RVTEC 2023
23-27 October
Honolulu, Hawaii

What's New in Appendix A of the Research Vessel Safety Standard

Rick Trask
NSF Wire Pool

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Discussion Topics

- Scope of Appendix A
- Tension members covered by Appendix A
- Steel wires and cables
  - Change in operational requirements for 9/16” Wire
  - Testing Steel wires and cables
- Wire Logs for both Steel and Synthetic Tension Members
- New Synthetic Sections
  - Appropriate factors of safety
  - Tension member evaluation
    - Testing
    - Visual inspection

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Appendix A of the RVSS

Revisions approved in June 2023 to RVSS Edition 11

Section A.0

"The purpose of this appendix to the RVSS is to establish safe and effective operating limits for overboard handling systems (OHS) used on ships in the Academic Research Fleet, where tension members may be loaded beyond traditional shore-side limits."

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Overboard Handling System Defined

Section A.2.16

OHS features a tension member coupling the object and the vessel, and payed beneath the surface of the water.

Systems used to:

- Tow objects
- Lower objects beneath the surface of the water
- Retrieve objects from beneath the surface of the water

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Photo by B. Van Mooy on R/V Knorr

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Tension Members covered by Appendix A

Section A.0

- Tension members covered by Appendix A include:
  - Those purchased and distributed by the NSF Wire Pool
  - Tension member(s) used as part of an OHS* that were acquired independently by the vessel
  - Tension members brought on board by any science party or outside organization that are to be used as part of an OHS.

Wire rope, cable, synthetics provided by any member of the science party, Winch Pools, tension members on loan from the Wire Pool etc.

The specific requirements for steel tension members depend on the factor of safety with which they will be used as defined in tables A.8.1 through A.8.4. Specific requirements for synthetics appear in Section A.8.3 and table A.8.5.

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*Overboard Handling System

Steel Wires and Cable

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Revised Operational Requirements
9/16” Wire Rope with Sheaves Grooved for .681 Cable

- Previously
  - To use 9/16” WR with $1.5 \leq FS < 2.5$
  - Minimum sheave diameter = 26” and groove diameter between .576” and .618”
- Reality:
  - 9/16” WR over-boarded using the same sheaves designed for .681 cable
  - Sheave diameter ≥27” and groove diameter between .698” and .748”
  - With this configuration 9/16” WR limited to operating with a FS ≥ 2.5 or seek waiver
- Currently
  - Testing Confirmed
  - 9/16” WR can be used $1.5 \leq FS < 2.5$
  - Sheaves grooved between .576” and .748” as long as the sheave diameter ≥27”

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Testing Steel Tension Members

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Responsibilities for Determining TBL of Tension Members

- Vessel Operator
  - Submit Break Test Request (BTR) via vessel's wire database
  - Send sample to the Wire Pool, labelled with NSF identifier w/ a copy of BTR
  - Submit the corresponding Tension Member Log and Lubrication Log*
- Science Party or outside organization intending to use their own tension member
  - Evidence of a current break test, consistent with the provisions of Appendix A
  - Provide that information to the vessel.
- Wire Pool
  - Conduct the break test and associated tests
  - Provide a copy of the TBL test results to the vessel operator primarily via the NSF Wire Pool Database. Email notification that new results are available.

* Recommend using the NSF Wire Pool Database to meet this requirement

Testing Steel Wires and Cables

- **Break test frequency depends on the factor of safety**
  - **SF ≥ 2.5 : Test every 2 years**
  - **1.5 ≤ SF < 2.5: Test annually**
- **Submit a break test request via the Wire Pool database**
  - **Send a 7 m sample w/ AT LEAST ONE END TERMINATED WITH FITTINGS USED IN THE FIELD to the Wire Pool. Accompany each sample with a printout of the corresponding break test request.**
  - **Sample from the new working end not the previous working end**
- **Submit the wire log via the Wire Pool database**

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Tension Member Logs (Applies to all tension members)

- RVSS Appendix A, Minimum Log Requirements Include:
  - Tension Member Identifier, e.g. NSF-18-C165
  - Winch manufacturer and model, e.g. Hawboldt SPRE-2640
  - Record of all spooling operations and cutbacks including re-terminations.
  - Sheave train description
    - No. of sheaves between winch and water
    - All sheave dimensions including “D” root diameter and “w” groove width.
  - Number and/or duration of deployments since last break test.
  - For EACH deployment:
    - Maximum tension during cast
    - Wire out* at time of maximum tension
    - Maximum wire out for each deployment

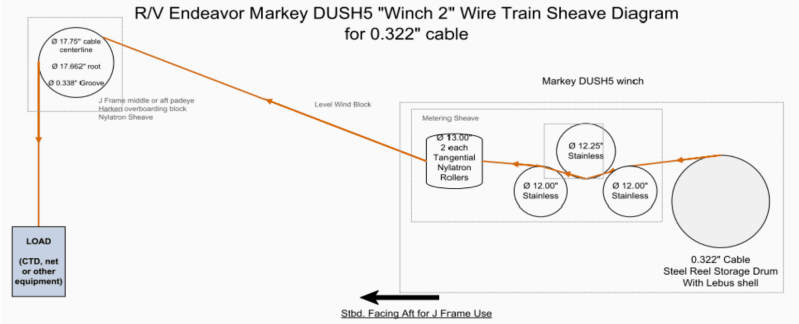
The vessel’s UNOLS Wire Database is configured to facilitate the entry of all the log requirements, including cutbacks, lubrication, updating wire length, uploading an associated file (e.g. log), entering comments.

