



Date: July 19, 2016

Job #: 7198

PO #: 281046

British Columbia Ferry Services Inc.  
Suite 500, 1321 Blanshard Street  
Victoria, BC V8W 0B7

Attention: Mr. Dan Isenor

Dear Sir:

As requested, Non-Destructive Testing has been conducted on July 19, 2016, on the following:

- **Spelter Sockets and Visual Inspection of Wire Ropes thru pontoons**

Please find the attached Test Report Forms to provide specific details of any discontinuity indications which were located at the time of this inspection.

We trust this information meets your present requirements. If you have any questions, please contact our office.

Yours truly,

**Inter-Mtn. Testing Ltd.**

s. 22 - signature

Don Muirhead  
President

DM/ta

## NON DESTRUCTIVE TESTING REPORT

**Client:** British Columbia Ferry Services  
Inc.  
Suite 500, 1321 Blanshard Street  
Victoria, BC V8W 0B7

<b>Job #:</b>	7198
<b>Date:</b>	July 19, 2016
<b>PO #:</b>	281046
<b>Client Rep.:</b>	S. Dubiel
<b>Location:</b>	Vancouver Island

**Attention:** Mr. Dan Isenor

<b>Items Inspected:</b>	Three (3) Spelter Sockets		
<b>Type of Inspection:</b>	Visual		
<b>Test Equipment:</b>	<b>AC Yoke Serial #:</b> n/a	<b>Epoch III Serial #:</b>	n/a
<b>Surface:</b>	Clean Bare Metal	<b>Medium:</b>	n/a
<b>Specification/Code:</b>	Quality Control		

### **Inspection Results:**

At the time of inspection, the equipment noted below was tested using Visual Testing techniques and was found to be free of indications at this time.

### **Tested:**

Three (3) ESCO Spelter Sockets at the Denman Island Terminal

- Drive Rope SN: WRI, 130172-03, Spelter Socket SN: F050
- South Rope SN: WRI, 130172-02, Spelter Socket SN: F068
- North Rope SN: WRI, 130172-01, Spelter Socket SN: 0849

Note: Only partial inspection as covers were over sockets.

**Technician:** R. Muirhead (CGSB 48.9712 – MT2E, PT2E)

#### **Limitation of Liability**

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## NON DESTRUCTIVE TESTING REPORT

**Client:** British Columbia Ferry Services  
Inc.  
Suite 500, 1321 Blanshard Street  
Victoria, BC V8W 0B7

<b>Job #:</b>	7198
<b>Date:</b>	July 19, 2016
<b>PO #:</b>	281046
<b>Client Rep.:</b>	S. Dubiel
<b>Location:</b>	Vancouver Island

**Attention:** Mr. Dan Isenor

<b>Items Inspected:</b>	Two (2) Floating pontoons - Twelve (12) rope entrance and exit locations
<b>Type of Inspection:</b>	Visual
<b>Specification/Code:</b>	Quality Control

### **Inspection Results:**

At the time of inspection, the equipment noted below was tested using Visual Testing techniques and was found to be free of indications at this time.

### **Tested:**

Six (6) locations on each floating pontoon (12 total locations) where the wire rope enters the pontoon from the ocean side and exits towards the land side anchors.

Areas inspected include the bell to rope contact area at the entrance and exit of each pontoon and approximately one (1) meter (outside) and (inside) of the bell.

Each examined area was found to free of external damages. Minor corrosion and rusting was apparent at all examined locations.

**Technician:** R. Muirhead (CGSB 48.9712 – MT2E, PT2E)

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# Wire Rope Report

**Denman Island Cable Ferry  
British Columbia  
Ferry Services Inc.**

Suite 500, 1321 Blanshard Street  
Victoria, BC V8W 0B7  
Canada

by  
**Inter-Mtn. Testing Ltd.**

Job #: 7198  
Date: July 20, 2016

## Introduction

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

### Denman Island Cable Ferry

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 broken wires (internal or external), indentations, or loss of metal 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 broken wires in the strand
- Quantity of broken wires
- Diameter of broken wires
- Gap between broken wires
- Sideways displacement of ends of broken wires

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.

