



CLOCK SPRING®

INSTALLATION GUIDE Underwater Snap Wrap

08/15/04

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See back page for full contact information.

2.0 CLOCK SPRING® Underwater SW

2.1 Record the following general data:

Date of repair: _____
Repair Identification Number (Optional): _____
Filler (MA 441) lot number: _____
Filler expiry date: _____
Filler activator lot number: _____
Filler activator expiry date: _____
Adhesive lot number: _____
Adhesive expiry date: _____
Adhesive activator lot number: _____
Adhesive activator expiry date: _____
Ambient temperature: _____
Water temperature: _____

2.2 Record the following pipeline data:

Location: _____
Pipe diameter: _____
Wall thickness: _____
Pipe grade: _____
Pipe type: (ERW, DSAW, EFW, Seamless, Etc.) _____
Product: _____
Operating pressure: _____
Installation pressure: _____
Pipe temperature: _____
Coating type: _____

2.3 Record the following defect information:

Defect Type: _____
Defect length: _____
Defect width: _____
Defect depth: _____
Defect circumferential extent: _____

2.4 Answer the following questions:

Are filler, adhesive and activators within expiry date?	Yes	No
Was a Critical Engineering Assessment completed?	Yes	No
Is Clock Spring® Underwater SW an acceptable repair?	Yes	No
Is the surface preparation equivalent to NACE #3?	Yes	No
Was Clock Spring® Snap Wrap configuration used?	Yes	No
Was the repair coated?	Yes	No

If any question is answered "No", and you are not familiar with the repair technique, contact Clock Spring Company L.P. for instruction.

3.0 **INSTALLATION PROCEDURE FOR Clock Spring® Underwater SW**

This procedure will provide guidance in the application of the Clock Spring® Underwater Snap Wrap repair system. Each installation will present unique challenges and this procedure may have to be modified to meet local conditions.

That portion of the repair that is above the waterline will be installed in the standard manner for a Clock Spring® Snap Wrap repair.

The Clock Spring® Underwater Snap Wrap repair is derived from the technology developed for Clock Spring® pipeline repair system. It is suitable for low pressure, small diameter systems. The basic specifications are:

Pressure	<500 psi (3.45 MPa)
Diameter	<24-inches (609 mm)
Number of wraps	4 or 8 (Application specific)
Nominal thickness	0.375-inches (9.5 mm)
Maximum defect depth	90% wall

Note: The Operator must check applicable local regulations and operating codes to determine if this repair is acceptable in the operating environment.

Note: Additional details on various aspects of this installation process are available in the Clock Spring® Installation Manual. Installers are advised to acquire, read and understand the procedures and processes in that manual.

A typical installation for the underwater Snap Wrap repair will be on a riser, at the splash zone. Some of the Snap Wraps will be applied underwater and some above the waterline. The scenario used in this example installation procedure assumes that a riser is to be repaired. The repair will cover the riser from 3 meters (12 feet) below the waterline to 2 meters (6-feet) above the waterline. Each Snap Wrap has a length of approximately 12-inches (305 mm). In this case, there will be 18 unit, placed side-by-side on the pipe.

The repair will be made using 4 concentric wraps of the Clock Spring® composite shell. The shell is in the form of a split sleeve, with a circumference slightly smaller (0.063-inches (1.5 mm) than the pipe being repaired. Each shell will fit around the pipe leaving a slight longitudinal gap. Each layer of the Snap Wrap will be applied such that the longitudinal seams are staggered from the longitudinal seams of the preceding layer. Each layer of the Snap Wrap will be applied such the circumferential seam between adjacent units is covered by the subsequent layer (staggered in the axial direction).

3.1 Pipe preparation

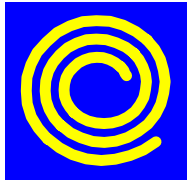
The area to be repaired must be cleaned. All pipe coating will be removed. The pipe surface will be brushed clean, removing all scale, loose debris, products of corrosion and residual pipe coating. The surface should contain a slight anchor pattern as specified in the NACE #3 Surface Finish standard. (See Clock Spring® Installation Manual for more detail.)

3.2 The pipe will be carefully inspected for dents, gouges, scrapes and corrosion. Any damaged areas will be evaluated using appropriate NDE techniques. Scrapes or gouges will be removed by grinding. If stress risers such as scrapes or gouges cannot be removed, an alternative repair method should be considered. The remaining wall thickness at the deepest feature, as a minimum, will be determined. The feature will be subjected to an Engineering Critical Assessment to determine if the Snap Wrap repair is acceptable.

Note: The Snap Wrap composite shell has a modulus of elasticity of 1×10^6 psi (6.9 GPa) and a failure stress of 18 ksi (138 MPa). GRIWrap for Snap Wrap can be used to assist with this assessment.