Log Example

(with fictitious data)

Tension Member Identifier e.g NSF-XX-CXXX	NSF-19-C187
Winch Manuf. and model: e.g.Hawboldt SPRE-2640	WINCH 2, MARKEY DUSH 5

Sheave Train Description:



Cruise No.	Date	Cast #	Cable Length [m]	Max Tension lbs.	Wire Out at Max Tension [m]	Wire In at Max Tension [m]	Max Wire Out [m]	Notes
EN-014	3-Jul-20	1	9855	4398	2800	7055	3000	
EN-014	4-Jul-20	2	9855	3500	1500	8355	1500	
	30-Jul-20		9848					7 m sample cut for Wire Pool
EN-015	21-Aug-20	1	9848	3042	1450	8398	1500	
EN-015	27-Aug-20	2	9848	5345	10	9838	100	
EN-015	29-Aug-20							Cut back 47 m due to tension spike
EN-015	29-Aug-20	3	9801	3495	1700	8101	2000	
EN-015	30-Aug-20	4	9801	4398	2800	7001	3000	

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Synthetic Tension Members

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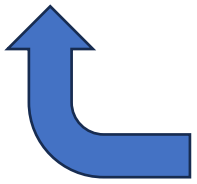
Synthetic Tension Members

Determining appropriate factors of safety (Section A.8.3.1)

A factor of safety of 5.0 or greater and D/d ratio = 40 is required along with the provisions detailed in Table A.8.5.

With adequate tension member history, details of the proposed operation and over-boarding configuration and anticipated loading the manufacturer can be consulted to determine if a lower factor of safety can be safely used during the proposed operation.



PLAN ACCORDINGLY!

THIS TAKES A LOT OF TIME

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Information required for evaluating operations where a factor of safety <5 is needed.

- A comprehensive log with all previous deployments
- Number of sheaves encountered during the over-boarding operation (including traction head sheaves)
- Tread diameter of all sheaves encountered
- Groove diameter of sheaves encountered
- Science Requirements
  - Dry and wet weights of gear to be deployed
  - Weight of sample(s) to be collected
  - Anticipated total static load during the proposed operation (deployed gear plus samples plus any transient loads [e.g. core pull out loads]

Synthetic Tension Member Evaluation

Testing Synthetic Ropes

- **Samples requested before and after each cruise when synthetic is utilized**
- **Sample prior to its next use can be taken from the working end.**
  - **Provides a reasonable pre-use condition, by considering any deterioration that may have occurred while in storage, e.g. environmental conditions, hot work, oils, grease contamination etc.**
- **At the conclusion of its use, a sample from the extreme working end is NOT representative of the rope's condition.**
  - **Sample from a section that has gone around all the sheaves while under load.**
  - **Sample location and length will vary from ship to ship.**
  - **Provides a post-use condition.**
  - **Contributes to determining to what degree the use has affected rope life.**

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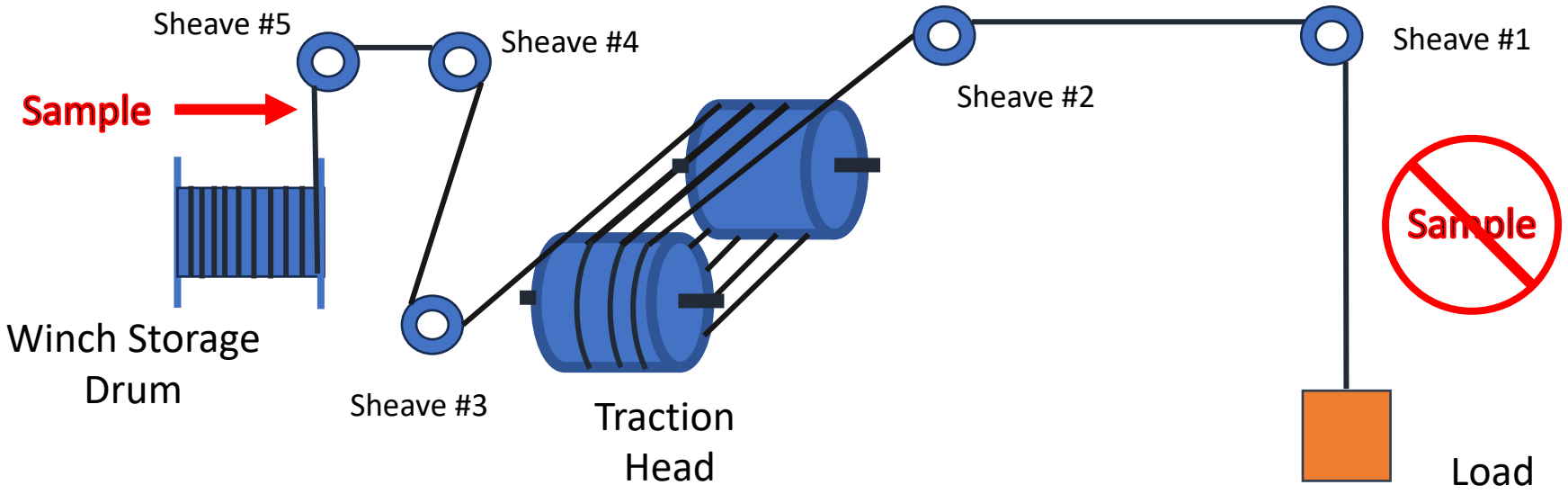
Post Cruise Synthetic Sample Location



Sample taken between the load and sheave #1 has not encountered all the components that contribute to degradation.

