Zerust® OIL & GAS
WORLDWIDE CORROSION SOLUTIONS

Zerust® Inhibitor Fusion (ZIF) Tape

Silicone Fusion Tape

Corrosion Solutions

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Zerust® Inhibitor Fusion (ZIF) Tape

Silicone Fusion Tape

The Problem

- Unprotected flanges, valves and instruments can lead to crevice corrosion and frozen nuts and bolts.
- Crevice corrosion between flange faces is a severe problem where the wedging action of corrosion products can lead to a significant risk of product leakage.
- Frozen nuts and bolts can lead to hours of delay to cold cut all bolts.

The Solution

Zerust® Inhibitor Fusion (ZIF) Tape

ZIF Tape can provide corrosion protection for flanges, valves, instrument preventing the severity of these problems.

Product Description

- ZIF Tape is a corrosion inhibiting tape based on silicone elastomers with proprietary Zerust corrosion inhibitor chemistry integrated into the matrix.
- It combines Zerust's proven corrosion protection benefits with the specific properties of a self-fusing film for easy, cold application.

Available in 36 ft. long, individual, whole rolls in 2", 4", 12" and 16" widths.

ZIF Tape Application

High Heat Temperature / Flange Protection

- ZIF Tape can be used as protection for flanges against corrosion for temperatures up to 200° C instead of the typically used Zerust® Transparent Flange Saver®.
- The Flange Saver is a transparent film infused with VCI that is wrapped around the flange, tightly secured, and forms an enclosure around the flange allowing the VCI molecules to adsorb onto metal surfaces to form a protective layer against corrosion.

ZIF Tape Application

Corrosion Under Insulation (CUI)

HISTORICAL DATA SHOWS THAT ABOUT 60% OF PIPE LEAKS ARE CAUSED BY CUI.

- CUI is any type of corrosion that occurs due to a moisture buildup on the external surface of insulated equipment.
- CUI is one of the Chemical/Petrochemical processing industries worst problems and the costs associated with mitigation are astronomical.
- If undetected, CUI can result in the shutdown of a process unit or an entire facility, and in rare cases it may result in a process safety incident.
- CUI is one of the most difficult processes to prevent.

ZIF Tape
Features

- It is stable under prolonged exposure to UV/sunlight and is translucent in appearance.
- It is non-tacky to the touch, but will ‘fuse’ within ~30 seconds to form a permanant bond.
- It is elastic in nature and can be stretched to provide closer fits to surfaces to which it is applied.
- This close fit, coupled with the application tension minimizes the gaps/spaces where moisture might penetrate.

Winner of the French Oil & Gas Council Innovation Award for Zerust’s® ZIF Tape

ZIF Tape
Features

- Provide protection by Zerust Corrosion Inhibitors. YES
- High capacity to conforms / molds when wrapped around/onto complex shapes. YES
- Bond to itself rapidly and remains non-tacky to the touch. YES
- Cold, easy and quick application process. YES
- No residue remains, when remove the tape. YES
- Wind, sunlight UV, oxygen and seawater resistance. YES
- No heat/equipment required. YES
- Wide range of application temperatures YES
- Flame resistant when wrapped. YES
- Protection from welding sparks. YES
- Good mechanical and puncture resistance, even around sharp edges. YES
- At least 5-10 years of corrosion protection. YES

Application Procedures Overview

Zerust® Inhibitor Fusion (ZIF) Tape

ZIF Tape Application Procedure

2° Cold Application @ EJA Jurong

ZIF Tape Application Preparation

Application Procedure @ EJA Jurong

Before using **ZIF Tape**, apply **Zerust® AxxaWashTM NW10-C** (5% into Fresh Water) onto the flange surface to provide powerful cleaning and corrosion prevention action on metallic and non-metallic substrates that are exposed to highly corrosive inorganic, bonded surface-reacted salts. This is an aqueous-based solution.

