CHAPTER 7

INSTRUMENT LOWERING SYSTEM DOCUMENTATION

Richard J. Findley

1.0 INTRODUCTION

An instrument lowering system is comprised of several components; the winch, wire and blocks are all an integrated part of the system. Each of these components needs to have usage and maintenance logged to clearly understand failure modes and to establish when a wire has served its useful life and should be retired. In the previous chapters, a number of factors have been identified, which directly affect wire life and also best practices for prolonging wire life and establishing criterion for the retirement of working cables.

The focus of this documentation will be to assist in determining how well these best practices are being followed and gathering the required data to determine if the criteria for retiring a cable have been reached.

In addition, winch performance, maintenance, and repair records are required in order to field and maintain a safe and reliable system. Compliance with ISM code will require maintenance and log keeping documentation consistent with each institution’s written operating procedures.

The accurate recording of the “Life History” of individual wires also serves a number of important functions when conscientiously applied across the community. Primarily it acts as a management control tool at the institutional level, a quality control device from the standpoint of the scientific user, a valuable source of background information in the event of a wire failure, and as justification for replacement of a wire or cable when required. Simple attention to the details involved in recording required information can make this documentation process an easy, yet effective means of control. The objective of the documentation process is to provide the winch and wire system user with a demonstrable performance record and previous cable history.

From a carefully practiced procedure of documentation, it is possible for the vessel operator to assess his wire and winch inventory and to make accurate assessments of his future requirements, as well as presenting, upon request, a complete history of any winch, block, or wire in his inventory.

The necessity for establishing a consistent means of documenting winch, wire and block histories cannot be stressed too heavily. In a climate of increased safety awareness and rising product and instrument costs, each loss, due to the failure of a instrument lowering system, through unrecorded incidents, inadequate practices, or operation of a wire past its realistic retirement condition, directly affects the entire community. This latter aspect is of importance where inter-institutional loans of wires occur. In this case, the borrower can receive a wire of known condition via its life history record. Since it is the task of the vessel operator to provide the scientist user with a safe and reliable winch and wire system at sea, it is important that the operator know the condition of the wires in his inventory with a fair degree of reliability. This condition is achievable through the documentation process.

The idea in lowering system documentation would be the use of a simple standard series of forms within the oceanographic community. Such a standardized format would allow easy evaluation of borrowed wires, provide an engineering database previously unavailable, and provide important feedback to wire manufacturers for product improvement. The implementation of a standard documentation format would in no way infringe on an institution's individuality, but would, instead, demonstrate the high level of cooperative effort that has been a part of this community.

2.0 WIRE AND CABLE DOCUMENTATION

Within this section, we will concentrate on the development of a basic documentation scheme designed to encompass all of the aspects of a wire's useful life. In addition, sample formats of suggested spreadsheet forms have been provided as a guide to establishing a comprehensive wire life history record.

This system only requires two forms to maintain a complete history of the cable these forms are referred to as the Activity Log and the Use Log. The Activity Log is used to record and track operations on the wire such as spooling, lubrication, termination, testing etc. The Use Log is used to maintain a record of meters deployed, and tension of each lowering or cast.

2.1 Wire Activity Log (Appendix A)

This document is presented as a spreadsheet, which would be the simplest method of maintaining this log, however it can be printed and maintained by hand. The correctly completed Wire Activity Log provides all the information needed to determine the status and location of a wire in a single place. There are two main sections to the form, the first part is the header data, and the second portion is in a tabular format.

Header Data

The information in this section would be filled out when the wire is originally acquired. It identifies the specific cable and provides the manufacturer information, specifications, and physical characteristics of the cable. Locating all of this information at the top of the log provides a constant reminder of the design limits of the cable. The information would not normally change during the life of the wire.

<u>Wire Identification #:</u> If accurate records are to be maintained; it will be necessary to establish a means of clearly identifying each individual wire or cable within the inventory. Any simple alphanumeric system can be adapted as long as it clearly identifies the individual wire or cable in some unique and non-repeatable form. The following illustrates one method of wire identification that can be employed.