Sample should be taken between Sheave #5 and winch storage drum

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Synthetic Tension Member Evaluation

Visual Inspection

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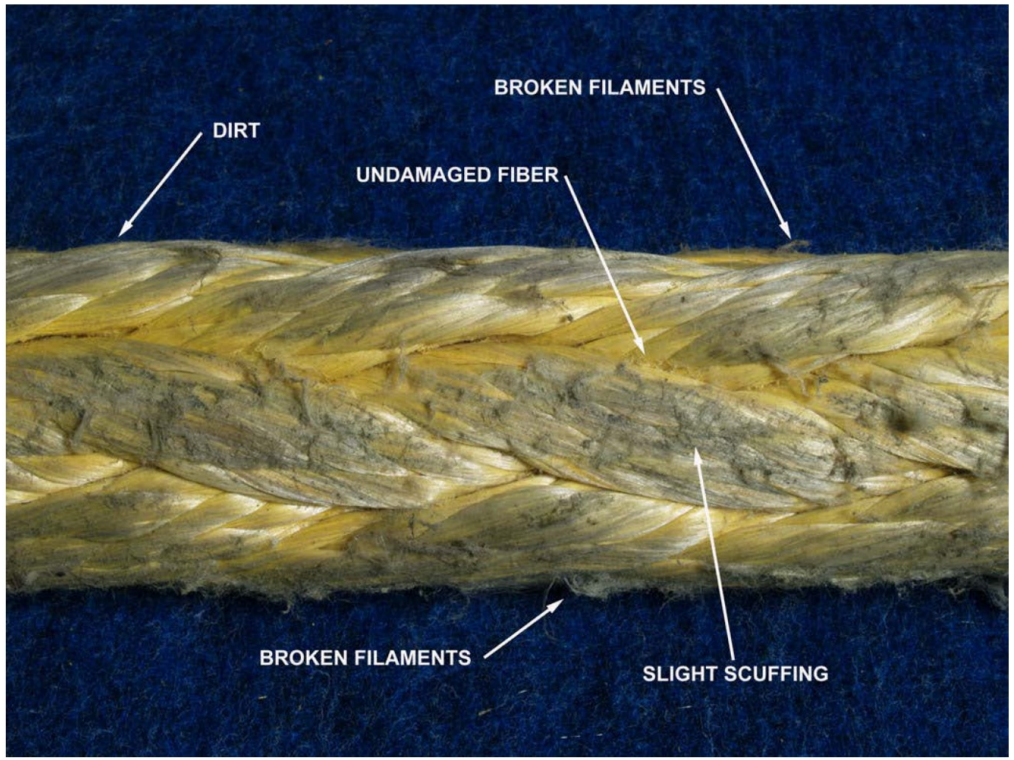
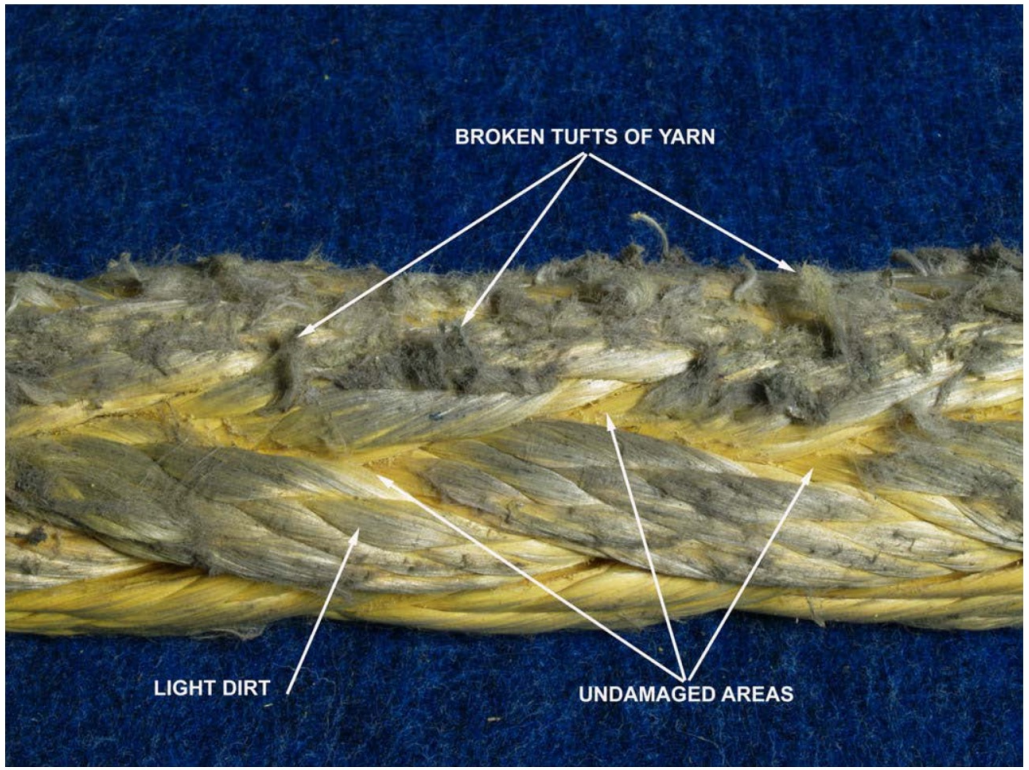
Surface Abrasion

