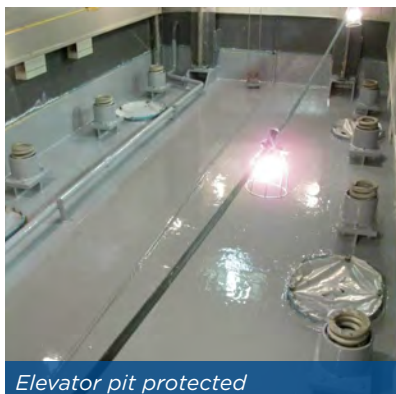
Belzona pioneered a spray-friendly pipe lining system that offers erosion-corrosion protection from sea water and entrained solid particles such as sand. The substitution of hard ceramic fillers for a thermoplastic filler blend ensures there is very little wear to the spray equipment. The material can be spin spray or brush applied in situ at wet film thickness up to 2000 microns without sagging, effectively covering girth welds and joints in a single coat. The thermoplastic filler blend is formulated to achieve excellent impact and sliding abrasion resistance, a high degree of toughness and chemical resistance.



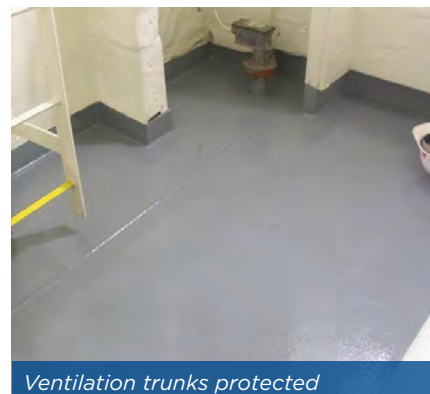
*New stern tube ready for lining*



*Stern tube protected*



*Elevator pit protected*



*Ventilation trunks protected*



*Critical loss of steel*



*Exhaust pipe rebuilt and coated*



*Spin spray applied internal exhaust pipe lining*



*Video: Spin-sprayed pipe lining*

## REPAIR OF SEALS AND RUBBER COMPONENTS

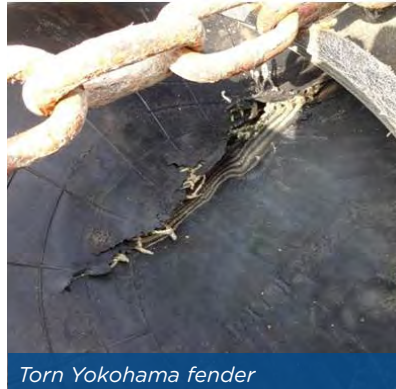
Flexible repair materials - a cold curing and rapid solution

Rubber equipment common in the Marine industry such as fenders, buoys and hoses are prone to in-service deterioration, where even minor rips and tears can lead to equipment being decommissioned. Vulcanisation can be considered as a repair alternative, but this option can be costly and time consuming. Belzona Elastomers are liquid-applied flexible polyurethanes, which can return the equipment into serviceable conditions with reduced downtime and for a fraction of the cost.

First introduced in 1985, Belzona Elastomers are commonly used to rebuild, seal and bond rubber equipment and components in situations where replacement is too costly and alternative materials are not able to provide a durable solution.

### FENDERS

By the very nature of their job, mooring equipment such as fenders are subjected to impact, abrasion and wear. As a result, punctures are common and cannot easily be repaired by conventional means such as hot vulcanising, which is time consuming, expensive and not always successful. Belzona Elastomers provide reliable repairs to these common problems. Tears and rips can be repaired using a Belzona Elastomer paste grade material, while surface deterioration is easily resolved with a coating grade.



*Torn Yokohama fender*



*Repair in progress*



*Yokohama fender repaired with Belzona*



## BELLOWS

Tears or holes on bellows should be immediately repaired to prevent serious mechanical damage; however, ordering and fitting replacements is time consuming and expensive. Belzona Elastomers can provide a fast and reliable repair alternative as these materials bond strongly to rubber and metal. The repair can be performed in-situ with an emergency repair Elastomer, a rubber repair material that cures in minutes.



*Ripped bellows*



*Localised repair*

## HATCH COVER GASKETS

Leaking or badly maintained hatch covers are a principal cause of cargo wetting and can lead to more serious consequences such as flooding and accelerated corrosion. Rubber packing that is physically damaged, cut or chafed will cause leaking and need to be rapidly repaired. When replacement seals are not available, liquid applied Belzona Elastomers can be used to rebuild damaged gaskets as they offer excellent durability and flexibility, helping to keep the hatch cover watertight.