Block #	1	2	3	4	5	6	7
Code	T	625	04	82	R	A	1

The particular alphanumeric combination shown above can be interpreted in the following manner:

Block 1 This letter refers to the particular cable type, i.e., F = fiber optic, T = trawl wire, H = hydrographic, E = Electro-mechanical cable, S = synthetic (i.e., Kevlar, Spectra, etc.). The letter used only identifies wire type as an aid in locating the wire in a storage area or during an inventory situation.

Block 2 The three-digit code shown in the example refers to the decimal diameter of the wire of that particular wire. These digits would obviously change for different diameter wires. Since a wire's diameter can always be reduced to a decimal equivalent, the three digit code would form a simple means of further identification.

Blocks 3 &4 - These two dual digit codes refer, respectively, to the month and year a specific reel of wire was received by an institution and placed in inventory. The date at which a reel of wire is placed in service becomes important when high reliability of the wire is required. By including the date of receipt in the identification number, a ready reference is provided at a glance.

Block 5 - The single letter code in this block can be used to identify the institutional point of origin of a particular reel of wire or cable and can become important as wires are loaned or traded amongst institutions. By being able to identify the institution managing the wire
in use, its background and use record are always available.

Block 6 - This block would be reserved for the identification of simultaneous purchases of the same wire by an institution. In this case, either an A or a B suffix would be added to the code to differentiate the individual wires, thereby preserving their individuality.

Block 7 - This variable length code would be reserved for the identification of sub-divisions of the original wire after delivery from the manufacturer. The original uncut wire would be designated 1. If that wire was cut into two pieces it would be designated as 1.1 and 1.2. If the 1.1 wire was further divided into three pieces it would be designated as 1.1.1, 1.1.2, and 1.1.3 thereby preserving their individuality and remain traceable to the original wire as delivered from the manufacturer.

Manufacturer: Self-explanatory.

Date of manufacture: Self-explanatory.

Manufacturers part #: Self-explanatory.

Manufacturers serial #: Self-explanatory.

Wire Construction: This line should contain a description of wire size, construction (i.e., 3 x 19, 3 x 46, 6 x 19, etc.), or for electro-mechanical cables the armoring, number of conductors, etc.

Original Length: Self explanatory

Lay Length: From previous chapters it has been shown that lay length determines optimal wrap angles for each sheave.

Minimum Bending Radius: The minimum bending radius for the cable, usually provided by the manufacturer.

Established by: Indicates who established the minimum bending radius. This entry ties responsibility of the selection of a safety related issue to a particular person or document. It should reference a person by name or refer to a document and who made the decision to apply the document. Typically, the manufacturers recommendation is used, but an institution may choose to adopt a more conservative value to increase the working life of the cable. A minimum bending radius should never be adopted which is less than the manufacturers recommendation!

Breaking Strength (with end free to rotate): The breaking strength with the end free to rotate as provided by the manufacturer. Since almost all use of oceanographic cables are used in this mode this specification should be used as opposed to breaking strength with both ends fixed.

Safety Factor: The value that will be used to determine the safe working load of the cable.

Established by: This entry ties responsibility of the selection of a particular safety factor to a particular person or document. It should reference a person by name or refer to a document and who made the decision to apply the document.

Elastic limit: As defined in previous chapters, the value which when exceeded causes permanent deformation of the wire. Wires that have been stressed past this point will have a reduced breaking strength.

Additional items would be recorded for conducting cable such as wire gauge, number of conductors, and resistance per unit length. Fiber optic cable adds additional parameters such number of fibers, db loss per unit length, fiber diameter etc.. These items should also be included in the header information.

Tabular Data

The data in this section of the form is used to record activities performed on the wire such as spooling, re-termination, lubrication and pull tests, etc..

A new line is created for each activity with multiple lines being used for multiple activities at the same time. All information from the line above that is still valid should be carried down to the next line or left blank if it is not valid.

Seq. #: When a spreadsheet version of the log is used, it is desirable to be able to sort the rows by activity. As an example, the information could be sorted to allow all of the times the cable was lubricated to be grouped. The sequence number allows for resorting back to the original chronological order. Since multiple activities may happen on the same day the date alone is insufficient.

