

# THE CORE-LUBE WIRE ROPE RECYCLING LUBRICATOR

A REPORT TO UNOLS

BY

KEN PALFREY, OSU

WITH

THE SHIP OPERATIONS STAFF, OSU



DECEMBER 1991

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# The "CORE-LUBE"

## Wire Rope Recycling Lubricator

By Ken Palfrey, OSU

With

## The Ship Operations Staff, OSU

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Since our evaluation of the Brooke Ocean Technology (BOT) "Cable maintenance System" we have continued to seek out competing cable lubricators with the goal of finding one with higher lubricant application pressures. In several attempts with the BOT device we were unable to develop lubricant pressures in excess of 5 PSI without excessive drip and spatter. At this pressure, which was lower than specified by the manufacturer, some beneficial lubrication was achieved but the lubricant did not fully penetrate the strands of wire rope or fully coat the second wire layer of EM cable. See our report "A Cable Maintenance System" of August 1989 and supplement of 29 January 1990. So far BOT has not offered any improvements to their device since these reports.

The Core-Lube System is manufactured by B&C Wireline Ltd.. This relatively small company specializes in the design of equipment for the petroleum industry. The Core-Lube device has been successfully used on oceanographic wire ropes and EM cables at the Institute of Ocean Sciences, a UNOLS/RVOC member. The Core-Lube System is best described by Figure 1.

With the encouragement of Dr. Richard W. West of the National Science Foundation, a manufacturer's demonstration and a UNOLS evaluation of the Core-Lube System was scheduled for 20 August 1991 at Newport, Oregon using R/V WECOMA. Dr. West also authorized the reprogramming of equipment grant funds to purchase a Core-Lube System for further testing should the evaluation indicate strong potential for the device in support of UNOLS vessel operator institutions. Ron Chisholm, President of B & C Wireline, provided and demonstrated the Core-Lube System as scheduled. Alan Metzler, Vice President and Technical Director of PMI Industries, also participated and is a distributor of the Core-Lube System.

For the demonstration and evaluation the 1/2" 3x19 wire rope spooled on WECOMA's coring winch was selected. This wire is an early Macwhyte, length 30,000 f t (9000 M), received in December 1987 and placed in service August 1988. At the time of the evaluation the wire showed considerable surface rust throughout its working length with little intact galvanizing or zinc oxide visible. It had not been cleaned or lubricated throughout its service life. The wire had experienced 377 cycles to a maximum length of 6200 M and maximum tension of 10,500 lbs during a four year service life, which we believe to be below average use. We felt this wire would provide the most challenging test of the Core-Lube System.

The wire rope was spooled off WSCOMA's winch drum onto a shore side storage reel on 19 August, the day prior to the demonstration and evaluation. The wire was not cleaned deliberately in order to evaluate the system's advertised capability to remove trapped moisture and detrimental particles (salt, rust, etc.) from the wire rope. The Core-Lube System was set up and operated on 20 August according to B&C Wireline's Instruction Manual, Figure 2. Photographs of the setup are contained in (Figures 3 & 4). The system performed flawlessly. Cable line speeds of up to 100 Meters/Min. ( 300 Feet/Min.) were achieved. Lubricant application pressures up to 60 Psi were achieved without leakage from the housing. A pressure of 40 Psi was believed adequate for full penetration of the lubricant and was held throughout the full length without any difficulty or appreciable loss of lubricant. Five and one-half (5.5) gallons of "Pre-Lube 19" was used. The small

amount of drip was easily controlled by a couple of absorbent pads. Various techniques were tried to remove some of the surface rust before the wire entered the lubricator housing. The BOT brush arrangement worked the best. At the conclusion of the demonstration as the device was being cleaned for storage the strainer basket was found to contain considerable rust and other detritus as expected.

Two months subsequent to the demonstration a section from the bitter end of the wire rope which had been lubricated but not used otherwise was dissected at Newport by the author and all strands were found to be clean, bright and uniformly coated with lubricant. PMI performed a laboratory analysis of a lubricated, used, outboard section of the wire rope. The results of that analysis which are contained in the Laboratory Test Report confirm the "Core-Lube System" provides full penetration of the lubricant. Because of the wear noted by PMI a destructive pull test of an outboard section was conducted at OSU. The result of this test was the wire failed under a static load of 19,850 lbs, well below the rated breaking strength of 25,700 lbs. Replacement is planned.

## **Conclusions and Recommendations:**

1. The "Core-Lube" recycling wire rope lubricator is a highly effective device for lubricating 3 x 19 wire rope to its core when used in conjunction with Grignard Company's "Pre-Lube 19". It offers the following advantages:

- > Fast easy set up
- > Recycles lube - cost effective
- > Doesn't make a mess - cable leaves system with no dripping.

### **Liners:**

- > Cost effective
- > Long life
- > Quick replacement

2. The "Core-Lube" is effective in removing some of the rust and other detrimental material which will accumulate on a wire rope used in oceanographic operations. However wires with a heavy accumulation of surface rust should be cleaned by mechanical means (brush, pressure wash) before passing through the lubricator. ( See Figure 1A New Up-Date )

3. B&C Wireline Ltd. reports the same lubricator housing can be used as a effective cable pressure washer unit, with a built in cable drier. ( See Figure 1A Up-Date ) The BOT Cable Maintenance system remains a highly effective wire rope and cable cleaner.

4. If a pressure washer is used to pre-clean a wire rope it should be dried before attempting to apply water-soluble "Pre-Lube 19". B&C Wireline also manufactures a "Cable Air Drier Unit" which removes water from wire rope by compressed air which sells for under \$500.00 see (Figure 5). OSU has purchased one for installation in R/V WECOMA's 1/2" wire train. This device can be used in tandem with the "Core-Lube System" as a dryer. The BOT system also has an effective air dryer section.

5. A "Core-Lube System" with liners and bushings for a normal UNOLS suite of wire ropes and cables can be purchased for about \$3,500 (US).

6. Further work needs to be done to develop the full potential of the "Core-Lube System" in support of UNOLS vessels. OSU will loan equipment for the cost of shipping and consumables to those institutions willing to report their experiences to UNOLS. ( See New Up-Dates Figures 5 & 6 )

7. B&C Wireline is available to answer any questions you may have concerning your particular application of the system.

( FIGURE 1 )

# CORE-LUBE SYSTEM

A NEW SOLUTION IN CABLE MAINTENANCE



950 SER.



Wire rope lubrication is no longer a messy, time consuming task. There is no other system with the versatility and efficiency of the Core-Lube System. The system has proven to penetrate and clean.

