



# MAINTAINING ASSET INTEGRITY IN THE OIL AND GAS INDUSTRY – UPSTREAM

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Belzona Protective Coatings and Engineering Composites

## OUR HISTORY

Established in 1952, Belzona has pioneered innovative polymer technology that has revolutionised industrial repair and maintenance procedures. Proven success has also led to a growing number of prominent clients specifying Belzona materials as a cost effective solution at the design stage of a project.

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.



100% solids epoxy protective linings for erosion-corrosion protection



High performance polyurethanes for flexible repairs



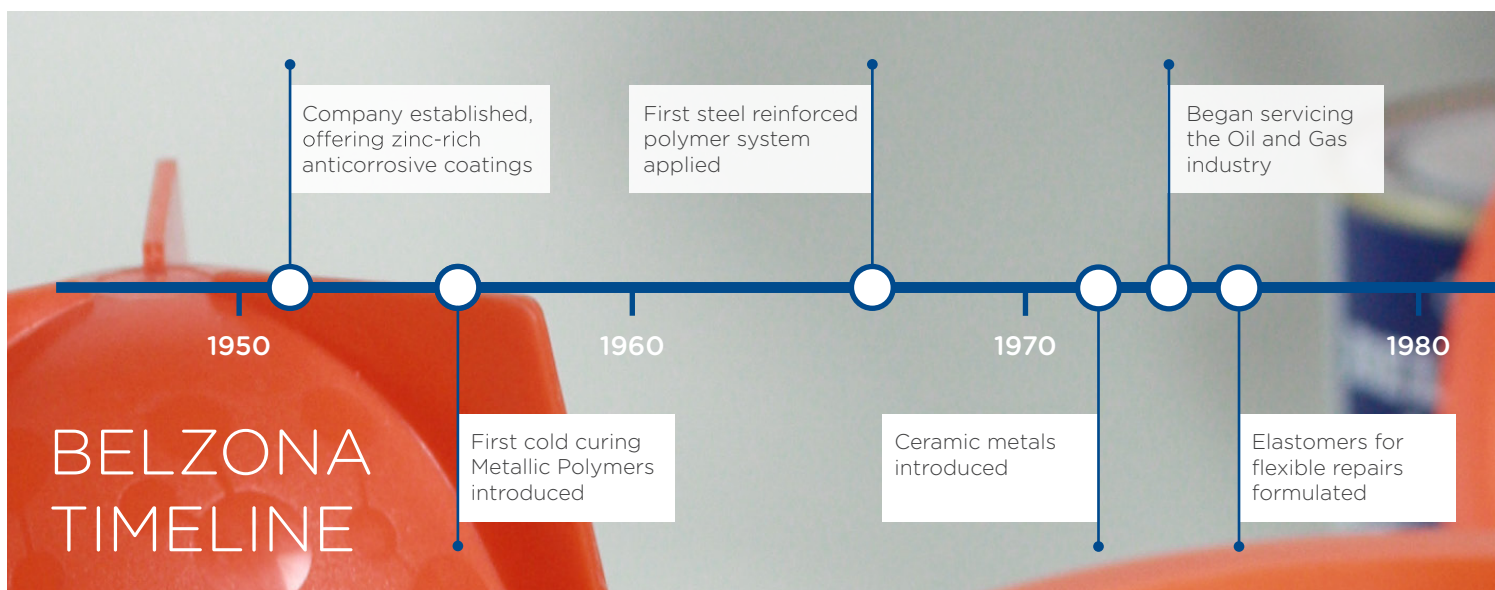
Composites for bonding, forming, shimming and rebuilding

## NOVEL SOLUTIONS TO AGE-OLD PROBLEMS

Aggressive chemicals and erosion-corrosion can take their toll on equipment and structures, resulting in increased capital and operating expenditure. Elevated temperature and pressure levels tend to exacerbate the problem and necessitate the use of high performance protective and repair materials with a proven track record. By utilising a Belzona solution, asset owners and engineering houses can incorporate suitable protection into the design of a newly built piece of equipment. Components that have been damaged in service can also be refurbished. Oil and Gas companies choose the Belzona solution because it helps them to:

