45000 Helm Street, Suite 150
Plymouth, MI 48170

Telephone: +1 734 582 2900
www.intertek.com

TRUCK FALL PROTECTION COMPANY LLC

ROPE SYSTEM DOWNWARD DEFLECTION EVALUATION TEST

SCOPE OF WORK:
OSHA 1910.29(b)(4), DATED MAY.05.2021 ON 1 NOFALLS SYSTEM KIT ON A FLATBED TRAILER

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RT-L-AMER-DET-005 (Oct 17, 2022)

TRUCK FALL PROTECTION COMPANY LLC
Jeff Bronson
20401 Trolley Industrial Drive
Taylor, MI 48180, USA
Ph: +1 (734) 624-7725
Email: jbronson@adicatrucking.com

SAMPLE DISPOSITION:

After testing, the samples were returned to the client for further evaluation.

ROPE SYSTEM DOWNWARD DEFLECTION EVALUATION TEST:

Date Received: NOV/10/2023
Date Tested: NOV/10/2023
Location Tested: Intertek – Plymouth, Michigan

DESCRIPTION OF SAMPLES:

Part Description: NoFalls System Kit
Condition of Sample: Production

TEST EQUIPMENT:

ASSET #	DESCRIPTION	MANUFACTURER	MODEL #	SERIAL #	CAL DUE
160692	LOAD CELL	LEBOW	3173-500	3136	NOV.03.2024
373-235	DC POWER SUPPLY	MASTECH	HY3030E	20181365	*VBU
373-345	DATA ACQ/SWITCH UNIT	KEYSIGHT	34972A	MY49030676	SEP.26.2024
373-879	STRING POT	MICRO-EPSILON	WDS-2000-P96-SR-U	32082	*VBU
373-900	MULTIMETER	FLUKE	116	60451530MV	MAR.08.2024
373-916	TAPE MEASURE	MILWAUKEE	48-22-6630	4524249939	NOV.09.2024

**VBU = Verified before use.*

TEST PROCEDURE:
Test Method: Per client request, with reference to OSHA 1910.29(b)(4), Dated May.20.2021
Number of Samples: One NoFalls System Kit on a Flatbed Trailer

- NoFalls System Kit

The customer requested that, in addition to the downward test load of 200-pound applied to the top guardrails, a 150-pound test load be applied outward to the middle guardrails. When defining downwards, the test load should be applied at a 90° angle to a flat surface, and the outward load should be applied parallel to the surface.

The NoFalls System Kit was secured onto a flatbed truck's trailer by the customer, with the wheels locked to ensure no rolling occurs. A ratchet strap attached to the guardrail being tested was pulled using a Servo motor to apply the requested test loads; a load cell was in line with this ratchet strap and pulley system to measure the test load.

A string pot, in line with the ratchet strap and pulley system, was used to measure the linear displacement of the ratchet strap attached to the guardrail where outward loads were applied. The string pot was verified using a calibrated tape measure. The calibration procedure used can be seen in Figure 1 below:

Tape Measure (in)	String Pot, Initial (in)	String Pot, Final (in)	String Pot Measurement (in)
1.0	78.530	77.505	1.025
5.0	78.514	73.531	4.983
12.0	78.523	66.515	12.008

Figure 1: String pot verification within the range of deflection (in) being tested

An uncalibrated tape measure was used to compare the unloaded height to the height of the guardrail under load where downward loads were applied.

Testing was done at laboratory ambient conditions at (23 ± 5) °C and 25—75% RH. The customer was present in the laboratory to observe testing.

ADDITIONAL TEST METHOD INFORMATION:
In addition to the outward 150-pound test load applied to the left-middle guardrail, excessive 200 and 250-pound forces were also applied to observe the guardrail's behavior per the customer's instruction. Excessive downward forces of 265 and 300 pounds were also applied to the left-top guardrail for similar reasons.