Date: Self explanatory.

Entered by: The person entering the data and bearing the responsibility for assuring the accuracy of the information.

Wire ID #: Because the wire identification number may need to change because of a sub-division and the previous history will still apply it is necessary to maintain a record of the changes in the wire ID #.

Activity: A keyword that describes the activity. Try to minimize the number of different keywords and keep the keyword consistent (i.e. don't spell out the activity one time and abbreviate it the next.) Some recommended keywords are: new, lubricate, pull test, rerig, terminate, subdivide, megger, remove, inspect, store, retire and dispose.

Ship/Location: Identifies the ship the wire is currently on or when ashore the building where it is located.

Winch/Spool ID: Identifies the winch the wire is currently installed on, or when ashore the spool, rack or other method of helping to locate the wire.

Orig. Bottom Now: In the process of transferring wires to and from storage drums the wire is end for ended. When the wire is in use tension and bending fatigue data will be recorded starting from the end of the wire in the water. When the wire is end for ended the subsequent data would apply to different section of cable, for this reason it is necessary to maintain a record of all end for ending activities. To maintain this information a convention needs to be established for identifying the specific end of the cable. In this system, the end of the cable that was at the root of the reel when delivered from the manufacturer is termed "Orig. Bottom." At the end of each wire activity the current location of the "Orig. Bottom" is recorded as being on either the top or bottom of the drum.

When a wire is sub-divided the end that was closest to the "Orig. Bottom" becomes the "Orig. Bottom" for that section.

Current Length: Self Explanatory.

Sheave # (1 through n): Because it has been established in previous chapters that bending radius, wrap angle and a correctly sized groove are critical factors in determining the working life of a cable, it is important to record the information about each of these parameters to aid in determining when a wire has reached the end of its life. Additional columns should be added for each sheave that the wire passes over. In the case of identical multiple sheaves such as would be encountered with a traction head or accumulator, a forth column would be added to the information for that sheave #, identifying the number of sheaves in the group.

Root Radius: Radius of the sheave at the bottom of the groove. The minimum value should be twice the minimum bending radius for the wire.

Wrap Angle: The total number of degrees that the wire is in contact with the sheave.

Groove Radius: The radius of the groove that the wire rides in. While a correctly sized groove diameter is an important consideration for all cables it is especially critical with conducting and fiber-optic cables.

Comments: Short comments can be place directly in the table. Longer discussions should be placed in a separate document and referenced here.

3.0 USE LOG (Appendix B)

This particular aspect of the documentation may well be the most important item in the system as it a record of the actual work done by the all of the components in the system. When properly recorded either by computer or manually, it will reflect length of wire deployed at each station, maximum stress placed on the wire, and documents the accumulated bending stress cycles. The data from this form when combined with the Activity Log provides a complete picture of the wire history.

The following example (Figure 7-2) represents a typical Use Log that has been filled out manually. For this form manually refers to either hand written or manually entered into a spreadsheet verses a computerized data logging system.

If a computerized data logging system were being used some of the data would need to be entered into the data logging system by the operator. In this situation, typical parameters would be winch operator, station number, station type and sea state.

Wire ID #: The number would be the same ID # as on the Wire Activity Log. By incorporating it in the "Use Log," a clear trail is established for that particular wire.

Cruise Number and Date: This information is used to correlate events with the Wire Activity Log and may be used by the science party.

Station Number: Primarily used by the scientific party. Different organizations may use different terminology such as lowering number or cast number.

Station Type: This item simply identifies the instrument being deployed. Since piston cores, dredges, or mid-water trawls all place unique stresses on the wire, a great deal of guesswork is eliminated in later analysis of the station. Type is identified on the form. In addition, this item is also used to identify wire tensioning deployment as well as the wire lubrication process.

Payload Weight (Air): Since the weight of any instrument attached to a reel of wire or cable should be known or can be determined easily, it is important that it be recorded as part of the permanent record. This will also provide a spot check of the tension measurement system if the same instrumentation is being used repeatedly at the same weight.