- Reduce capital expenditure
- Lower maintenance costs
- Improve efficiency and safety
- Reduce downtime
- Simplify maintenance procedures
- Extend machinery and equipment life

Belzona offers a range of coatings and composites carefully formulated to address various issues faced by the Oil and Gas 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 [belzona.com/find](http://belzona.com/find)

**CORPORATE OFFICES**

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<p><b>Belzona Inc</b>                  Miami, FL, USA                  t: +1 (305) 594-4994                  f: +1 (305) 599-1140</p>
<p><b>Belzona Polymerics Ltd</b>                  Harrogate, UK                  t: +44 1423 567641                  f: +44 1423 505967</p>
<p><b>Belzona Asia Pacific</b>                  Chonburi, Thailand                  t: +66 33 005600</p>

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.



# INTERNAL SURFACE PROTECTION FROM FLOWING CORROSIVE MEDIA

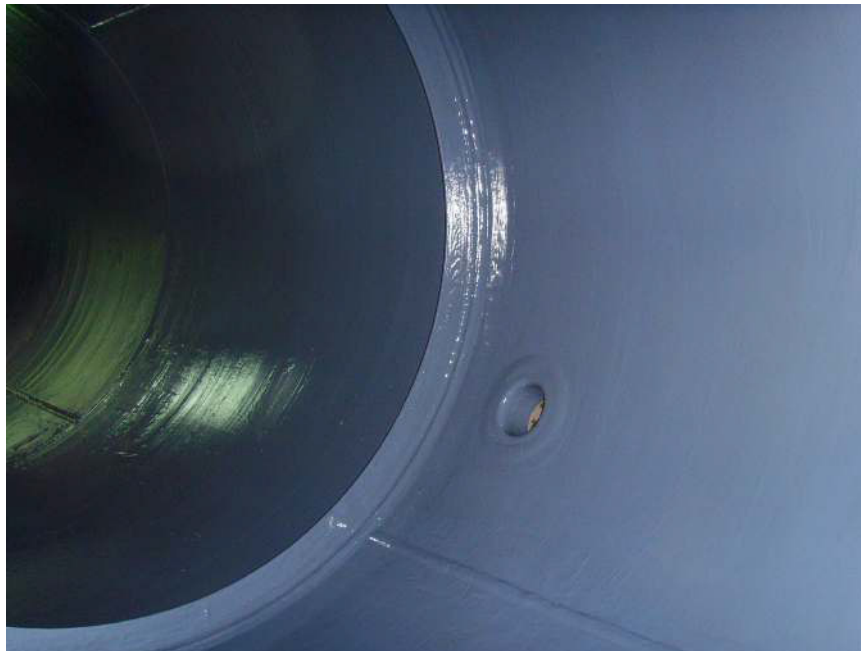
Process vessels - protection, reclamation and modification

*Applied at ambient temperatures, VOC-free Belzona linings facilitate corrosion prevention, repairs and vessel modifications.*

Belzona liquid applied vessel linings were first specified in 1987 for separator corrosion repair and protection at a UK North Sea platform. Outstanding erosion resistance prevented wear during the sand jetting system operation and has prompted the use of Belzona linings on hundreds of other vessels. We now offer a complete solution for pressure vessels handling liquid hydrocarbons, gas and process chemicals including separators, slug catchers, knock-out drums and many more. Based on the experience of corrosion repair and prevention, spanning two decades, in the early 2000s asset owners and operators began to specify Belzona linings at the design stage to protect newbuild vessels.

Our linings can be spray or hand applied and, once cured in service, form a barrier between the substrate and corrosive media, enabling the operator to implement a corrosion management plan. As well as resisting erosion-corrosion, Belzona linings are designed to withstand vast pressure and temperature fluctuations, including steam-out and explosive decompression.

In addition to internal vessel lining, a complete corrosion solution includes small bore nozzle and flange face protection in order to fully isolate the substrate from a corrosive environment. Belzona vessel lining systems offer long-term corrosion protection and are easier to maintain than alternative corrosion protection technologies.



