Update from the National Science Foundation Wire Pool

Rick Trask

NSF Wire Pool Manager

UNOLS

UNIVERSITY-NATIONAL OCEANOGRAPHIC LABORATORY SYSTEM

Topics for discussion

- Synthetic Rope
- .681 Power Optic Cable

UNOLS
UNIVERSITY-NATIONAL OCEANOGRAPHIC LABORATORY SYSTEM

Synthetic Rope Update

UNOLS
UNIVERSITY-NATIONAL OCEANOGRAPHIC LABORATORY SYSTEM

Synthetic Rope

* 9/16” diameter Plasma HiCo 12 strand rope
* Two lengths purchased by the Wire Pool: 12,000 m and 10,000 m
* 12,000 m length on the *R/V Neil Armstrong* .681 Traction Winch and used during two coring cruises.
* 10,000 m length went on the West Coast Winch Pool DYNACON Traction winch for use during a coring cruise on the *R/V Thomas Thompson*

UNOLS
UNIVERSITY-NATIONAL OCEANOGRAPHIC LABORATORY SYSTEM

9/16” HiCo Plasma Usage

Ship	Armstrong	Thompson	Armstrong	Armstrong
Cruise	AR23-1	TT1811	AR36	AR37
Winch	Markey Traction	DYNACON Traction	Markey Traction	Markey Traction
Date	Oct 2017	Nov/Dec 2018	Sept 2019	Sept 2019
Number of Casts	25	41	8	4
Max line Out	5266 m	3825 m	2465 m	36 m
Max Tension	22,290 lbs.	20,000 lbs.	14,244 lbs.	4,437 lbs.

NSF-18-SYNT-002 Break Test Results Post TT1811

* 8700 m piece (10,000 m -1,300 m)
* Nominal Breaking Load: 37,900 lbs.
* Tested Breaking Load (New): 43,350 lbs.
* TBL after 38 coring ops: 45,750 lbs.

* 1300 m piece damaged due to slippage
* Nominal Breaking Load : 37,900 lbs.
* Tested Breaking Load (New) : 43,350 lbs.
* TBL: 85% of new TBL, 97% of NBL 36,790 lbs.

UNOLS
UNIVERSITY-NATIONAL OCEANOGRAPHIC LABORATORY SYSTEM

.681 Power Optic Cables

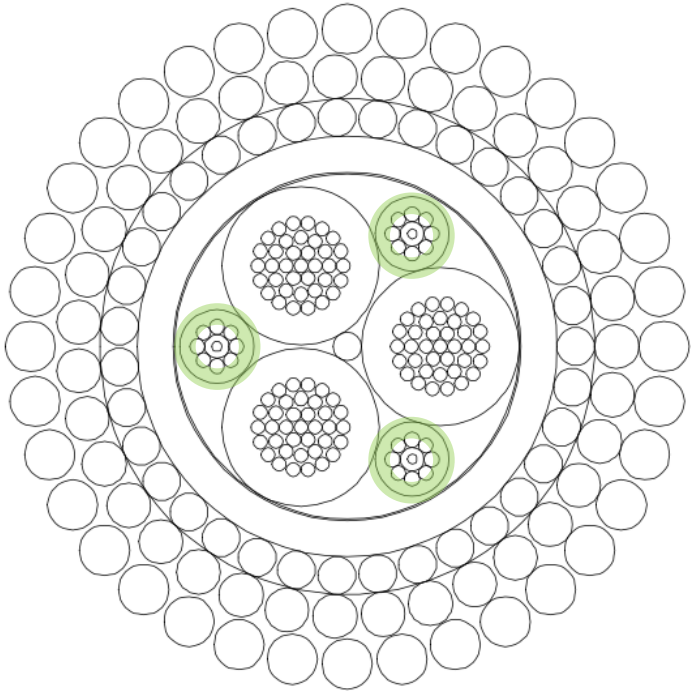
UNOLS
UNIVERSITY-NATIONAL OCEANOGRAPHIC LABORATORY SYSTEM

.681 Power Optic Cables

* Principal power optic cable currently available from the Wire Pool is .681” diameter.
* Used primarily with traction winches
* Use on direct drive winches has been attempted
* Having one cable design that can be used on both traction and direct drive winches is desirable.
* Apology in advance for showing too many cable cross sections.