## TWO SYSTEMS AVAILABLE



### **850 SER.**

Max. Wire Rope Size: 1.500" (41.28mm)  
Max. EM Cable Size: 1.680" (42.67mm)  
Min. ----- Cable Size: 0.062" ( 1.59mm)



### **950 SER.**

Max. Wire Rope Size: 3.543" (90.00mm)  
Min. Wire Rope Size: 0.625"  
(15.88mm)

- Penetrates lubricant into the wire rope.
- Has (4) injection nozzles for even coverage.
- Eliminates lubricant dripping and fling- off, by air wiping the cable.
- Removes trapped moisture and detrimental particles.
- Continuously circulates & filters gallons of lubricant around the cable under Air & Oil pressure.
- No cable damage due to metal to metal contact with the cable. Uses hard rubber scraper bushings.
- Applies Light to Heavy Gear Oils.
- Quick to rig up.
- Easy to Operate.

850 SER.

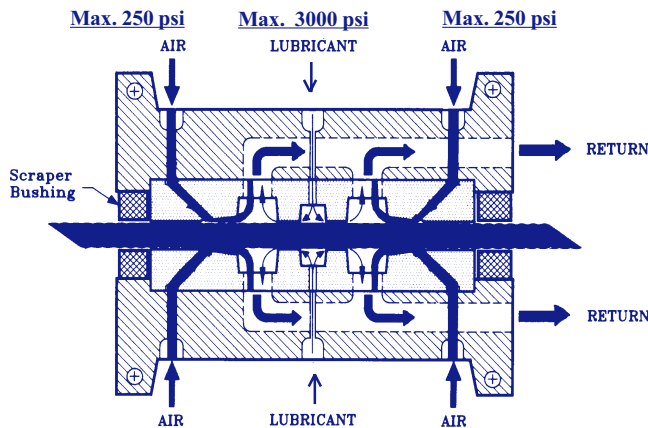


# The Core-Lube System offers AIR SEAL Pressure Technology along with high pressure Lubricant Injection @ 3000 psi.

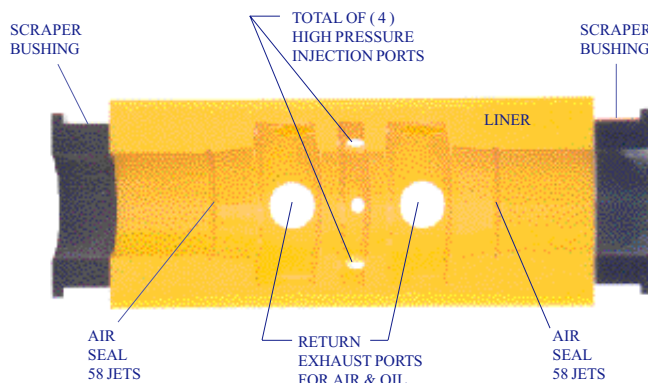


850 Ser. Complete System

**Core-Lubes patented Air-Seal System ensures that the lubricant remains within the housing thus preventing wastage and environmental contamination.**



**The Kinetic Energy behind the patented AIR SEALS sets the CORE-LUBE SYSTEM apart from all other lubricating devices.**



## Comments From Customers:

Rope fling-off and mess has virtually been eliminated.

Core-Lube performed as advertised.

The other lubricating systems were messy, subject to a lot of wastage and trapped moisture internally.

The Core-Lube System penetrated the wire rope rapidly with lubricant and removed most of the moisture internally and externally without a mess.

The maintenance crews found the Core-Lube System clean, neater and faster over all other systems.

## CORE-LUBE SYSTEM The Problem Solving Solution

The miners shown in the photo won \$16,000.00 when they submitted the Core-Lube System in a contest put on by their company, for the best overall problem solving solution of the year. They had used two other grease lubricators prior to the Core-Lube System.



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# INSTRUCTION MANUAL

## CORE-LUBE SYSTEM

( FIGURE 2 )

**850 SER.**

System # 850-SCS-V1

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### GENERAL DESCRIPTION

The Core-Lube System's primary objective is to penetrate, clean and coat wire rope with lubricant. This is accomplished by circulating lubricant around and through the cable under pressure.

### CORE-LUBE DATA

**850 Ser. Cable Capacity:**

Min. Cable Dia. 0.062" ( 1.57 mm)

Max. Cable Dia. 1.680" (42.67 mm)

**Materials:**

Polypropylene, Buna N,  
Polyvinyl-Chloride(PVC),  
Polyurethane, Brass, Copper,  
Stainless Steel

**Weight:**

Housing - 11 Lbs ( 5.0 Kg)

Pump - 17 Lbs ( 7.7 Kg)



### AIR REQUIREMENT

**Min. Air Capacity: 15 CFM @ 100 PSI**

**Min. Air Pressure: 70 PSI (480 kPa)**

**Max. Air Pressure: 200 PSI (1380 kPa)**

The air capacity required to operate the system will very depending on the diameter of the wire rope or liner size.

For best results 20 cfm (9 dm<sup>3</sup>/s) or more @ 100 psi (690 kPa) is recommended..



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( FIGURE 2 )



Mfg. B & C WIRELINE LTD. ( Canada )  
Ph: 403 529-9645 Fax: 403 527-1369

E-Mail: [corelube@telusplanet.net](mailto:corelube@telusplanet.net)

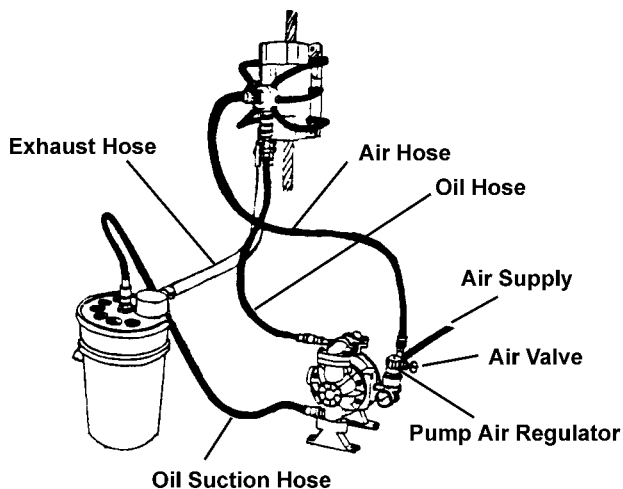
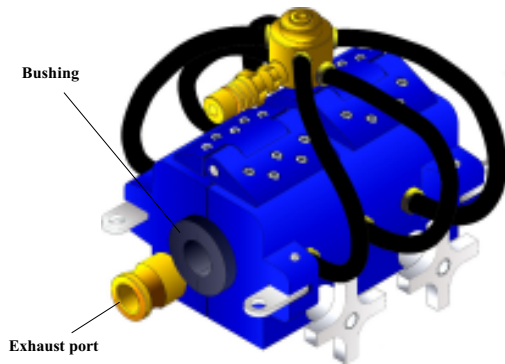
## OPERATING SAFETY PRECAUTIONS