*Belzona lining applied to a newly fabricated separator*



*Cold forming isolates flange faces from corrosive media*



*Prefabricated Belzona insert bonded into small bore nozzle*





Video: Process vessel corrosion protection



### VESSEL LINING REPAIRS

Failed coatings (or Belzona linings due for planned maintenance) can be repaired in situ with minimal disruption to operations. Patch repair, partial recoat or full recoat options reduce downtime, prolong vessel service life and extend maintenance-free periods.



Touch up after 9 years



Glass flake lining repair



Full recoat

### FLANGE FACE FORMING

Crevice and galvanic corrosion can be prevented or repaired with a unique Belzona composite forming technology. Prefabricated formers are used to shape the specified Belzona material that bonds strongly to the flange face. The sealing face is then effectively isolated from corrosive media whilst maintaining its shape and profile.



Corroded flange



Forming technique



Completed application

### SMALL BORE NOZZLE PROTECTION

Narrow nozzles no longer need to be considered "the Achilles' heel" of process vessels. Tailor made Belzona inserts can be bonded into the nozzle using a fluid grade material, eliminating the risk of pinholes or holidays. Excellent chemical and erosion resistance ensures long-term protection of the nozzle, thus extending maintenance-free periods.



Deteriorated nozzle



Pre-fabricated insert



Nozzle protected

### VESSEL MODIFICATION

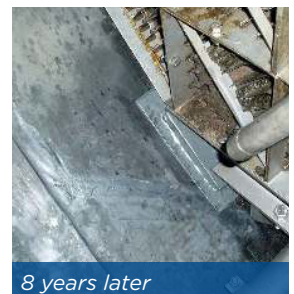
Where hot work is not permissible or desirable, cold bonding of vessel internals allows for modification and eliminates the need for post weld heat treatment. Tensile shear, tensile and cleavage adhesion tests performed show that Belzona bonding can be superior to welding.



Separator modification



Cold bonding technology



8 years later

For more information read In Focus: Process Vessels, [belzona.com/vessels](http://belzona.com/vessels)

# INTERNAL SURFACE PROTECTION FROM FLOWING CORROSIVE MEDIA

## Transfer pipe – erosion-corrosion protection lining

Sand entrainment and high flow rates coupled with large quantities of CO<sub>2</sub>, H<sub>2</sub>S and brine can lead to pipe corrosion rates of several hundred mils per year. In 2012, Belzona pioneered a spray-friendly pipe lining system that offers erosion-corrosion protection. The substitution of hard-ceramic fillers for a thermoplastic filler blend ensures there is very little wear to the spray equipment.

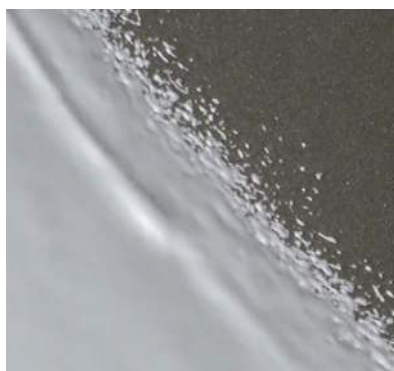
Sprayable erosion-corrosion protective linings allow for the material to be spin spray applied in situ at wet film thickness up to 1250 microns without sagging, effectively covering girth welds and joints in a single coat. The thermoplastic filler blend is formulated to achieve excellent impact and sliding abrasion resistance, a high degree of toughness and chemical resistance.

Next generation pipe linings are available in medium and elevated temperature variations of up to 95°C (203°F). When comparing Belzona sprayable thermoplastic filler blend linings with ceramic filled epoxies, abrasion tests revealed reduced volume loss. Tests and in-service performance confirm that these novel linings provide outstanding erosion resistance in extreme wear environments.

