

# Clamping & Banding Systems

Engineered Systems





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# Introduction

The global demand for the extraction of hydrocarbons from new, deeper and more demanding waters leads to contractors and operators facing even more challenging issues. In this vast and diverse global industry sector, Trelleborg Offshore's proven competencies in polymer engineering and the production of buoyancy products enable a wide variety of solutions including a comprehensive range of resilient foam buoys and fendering solutions.

Trelleborg Offshore is **Proven to Perform**.

## Company Profile

In January 2006 Trelleborg AB acquired all Trelleborg CRP group companies. Trelleborg, a company with over 23,000 employees operating in more than 40 countries has market leading positions based on advanced polymer technologies and in depth applications know how. Today, operating as 'Trelleborg Offshore', these companies have a shared interest in the provision of solutions for the offshore industry.

Working in partnership with member companies, Trelleborg Offshore is able to utilise a vast resource pool ensuring its clients are provided with the most superior solutions available in the market.

Benefiting from a number of synergies from across the group including combined research and development programmes, materials technology, cost efficiency initiatives, production and logistical

flexibility and a sound financial platform, Trelleborg Offshore remains true to the principles of customer service and product innovation that launched the company over 30 years ago.



Trelleborg Offshore - Skelmersdale Facility

## Customer Focus

Trelleborg Offshore prides itself on a long successful track record in the offshore industry. With a strong reputation for quality Trelleborg Offshore are considered to be a first choice supplier to many key industry OEM's, contractors and operators. This recognition and high level of trust has been achieved through commitment to service from first enquiry to final delivery.

All projects are assigned dedicated project managers, helping to ensure completion 'on time and within budget', essential in today's fast paced industry.

## Core Values

Our core values are long term commitments, which, when coupled with the business concept, goals and strategies guide us in making decisions and conducting business. Our core values are:

- Customer focus.
- Performance.
- Innovation.
- Responsibility.

## Global Network & Markets

Trelleborg Offshore employ more than 1,000 highly trained staff in strategically located manufacturing and office facilities across the globe. These facilities are complimented by a number of polyurethane and syntactic processing and dispensing plants servicing global marine requirements.

To service local markets the group is supported by a wide network of agents and representatives.

### Companies currently within Trelleborg Offshore are:

- Trelleborg CRP Ltd., Skelmersdale, UK (two facilities)
- Trelleborg CRP Inc., Houston, USA (three facilities)
- Trelleborg Emerson & Cuming, Inc., Boston (two facilities)
- Trelleborg OCP Ltd., Barrow-in-Furness, UK
- Trelleborg Offshore, Compiègne, France
- Trelleborg Offshore, Stavanger, Norway
- Trelleborg Offshore, Skelmersdale, UK
- Trelleborg Viking AS., Mjøndalen, Norway

### The companies service the following core sectors:

- Subsea
- Cable & Flowline Protection
- Engineered Products
- Drilling
- Thermal Insulation
- Marine
- Glass Microspheres
- Seismic
- Defence
- Industrial
- Fire Protection
- Downhole Products

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### Trelleborg Offshore - Global Network & Markets

● Agents ● Manufacturing Facilities ● Sales Offices



# Piggyback Clamps

## Description

A pipeline laying operation may have a requirement to simultaneously lay a small diameter service line or umbilical. During installation, to ensure that the secondary lines are adequately supported between surface and seabed, they may be attached to the main pipeline using a clamp arrangement. This attachment method is known as piggybacking.

The Trelleborg CRP piggyback clamping system uses a moulded saddle, tailored to the radius of the main line and is secured by circumferential straps. The saddle, which encompasses the secondary line holding it in place, has an axial split on its base to allow easy installation of the secondary line.



