ENGINEERED COMPOSITE SOLUTION

FUTUREWRAP

ASSURED INTEGRITY GROUP INCORPORATED

We are a Non-Destructive Testing (NDT), In-service Inspection and Engineering company providing services to a diverse clientele. Our goal is to strive to become Canada's number one Engineering, NDT, and In-service inspection provider.

ASSURED INTEGRITY GROUP INC.

ecs ENGINEERED COMPOSITE SOLUTIONS

Welcome to Engineered Composite Solutions

Assured Integrity Group is in partnership with Engineered Composite Solutions, the company behind FutureWrap. FutureWrap is a unique engineered composite repair system for the Oil & Gas Sector, Refineries, Chemical Plants, Power Stations (both nuclear and conventional) and Renewable Energy Sector. With a highly experienced team, ECS is a leading supplier of engineered composite systems in the energy sector.

Working together, our aim is to deliver high quality repairs, with an excellent service and long-term testing and innovative approach. ECS harness the latest resin and cloth technology to offer a high-quality repair system. FutureWrap closes existing technology gaps within the composite repair industry to ensure cost effective and time efficient solutions.

Behind the scenes is an accomplished and passionate team with years of experience in composite industry.

Quality Management System Requirements

Assured Integrity Group has obtained approval for Alberta quality management system Certificate of Authorization Permit (AQP registered with ABSA) for Engineered Composite Systems for Pressure Equipment Alterations. ECSPS – Engineered Composite System Procedure Specification and PQR Procedure Qualification Record has been registered with ABSA. Assured is also authorized to perform integrity assessments of pressure equipment.

Alberta Government

ABSA the pressure equipment safety authority

Certificate of Authorization Permit

Quality Management System

Expiry Date: **August 1, 2026** Reg. No.: **AQP-22223**

ASSURED INTEGRITY GROUP INC.
207, 6051B - 47 STREET
LEDUC, ALBERTA

having complied with the provisions of the SAFETY CODES ACT, is hereby authorized to perform the activities identified in the following table:

	Construction	Repair	Alter
Pressure Piping			
ASME B31.3 Process Piping	- - -	- - -	Shop/Field
ASME B31.5 Refrigeration Piping	- - -	- - -	Shop/Field
ASME B31.9 Building Services Piping	- - -	- - -	Shop/Field

Government of Alberta ■ PROVINCE OF ALBERTA

Form No. AB-121
Rev.(2015/09)

As a condition of this permit, the holder is required to participate in interim audits by a safety codes officer to verify that the quality management system is being maintained in a manner acceptable to a safety codes officer.

Dated at Edmonton, this 10th day of August, 2023

Chief Inspector and Administrator

Certificate No.: 16011

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Products

FutureWrap composite repair systems have been developed and qualified to ISO24817 to provide a long-term integrity solution to a whole host of damage mechanisms that occur onshore, offshore within the oil & gas, energy, and renewable sectors. These damaged mechanisms include internal and external corrosion / erosion, through wall defects, cracking, CUI and mechanical damage. The repairs can be applied to all component types or pipework and pipelines, caissons and risers, structural components, including decks. FutureWrap systems are also compatible with Stainless, Carbon steel, Duplex, Super Duplex and Cunifer.

The range of FutureWrap repairs are designed to optimise performance (maximum pressure, maximum and minimum temperature, and chemical resistance) with ease of installation.

FutureWrap has ABS approval with a Product Design Assessment (PDA) for FutureWrap composite repair products against the ASME standard PCC-2 Article 4.1.

The following lists the individual repair systems within the FutureWrap repair range detailing the performance range and other technical details.

ECS: Futurewrap Product Range

FutureWrap Low Temp™
FutureWrap Bio
FutureWrap Fire
FutureWrap High Temp™
FutureWrap Live™
FutureWrap Aquasplash™
FutureWrap Structural™
FutureWrap HIDRS™
FutureWrap Cunifer™
FutureWrap SOS™
FutureWrap RFID™
FutureWrap Glycol™

FutureWrap Features & Benefits

Capability of our ECS

Our priority is our clients. We offer top class service delivery and are committed to the industry and our clients through “innovation". We believe in long term testing and this, together with our drive on innovation, allows us to deliver the best technology available, with our ongoing promise to solve the integrity issues for each one of our clients.

We are here to help you save millions on shutdowns and pipe line replacement costs.

Our Future Wrap can be used to repair any Pipe Size & Schedule with different geometry, including tees, flanges, and varying diameter pipe. ECS can be used to repair piping defects caused by external corrosion or internal erosion or corrosion, thereby eliminating the limitations in operations caused by wall thinning if not repaired.

