



Static and Fatigue Testing of 0.5-in Barrier Cable Anchorages

PTI M10 Static Testing of Post-Tensioned Products, Inc. Barrier Cable Anchorages

9140 CR 229 N

Sanderson, Florida 32087



FINAL REPORT

July 11, 2023

WJE No. 2021.3293

PREPARED FOR:

Post-Tensioned Products, Inc.

9140 CR 229 N

Sanderson, Florida 32087

PREPARED BY:

Wiss, Janney, Elstner Associates, Inc.

330 Pfingsten Road

Northbrook, Illinois 60062

847.272.7400 tel



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9140 CR 229 N
Sanderson, Florida 32087

A handwritten signature in black ink, reading "John Pearson".

John Pearson
Project Manager

A handwritten signature in black ink, reading "Brian F. Easton".

Brian Easton
Project Engineer

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INTRODUCTION

At the request of Post-Tensioned Products, Inc. (PTP), the firm of Wiss, Janney, Elstner Associates, Inc. (WJE) conducted testing services following the procedures outlined in the Post Tensioning Institute (PTI) M10.2-17, *Specification for Unbonded Single Strand Tendons*, and PTI M10.4-07, *Specification for Seven-Wire Prestressed Steel Strand for Barrier Cable Applications*. Testing summarized in this report was performed using PTP 0.50-in galvanized barrier cable end anchorage and galvanized three-piece wedge.

Scope of Work

The scope of work consisted of performing tests by WJE in accordance with PTI M10.2-17 and M10.4-07 for the PTP barrier cable anchorage and three-piece wedge. It is noted that PTI M10.4-07, Section 2.4.5.1 *Castings and Machined Barrel Anchors* states "Castings and machined barrel anchors shall conform to PTI's Specification for Unbonded Single Strand Tendons, Section 2.2.1.1 for static testing criteria and Section 2.2.1.2 for fatigue testing criteria." These references are for a previous version of PTI M10.2. The current applicable sections of PTI M10.2-17 are 2.5.6 – Static test and 2.5.7 – Fatigue test.

All testing utilized galvanized Grade 270 low relaxation 7-wire strand. The following tasks were performed as part of the scope of work:

- Random sampling from multiple strand anchorage samples provided.
- Random sampling from the multiple strand samples provided and performing static tensile tests to determine the breaking strength of the strand.
- Performing static load and fatigue tests of strand with the use of anchorages.

Test results were compared to the requirements stated in PTI M10.2-17.

BASIC PRODUCT INFORMATION

Product Description

The PTP 0.5-in galvanized barrier cable anchorage is a machined steel barrel anchor. The PTP galvanized three-piece wedge is used with the galvanized barrier cable anchorage to grip a 0.5-in. diameter strand (Figure 1). A drawing of the galvanized anchorage and three-piece wedge is included in Appendix A.

Product Sampling

All of the products for the testing program were sampled by WJE from material sent to WJE by PTP.

TEST METHODS AND REQUIREMENTS

All testing of the strand and anchorages were conducted by WJE personnel at our structural laboratory in Northbrook, Illinois. Test machine calibration records are included in Appendix B. All testing protocols followed WJE's Quality Manual. All anchorages tested were assembled from components shipped to WJE. WJE personnel assembled each anchorage from components supplied prior to testing.

Strand Static Load Tests

Representative strands were chosen from the samples provided to determine the actual breaking strength of the strand and compared to the breaking strengths of the anchorage static tests. These tests were

conducted in accordance with ASTM A1061, *Standard Test Methods for Testing Multi-Wire Steel Strand* and results were compared to ASTM A416 *Standard Specification for Steel Strand, Uncoated Seven-Wire for Prestressed Concrete* requirements. A total of three samples were tested and the results were averaged to determine the actual breaking strength to be used for comparison to the anchorage tests. Additionally, a short length of strand approximately 12-in long was cut from a sample and weighed. The density of steel, the strand weight, and length of strand were used to calculate the cross-sectional area of the strand which is used in determining the strand modulus of elasticity. Based on these measurements, the strand used for testing the anchorages meets the minimum ultimate tensile capacity requirements listed in ASTM A416. Table 1 summarizes the strand control test results. The load-elongation plots for all three strand tests can be seen in Appendix C.