For more information download a white paper on [belzona.com/1331](http://belzona.com/1331)



*Internal pipe lining*



*Girth weld covered in a single coat*



*Spin spray application*



Video: Spin-sprayed pipe lining



Video: Pump repair and protection

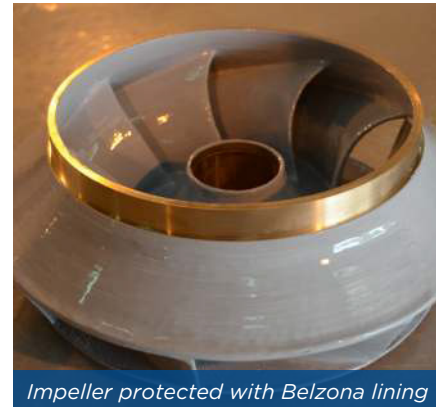


## PUMPS

Pump deterioration leads to decreased pumping efficiency and eventually costly part replacement. Pitting, worn wear ring clearances as well as casing thin and through wall defects can be rebuilt using composites specifically designed for pumping applications. Pumping efficiency is restored and enhanced with the use of a hydrophobic smooth lining, which also protects from erosion-corrosion and cavitation. Once the pump has been protected with Belzona, it can remain maintenance-free for many years.



New firewater pump lining



Impeller protected with Belzona lining

Due to over 30 years' experience in repairing and restoring upstream pumps, Belzona linings are now specified to protect new pumps, thus significantly extending the lifetime of the assets and subsequent maintenance-free periods. Belzona linings have become a first choice in protecting firewater pumps in particular, offering long-term corrosion protection and seizure prevention.

For more information on Belzona solutions for pumps view a 3D map detailing various application areas and case studies on [belzona.com/pumpmap](http://belzona.com/pumpmap)



Seawater lift pump chambers



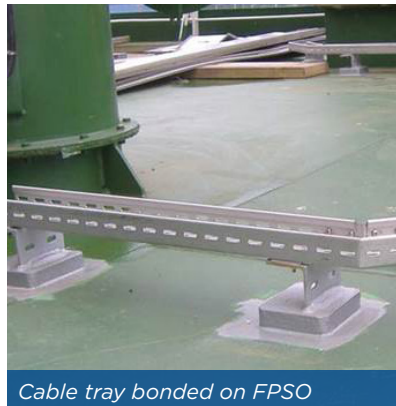
Protected with Belzona lining

## STRUCTURAL BONDING

Applied at ambient temperatures, 100% solids Belzona materials create a high performance adhesive.

Design and maintenance scenarios that would historically involve hot work can be completed with the use of polymeric cold bonding composites. This technology is applied and cures at ambient temperatures, thus improving safety and reducing downtime.

Belzona bonding was first used in the late 1950s to attach equipment ID tags. Over the years materials were enhanced to resist higher pressures and temperatures as well as demonstrate comparably high adhesion and compressive strength.



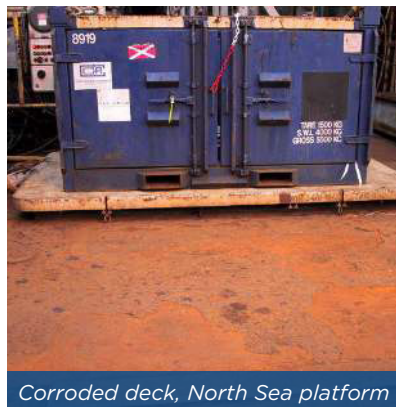
Cable tray bonded on FPSO



Handrail bonding

## COLD WELDING DECK EQUIPMENT

Cold bonding deck 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) deck equipment, framework and supports can be bonded permanently and safely. Belzona cold bonding is equally effective at a fabrication stage, during turnarounds or whilst the platform is in operation. Belzona cold bonding materials are also recommended to fill gaps arising in tack welded elements, such as pipe saddles supports.