The goals of composite repair are to arrest the progress defects *and* restore walls. This allows operators to use systems to their maximum operating designs. It can withstand temperatures ranging from -75 to +220 degrees Celsius, and up to 3600 psi. Future Wrap repair systems are custom engineered to function in specific site conditions. It provides re-enforcement of the piping in both the axial and hoop directions and delivers uniform loading throughout the repair.

There are many resemblances between Engineered Composite Systems and Engineered Pressure Enclosures in terms of what they can do, but because of lightweight and great strength, Engineered Composite Systems is an excellent material for the repair and alteration of pressure equipment. Our Future Wrap ECS is a great option for extending piping life without interrupting operations, because repairs can be performed without shut down.

Our Engineered Composite can be used to make it until your next turnaround and can be engineered to last as long as the owner user want, for up to 20 years or more, that is, you can decide to extend the life of an asset with a permanent repair using Composite.

The systems are designed and engineered to restore pipeline systems to their original design parameters and allows for the piping systems to operate at its MAOP (Maximum Allowable Operating Pressure) without the need to shut down the plant, unit or system**.**
Our composite pipe repair applications save time, labour and equipment costs. In most cases there is no plant downtime. Pipes can be wrapped while the line is in service whilst requiring no line evacuation, no welding of pipe, no cutting the pipe, no heavy equipment handling requirements and no volatile compounds on the repair of Corroded Piping Systems.

Typical Industry
Typical industries we serve include:

- Offshore Oil Rigs
- Petrochemical Plants
- Refineries
- Fertilizing Companies
- Chemical Plants

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- Water Supply
- Paper and Pulp
- Sugar
- Mining
- Energy Plants
- Transmission Pipelines

Technical Features and advantages

ECS benefits can be summarised below:

- Can be applied to live lines resulting in no need for shutdown
- Requires no hot work permit
- Cost effective and state of the art composites
- Corrosion resistant resulting in no maintenance requirements
- High temperature and chemical resistant. High corrosion, acids and chemical resistance.
- High adhesion quality resulting in a superior bonded repair
- Speedy and cost-effective repair solution versus replacement
- Industry renowned technical support by Professor Simon Frost
- Can be applied by rope access

- ECS can mobilise a fully independent team – no need for platform assistance
- 24/7 Operational and Technical support
- ECS Warranty for up to 20 years
- Strongest composite system available in the industry – it is proved stronger than steel.
- Engineered solution with certified compliance and Professional Engineer Verified design calculations.
- External application without the need to isolate the processes.
- Extend design life of compromised assets.
- Eradicate unforeseen down time.
- No Pressure limitations.
- Ability to handle complex piping geometries, bends, tee`s, vessels, tanks etc.
- No Hot work required.
- No heavy equipment required.
- Lightweight (No support systems required).
- High temperature resistance.
- Fast curing systems.
- High tensile strength and modulus.
- High strength per $ invested.
- Trained installers in accordance with ASME PCC2 and ISO24817

FutureWrap Applications

Using the latest technologies and innovations, FutureWrap composite repair systems have been developed to provide long term integrity solutions across many applications. Working in harsh environments within the Oil & Gas, Energy and Renewable sectors, FutureWrap works at its best, offering solutions to damaged mechanisms, such as internal and external corrosion, cracking and mechanical damage. The repairs can be applied to all component types or pipework and pipelines, caissons and risers and also structural components, including decks.

Typical Applications

- Pipework
- Pipelines
- Tanks and Vessels
- Structural Rehabilitation / Strengthening
- Caissons / Risers
- High Impact Deck Areas
- Live Leak Sealing
- Subsea
- Renewable Energy
- Corrosion Prevention
- Late Life of Field and Decomissioning

Features

- IRATA Rope Access Trained Applicators
- FutureWrap Training
- 24/7 Technical and Operational Support
- RFID Tagging and Repair Management

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Virtual Tour of Applications:

Pipework - Applied to all components of pipework suffering from wall loss.

Pipelines - FutureWrap repairs can be applied to any length of Pipeline.

Tanks and Vessels - Applied to tanks and vessels, including main body, attachments etc.

Structural Rehabilitation - Futurewrap repairs can be applied to structural components requiring repair.

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Caissons and Risers - Applied to caissons and risers above, below and within the splash zone.

High Impact Deck Areas - Applied to both decks and roofs and perfect for high impact deck repairs.