- \* Do not pump flammable materials through the system.
- \* Do not smoke near the system when in operation.
- \* Keep container away from open flame and sparks.
- \* Heed all **Warnings & Cautions** listed in the Pump Operation Manual.

ARO PUMP MODEL #666053-388

### WARNING:

Do not use N-METHYLPYROLIDON to clean or purge the Core-Lube System.



## OPERATING INSTRUCTIONS

### STEP 1

#### Selecting the correct size liner and bushing:

Ideally the Liner & Bushing should match the cable diameter, however a variance in tolerance of 3.0% is acceptable.

The liner size is marked in decimal inches on its inner face.



#### Do not force the liner around a wire rope that is too large.

Both the liner and the bushing fit into dowel pins in the housing. The bushing prevents wear to the liner and should be inserted at the end where the wire rope enters the housing.

### STEP 2

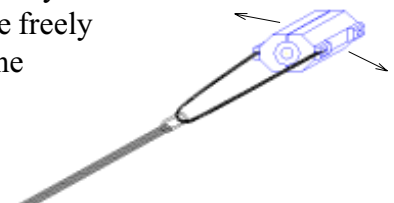
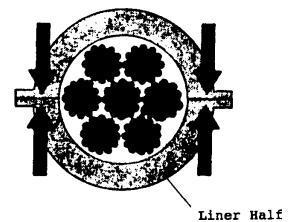
\* Position the Core-Lube housing around the wire rope with the exhaust port facing downwards.

\* Check to ensure the exhaust hose can reach the container.

\* Tighten the housing around the wire rope and check that the liner halves seal together.

Anchor the chains to a secure structure and shackle the other ends to the housing. Adjust the length of the chains for an even pull on the housing.

When positioning the housing in front of a winch, anchor one chain or sling a sufficient distance away to allow the housing to move freely across the face of the drum.

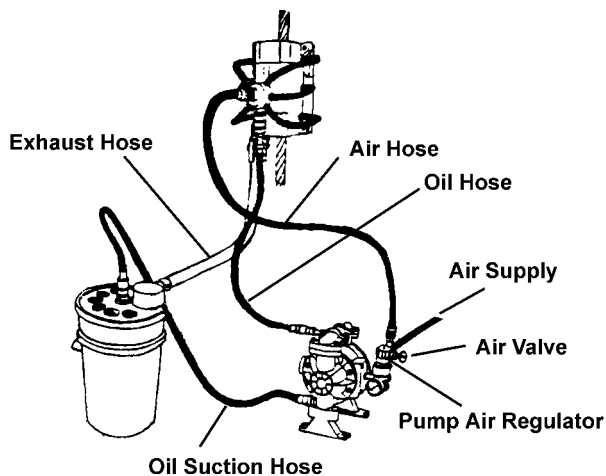


## STEP 3

Fill the container with lubricant approximately half to three quarters full. Place the container and pump at the foot of the housing and connect all hoses. Each hose has its own distinct coupler to eliminate errors.

**Important:** Make sure the pump air regulator and air valve is shut off before connecting the air supply hose to the pump. The air port connection is a 1/2" male pipe thread.

For best results utilize an air supply hose with a inside diameter of 1/2" or larger. If a 1/2" diameter is not available a 3/8" ID hose can be used.



## STEP 4

### *Systems Operation.*

**First** - Open the Air Seal Valve. (This controls the air volume & pressure to the air-jets or seals).

**Note:** Do Not run cable though the housing without air flowing to the Air Seals. Doing so may clog the small air jets.

**Second** - Open the pumps regulator valve until you hear the pump start pumping. Keep the pump pressure low at first and watch for lubricant to start flowing through the transparent exhaust hose back to the container.

**Third** - Start moving the cable though the housing slowly at first and increase the speed after every thing looks OK.

- Monitor the amount of lubricant flowing through the exhaust return hose. Increase the pump pressure as the cable speed increases to maintain good coverage.

- The pressure required to maintain a good flow will vary depending on temperature and viscosity of the lubricant.

**Important:**

It is not necessary to pump a high volume of lubricant to achieve good penetration and coverage. As long as lubricant returns through the clear exhaust hose you will achieve good results.



## STEP 5 Completion

- On completion of the lubrication operation, **First** turn off the pump.
- To remove excess lubricant, circulate the air a few minutes through the system.
- Uncouple the exhaust hose and couple together for storage. This will contain any residual lubricant left in the hose.
- Uncouple all other hoses for storage.
- The lubricant can be left in the container for the next lube job, with the exception of lubricants that set up like paint.

### **IMPORTANT:**

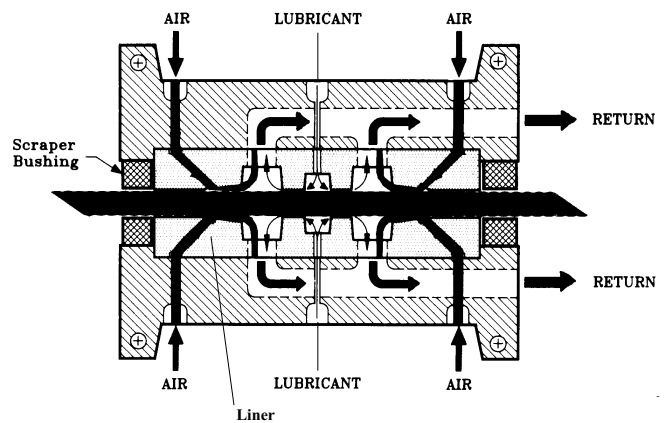
**If the lubricant used sets up like paint, it must be purged from the system after each use.**

Purge and clean the system with any petroleum oil, diesel fuel or kerosene.

