



Wire Rope Report

Baynes Sound Connector Cable Ferry
Asset #: 42076, 41878 and 41876
BC Ferry Services Inc.
Suite 500, 1321 Blanshard Street
Victoria, BC V8W 0B7
Canada

by
Inter-Mtn. Testing Ltd.

Job #: 7198
Date: December 13, 2016
Revision Date: January 17, 2017

Introduction

As requested by Mr. Dan Isenor, Non-Destructive Testing was conducted on the following wire rope:

Baynes Sound Connector Cable Ferry (Denman Island)

The test equipment operates using proven magnetic flux leakage technology. The wire rope is fully saturated with a longitudinal magnetic field as it moves through two cylindrical permanent magnets. Defects in the rope such as indentations, or loss of metal area due to corrosion or localized wear and abrasion produce a leakage in the magnetic field which is detected by highly sensitive cylindrical search coils. The output of the search coils is recorded for permanent reference on a moving strip chart recorder or computer as a series of peaks of varying amplitude and width.

The amplitude and width of the peak recorded on the chart paper or computer due to broken wires is dependent on a number of variables including the following:

- Location of anomalies in the strand
- Quantity of anomalies
- Diameter of anomalies
- Gap between anomalies
- Sideways displacement of ends of anomalies

If the rope is free of discontinuities, magnetic leakage cannot occur and the baseline of the recording chart remains relatively smooth.

An overall roughness of the baseline of the recording chart is usually interpreted as an indication of internal corrosion within the rope. However, to accurately assess the degree of internal corrosion, a comparison of the recordings taken at different time intervals with the same rope speed and sensitivity over the service life of the rope is required.

A visual inspection is also completed by the technician to identify any distortion in the rope and to verify the overall external condition of the rope at the time of inspection. Due to the nature of this plastic coated wire rope, visual inspection is nearly impossible except in areas where plastic coating has been removed. A measurement of the diameter of the wire rope at various intervals is also completed. Special attention is taken in the area where large amounts of disturbances and changes in the metallic area may reduce the effectiveness of the test equipment.

None of the wire ropes tested had more than a 3% loss of metallic areas in the tested length. For wire rope retirement standards in mining and offshore industries, the amount of loss of metallic area (LMA) before ropes are to be discarded is 8%. There is no set standard for retirement criteria for cable ferries as far as we know. Inter-Mtn. Testing Ltd. cannot comment on the condition of these sections of this wire rope which were not accessible for non-destructive testing.

Note: This non-destructive wire rope inspection is only one component of wire rope monitoring and maintenance. The client must also perform regular visual inspections to monitor the overall condition of the wire rope.


Inter-Mtn. Testing Ltd. (IMT) has prepared this report based on the condition of this wire rope at the time of this inspection. IMT does not warranty the future condition of this wire rope subsequent to this inspection. This report does not include any analysis on the design or engineering of this wire rope in this application.

We trust this information meets your present requirements. Please contact our office if you have any questions or require further information.

Yours truly,

Inter-Mtn. Testing Ltd.

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Don Muirhead
President

Reviewed by:

Mr. D. Cox, P. Eng.
Dan Cox Consultants, Inc.

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Limitation of Liability

Inter-Mtn. Testing Ltd. (IMT) has prepared this Report solely for the confidential use of the client named above, and for no other purpose. This report is based on the condition of the accessible components of the equipment tested at the time of this inspection and does not include an opinion on the condition of this equipment at any time subsequent to the testing. IMT does not warrant the future condition of the equipment. Any and all claims you may have against IMT, its professional staff and employees arising out of all services referred to herein shall be regarded as one Claim to which our liability to you shall be limited to the lesser amount of \$5,000 or the amount of liability insurance available to IMT to respond to the Claim. You will not bring any proceedings in any court of any jurisdiction advancing any claim against our professional staff and employees in their personal capacity. No Claim may be brought against IMT in contract or tort more than two (2) years after the delivery of this Report. IMT makes no representations of any kind to any other person in respect of the subject matter of this Report. Accordingly, IMT will accept no responsibility for the use or reliance upon any statement in this Report by any other person.

Baynes Sound Connector Cable Ferry – BC Ferries Asset #: 41876 – November 7, 2016

Inspection Results

Based on our observations at the time of this inspection, the following results were recorded:

Rope:	Baynes Sound Connector Cable Ferry – BC Ferries Asset #: 41876
Previously was the Drive Rope in July 2016	SN: 13072-01
Currently is in the South rope position	
Number of anomalies in November 2015:	Two (2)
Number of anomalies in April 2016:	Four (4)
Number of anomalies in July 2016:	Seven (7)
Largest LMA anomaly in November 2016:	2.0%

Non-destructive testing was conducted on the accessible length of this wire rope as well as a visual inspection at several locations on the body of this wire rope. Please refer to the following chart for a more complete analysis of this wire rope.