Live Leak Sealing - Repairs topside or subsea components with live leaks.

Subsea - Repairing structural components, pipework, pipelines caissons risers.

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Renewables - Repair solutions for wind turbine blades and other support structures.

Corrosion Prevention - Prevents or mitigates all types of corrosion caused by CUPS, CUI, etc.

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Late Life of Field and Decom - Cost-effective asset integrity during both late life field operations and decommissioning.

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Case Studies

Case study – 4 inch seawater injection flowline suffering internal corrosion

Integrity issue

A 4 inch seawater flowline was suffering from internal corrosion. The measured wall thickness of 12.8 mm was below the CONC value. It was proposed to use a Futurewrap composite repair to reinstate the integrity of the pipework.

Design

The design of the Futurewrap repair was according to ISO 24817. The design approach was for pipework strengthening only with allowance for the remaining wall thickness of the pipework. The design parameters were; internal pressure 355 bar, temperature 40ºC, design lifetime 2 years, remaining wall thickness of steel 12 mm. The repair design resulted in a thickness of 11.35 mm (15 layers) of Futurewrap Glass/LT with an axial length of repair of 440 mm.

Installation

The installation steps are shown in the photographs. The pipework was depressurised. The surface preparation was to ST3. Full QA/QC measurements were made to demonstrate that the Futurewrap repair was applied in accordance with ISO 24817.

Summary

A 4 inch seawater flowline suffering internal corrosion was repaired using a Futurewrap Glass/LT composite repair. The repair was completed within 3 days allowing the pipework to be re-pressurised with the pipework returned to its original integrity.

Initial condition of pipework

After surface preparation

During repair application

Completed repair

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Case study – 8 inch produced water pipework

Integrity issue

A 8 inch produced water pipework was suffering from internal corrosion. Localised internal corrosion had caused severe pitting which was expected to do through wall within months. It was proposed to use a Futurewrap composite repair to reinstate the integrity of the pipework.

Initial condition of pipework

Design

The design of the Futurewrap repair was according to ISO 24817. The design approach was for pipework strengthening and leak sealing. The design parameters were; internal pressure 19.6 bar, temperature 40°C, design lifetime 2 years, through wall defect size 25 mm diameter. The repair design resulted in a thickness of 5.1 mm (8 layers) of Futurewrap Glass/LT composite repair with an axial length of 750 mm.

After surface preparation

Installation

The installation steps are shown in the photographs. The pipework was depressurised. The surface preparation was to ST2. Full QA/QC measurements were made to demonstrate that the Futurewrap repair was applied in accordance with ISO 24817.

During repair application

Summary

A 8 inch produced water pipework suffering internal corrosion was repaired using Futurewrap Glass/LT composite repair. The repair was completed within 2 days allowing the pipework to be re-pressurised returning the pipework to its original integrity.

Completed repair

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Case study – 12 inch HP flare line

Integrity issue

A 10 inch mixed HP flare line was suffering from external corrosion. The external corrosion was so severe in places that the design premise was to assume a through wall defect. It was proposed to use a Futurewrap composite repair to reinstate the integrity of the pipework.

Design

The design of the Futurewrap repair was according to ISO 24817. The design approach was for pipework strengthening and leak sealing. The design parameters were; internal pressure 8.1 bar, temperature 90ºC, design lifetime 10 years, through wall defect. The repair design resulted in a thickness of 5 mm (6 layers) of Futurewrap Glass/LT composite repair with an axial length of 1350 mm.

Installation

The installation steps are shown in the photographs. The pipework was depressurised. The surface preparation was to ST3. Full QA/QC measurements were made to demonstrate that the Futurewrap repair was applied in accordance with ISO 24817.

Summary

A 12 inch HP flare line suffering external corrosion was repaired using Futurewrap Glass/LT composite repair. The repair was completed within 4 days allowing the pipework to be re-pressurised returning the pipework to its original integrity.

Initial condition of pipework

After surface preparation

During repair application

Completed repair

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Case study – Strengthening of an 8 inch stub

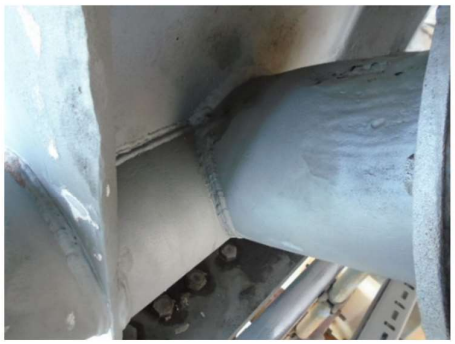
Integrity issue

A 8 inch stub (carbon steel) was suffering from external corrosion. The external corrosion was sufficiently severe that the remaining wall thickness would not provide sufficient strength to withstand the acting structural loads. It was proposed to use a Futurewrap Structural composite repair to reinstate the strength of the 8 inch stub.