Tearing or wearing of surface filaments
New rope, put in service, slightly fuzzy over entire surface, to be expected.
Isolated areas of extensive abrasion is not normal

Slight external abrasion on rope surface



Example of moderate surface abrasion

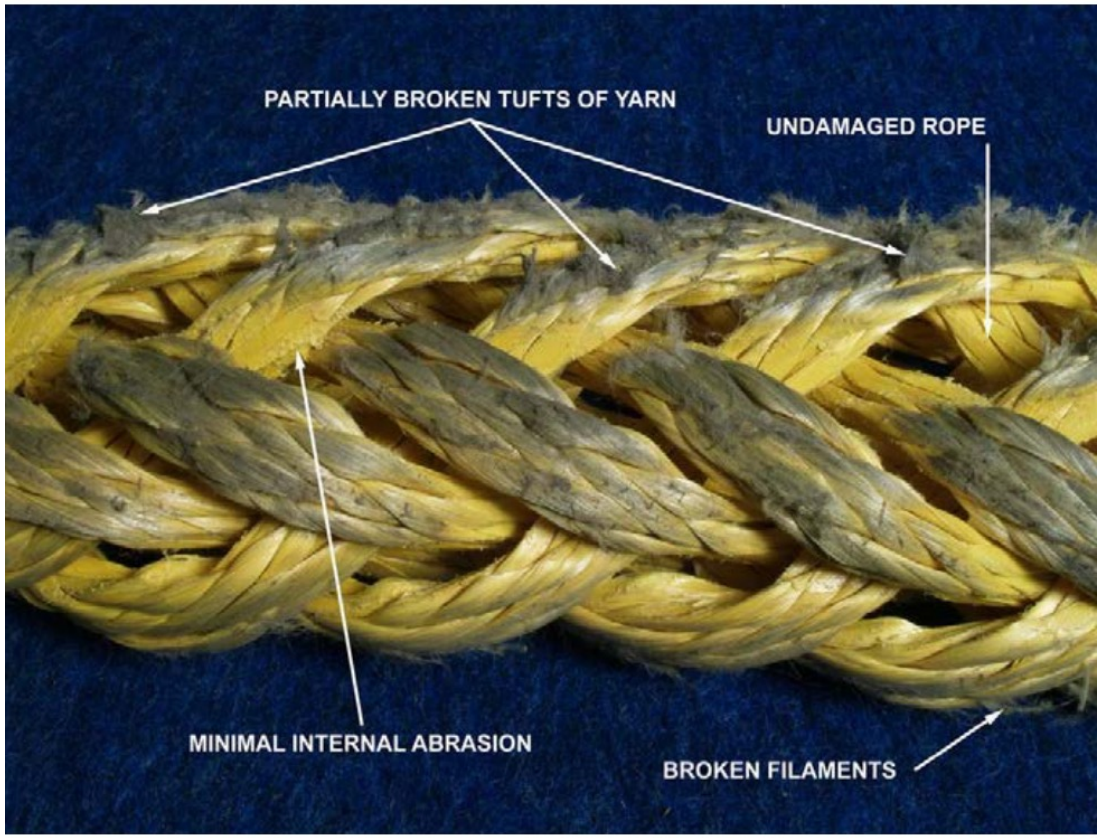


Moderate Abrasion indicates an approximate strength loss of about 10%

From Cortland Document: Plasma and BOB Tugger Winch Rope Usage, Inspection and Repair Manual, Doc No. ETN-031

Internal Abrasion

Example of moderate external damage but minimal internal damage



From Cortland Document: Plasma and BOB Tugger Winch Rope Usage, Inspection and Repair Manual, Doc No. ETN-031

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Cuts

Even squared off fiber ends at point of damage
Extent of damage depends on depth, will reduce strength, rope may become unbalanced.

Partially cut strand

From Cortland Document: Plasma and BOB Tugger Winch Rope Usage, Inspection and Repair Manual, Doc No. ETN-031

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Pulls

Object snags a yarn or strand and pulls it away from rope surface forming a loop. Attempt to work the pulled strand back