Corroded deck, North Sea platform



Belzona plate bonding

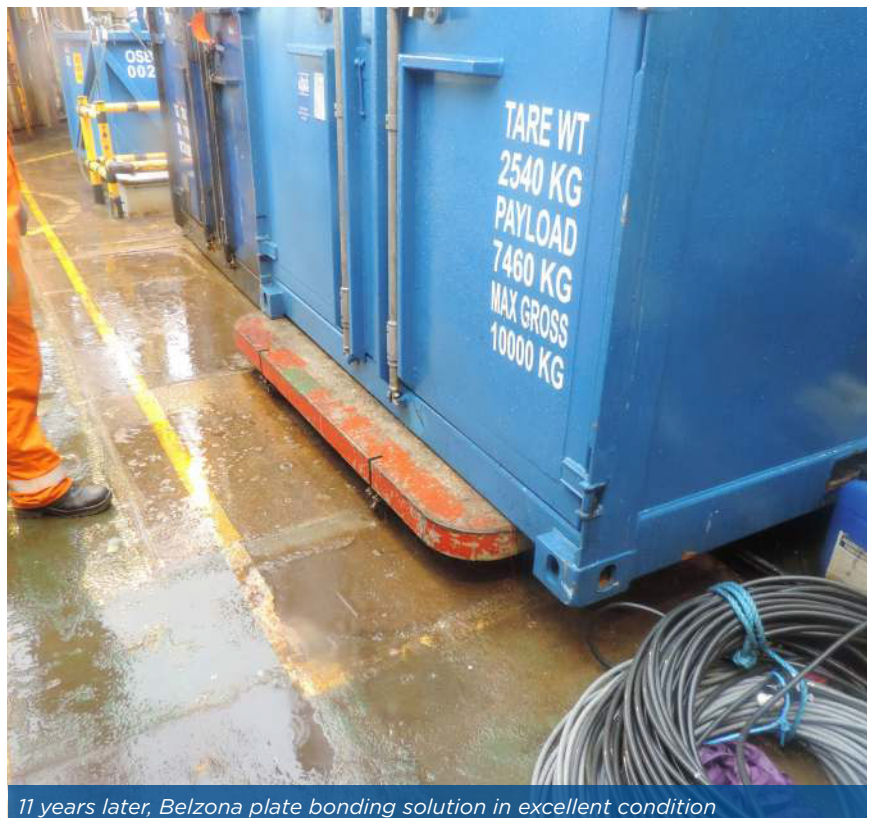
## DECK MAINTENANCE - PLATE BONDING

Corroded equipment and structures can be repaired in situ with Belzona's pioneering injection bonding technology. This technique has been successfully utilised for deck renovation and other structural integrity repairs. Over a decade of successful applications, which are still in service today, attest to this method's effectiveness and have prompted engineering houses to specify injection bonding for greenfield applications.

To see Belzona Know-How in action, including bonding applications, visit [khia.belzona.com](http://khia.belzona.com) - our dedicated case study database



Video: Injection bonding



11 years later, Belzona plate bonding solution in excellent condition



## BEARING INSTALLATION/ BONDING

Bearings are susceptible to friction damage and galvanic corrosion. Since the 1970s, Belzona has been used to prevent bearing corrosion by seating rudder pintle bearings.

After a trial ship application in 1979, Belzona was accepted as a permanent installation and used from new on all Germanischer Lloyd classed vessels.

One of the first and perhaps most notable bearing bonding applications in service today was performed on a flagship liner, Queen Elizabeth 2.

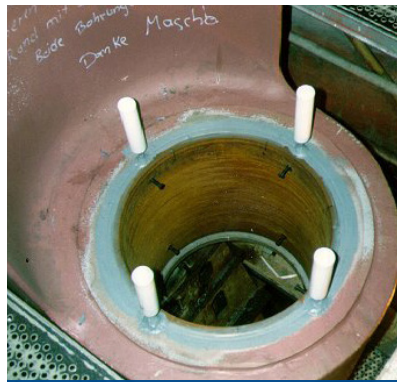
Bearing bonding is carried out by injecting the Belzona material between the bearing and the housing. The Belzona shim takes up any ovality or housing wear, thus creating a durable barrier with 100% surface contact, electrically isolating the bearing. This method has been applied to multiple situations including riser bearings and bushes amongst others.

## SHIMMING, CHOCKING AND LEVELLING

Following over five decades of bonding and shimming applications, in 2014 Belzona developed a novel pourable chocking compound. The system is ideal for pouring foundations for heavy equipment and to maintain precise alignment under machinery ensuring effective bearing underneath.

Bespoke shims and lengthy shelf life coupled with excellent mechanical properties have inspired numerous global specifications.