Polyurethane Blocks & Metallic Strapping



Polyurethane Blocks & Kevlar Strapping



Piggyback Blocks being installed on Lay Barge



Piggyback Blocks installed onto onshore section of pipeline



Banding being installed onto the blocks on the Lay Barge

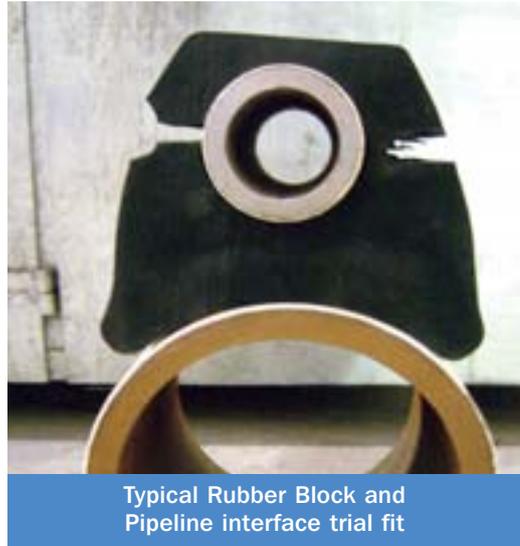
## Material

Clamps can be manufactured from various materials, including rubber, polypropylene and polyurethane elastomer, or similar material which are tough, durable and suitable for long term subsea service.

Clamp bodies can be manufactured from EPDM Rubber, or similar material that exhibits the same properties, such as toughness, durability and suitability for long term subsea service life.

The clamps are usually extruded through machined die plates, producing a semi-rigid material, giving minimal deformation and creep over long term service life, which makes it an ideal material for use in the manufacture of spacers and clamps for the oil and gas industry.

Metallic straps are offered in carbon steel, stainless steel, or Inconel depending on the specified design life of the system with Kevlar straps also as an option.



Typical Rubber Block and Pipeline interface trial fit

## APBS & Hybrid Design

### Description

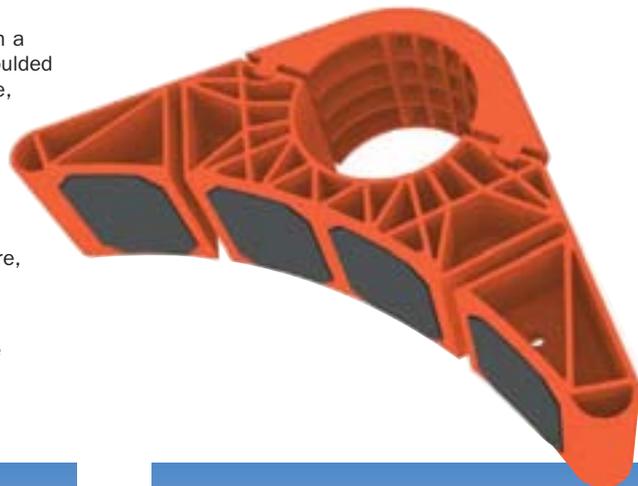
Due to the requirements for a lighter, easy to handle clamp, Trelleborg CRP Ltd. have developed a hybrid clamping system that utilises the strength and lightness of polypropylene, coupled with the higher coefficient of friction, of rubber.

The piggy-back clamps, are manufactured from a high performance, tough, durable injection moulded polypropylene material and consist of a saddle, with a removeable cap, to protect the Pipe/MEG line from direct contact with the banding.

Another advantage of the injection moulded system, is the high degree of accuracy that can be achieved by this method of manufacture, assuring required radii can be achieved.

To achieve an increased coefficient of friction, between the clamp saddle and the carrier, the saddles have cavities moulded into them, into which moulded rubber pads are inserted.

The system can be used with steel, alloy or Kevlar securing straps, depending on the life expectation of the straps, and the installation and operational loads.



Polypropylene Block showing two-piece construction (Body and Cap)



Polypropylene Block complete with Rubber Pads on underside

# Rigid Riser Clamps

## Description

During a life of a fixed production platform it is often necessary to fit additional risers to the structure. A new rigid riser connected directly to the existing structure is an effective option when no suitable J-tube is present. Any connections between the riser and the platform structure must be capable of subsea assembly and be able to carry both static and dynamic loads throughout the design life. Connections of this nature may be made using rigid riser clamps.

The clamps normally consist of three main elements: saddle, securing system, and cover. The saddle sits on the existing platform structure and is secured in place by a set of circumferential straps. The cover fits around the riser and is either held to the saddle by additional straps or by a bolting system. A metallic saddle may be lined with a material to promote friction between it and the platform structure.



Epoxy Composite Clamps and Kevlar Straps



Polyurethane Clamps and Kevlar Straps

## Material

The choice of materials for a rigid riser clamping system depends upon the magnitude of the external loads to be carried.