ACCEPTANCE CRITERIA:
As per OSHA 1910.29(b)(4), the acceptance criterion is as follows: when the 200-pound (890-N) test load is applied in a downward direction, the top rail of the guardrail system must not deflect to a height of less than 39 inches (99 cm) above the walking-working surface. The customer set an additional, similar acceptance criterion at a 150-pound test load, where the top rail of the guardrail system must not deflect to a height of less than 22 inches.

RESULTS:
Data from Figure 3 satisfies the acceptance criteria, and the top guardrails do not deflect to a height of less than 39 inches above the walking-working surface when a 200-pound load is applied. This holds for the 150-pound load as well, naturally, as less deflection is expected when a lesser load is applied.

TEST PROCEDURE (cont'd):

The bowing on the top-left metal guardrail is recorded to be 0.80 in as per data collected from the string pot, but the uncalibrated tape measure did not catch this deflection. This is well above the threshold for the acceptance criterion. Figure 3 also includes more abusive loads at 265 and 300 lbf, as per the customer's request. The data from the string pot was inconclusive for the top-right strap guardrail; however, the uncalibrated tape measure recorded the height to be 40.0 inches. The accuracy of an uncalibrated tape measure cannot be guaranteed. There are also other flaws with relying on results from a tape measure, as there is a higher possibility of user error from parallax and precise alignment. However, the resolution of a tape measure is sufficient for the acceptance criteria.

Data for deflection during outward pulls is included in the report for the customer to interpret, as Intertek was not given any acceptance criteria for outward test loads. A summary of this data can be seen in Figure 2. It may be worth noting that the rear wheels of the system are suspended mid-air during outward pulls; the force when this begins occurring was recorded to be approximately 40 lbf. Refer to Figure 23.

Where applicable, linear interpolation was used to estimate the deflection at the exact load points using the following equation: $x = x_1 + (F - F_1) \cdot (x_2 - x_1) \cdot (F_2 - F_1)^{-1}$. This is because the test load is applied at approximately the required load, not the exact load correct to the second decimal place.

The bottom-right weld broke off the system post-test. This did not occur during testing but while the sample was being moved. Refer to Figure 27.

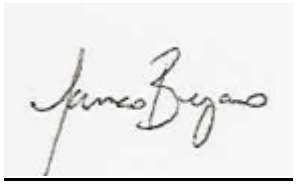
APPENDICES:

Appendix A – Results
Appendix B – Test Data
Appendix C – Photographs

REPORT AUTHORIZED PER ISO 17025:2017

When signed with physical or electronic signature, the contents of this report have been prepared and approved per Intertek's quality process in accordance with ISO 17025. This lab is accredited to ISO 17025 by A2LA under scopes 0078.04 & 0078.05.

Ayman Mannan
Engineer



James Bryans
Department Manager

APPENDIX A – RESULTS

Test Location	Direction	Force (lbf)	Deflection (in)
Left-Middle Strap	Outwards (180°)	150	9.37
		200	9.47
		250	10.37
Right-Middle Strap		150	9.01
		200	11.22

Figure 2: Deflection (in) results found for force (lbf) application for outward pulls from the string pot

Test Location	Direction	Force (lbf)	Measurement From Bed Floor to Guardrail (in)	Deflection (in)
Left-Top Bar	Downwards (90°)	0	50.5	0.0
		200	50.5	0.0
		265	50.0	0.5
		300	49.5	1.0
Right-Top Strap		0	50.5	0.0
		150	45.0	5.5
		200	40.0	10.5

Figure 3: Deflection (in) and measurement from bed pan to top guardrail results found for force (lbf) application for downward pulls from the measuring tape