After 3 hours (City Water)	
WITH AxxaWash NW10	**WITHOUT Inhibitor**

ZIF Tape Application

Application Procedure @ EJA Jurong

ZIF Tape Application

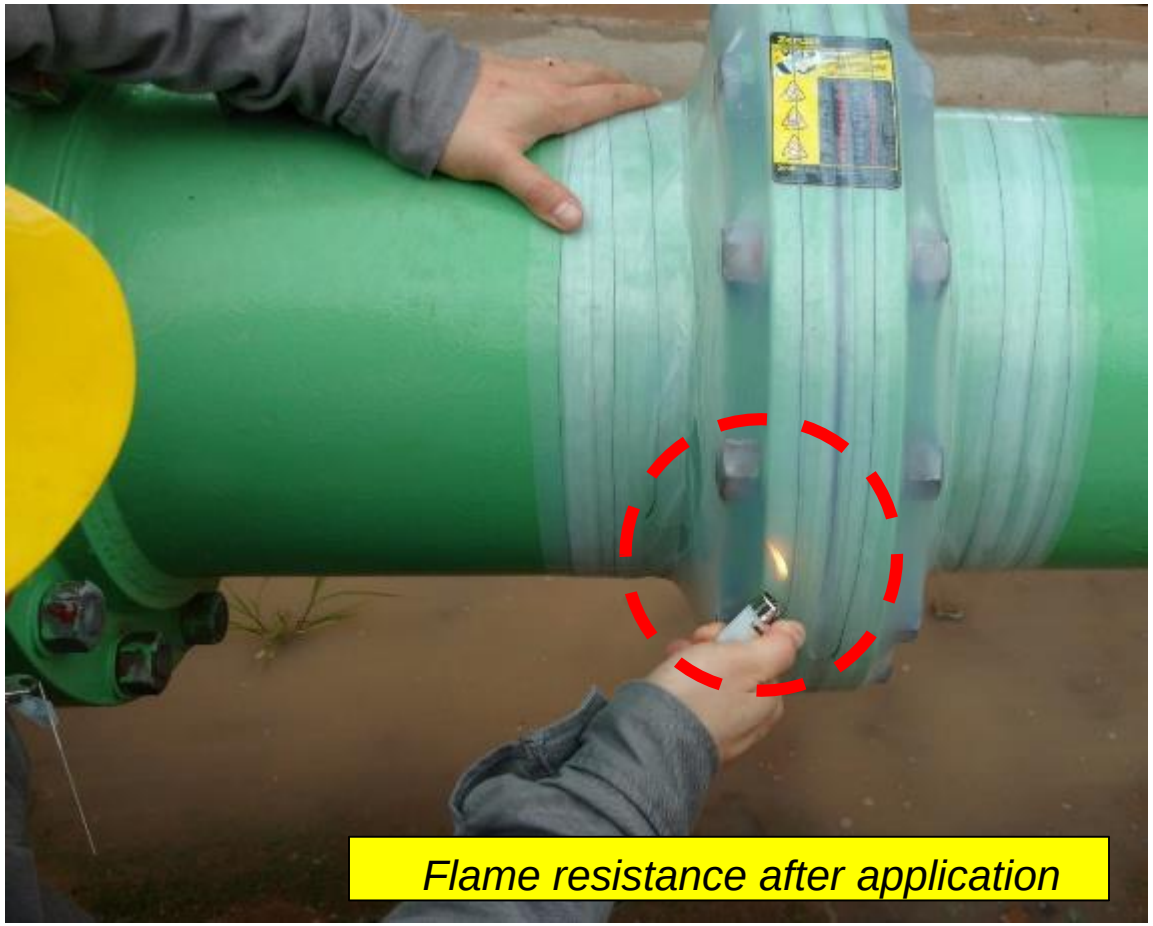
Application Procedure @ EJA Jurong

ZIF Tape Application

Application @ EJA Jurong

Completed ZIF Tape Application

Application Procedure @ EJA Jurong



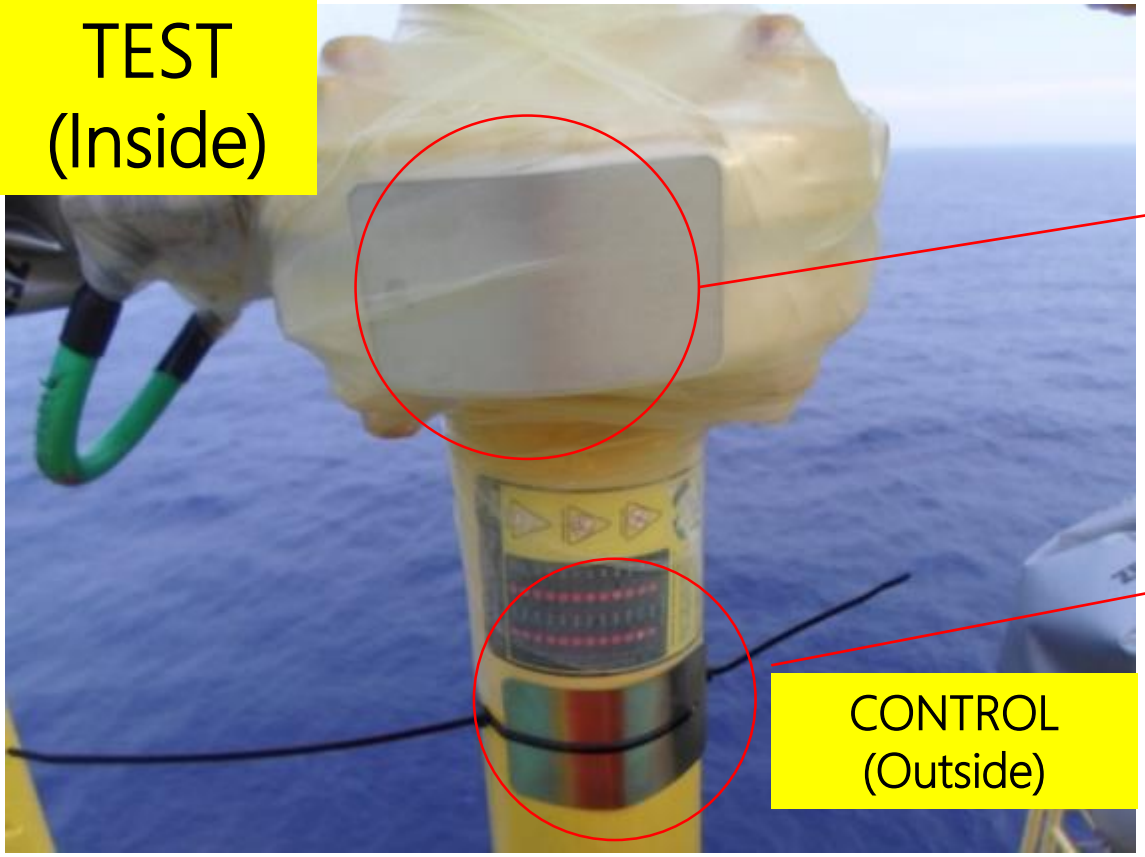
Zerust® Inhibitor Fusion (ZIF) Applications & Results