The saddle may be fabricated from carbon steel in the case of significant loads. Alternatively, for reduced loads, the saddle may be manufactured from a suitable polyurethane elastomer or epoxy composite material. Covers can also be supplied in either polyurethane or composite materials.

The securing straps consist of parallel Kevlar fibres held within an abrasion resistant polymer sheath, held together by the means of a super duplex tensioner.



Polyurethane Clamps with hinged covers for quick release

# Bundle Clamps

## Description

A subsea production structure may be tied back to a fixed structure or an adjacent subsea facility by a set of subsea lines. Bundle clamps, including flat pack bundle clamps for small bore service and injection lines, secured at regular intervals, provide an effective solution to laying subsea lines simultaneously. These lines also remain grouped on the seabed; a configuration which simplifies any subsequent burial operation.

## Material

Clamp bodies are moulded from an appropriate grade of polyurethane elastomer to a predetermined configuration of cylindrical recesses which bed the lines in place.

The securing systems include metallic bands or fasteners supplied in highly corrosion resistant materials.



Installation of Bundle Clamp



Bundle Clamp assembled complete with Metallic Straps

# Pipeline Centralisers

## Description

The requirement to locate a number of riser pipes within a caisson has always presented pipeline engineers with problems.

The increasing use of fully coated and thermally insulated riser pipes raises the question as to how to prevent or reduce the risk of damaging these coatings as the risers expand and contract during their operational life. Traditional fabricated steel centraliser clamps have proved difficult and expensive to insulate at the support points.

Trelleborg CRP has overcome these inherent problems by moulding a segmental polyurethane bundle centraliser clamp which offers insulation and is in itself corrosion resistant. The ability to match the grade of polyurethane according to the application generally ensures a 'coating friendly' centraliser processing excellent structural strength and rigidity.

The use of another Trelleborg CRP product, POLYSLIP™ (a high molecular weight polyethylene), when fitted as pads on the circumference of the centraliser, provides a low friction interface with the caisson during the bundle 'pull-in'.



# Riser Clamps



Riser Clamps complete with Kelvar Straps installed on platform

## Description

Floating production platforms are normally connected to the subsea facilities by flexible risers and umbilicals. In these systems it is often necessary to support the umbilicals directly from the risers. Such a configuration has the advantage of reducing congestion in the subsurface zone, which is particularly important at the platform interface.

Umbilicals may be secured to dynamic risers by installing clamps at discrete intervals.

A typical Trelleborg CRP clamp consists of a moulded central spacer into which are bolted two half clamps to secure the respective lines. In cases where a significant axial load is to be transferred, the moulded components may include an internal metallic structure.

When the production riser is deployed on a regular basis, e.g. a test production vessel, a hinged three part clamp can be supplied in order to reduce installation times.



Riser Clamps installed on site

## Material

The clamp bodies are manufactured from polyurethane elastomer. This is a tough yet flexible material which is only slightly negatively buoyant (1100 kg/m<sup>3</sup>); a most important attribute in the case of deep water systems.

The clamps are available in a wide range of colours including high visibility options to aid in-service inspection.

Metallic components are normally supplied in highly corrosion resistant metals suitable for an extended service life.

## Umbilical Clamps

Work over riser clamps are required for annulus pipes as part of intervention drilling projects. This requires clamps which have a minimum number of parts, light weight construction and are suitable for use in a harsh operating environment (Drilling fluids etc.).

Clamps and Guides for these applications have been supplied to many contractors (FMC Technologies global organisation in particular). The annulus guides and clamps comprise a one-piece polyurethane elastomer moulded body fixed in position by a circumferential securing strap and tensioning assembly. The tensioning assembly is retained with the moulding ensuring that there are no loose components. This design has the following advantages over a metallic clamp assembly:-

- Light Weight Material (neutral in sea water, buoyant in drilling fluid).
- Excellent abrasion resistance.
- Quick and easy installation.
- No loose parts.
- One screw only for installation.
- Spare parts available.
- Proven track record.

# Polyurethane Spacers

## Description

To complement Trelleborg CRP's versatile range of clamping systems, a new series of moulded polyurethane spacers has been developed. These include spacers for dual lay pipeline installations and saddle spacers to interface between buoyancy tanks and pipelines.