APPENDIX B – TEST DATA

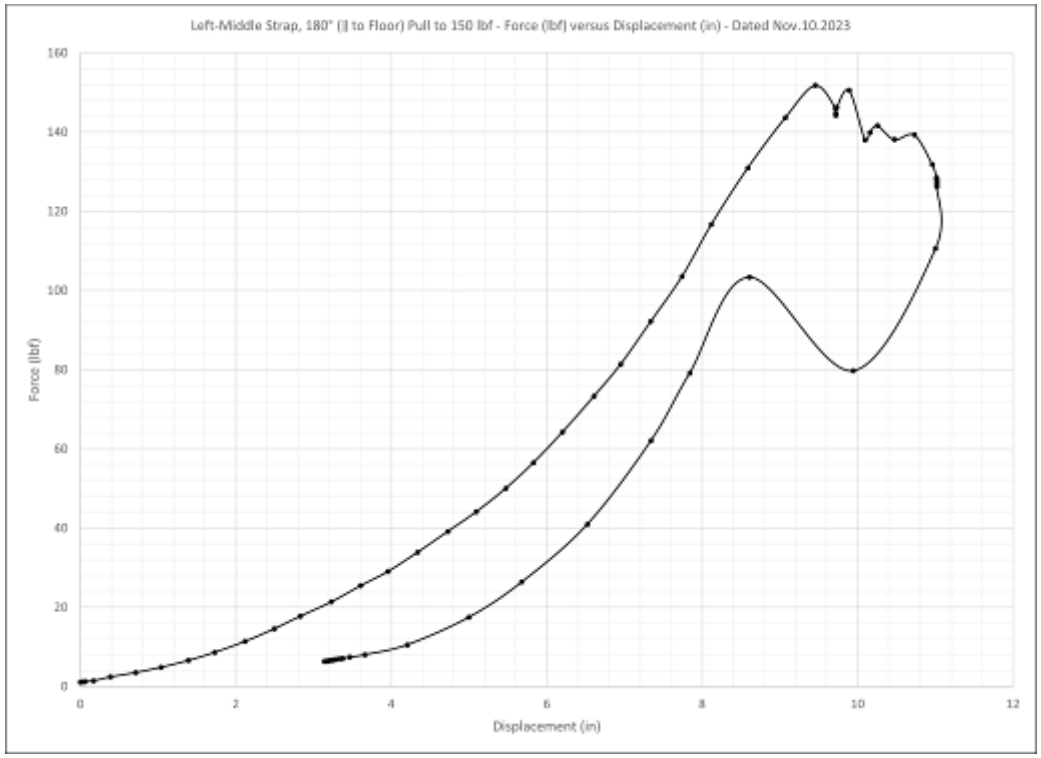


Figure 4: Left-middle strap, pull to 150 lbf, Force (lbf) versus Displacement (in)

