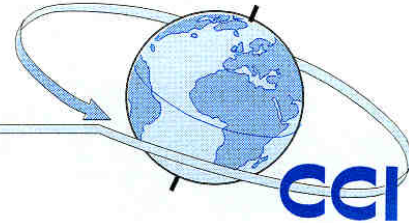


Corrosion Control International

Onshore & Offshore Corrosion Protection



RETROWRAP SL

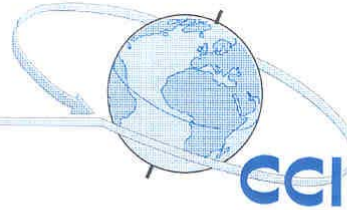
"COLD WORK" STATUS

CONDUCTOR CONNECTOR

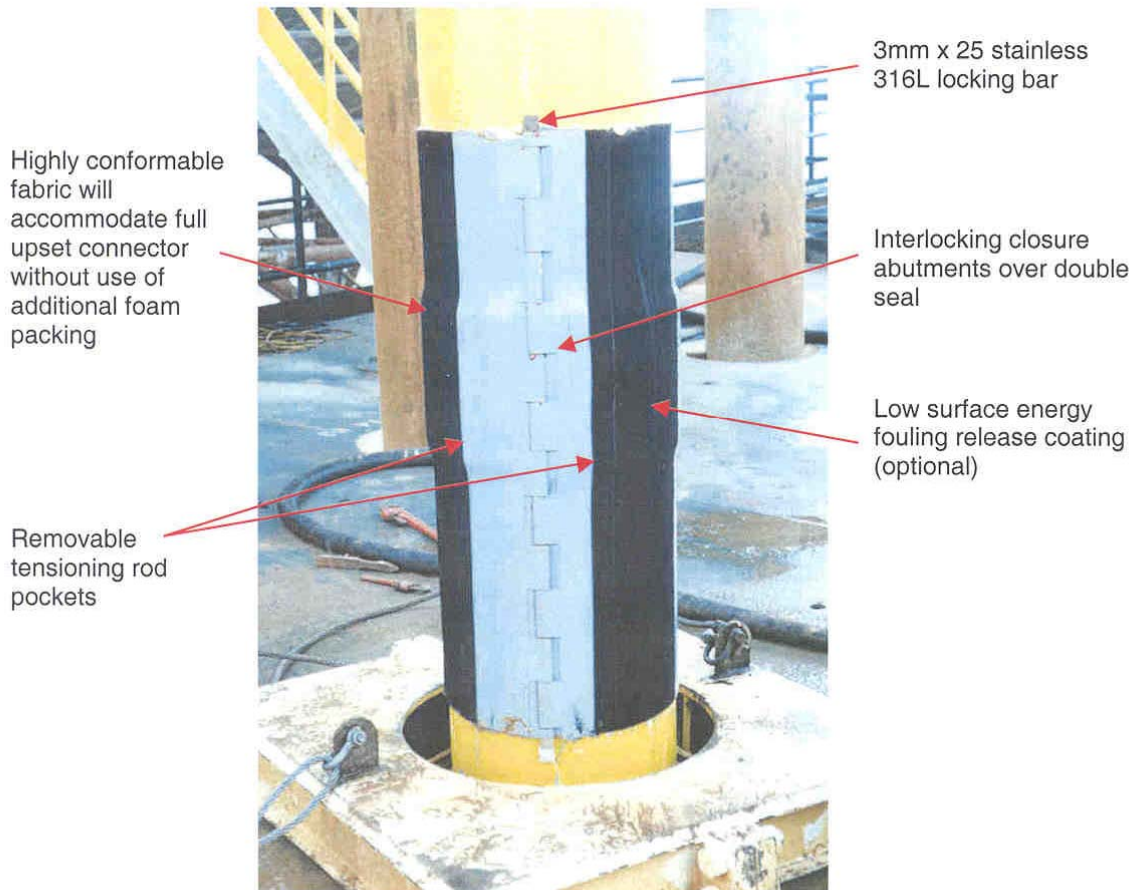
ENCAPSULATION SYSTEM

**Designed by: Corrosion Control International
Division of Slickbar Products Corporation**

U.S. Patent #5,435,667



RETROWRAP SL



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Introduction

RETROWRAP SL has been specifically designed to provide “cold work” status installation and to facilitate passage through the conductor guide tubes during drilling operations. It is an external wraparound corrosion protection system which provides an easily installed encapsulation system for the supplementary long term cladding of subsea conductor connectors. When installed, it complements the internal seal assemblies within the made up connector and obviates the risk of crevice corrosion occurring during service life.

