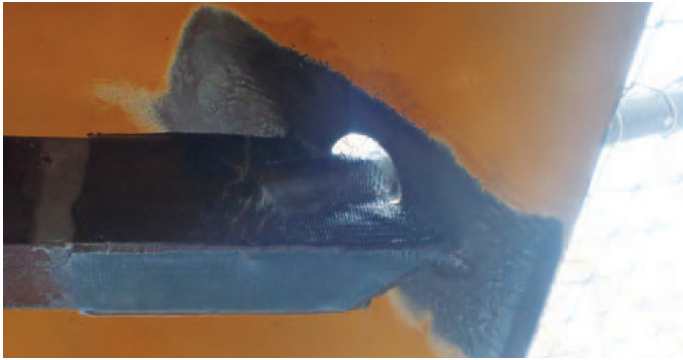


## ENGINEERED COMPOSITE REPAIRS



Our world class reputation is built on our ability to deliver innovative, bespoke and cost effective composite solutions to some of the largest oil and gas companies globally. Our global footprint allows us to deploy trained personnel and equipment wherever they are needed, quickly and efficiently.

Through our Technowrap™ technology, we provide and maintain bespoke solutions to integrity management problems related to pipelines, piping systems, structures, caissons and risers and vessels in a range of conditions, with little or no downtime.

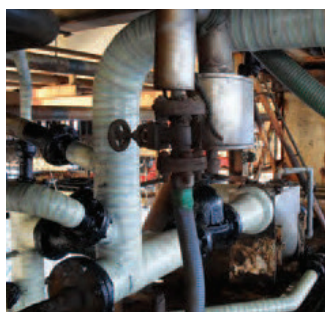
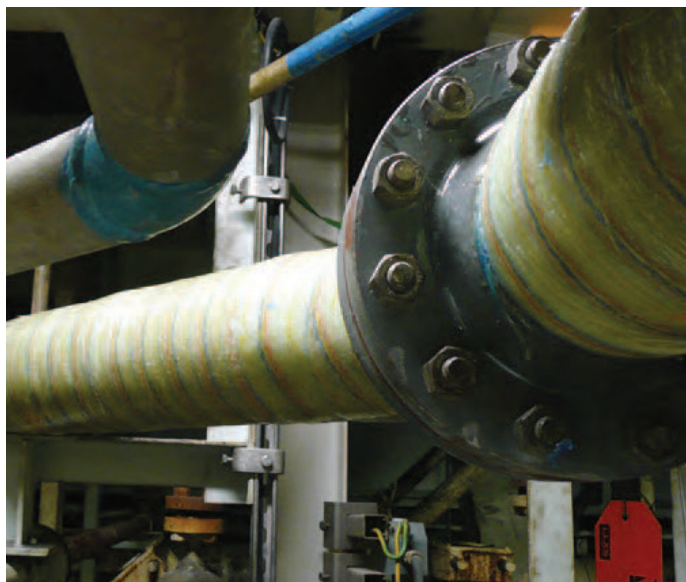
Our Technowrap™ technology has Lloyds Register "Type Approval". This range comprises a series of design-engineered systems developed to suit a variety of conditions. The system utilises composite technology that is internationally recognised and accredited for its outstanding performance.

Major organisations within the oil and gas industry have benefited from our Technowrap™ engineered composite solutions. Clients choose us for:

- Effective solutions for pipework, pipeline & structural integrity issues
- Can be applied to live systems with little or no impact on production
- Cold repair system - No hot work
- Fast, cost effective & easy to install - minimal facilities required
- Worldwide independent accreditations (Lloyds Register "Type Approval" & ABS Design & Manufacturing)
- Exceptional strength & adaptability of composites
- Long term alternative to steel replacement

The types of corrosion, erosion defects or damage that can be repaired include:

- Internal (e.g. corrosion pits)
- External (e.g. dents)
- Through-wall (e.g. leaks)
- Cracks

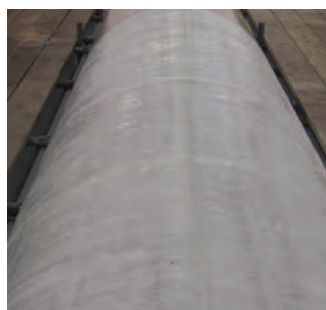
**TECHNOWRAP 2K™**

Technowrap 2K™ is an original product of the innovative Technowrap™ composite repair product line.