Rochester A302351

Description	Inch	mm
ELEMENT A; Power Single (3)		
Cdr: #11 AWG, Hard-drawn Cu		
Ins: Polyethylene	0.156	3.96
ELEMENT B; Optical Steel-Light® (3)		
Fiber: 8.3/125/245 μm SMF		
Buffer: Hytrel®	0.024	0.61
Armor: 8/0.015" Plow Steel	0.054	1.37
Belt: Polyethylene	0.074	1.88
ASSEMBLY		
Core: Filler Rod	0.030	0.76
Layer 1: 3 Element B's with 1 Element A in each interstice. Void fill and tape.	0.344	8.74
Belt: Polyethylene	0.415	10.54
ARMORING		
1st Layer: 35 wires GEIPS	0.495	12.57
2nd Layer: 35 wires GEIPS	0.583	14.81
3rd Layer: 36 wires GEIPS	0.681	17.30

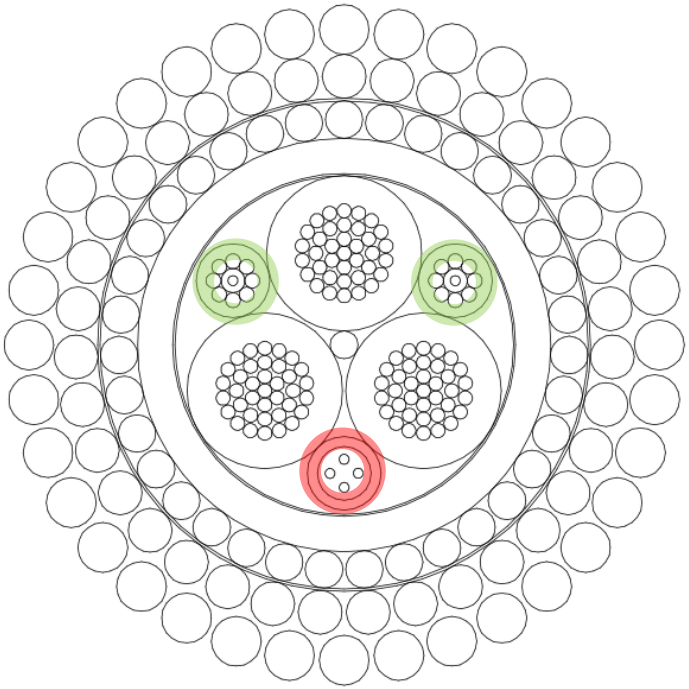


Optical Attenuation observed during spooling

Optical attenuation noted after 4500 m deep cast

Rochester A309063

Description	Inch	mm
ELEMENT A; Power Single (3)		
Cdr: #11 AWG (3.78 mm²) HD Cu	0.097	2.46
Ins: HDPE	0.156	3.96
ELEMENT B; Optical Steel-Light® (2)		
Fbr: 8.3/125/245 µm SM	0.010	0.25
Bffr: Hytrel®	0.024	0.61
Armr: 8/0.015" Plow Steel	0.054	1.37
Belt: HDPE	0.074	1.88
ELEMENT C; Optic Tube (1)		
Fbr: 8.3/125/245 µm SMF (4)	0.010	0.25
Tube: Type 304 SS	0.074	1.88
ASSEMBLY		
Core: Fill Rod	0.030	0.76
Layer 1: 3 A's with 2 B's and 1 C in interstices. Void filled and bound with Adh/Poly tape.	0.344	8.74
BELT		
HDPE	0.415	10.54
STRENGTH MEMBER		
Layer #1: 35/0.0375" GEIPS	0.495	12.57
Layer #2: 35/0.044" GEIPS	0.583	14.81
Layer #3: 36/0.050" GEIPS	0.681	17.30