RETROWRAP SL's elastomeric properties and closure system provides the unique capability of removal and subsequent replacement to facilitate routine inspection of the substrate or reuse in the event of a pull back operation.

Hoop tension imposed in the tough resilient outer skin acts to force the inner layer against the surface of the substrate, thereby causing the thixotropic gel and its corrosion inhibitor to form a close association with the substrate. The thixotropic nature of the sealant allows it to be exuded into any surface irregularities, thereby providing a seal and thus prevent the ingress of oxygenated water from entering the outer extremities of the joint mechanism.

The system is modular and therefore a multiplicity of units may be deployed to encapsulate virtually any length of circular and flanged section pipe together with rectangular or square section piles in any orientation.

Safety and the Offshore Environment

Offshore oil and gas installations, by their very function and location, are susceptible to practices or processes which, if incorrectly controlled or monitored, can expose operational personnel to highly hazardous situations. For this reason, "The Permit to Work" scheme was introduced, in particular, the "Hot Work Permit". The recommendations of the Cullen report are widely referred to by designers and operators alike, especially where fires and their likely causes are concerned.

In designing the RETROWRAP SL, a total encapsulation system for safe, "flame free" corrosion protection of risers, conductor connectors, CCI has considered safety, reliability and ease of installation as the paramount requirements whether in the inhospitable environment of the North Sea, where sub-zero temperatures are often experienced, or at the elevated temperatures of the Middle East.

Design Criteria

In preparing our technology package, we have based our design around materials with a proven long term resistance to a marine environment.

The multi-layer fabric utilized within the main wrap panel and the polyamide 6/6 reinforced fabric of the abutment closure assembly are resistant to long term immersion in sea water and to the attendant biological, chemical, UV and ozone attack together with ambient temperature variations ranging from Northern to Equatorial waters and substrate temperatures typical of "Hot/live" risers.

No labor intensive ancillary materials or pre-installation processes are required, such as primers, pastes and tapes on extensive substrate cleaning. Every effort has been made to simplify assembly and to reduce the possibility of human error without detracting from long term performance.

The materials in the system are stressed below their operational limits ensuring a high safety factor in all parameters while in service. If accidentally punctured, the hoop tension will cause the gel impregnated within the inner layer carrier to be excluded from the damaged area and "self seal". The inhibitor within the gel will neutralize any oxygenated water which has permeated through the damaged wrap at the time of impact. The design of the laminar membrane and the hoop tension involved combine to ensure that in the extremely unlikely event of a tear being introduced to the RETROWRAP SL, the tear will not propagate.

The basic objective was to design a system that while fulfilling all of the requirements once in service, would be "operator friendly" with safety and application key "hands on" features.

Construction

RETROWRAP SL is a multi-layer monocoque construction consisting of two polyamide textile reinforced scrims encapsulated within a polyurethane matrix with a polyurethane outer skin. Simultaneously bonded during production, is a polyester or polypropylene, penetration resistant, felt inner layer which is impregnated with corrosion inhibitors suspended within a thixotropic hydrophobic gel. Multi-layer, abrasion resistant fabrics have been developed in response to a demand for a cost effective material dedicated to provide all the requirements identified over the past ten year's of wrap construction, utilizing supportive data obtained from the use of polyurethane in a marine environment.

The Outer Skin

In designing the system, we considered the following operational parameters in addition to those necessary for the material to retain hoop tension throughout the projected operational life of the fabric.