This rope was in the "Drive" position during this inspection. It is being called the "South" position in order to allow for consistency and to mitigate confusion within this report.

As a change in the reporting structure has been requested, Inter-Mtn Testing will now provide the largest LMA anomaly per inspection, as opposed to the quantity of anomalies found. The reason is to provide more relevant information and mitigate reporting variables.

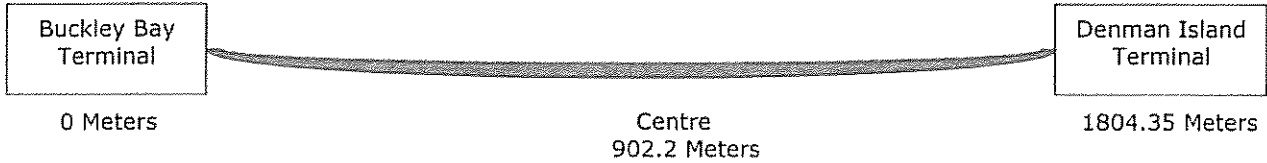
This wire rope was found to be in good condition at the time of this inspection, no significant changes since last test in July 2016. This rope has not been rotated since the last test in July 2016.

As this wire rope was in the "Drive" position, it was tested from the engine room (in the center of the ferry), therefore; the wire rope from the center of the ferry drive room to the shore is not accessible for inspection – Inter-Mtn. Testing Ltd. cannot comment on these sections of rope.

Note: Visual inspection was difficult due to plastic coating and mud on ropes. Diameter measurements were not accurate due to plastic coating interference.

BC Ferry Services Inc. – BC Ferries Asset # 41876 – November 7, 2016

This rope was in the "Drive" position during this inspection. It is being called the "South" position in order to allow for consistency and to mitigate confusion within this report.



Baynes Sound Connector Ferry – BC Ferries Asset #: 41876 – Currently in "South" Rope Position			
Rope Construction:	6 X 19 Seale (Coated)	Length:	1804.35 meters
Sens:	SU 40-45 92% - 42 mm	Diameter:	1 5/8"
Machine Used:	MH 24-64	Av. Diameter:	n/a
Location:	Comments:	Rope Speed:	204 ft/min (2.0 knots)
0	Start of test at Buckley Bay side		
0.81	Three (3) calibration wires – 3" long		
22.0-51.5	Radio interference		
254.92	Radio interference		
539.22	1.00% Loss of Metallic Area (LMA) – not visually identified		
631.53	1.00% LMA – not visually identified		
778.02	1.00% LMA – not visually identified		
1296.09	2.00% LMA – not visually identified		
1308.11	1.10% LMA – not visually identified		
1508.42	1.00% LMA – not visually identified		
1760.42	Magnetic anomaly – shows up on multiple traces		
1804.35	End of test at Denman Island side		
Comments:	<p>Testing of BCF 41876 was completed in the "Drive" rope position – terminal to terminal only.</p> <p>Note: LMA locations may differ slightly from previous inspections due to factors such as, but not limited to: start placement of the test head, model of equipment used and/or interpretation of data by the technician.</p>		
Specification:	Quality Control		