The testing equipment was positioned at the end sheave closest to pontoon on the ferry; therefore, portions of the rope not able to be tested include the following:

- **Denman Island Terminal:** Test head location on ferry to Spelter socket – approximately 10 meters.
- **Buckley Bay Terminal:** Test head location at front sheave on ferry to carpenter stoppers (excess cable after carpenter stopper included) – approximately 320 meters.

Due to factors such as, but not limited to; submersion of the rope in water, access to the rope inside of the terminal bridge pontoons, access to the rope from pontoons to the carpenter stoppers in the Buckley Bay terminal and the manner in which the excess rope is stored prevented Inter-Mtn. Testing Ltd. technicians from obtaining 100% coverage of the 2140 meters of rope.

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 these wire ropes 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 these wire ropes at the time of this inspection. IMT does not warranty the future condition of these wire ropes subsequent to this inspection. This report does not include any analysis on the design or engineering of these wire ropes in this application.

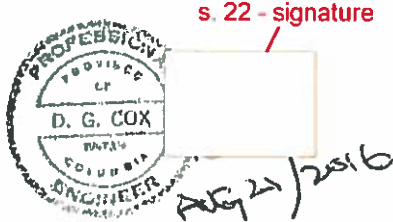
We trust this information meets your present requirements. Please contact our office if you have any questions or require further information.

Yours truly,

**Inter-Mtn. Testing Ltd.**

s. 22 - signature

Don Muirhead  
President



Reviewed by:

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

DM/ta

**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.

## Inspection Results

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

<b>Rope:</b>	Denman Island Cable Ferry – North Rope
<b>Previously was the Drive Rope in November 2015</b>	
<b>Number of anomalies in November 2015:</b>	Two (2)
<b>Number of anomalies in April 2016:</b>	Twenty-Seven (27)
<b>Number of anomalies in July 2016:</b>	Forty (40)

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 Wire Rope Test Report for a more complete analysis of this wire rope.

<b>Rope:</b>	Denman Island Cable Ferry – Drive Rope
<b>Previously was the South Rope in November 2015</b>	
<b>Number of anomalies in November 2015:</b>	Two (2)
<b>Number of anomalies in April 2016:</b>	Four (4)
<b>Number of anomalies in July 2016:</b>	Seven (7)

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 Wire Rope Test Report for a more complete analysis of this wire rope.

<b>Rope:</b>	Denman Island Cable Ferry – South Rope
<b>Previously was the North Rope in November 2015</b>	
<b>Number of anomalies in November 2015:</b>	Three (3)
<b>Number of anomalies in April 2016:</b>	Fifty-Seven (57)
<b>Number of anomalies in July 2016:</b>	Fifty-Nine (59)

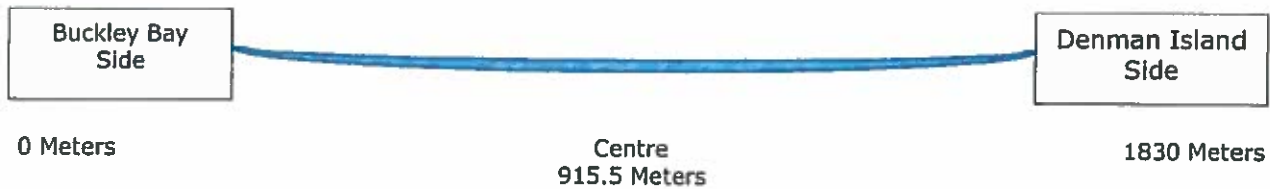
Non-destructive testing was conducted on the accessible length of this wire rope as well as a visual inspection at several locations on the body of this wire rope. Please refer to the Wire Rope Test Report for a more complete analysis of this wire rope.