Initial condition of stub

Design

The design of the Futurewrap Structural repair was to replace the strength reduction due to loss of wall thickness. The design parameters were; thickness of steel to be replaced 7 mm, temperature 30ºC, design lifetime 10 years. The repair design resulted in a thickness of 12 mm (10 layers) of Futurewrap Structural Carbon/LT composite repair with an axial length of 290 mm.



After surface preparation

Installation

The installation steps are shown in the photographs. The surface preparation was to Sa2.5. Full QA/QC measurements were made to demonstrate that the Futurewrap repair was applied in accordance with ISO 24817.

During repair application

Summary

A 8 inch stub suffering external corrosion was repaired using Futurewrap Structural Carbon/LT composite repair. The repair was completed within 3 days returning the strength of the stub to its original value.

Completed repair

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Case study – Weld repair on a 10 inch water injection system

Integrity issue

The welds on two sections of pipework on a 10 inch water injection system constructed from super duplex steel were suffering from internal corrosion coupled with manufacturing defects. The weld defects were through wall. To reinstate the integrity of these sections of pipework it was proposed to use a Futurewrap Glass/HT composite repair.

Initial condition of weld

Design

The design of the Futurewrap Glass/HT repair was to both seal the through wall defect and strengthen the pipework assuming the internal corrosion had completely removed the weld. The design parameters were; pressure 18.5 bar, temperature 70ºC, design lifetime 20 years. An HT repair was used as the pipework surface temperature during application would be 70ºC implying that rapid curing of the repair during installation would be an issue. The repair design resulted in a thickness of 6.5 mm (8 layers) of Futurewrap Glass/HT composite repair with an axial length of 650 mm.

After surface preparation and profiling

Installation

The installation steps are shown in the photographs. The surface preparation was to ST3. Rapid resin curing was controlled. Full QA/QC measurements were made to demonstrate that the Futurewrap repair was applied in accordance with ISO 24817.

Completed repair

Summary

Welds on two 10 inch sea water injection super duplex pipework suffering internal corrosion coupled with manufacturing defects were repaired using Futurewrap Glass/HT composite repair. The repair was completed within 3 days reinstating the integrity of the pipework.

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Case study – Drilling mud tank

Integrity issue

A CSU drilling mud tank, 2.8 meter diameter, which had been out of service for several years was to be re-commissioned. There were several holes in the main body of the tank as well as in the pipework attachments. The cause of these through wall defects was internal erosion/corrosion. A repair solution was sought to return the tank to service using an engineered Futurewrap repair. To reinstate the integrity of the tank, it was proposed to use several Futurewrap Glass/LT composite repairs on the tank main body and associated pipework.

Design

The design of the Futurewrap Glass/LT repair was to seal and strengthen the tank. The design parameters were; pressure 0.4 bar, temperature 20^{0}C, design lifetime 20 years. It was assumed that the composite repair would withstand the applied loads and seal without any allowance for the remaining wall thickness of the tank. The design resulted in a thickness of 5 mm (6 layers) of Futurewrap Glass/LT composite repair with an axial length of 260 mm. The repairs on the tank main body were applied as patches.

Installation

The installation steps are shown in the photographs. The repair was applied off ropes as the pipework is elevated. The surface preparation was to ST3. Full QA/QC measurements were made to demonstrate that the Futurewrap repairs were applied in accordance with ISO 24817.

Summary

A drilling mud was repaired using Futurewrap Glass/LT composite repairs. The repairs were completed within 3 days reinstating the integrity of the tank.

Initial status of tank body – Patch 1

Completed repair – Patch 1

Initial status of tank pipework

Completed repair – tank pipework

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Case study – 32 inch glycol still column

Integrity issue

A 32 inch line off a glycol still column was suffering from external corrosion. A previous composite repair had been applied and reached the end of its design life. It was proposed to use a Futurewrap composite repair over the existing repair to reinstate the integrity of the pipework.

Design

The design of the Futurewrap repair was according to ISO 24817. The design approach was for pipework strengthening and leak sealing (at edges of the composite repair). The design parameters were; internal pressure 3.5 bar, temperature 230ºC, design lifetime 15 years, slot through wall defect length of 25 mm. The repair design resulted in a thickness of 5 mm (4 layers) of Futurewrap Carbon/HT composite repair with an axial length of 460 mm.

