



Date: April 19, 2016

Job #: 7198

PO #: 277330

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

Attention: Mr. James Adams

Dear Sir:

As requested, Non-Destructive Testing has been conducted on April 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

Job #:	7198
Date:	April 19, 2016
PO #:	277330
Client Rep.:	J. Adams
Location:	Vancouver Island

Attention: Mr. James Adams

Items Inspected:	Three (3) Spelter Sockets		
Type of Inspection:	Magnetic Particle		
Test Equipment:	AC Yoke Serial #: IMT01	Epoch III Serial #:	n/a
Surface:	Clean Bare Metal	Medium:	8-A Red
Specification/Code:	Quality Control		

Inspection Results:

At the time of inspection, the equipment noted below was tested using Magnetic Particle and 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

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.

NON DESTRUCTIVE TESTING REPORT

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

Job #:	7198
Date:	April 19, 2016
PO #:	277330
Client Rep.:	J. Adams
Location:	Vancouver Island

Attention: Mr. James Adams

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

Inspection Results:

At the time of inspection, the equipment noted below was tested using and 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: April 19, 2016

Introduction

As requested by Mr. James Adams, 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 center line of 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 30 meters.
- **Buckley Bay Terminal:** Test head location on ferry to carpenter stoppers (excess cable after carpenter stopper included) - approximately 350 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 the 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.



s. 22 - signature

Reviewed by:

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

DM/ta

Yours truly,

Inter-Mtn. Testing Ltd.

Don Muirhead
President

s. 22 - signature

Limitation of Liability

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Inspection Results

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

Rope:	Denman Island Cable Ferry – North Rope
Previously was the Drive Rope in November 2015:	(2) anomalies
Number of anomalies in April 2016:	27
Average diameter measured:	1.67"
Minimum diameter measured:	1.64"
Number of diameter measurements taken:	17

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.

Rope:	Denman Island Cable Ferry – Drive Rope
Previously was the South Rope in November 2015:	(2) anomalies
Number of anomalies in April 2016:	4
Average diameter measured:	1.68"
Minimum diameter measured:	1.67"
Number of diameter measurements taken:	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 Wire Rope Test Report for a more complete analysis of this wire rope.

Rope:	Denman Island Cable Ferry – South Rope
Previously was the North Rope in November 2015:	(3) anomalies
Number of anomalies in April 2016:	57
Average diameter measured:	1.67"
Minimum diameter measured:	1.66"
Number of diameter measurements taken:	17

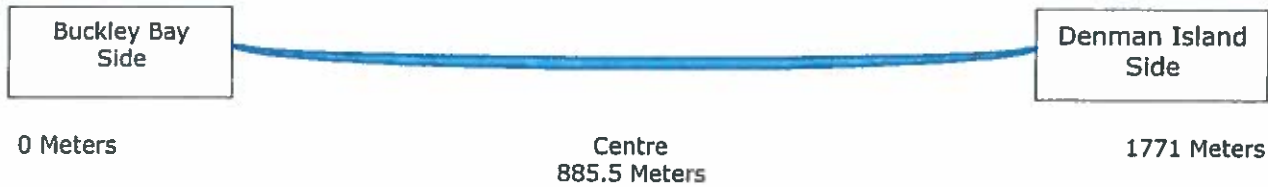
Non-destructive testing was conducted on the accessible length of this wire rope as well as a visual inspection at several locations on the body of this wire rope. Please refer to the Wire Rope Test Report for a more complete analysis of this wire rope.

These wire ropes were found to be in good condition at the time of this inspection.

Note: Wire ropes have been rotated since the last test in November 2015.

North rope (SN-WR1, 130172-03 BCF Asset # 41874) became the South rope in April 2016
Drive rope (SN-WR1-130172-02 BCF Asset # 42076) became the North rope in April 2016
South rope (SN-WR1-130172-01 BCF Asset # 41876) became the Drive rope in April 2016