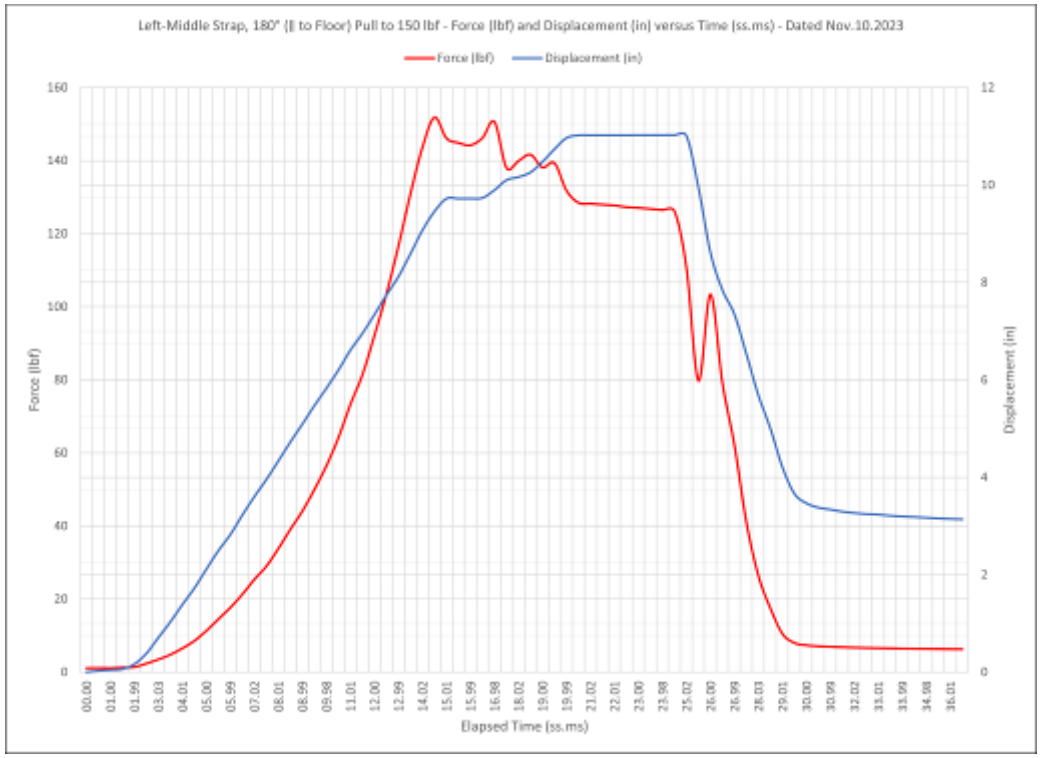


Figure 5: Left-middle strap, pull to 150 lbf, Force (lbf), and Displacement (in) versus Elapsed Time (ss.ms)

APPENDIX B – TEST DATA (cont'd)

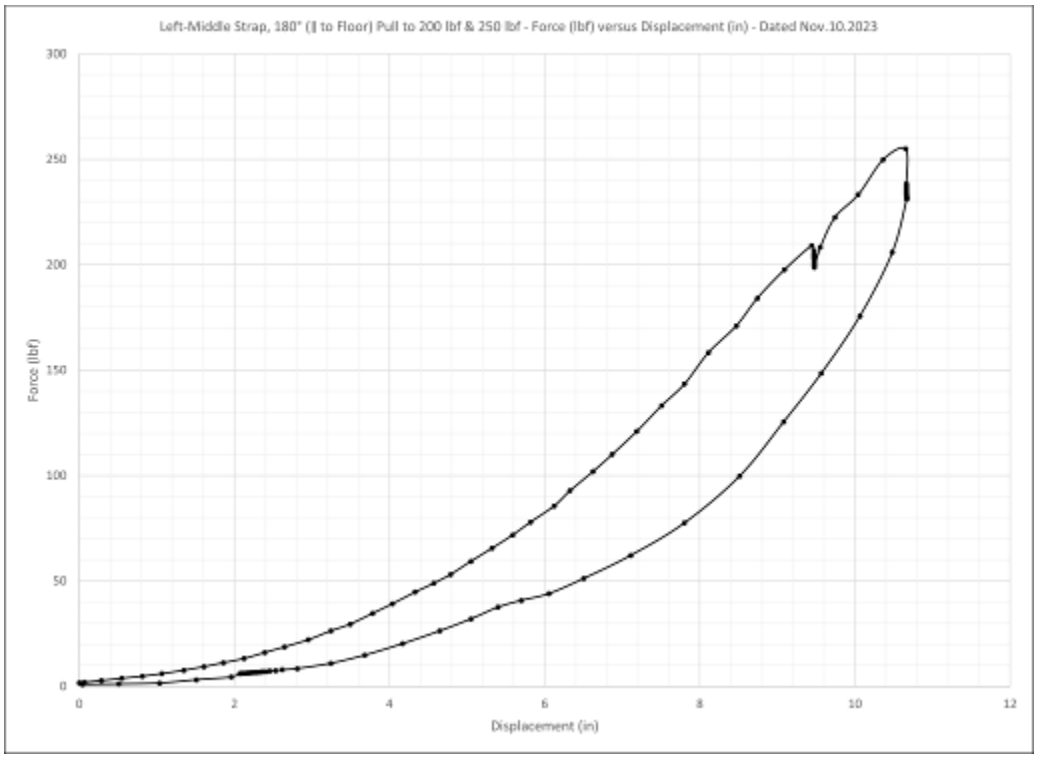


Figure 6: Left-middle strap, extra pulls to 200 and 250 lbf, Force (lbf) versus Displacement (in)

