



EM Hose Strain Test Report

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1.0 Scope

The objective of this test was to characterize the strain distribution of two 5m OOI EM stretch hoses (ref item 3707-00351) by quantifying dimensional changes in diameter at predetermined intervals as a result of strain induced by the application of various tensile loads. Continuity of conductor bundles in each hose was verified before and after test.

2.0 Overview

Test was conducted using Roberts Horizontal Tensile Tester located in the rigging shop. A current calibration certificate was obtained during a prior test. During filling, each hose was fixtured by holding the terminations upwards while filling with water ensuring that internal air-bubbles were not introduced. Both were closed with an SAE plug screw with integral O-ring to seal the inside sections. Hoses were marked at 20 cm intervals for measurement location consistency. Each hose was labeled 1 and 2. All values are in metric units unless otherwise noted.

For raw test data, see Appendix A. The original length (L-orig.) of both hoses was approximately 457cm. The final length for both hoses was limited to the stroke of the Horizontal Tensile Tester to 640cm. Both tests were conducted at ambient room temperature. Internal fluid pressure was not evaluated in this test in contrast to previous tests.



3.0 Test Procedure

1. Apply item anti-seize item H to threads of bolt item E.
2. Assemble one interface plate item C using one style-B gasket to each end of hose item A.
3. Verify that nut items D have sufficient torque applied.
4. Mark one end of hose item A with number 1 and the other end as number 2.
5. Fix one shackle item G to each eye-tab of interface plate item C.
6. Assemble shackle of hose marked with number 1 to fixture of testing machine item I closest to controls (left side).
7. Assemble shackle of hose marked with number 2 to fixture of testing machine item I farthest from control panel (right side).
8. Verify calibrated gauge is set to zero.
9. Initiate pull test machine and stretch hose item A 30.5 cm and then hold.
10. Measure circumference of hose at each interval with measuring tape item K and record.
11. Check continuity of each wire. If continuity is interrupted, record color of wire.
12. Repeat Steps-9, 10, & 11 at increments of 30.5 cm a total of ten times until hose is stretched to approx. 762 cm in length (25 ft).
13. Verify tensile load immediately after machine stops.
14. Decrease load until hose reaches its original position.
15. Repeat Step 10.
16. Repeat Steps 1-15 for second hose.

4.0 Test Materials

- A. Quantity 2 - P/N T.B.D. – EM Hose Assembly 5m
- B. Quantity 2 - 3707-00195-00001 – Gasket, Style B, ¼ inch, Neoprene
- C. Quantity 2 - Style B interface plates, PN unknown
- D. Quantity 12 - 5/8-11 inch 316 nuts
- E. Quantity 12 - 5/8 x 3 inch 316 bolt
- F. Quantity 24 - 5/8 inch 316 flat washer
- G. Quantity 2 - 5/8 shackle
- H. Quantity as needed - Anti-seize or threadlock
- I. Quantity 1 - Horizontal tensile testing machine
- J. Quantity as needed - Fresh water, sufficient quantity to fill hose
- K. Quantity 1 - Measuring tape
- L. Quantity 1 - Digital multi-meter

5.0 Results

For raw test data, see Appendix A. The original length (L-orig.) of both hoses was approximately 457cm. The final length for both hoses was limited to the stroke of the Horizontal Tensile Tester to 640cm. Both tests were conducted at ambient room temperature. In both tests, the EM hoses exhibited time dependent variation as the hose was stretched and relaxed at each interval (Figure 1 & 2).

The dimensional change as a result of the applied load appeared to be normally distributed (Figure 3 & 4) and was concentrated around the median length. In both hoses, the greatest recorded change in diameter occurred at the 220cm interval. The average change in diameter at the center of the hose appeared to follow a Poisson distribution (Figure 7 & 8) but a larger sample size would be desirable to verify this. The maximum amount of tension was recorded at each interval. Tensile load was found to be non-linear with greater concentrations at the initial stretch intervals (Figure 5 & 6).