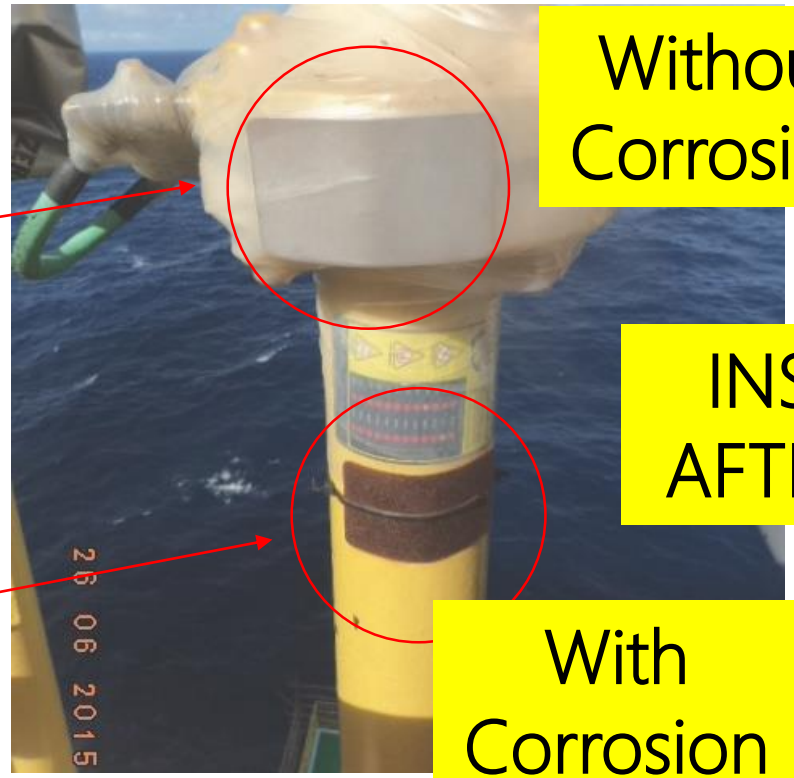
FPSO/Shipyard/Flanges

ZIF Tape Flange Trials

@Petrobras FPSO P56

Carbon Steel Panel SAE1010





ZIF Tape

@Petrobras P56 FPSO – Offshore environment

ZIF Tape

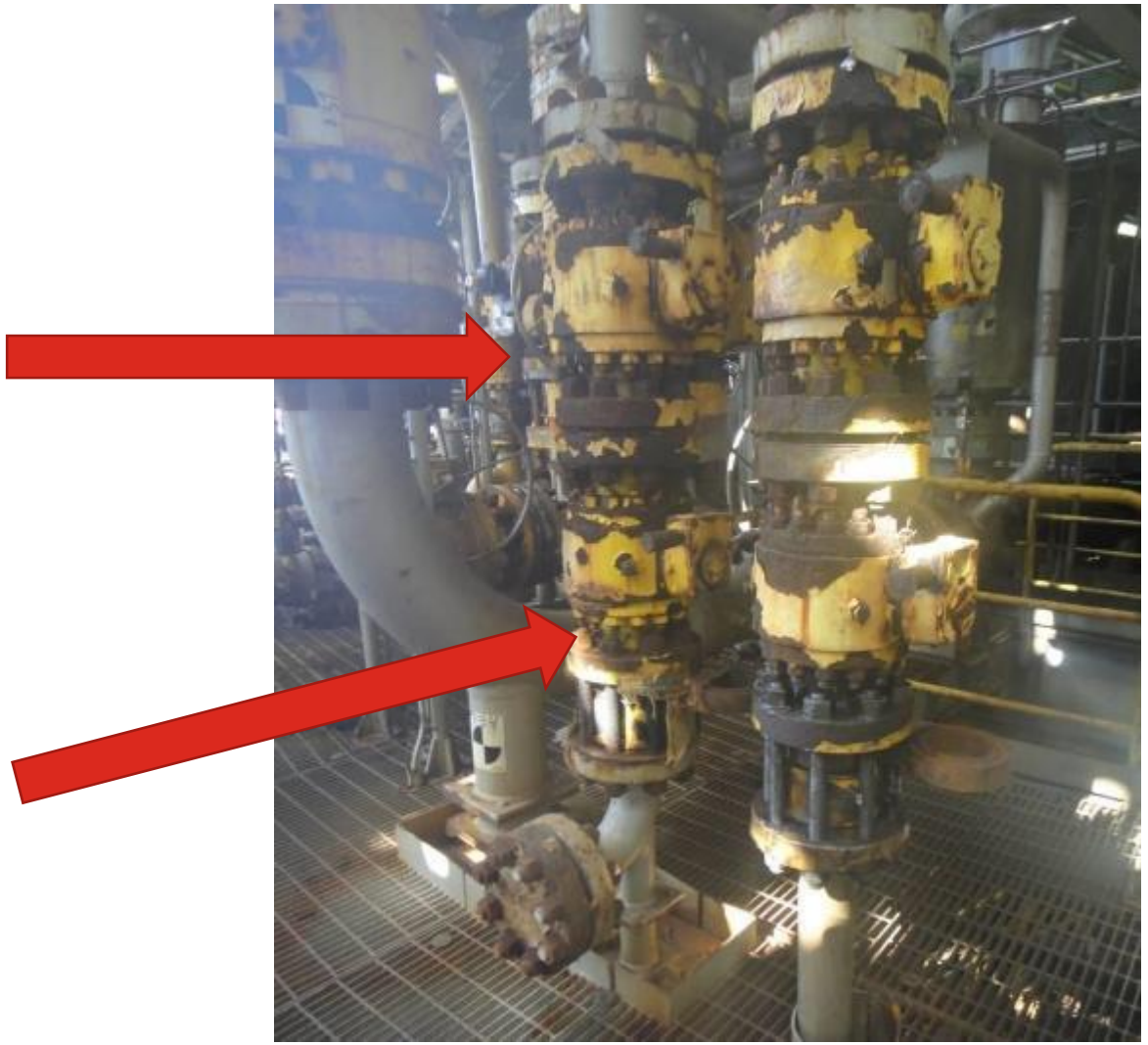
@Petrobras P56 FPSO – Offshore environment

FPSO in Brazil – Flange Corrosion Problem

After 4 Years

- <u>Frozen nuts and bolts:</u> Hours of delay to cold cut all bolts.

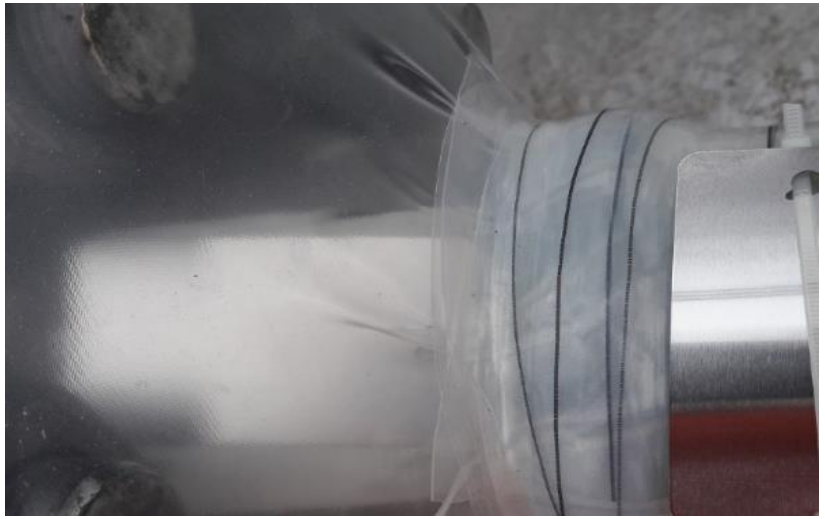
- <u>Crevice corrosion between flange faces:</u> Wedging action of corrosion product causes significant risk of product leakage



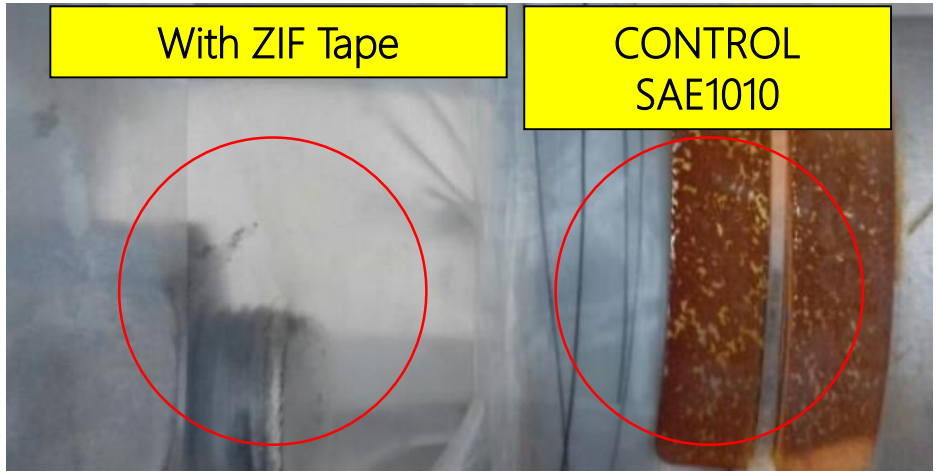
ZIF Tape

ZIF Tape Flange Trials

@Petrobras FPSO P56



INSPECTION
AFTER 45 DAYS



ZIF Tape

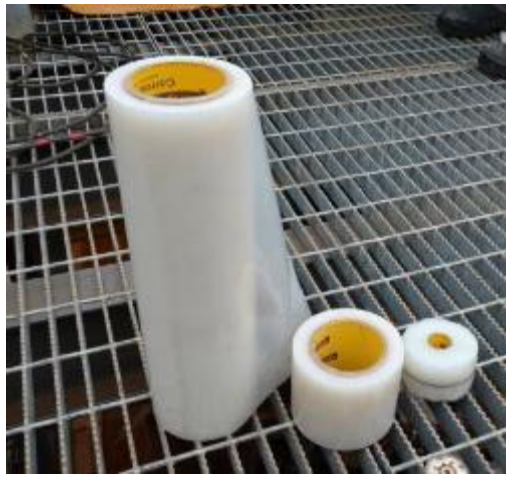
@Petrobras FPSO

Fita ZIF Tape
@Petrobras FPSO

Fita ZIF Tape
@Petrobras FPSO

ZIF Tape | Shipyard Application

@ Brasa Shipyard



ZIF Tape | Shipyard Application

@ CTF FERROSTAAL - Shipyard

ZIF Tape Application

MODEC

Atmospheric Corrosion (Partial CUI) Field Trial Case Study Report

Zerust® Inhibitor Fusion (ZIF) Tape

Central Europe/Belgium

CUI Field Trial Introduction

- ZIF Tape being applied on petroleum refinery in Belgium, this included multiple areas of live trial on <+100°C lines.

- Client has historical issues of Corrosion Under Insulation (CUI) lines and looking for a more robust solution to provide longevity and maintain integrity for continued safe operations.

- Trial was conducted on various operational "live lines" from ambient to +100°C

- Trial timelines

- Implementation November 2018.
- Inspection of trialed areas October 2019.