### **WARNING:**

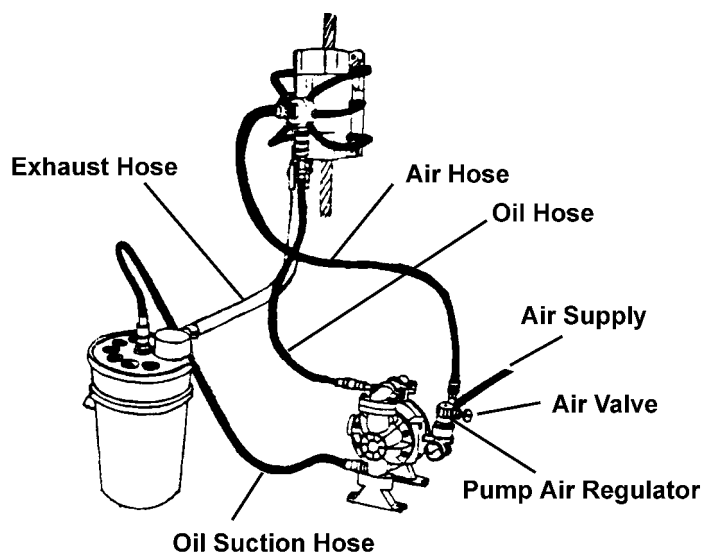
**DO NOT USE N-METHYLPYROLIDON** to purge or clean the Core-Lube System.

### HOUSING OIL & AIR FLOW



### CABLE LUBRICANT INFORMATION

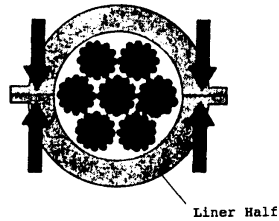
The Core-Lube System can apply a variety of wire rope lubricating oils, but it is not designed to apply grease or tar. Temperature has a dramatic change on the lubricants viscosity. In cold weather it is advisable to use a lighter lubricant. The lubricant must be able to run or flow through the exhaust hoses at lower temperatures.



## TROUBLE SHOOTING

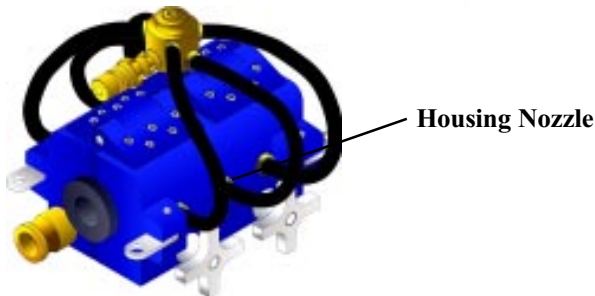
### \* If air escapes from the sides of the housing:

- Check for objects lodged between the sealing surfaces of the liner halves.
- The cable may be too large, preventing the liner halves from sealing properly. A larger size liner will be required.



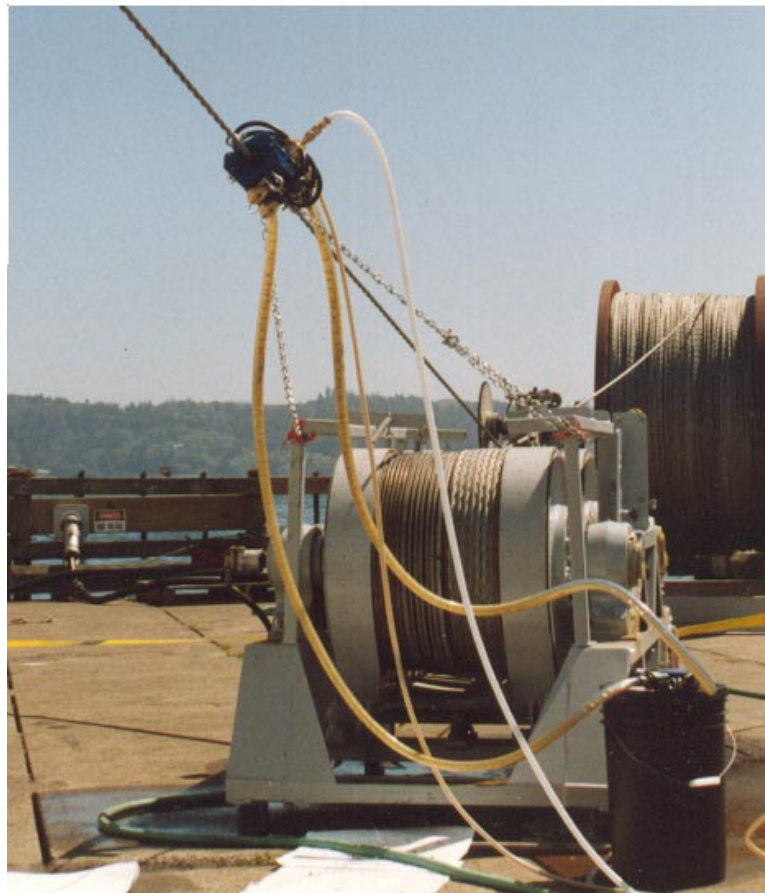
### \* Low Pump output volume:

- Check the suction strainer for blockage.
- The lubricant may be too thick because of cold weather, use a thinner oil or warm the oil to room temperature.
- Check housing nozzles for blockage.