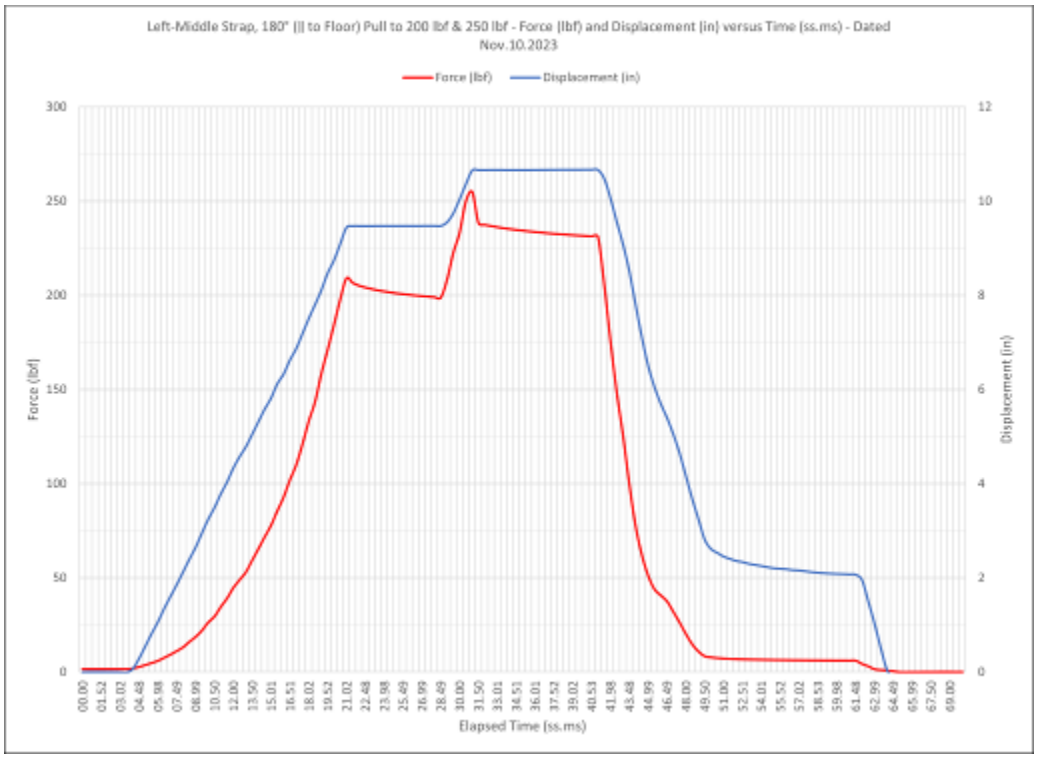


Figure 7: Left-middle strap, extra pulls to 200 and 250 lbf, Force (lbf), and Displacement (in) versus Elapsed Time (ss.ms)

APPENDIX B – TEST DATA (cont'd)