Figure-1

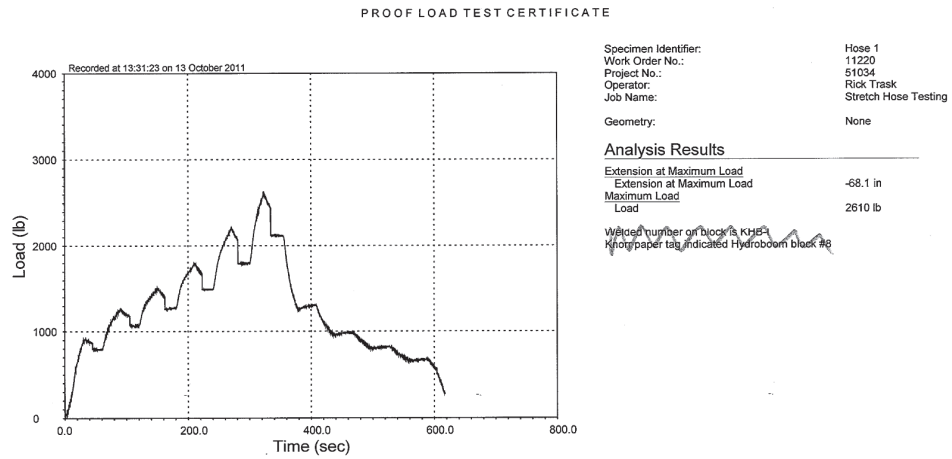


Figure-2

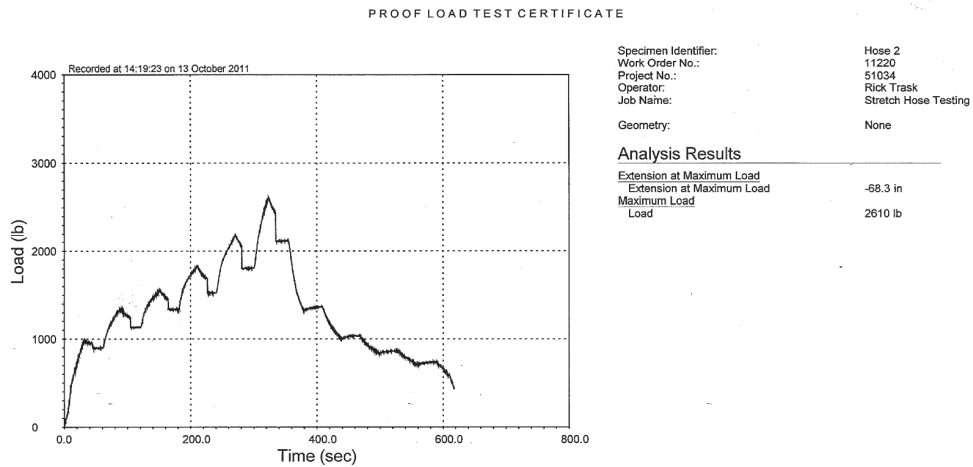


Figure-3

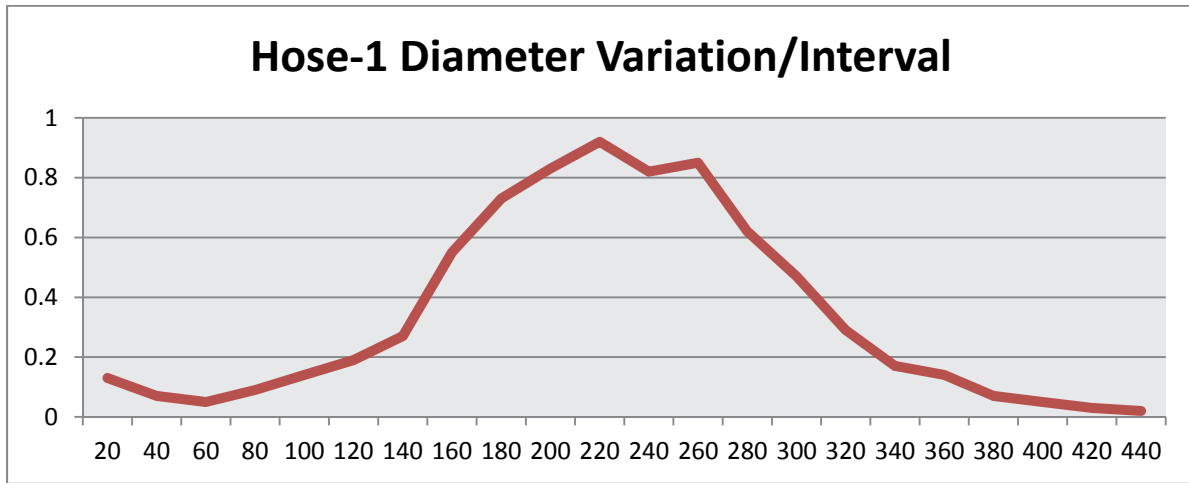


Figure-4

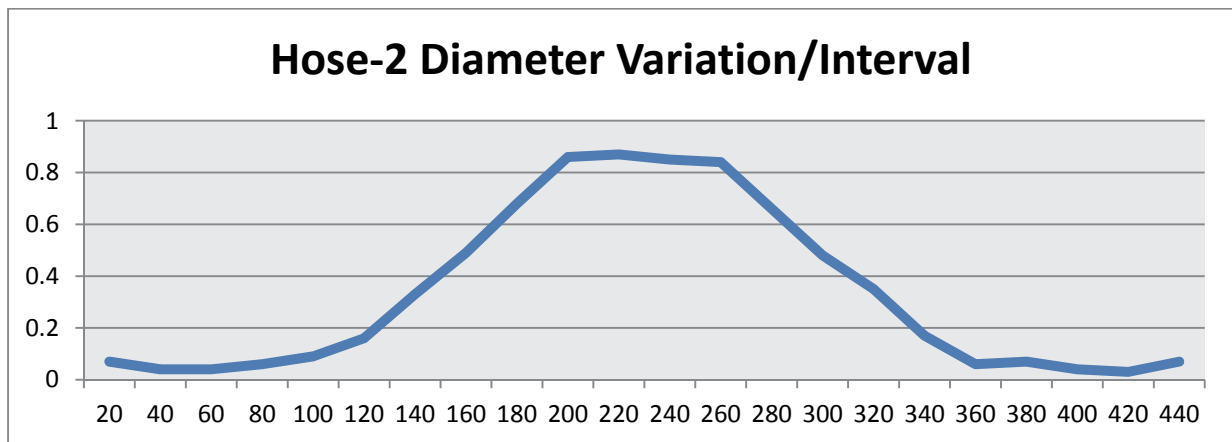


Figure-5

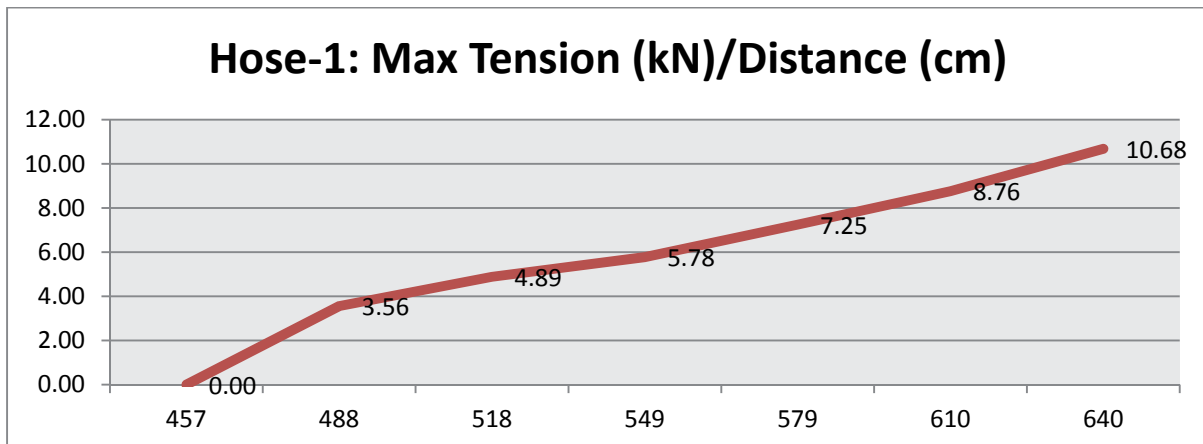


Figure-6

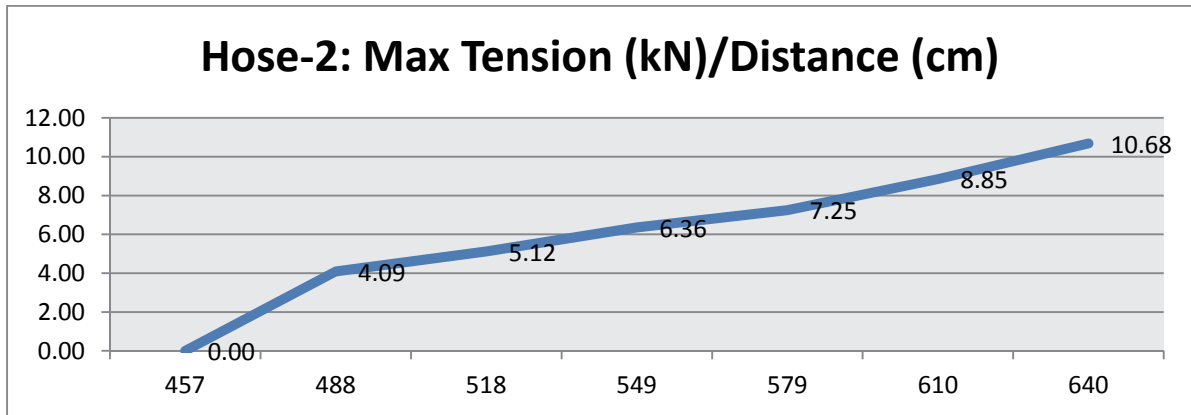


Figure-7

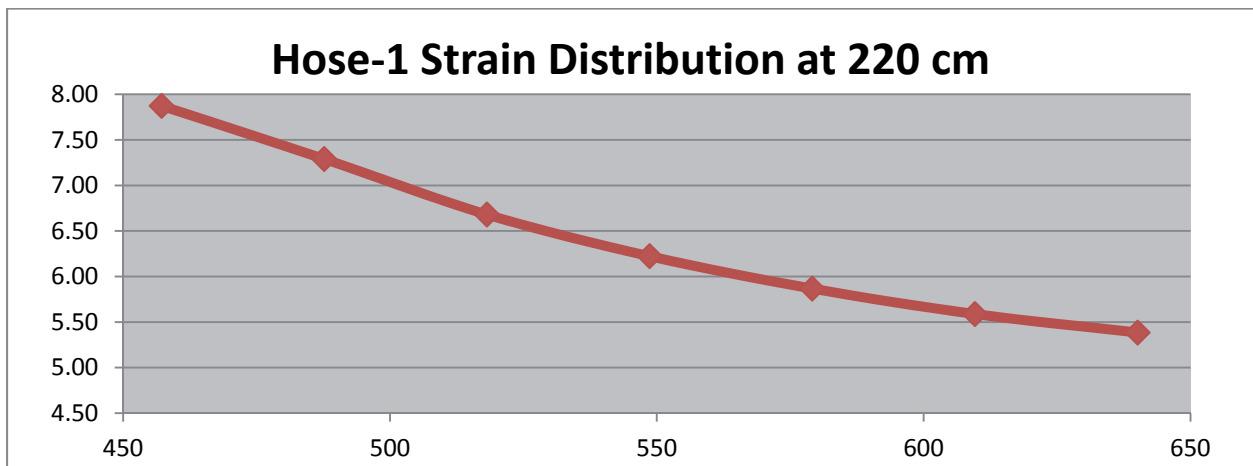