Available Wire Length: This number refers to the length of wire which is available for use. It would represent the amount of wire available after subtracting the amount the institution determines is suitable to remain on the winch from the wire length reported on the last entry of the Wire Activity Log. Some institutions only require several turns others require an entire layer.

Sea State/Weather: Since the motion of the vessel, due to sea conditions and weather, imparts stresses to the wire, the recording of these conditions becomes a necessary part of any later wire analysis and should be included as part of the permanent record.

Maximum Wire Out Maximum Tension: These two numbers are derived from the actual lowering record and are repeated at the top of the Use Form as a means of ready reference for wire analysis or the determination of a maximum wire length to be paid out during the lubrication process. A place to mark if the safe working load or elastic limit has been exceeded should also be provided. **Any time the elastic limit is exceeded a record should be made in the Wire Activity Log.**

The bulk of the remainder of the form is self explanatory. The frequency of recording the amount of wire over the side is an individual choice, but should be no less than once every 500 meters, or at the time of specific events (i.e., winch speed changes, corer pullout, etc.). Major events, such as winch malfunctions, and cables jumping of sheaves occur pertinent to a specific lowering. Any events that may reduce the strength of the wire should be recorded on this form and on the Wire Activity Log.

3.0 WINCH DOCUMENTATION

Given the variety of winches found on most research vessels and the fact that they are the primary working tool of the oceanographer, it is fairly obvious that they deserve special attention to ensure their operational readiness. This special attention should take the form of programmed maintenance, and repair combined with a procedure of reporting the performance of such maintenance. Compliance with ISM code will require regularly scheduled maintenance and documentation of that maintenance.

Winch Activity Log (Appendix C)

A Winch Activity Log is similar to the Wire Activity Log and should be employed. It is again suggested that this information be maintained in a spreadsheet but it could also be printed and filled out by hand. An examination of the header and tabular data on the example form is self explanatory and therefore is not listed here.

Each operation is logged on a separate line as was done on the Wire Activity Log.

4.0 BLOCK DOCUMENTATION

Blocks are a critical part of the instrument lowering system. Failure of a block under load can be one of the most dangerous situations on board a vessel an improperly sized bloks can significantly reduce the breaking strength of the wire and reduce wire life. As in the other parts of this system compliance with ISM code will require regularly scheduled maintenance and documentation of this critical component of the system.

Block Activity Log (Appendix D)

An examination of the header and tabular data on the example form is self explanatory and therefore is not listed here with one exception below that needs special attention.

<u>Hook Safe Working Load:</u> Most blocks are rated on the load at the point of attachment. This value is not the same as the wire tension. A block with a 180 degree wrap angle will have a load on it which is twice the wire tension. A block that the wire just “kisses” will have a small fraction of the wire load. If the manufactures Safe working load (SWL) specification does not specify hook load, contact the manufacturer and get in writing how they have defined the safe working load.

5.0 INCIDENT REPORTING

Although no one likes to consider all the things that can go wrong, it is important that when they do occur they be fully and accurately reported. The minimization of a problem or a catastrophic failure by either refusing to face the problem or by simple acceptance of such a failure as a natural occurrence does nothing to eliminate the initial causes of the problem. By minimizing a problem all that is accomplished is the recreation of the same set of conditions that led to the problem or failure in the first place and the probability of another problem or failure in the future is more or less assured.

In order to derive a comprehensive record from a system failure it is necessary to collect and analyze the available information. There are three distinct phases in analyzing a system failure. The onboard data gathering with initial analysis, the post engineering analysis which is done ashore, and the corrective measures taken to prevent reoccurrence. Each phase should be combined in a single incident report.

It is felt that this style of report should be circulated to other users engaged in the same type of at-sea work as a warning and as a preventative against similar failures. It should be remembered that unless adequate and accurate data is made available to users and manufacturers alike, it is not possible to influence product improvement or increase our at-sea reliability.