The multi-directional glass cloth used in conjunction with our epoxy resin solution was developed for use in the repair of piping and vessels, creating a more cost effective solution than traditional metallic materials. Once applied, Technowrap 2K™ can seal through-wall defects and re-instate the structural integrity of the defective pipe section.

Fibre	E-glass tri-axial woven cloth 0° ± 45°
Application	Complex geometries Piping systems Strengthening Pressure retention Leak sealing
Defect types	Internal External Through-wall
Max design pressure	Up to 250 bar
Max design temp	Up to 220°C
Approx cure time	24 hours
Chemical resistance	3 < pH < 10



**TECHNOWRAP PRS™**

Technowrap PRS™ (Pipeline Repair System) is a composite repair system specifically for long, straight piping sections or pipelines. It was developed in response to demand from clients who required a product that provided a cost-effective method of returning externally corroded pipelines to their original pressure retention capability and structural design integrity.

Fibre	E-glass uni-directional woven cloth 0°
Application	For strengthening of pipelines Straights Bends
Defect types	Internal or external up to 80% of the original wall thickness
Max design pressure	Up to 150 bar
Max design temp	Up to 220°C
Approx cure time	24 hours
Chemical resistance	3 < pH < 10





**TECHNOWRAP SRS™**

Our Technowrap SRS™ (Structural Rehabilitation System) utilises the unique features of carbon fibre technology intended for structural strengthening applications. It is less than one-quarter the weight of steel, which makes it 4 times as stiff on a weight to weight basis. It is approximately twice as strong in tension and it has a better fatigue performance than steel, aluminium or titanium.

Fibre	Carbon Quadraxial woven cloth 0°/45°/-45°/90°
Application	For strengthening of tanks, vessels, roofs, floors, beams, columns, support members, struts, bridge and jetty supports, accommodation modules, walkways, HVAC ducting, handrails, signage
Defect types	Wall loss and cracking
Max design temp	Up to 220°C
Approx cure time	24 hours
Chemical resistance	3 < pH < 10



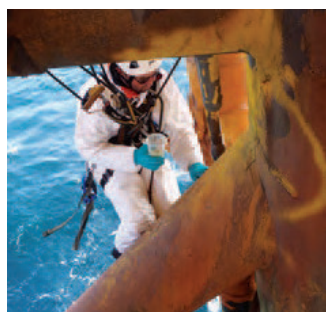
**TECHNOWRAP H.P. PRS™**

Technowrap H.P. PRS™ (High Pressure Pipeline Repair System) has been designed for use on land. The system's intended application is for large diameters of pipe work, such as a 36 inch pipe operating at 50 bar pressure, and is ideally suited to the Middle East market. The uni-directional carbon based cloth applied with our epoxy resin system results in a fast application time.



Fibre	Carbon uni-directional woven cloth 0°
Application	For strengthening of high pressure pipelines (straights and bends) Designed for use on land
Defect types	Internal or external up to 80% of the original wall thickness
Max design pressure	Up to 250 bar
Max design temp	Up to 220°C
Approx cure time	24 hours
Chemical resistance	3 < pH < 10



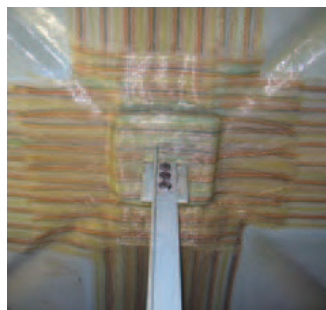
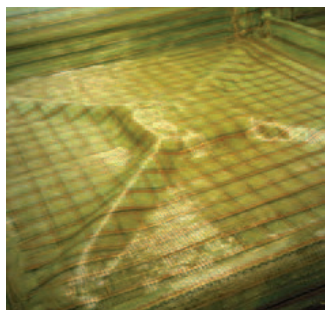
**TECHNOWRAP SPLASHZONE™**

Technowrap Splashzone™ can be applied either on wet surfaces or within wet or submerged environments. The repair system consists of either a carbon or glass reinforcement encased in a water tolerant epoxy resin. Based on successful conclusion of the qualification tests (according to ISO 24817) and application trials, the Technowrap Splashzone™ repair product can provide a repair solution for a design lifetime of up to 20 years.