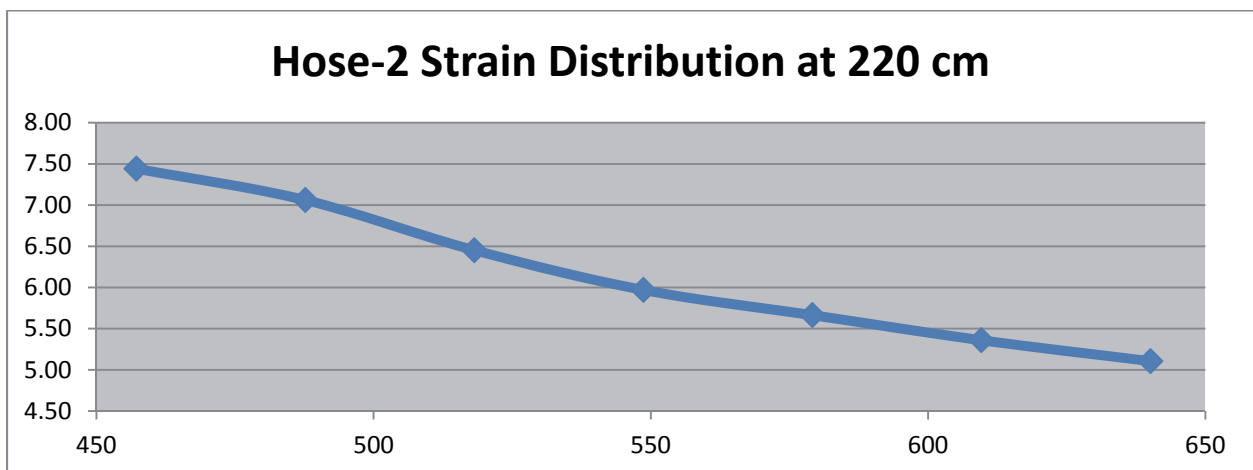


Figure-8



6.0 Summary

Both of hoses exhibited similar behaviors in each phase of the test. Initial tensile loads were found to be the greatest, followed by relaxation in recorded load values over time increments of 20-40 seconds. After this time, measured tensile load values remained constant. It is important to note, that measured values were conducted beginning at one end of each hose and required about five minutes overall. This means that the measurements taken at the center (where the greatest strain was observed) reflect the relaxed condition of the hose. Relaxation typically occurred 20-40 seconds after elongation at each interval. Additionally, wall thickness uniformity was not taken into consideration.