Phase 1 Shipboard Data Gathering and Preliminary Analysis

This section of the report should be completed at sea immediately following a system failure. The report should list all of the hardware involved including the winch, wire, block, instrument, and any shackles or hardware that were in use. Any visible damage to the hardware should be described and supplemented by photographs. In the event of catastrophic failure, use of all the hardware involved should terminated since the hardware may no longer be capable of meeting its original load specifications. These items should be preserved for later analysis.

A brief description of all items of equipment lost should be listed in the space provided. The equipment may not be a direct cause of the failure, but its description will provide useful data during a later analysis.

It is crucial that the actual point of failure be identified as accurately as possible to aid the engineering analysis. Major differences in failure modes can be determined if the location of the break is known. For instance, a failure at the winch probably does not have the same cause as one occurring at the outboard sheave. A list of all possible witness should be made along with any of his or her observations. Be aware that their observations may conflict. Be sure to take them down as they describe the event. Determine if anyone onboard happened to be taking video or still pictures at the time of the failure, if so make arrangement to ensure that copies are obtained.

Once all pertinent data has been assembled, a preliminary cause of the failure should be determined and recorded. This evaluation while preliminary but is nonetheless valuable in an assessment of the actual problem. Once this on-site evaluation is completed, it should be endorsed by either the vessel's captain or other responsible party. The Winch Activity Log, Wire Use Log, and Block Activity log should be updated with the report name added to the remarks column in each report.

Phase 2 <u>Ashore Post Engineering Analysis</u>

In this phase the in shipboard report is reviewed, an analysis of all of the hardware involved should be conducted which may include non-destructive or destructive testing. The results of the investigation should be included in this section of the report. Any hardware, which is suspected to have been stressed beyond its normal safe working load, should either be load tested or clearly marked as scrap.

Phase 3 <u>Corrective Action</u>

Once the cause of a system has been established, it is obviously necessary to institute some form of corrective action to ensure that a repeat failure will not occur. When a course of action has been selected a summary of that action should be recorded in the report. and added to the Incident Report to complete the package. Corrective action may take the form of either procedural changes in its simplest form or may result in major structural or component changes in the winch system.

6.0 SUMMARY

The documentation system that has been described in the preceding sections constitutes a basic minimum that would be required to effect a safe and reliable instrumentation lowering system.

The success of this or any other documentation scheme rests with the individuals who are responsible for submitting the required information and their cooperation can be more easily achieved if the demands on their time are kept to a minimum. In other words, the proliferation of unique forms and reports should be kept to a minimum if the system is to have any real value.

It is strongly encouraged that the documentation scheme, no matter what it is, be established as a standard within an organizational group such as UNOLS, NOAA, etc. Once this is accomplished, the control over, and reliability of the wires and winches within these Organizations becomes a realistic approach to the problem.

7-16

REFERENCES

Winch and Wire Handbook, Second Edition. University National Oceanographic Laboratory System

Wire Activity Log (Mechanical Cable)

Wire Identification #	T5000298WA1.1		
Manufacturer	Rusty's Wire Inc.	Minimum bend radius (in inches)	12
Date of Manufacture	12/12/98	Established by	I. M. Responsable
Manufactures Part #	1243	Breaking Strength (with end free to rotate)	25000
Manufactures Serial #	45638	Saftey Factor	5
Construction	1/2" 3x19 GIPS	Established by	I. M. Responsable
Original Length	10,000	Safe working Load	5000
Lay Length (in inches)	9.25	Elastic limit	19000