Fibre	E-glass or carbon
Key characteristics	Epoxy resin system which can cure and adhere in wet or submerged conditions
Defect types	Internal External
Max design pressure	Up to 100 bar
Max design temp	Up to 55°C
Approx cure time	36 hours
Chemical resistance	4 < pH < 9





**TECHNOWRAP POTABLE™**

Technowrap Potable™ is a design engineered glass-based repair system specifically designed and certified for potable water applications and can be used on all pipe work components. It consists of a glass fibre reinforcement encased in an epoxy resin which has been specifically formulated for use in drinking water applications. The repair system has been successfully tested to BS 6920, confirming its suitability for potable water applications.

Fibre	E-glass
Key characteristics	Ambient cure epoxy resin system approved for potable water service
Defect types	Internal External Through-wall
Max design pressure	Up to 250 bar
Max design temp	Up to 80°C
Approx cure time	24 hours
Chemical resistance	4 < pH < 9



**TECHNOWRAP™ CUNIFER**

Technowrap™ Cunifer is a repair system designed specifically for the repair of cunifer pipework. Cunifer, being a soft material, implies that when preparing the pipe surface the achievable surface profile is less than ideal from an adhesion perspective. This repair system overcomes this surface profile problem by improving the crack initiation resistance of the repair system. This improvement in crack initiation resistance results in increased pressure containment capacity and also increased strengthening.

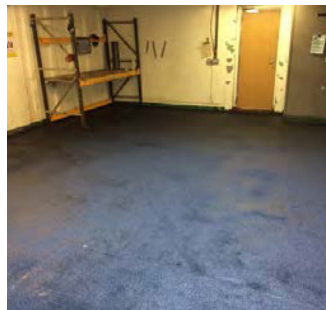
Fibre	E-glass – tri-axial stitched cloth 0°/+45°/-45°
Resin	Toughened epoxy resin
Application	Complex geometries on pipework systems Strengthening, pressure retention and leak sealing
Defect type	Internal, external, through-wall
Max design pressure	Up to 50 bar
Max design temp	Up to 65°C
Approx cure time	24 to 36 hours



**TECHNOWRAP DRS™ - DECK REPAIR SYSTEM**

Technowrap™ DRS (Deck Rehabilitation System) is a repair system for the rehabilitation of damaged or corroded deck areas. The major engineering challenge in designing a repair system for deck plates is to ensure that the damage tolerance of the repair system can meet the demands of the day to day impacts that the deck has to withstand.

To achieve this damage tolerance, a repair system consisting of carbon fibre cloth and an epoxy resin, which is infused with rubber nano-particles, has been developed. It is the rubber nano-particles which toughens the repair for improved impact and abrasion resistance. Another key requirement of the repair system is to ensure a non-slip outer surface. This has been developed by combining aggregate with the resin system.



Fibre	Carbon – quadraxial stitched cloth 0°/+45°/-45°/90°
Resin	Rubber toughened epoxy resin
Application	Deck areas
Defect type	Corrosion and through-wall
Max design temp	Up to 60°C
Approx cure time	36 hours
Max in-plane strength	750 kN/metre
Max impact resistance	> 2000 kJ



# TECHNOWRAP™ ULT

## ULTRA LOW TEMPERATURE



Technowrap™ ULT (Ultra Low Temperature) repair system is the ideal solution for repair and strengthening of pipes where low ambient temperatures are an issue. The resin system has an enhanced curing rate at lower ambient temperatures.

The faster curing time at lower temperatures make this resin system ideally suited for ambient temperatures between 5 and 10°C. Technowrap™ ULT under these conditions has a curing time of 24 hours, 12 hours shorter than standard ambient cure repair systems. By introducing a faster cure the cost effectiveness is increased through reduced repair installation times.

Fibre	E-glass tri-axial woven cloth 0° ± 45°
Application	Complex geometries Piping systems Strengthening Pressure retention Leak sealing
Defect types	Internal External Through-wall
Max design pressure	Up to 250 bar
Max design temp	Up to 220°C
Approx cure time	15 hours at 25°C





TECHNOWRAP™ E1



Technowrap™ E1 is an external corrosion protection coating developed for pipework and structures. E1 is a thicker laminate than our standard 2K, therefore each layer applied provides greater impact resistance while still adhering to the substrate and providing pressure containment.