Same design is on a spare DSL Rapp Winch drum

Same design is on the R/V Atlantis Traction Winch

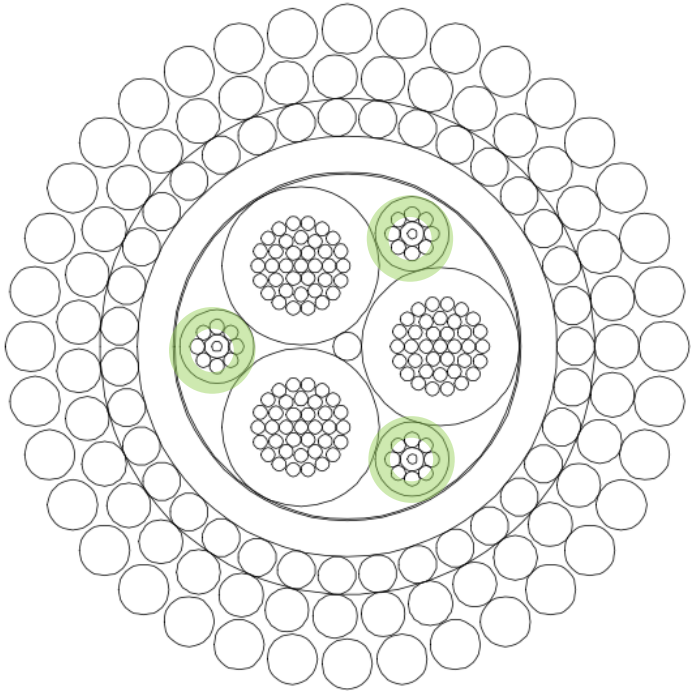
Used on a direct drive winch by Ocean Exploration Trust

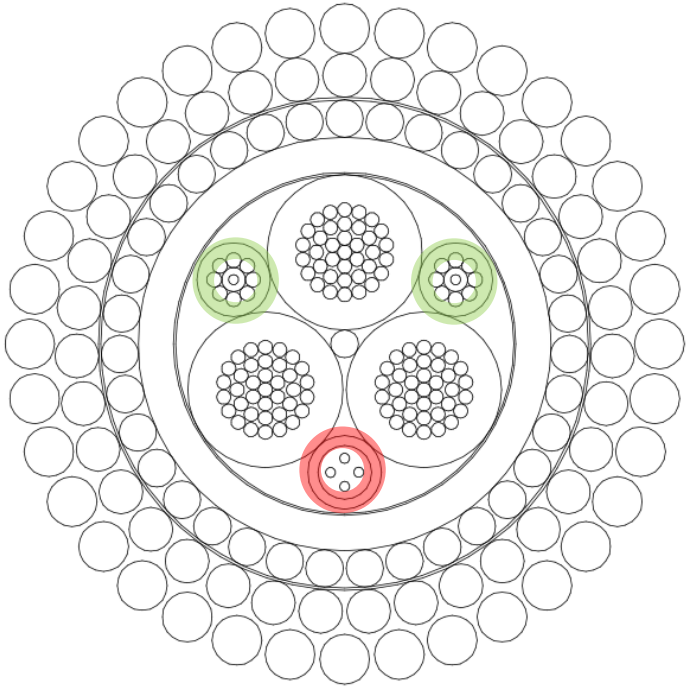
Used successfully for three seasons

Failure due to an electrical short between Cu conductor to steel tube

Failure occurred during the mid water recovery haul in (around 2000 m of cable out) at the end of a series of dives to nearly 4000 m on a 4500 m cable