Polymer Coating of the Outer Skin

Various polymers were considered, however the following requirements indicated that use of polyurethane:

1. **Toughness**
2. **Abrasion resistance**
3. **Good U.V. resistance**
4. **Good ozone resistance**
5. **Resistance to high climatic temperature**
6. **Good adhesion to fabrics**
7. **Proven long life when immersed in seawater**
8. **Resistance to hydrocarbon oil contamination**
9. **Lack of degradation by any form of marine life.**
10. **Oxidization resistance**
11. **Capability of being fabricated by in line high frequency polymer welding techniques.**

Primary Penetration Layer

Polyester felt which provides the primary penetration and carrier for the corrosion inhibiting gel is in line bonded during the production of the multi-layer fabric to become an integral part of the RETROWRAP SL wrap fabric.

The thixotropic gel and its attendant "active" corrosion inhibitors are factory applied to the point of saturation in quantities calculated to provide protection throughout the operational life of the product.

Thixotropic Inhibited Sealant Gel

A petrolatum based gel which exhibits a high degree of thixotropy, liquefying at installation to convey the active corrosion inhibiting additives to the interstices of the substrate, and solidifying again soon after.

The gel is intensely hydrophobic, dispersing water on contact with the substrate while remaining inert to the physical and chemical effect of marine and fresh water throughout the operational lifetime of the system.

Applied at elevated temperature in liquid form to the geotextile felt to the point of saturation ($\approx 3\text{kg/sq. M}$). Once applied, the gel exhibits stability through an extensive operational temperature range with slump and melt points being outside those encountered in most applications.

Construction (Continued)

Wraparound Interlocking Closure Seal

To facilitate easy passage through the guide tubes, RETROWRAP SL utilizes a mortise and tenon closure composed of high tensile polyurethane coated polyester fabric abutments through which, after tensioning and alignment of the abutment loops, a flat stainless steel 316 L locking strip is inserted.

Upon release of the closure forces, induced by the mechanical caliper closure unit, tension is transferred to the closure assembly, thereby causing the seal assembly to compress the integral inner sealing flap to create a watertight seal.

Since the total "stand off" of the assembled joint from the OD of the connector is only 14 mm, easy passage is provided through the guide tubes, with little or no risk of damage.

RETROWRAP SL installation can be carried out subsea, or on the drill deck and requires no in depth product installation training since it is designed to be resistant to typical "site conditions". If required, it can be removed and refitted to facilitate substrate inspection, or where a "pull back" situation exists , the wraps may be reused at a later date

Physical Data

Heavy Duty Wrap Fabric - Type TR-0099 - 2 Ply (BX-2-90UF)

Typical Properties

Coating Material		100% PTMEG Polyurethane
Color		Black
Urethane Surface Finish (Max.)		350 R.M.S.
Total Thickness, Finished $\pm .015$ " (inclusive of polyester felt)		0.210"
Weight, Finished	ASTM D-751	90 oz/sq yd(± 3 oz)
Base Fabric		
Type		Nylon
Weight	ASTM D-751	12 oz/sq yd x 2 ply
Strip Tensile MD/XMD	ASTM D-751	1200/1200 lbs.
% Elongation at Break	ASTM D-751	45%
Tongue Tear MD/XMD (± 20 lbs)	ASTM D-751	200/200 lbs.
Taber Abrasion	ASTM 3389 1000 g weight H -18 wheel	> 40,000 cycles (min) No sign of reinforcing fabric exposure
Coating Adhesion	ASTM D-751	40 \pm 5 lbs/inch
Accelerated Weathering	ASTM D-4396	1000 hrs excellent
Low Temperature Bend	ASTM D-746	- 70° F
Wrap Operating Temp. Range		-20° C to 100° C
Felt		
Type	Polyester	
Weight	ASTM D-751	19 oz/sq yd

Specifications subject to change without notice

Corrosion Inhibiting Gel

This petrolatum based gel exhibits a high degree of thixotropy with active corrosion inhibiting additives.

The gel is intensely hydrophobic, dispersing water on contact with the substrate while remaining inert to the physical and chemical effect of marine and fresh water throughout the operational lifetime of the system.