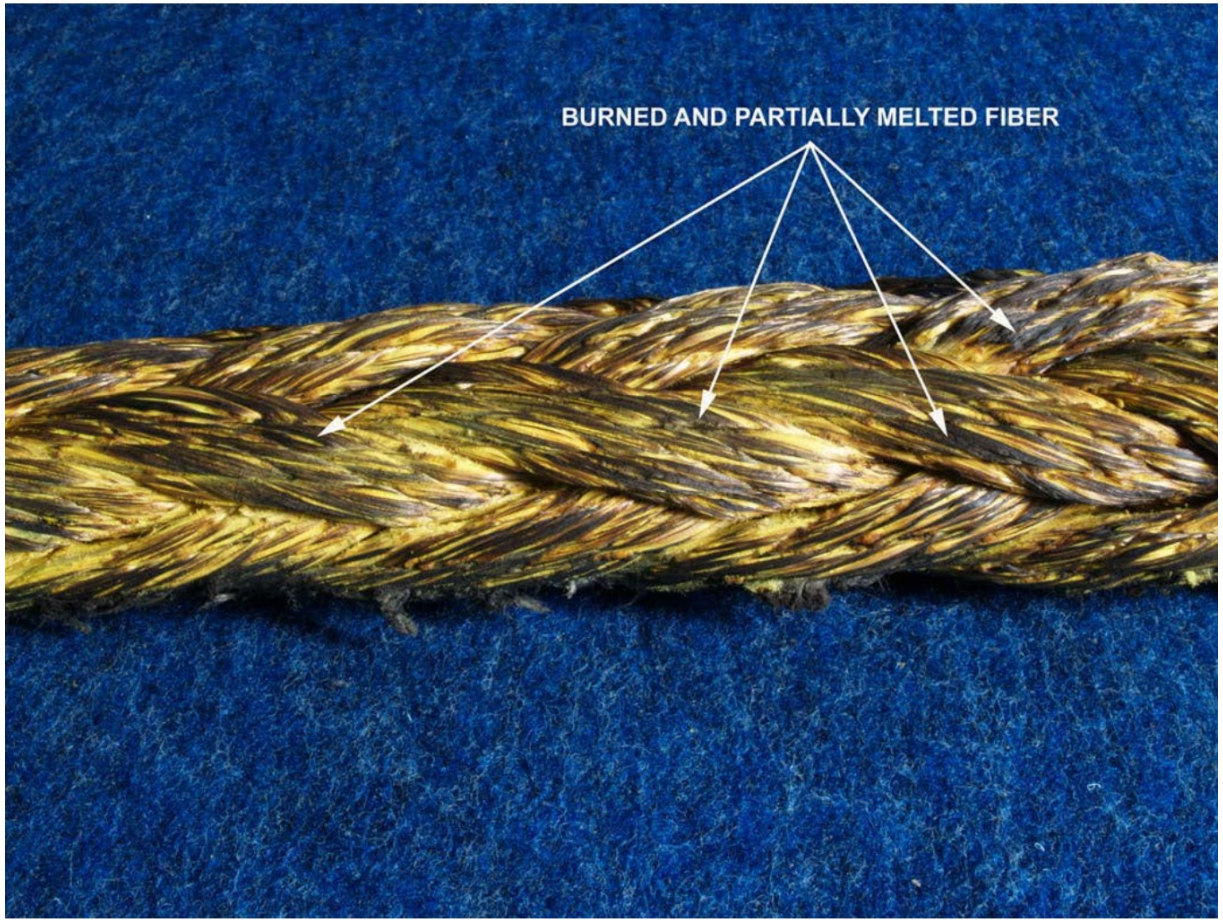
Pulled strand

From Cortland Document: Plasma and BOB Tugger Winch Rope Usage, Inspection and Repair Manual, Doc No. ETN-031

Burns

All synthetic fiber can melt due to frictional heating.
Glassy fused area on the rope's surface.

Example of burned and partially melted fiber



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Uneven diameter

Distortion, significant diameter change, inconsistency in overall measurements will decrease the performance of the rope.

From: Samson Rope User's Manual, Guide to Rope Selection, Handling, Inspection and Retirement, Page 48

Contaminants

- Abrasive contaminants such as sand blast grit or rust can damage internal fibers.
- Exposure to common chemicals, and petroleum products should be avoided.
- Discoloration with suspected chemical exposure are reasons for removal.

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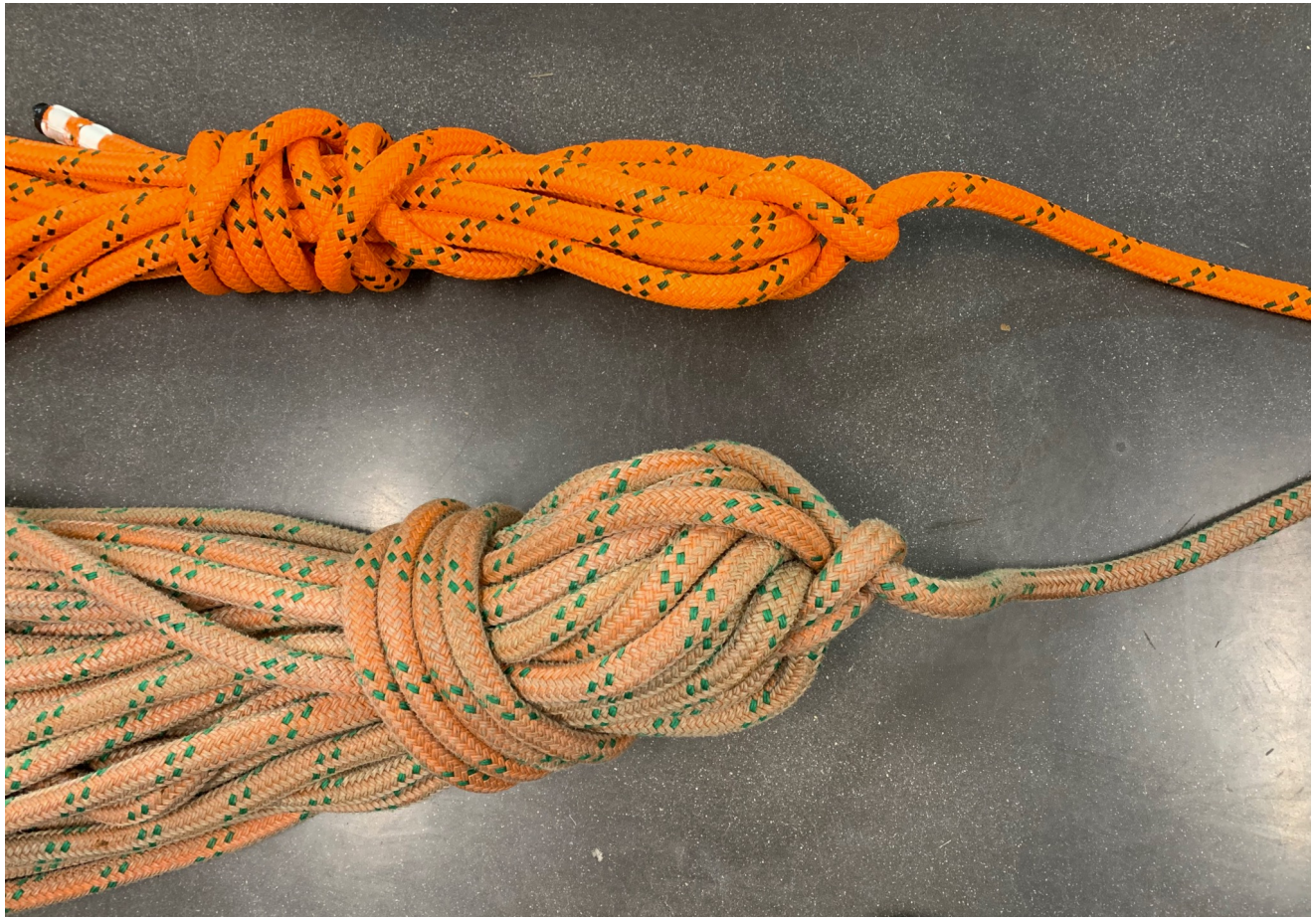
Discoloration