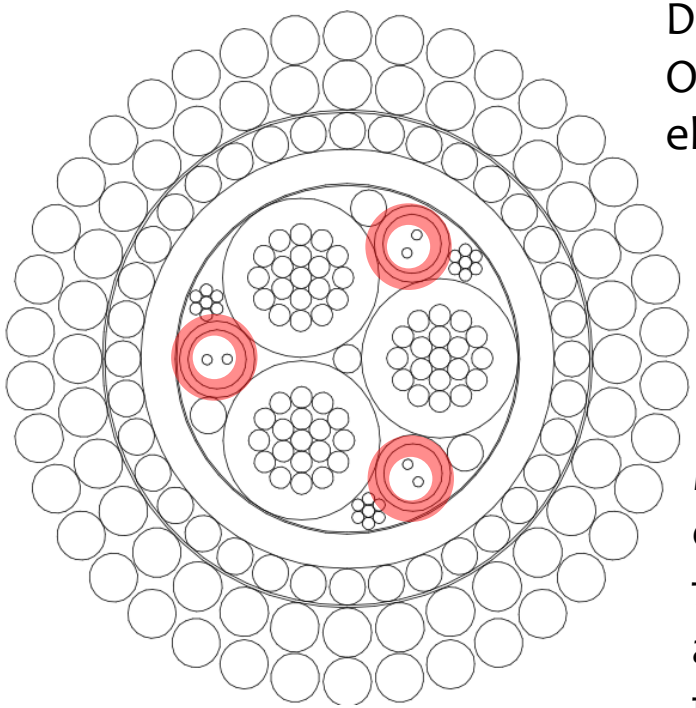
A302351 and A309063





Rochester A309960

Description	Inch	mm
ELEMENT A; Power Single (3)		
Cdr: #11 AWG (4.3 mm²) HD Cu	0.102	2.59
Ins: XLPE	0.156	3.96
ELEMENT B; Optic Tube (3)		
Fbr: 8.2/125/242 μm SM (2)	0.010	0.25
Tube: Type 304 SS	0.074	1.88
ASSEMBLY		
Core: Fill Rod	0.030	0.76
Layer 1: 3 A's with 3 B's, 3 drain wires, and 3 fill rods in interstices. Void filled and bound with Al/Poly and Adh/Poly tapes.	0.346	8.79
BELT		
HDPE	0.411	10.44
STRENGTH MEMBER		
Layer #1: 36/0.0360" GEIPS (Void filled)	0.488	12.40
Layer #2: 32/0.0485" GEIPS	0.585	14.86
Layer #3: 38/0.0488" GEIPS	0.681	17.30

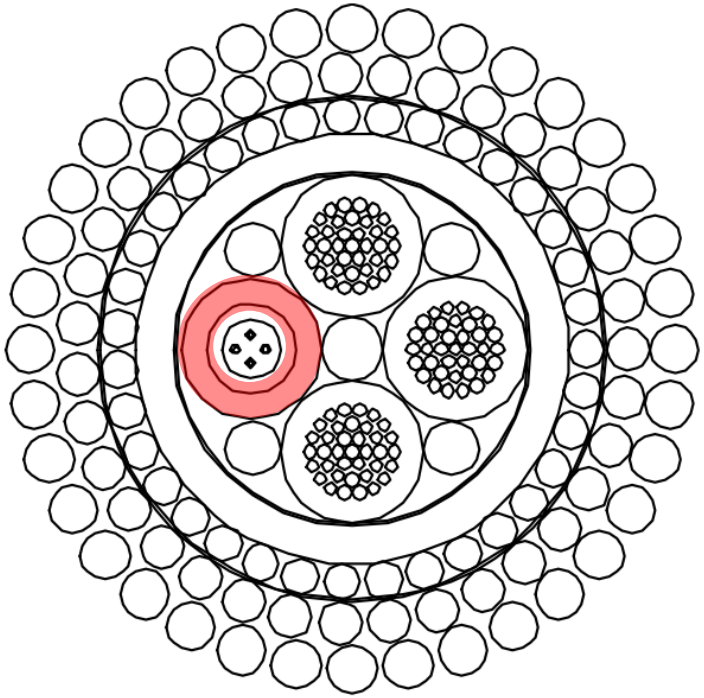


During installation by OET cable failed electrically.