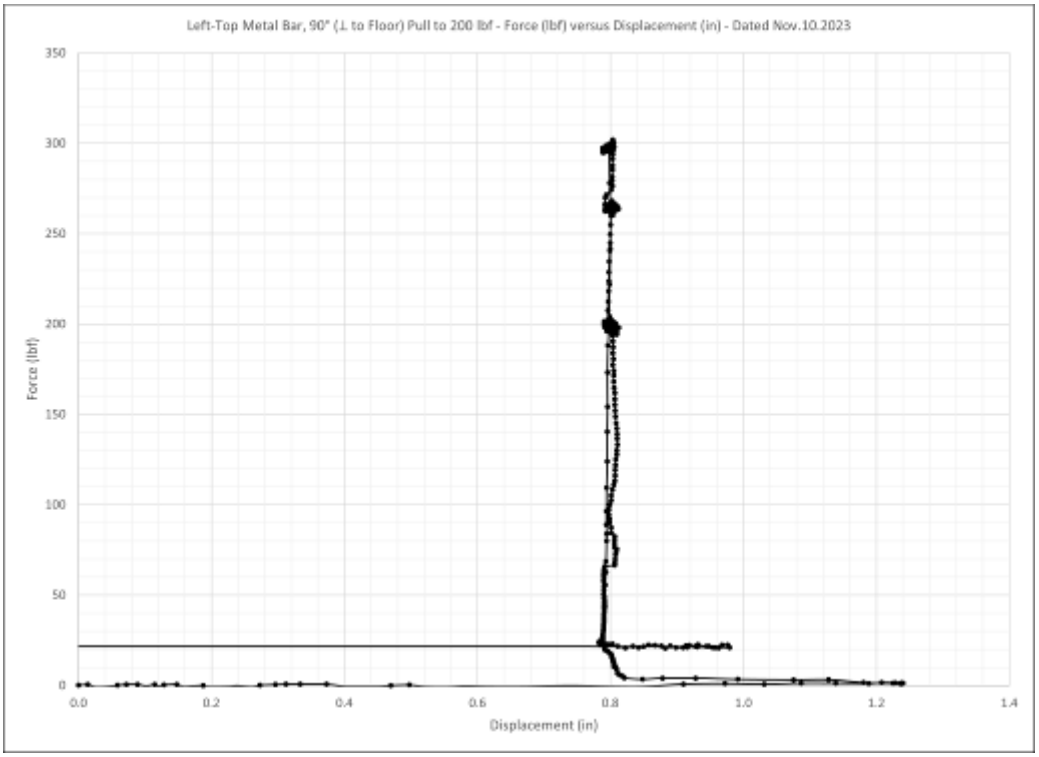


Figure 8: Left-top bar, pull to 200 lbf with an extra 250 lbf and 300 lbf pull, Force (lbf) versus Displacement (in)