For more information on Belzona's chocking solutions visit [belzona.com/7111](http://belzona.com/7111)



Rudder bearing bonding - top view



Rudder bearing bonding - bottom view



Bush installation, North Sea



Riser bearing bonding



Pourable shimming in action



Bespoke chocking solution

# PIPEWORK EXTERNAL CORROSION REPAIR AND PROTECTION

Heat activated solutions applied on-line

## CUI REPAIRS

Corrosion under insulation occurs at an accelerated rate and can remain undetected for some time. Taking affected parts of the pipework out of service for repairs or replacement can in turn lead to high costs and lengthy downtime. To address this problem, in the late 1990s, Belzona formulated heat activated composites and coatings that facilitate on-line repairs. These materials adhere exceptionally well to hot contaminated surfaces and penetrate deep into the substrate eliminating the need for an angular blast profile prior to application.

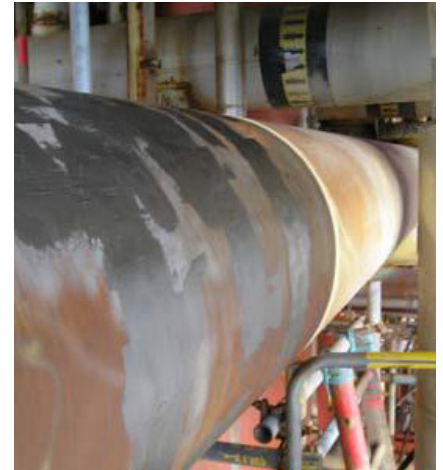
Simple manual surface preparation and on-line brush application have inspired the use of Belzona heat activated materials to combat CUI globally, from the Gulf of Mexico to the North Sea. Typical applications in the range of -10°C to 150°C (50°F - 302°F) will resist salt spray and commonly found inorganic acids and alkalis at concentrations up to 20%.

Insulation can then be sealed with a breathable membrane to prevent further liquid permeation. Belzona membrane can be easily cut open for localised inspection and resealed with little impact on the process.

For more information on CUI solutions visit [belzona.com/cui](http://belzona.com/cui)



Corrosion under insulation



Pit filling



Coating application



Finished application

## THERMAL INSULATION BARRIER

Thermal insulation reduces the amount of heat transfer through a surface, increasing the efficiency of equipment and ensures the safety of operators against contact-burn injuries.

Belzona have developed a solution that provides thermal insulation to metal pipework, ductings and other industrial equipment whilst also displaying excellent corrosion resistance and eliminating corrosion under insulation (CUI).

For more information on Belzona's anti-corrosion thermal insulation barrier, visit:

[belzona.com/5871](http://belzona.com/5871)



Plural spray application of Belzona 5871



Video: How to Install a Thermal Insulation Barrier for Corrosion and Safety Protection

# PIPEWORK EXTERNAL CORROSION REPAIR AND PROTECTION

Cold applied 100% solids materials

## PIPE WRAPS AND PLATE BONDING

Thin and through wall defects caused by external and internal corrosion can be repaired using composite wrap systems. A wrap system is composed of a reinforcement sheet and a Belzona material, tailored to the asset's performance criteria, such as presence of contaminants, operating temperatures and pressures amongst others. A wrap system can also be applied in conjunction with a bonded plate where additional reinforcement is required.

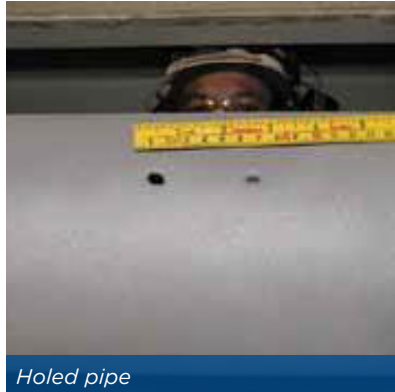
Following almost five decades of pipe wrap installations, in 2007 we added Belzona SuperWrap to the range, which is compliant with ASME PCC2 Article 4.1 and ISO/TS 24817. Every Belzona SuperWrap system is individually designed and applied by validated specialists. Repairs can be carried out to a variety of defects to restore pressurised pipeline and pipework integrity. In 2014, Belzona SuperWrap II was released, which exhibits greater strength and allows for a much more efficient application procedure, therefore reducing overall costs and downtime.