UV exposure tends to cause discoloration. Long periods of exposure will decrease the overall strength. Chemicals may cause discoloration



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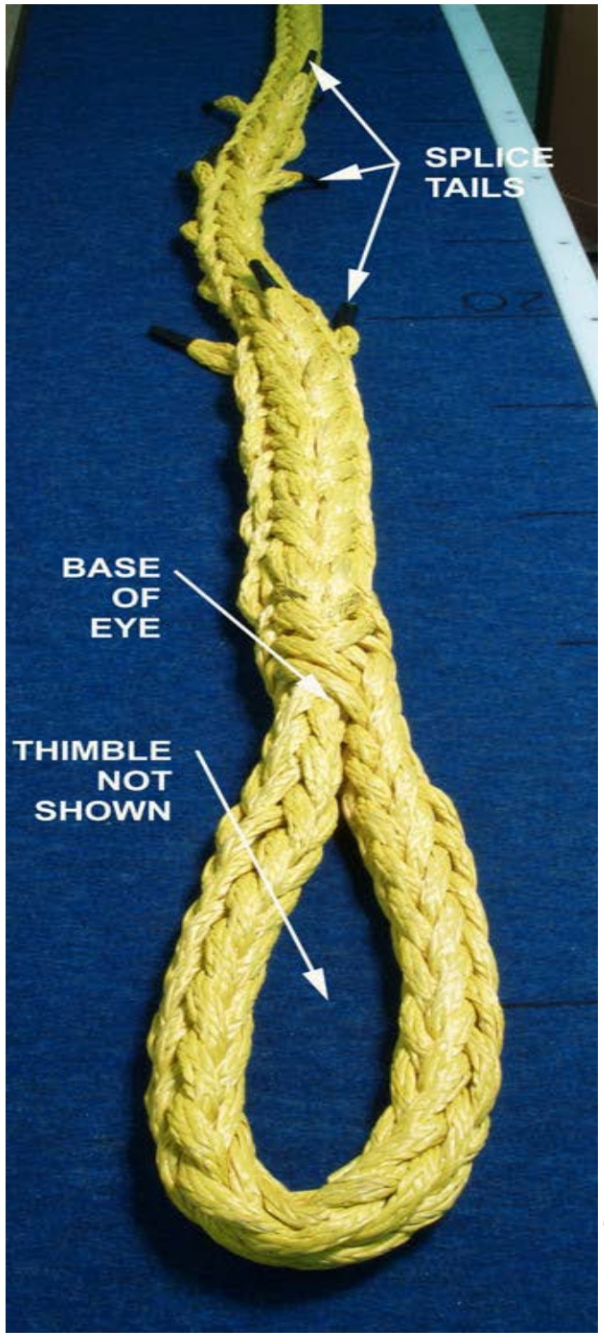
Creep

Splice condition

- Signs of abrasion, cuts, dirt
- Accepted splicing procedure utilized
- Seated properly in the thimble and not cocked
- Splice tails exposed without any slippage