Manufacturer sees evidence that the failure occurred as a result of the way the cable was being wound.

Rochester A710429

Description	Inch	mm
ELEMENT A; Power Single (3)		
Cdr: #11 AWG (3.78 mm²) HD Cu	0.097	2.46
Ins: XLPE	0.141	3.58
ELEMENT B; Optic Tube (1)		
Fbr: 8.3/125/245 µm SM (4)	0.010	0.25
Tube: Type 304 SS double wall	0.095	2.41
Belt: EPC	0.141	3.58
ASSEMBLY		
Core: Fill Rod	0.063	1.60
Layer 1: 3 A's and 1 B with 4 fill rods in interstices. Void filled and bound with Adh/Poly tape.	0.348	8.84
BELT		
HDPE	0.415	10.54
STRENGTH MEMBER		
Layer #1: 35/0.0375" GEIPS Void Filled	0.493	12.52
Layer #2: 35/0.0440" GEIPS	0.581	14.76
Layer #3: 36/0.0500" GEIPS	0.681	17.30



Fibron RM0049

Assembly Detail:

A) 3 off dual layer insulated 5 mm² stranded plain copper power conductors,(U_0/U = 2.6/4.5 kV_{rms} max.)

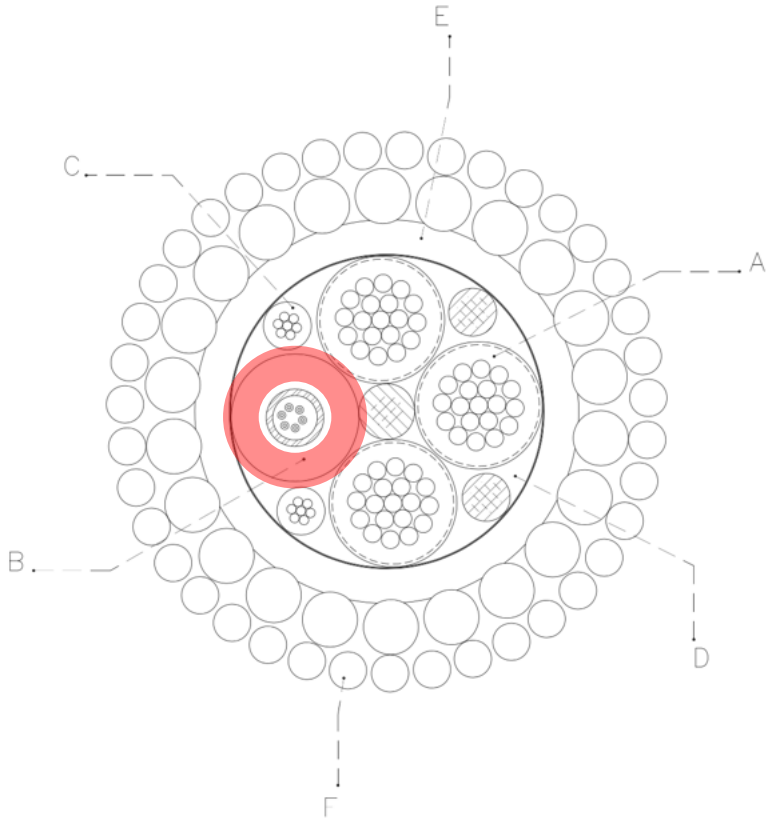
B) 1 off jacketed, gel filled stainless steel tube containing 6 x single-mode optical fibres.