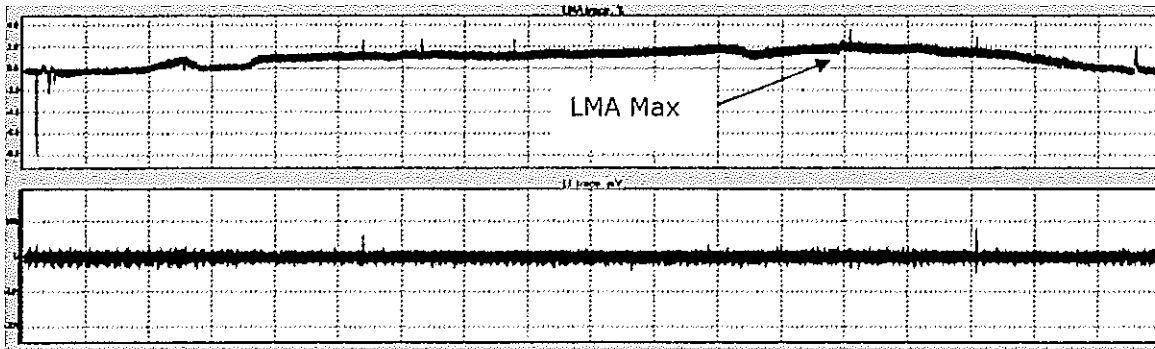
Technicians: R. Muirhead / N. Massong

Data Interpreter: D. Muirhead

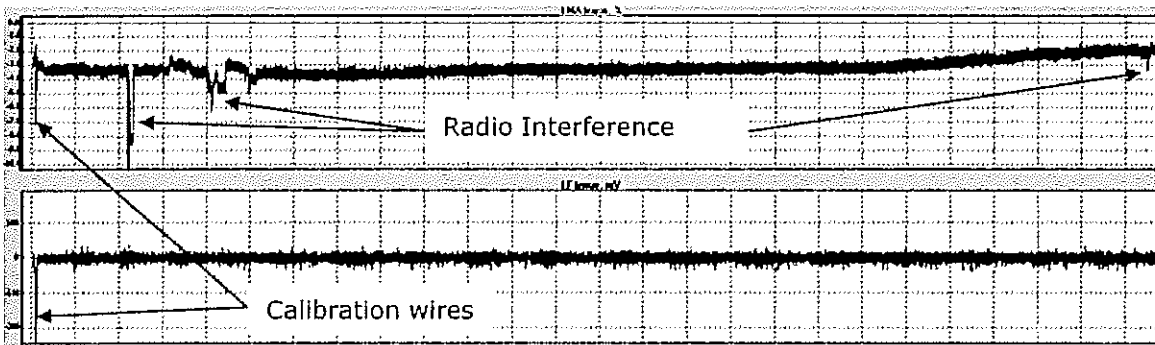
Baynes Sound Connector Cable Ferry – BC Ferries Asset #: 41876 – November 7, 2016

This rope was in the "Drive" position during this inspection. It is being called the "South" position in order to allow for consistency and to mitigate confusion within this report.

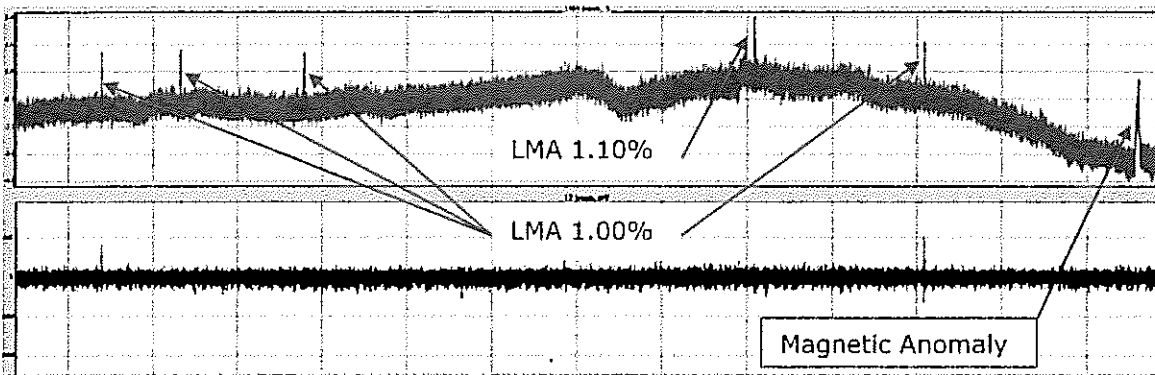
Travelled Section:



Above: Full view of trace (Buckley Bay start) - Overall loss of percentage as shown by Full View trace indicates overall loss of metallic area up to 2% plus individual areas of 1.00%.



Above: Detailed view of calibration wires and radio interference



Above: Detailed view of LMA Loss and Gain

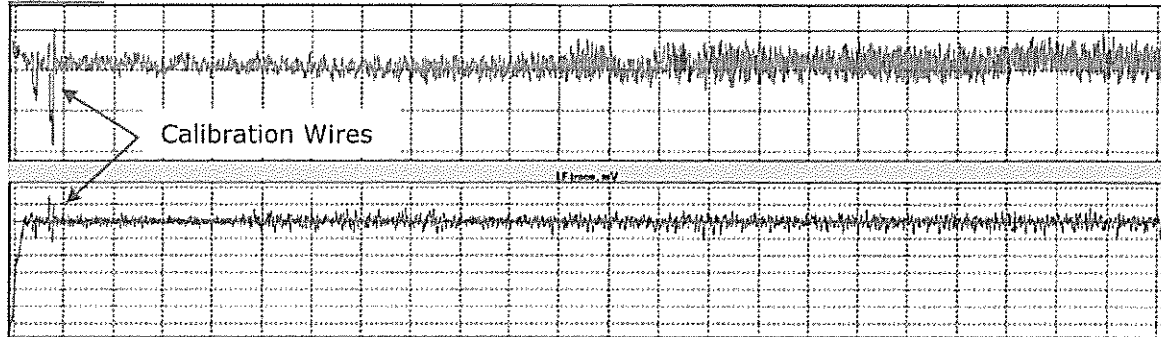
Shore to Pontoon Section:

The following traces represent the wire rope section located between shore and the corresponding pontoon. Each inspection was conducted from the shore to the pontoon.

Note: Manual speed and proximity to water surface may cause variances in each trace.