Table 1. Summary of 7-Wire Strand Tests

Test Number	Weight (g) ¹	Length (in) ¹	Area (in ²) ¹	Load at 1% Elongation (lbf)	Ultimate Load (lbf)	Elongation at Ultimate Load (%)
050-1	236.3	11.943	0.153	37,220	41,890	4.61
050-2				37,370	42,340	5.68
050-3				37,210	42,150	5.70
Average				37,267	42,127	5.33

Note 1: information used to calculate strand area

Anchorage Static Load Tests

Three static load tests were performed in a Riehle universal test machine (s/n 47247) set on the 100,000 lbf force range using a 0.5-in PTP galvanized barrier cable anchorage with a PTP galvanized three-piece wedge on one end of the 0.5-in strand. The anchorage reacted on a bearing plate in the bottom head of the test machine (Figure 1). The opposite end of the strand was restrained by grips in the top head of the test machine that did not cause stress risers in the strand. The strand was first secured by the grips in the top head and then passed through the bearing plate in the bottom head where it was connected to an anchorage. The static load tests were performed in accordance with PTI M10.2-17 Section 2.5.6 – Static test.

The strands used for the tests had a gage length of at least 45-in between the anchorage and test machine grips. A minimum baseline gage length of 42-in is required per PTI M10.2-17. An extensometer was used to measure elongation during testing up to approximately 1.1 percent elongation. The extensometer was removed to prevent damage when strand failure occurred, and test machine head travel was used beyond 1.1 percent elongation to measure elongation at ultimate load. At the conclusion of each test, the gage length was re-measured and recorded to verify the actual elongation. Load and elongation data were recorded for each test.

In accordance with PTI M10.2-17, Section 2.5.4 – Strength test criteria, each static test assembly was considered to pass when the failure load of the strand exceeded 95 percent of the minimum ultimate tensile strength of the strand and the strand elongation at ultimate load was at least 2 percent. The minimum ultimate tensile strength of 0.50-in is 41,300 lbf as defined in ASTM A416 and 95 percent of the minimum ultimate tensile strength is 39,235 lbf. Based on the results, which are shown in Table 2 below,

all three static tests meet the requirement of PTI M10.2-17. The load-elongation plots for all three tests can be seen in Appendix D.

Table 2. Summary of Anchorage Static Load Tests

Test Number	Anchorage Material	Elongation at Ultimate Load (%) ¹	Ultimate Load (lbf)	95% of Control Strand Minimum Ultimate Tensile Load (lbf)	Pass/Fail
1	PTP 0.50-in galvanized barrier cable anchorage and three-piece wedge	3.93	41,400	39,235	Pass
2	PTP 0.50-in galvanized barrier cable anchorage and three-piece wedge	3.21	40,640	39,235	Pass
3	PTP 0.50-in galvanized barrier cable anchorage and three-piece wedge	4.19	41,580	39,235	Pass

Note 1: Elongation exceeds 2 percent minimum requirement

Fatigue Load Tests

Fatigue load tests were performed using PTP 0.5-in galvanized barrier cable anchorage with a PTP galvanized three-piece wedge on either end of a length of strand. An MTS Model 661.23A-01 (s/n 1261214) 55,000 lbf actuator was used to apply the fatigue loads. Two tendon samples were tested in general accordance with PTI M10.2-17. One end of a test sample was connected to a reaction fixture consisting of steel plates separated by threaded rods bolted to a hydraulic actuator (Figure 2). The strand passed through the structural floor opening with an anchorage bearing on the underside of the floor (Figure 3). Each sample length between anchorages was approximately 60-in.

The first part of a fatigue load test consisted of 500,000 cycles with a cycle frequency of 6 Hz. The load range of cycling was between 60 and 66 percent of the strand's minimum specified breaking strength of 41,300 lbf (24,780 lbf to 27,258 lbf). The hydraulic actuator limits were set between 24,720 lbf and 27,320 lbf to ensure the specified load range was achieved. Data for the 500,000-cycle fatigue test were recorded on a per cycle basis. Recorded data included maximum force and minimum force applied per cycle.

At the completion of the 500,000-cycle portion of a fatigue load test, 50 cycles with a cycle frequency of 1 Hz were performed with a load range of cycling between 40 and 85 percent of the strand's minimum specified breaking strength of 41,300 lbf (16,520 lbf to 35,105 lbf). The hydraulic actuator limits were set between 16,400 lbf and 35,200 lbf to ensure the specified load range was achieved. Recorded data included maximum and minimum force applied for each cycle.

At the conclusion of the testing, the anchorage configuration was deemed to pass if neither the strand nor anchorage failed during any part of the fatigue tests. Based on the results, which are shown in Table 3 below, both tendons passed the requirements of PTI M10.2-17 Section 2.5 and PTI M10.4-07 Section 2.4. The cycle-load plots for both tendon tests can be seen in Appendix E.