Seq. #	Date	Entered by	Wire ID #	Activity	Ship/ Location	Winch/ Spool ID	Orig. Bottom Now	Current Length M	Sheave #1 Root Radius Inches	Sheave #1 Groove Radius Inches	Sheave #1 Wrap Angle Deg.	Sheave #2 Root Radius Inches	Sheave #2 Groove Radius Inches	Sheave #2 Wrap Angle Deg.	Coments
1	02/02/98	T. Allen	T5000298WA1	Receive	Shed 32	B	Bot	10000							New
2	02/02/98	T. Allen	T5000298WA1	Lubricate	Shed 32	B	Bot	10000							Lubed at Factory
3	03/15/98	B. Sims	T5000298WA1	Spool	RV Rolly	SN 2345	Top	10000	12	0.510	45	10	0.252	90	Spool_report.doc
4	03/15/98	B. Villa	T5000298WA1	Terminate	RV Rolly	SN 2345	Top	10000	12	0.510	45	10	0.252	90	Electroline
5	03/15/98	A. Bundy	T5000298WA1	Pull Test	RV Rolly	SN 2345	Top	10000	12	0.510	45	10	0.252	90	Tested to 5500 #
6	06/15/98	T. Allen	T5000298WA1	Terminate	RV Rolly	SN 2345	Top	9985	12	0.510	45	10	0.252	90	Electroline
7	06/15/98	T. Allen	T5000298WA1	Pull Test	RV Rolly	SN 2345	Top	9985	12	0.510	45	10	0.252	90	Tested to 5500 #
8	03/01/99	B. Sims	T5000298WA1	Rerig	RV Rolly	SN 2345	Top	9985	12	0.510	45	16	0.260	90	Rplcd. Undersized block
9	03/01/99	B. Villa	T5000298WA1	Terminate	RV Rolly	SN 2345	Top	9985	12	0.510	45	16	0.260	90	Electroline
10	03/01/99	A. Bundy	T5000298WA1	Pull Test	RV Rolly	SN 2345	Top	9985	12	0.510	45	16	0.260	90	Tested to 5500 #
15	03/15/99	T. Allen	T5000298WA1.1	Subdivide	RV Rolly	SN 2345	Top	3000	12	0.510	45	16	0.260	90	Incident_03_05_1999.doc
16	03/15/99	B. Sims	T5000298WA1.1	Lubricate	RV Rolly	SN 2345	Top	3000							Prelube 19
17	03/15/99	B. Villa	T5000298WA1.1	Remove	Shed 32	L	Bot	3000							
18	12/01/00	A. Bundy	T5000298WA1.1	Spool	RV Pitch	SN 3723	Bot	3000	6	0.510	180				Does not levelwind
19	12/01/00	T. Allen	T5000298WA1.1	Terminate	RV Pitch	SN 3723	Top	3000	6	0.510	180				U-Bolt Clamps
20	12/01/00	T. Allen	T5000298WA1.1	Pull Test	RV Pitch	SN 3723	Top	3000	6	0.510	180				Tested to 5500 #
21	12/09/00	B. Sims	T5000298WA1.1	EL Exceed	RV Pitch	SN 3723	Top	2300	6	0.510	180				Incident_2000_12_09.doc
22	12/15/00	B. Villa	T5000298WA1.1	Remove	Shed 32	C	Bot	2300							
23	12/20/00	A. Bundy	T5000298WA1.1	Retired	Shed 32	C	Bot	2300							
24	01/15/01	F. Sanfor	T5000298WA1.1	Disposed											

Appendix A - Sample Wire Activity Log

Use Log

Wire ID #	T5000298WA1.1	Date	9-Dec-00
Cruise #	PI0017	Station Type	Rock Dredge
Station #	1	Sea State	4
Payload Wt. (air)	600	Available Wire Length	2700 M
Breaking Strength	25000	Winch Operator	Bart Sims
Safety Factor	5		
Safe Working Load	5000	Exceeded this cast ?	Y or N
Elastic Limit	19000	Exceeded this cast ?	Y or N
Max. wire paid out	2500		
Max. tension observed	9958		

Time GMT	Wire Out Meters	Max Observed Tension	Rate Out	Rate In	Comments
8:30	0	0	0	0	Tensiometer reads 0 with no load
	-2	595			Lifted dredge off deck, air weigh ok
8:30	3	440	60		Started down
8:39	500	777			
8:48	1020	1114			
8:57	1490	1451			
9:06	2100	1788			
9:10	2500	2125	0		Manual Brake Set, Pawl Set
9:12	2500	3688	0		
9:14	2500	3756	0		
9:16	2500	3897	0		Al Bundy relieved Bart Sims as winch operator
9:20	2500	4615	0		
9:25	2500	5345	0		
9:30	2500	6345	0		
9:35	2500	8721	0		
9:40	2500	9958	0		
9:42		1961	0		Shudder throught ship
9:42		1952	0		
9:50	2500	1946		70	Start bringing in wire
10:14	200			0	Reached end of wire, dredge gone
					See Incident_2000_12_09.doc