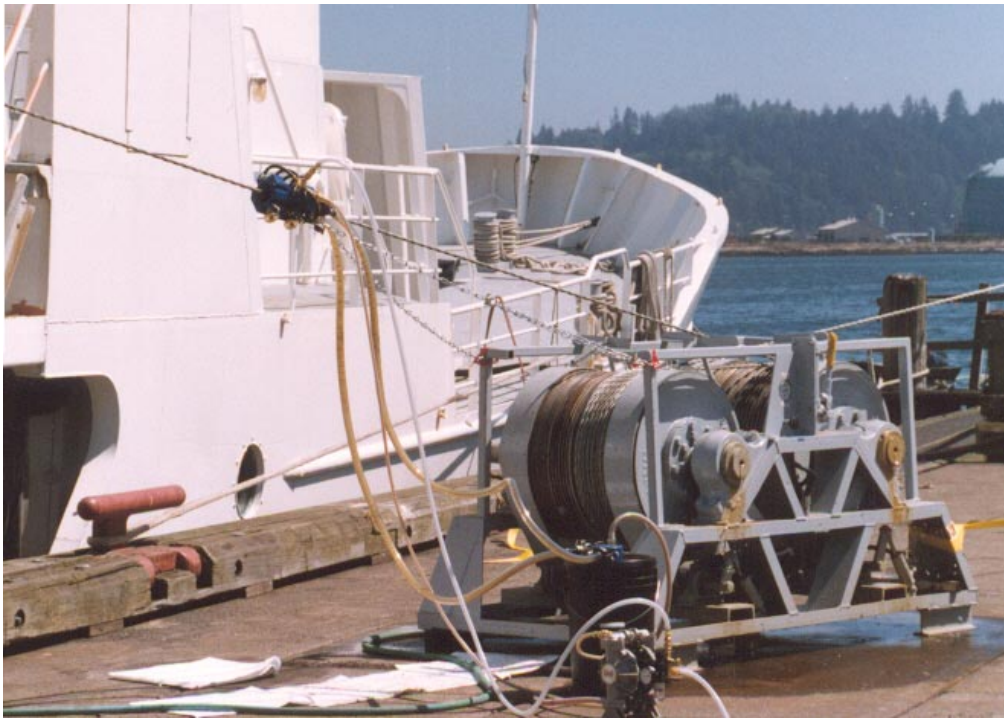


- Refer to pump Operator's Manual 66605X-X for more information.

**( FIGURE 3 )**



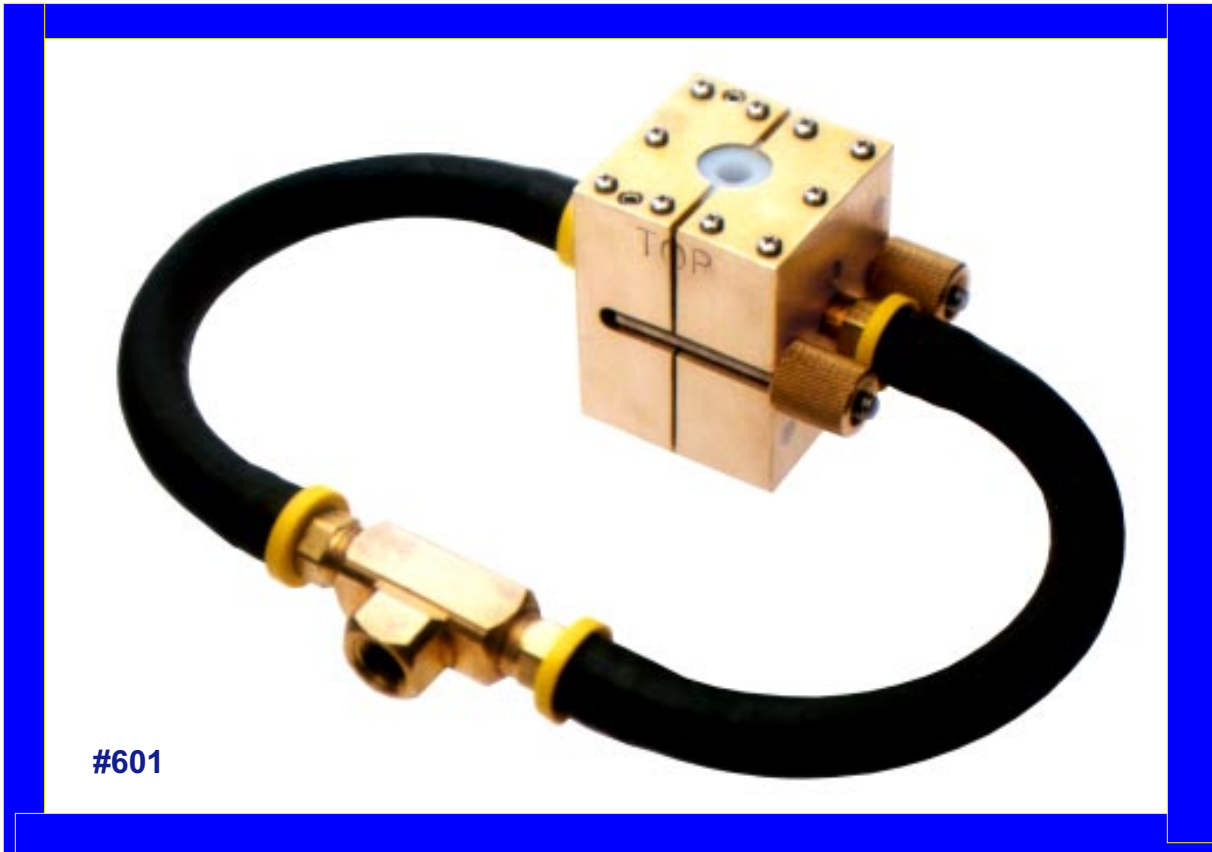
( FIGURE 4 )



( FIGURE 5 )

# CABLE AIR WIPER EQUIPMENT

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#601



**B&C WIRELINE LTD.**

Phone: 403-529-9645

Fax: 403-527-1369

E-mail: [corelube@telusplanet.net](mailto:corelube@telusplanet.net)

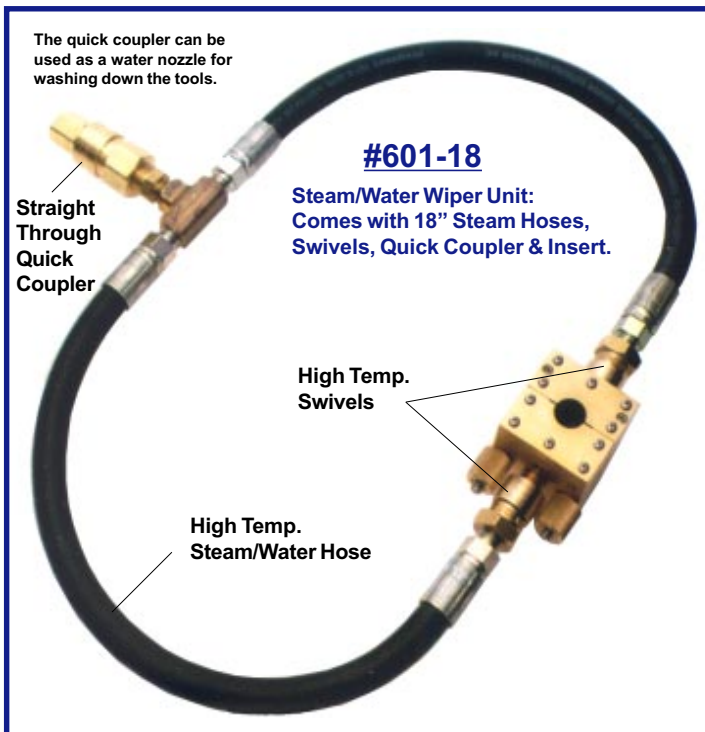
# CABLE AIR WIPER

## WIRELINE WIPER DIFFERENCES:

The difference between the Air Wiper and Steam/Water Wiper is the type of hoses, fittings and inserts used.