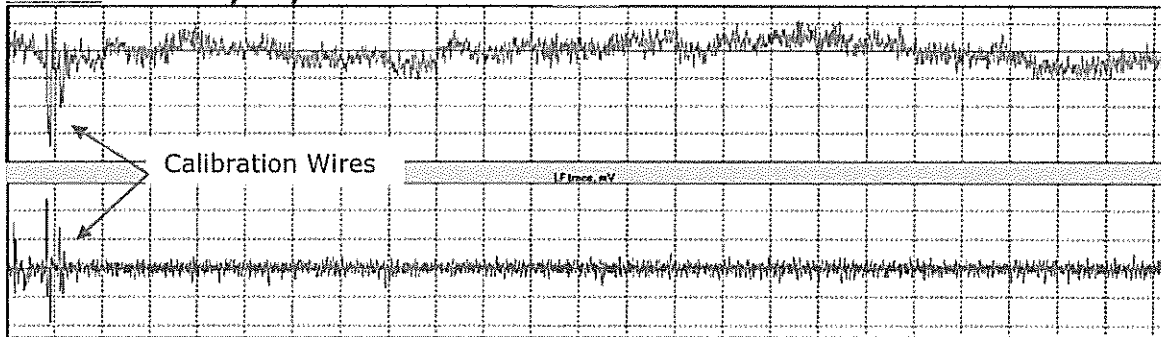
South Rope – BCF Asset#: 41876

24.19m – Denman Island Side



Location (m):	Comments:
0	Start Test
0.82	1 x 3" Calibration Wire
1.11	2 x 3" Calibration Wire
24.19	End Test

23.29m – Buckley Bay Side



Location (m):	Comments:
0	Start Test
0.31	1 x 3" Calibration Wire
0.68	2 x 3" Calibration Wire
23.29	End Test

Baynes Sound Connector Cable Ferry – BC Ferries Asset #: 42076– December 13, 2016

Inspection Results

Based on our observations at the time of this inspection, the following results were recorded:

Rope:	Baynes Sound Connector Cable Ferry – BC Ferries Asset #: 42076
This is a new rope, no previous inspection:	December 13, 2016
This rope is currently in the Drive position	
Largest LMA anomaly in December 2016	1.21%

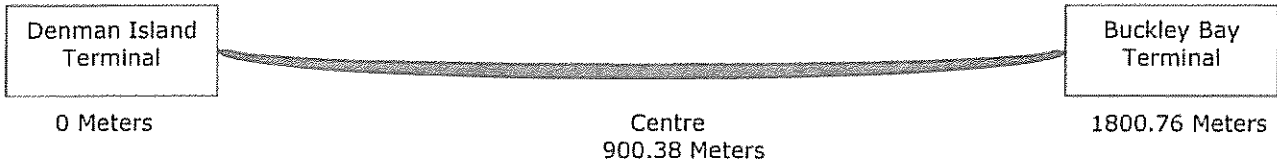
Non-destructive testing was conducted on the accessible length of this wire rope as well as a visual inspection at several locations on the body of this wire rope. Please refer to the following chart for a more complete analysis of this wire rope.

As a change in the reporting structure has been requested, Inter-Mtn Testing will now provide the largest LMA anomaly per inspection, as opposed to the quantity of anomalies found. The reason is to provide more relevant information and mitigate reporting variables.

This wire rope was found to be in good condition at the time of this inspection with no significant LMA anomalies.

Note: Visual inspection was difficult due to plastic coating and mud on ropes. Diameter measurements were not accurate due to plastic coating interference.

BC Ferry Services Inc. – BC Ferries Asset # 42076 – December 13, 2016



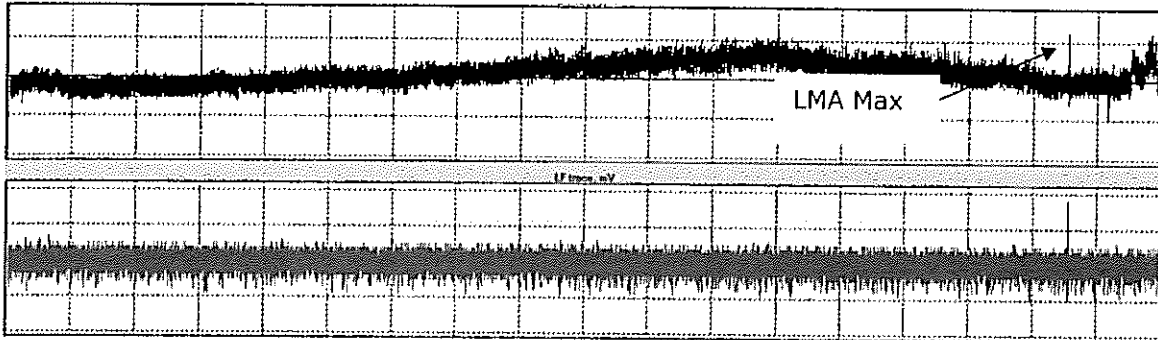
Baynes Sound Connector Ferry – BC Ferries Asset #: 42076 – Drive Rope			
Rope Construction:	6 X 19 Seale (Coated)	Length:	1800.76 meters
Sens:	SU 40-45 92% - 42 mm	Diameter:	1 5/8"
Machine Used:	MH 24-64	Av. Diameter:	n/a
Location:	Comments:	Rope Speed:	204 ft/min (2.0 knots)
0	Start of test at Denman Island Terminal		
0.2	1 x 3" Calibration Wire		
0.5	2 x 3" Calibration Wires		
21.67	Magnetic Anomaly		
1657.3	LMA Anomaly – 1.2%		
1804.35	End of test at Buckley Bay side		
Comments:	Note: LMA locations may differ slightly from previous inspections due to factors such as, but not limited to: start placement of the test head, model of equipment used and/or interpretation of data by the technician.		
Specification:	Quality Control		