Installation

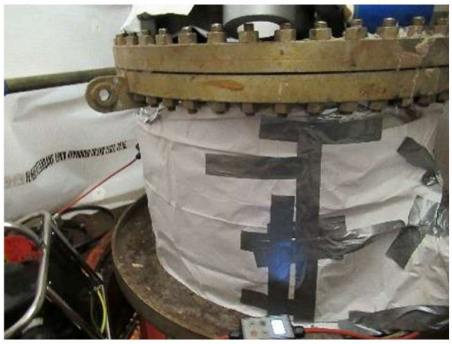
The installation steps are shown in the photographs. The pipework was depressurised. The surface preparation was to ST2. Heat blankets were used to post cure the repair. Full QA/QC measurements were made to demonstrate that the Futurewrap repair was applied in accordance with ISO 24817.

Summary

A 32 inch line with an out of date composite repair was repaired using Futurewrap Carbon/HT composite repair. The repair was completed within 6 days allowing the pipework to be re-pressurised returning the pipework to its original integrity.

Initial condition of pipework

After surface preparation



During repair application

Completed repair

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Case study – 24 inch drilling mud line

Integrity issue

A 24 inch drilling mud line was suffering from external corrosion. It was proposed to use Futurewrap composite repairs over 4 defects to reinstate the integrity of the pipework.

Design

The design of the Futurewrap repair was according to ISO 24817. The design approach was for pipework strengthening and leak sealing. The design parameters were; internal pressure 9.2 bar, temperature 50ºC, design lifetime 10 years, slot through wall defect length of 50 mm. The repair design resulted in a thickness ranging from 6 to 12 mm (6 to 14 layers) of Futurewrap Glass/LT composite repair with an axial lengths from 650 to 900 mm.

Installation

The installation steps are shown in the photographs. The pipework was depressurised. The surface preparation was to ST3. Full QA/QC measurements were made to demonstrate that the Futurewrap repair was applied in accordance with ISO 24817.

Summary

A 24 inch drilling mud line was repaired using Futurewrap Glass/LT composite repair. The repairs were completed within 8 days allowing the pipework to be re-pressurised returning the pipework to its original integrity.

Repair 1 - Initial condition, final repair

Repair 2 - Initial condition, final repair

Repair 3 - Initial condition, final repair

Repair 4 - Initial condition, final repair

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Case study – Foam tank

Integrity issue

A stainless-steel foam rectangular tank, 1.2 meter high was suffering from cracking of the welds. The cause of these defects was combined manufacturing defects and external chloride cracking. A repair solution was sought to return the tank to service using an engineered Futurewrap repair. To reinstate the integrity of the tank, it was proposed to use Futurewrap Carbon/LT composite repairs over the damaged welds.

Design

The design of the Futurewrap Carbon/LT repair was to strengthen the tank assuming 4 mm loss of tank wall. The design parameters were; pressure 1 bar, temperature 40ºC, design lifetime 2 years. It was assumed that the composite repair would share the applied loads with the remaining wall thickness of the tank. The design resulted in a thickness of 5 mm (4 layers) of Futurewrap Carbon/LT composite repair with a width of 255 mm.

Installation

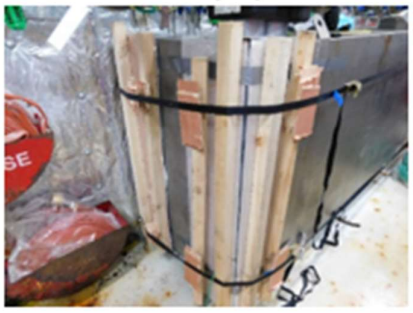
The installation steps are shown in the photographs. The repair was applied off ropes as the pipework is elevated. The surface preparation was to ST3. Full QA/QC measurements were made to demonstrate that the Futurewrap repairs were applied in accordance with ISO 24817.

Summary

A foam mud tank was repaired using a Futurewrap Carbon/LT composite repair. The repairs were completed within 3 days reinstating the integrity of the tank.

Initial status of tank

After surface preparation



During repair application

Completed repair

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Case study – 20 inch tee

Integrity issue

A 20 inch tee with a hydrocarbon export pipework was suffering from internal corrosion. Further internal corrosion was expected to occur and therefore a composite repair solution was sought. To reinstate the integrity of this section of pipework it was proposed to use a Futurewrap Carbon/HT composite repair.