For more information read In Focus: Pipe Wraps on [belzona.com/wraps](http://belzona.com/wraps)

## FLANGE PROTECTION

Repairing flange crevice corrosion can be a very costly exercise, whereas common preventative measures in most cases are not 'inspection friendly'. The Belzona encapsulating membrane system introduced in 2014 seals bolted flange connections preventing corrosion. The liquid applied system includes a corrosion inhibitor and was designed to allow for periodic inspection, where flexible protection can be cut, peeled back and then easily resealed. To maintain Health and Safety standards, the system is hand applied, cures at ambient temperatures and can resist common corrosive media.

For more information visit [belzona.com/3412](http://belzona.com/3412)



*Holed pipe*



*Belzona SuperWrap II applied*



*Belzona SuperWrap II on a t-piece*



*Belzona SuperWrap II close up*



*Flange in need of protection*



*Belzona 3412 applied*



*Peel to inspect, reseal to protect*



Video: Application, peeling and resealing

## MARINE WORK

### Splash zones - applications above and below the water line

Constant salt spray and wave impact create perfect conditions for vast erosion-corrosion and necessitate in-situ repairs in order to avoid replacement costs. To address these issues, Belzona formulated a surface-tolerant coating and composite in 2002. Applied and cured above or below the water line, these materials have the ability to displace contaminants and bond strongly to the substrate. These surface-tolerant materials are specified where contact with water and other contaminants is present during their application on risers, platform legs and other splash zones.



*Corroded riser*



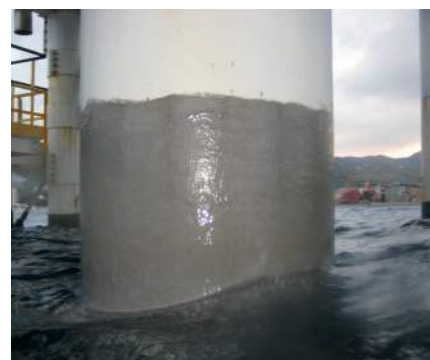
*Corrosion repaired and cladding sealed*

### RISERS

Rubber cladding does not offer permanent protection and tends to deteriorate after a few years in service, with sea water corroding the steel underneath the cladding. Belzona offers a complete system, which restores corroded metal and repairs cladding in situ, sealing the neoprene boot topping of the riser, thus preventing further water permeation. Due to proven longevity of cladding edge sealing, marine engineers specify Belzona flexible solution on new risers to prevent water ingress between the cladding and the metal.



*Corroded platform leg*



*Coating applied*

### PLATFORM LEGS

Sea water movement with abrasive residues is capable of wearing away sacrificial protection and causing severe damage to the platform legs, particularly around the water line. Belzona surface-tolerant materials can be used to rapidly repair and prevent platform leg corrosion. Liquid-applied in situ and long lasting, the system forms a durable barrier between the substrate and the sea water.

### SUBSEA COATINGS

Following over a decade of applications on platform legs, FPSO operators specify Belzona surface-tolerant materials for hull coating repairs and other subsea coating applications.

For more information on Belzona solutions for splash zones visit [belzona.com/splashzones](http://belzona.com/splashzones)



Video: Riser repair



*Inspected five years later*

## MARINE WORK

### Flexible repairs – liquid applied durable protection

Auxiliary rubber equipment such as fenders, hoses and cables are prone to in-service deterioration, where even minor rips and tears can lead to equipment being decommissioned. Belzona Elastomers are liquid-applied flexible polyurethanes, which can reduce downtime and eliminate the need for replacement. First introduced in 1985, Belzona Elastomers are commonly used in situations where replacement is too costly and alternative materials are not able to provide a durable repair.

### FLOATING HOSES AND FENDERS

Hoses can be damaged in service or in transit and require a fast and durable repair solution. Belzona Elastomers adhere strongly to any type of hose and provide outstanding abrasion and impact resistance once the hose is put back in service. Belzona Elastomers are endorsed by reputable floating hose manufacturers as their recommended repair material. 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 [belzona.com/hoses](http://belzona.com/hoses)



*Hose damaged in transport*



*Belzona flexible repair*



*Deteriorated fender*



*Fender repaired*



Video: Floating hose 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, including NACE, ASTM, ISO, Lloyds and many more. Numerous high profile Oil and Gas companies prequalify the use of Belzona materials at the design stage and for asset maintenance.