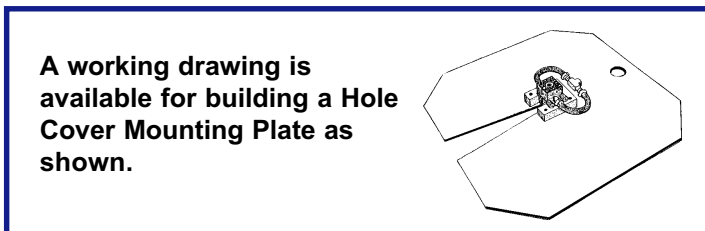
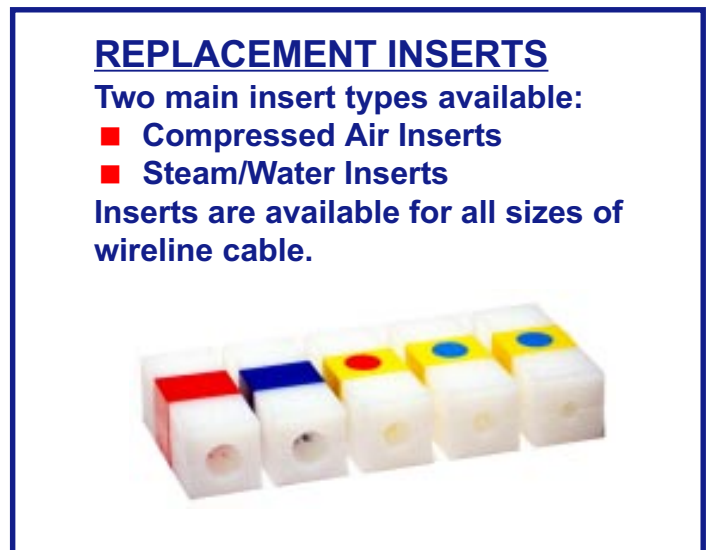
Replacement inserts are designed for either Air use or Steam/Water use and come in a wide range of sizes.

The main wiper block can be ordered with a variety of options such as Air Hoses, Steam Hoses, Mounting Disk, Couplers, Swivels, etc... See Parts & Price List for more information.



## WIRELINE WIPER ADVANTAGES

- Compact
- Quick to rig up.
- Long lasting abrasion resistant inserts.
- Can be left coupled around the wireline when running into the well.



**B&C WIRELINE LTD.**

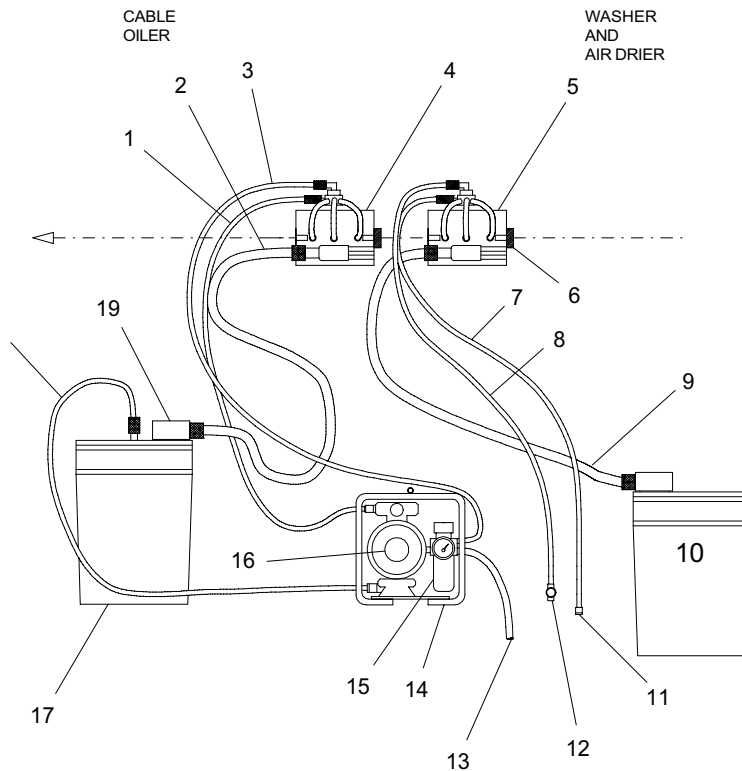
Medicine Hat, Alberta, Canada  
Phone: 403-529-9645  
Fax: 403-527-1369  
E-mail: [corelube@telusplanet.net](mailto:corelube@telusplanet.net)

# ( FIGURE 6 )

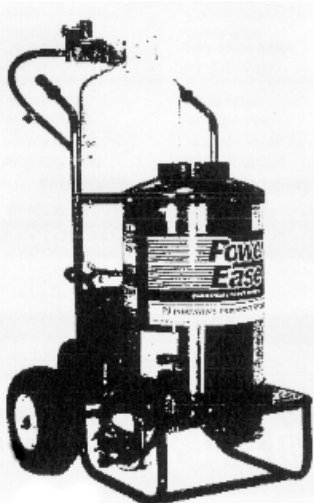
## CABLE OILER PRESSURE WASHER & AIR DRIER



The Core-Lube System comes complete with hoses with quick couplings, containers with filters, chains, shackles, pump and fittings.