Example of an eye splice



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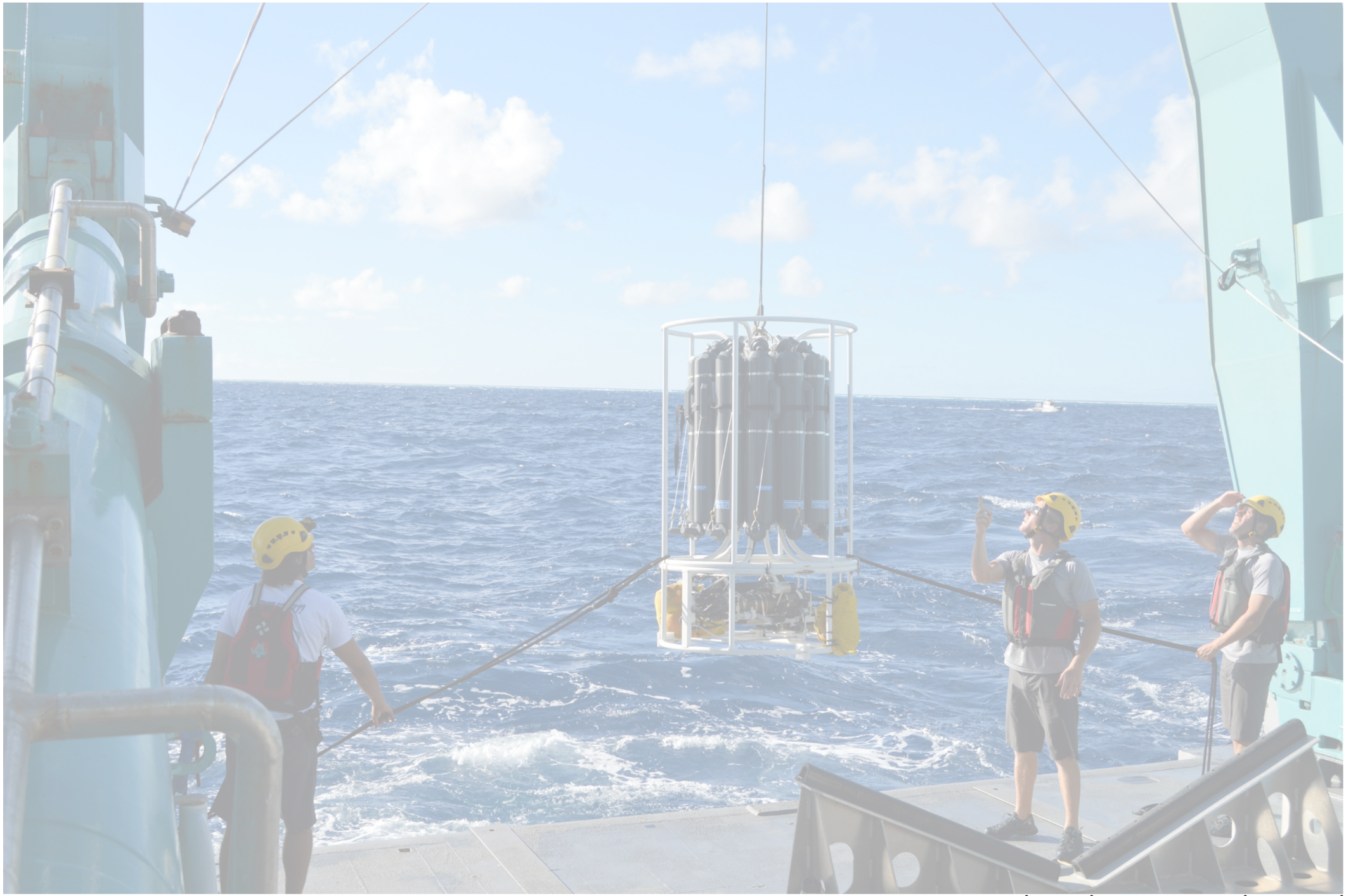

Log Example

(with fictitious data)

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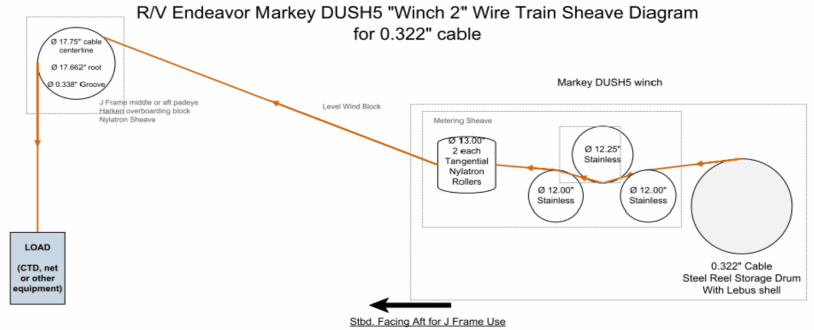
Sheave Train Description:



Number of Deployments Since Last Break Test	10

Cruise No.	Date	Cast #	Cable Length [m]	Max Tension lbs.	Wire Out at Max Tension [m]	Wire In at Max Tension [m]	Max Wire Out [m]	Notes
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Responsibilities for Determining TBL of Tension Members

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  - Submit Break Test Request (BTR) via vessel's wire database
  - Send sample to the Wire Pool, labelled with NSF identifier w/ a copy of BTR
  - Submit the corresponding Tension Member Log and Lubrication Log*
- Science Party or outside organization intending to use their own tension member
  - Evidence of a current break test, consistent with the provisions of Appendix A
  - Provide that information to the vessel.
- Wire Pool
  - Conduct the break test and associated tests
  - Provide a copy of the TBL test results to the vessel operator primarily via the NSF Wire Pool Database. Email notification that new results are available.