Technicians: R. Muirhead / N. Massong

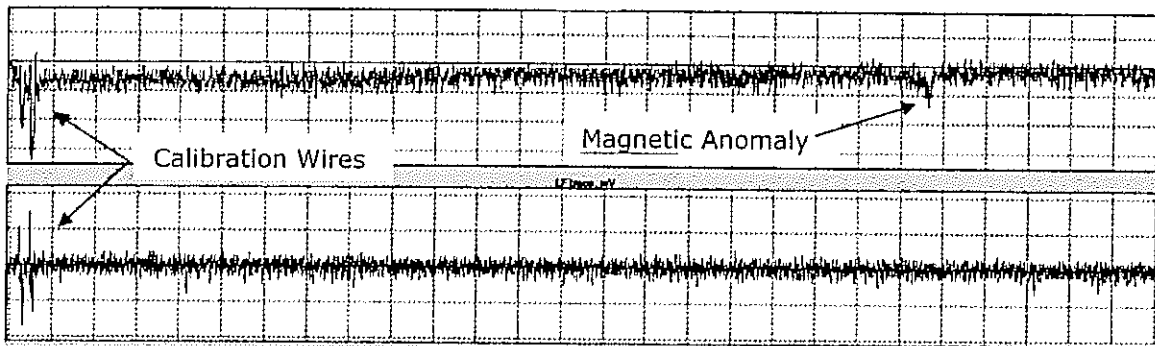
Data Interpreter: D. Muirhead

Baynes Sound Connector Cable Ferry – BC Ferries Asset #: 42076– December 13, 2016

This rope is currently in the "Drive" position.



Above: Full view of trace (Denman Island start) - Overall loss of percentage as shown by Full View trace indicates overall loss of metallic area up to 1% plus Individual areas of up to 1.2%.



Above: Detailed view of calibration wires and magnetic anomaly

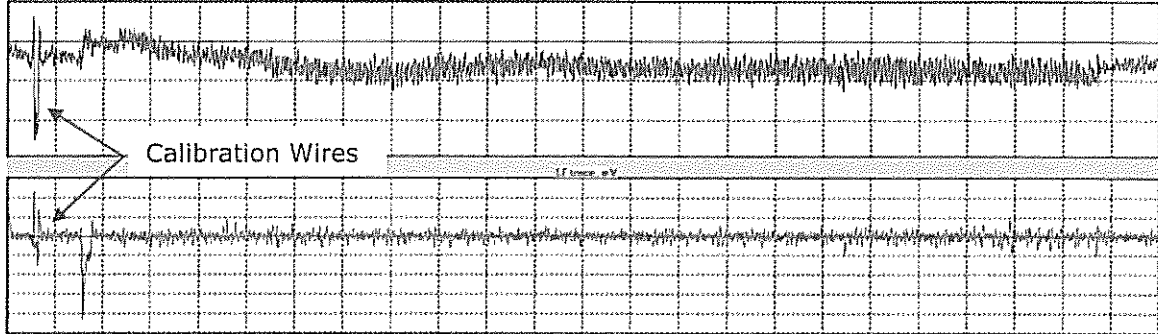
Shore to Pontoon Section:

The following traces represent the wire rope section located between shore and the corresponding pontoon. Each inspection was conducted from the shore to the pontoon.

Note: Manual speed and proximity to water surface may cause variances in each trace.