- 1 OIL HOSE WITH QUICK COUPLINGS
- 2 RETURN EXHAUST OIL HOSE WITH QUICK COUPLINGS
- 3 AIR HOSE WITH QUICK COUPLINGS
- 4 OILER HOUSING
- 5 1500 PSI @ 2GAL./MIN. WASHER / AIR DRIER HOUSING
- 6 SCRAPER BUSHING
- 7 1500 PSI WATER HOSE WITH QUICK COUPLINGS
- 8 AIR HOSE WITH QUICK COUPLINGS
- 9 RETURN EXHAUST WATER AND AIR HOSE
- 10 CONTAINER & MANIFOLD
- 11 1/4"NPT FITTING
- 12 1/4"NPT FLOW CONTROL VALVE
- 13 AIR SUPPLY HOSE TO PUMP AND AIR SEALS ( NOT INCLUDED )
- 14 ALUMINIUM CAGE
- 15 AIR REGULATOR TO CONTROL PUMP OUTPUT FLOW
- 16 ARO PUMP
- 17 5 GAL. CONTAINER WITH FILTERS
- 18 SUCTION HOSE WITH QUICK COUPLINGS
- 19 EXHAUST MANIFOLD



**POWER EASE HOT WATER  
PRESSURE CLEANER  
Model: HW-1520EA1 DIESEL**

2.2 Gal./Min. water  
Operating Pressure: 1500 Psi  
150,000 BTU Input  
115/230VAC - 1PH -- HP2.0

**B&C WIRELINE LTD.**

Phone: 403-529-9645 Fax: 403-527-1369  
E-Mail: [corelube@telusplanet.net](mailto:corelube@telusplanet.net)



20 September 1991

**Hatfield Marine Science Center**

Attn: Mr. Kennard M. Palfrey  
Marine Superintendent  
Newport, Oregon 97365-5296

Dear Ken:

Enclosed are the laboratory notes and letter report on our findings regarding the effectiveness of the CORE-LUBE in penetrating your 3XI9 wire rope with Pre-Lube 19.

Very briefly, it certainly looks as though the Pre-Lube 19 totally penetrated to the surface of the king wire core of each cable bundle. I certainly was impressed as your cable was totally locked-up with debris in all the interstices. Definitely understandable after six years. The debris was not chemically analyzed but appeared to be composed of ferrous oxide (Brown/Black powder & glaze) and some zinc oxide (caked white powder). Some of the wires had that glazed black/brown oxide scale that one sees where zinc plating once was located. This black/brown glaze is some combination of iron and zinc oxides that occur with the 'salts' in ocean water - perhaps more properly called the halides. This glaze appears impervious (including Pre-Lube 19) but certainly has Pre-Lube 19 on its surface.

If I can be of further service Ken, just let me know. I'm going to attempt some 35 mm photos under the microscope and if successful I'll rush prints to you.

Very truly yours,

Allan R. Metzler, Sr.  
Vice President  
Technical Director

cc Laboratory Notes  
Report, Cable Dissection





LTR-468

## LABORATORY TEST REPORT

<b>CUSTOMER:</b> HATFIELD MARINE SCIENCE CENTER	<b>CONTRACT No.</b> _____
<b>TYPE OF TEST:</b> CABLE DISSECTION	<b>PMI JOB NO.</b> N/A
<b>START DATE:</b> 20 SEPTEMBER 1991	<b>COMPLETION DATE:</b> 22 SEPTEMBER 1991
<b>SPECIMEN TESTED:</b> 3 x 19 X 1/2" WIRE ROPE	

### PURPOSE OF TEST

Determine amount of penetration of Pre-Lube-19 into 3x19 wire rope as applied with the CORE-LUBE SYSTEM on August 22 1991 at HMSC, Newport, Oregon.

### DESCRIPTION

Pre-Lube 19 was applied to the cable at (30 - 60 Psig) with a cable speed of (50 -100 Ft/ Min.) with a re-spooling cable tension of 1200 -1500 pounds. A wire cleaning brush was used prior to the lubricating device.

### TEST RESULTS

Dissection showed 100% penetration of the Pre-Lube 19 to the center king wire surface in each of the three bundles of the 3x19x1/2" wire rope. (See attached notes.)

### COMMENTS

Dissection was performed one month after application, which allowed the Pre-Lube 19 to penetrate the scale and debris between each wire. Debris was iron and zinc oxides and other corrosion products unique to seawater operation.

**Prepared by:**

*Allen R. Metzler, Sr. Title: V.P., Tech. Dir. Date: Sept. 23, 1991*

**Approved by:**

*Allan R. Metzler, Jr. Title: Technical Ops. Mgr. Date: Sept. 23, 1991*

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( 1 )

26 September 1991



Outside Surface of 3 x 19 Wire Rope:

Individual Wires are 0.060" in Diameter. Glazed material Pre-Lube 19

Magnified 17.5 X  
Stereo Microscope Film, Kodak Gold  
ASA 200 Daylight Exposure 5 sec.

(Photo 00A)

This illustrates the complete "lack—up" of the individual armor wires due to debris. The flat "mushroom shape an the wire behind the whiter thread that looks like a whale tail is rust/ lubricant where a wire laid.



Outside Surface of 3 x 19 Wire Rope:

Same as above but reduced in magnification to 12.5 times.

Lubrication was done on 22 August 1991 and the dissection was done on 26 September 1991.

Film Kodak Gold with (ASA 200, 15 sec. exp.)

(Photo 3A)

Partially shows two of the 3 X bundles and where they bear upon each other. This is the flat "mushroom" shaped depression behind the white whales tail shaped thread in the middle of the photo.

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( 2 )



Outer Bundle Wire:  
0.058"- 0.060" OD.

Individual wire as shown in photos  
00A & 3A.

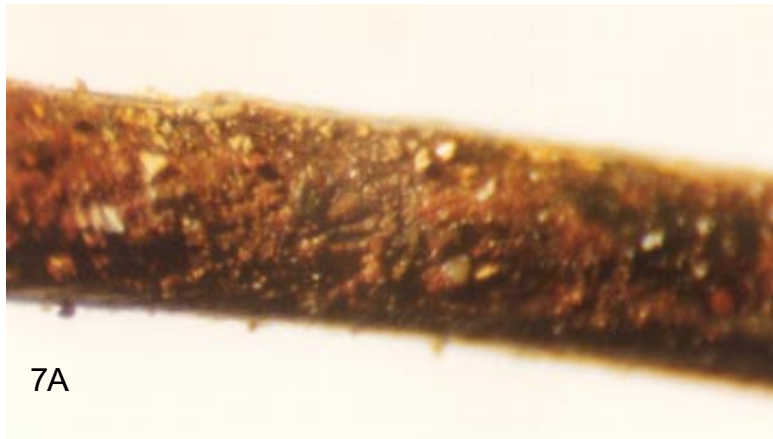
Nine (9) such wires around each  
bundle of the 3 x 19 wire rope.

Magnified 32.5 times

ASA 200, Exp. 8 sec.