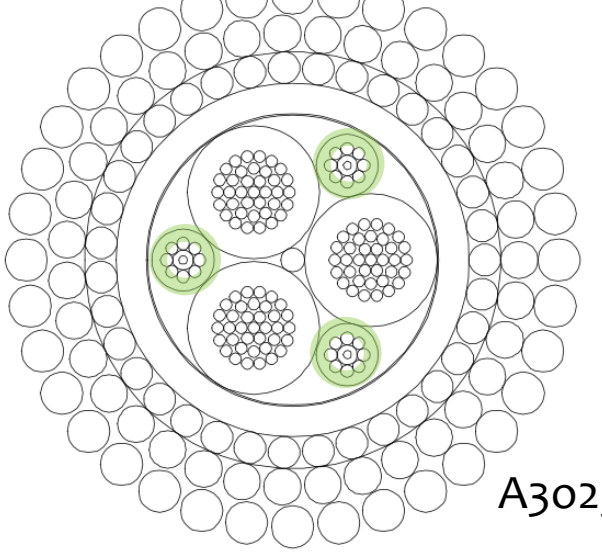
C) 2 off polyethylene insulated 0.5 mm² stranded plain copper earth conductors.

D) Assembly voids filled with silicone rubber compound.

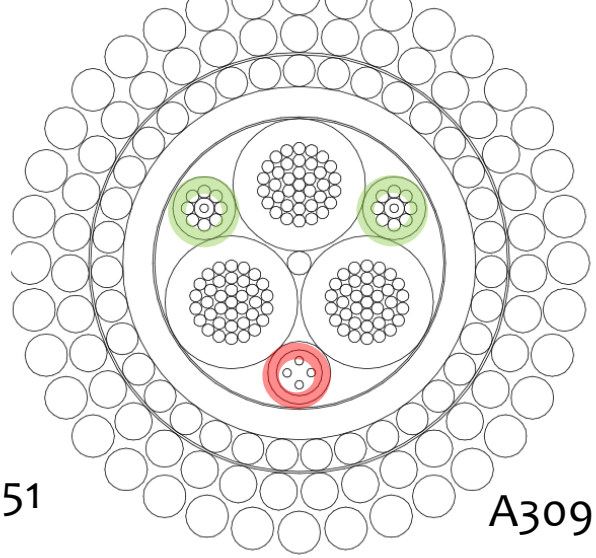
E) Polyethylene sheath, (1.1 mm nominal thickness).

F) Two dressed, contra-helical layers of high tensile galvanised steel wire armour.