The inhibitor is applied at an elevated temperature in liquid form to the geotextile felt to the point of saturation ($\approx 3\text{kg/M}^2$ 0.6 lbs/ft²). The application of the corrosion inhibiting gel is usually done either during manufacture but can be done at the installation site. Once applied, the gel exhibits stability through an extensive operational temperature range with slump and melt points being outside those encountered in most applications.

Components of the gel are as follows:

<u>Components</u>	<u>Approximate \pm %</u>
Refined Petroleum Wax	50%
Thixotropic Media	40%
Oxyalkylates and Alcohol in Heavy Aromatic Naphtha	10%

Color:	Tan
Appearance:	Soft Paste
Odor:	Oily Hydrocarbon
Specific Gravity:	1.2



RETROWRAP SL INSTALLATION



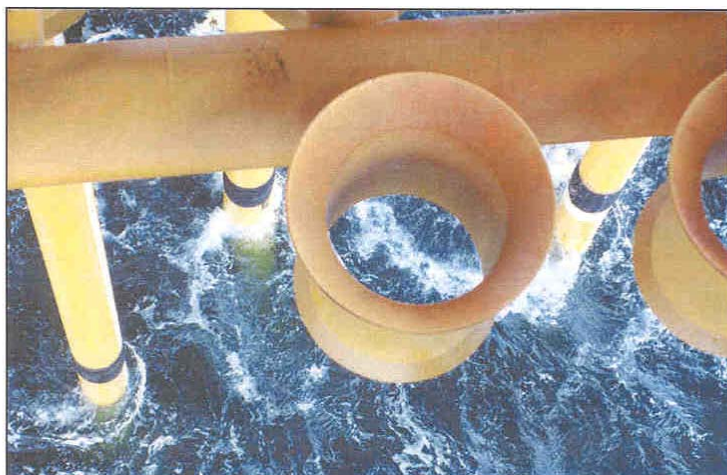
Vetco SR20 connector at work station awaiting installation of low profile SL type wrap.



Low profile wrap positioned loosely over SR20 connector. Note the gap between each end of wrap.



Locking bar in position. Technician releasing pressure from hydraulic jacks.



Conductors in position. Upper wraps clearly visible. All connectors protected to mud line. In foreground is empty guide awaiting conductor installation.

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RETROWRAP SL INSTALLATION PROCEDURE

TOOLS REQUIRED

- (2) Retrowrap Installation Calipers (3 calipers for upset joint)**
- (2) Retrowrap 1/2" Diameter Re-Usable Tensioning Rods**
- *(1) 1/2" Drive, Compressed Air Operated, 300 ft/lb, Pistol Grip Impact Wrench**
- (1) 1/2" Drive 6 Point 1 ¼ AF Socket To Suit Caliper Unit Drive Nut**
- *(1) Screwdriver 3/16"-1/4" Blade**
- *(1) Rubber Mallet**

Note: Tools marked * are not supplied by CCI unless specifically requested.

- 1. Insure that the connector joint areas has been wiped clean in accordance with the Client's cleaning procedure, if any. Using chalk, mark the required position of the wrap over connector joint**
- 2. Check all components. Each wrap requires;**
 - 1 each - closure bar and gray plastic end cap**
 - 2 each - re-usable 1/2" diameter tensioning rods**
 - Re-usable installation calipers**
- 3. Lay RETROWRAP SL out on the deck gelled side down. (Do not remove release plastic if supplied.)**
- 4. Grease 1/2" diameter tensioning rods prior to inserting into pockets attached to outer wrap panel.**
- 5. Apply grease to locking bar and inside wrap abutments.**

6. Check that installation calipers are in good condition and are well lubricated. Attach impact wrench via 1 ¼ AF socket to caliper, and power closure jaw in and out.
7. Pull away release plastic from wrap (if supplied) and proceed to Step 8.
8. Fit wrap around connector between chalk marks. Position points of each caliper jaw into the holes located in the opposing tensioning pockets on each side of the closure and using impact wrench lightly tension each caliper until wrap is self supporting. Check that position is correct, then lightly tension.
9. Continue tensioning the RETROWRAP SL until the loops of the wrap closure area all line up and inner sealing flap is seen to be located under opposing edge. This will enable the stainless locking bar to pass easily through the loops until approximately 1 ½” are protruding from the lower end of the wrap.
10. Release tension on each caliper sequentially and remove from wrap. Remove 1/2" diameter rods from tensioning pockets. Grease and refit into next wrap.
11. With bar fully inserted, place cap on end of lock bar and drive on with rubber mallet. If it's an “upset connector,” use mallet to form closure bar to joint profile.