BC Ferry Services Inc. - North Rope ~ April 19, 2016



Denman Island Ferry - North Rope			
Rope Construction:	6 X 19 Seale	Length:	1771 meters
Sens:	2.42 - 2.05	Diameter:	1 5/8"
Machine Used:	LMA 300 (C)	Av. Diameter:	1.67"
Location	Comments	Location	Comments
0	Start of test at Buckley Bay side		
31	Two (2) calibration wires - 3" long		
32	One (1) calibration wire - 3" long		
457	One (1) broken wire		
476	Two (2) broken wires		
476.5	One (1) broken wire		
478	One (1) broken wire		
480	One (1) broken wire		
596	One (1) broken wire		
642	One (1) broken wire		
648	One (1) broken wire		
652	One (1) broken wire		
655	One (1) broken wire		
774	One (1) broken wire		
794	One (1) broken wire		
1150	Two (2) broken wires		
1151	Nick/abrasion		
1152	Nick/abrasion		
1161	Two (2) broken wires		
1162	Nick/abrasion		
1171	One (1) broken wire		
1176	Two (2) broken wires		
1177	One (1) broken wire		
1180	Two (2) broken wires		
1198	Two (2) broken wires		
1218	Two (2) broken wires		
1771	End of test at Denman Island Side		
Comments:	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.		
Specification:	Quality Control		

Technicians: D. Muirhead, R. Muirhead

Data Interpreter: D. Muirhead

BC Ferry Services Inc. - Drive Rope – April 19, 2016



Denman Island Ferry – Drive Rope			
Rope Construction:	6 X 19 Seale	Length:	1500 meters
Sens:	SU 30-35	Diameter:	1 5/8"
Machine Used:	MH 24-64	Av. Diameter:	1.68"
Location	Comments	Rope Speed:	1.2 m/sec (2.5 knots)
		Location	Comments
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		
1498	Two (2) calibration wires – 3" long		
1500	End of test at Denman Island side		
Comments:	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.		
Specification:	Quality Control		

Technicians: D. Muirhead, R. Muirhead, V. Klein

Data Interpreter: D. Muirhead

BC Ferry Services Inc. - South Rope - April 19, 2016



Denman Island Ferry - South Rope			
Rope Construction:	6 X 19 Seale	Length:	1750 meters
Sens:	2.42 - 2.05	Diameter:	1 5/8"
Machine Used:	LMA 300 (C)	Av. Diameter:	1.67"
Location	Comments	Rope Speed:	1.2 m/sec (2.5 knots)
0	Start at Buckley Bay side	Location	Comments
30	Two (2) calibration wires - 3" long	Continued	
362	1+1 broken wires & nick/abrasion	1107	One (1) broken wire
387	Two (2) broken wires	1112	One (1) broken wire
613	One (1) broken wire	1115	One (1) broken wire
754	One (1) broken wire	1116	One (1) broken wire
903	One (1) broken wire	1118	One (1) broken wire
908	One (1) broken wire	1119	One (1) broken wire
1021	One (1) broken wire	1125	One (1) broken wire
1024	One (1) broken wire	1127	One (1) broken wire
1025	One (1) broken wire	1128	One (1) broken wire
1029	One (1) broken wire	1129	One (1) broken wire
1044	One (1) broken wire	1134	One (1) broken wire
1050	One (1) broken wire	1135	One (1) broken wire
1054	One (1) broken wire	1140	One (1) broken wire
1056	One (1) broken wire	1141	One (1) broken wire
1057	One (1) broken wire	1144	One (1) broken wire
1062	One (1) broken wire	1146	One (1) broken wire
1064	One (1) broken wire	1147	One (1) broken wire
1070	One (1) broken wire	1149	One (1) broken wire
1078	One (1) broken wire	1152	One (1) broken wire
1086	One (1) broken wire	1153	One (1) broken wire
1088	One (1) broken wire	1156	One (1) broken wire
1090	One (1) broken wire	1157	One (1) broken wire
1095	One (1) broken wire	1158	One (1) broken wire
1097	One (1) broken wire	1163	One (1) broken wire
1098	One (1) broken wire	1164	One (1) broken wire
1103	One (1) broken wire	1165	One (1) broken wire
1104	One (1) broken wire	1740	Two (2) broken wires - not visible
Continued...		Some rope distortion - previously identified	
		1750	End of test Denman Island side
Comments:	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.		
Specification:	Quality Control		

Technicians: D. Muirhead, R. Muirhead

Data Interpreter: D. Muirhead

#102-140 Commercial Drive, Kelowna, B.C. Canada V1X 7X6

tel 250-491-4250 fax 250-801-6849

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 #	April 2016
2	Original North rope became the South rope in April 2016
2	Original Drive rope became the North rope in April 2016
2	Original South rope became the Drive rope in April 2016