- 3.3 The layers of the repair will be built up in both the axial and circumferential directions. The first layer of the repair will be used to mold the filler material in place and will be completed before the repair area is built up in the circumferential direction. The second, third and fourth layers will be applied with the longitudinal seams staggered (90° from the longitudinal seam on the underlying layer) and centered over the circumferential gap between adjacent sleeves. Some sleeves will have to be cut circumferentially to achieve a square end at the outside, axial extent of the repair.
- 3.4 Filler Material (Underwater application)
Apply the first sleeve (without adhesive) over the pipe and mark its position on the pipe. Remove the sleeve.
- 3.5 Determine the air, water and sub-surface pipe temperatures. Using the average temperature, T , of the water temperature (T_w) and the sub-surface pipe temperature (T_p), determine the mix ratio of activator and filler. $T = \frac{T_w + T_p}{2}$ Mix an adequate amount of filler material to completely fill the voids at the position where the Snap Wrap sleeve is to be applied.
- 3.6 Filler material is a Methacrylate adhesive consisting of a paste and an activator. The filler and activator for the sub-surface application will be mixed according to the temperature, T , determined in step 3.5. Refer to the chart on the Filler tube for the proper mix ratio. Table 2 is provided here for reference only. If the information in this table is at variance with the mix ratio charts on the Filler tube, that ratio will take precedent. (See Table 2 – Activator Quantity for Filler). Mix the filler and activator for 3 minutes until the mixture is uniform in color and completely mixed. (See Clock Spring® Installation Manual for more detail.)
- 3.7 Submerge the filler material on a suitable pallet and mold to contour of original pipe. A second diver may be required to help hold the filler material in place.
- 3.8 Cover the filler material with the supplied plastic wrap, and hold in place until the Snap Wrap sleeve can be snapped over both the plastic wrap and the filler.
- 3.9 Adhesive (Underwater application)
The adhesive is a Methacrylate consisting of two parts: adhesive and activator. The mix ratio for the sub-surface portion of the repair will depend on the application temperature, T , determined in step 3.5. Refer to the chart on the Adhesive container for the proper mix ratio. Table 1 is provided here for reference only. If the information in this table is at variance with the mix ratio charts on the Adhesive container, that ratio will take precedent. (See Table 1 – Activator Quantity for Adhesive). The mix ratio, ambient air temperature, water temperature and pipe temperature will all affect the working time available before the adhesive cures.
- 3.10 Using the temperature T , calculated in step 3.5, determine the correct mix ratio. Mix adhesive and activator according to standard Clock Spring procedures. (See Clock Spring® Installation Manual for more detail.)
- 3.11 Clean and thoroughly dry the first layer composite sleeve.
- 3.12 Liberally apply the mixed adhesive to the inside of this sleeve.
- 3.13 The diver will submerge the sleeve and snap it in place over the prepared location on the pipe. This location will be filled with the filler material and over-wrapped with the plastic sheet.
- 3.14 Install five band clamps (supplied). Tighten the clamps starting at the center clamp and alternating outwards. Tightening will take several minutes as the filler material flows into the voids under the sleeve and both filler and adhesive flow outward, towards the end of the sleeve. Re-tighten clamps as necessary.

- 3.15 Allow unit to stabilize for 15 minutes. Remove excess filler and adhesive at the sleeve ends and along the longitudinal seam.
- 3.16 Install an adjacent sleeve, using the same technique, being sure to butt the sleeve as tightly as possible to the one installed on the pipe. Continue this process until the base layer (first layer) of sleeves is completely installed over the repair area.
- 3.17 The filler and adhesive will cure in approximately two hours. Prior to cure, it is important to remove excess filler and adhesive that has extruded (leaked) out the longitudinal seam. This seam must be flush with the composite sleeve surface so that the next wrap of the composite will fit snugly to the first wrap.
- 3.18 Remove all clamps after the adhesive is cured.
- 3.19 Clean the longitudinal seam of each sleeve of any material that will impede, or affect, the installation of the second wrap layer.
- 3.20 Apply the second, third and fourth layers of composite sleeves. Mix adhesive and apply a liberal amount to the inside surface of the sleeve.
- 3.21 The diver will snap the sleeve in place, centered on the gap between two adjacent base-layer sleeves, with the longitudinal seam positioned away from both longitudinal seams on the underlying layer.
- 3.22 Using the same technique, install another sleeve, being sure to butt the sleeves tightly together. Continue to build the repair in both the axial and circumferential direction. When a fourth layer sleeve is installed it can be clamped in place with the band clamps supplied. Tighten as before.
- 3.23 If the installation process is to be suspended for any reason, such as diver fatigue or operational efficiencies, the exposed portions of the second and third layer sleeves already installed must be clamped with the band clamps. Allow the clamped sleeve to stabilize for 15 minutes and remove excess adhesive from the sleeve ends and the longitudinal seam. Allow the adhesive to cure before restarting the repair process. Remove the clamps, clean the sleeve surfaces and complete the repair.
- 3.24 Continue the installation process until the entire repair is complete and all fourth-layer sleeves are held in place with band clamps.
- 3.25 The final repair will be four layers thick. Each layer will be staggered in the axial direction from the layer beneath and the longitudinal seams will be positioned such that no two adjacent layers have seams in the same circumferential position on the pipe.
- 3.26 When the adhesive has fully cured, remove the clamps and coat the repair area with a protective coating.



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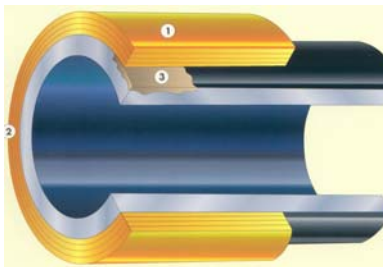
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