NOTE:

In designing our SL wrap system, special attention has been given to simplify the installation procedure and to provide well engineered robust closure tools specifically developed for the purpose, utilizing 10 years of offshore design experience.

Typical installation time for a 24 x 12” diameter SL wrap is 3 - 4 minutes.

Conclusion

RETROWRAP SL provides an easily installed retrofit method of corrosion or environmental protection of piles, vertical risers and pipes.

The installation of the RETROWRAP SL unit has a unique "Cold Work Permit" status which fully complies with Oil and Gas Offshore Industry's "Codes of Practice".

To facilitate complete post installation visual/NDT inspection surveys and/or maintenance without extensive surface preparation at intervals indicated by the client, the facility exists to remove and refit RETROWRAP SL units without detriment to the long term performance of the material.

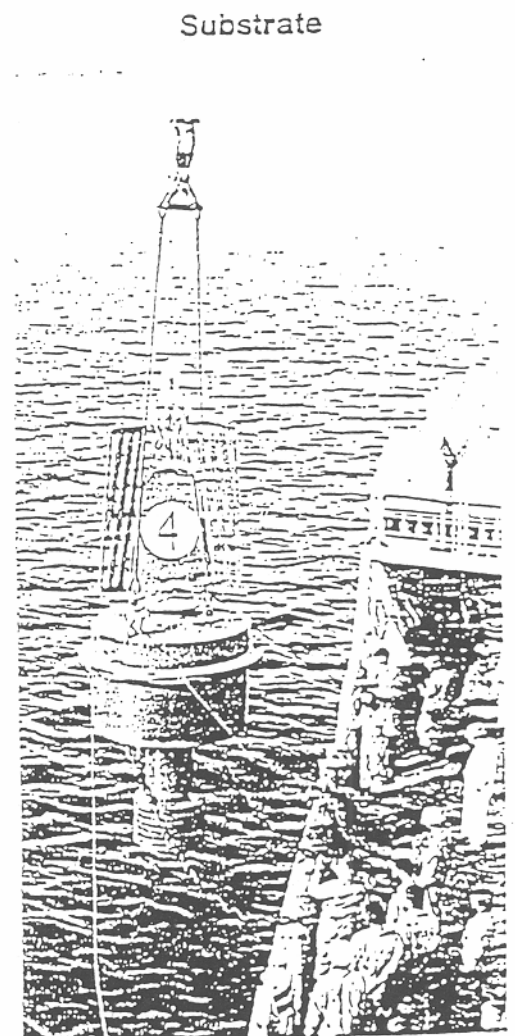
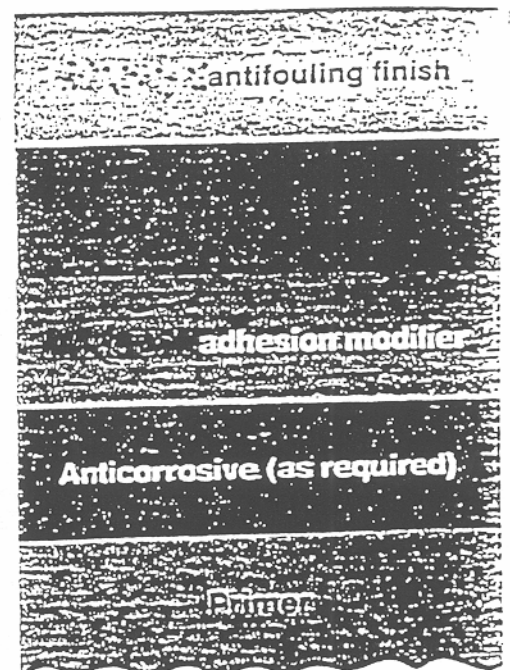
Silicone Fouling Release Coating

Introduction

Elastomeric polydimethylsiloxanes PDMS are the only low surface energy polymers that can be formulated into non-toxic fouling release coatings. These coatings differ from anti-fouling coating in that the control of the marine fouling is due to the physical nature of the surface instead of the presence of a toxic agent.