Fibre	E-glass cross-ply (00/900) stitched cloth
Resin	Two-part epoxy resin system
Application	Complex geometries on pipework systems and pipelines. External corrosion protections and strengthening
Defect type	Wall loss through corrosion, internal or external
Max design pressure	Up to 20 bar
Max design temp	Up to 85°C
Approx cure time	24 to 36 hours





**TECHNOWRAP™ GLYCOL**

Technowrap™ Glycol is an original product from the innovative Technowrap composite repair product line. The multi-directional glass cloth used in conjunction with our specialised formulated epoxy resin system is developed for use for the repair of piping and vessels containing up to 100% glycol. Once applied Technowrap Glycol can seal through wall defects and re-instate the structural integrity of the defective pipe section.



Fibre	E-glass tri-axial stitched cloth 0° ± 45°
Application	Complex geometries Piping systems Pressure retention Leak sealing
Defect types	Internal External Through-wall
Max design temp	Up to 90°C with 100% glycol
Approx cure time	24 hours



## TECHNOWRAP CORE™ & CORE KITS

### GENERAL INFORMATION

Technowrap Core™ is a short term repair solution consisting of a glass fibre reinforcement with a polyurethane resin system.

Technowrap Core™ is validated to ISO 24817 and ASME PCC-2-2015. Technowrap Core™ can be applied on straight and slight bend pipe sections.

### THE FACTS

Technowrap Core™ will restore asset integrity of non hydrocarbon straight and bend pipe work suffering from external damage or wall loss operating up to a maximum pressure of 25 bar g / 362 psi and temperature up to 80°C / 176°F. It can also be used for maintenance of through wall defects for non-hydrocarbon lines operating up to a maximum pressure of 15 bar g / 217 psi and temperature of 70°C / 158°F.

### INSTALLATION

Technowrap Core™ can be stored on site as a stock item for application at your convenience for when and where you have an urgent repair requirement. It can be applied by your own on site personnel by following the comprehensive instruction leaflet and guidelines provided.

### TECHNOWRAP CORE™ KITS

Technowrap Core™ Kits are available from ICR as a stock item; containing all the consumables you need to apply the repair in one compact, easy to store container. A Technowrap Core™

Kit includes:

- Easy to follow instruction leaflet
- Core (as per amount required for repair)
- Epoxy putty
- Stricture
- Water sprayer
- Through-Wall Penetration (TWP) plugs
- Retaining strap
- Disposable gloves

The Technowrap Core™ Kit packaging also doubles up as a water container which you can use during repair installation.



## LEAK SEALING TOOL KIT



The leak sealing tool kit comprises of a number of leak sealing methods utilised by ICR Technicians prior to carrying out a Composite repair. The clamp included in the tool kit is made with powder coated carbon steel and is supplied with an internal rubber patch for ease of leak sealing. Due to its construction and low profile, the clamp can be used in combination with ICR's engineered composite systems, to seal the leak and then to reinforce the clamp after sealing. The clamp measures 3.5" in width and are available in lengths designed for diameters ranging from 2" to 8". The "clamp linking design," allows several clamps to link together to form a clamp for pipe diameters up to 24".

The leak sealing tool kit can be utilised for leak sealing under the following conditions:

The intention of the leak sealing capability offered by ICR is to provide a temporary (mechanically) leak sealing solution, prior to the application of a compliant Technowrap™ composite repair providing a long term repair solution up to 20 years.



Repair class	Class 1 and 2
Service conditions	Drains, cooling media, sea water, fire water, potable water
Design pressure	< 20 bar
Design temp	< 40°C

### OUR ADVANTAGES

We provide leak sealing service with the following advantages:

- Leak repairs are temporary but when overwrapped with an ISO compliant composite repair system can provide a long term solution
- Trained and experienced leak sealing technicians
- Application of the latest leak sealing techniques
- Variety of leak sealing options available

Our certified technicians have years of field experience. They are well-trained and well-equipped with the appropriate equipment to handle leaks.