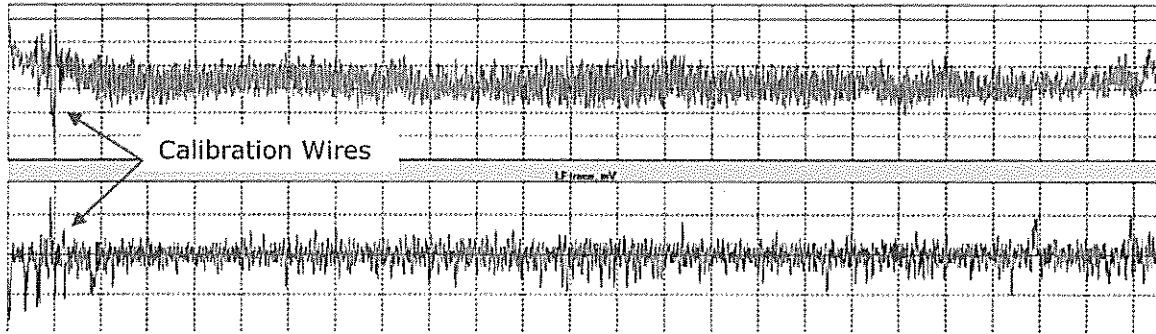
Drive Rope – BCF Asset#: 42076

24.11m – Denman Island Side



Location (m):	Comments:
0	Start Test
0.58	3 x 3" Calibration Wire
24.11	End Test

23.29m – Buckley Bay Side



Location (m):	Comments:
0	Start Test
0.6	1 x 3" Calibration Wire
0.9	2 x 3" Calibration Wire
24.66	End Test

Baynes Sound Connector Cable Ferry – BC Ferries Asset #: 41878 – December 13, 2016

Inspection Results

Based on our observations at the time of this inspection, the following results were recorded:

Rope:	Baynes Sound Connector Cable Ferry – BC Ferries Asset #: 41878
Previously was the Drive Rope in November 2015	SN: 13072-03
Currently is the North Rope – December 2016	
Number of anomalies in November 2015:	Two (2)
Number of anomalies in April 2016:	Twenty-Seven (27)
Number of anomalies in July 2016:	Forty (40)
Largest LMA Anomaly in December 2016:	2.6%

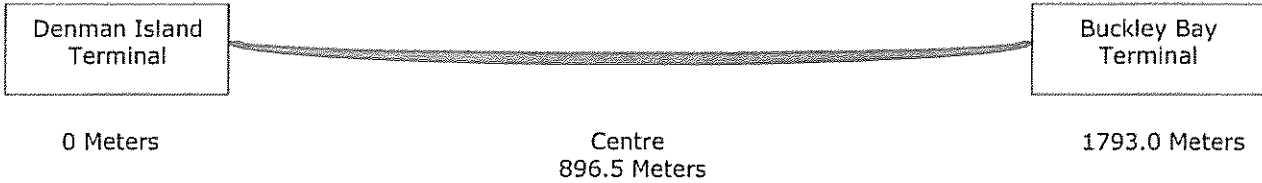
Non-destructive testing was conducted on the accessible length of this wire rope as well as a visual inspection at several locations on the body of this wire rope. Please refer to the following chart for a more complete analysis of this wire rope.

As a change in the reporting structure has been requested, Inter-Mtn Testing will now provide the largest LMA anomaly per inspection, as opposed to the quantity of anomalies found. The reason is to provide more relevant information and mitigate reporting variables.

This wire rope was found to be in good condition at the time of this inspection, no significant changes since last test in July 2016. This rope has not been rotated since the last test in July 2016.

Note: Visual inspection was difficult due to plastic coating and mud on ropes. Diameter measurements were not accurate due to plastic coating interference.

BC Ferry Services Inc. – BC Ferries Asset # 41878 – December 13, 2016



Baynes Sound Connector Cable Ferry – BC Ferries Asset #: 41878 – North Rope			
Rope Construction:	6 X 19 Seale	Length:	1793.1 meters
Sens:	92% @ 42mm	Diameter:	1 5/8"
Machine Used:	Wintros 24-64	Rope Position	North
Location	Comments	Location	Comments
0	Start of test at Buckley Bay side	1232.3	LMA Anomaly – 1.5%
0.4	1 x 3" Calibration Wire	1333.1	LMA Anomaly – 1.5%
1	2 x 3" Calibration Wires	1333.2	LMA Anomaly – 1.4%
448.4	LMA Anomaly – 1.5%	1334.4	LMA Anomaly – 1.3%
600.9	LMA Anomaly – 2.6%	1334.5	LMA Anomaly – 1.5%
621.5	LMA Anomaly – 2.2%	1335.4	LMA Anomaly – 0.8%
639.5	LMA Anomaly – 2.2%	1336.0	LMA Anomaly – 1.2%
642.5	LMA Anomaly – 2.4%	1336.1	LMA Anomaly – 1.4%
642.9	LMA Anomaly – 0.9%	1336.2	LMA Anomaly – 1.3%
643.5	LMA Anomaly – 2.2%	1336.3	LMA Anomaly – 1.4%
648.3	LMA Anomaly – 1.2%	1336.5	LMA Anomaly – 1.1%
658.4	LMA Anomaly – 1.0%	1336.8	LMA Anomaly – 1.6%
659.0	LMA Anomaly – 1.8%	1352.5	LMA Anomaly – 0.8%
667.5	LMA Anomaly – 0.8%	1355.8	LMA Anomaly – 1.4%
669.9	LMA Anomaly – 1.7%	1793.1	End of test at Denman Island Side
748.9	LMA Anomaly – 1.5%		
750.5	LMA Anomaly – 1.4%		
752.4	LMA Anomaly – 1.4%		
1023.2	LMA Anomaly – 1.2%		
1043.6	LMA Anomaly – 1.1%		
1089.3	LMA Anomaly – 0.7%		
1094.9	LMA Anomaly – 0.9%		
1101.8	LMA Anomaly – 1.4%		
1146.3	LMA Anomaly – 2.1%		
1172.8	LMA Anomaly – 1.4%		
1178.3	LMA Anomaly – 1.6%		
1203.3	LMA Anomaly – 1.6%		
Additional Comments:	Untested cable: Denman Island to test head – approximately 10 meters and test head to excess cable on Buckley Bay – approximately 330 meters. Approximately 340 meters of cable not tested.		
Specification:	Quality Control		