Spacers were traditionally manufactured in wood or steel, each with their inherent problems, i.e. wood splintering, steel corrosion, weight etc.

Trelleborg CRP manufactured some of the first polyurethane spacers/saddles which replaced wooden saddles during a major offshore pipeline installation in the southern North Sea gas fields.

Since then a large number of projects have been completed worldwide as the following benefits of polyurethane spacers became apparent:

- Neutral buoyancy in seawater.
- Corrosion resistant, unaffected by seawater or UV degradation.
- Polyurethane can be moulded into complex shapes.
- 30 year design life.



Pipeline Interface Saddles for Buoyancy Tanks



Dual Lay Pipeline Spacers with Metallic Banding installed on Lay Barge

# Polyloop™ Securing Systems

## Description

If clamp assemblies are to perform successfully, close attention must be paid to the securing systems. POLYLOOP™ securing systems comprise an endless loop usually manufactured from Polymer coated Kevlar and a metallic tensioning assembly to draw the loop together and maintain the required operating tension.

POLYLOOP™ varies in width, thickness and load carrying capacity depending on the design duty.

The metallic tensioning assemblies are supplied in a range of materials suitable for 'installation aids' or a long term 30 year design life. Materials include:

- Carbon steel.
- Stainless steel.
- Super duplex stainless steels.
- Titanium.



Kevlar Strap and Tensioning Assembly detail



## System Verification

Trelleborg CRP carefully researches each project to ensure that appropriate securing systems are utilised for clamp assemblies. This involves working closely with customers during development and includes load testing at the factory based on individual project specifications. An additional benefit to clients is the ability at Trelleborg CRP to utilise many years of experience producing clamping systems which function successfully in difficult and extremely hostile environments.



In-house load testing for Factory Acceptance Testing

# Compliant Clamps

## Description

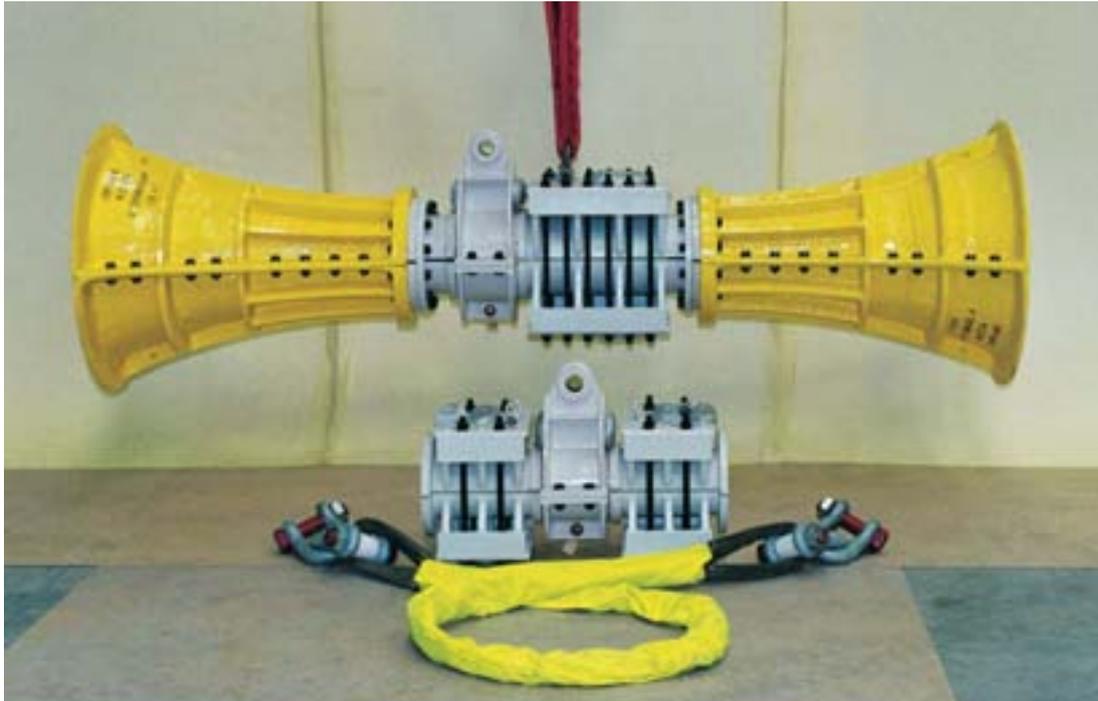
Deep waters often require compliant clamping solutions which are specifically designed to ensure that clamp axial capacity and flexible integrity is maintained as the flexible riser/umbilical contracts. In addition, these clamping solutions may be required to secure buoyancy modules or tether clamps onto highly insulated flexible risers or deep water umbilicals which exhibit large diametric contractions due to tension, hydrostatic pressure and material creep.