**PRODUCT OVERVIEW**

Technowrap™ composite repairs are Lloyds Register Type Approved, DNV Type Approved and ABS Design & Manufacturing Approved and are fully qualified to ISO 24817 and ASME-PCC2. All of our products go through rigorous checks and have been tested within the following range of temperatures and pressures:

- Temperature range of -75 to 220°C
- Pressure range tested up to 250 bar

All Technowrap™ repairs come with a life-time guarantee of up to 20 years assuming ICR perform the design of the repair and that trained Technowrap™ installers perform the application.

The resins used in Technowrap™ composite repairs are chemically resistant to a wide range of fluids present in Oil and Gas production facilities.



Max. pressure:	Tested up to 250 bar
Temperature range:	-75 to 220°C
Range of fluids:	Most fluid types occurring in Oil and Gas applications
Component types:	Piping systems, pipelines, vessel / tanks, caissons & risers, walkways, handrails, roofs, decks
Substrates qualified for:	Carbon steel cast iron 6 moly 316 stainless steel Cunifer Duplex Super duplex Titanium GRP & GRE
Defect types:	Internal defects External defects Through-wall defects
Surface preparations:	Sa 2.5 ST2 ST3
Approvals:	Lloyds Register Type Approved DNV Type Approved ABS Design & Manufacturing Approved Fully qualified to ISO 24817 ASME PCC-2

## TECHNOWRAP™ RESINS

Resin system	<b>Low Temperature (LT)</b>
Reinforcements	2K, HP PRS, PRS, SRS
Key characteristic	Ambient cure epoxy resin system at low ambient temperatures
Temperature range	-75°C to 90°C
Cure time	24 hours at 25°C
Lap shear strength (MPa)	15

Resin system	<b>High Temperature (HT)</b>
Reinforcements	2K, HP PRS, PRS, SRS
Key characteristic	High temperature epoxy resin system (which requires post curing)
Temperature range	90°C to 220°C
Cure time	36 hours at 80°C
Lap shear strength (MPa)	10

Resin system	<b>Ultra Low Temperature (ULT)</b>
Reinforcements	2K, HP PRS, PRS, SRS
Key characteristic	Faster cure epoxy resin system at lower temperatures
Temperature range	-75°C to 92°C
Cure time	15 hours at 25°C
Lap shear strength (MPa)	20

Resin system	<b>Splashzone</b>
Reinforcements	2K, HP PRS, SRS
Key characteristic	Epoxy resin system which can cure and adhere in wet or submerged conditions
Temperature range	0°C to 55°C
Cure time	24 hours at 35°C
Lap shear strength (MPa)	9

Resin system	<b>DRS</b>
Reinforcements	SRS
Key characteristic	Rubber toughened epoxy resin
Temperature range	0°C to 60°C
Cure time	36 hours at 20°C
Lap shear strength (MPa)	15

Resin system	<b>Potable</b>
Reinforcements	2K
Key characteristic	Ambient cure epoxy resin system approved for potable water service
Temperature range	0°C to 80°C
Cure time	24 hours at 20°C
Lap shear strength (MPa)	10

Resin system	<b>High Ambient (HA)</b>
Reinforcements	2K, HP PRS, PRS, SRS
Key characteristic	Ambient cure epoxy resin system at high ambient temperatures
Temperature range	-75°C to 90°C
Cure time	24 hours at 40°C
Lap shear strength (MPa)	13

Resin system	<b>Glycol</b>
Reinforcements	2K
Key characteristic	Ambient cure epoxy resin system for 100% Glycol (TEG or MEG) service
Temperature range	0°C to 90°C
Cure time	24 hours at 27°C
Lap shear strength (MPa)	8

Resin system	<b>Cunifer</b>
Reinforcements	2K
Key characteristic	Epoxy system specifically designed for adhesion to cunifer pipework
Temperature range	0°C to 90°C
Cure time	24 hours at 20°C
Lap shear strength (MPa)	15

Resin system	<b>Ultra High Ambient (UHA)</b>
Reinforcements	2K, HP PRS, PRS, SRS
Key characteristic	Slightly longer working life than HA. Allows more working time on larger/complex repairs
Temperature range	-75°C to 68°C
Cure time	30 hours at 45°C
Lap shear strength (MPa)	20