Data collected from the field influences improved formulations and application methodology to ensure increasingly efficient in-service performance.



### SPECIFICATION

Optimum materials and application procedures are selected to meet specific design and operating conditions of the asset. Dedicated project engineers 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 validated training. Combined with method statements, quality control procedures and daily inspection reports we strive to ensure application standards are maintained.



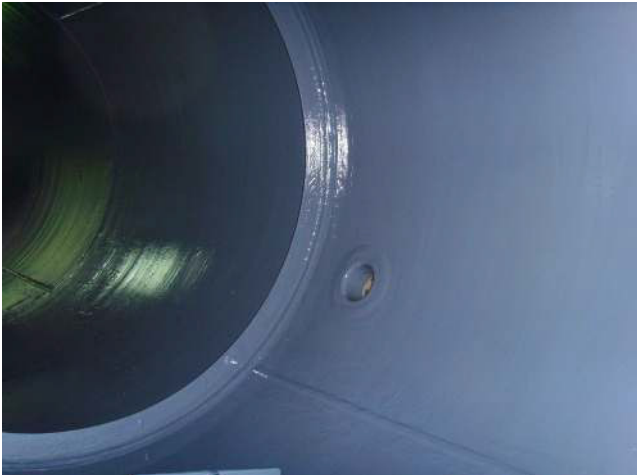
### INSPECTION

Inspection is carried out by certified inspectors (e.g. NACE, FROSIO) 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 OIL AND GAS INDUSTRY – UPSTREAM

**HIGH PERFORMANCE LININGS**  
resistant to high pressures and temperatures



**COLD BONDING**  
to replace hot work



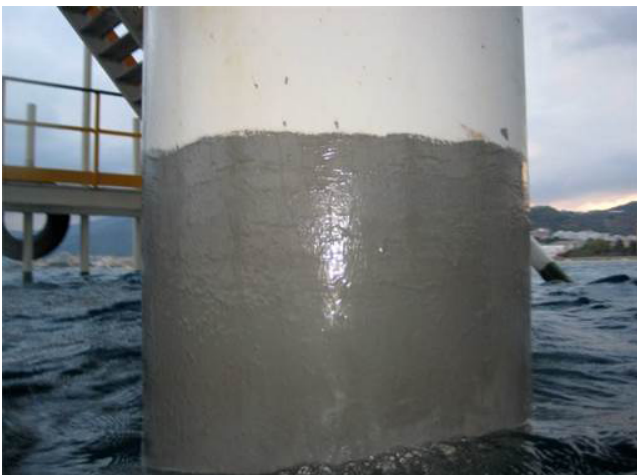
**WRAPS**  
for pressurised pipework repairs



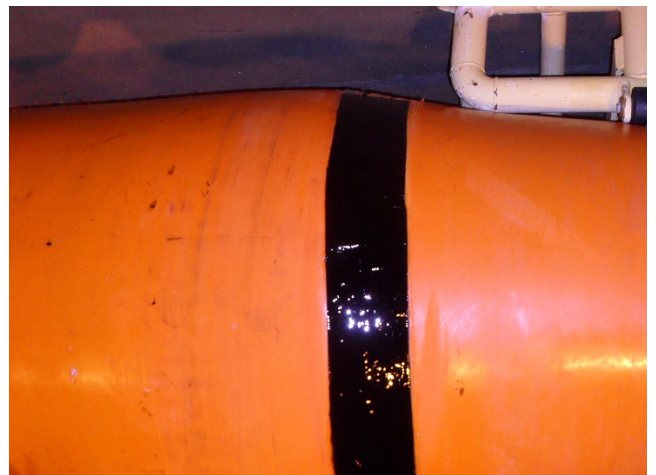
**HEAT ACTIVATED COATINGS**  
for hot surface repairs on-line



**SURFACE-TOLERANT PROTECTION**  
for applications above and below the waterline



**ELASTOMERS**  
for flexible 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