Table 3. Summary of Anchorage Fatigue Load Tests

Tendon Number	Anchorage Material	Load Test Cycles	Start Length (in.)	Final Length (in.)	Load Range		Pass/Fail ¹
					Min Load (lbf)	Max Load (lbf)	
1	PTP 0.50-in galvanized barrier cable anchorage and three-piece wedge	500,000	60	60	24,780	27,258	Pass
1	PTP 0.50-in galvanized barrier cable anchorage and three-piece wedge	50	60	60	16,520	35,105	Pass
2	PTP 0.50-in galvanized barrier cable anchorage and three-piece wedge	500,000	60	60	24,780	27,258	Pass
2	PTP 0.50-in galvanized barrier cable anchorage and three-piece wedge	50	60	60	16,520	35,105	Pass

Note 1: All components remained intact

SUMMARY

WJE conducted testing services following the procedures outlined PTI M10.2-17, *Specification for Unbonded Single Strand Tendons*, and PTI M10.4-07, *Specification for Seven-Wire Prestressed Steel Strand for Barrier Cable Applications*. Testing was performed using an anchorage configuration of PTP 0.5-in galvanized barrier cable anchorage with a PTP galvanized three-piece wedge.

The anchorage assemblies' static test results exceeded 95 percent of the strand minimum specified tensile strength and the elongation at ultimate load exceeded the minimum of 2 percent. The anchorage assemblies successfully completed the fatigue test requirements. The anchorages listed in Table 2 and Table 3 passed the requirements outlined in PTI M10.2-17 and M10.4-17.



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FIGURES



Figure 1. 0.50-in galvanized barrier cable anchorage with galvanized three-piece wedge installed in test machine for static testing



Figure 2. Fatigue anchorage sample bearing on steel plate connected through threaded rods and steel plate to hydraulic actuator



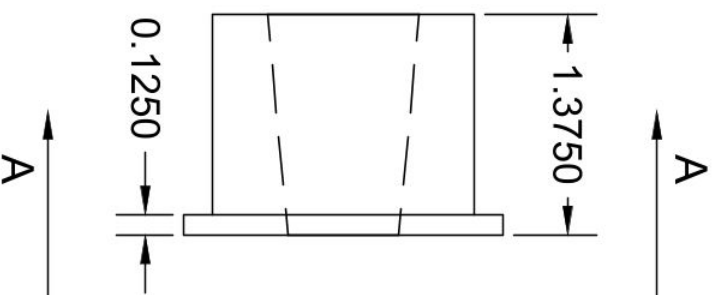
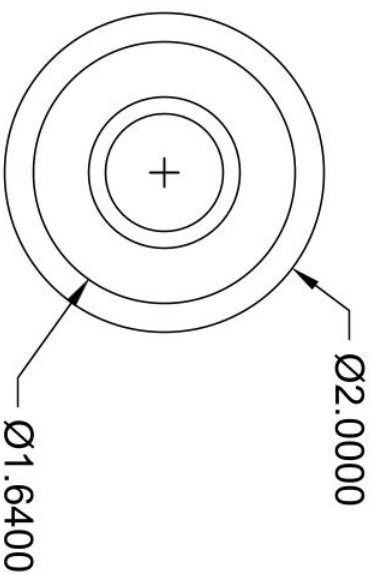
Figure 3. Fatigue anchorage sample bearing on the underside of the structural floor



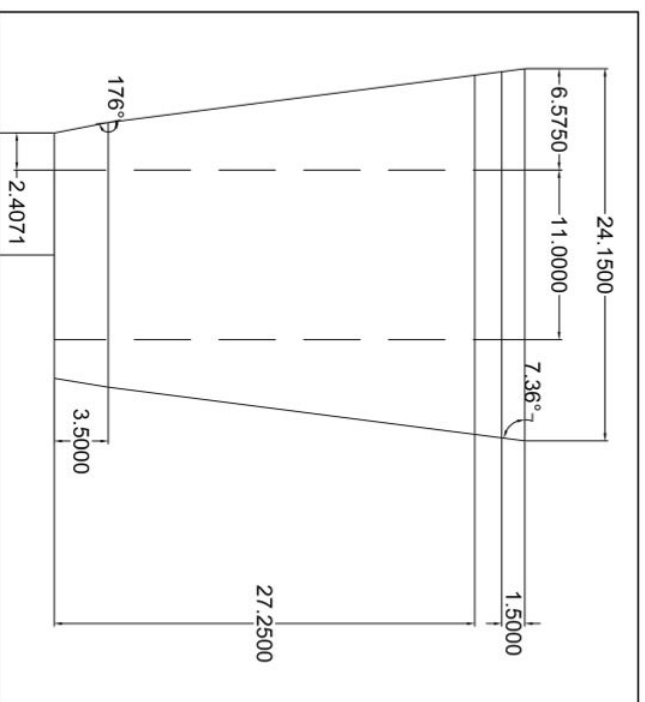
Static and Fatigue Testing of 0.5-in Barrier Cable Anchorages