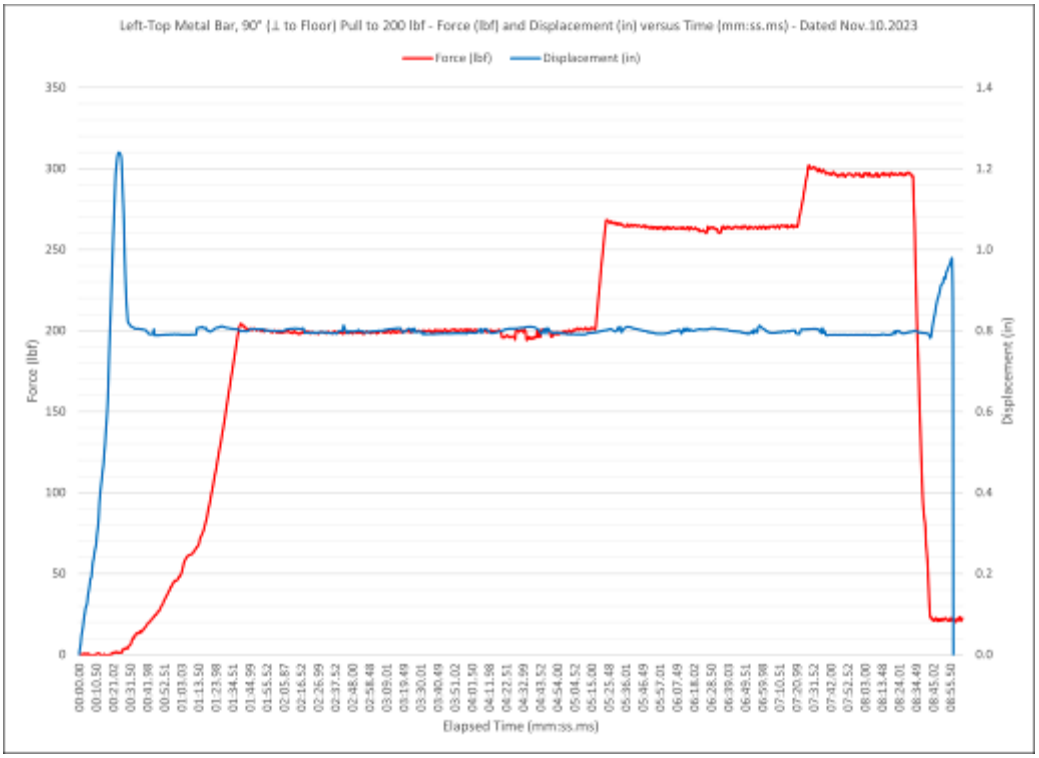


Figure 9: Left-top bar, pull to 200 lbf with an extra 265 lbf and 300 lbf pull, Force (lbf), and Displacement (in) versus Elapsed Time (mm:ss.ms)

APPENDIX B – TEST DATA (cont'd)

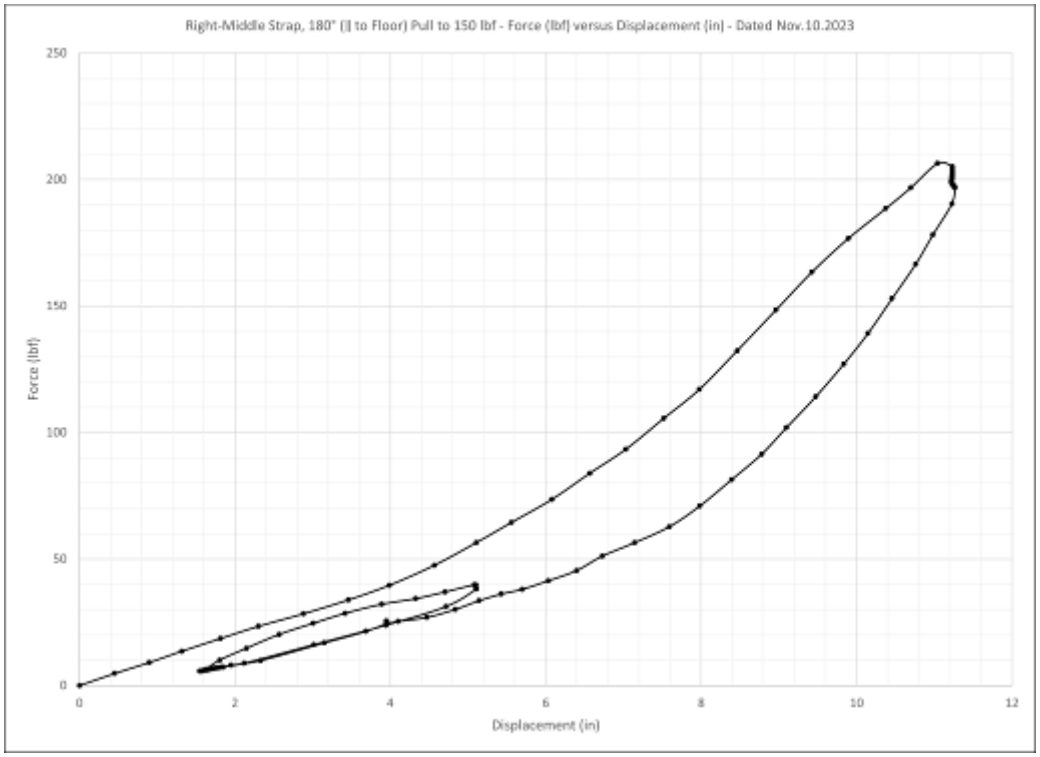


Figure 10: Right-middle strap, pull to 150 lbf with an extra 200 lbf pull, Force (lbf) versus Displacement (in)