*Cracked expansion gasket*



*Repair completed*

## FLOATING HOSES

Floating hoses and buoyancy devices can represent a significant expense, as the rubber, internal surfaces and flange faces can often be damaged due to in service or in transit deterioration. If the damage is not addressed at an early stage, it can lead to loss of buoyancy and ultimately catastrophic fuel or oil spillage with potentially costly implications.

Belzona Elastomers provide a rapid and resistant repair solution to damaged floating hoses and buoyancy devices. Our rubber repair materials adhere strongly to any type of hose and provide outstanding abrasion and impact resistance once the hose is put back in service. Due to Belzona's range of multi-purpose Elastomers, we are able to repair both localised and large defects, as well as ensure high quality repairs onto vertical surfaces.

Corroded flange faces and internal surfaces can also be repaired and protected with the use of Belzona lining and flange face forming technology.

For more information on floating hose repairs visit [www.belzona.com/hoses](http://www.belzona.com/hoses)



*Floating hose buoyancy device*



*Major damage*



*Damaged areas repaired*



Video: Floating hose repair

## AT SEA REPAIRS

### Marine Emergency Repair Kit for the rapid and simple repair of marine equipment

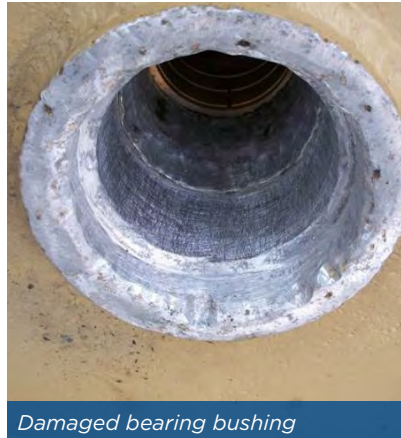
Due to limited resources off-shore and the need for emergency repair and maintenance of essential vessel equipment, Belzona has developed a Marine Emergency Repair Kit that contains all of the necessary items needed for temporary and permanent repair of equipment such as pipes, engines, shafts and hydraulic rams.

The Belzona fast curing and extended working life polymeric repair materials included in the kit are suitable for use in all climates and application situations. These materials are easy to apply with the spatula or applicator provided in the kit, no specialists tools required.

Our Marine Emergency Repair Kit provides a versatile, safe and simple repair solution to unplanned maintenance needs at sea.

### FLANGE FACE FORMING

Crevice and galvanic corrosion can be repaired with a unique Belzona composite forming technology. Prefabricated formers are used to shape the specified Belzona material, which bonds strongly to the flange face. The sealing face is then effectively isolated from corrosive media whilst maintaining its shape and profile. This simple repair can be carried out in situ without disassembling the equipment and eliminating the need for welding.



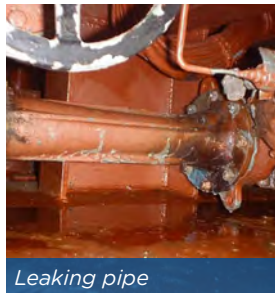
Video: Flange face forming





## PIPE AND TANK LEAK SEALING

The Marine Emergency repair kit contains all the materials needed to perform a live leak repair on pipework and tanks. Leaking pipes can be quickly stemmed utilising a fast curing paste and a Belzona polymeric wrap technique can be used to achieve a permanent solution.



*Leaking pipe*



*Problem area*



*Live leak sealing*

## SHAFT AND KEYWAY EMERGENCY REPAIR

Gland packing and bushing damage to the shaft, together with sand abrasion and sea water exposure, can lead to severe erosion-corrosion on shafts. Damaged shafts and oversized keyways can be rebuilt in-situ to their original dimensions without machining using Belzona's cold curing repair composites.



*Scored keyway*



*Rebuilding in progress*



*In situ repair*

## ENGINE BLOCK CRACK REPAIR

Engines in the marine industry commonly suffer from cracked casings. The Marine Emergency Repair Kit allows for the quick repair of engine cracks without the need for welding, eliminating heat distortion problems. Belzona solutions are recognised and approved by medium and slow speed diesel engine manufacturers.