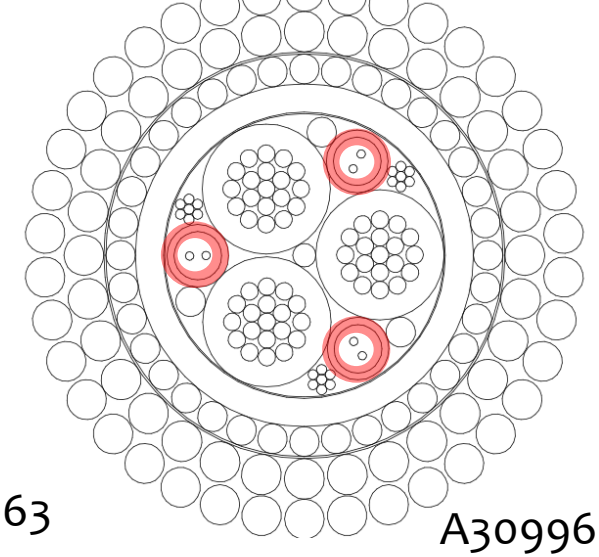




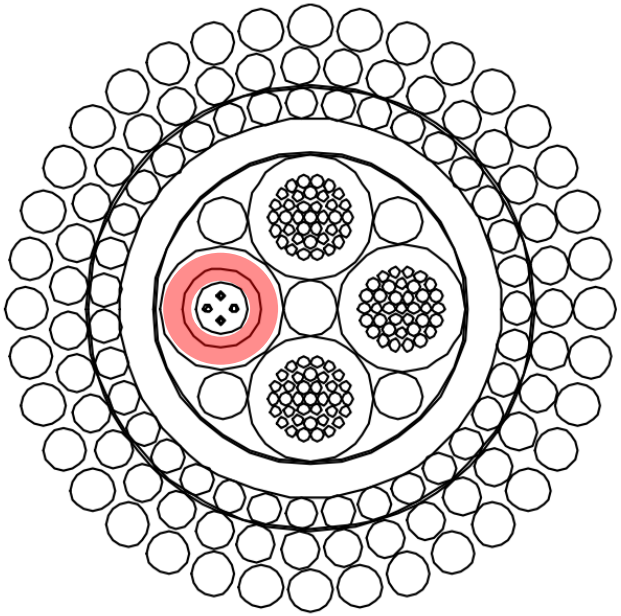
A302351



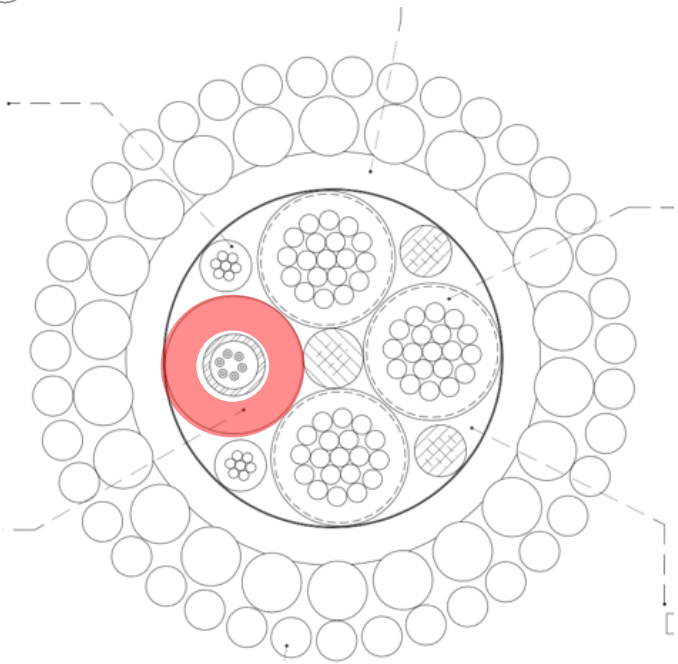
A309063



A309960



A710429



RM0049

Planned testing of the A710429 and RM0049

Desire to use .681 Power Optic cable on portable direct drive winches.

Enables expedited mobilization on smaller vessels.

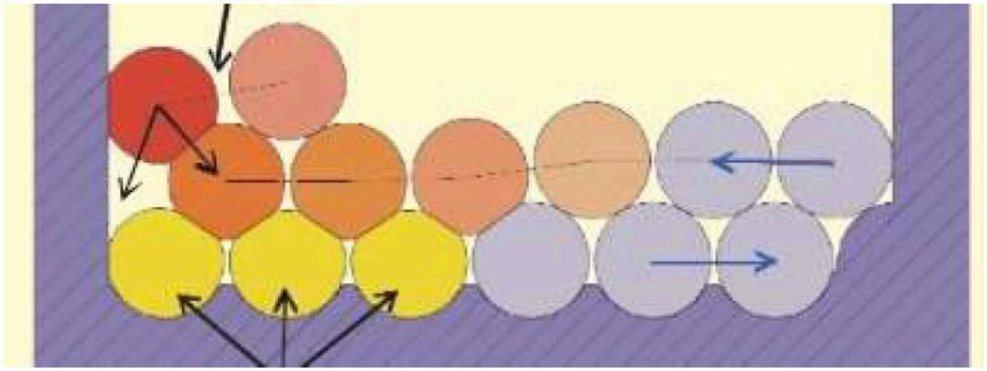
Determine if the cable is capable of withstanding radial crushing loads imparted on bottom layers of cable (near the drum) by successive layers on top.

Evaluate two prototype cables.

Testing to be done at Tension Member Technology in Huntington Beach, CA.