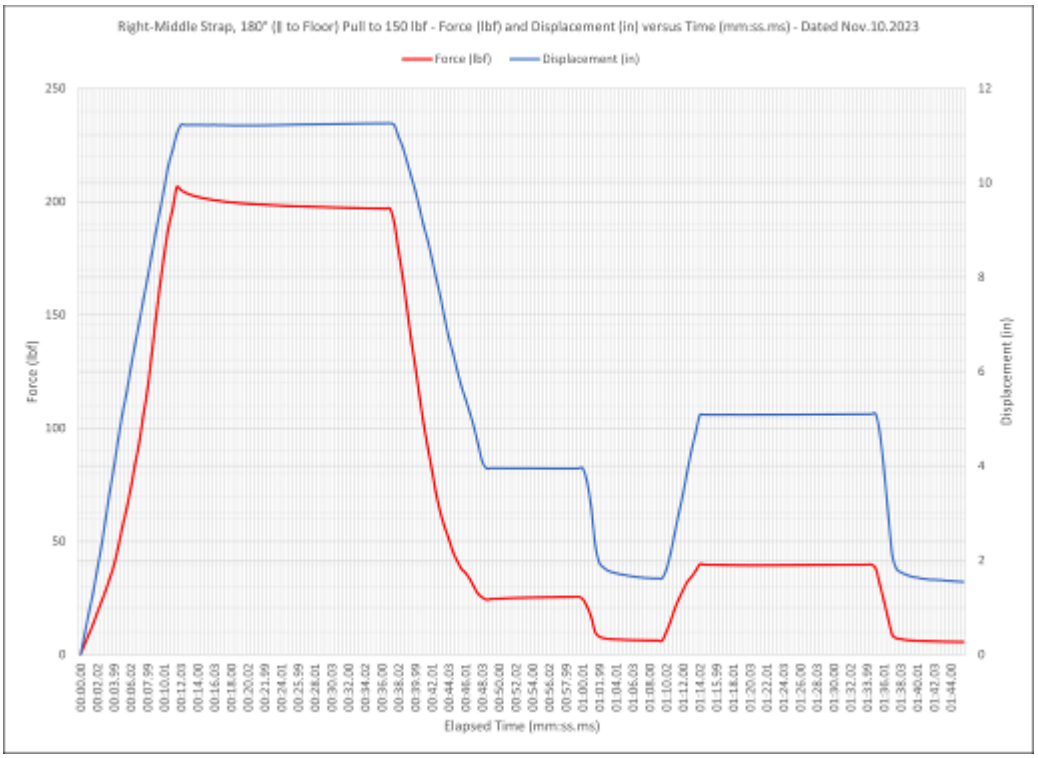


Figure 11: Left-top bar, pull to 200 N with an extra 260 N and 300 N pull, Force (lbf), and Displacement (in) versus Elapsed Time (mm:ss.ms)

APPENDIX C – PHOTOGRAPHS

Figure 12: Left-middle slack

Figure 13: Left-middle slack

Figure 14: Left-middle under load

Figure 15: Left-top slack

APPENDIX C – PHOTOGRAPHS (cont'd)

Figure 16: Left-top under 200 lbf load

Figure 17: Left-top measurement at 200 lbf

Figure 18: Left-top under 300 lbf load

Figure 19: Left-top measurement at 300 lbf

APPENDIX C – PHOTOGRAPHS (cont'd)

Figure 20: Right-middle slack

Figure 21: Right-middle under load

Figure 22: Side rails being torqued

Figure 23: Undercarriage wheels suspended in air

APPENDIX C – PHOTOGRAPHS (cont'd)

Figure 24: Right-top slack

Figure 25: Right-top under 150 lbf load and measurement

Figure 26: Right-top under 200 lbf load and measurement

Figure 27: Weld break post-test