**These wire ropes were found to be in good condition at the time of this inspection, no significant changes since last test in April 2016. A visual inspection of North and South wire ropes in area between 1000-1160 meters confirmed single broken wires and some corrosion.**

**Note: Visual inspection was difficult due to plastic coating and mud on ropes. Diameter measurements were not accurate due to plastic coating interfering. North and South guide ropes were also tested in accessible (20m) section between sockets and pontoon on the Denman Island side. No discontinuities or significant loss of metallic area was detected on either ropes in these areas.**

**Note: Wire ropes have not been rotated since the last test in April 2016.**

**BC Ferry Services Inc. - North Rope - July 20, 2016**



<b>Denman Island Ferry - North Rope</b>			
<b>Rope Construction:</b>	6 X 19 Seale	<b>Length:</b>	1830 meters
<b>Sens:</b>	2.42 - 2.05	<b>Diameter:</b>	1 5/8"
<b>Machine Used:</b>	LMA 300 (C)	<b>Av. Diameter:</b>	n/a
<b>Location</b>	<b>Comments</b>	<b>Rope Speed:</b>	1.2 m/sec (2.5 knots)
		<b>Location</b>	<b>Comments</b>
0	Start of test at Buckley Bay side	1171	One (1) broken wire
150	Two (2) calibration wires - 3" long	1176	Two (2) broken wires
457	One (1) broken wire	1177	One (1) broken wire
476	Two (2) broken wires	1180	Two (2) broken wires
476.5	One (1) broken wire	1198	Two (2) broken wires
478	One (1) broken wire	1200	One (1) broken wire - new
480	One (1) broken wire	1218	Two (2) broken wires
596	One (1) broken wire	1390	One (1) broken wire - new
621	One (1) broken wire - new	1760	Two (2) calibration wires - 3" long
642	One (1) broken wire	1761	One (1) calibration wire - 3" long
648	One (1) broken wire	1830	End of test at Denman Island Side
652	One (1) broken wire		
655	One (1) broken wire		
774	One (1) broken wire		
794	One (1) broken wire		
920	One (1) broken wire - new		
924	One (1) broken wire - new		
935	One (1) broken wire - new		
950	One (1) broken wire - new		
1090	One (1) broken wire - new		
1095	One (1) broken wire - new		
1105	One (1) broken wire - new		
1150	Two (2) broken wires		
1151	One (1) broken wire		
1152	One (1) broken wire		
1161	Two (2) broken wires		
1162	One (1) broken wire		
<b>Comments:</b>	<b>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.</b>		
<b>Specification:</b>	Quality Control		

**Technicians:** D. Muirhead, R. Muirhead

**Data Interpreter:** D. Muirhead



**BC Ferry Services Inc. - Drive Rope - July 20, 2016**



<b>Denman Island Ferry - Drive Rope</b>			
<b>Rope Construction:</b>	6 X 19 Seale	<b>Length:</b>	1500 meters
<b>Sens:</b>	2.42 - 2.05	<b>Diameter:</b>	1 5/8"
<b>Machine Used:</b>	LMA 250 (A)	<b>Av. Diameter:</b>	n/a
<b>Location</b>	<b>Comments</b>	<b>Rope Speed:</b>	1.2 m/sec (2.5 knots)
		<b>Location</b>	<b>Comments</b>
0	Start of test at Buckley Bay side		
210	Magnetic anomaly		
530	Wire gap - two (2) broken wires - not visually found		
640	Wire gap - two (2) broken wires - not visually found		
850	One (1) broken wire - new - not visually found		
900	Two (2) calibration wires - 3" long		
1130	One (1) broken wire - new - not visually found		
1265	One (1) broken wire - new - not visually found		
1498	Two (2) calibration wires - 3" long		
1500	End of test at Denman Island side		
<b>Comments:</b>	<b>Untested cable: Denman Island to test head - approximately 30 meters and test head to excess cable on Buckley Bay - approximately 350 meters. Approximately 380 meters of cable not tested.</b>		
<b>Specification:</b>	Quality Control		