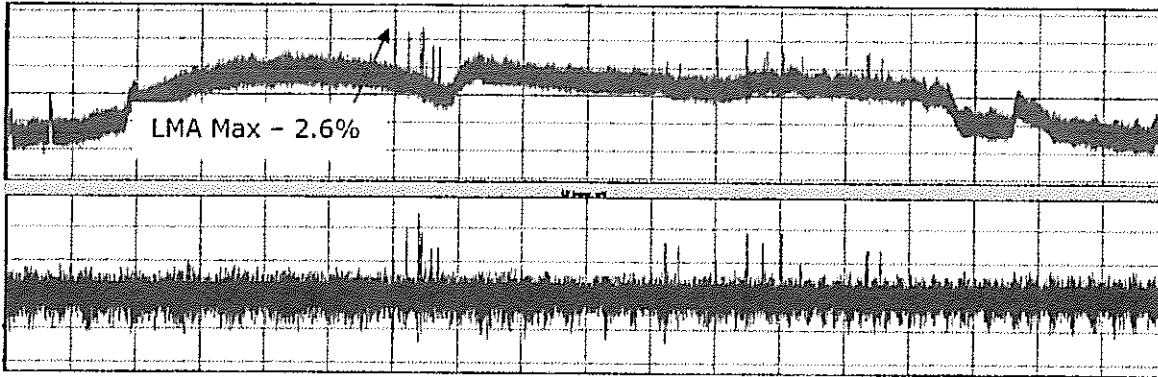
Note:
 Using the different type of inspection equipment, Inter-Mtn. Testing Ltd. is able to view a more detailed inspection, therefore; anomalies previously found may differ slightly in size and location from the results of the most current inspection.

Technicians: R. Muirhead / N. Massong

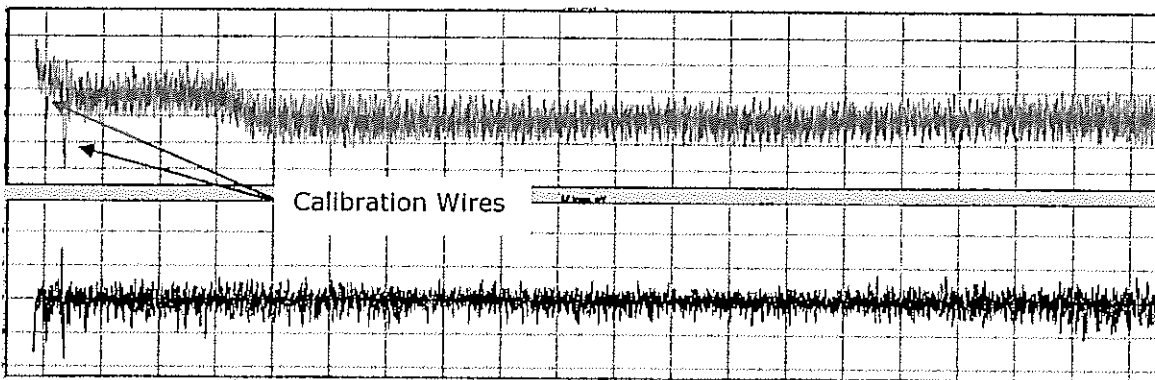
Data Interpreter: D. Muirhead

Baynes Sound Connector Cable Ferry – BC Ferries Asset #: 41878 – December 13, 2016