CUI/Scab Repair Project Related Comparisons

Conventional Coating
Vs. ZIF Tape

Conventional Coating

- 3 layer Epoxy
- Permits
- Blast equipment/Hoses/ Gauntlets/PPE
- SA 2.5 – reliance on the skill of the application team
- BOLL cert
- Air purification tests
- Compressors (EX rated zone 0)
- Generators (EX rated zone 0)
- 3 x man team (min. requirement for blasting team)
- Paint
- Spray Equipment
- QA/QC Inspector
- Holiday test
- Potential mechanical damage to the coating allowing for corrosion triangle to take effect.

ZIF Tape:

- Minor Surface preparation; wire brush and solvent application.
- Only Cold Work Permit needed and 2 technicians for implementation
- Wrap ZIF Tape around pipe, making sure to overlap tape as you go for proper fusion.

Site 1 & Site 2 Locations

Problem:

Widespread atmospheric corrosion witnessed, client looking at reducing commercial factors and ease of implementation whilst maintaining integrity for continued operations without shutdown.

Solution:

Zerust Oil and Gas were selected to “trial” ZIF Tape on various scab repair areas, as client was keen to explore new technologies and smarter ways of working, client was able to conduct such trails with relative ease and non intrusive manner and no need for blasting certifications and all the set up required for a 3 layer coating system.

ZIF Tape was applied on 2”-6” lines at multiple temperature(s) in approx. 1 meter trial sections.

Most trial sections were cleaned to ST2 and wrapped with ZIF Tape within a 10 minute period.

Site 1 & Site 2

Bare Substrate Exposed:

NDT – Non Destructive Testing

Thickness measurements were taken and written on the steel substrate.

Site 1 & Site 2

Inspection and Integrity Lead Recording NDT Data

Multiple Areas Were Utilized

Site 1 & Site 2

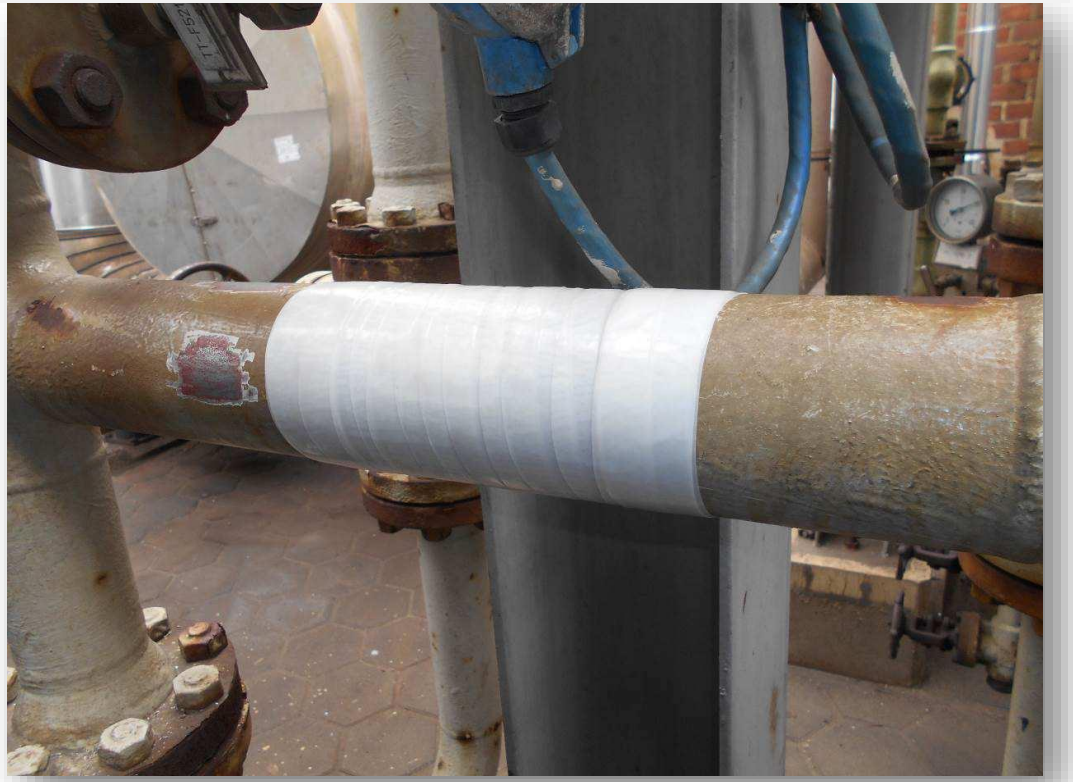
Implementation of ZIF Tape following NDT Inspections.

Site 1 & Site 2

50% Side By Side Overlap During Implementation

Protected vs Control

Scrapped back exposed metal left open to atmospheric corrosion vs protected pipeline using ZIF Tape.



Site 1 & Site 2

Various Horizontal & Vertical Areas Trialed

Site 1 & Site 2

Implementation on Bends to Demonstrate Ease of Installation

Protected and Control Test

Results and Conclusions

11 Month Field Trial with ZIF Tape for CUI

- The ZIF Tape was removed (October 2019) following a 11 month live field trial.
- The wrapped pipework/panels with blank scraped surface were corrosion free, whereas the unprotected panels without tape had atmospheric surface corrosion.
- As witnessed in the provided images, the main pipelines were also protected from atmospheric corrosion.
- The trial was so conclusive and evidential that the client did not require to Re-NDT the protected areas as they showed zero signs of corrosion.

Trial Results

Date(s):

Conducted - November 2018

Inspected - October 2019

Duration - 11 months duration.