Design

The design of the Futurewrap Carbon/HT repair was to strengthen the pipework assuming the internal corrosion rate was 2 mm/year. The design parameters were; pressure 100 bar, temperature 200ºC, design lifetime 2 years. It was assumed that the remaining wall thickness at the end of design life was 10 mm. The repair design resulted in a thickness of 18.9 mm (16 layers) of Futurewrap Carbon/HT composite repair with an axial length of 1190 mm.

Installation

The installation steps are shown in the photographs. The surface preparation was to ST3. Rapid resin curing was controlled. Full QA/QC measurements were made to demonstrate that the Futurewrap repair was applied in accordance with ISO 24817.

Summary

A 20 inch tee section of export pipework system suffering internal corrosion was repaired using Futurewrap Carbon/HT composite repair. The repair was completed within 7 days reinstating the integrity of the pipework.

Original status of pipework

After surface preparation

During repair application

Completed repair

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Case study – 16 inch crude oil separator line

Integrity issue

A 16 inch crude oil separator line was suffering from internal corrosion. The measured remaining wall thickness was 3.4 mm. It was estimated that the corrosion rate was 0.6 mm/year. The repair was designed for a 2 year life where it was assumed therefore that the remaining wall thickness at end of life of the repair was 2.2 mm. It was proposed to use a Futurewrap composite repair to reinstate the integrity of the pipework.

Initial condition of pipework

Completed repair

Design

The design of the Futurewrap repair was according to ISO 24817. The design approach was for pipework strengthening only with allowance for the remaining wall thickness of the pipework. The design parameters were; internal pressure 12.8 bar, temperature 230°C, design lifetime 2 years. The repair design resulted in a thickness of 5 mm (6 layers) of Futurewrap Glass/HT with an axial length of repair of 1120 mm.

Installation

The installation steps are shown in the photographs. The pipework was depressurised. The surface preparation was to ST3. Full QA/QC measurements were made to demonstrate that the Futurewrap repair was applied in accordance with ISO 24817.

Summary

A 16 inch crude oil separator line suffering internal corrosion was repaired using a Futurewrap Glass/HT composite repair. The repair was completed within 3 days allowing the pipework to be re-pressurised with the pipework returned to its original integrity.

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Case study – 30 inch tee/header

Integrity issue

The weld of a 30 inch tee/header pipework containing cooling water was suffering from severe external corrosion. The corrosion had reduced the wall thickness such that the weld was weeping. It was proposed to use a Futurewrap composite repair to reinstate the integrity of the pipework.

Design

The design of the Futurewrap repair was according to ISO 24817. The design approach was for pipework strengthening and leak sealing accounting for the limited landing area caused by the weld neck flange. The design parameters were; internal pressure 12.8 bar, temperature 93°C, design lifetime 10 years, through wall defect. The repair design resulted in a thickness of 19 mm (23 layers) of Futurewrap Glass/LT composite repair with an axial length of 770 mm.

Installation

The installation steps are shown in the photographs. The pipework was depressurised. The surface preparation was to ST3. Full QA/QC measurements were made to demonstrate that the Futurewrap repair was applied in accordance with ISO 24817.

Summary

A 30 inch cooling water tee/header suffering severe external corrosion was repaired using Futurewrap Glass/LT composite repair. The repair was completed within 11 days allowing the pipework to be re-pressurised returning the pipework to its original integrity.

Initial condition of pipework

After surface preparation

During repair application

Completed repair

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Case study – 36 inch reducer

Integrity issue

The weld of a 36 inch cooling water line was suffering from severe external corrosion. The corrosion had reduced the wall thickness such that the weld was weeping. It was proposed to use a Futurewrap composite repair to reinstate the integrity of the pipework.

Design

The design of the Futurewrap repair was according to ISO 24817. The design approach was for pipework strengthening and leak sealing accounting for the limited landing area caused by the weld neck flange. The design parameters were; internal pressure 12.8 bar, temperature 50°C, design lifetime 10 years, through wall defect. The repair design resulted in a thickness of 16.5 mm (20 layers) of Futurewrap Glass/LT composite repair with an axial length of 350 mm.

Installation

The installation steps are shown in the photographs. The pipework was depressurised. The surface preparation was to ST3. Full QA/QC measurements were made to demonstrate that the Futurewrap repair was applied in accordance with ISO 24817.