Trelleborg CRP have developed a number of compliant clamping solutions which have been qualified to meet the following demanding design criteria:

- Axial capacity maintained with diametric contractions of up to 30mm on the flexible.
- Field proven solutions available with capacities of up to 55te.
- Compliant clamping solutions qualified on flexibles with diameters up to 480mm.



# Tether Clamps



## Description

In certain configurations flexible risers need to be secured to the seabed. This is often done by means of a steel tether clamp, tether systems and seabed anchor. The clamps are designed to withstand high differential axial loads on the riser, together with high tether loads to the anchor, whilst coping with all the usual difficulties of clamping onto flexible structures, i.e. expansion, contraction, low friction etc.

Also to be considered in the design of such clamps is bending protection, since the clamps are usually located in a dynamic section of the riser, and overbending around the ends of the clamp can be a problem. It is therefore often a requirement to build the clamps with bending stiffeners, bellmouths or bending restrictors fitted.

## Material

The clamps are generally fabricated from high strength structural steel in accordance with NORSOK specifications, although there is also an option to use a lightweight all composite GRP design if necessary.

Corrosion protection is afforded by means of a subsea paint system and an integral cathodic protection system designed to the latest DNV codes.

If bending stiffeners or bending restrictors are required these are moulded from Trelleborg CRP's advanced polyurethane elastomer materials, to provide durable high performance products suitable for extended subsea design life.

Alternatively lightweight Bellmouths can be constructed using the latest aerospace grade fibre reinforced composite materials.



# Banding Systems

## Trelleborg Service

As one of the world's largest buyers, users and suppliers of high grade metallic banding, Trelleborg CRP offer a reliable service that reduces cutting, stockholding and installation costs.

Trelleborg CRP's product range includes Alloy 625, Titanium, Stainless steel and Carbon steel supplied in 25kg and 50kg coils or pre-cut individual lengths. When supplied pre-cut, each band incorporates radial ends and a pre-installed seal to simplify on-site tool operation and reduce installation time.

With extensive stock and over 30 years of banding experience gained in harsh offshore environments, Trelleborg CRP offer an augmented service, combining material knowledge with worldwide inventory and distribution expertise - providing a cost-effective and convenient service.

## Core Banding Materials

### Alloy 625

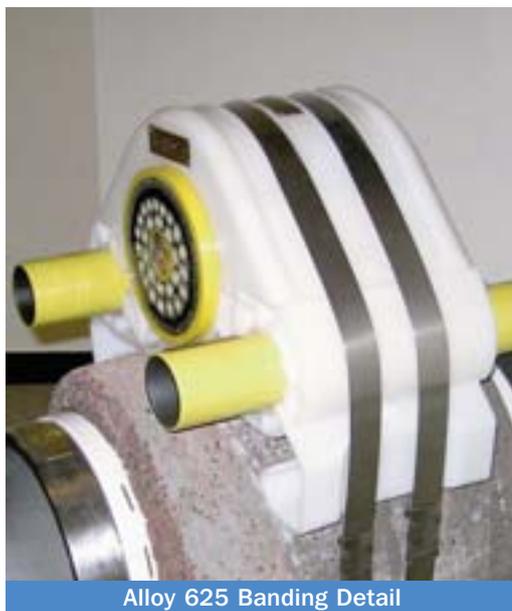
Alloy 625 is a nickel-chromium alloy containing molybdenum. Exhibiting high tensile strength and excellent anti-corrosion properties, it is especially resistant to crevice corrosion.

The tensile properties of Alloy 625 enable it to be used in high load applications in Marine, Subsea and Chemical environments.