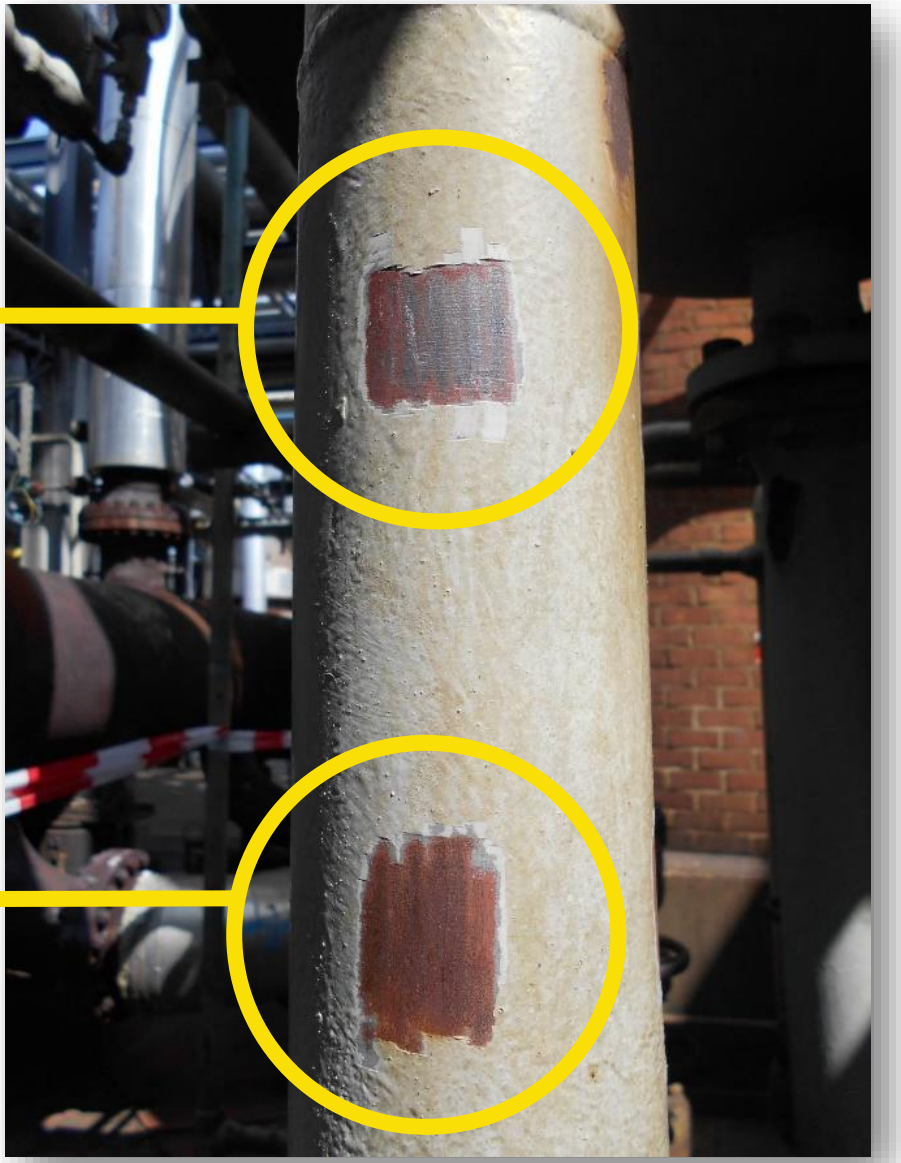
Trial Results

Top exposed panel

- Protected with ZIF Tape
- Bare, scrapped area corrosion free

Bottom exposed panel

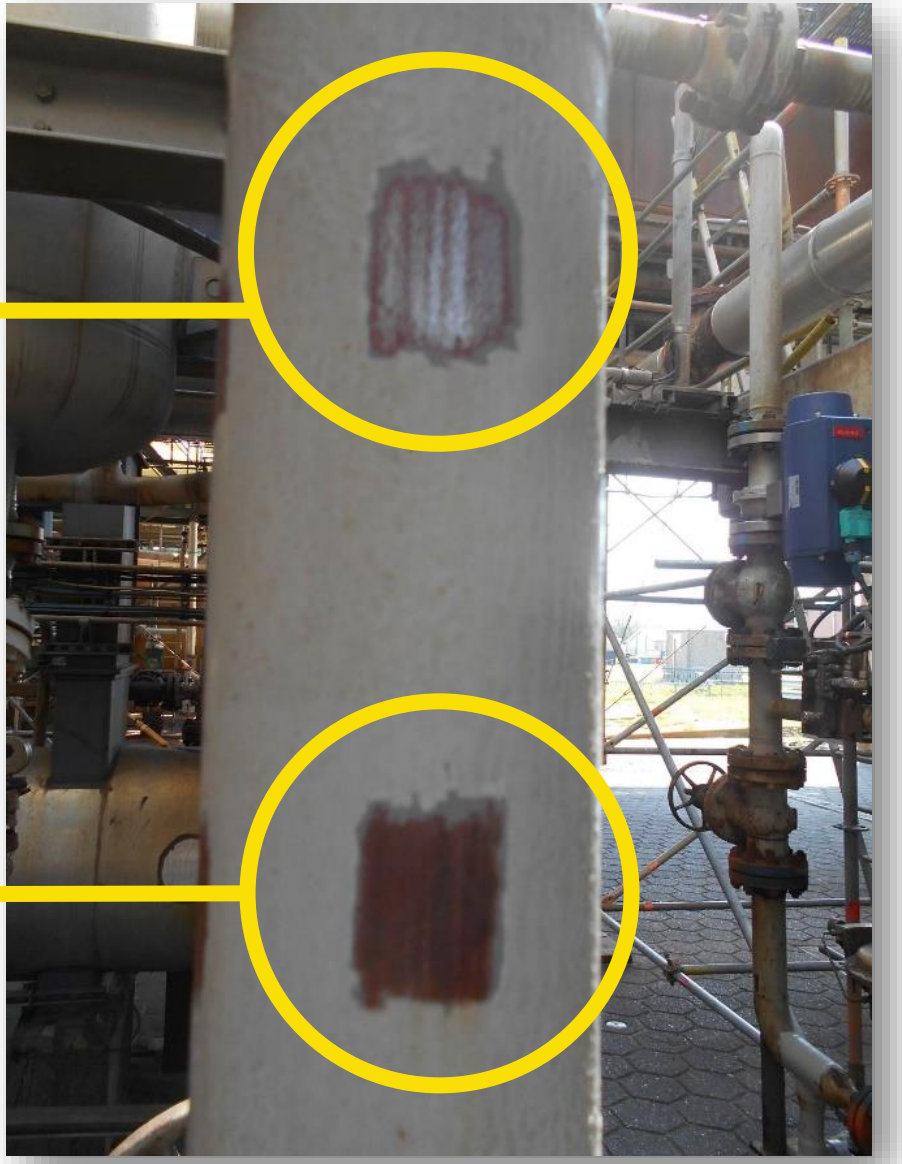
- Visible signs of degradation and surface corrosion