*Cracked engine casing*



*Cracks terminated*



*Completed repair*

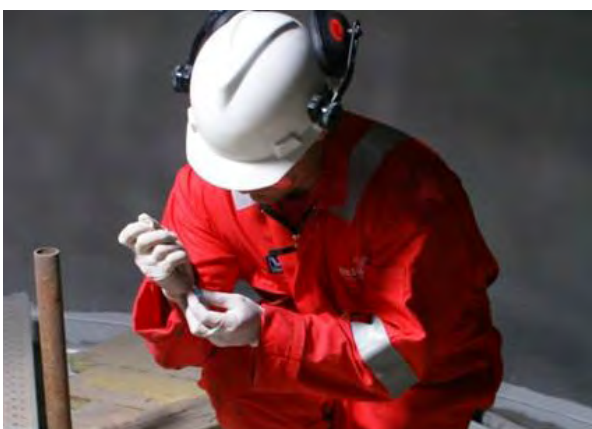
## GLOBAL APPLICATION STANDARDS



### PREQUALIFICATION

Belzona materials are subject to stringent independent and in-house testing, documented in the product specification sheets and chemical resistance charts. Testing is performed in our ISO 9001 audited laboratory to recognised standards as well as by external partners.

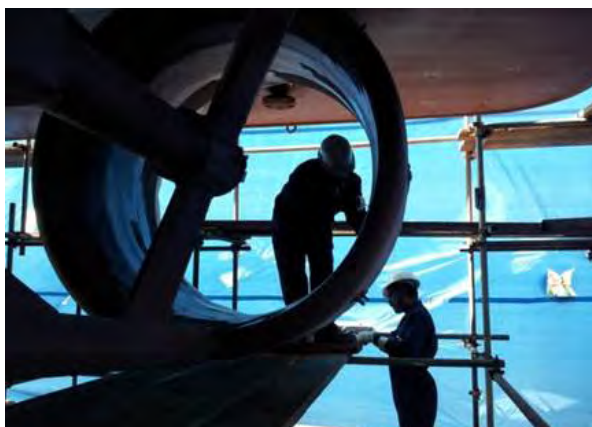
Belzona materials are approved by classification societies from all around the world including American Bureau of Shipping, Bureau Veritas, China Classification Society, Germanischer Lloyd, Korean Register of Shipping and Russian Maritime Register of Shipping. In addition, our products have received acknowledgements from the U.S. Navy and the U.K. Ministry of Defence.



### SPECIFICATION

Optimum materials and application procedures are selected to meet specific design and operating conditions of the asset. Dedicated Belzona trained Marine specialists coupled with round the clock head office technical support allow for the correct material and application procedure to be specified.

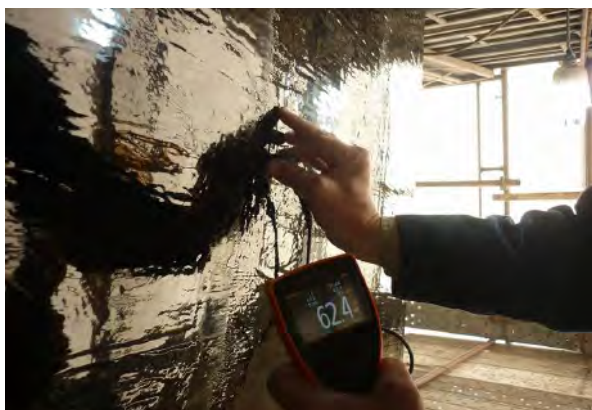
We also maintain a comprehensive database accessible by the Global Belzona Distributor network, which facilitates sharing of information and experience, improving specification and application standards.



### APPLICATION

Application standards, including surface preparation, are integral to the success of solution implementation. Belzona recognises the need to set and monitor global application standards.

Applications are carried out by experienced and trained personnel. Belzona runs training programmes with theoretical and practical courses, including on-site training programs. Combined with Marine specific application specifications, method statements, quality control procedures and daily inspection reports, we strive to ensure application standards are maintained.



### INSPECTION

Inspection is carried out by certified inspectors (e.g. NACE) prior to, during and upon completion of the application to ensure Belzona systems are applied in accordance with our standards and client's requirements.

Upon nearing the end of the system's expected service life, the asset is inspected again and appropriate action recommended, which may involve minor repair work or no action, as Belzona systems tend to outlast projected service life.

# BELZONA SOLUTIONS FOR THE MARINE INDUSTRY

## CAVITATION RESISTANT COATINGS

to reduce cavitation damage



## COLD BONDING AND SHIMMING

to replace hot work



## CHOCKING COMPOUND

for equipment installation



## COATINGS AND LININGS

resistant to erosion-corrosion under immersion



## ELASTOMERS

for flexible repairs



## EMERGENCY REPAIR MATERIALS

for at sea repairs





ISO 9001:2008  
Q 09335  
ISO 14001:2004  
EMS 509612

Belzona products are manufactured  
under an ISO 9000 Registered Quality  
Management System

UK • USA • Canada • Thailand