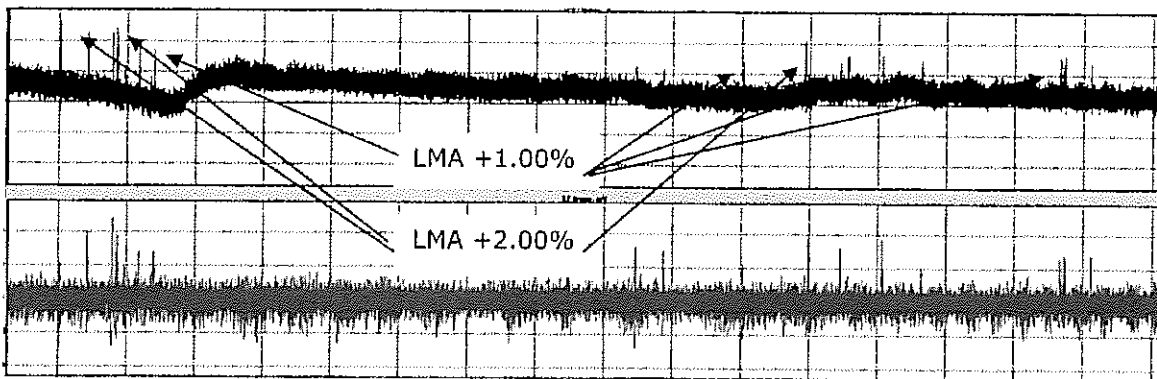
This rope is currently in the "North" position.



Above: Full view of trace (Denman Island start) - Overall loss of percentage as shown by Full View trace indicates overall loss of metallic area up to 2% plus individual areas of up to 2.6%.



Above: Detailed view of calibration wires



Above: Detailed view of LMA Loss and Gain

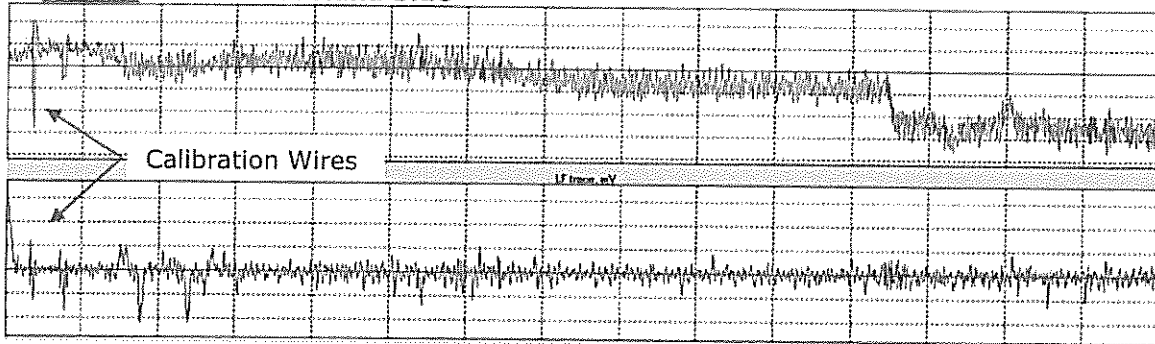
Baynes Sound Connector Cable Ferry – BC Ferries Asset #: 41878 – December 13, 2016

Shore to Pontoon Section:

The following traces represent the wire rope section located between shore and the corresponding pontoon. Each inspection was conducted from the shore to the pontoon.

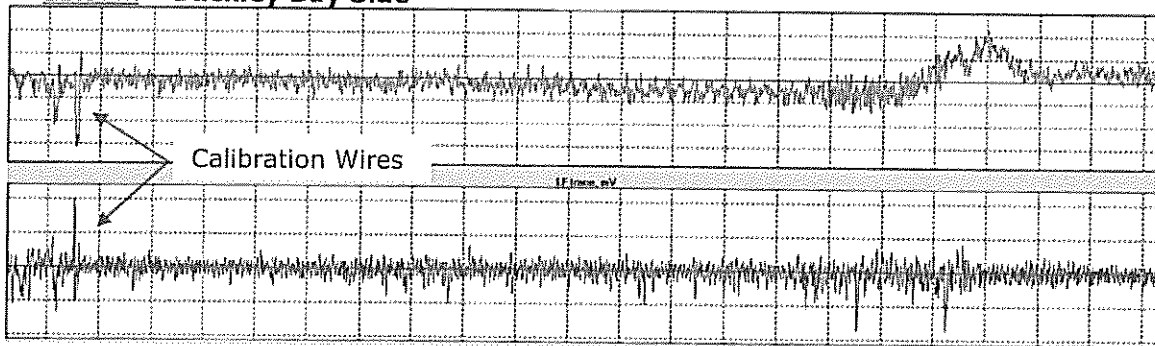
Note: Manual speed and proximity to water surface may cause variances in each trace.

**North Rope – BCF Asset#: 41878
15.03m – Denman Island Side**



Location (m):	Comments:
0	Start Test
0.32	1 x 3" Calibration Wire
0.71	2 x 3" Calibration Wire
15.03	End Test

22.17m – Buckley Bay Side



Location (m):	Comments:
0	Start Test
0.9	1 x 3" Calibration Wire
1.3	2 x 3" Calibration Wire
22.17	End Test