Trial Results Continued

Top exposed panel

- Protected with ZIF Tape
- Bare, scrapped area corrosion free



Bottom exposed panel

- Visible signs of degradation and surface corrosion

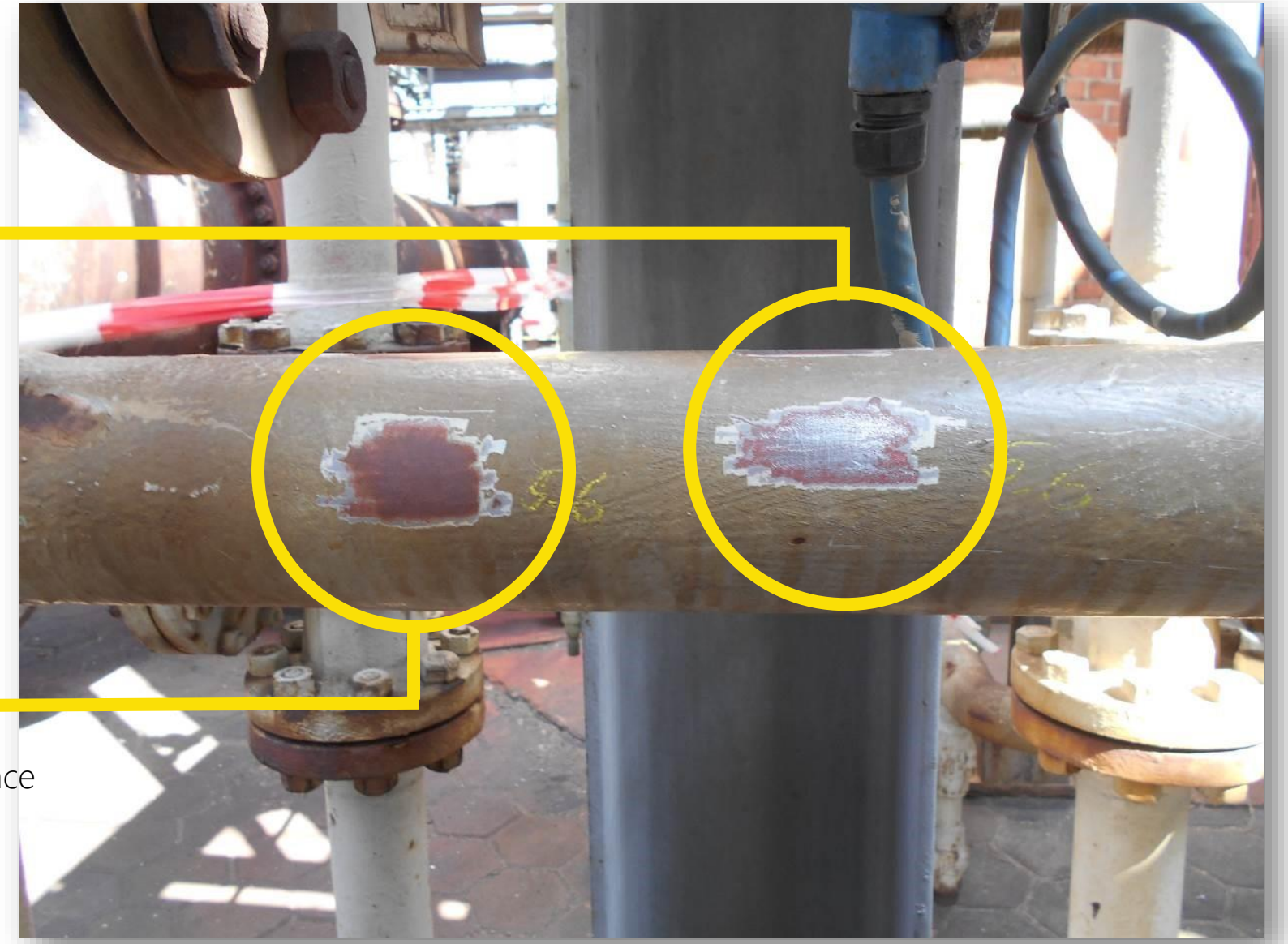
Trial Results Continued

Right-hand side exposed panel

- Protected with ZIF Tape
- Bare, scrapped area corrosion free

Left-hand side exposed panel

- Visible signs of degradation and surface corrosion



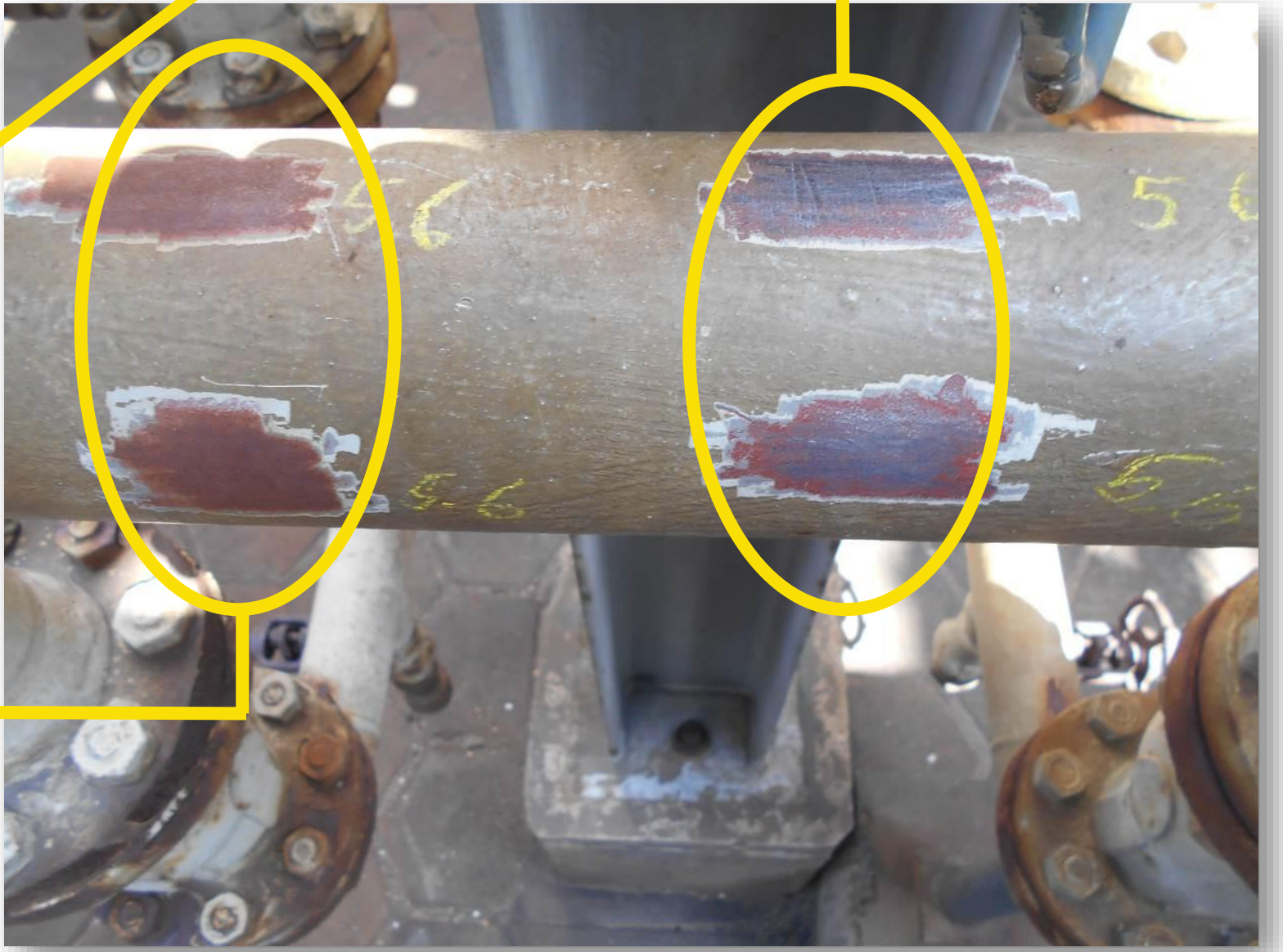
Trial Results Continued

Right-hand side exposed panel

- Protected with ZIF Tape
- Bare, scrapped area corrosion free

Left-hand side exposed panel

- Visible signs of degradation and surface corrosion



Trial Results

Protected Vertical and Bend within Protected Area(s) of Applied ZIF Tape

Pipeline was Operating at Over +100°C

6 Month Field Trial for Pipe Protection

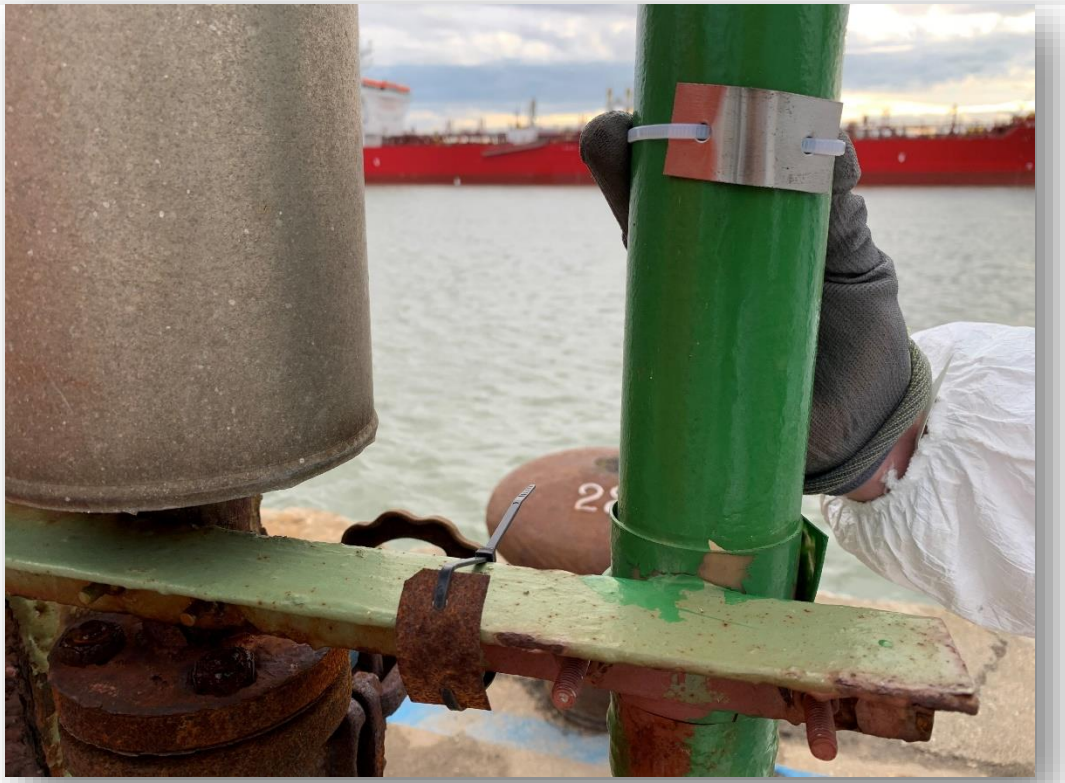
With Zerust® Inhibitor Fusion (ZIF) Tape

Trial Results

Protected Pipe and Coupon with Applied ZIF Tape