Silicone Technology

Polydimethylsiloxane is a heterogeneous molecule with a very flexible backbone the lowest of all common polymers which enables the polymer chain to adapt to the lowest surface energy configuration. After a short time in water, the PDMS rotates and exposes the silicone backbone which results in a substantial increase in surface energy which in practice can be compared to a dynamic coefficient of friction of less than ice upon ice.



Silicone Technology (continued)

In recent years, Polymer chemistry has advanced to enable the development of "Tie coats" on adhesion enhancement systems which modifies a base coating over which the PDMS may be applied.

CCI is currently working with two leading system suppliers and can provide this non-toxic system as a factory applied treatment to the surface of our wrap fabric.

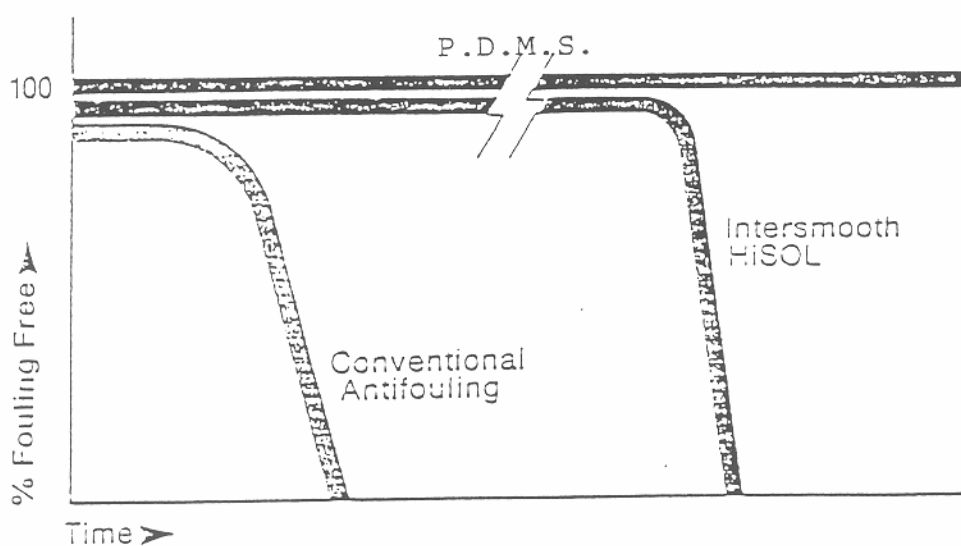
Trade name: "NO-GRO"

Test sites:

Miami, Florida
F.I.T. Melbourne, Florida
British Gas, Fowey, Cornwall, UK
Marine Paint Res. Center,
Arabian Gulf, Bahrain

Major Clients:

U. S. Navy, USA
Chevron, UK
B.P., UK
British Gas, UK
ADMA OPEC, UAE
Shell, UK
Statoil, Norway



RETROWRAP SL

CLIENT USER LIST

ESSO JOTUN

B. P. EXPLORATION

B. P. NORWAY

BRITISH GAS

CHEVRON U. K.

CONOCO U. K.

ELF ENTERPRISE

OIL STATES OILFIELD SERVICES

LASMO

MOBIL NORTH SEA

PHILLIPS PETROLEUM U. K.

PHILLIPS PETROLEUM NORWAY

QATAR GAS & PETROLEUM

SHELL U. K.

STENA OFFSHORE

TOTAL U. K.

ABB VETCO GRAY

XL SYSTEMS

TRINMAR (Riser Clamp Lining)

HIBERNIA DEVELOPMENT