**Technicians:** D. Muirhead, R. Muirhead

**Data Interpreter:** D. Muirhead

**BC Ferry Services Inc. - South Rope - July 20, 2016**



<b>Denman Island Ferry - South Rope</b>			
<b>Rope Construction:</b>	6 X 19 Seale	<b>Length:</b>	1830 meters
<b>Sens:</b>	2.42 - 2.05	<b>Diameter:</b>	1 5/8"
<b>Machine Used:</b>	LMA 300 (C)	<b>Av. Diameter:</b>	n/a
<b>Location</b>	<b>Comments</b>	<b>Rope Speed:</b>	1.2 m/sec (2.5 knots)
		<b>Location</b>	<b>Comments</b>
0	Start at Buckley Bay side	1109	One (1) broken wire - new
55	Two (2) calibration wires - 3" long	1112	One (1) broken wire
310	One (1) broken wire - new	1115	One (1) broken wire
362	1+1 broken wires & nick/abrasion	1116	One (1) broken wire
387	Two (2) broken wires	1118	One (1) broken wire
613	One (1) broken wire	1119	One (1) broken wire
754	One (1) broken wire	1125	One (1) broken wire
903	One (1) broken wire	1127	One (1) broken wire
908	One (1) broken wire	1128	One (1) broken wire
1021	One (1) broken wire	1129	One (1) broken wire
1024	One (1) broken wire	1134	One (1) broken wire
1025	One (1) broken wire	1135	One (1) broken wire
1029	One (1) broken wire	1140	One (1) broken wire
1044	One (1) broken wire	1141	One (1) broken wire
1050	One (1) broken wire	1144	One (1) broken wire
1054	One (1) broken wire	1146	One (1) broken wire
1056	One (1) broken wire	1147	One (1) broken wire
1057	One (1) broken wire	1149	One (1) broken wire
1062	One (1) broken wire	1152	One (1) broken wire
1064	One (1) broken wire	1153	One (1) broken wire
1070	One (1) broken wire	1156	One (1) broken wire
1078	One (1) broken wire	1157	One (1) broken wire
1086	One (1) broken wire	1158	One (1) broken wire
1088	One (1) broken wire	1163	One (1) broken wire
1090	One (1) broken wire	1164	One (1) broken wire
1095	One (1) broken wire	1165	One (1) broken wire
1097	One (1) broken wire	1728	Two (2) calibration wires - 3" long
1098	One (1) broken wire	1729	One (1) calibration wire - 3" long
1103	One (1) broken wire	1740	Two (2) broken wires (not visually located)
1104	One (1) broken wire	Some rope distortion - previously identified	
1107	One (1) broken wire	1830	End of test at Denman Island side
<b>Comments:</b>	<b>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.</b>		
<b>Specification:</b>	Quality Control		

**Technicians:** D. Muirhead, R. Muirhead

**Data Interpreter:** D. Muirhead

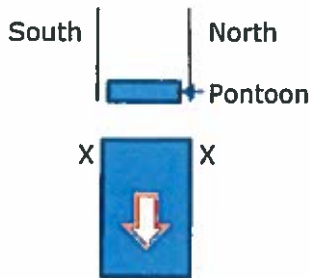
Denman Island Cable Ferry - Original Chart Table

Test #	Rope	Rope SN	BCF Asset #	Date
1	North	WR1, 13072-03	41874	November 2015
1	Drive	WR1, 13072-02	42076	November 2015
1	South	WR1, 13072-01	41876	November 2015

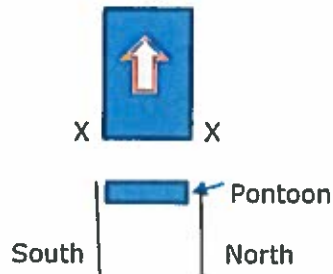
Test #	Test #2 - April 2016, Test #3 July 2016
2 and 3	Original North rope became the South rope in April and July 2016
2 and 3	Original Drive rope became the North rope in April and July 2016
2 and 3	Original South rope became the Drive rope in April and July 2016



**Run #1 Denman to Buckley**



**Run #2 Buckley to Denman**



X = Test head location

Equipment set up to give extra length within 20' of pontoon for Run #2 to other end of ferry.