This pipe was jetty side in close proximity to a massive salt mountain creating a harsh and severe environment conducive for corrosion.

Removal of ZIF Tape 6 Months After Application with No Signs of Corrosion to Coupon



Trial Results

Protected Pipe and Coupon with Applied ZIF Tape

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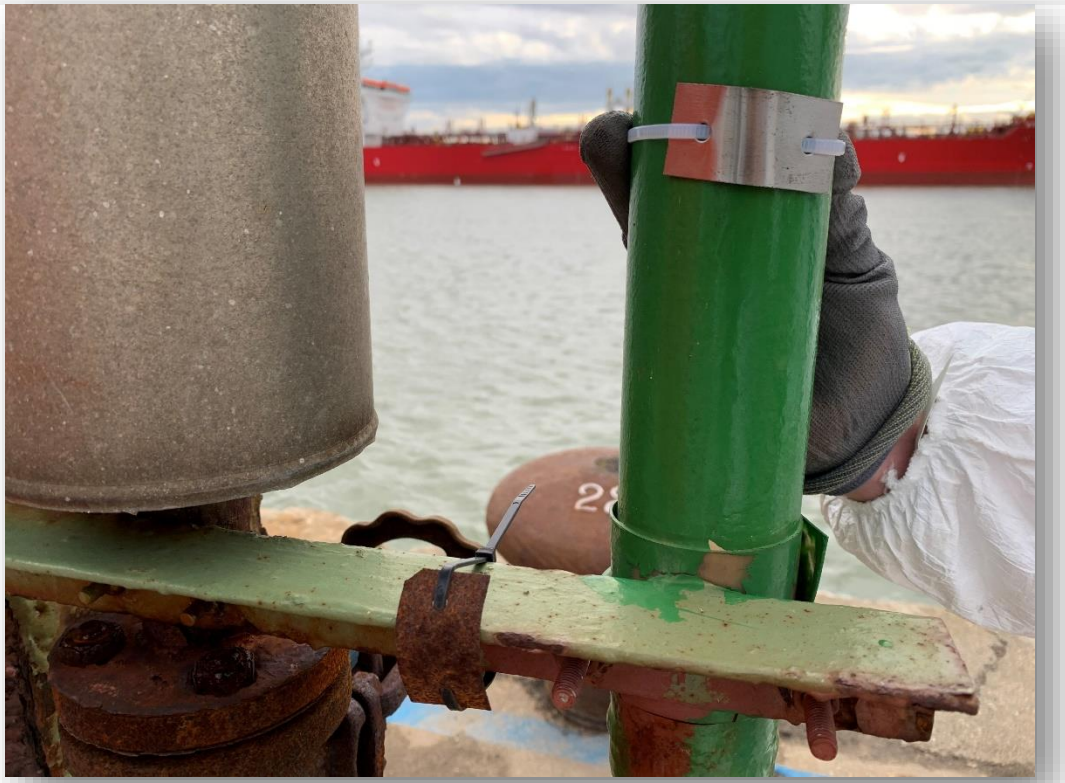
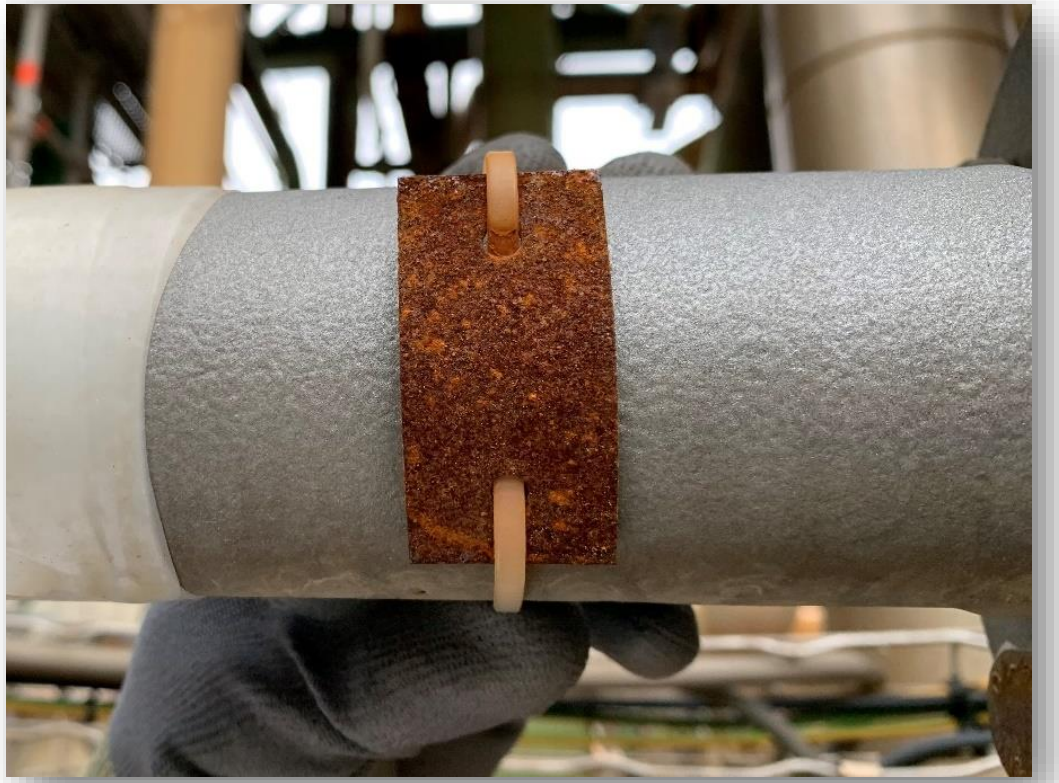


Trial Results

Control Coupon



Protected Coupon After 6 Months

Client Testimonial

From: CONFIDENTIAL
Date: Mon, 4 Nov 2019 at 07:58
Subject: RE: Zerust CUI Tape Trial and Meeting Results. Rig-Tech, CONFIDENTIAL
To: Dale Matthews <dale@rig-tech.co.uk>
CONFIDENTIAL

Hello Dale,

I was on holiday last week. In annex some of the photos from the status of the pipes after removal of the Zerust tape.
I removed the tape at the end of august. The pipe surfaces were in the same condition as before we placed the tape.
For that reason, I didn't plan any other UT on it.