Appendix – A Test Data

Hose - 1 intervals (cm)	LENGTH ORIGINAL (cm)	INCREMENT-1	INCREMENT-2	INCREMENT-3	INCREMENT-4	INCREMENT-5	LENGTH FINAL (cm)
	457	488	518	549	579	610	640
20	16.51	16.38	16.51	16.54	16.76	16.64	16.43
40	17.34	17.27	17.15	17.17	17.22	17.22	17.15
60	13.21	13.21	13.18	13.13	13.18	13.18	13.06
80	9.91	9.83	9.78	9.78	9.70	9.68	9.65
100	9.45	9.32	9.27	9.22	9.17	9.12	9.02
120	9.14	9.02	8.94	8.92	8.81	8.74	8.56
140	8.89	8.76	8.66	8.64	8.51	8.26	8.13
160	8.56	8.31	8.13	7.92	7.57	7.24	7.11
180	8.38	8.00	7.75	7.42	6.93	6.60	6.43
200	7.87	7.57	7.06	6.63	6.22	5.89	5.72
220	7.87	7.29	6.68	6.22	5.87	5.59	5.38
240	7.75	6.55	6.68	6.22	5.84	5.56	5.33
260	7.62	7.47	6.91	6.35	6.05	5.69	5.46
280	7.87	7.87	7.65	7.24	6.86	6.55	6.38
300	8.26	8.26	8.13	7.92	7.59	7.24	7.14
320	8.51	8.79	8.66	8.56	8.43	8.15	7.98
340	9.14	8.94	8.94	8.89	8.81	8.69	8.64
360	9.32	9.19	9.14	9.14	9.02	9.02	8.92
380	10.11	10.03	10.01	9.98	9.98	9.93	9.91
400	13.08	13.16	13.08	13.08	13.08	13.00	13.03
420	16.89	16.89	16.87	16.87	16.89	16.81	16.84
440	16.38	16.38	16.43	16.38	16.38	16.38	16.38

Appendix – A Test Data

Hose-2 intervals (cm)	LENGTH						
	ORIGINAL (cm)	INCREMENT-1	INCREMENT-2	INCREMENT-3	INCREMENT-4	INCREMENT-5	LENGTH FINAL (cm)
	457	488	518	549	579	610	640
20	15.98	16.05	16.03	16.05	16.00	15.90	15.90
40	16.43	16.41	16.38	16.36	16.43	16.33	16.41
60	12.07	12.07	11.99	11.99	11.99	11.99	12.01
80	9.96	9.93	9.88	9.88	9.88	9.80	9.80
100	9.22	9.12	9.07	9.07	9.02	8.99	8.97
120	8.94	8.81	8.76	8.71	8.69	8.59	8.43
140	8.53	8.33	8.23	8.13	8.03	7.80	7.57
160	8.15	7.92	7.85	7.62	7.37	6.99	6.83
180	7.90	7.65	7.37	7.06	6.58	6.30	6.15
200	7.52	7.19	6.63	6.12	5.79	5.46	5.28
220	7.44	7.06	6.45	5.97	5.66	5.36	5.11
240	7.49	7.11	6.53	6.10	5.77	5.44	5.23
260	7.59	7.24	6.73	6.22	5.89	5.59	5.36
280	7.85	7.54	7.26	6.99	6.53	6.25	6.15
300	8.03	7.87	7.70	7.52	7.21	6.91	6.76
320	8.66	8.43	8.36	8.23	8.10	7.85	7.65
340	9.02	8.89	8.84	8.79	8.69	8.64	8.51
360	9.30	9.27	9.25	9.22	9.22	9.17	9.12
380	9.96	9.86	9.80	9.80	9.80	9.80	9.73
400	13.26	13.26	13.23	13.18	13.21	13.26	13.18
420	16.84	16.87	16.87	16.79	16.81	16.87	16.84
440	14.94	14.83	14.88	14.91	14.91	15.06	14.91