### Titanium

Titanium combines an outstanding strength to weight ratio with excellent anti-corrosion properties, making it ideally suited to small diameter yet heavy duty banding applications. Titanium exhibits exceptional resistance to corrosive attack from salt water, acids, alkalis and industrial chemicals.

Trelleborg CRP also offers alternative metallic/alloy banding materials, optimised to suit specific application requirements.



Alloy 625 Banding Detail

## Stainless Steel

Grade 316 stainless steel banding is suitable for medium duty installations, typically within the automotive, food and pharmaceutical industries or medium term installations in seawater.

## Carbon Steel

Carbon steel is a cost effective alternative for use in non-corrosive environments or temporary applications. Carbon Steel offers high tensile strength and is often used within the packaging industry or as a temporary installation aid in a Subsea or Marine environment.

## Non-Metallic Banding

For less arduous applications, Trelleborg CRP also supply a non-metallic strapping system, which combines a separate strap and low profile seal.

Both band and seal are manufactured from a glass filled Nylon 11 material which exhibits excellent resistance to the most corrosive environments, in particular seawater.

The seal has been designed with a smooth low profile, minimising the risk of snagging on a third party object.

The band is efficiently installed using either manual or pneumatic tooling.

## Kevlar®

For extreme high load conditions Trelleborg CRP offers a wide range of Kevlar strapping systems with nominal breaking loads of between 5Te and 12.5Te. Each strap is precisely manufactured to length and supplied complete with a high strength tensioning assembly. Metallic tensioning assemblies are supplied in alternative metallic grades to suit system design life.



Alloy 625 Showing Crimp Detail



Kevlar Strap and Tensioning Assembly under Load Testing



## EUROPE

### Trelleborg CRP Ltd.

Paxton Place, West Pimbo  
Skelmersdale, Lancashire  
Tel: +44 (0)1695 714300  
Fax: +44 (0)1695 555586

Stanley Way, Skelmersdale  
Lancashire WN8 8EA, UK  
Tel: +44 (0)1695 712000  
Fax: +44 (0)1695 712111

Email: [crpsales@trelleborg.com](mailto:crpsales@trelleborg.com)  
Website: [www.trelleborg.com/crp](http://www.trelleborg.com/crp)

### Trelleborg Viking AS

PO Box A, 3051 Mjøndalen,  
Norway  
Tel: +47 32 23 20 00  
Fax: +47 32 23 22 00

Email: [viking@trelleborg.com](mailto:viking@trelleborg.com)  
Website: [www.trelleborg.com/viking](http://www.trelleborg.com/viking)

## NORTH AMERICA

### Trelleborg CRP Inc.

3131 West Little York Road, Houston  
TX 77091, USA  
Tel: +1 (713) 956 0435  
Fax: +1 (713) 290 0211

1902 Rankin Road, Houston  
TX 77073, USA  
Tel: +1 (281) 774 2600  
Fax: +1 (281) 774 2626

Email: [crpsales@trelleborg.com](mailto:crpsales@trelleborg.com)  
Website: [www.trelleborg.com/crp](http://www.trelleborg.com/crp)

### Trelleborg Emerson & Cuming, Inc.

209 Forbes Boulevard, Mansfield  
MA 02048, USA  
Tel: +1 (774) 719 1400  
Fax: +1 (774) 719 1410

24 Teed Drive, Randolph  
MA 02368, USA

### Regional Sales Offices

114 rue Saint Lazare - BP20609  
60476 - Compiègne cedex 2, France  
Tel: +33 (0)3 44 23 03 50  
Fax: +33 (0)3 44 23 03 49

Norsea Dusavik, Bygg 1, PO Box 138,  
4001 Stavanger, Norway  
Tel: +47 51 54 38 00  
Fax: +47 51 54 35 00

Email: [offshoresales@trelleborg.com](mailto:offshoresales@trelleborg.com)  
Website: [www.trelleborg.com/offshore](http://www.trelleborg.com/offshore)



**WWW.CABLEJOINTS.CO.UK**  
**THORNE & DERRICK UK**  
**TEL 0044 191 490 1547 FAX 0044 477 5371**  
**TEL 0044 117 977 4647 FAX 0044 977 5582**  
**WWW.THORNEANDDERRICK.CO.UK**