Regards,

CONFIDENTIAL
Inspection Engineer
CONFIDENTIAL

Welding Sparks Resistance Test

With Zerust® Inhibitor Fusion (ZIF) Tape

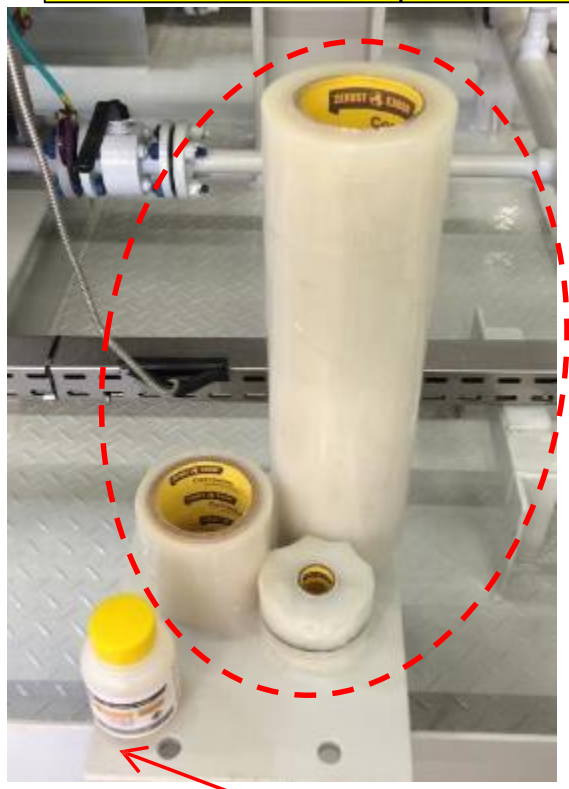
MODEC

ZIF Tape

Welding sparks resistance test

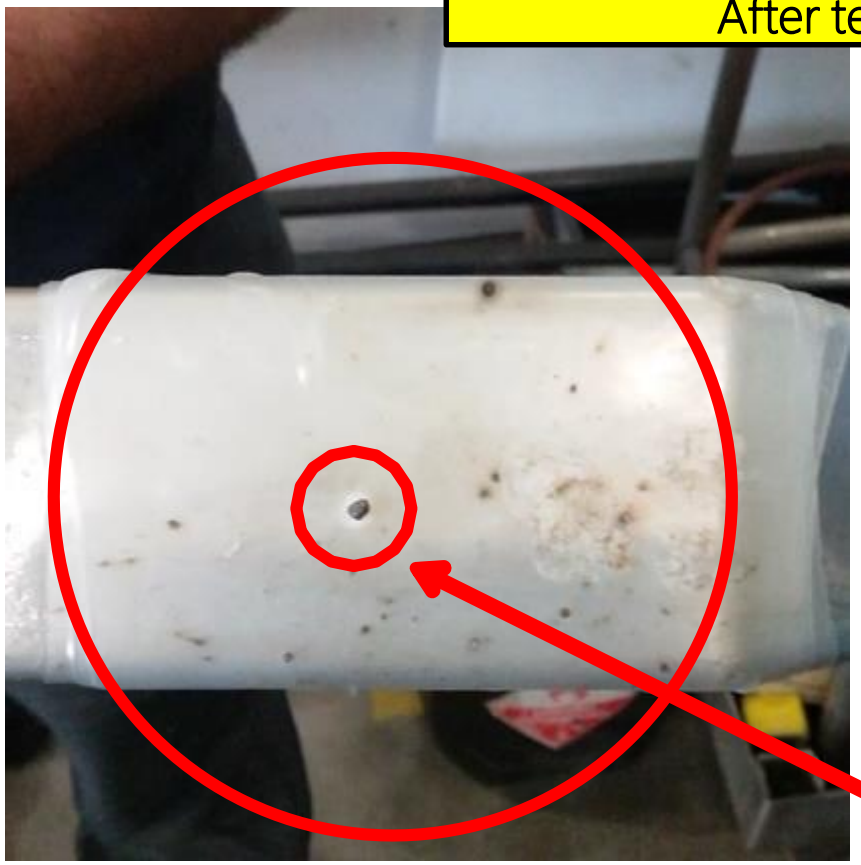
The application procedure starts with spraying **Zerust® AxxaWash™ NW10-C** (Diluation rate 1:20 OR 5% into City Water) onto the flange/metal surface to provide powerful cleaning and corrosion prevention action on metallic and non-metallic substrates exposed to highly corrosive inorganic, bonded surface-reacted salts. It is an aqueous-based solution.

Then apply **ZIF Tape**.



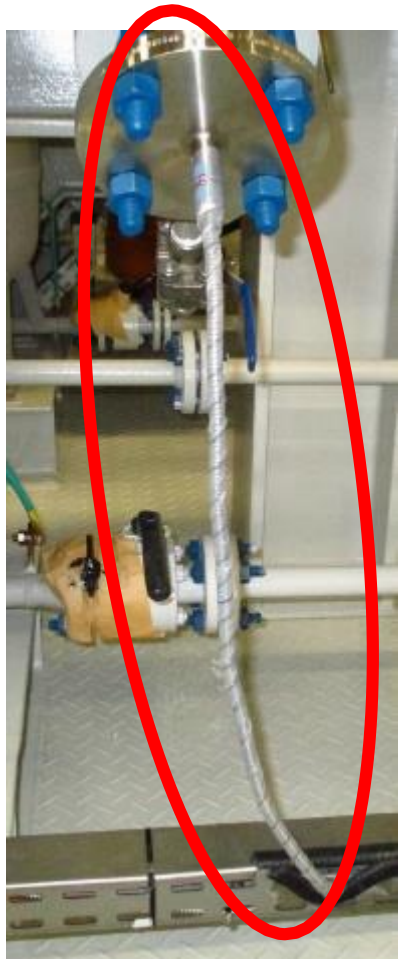
ZIF Tape

Application Procedure



ZIF Tape

Where ZIF Tape can be applied to provide protection from welding sparks and corrosion during the construction phase.



Zerust® Inhibitor Fusion (ZIF) Tape Conclusion

- Easy to Implement
- Substantial overall commercial savings vs. conventional coating systems
- Non-Intrusive
- Continued In-Service Operational activities
- 5-10+ years of protection
- Easy to inspect due to translucent nature of the ZIF Tape.
- Easy to remove
- Provides a 2 layer barrier:
  - By means of a physical barrier of a robust Silicone based material
  - By means of a corrosion inhibitor that will form a molecular layer of protection and neutralize any contaminants.

Zerust® OIL & GAS
WORLDWIDE CORROSION SOLUTIONS

Thank You

For more information,
please visit our website

www.zerust-oilgas.com