Summary

A 36 inch cooling water reducer suffering severe external corrosion was repaired using Futurewrap Glass/LT composite repair. The repair was completed within 11 days allowing the pipework to be re-pressurised returning the pipework to its original integrity.

Initial condition of pipework

After surface preparation

During repair application

Completed repair

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Case study – 30 inch straight

Integrity issue

The weld of a 30 inch straight section of pipework containing cooling water was suffering from severe external corrosion. The corrosion had reduced the wall thickness such that the weld was weeping. It was proposed to use a Futurewrap composite repair to reinstate the integrity of the pipework.

Design

The design of the Futurewrap repair was according to ISO 24817. The design approach was for pipework strengthening and leak sealing accounting for the limited landing area caused by the weld neck flange. The design parameters were; internal pressure 12.8 bar, temperature 93°C, design lifetime 10 years, through wall defect. The repair design resulted in a thickness of 16.7 mm (20 layers) of Futurewrap Glass/LT composite repair with an axial length of 810 mm.

Installation

The installation steps are shown in the photographs. The pipework was depressurised. The surface preparation was to ST3. Full QA/QC measurements were made to demonstrate that the Futurewrap repair was applied in accordance with ISO 24817 despite the limited access.

Summary

A 30 inch cooling water tee/header suffering severe external corrosion was repaired using Futurewrap Glass/LT composite repair. The repair was completed within 11 days allowing the pipework to be re-pressurised returning the pipework to its original integrity.

Initial condition of pipework

After surface preparation

During repair application

Completed repair

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Case study – 36 inch produced water caisson (upper section)

Integrity issue

The upper section of a 36 inch produced water caisson was suffering from external corrosion. It was proposed to use a Futurewrap composite repair to reinstate the strength and therefore integrity of the caisson as the remaining wall thickness was down to 2 mm in some locations.

Design

The design of the Futurewrap repair was according to ISO 24817. The design approach was to strengthen and locally leak seal. The design parameters were; internal pressure 1.5 bar, axial load 194 kN, bending moment 176.8 kNm, temperature 60°C, design lifetime 20 years. The repair design resulted in a thickness of 6.2 mm (4 layers) of Futurewrap Carbon/Aquasplash composite repair with an axial length of 2300 mm.

Installation

The installation steps are shown in the photographs. The caisson was depressurised. The surface preparation was to ST3 in 1 meter bands. Full QA/QC measurements were made to demonstrate that the Futurewrap repair was applied in accordance with ISO 24817. The repair was applied off ropes

Summary

A 36 inch section of produced water caisson was repaired using Futurewrap Carbon/Aquasplash composite repair. The repair was completed within 14 days allowing the pipework to be re-pressurised and returning it to its original integrity.

Initial condition of pipework

After surface preparation

During installation

Final cured repair

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Case study – 14 inch cargo line

Integrity issue

The weld on a 14 inch weld neck flange from a hydrocarbon cargo line on a FPSO off the west coast of Africa was suffering from preferential internal corrosion. It was proposed to use a Futurewrap composite repair to reinstate the strength and seal the potential threat of a through wall defect.

Design

The design of the Futurewrap repair was according to ISO 24817. The design approach was to strengthen and locally leak seal. The design parameters were; internal pressure 2 bar, temperature 40°C, design lifetime 3 years. The repair design resulted in a thickness of 5 mm (6 layers) of Futurewrap Glass/LT composite repair with an axial length of 2000 mm.

Installation

The installation steps are shown in the photographs. The potential threat of a through wall defect was dealt with by installing a clamp over the weld. The clamp and flange were then profiled with filler, followed by application of the 6 layers of Futurewrap Glass/LT repair. Full QA/QC measurements were made to demonstrate that the Futurewrap repair was applied in accordance with ISO 24817.

Summary

A 14 cargo line suffering internal corrosion at a weld neck flange was repaired using a Futurewrap Glass/LT composite repair. The repair was completed within 5 days allowing the pipework to be returned to its original integrity.

Initial condition of pipework with sealing clamp

After profiling

Final cured repair

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Case study – 14 inch crude oil cargo line

Integrity issue

A 14 inch crude oil cargo line was suffering from local internal corrosion resulting in a through wall defect close to a flange. The through wall defect was temporarily sealed. It was proposed to use a Futurewrap composite repair to reinstate the pipework strength and provide a long term seal over the temporary mechanical seal.

Design

The design of the Futurewrap repair was according to ISO 24817. The design approach was to strengthen and locally leak seal. The assumed defect size was a fully circumferential slot of width 1250 mm. The design parameters were; internal pressure 2 bar, temperature 40ºC, design lifetime 3 years. The repair design resulted in a thickness of 5 mm (6 layers) of Futurewrap Glass/LT composite repair with an axial length of 2150 mm.