Appendix B - Sample Use Log

WINCH ACTIVITY LOG

Manufacturer	X. Pensive Machinery Corp
Model #	BAD-322
Serial #	3723
Date of Manufacture	1/1/98
Maximum Pull (Full Drum)	5000 lb.
Maximum Pull (Bare Drum)	10000 lb
Wire Size Designed For	.322"
Capacity	10,000 m

Seq. #	Date	Entered by	Activity	Ship/ Location	Installed Wire ID #	Comments
1	02/02/98	T. Allen	Receive	Shed 32		
2	02/02/98	T. Allen	Lubricate	Shed 32		Per manufacturers startup procedure
3	03/15/98	B. Sims	Install	RV Rolly		01 Deck lined up with aft eye of side a-frame
4	03/15/98	B. Villa	Spool	RV Rolly	C3220298WA1	
5	04/14/98	A. Bundy	Lubricate	RV Rolly	C3220298WA1	Per manufacturers 30 day lube schedule
6	05/14/98	T. Allen	Lubricate	RV Rolly	C3220298WA1	Per manufacturers 30 day lube schedule
7	06/13/98	T. Allen	Lubricate	RV Rolly	C3220298WA1	Per manufacturers 30 day lube schedule
8	07/13/98	B. Sims	Lubricate	RV Rolly	C3220298WA1	Per manufacturers 30 day lube schedule
9	08/12/98	B. Villa	Lubricate	RV Rolly	C3220298WA1	Per manufacturers 30 day lube schedule
10	09/11/98	A. Bundy	Lubricate	RV Rolly	C3220298WA1	Per manufacturers 30 day lube schedule
15	10/11/98	T. Allen	Lubricate	RV Rolly	C3220298WA1	Per manufacturers 30 day lube schedule
16	11/10/98	B. Sims	unspool	RV Rolly		
17	12/10/98	B. Villa	Remove	Shed 32		
18	01/09/99	A. Bundy	Install	RV Pitch		
19	12/01/00	T. Allen	Spool	RV Pitch	T5000298WA1.1	
20	12/01/00	T. Allen	Lubricate	RV Pitch	T5000298WA1.1	Per manufacturers 30 day lube schedule
21	12/09/00	B. Sims	Incedent	RV Pitch	T5000298WA1.1	See Incident_2000_12_09.doc
22	12/15/00	B. Villa	Unspool	RV Pitch		
23	12/20/00	A. Bundy	Remove	Shed 32		
24	01/15/01	B. Villa	Ship			Sent to manufacturer for inspection

Appendix C - Winch Activity Log

BLOCK ACTIVITY LOG

Manufacturer	Tiny Block Inc.
Model #	6/500
Serial #	1
Date of Manufacture	Unknown
Safe Working Load	20000 lb.
Safety Factor	?
Root Radius	8" 6"
Groove Radius	0.51

Seq #	Date	Entered by	Activity	Ship/ Location	Installed Wire ID #	Comments
1	02/02/98	T. Allen	Receive	Shed 32		Found block on warehouse shelf
2	03/04/98	A. Bundy	Install	RV Pitch		Took specs off plate on side of block
3	12/09/00	C. Bleigh	Incedent	RV Pitch	T5000298WA1.	See Incident_2000_12_09.doc
4	12/15/00	B. Villa	Remove	Shed 32		
5	12/20/00	F. Sanford	Disposed			

Appendix D - Sample Block Activity Log

Appendix E
Incident Report

Date: December 9, 2000
By: Capt. Bleigh

At 9:42 GMT we were underway at 1.5 knots in the process of performing a rock dredge at a position Lat 26 00 N, 80 00 west, and the wire parted. There was 2500 meters of ½" 3x19 wire out. The tension never got over 9958 lbs which is less than half the breaking strength. The winch in use was SN 2345, the wire in use was T5000298WA1.1. The block in use was a Little Block serial number

1. The winch was located on the after deck about 15 ' from the stern. Our in house manufactured rock dredge and 200 meters of wire lost.