Layer Transition Crush

* Worst case crushing scenario
* Third layer from the drum which runs along the cheek
* The first wrap of the third layer is the least supported wrap on the drum.
* Knifes in and experiences worst case crush pressure



Credit to Lebus Inc.

Layer Transition Crush Test

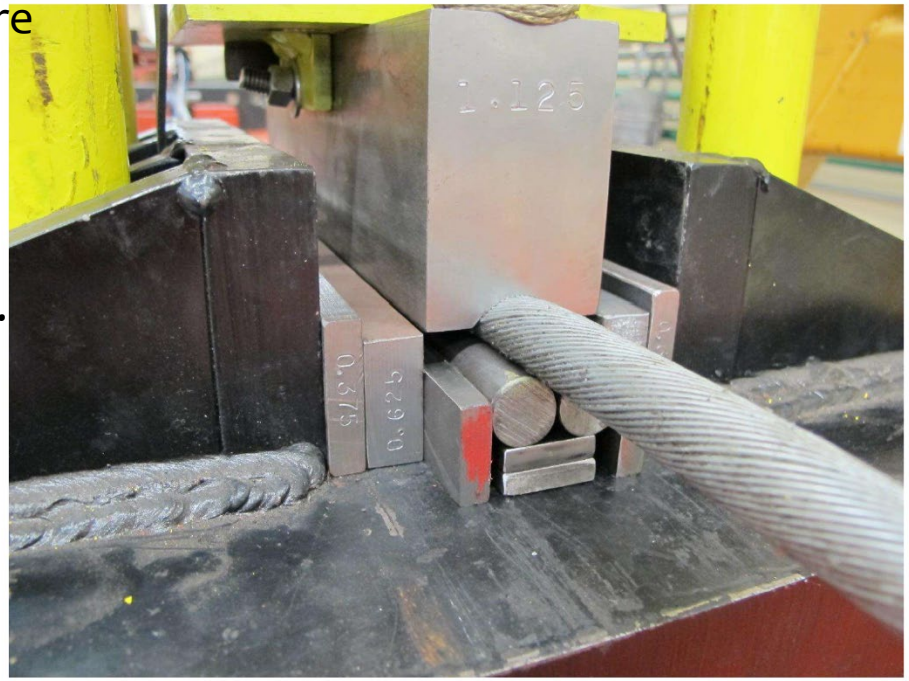
Short length under working tension.

Cable is pushed down by the 10” long U-grooved shoe to create the radial pressure

Crushed against 2 parallel bars of cable dia.

Spacing between the bars is increased until the gap is approx. 75% of the cable dia. This simulates the gap between the cheek and the second layer wrap.
Crush load can be increased.

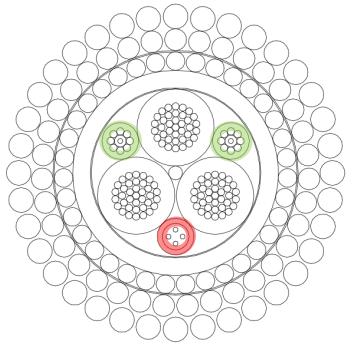
Run current through conductors to bring polymer core up to a temp that TMT calculates it would experience buried in the third lay while under peak operating current.



Credit to TMT Laboratories

Test Validation

* Rochester A309063 will also be tested since it has suffered one well documented case of conductor to FIST electrical short.
* Failure occurred on the OET direct drive DYNACON
* Failure traced to the general area of the 2nd to 3rd layer transition.
* A309063 has both Steel-Light® which have experienced reversible attenuation and a FIST which shorted with a conductor during use on a direct drive winch.



A309063

Summary

* Plasma HiCo continues to be used for coring with fair results.
* There is more than one .681 cable in use in the fleet.
* Two .681 designs are being tested for suitability with direct drive winches.
* What we learn from the .681 tests may be applicable to other power optic cables that are used on direct drive winches such as next generation hydrographic cables as planned for the RCRVs.

Thank you