Installation

The installation steps are shown in the photographs from surface preparation through to final curing of the 6 layers of the Futurewrap Glass/LT repair. Full QA/QC measurements were made to demonstrate that the Futurewrap repair was applied in accordance with ISO 24817.

Summary

A 14 inch crude oil cargo line suffering internal corrosion was repaired using a Futurewrap Glass/LT composite repair. The repair was completed within 5 days allowing the pipework to be returned to its original integrity.

Initial condition of pipework

After surface preparation and profiling

During repair application

Final cured repair

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Case study – 4 inch Hi Ex foam line

Integrity issue

A 4 inch Hi Ex foam stainless steel foam line was suffering from localised internal corrosion at a weld resulting in a small through wall defect close to a flange. It was proposed to use a Futurewrap Glass/LT composite repair to reinstate the pipework strength and provide a long term seal. Furthermore, as the repair was required to have fire performance requirements then over the composite repair a Futurewrap Fire repair was proposed.

Design

The design of the Futurewrap repair was according to ISO 24817. The design approach was to strengthen and locally leak seal. The assumed defect size was fully circumferential of width 25 mm. The design parameters were; internal pressure 6 bar, temperature 20ºC, design lifetime 20 years. The repair design resulted in a thickness of 5 mm (6 layers) of Futurewrap Glass/LT composite repair with an axial length of 200 mm. 10 layers of Futurewrap Fire were applied over the repair to meet the fire performance requirement of the pipework not exceeding 900ºC.

Installation

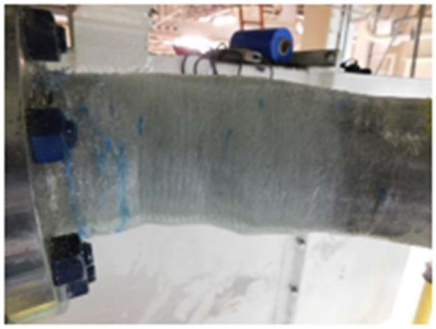
The installation steps are shown in the photographs from surface preparation through to curing of the 6 layers of the Futurewrap Glass/LT repair and 10 layers of the Futurewrap Fire repair. Full QA/QC measurements were made to demonstrate that the Futurewrap repair was applied in accordance with ISO 24817.

Summary

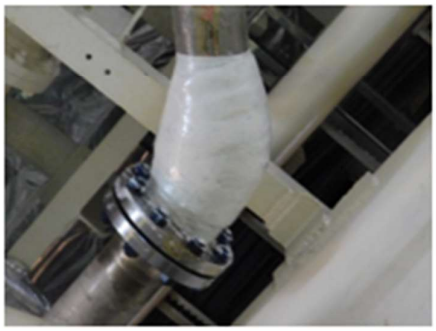
A 4 inch Hi Ex foam line suffering internal corrosion was repaired using a Futurewrap Glass/LT composite repair and fire protected with a Futurewrap Fire repair. The repair was completed within 5 days allowing the pipework to be returned to its original integrity.

Initial condition of pipework

After surface preparation



Completed Glass/LT repair



Completed repair with Fire repair

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Case study – 6 inch drains caisson nozzle

Integrity issue

A 6 inch drains caisson nozzle had previously been repaired using an engineered composite repair. The design lifetime of the existing repair had expired. It was proposed to use a Futurewrap composite repair to overwrap the existing repair to reinstate the pipework integrity.

Initial condition of pipework and repair

Design

The design of the Futurewrap repair was according to ISO 24817. The design approach was for the composite repair to strengthen and seal (assuming that the existing repair would fail) The design parameters were; internal pressure 3.5 bar, temperature 60°C, design lifetime 10 years. The repair design resulted in a thickness of 5 mm (6 layers) of Futurewrap Glass/LT composite repair with an axial length of 1300 mm.

After surface preparation and profiling

Installation

The installation steps are shown in the photographs from surface preparation through to final curing of the 6 layers of the Futurewrap Glass/LT repair. The surface preparation was ST2. Full QA/QC measurements were made to demonstrate that the Futurewrap repair was applied in accordance with ISO 24817.

During repair installation

Summary

A 6 inch drains caisson nozzle had an expired composite repair applied. The integrity of the drain line was restored using a Futurewrap Glass/LT composite repair. The repair was completed within 5 days.

Final cured repair

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