Crewmembers Sims, and Allen were both standing on the aft deck taking a cigarette break by the a-frame when the wire parted. They both report feeling the ship shudder. Since the wire parted underwater, they did not see anything else. No one happened to be taking pictures at the time.

The winch operator was ordinary seaman Al Bundy, he reported that he had been writing down the tension every 5 minutes and did not observe the tension exceeding 9958 pounds.

The first mate, Fletcher Christian was watching the radar as another ship was in the area; he also felt a shudder but did not have anything else to report.

The Wire Use Record, Wire Activity Log, Winch Activity Log, and Block Activity Log were annotated with the file name of this report.

A photo of the end of the cable is attached.

Preliminary cause of failure: Defective cable.

Respectively Submitted

Captain Bleigh

Shoreside Analysis
By: Bob Villa

The wire was physically inspected and appears to be recently lubricated. There was minimal corrosion. A review of the wire activity log and incident report dated March 3, 1999 indicates that this section of wire came from a longer wire that was damaged when the wire jumped a sheave. This particular section was from the bottom of the drum and had never been in the water before.

A section of the cable was taken from the end of the cable and at 2000 meters from the "Original Bottom of Cable" both were pulled to destruction. The end section failed at 19,238 pounds. The section from 2000 meters from the failed 21356 pounds.

An additional section was taken from the wire that had not been deployed in this incident. By reviewing the Wire Use Log it has been determined that his section of wire has never been in the water. This section was pulled to destruction and failed at 25873 pounds.

From these results, it appears that the cable has been weakened in use during the cast made at station 1.

A review of the wire use record indicates that the wire tension was being observed every 5 minutes. The manual brake and pawl were sent which would have prevented the winch from slipping.   I have also reviewed the over boarding sheave and found that the radius of the sheave is only 6". The minimum radius for this cable is 12". The radius of the sheave groove is .51 inches which is suitable for a 1" cable not the .5" which was in use.

I interviewed the scientist Bill Nye who had attached the dredge to the cable and determined that a weak link was not in use on the rock dredge.

Final determination of cause of failure:
The wire exceeded its breaking strength, the manual observation of the readout was not often enough to note the true tension of the cable.

Additional Findings:
The block that was used was the wrong size for the wire. The manufacturer of the block is no longer in business and the safety factor in determining its SWL is unknown. The block was placed in service without knowing it's previous history. It may have previously abused which can lower it's load capacity.

The safe working load of the cable was exceeded while the crewmembers were loitering around an over the side operation. There was no reason for them to be in this area.

The manual brake and the pawl were set on the winch which would prevent the operator from being able to pay out wire while the ship was slowed down.

There wasn't a weak link in place, which almost guarantees that a catastrophic failure will occur if the dredge hangs up.

The winch has been subject to a load in excess of its design load. It will be returned to the manufacturer for inspection.

The elastic limit of the wire has been exceeded and will be disposed of.

The block will be cut up and disposed of. It has been stressed past its SWL, its history is uncertain and its dimensions are unsuitable for oceanographic work..

All of the shackles and small rigging hardware has been marked scrap and disposed of

Respectfully Submitted

Bob Villa

Corrective Action

Corrective Action Recommended as of a result of incident on November 9, 2000
By: Bob Villa

To prevent the use of undersized blocks and to familiarize personnel with the correct procedures for safely performing over the side operations, all crewmembers and shore personnel have attended a one-day in house seminar on winches and wires. The seminar was based on the Winch and Wire Handbook supplied by UNOLS.

The Wire Activity Log should be modified so that when an improperly sized sheave is entered into the tabular data the entry turns red.

Crewmembers should review all of the existing Incident Reports so they learn from past mistakes.

Signs should be posted on the deck warning all personnel who are not engaged in the current activities to keep clear of the area.

Weak links should always be used in all operation where the ship is moving such as trawling and grappling.

An electronic tension measurement and logging system should be installed with alarms alerting the operator when the SWL of the cable is exceeded.

The manual brake and pawl should not be set.