(Photo 4A)

This outer armor wire, separated  
from the bundle shows lubricant  
totally around the wire after re-  
moval. This wire (typ. of 9) lays on  
top of an inner layer of 9 smaller  
wires. Debris sealed the inter-  
stices.



Inner Bundle Wire: 0.034"- 0.035"  
OD.

Typical of 9 such wires around  
inner king wire.

Magnified 32.5 times

ASA 200, Exp. 15 sec.

(Photo 7A)

The inner nine armor wires around the king wire were totally covered with liquid lubricant upon initial dissection (after 1 month). Smelled of Linseed Oil (Pre-Lube 19) & set-up (gummy) after (1) day exposure (air).

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( 3 )



Central King Wire:  
0.069 - 0.011 OD.

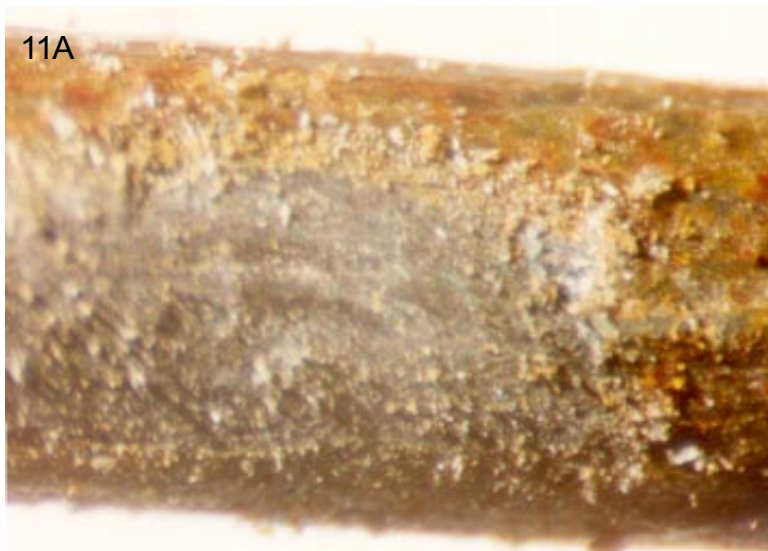
One center wire from one of the  
three bundles (3 x 19 wire rope.)

Magnified 32.5 times

ASA 200, Exp. 15 Sec.

(Photo 9A)

The central king wire was wet with  
lubricant upon dissection & had  
the linseed oil smell of Pre-Lube  
19. Black/Brown corrosion on the  
surface interstices with upper layer  
of armor completely blocked with  
debris.



Central King Wire:  
0.069" - 0.070" OD.

No Galvanizing.

Magnified 32.5 X

Dark area is steel.

(Photo 11A)

Shows king wire after scraping with a knife. Iron oxides mixed with "gummy" lubricant. Black stain/coating on wire possibly zinc & iron oxides. Some pitting 0.003" deep, at most on king wire.

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( 4 )



Outer Bundle Wires: (0.070" OD)

Another View

Magnified 20 times

Color Balanced using a Wratten 80B filter.

ASA 200, Exp. 40 sec.

(Photo 11B)

Showing the debris lock-up between armor wires. What appears as white powder are specular reflections from point sources of light in this time exposure. One salt crystal appears on the left, middle of photo.



Outer Bundle Wires: (0.070" OD)

Showing Space Between Two Adjacent Bundles.

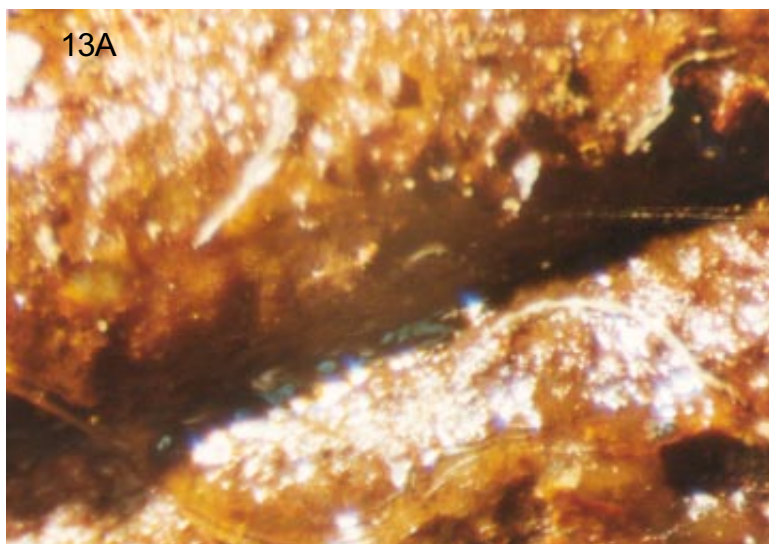
Magnified 35 times

Color Balanced (80B)

ASA 200, Exp. 30 sec.

(Photo 12B)

This view shows the spots where the third (and missing) bundle lay across the other two bundles. The "mushroom" debris can be seen surrounded by lubricant. A piece of "gummy" lubricant can be seen on the left, middle.



Outer Bundle Wires (0.060" OD)

Magnified 35 X

(Photo 13A)

Another section of the outer bundle wires (0.060" OD) showing the complete lock-up between wires by debris and corrosion products. These products were not analyzed but appear to be ferrous and ferric oxide and zinc oxide (a white powder's been observed that's not salt crystals).

The small white spots in this photo are specular reflections from clear or crystalline material due to the long exposure times. Some bits of debris (upper left corner) are re-crystallized salts from the seawater. The glazed, caramel-looking objects are polymerized pieces of Pre-Lube.

During dissection, at those cross-over points where one wire would bear on another wire, a bright, shiny spot was observed with Pre-Lube 19 both surrounding the spot and on the spot. These were the areas referred to as "mushrooms". These spots, more than any other areas showed that lubricant stopped the oxidation process for the month period from when lubrication was performed and when the dissection occurred.

One item remains to be determined and that is the influence pressure application had on penetrating the locked-up and clogged interstices. PMI will continue to perform tests to determine if oil pressure alone, at the time of lubrication, or capillary action of the Pre-Lube 19 into the porous debris over a months time caused the deep penetration to the king wire. Our opinion is that pressure forced the fluid to the core as the Pre-Lube 19 sets up in a few hours after exposure to air.

The end result, however, appears to be the same as the cable is protected from further corrosion.