* Recommend using the NSF Wire Pool Database to meet this requirement

Tension Member Identifier e.g NSF-XX-CXXX

Winch Manuf. and model: e.g.Hawboldt SPRE-2640

Sheave Train Description:

Number of Deployments Since Last Break Test

Cruise No.	Date	Cast #	Max Tension	Wire Out at Max Tension	Wire In at Max Tension	Max Wire Out	Notes

Rope Inspection

- Abrasion
  - Tearing or wearing of surface filaments
  - New rope, put in service, slightly fuzzy over entire surface, to be expected.
  - Isolated areas of extensive abrasion not normal.
- Cuts
  - Even squared-off fiber ends at the point of damage
  - Extent of damage depends on depth, will reduce strength, rope may become unbalanced.
- Pulls
  - Object snags a yarn or strand and pulls it away from rope surface forming a loop. Attempt to work the pulled strand back
- Burns
  - All synthetic fiber can melt due to frictional heating. Glassy fused area on the rope's surface.
- Contaminants
  - Abrasive contaminants such as sand blast grit or rust can damage internal fibers. Exposure to common chemicals, and petroleum products should be avoided. Discoloration with suspected chemical exposure are reasons for removal.
- Discoloration
  - UV exposure tends to cause discoloration. Long periods of exposure will decrease the overall strength. Chemicals may cause discoloration.
- Uneven diameter
  - Distortion, significant diameter change, inconsistency in overall measurements will decrease the performance of the rope.
- Quality of Splice
  - Inspect all splices. Conform to accepted splicing procedures for the specific rope.
- Creep
  - Plastic deformation under load. Load hanging for long duration (months). It is accumulative. Checked by measuring the length between picks. Concern if length increases by 10% or more.

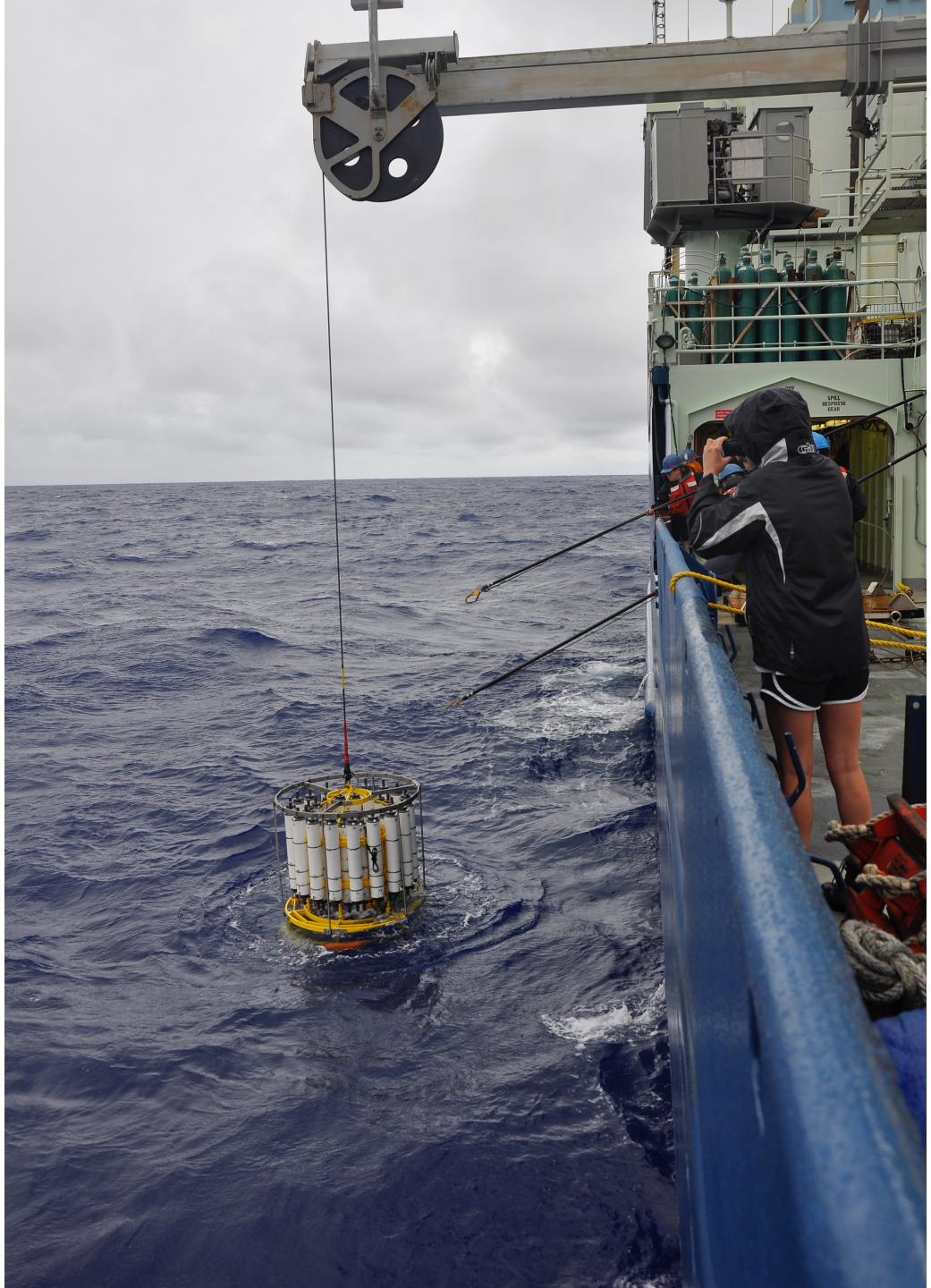

Photo by D. Gong on R/V Atlantis

Determining TBL for Tension Members

- Break tests performed by the Wire Pool
- Submit break test request via the vessel's wire database
- Send sample to: NSF Wire Pool

  Woods Hole Oceanographic Inst.

  266 Woods Hole Road,

  Woods Hole, MA 02543

  c/o Rick Trask
- Label sample with NSF identifier and include copy of break test request with the sample.