PTI M10 Static Testing of Post-Tensioned Products, Inc. Barrier Cable Anchorages

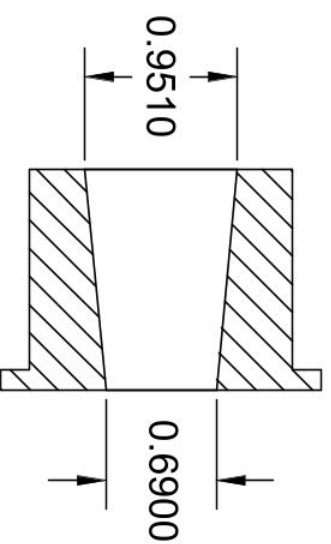
APPENDIX A. GALVANIZED ANCHORAGE AND WEDGE DRAWING



NOTES:
TOLERANCE $\pm .01$
MATERIAL USED IS CRT
1045



THREE PIECE WEDGE



SECTION A-A

BARREL ANCHOR P-T-P

DRAWN BY
GABRIEL LEBEL-LEPAGE
06/08/23



Static and Fatigue Testing of 0.5-in Barrier Cable Anchorages

PTI M10 Static Testing of Post-Tensioned Products, Inc. Barrier Cable Anchorages

APPENDIX B. TEST MACHINE CALIBRATION CERTIFICATES



Certificate Of Calibration

Equipment Calibration was performed at the address below for



WISS, JANNEY, ELSTNER ASSOC.

330 PFINGSTEN ROAD
NORTHBROOK, IL 60062



Certificate # 866.01
Calibration

Date of Calibration

Monday, March 20, 2023

Issue Date:

03/26/2023

Manufacturer: RIEHLE

Capacity: 500000

Next Cal: 20-Mar-2024

Model: 500FH

Serial #: 47247

Customer #: 691

Language LBS

Force Calibration Results

Accuracy: 1.0 %

Range	Verified Range Force	Uncertainty %	Maximum Error %
500000	50000 - 500000	0.29	0.41
250000	25000 - 250000	0.29	0.64
100000	20000 - 100000	0.29	-0.61
20000	2000 - 20000	0.29	-0.46

Cal-Rite Corporation has calibrated the testing equipment described above in accordance with ISO/IEC 17025:2017, ANSI/NCSL Z540-1-1994 and 10-CFR-21. All elastic verification devices have been calibrated in accordance with ASTM E74 practices and are traceable to the International System of Units (SI) through NIST.

Computed forces have been temperature corrected as necessary.

The uncertainty of the calibration process was estimated approximately at the 95% confidence level (k=2).

When a decision rule is stated in the governing specification, the prescribed decision rule was used in the pass/fail determination unless otherwise noted. In all other cases where a statement of conformance is made, the determination of conformance is made solely on the measurements falling in or out of the applied tolerance.

Measurement uncertainty is stated, but not used to determine pass/fail status.

This certificate relates only to the item calibrated.

The equipment listed above has met all applicable clauses of the governing specification unless noted below:

☐ 11.1 Lower Limit below 200X Resolution

☐ 11.5 Does not return to zero in 30 seconds

Specification: ASTM E 4-21

QMS Revision: 01-22

Service Comments: Calibrated machine force in accordance with ASTM standards. All readings found and left within tolerance. No adjustments required.

As Found Condition: In Tolerance

Calibration Method: Follow the Force

Calibration Procedure: CR100 Rev 16

Software Version: N/A

Service Order #: 19502 - 25

NATHAN HATHAWAY

SERVICE ENGINEER

As a mutual protection to the purchaser, the public, and ourselves, all Cal-Rite calibration reports are submitted as the confidential property of the purchaser, and any authorization for publication of statements, conclusions, or extractions from or regarding our reports is reserved pending our prior written approval.



Certificate # 866.01
Calibration

WISS, JANNEY, ELSTNER ASSOC.

330 PFINGSTEN ROAD

NORTHBROOK, IL 60062

Calibration Date: 20-Mar-2023

Next Calibration: 20-Mar-2024

Customer #: 691

Temp/Humidity: 67.4 F/24.7%

Manufacture: RIEHLE

Capacity: 500000

Test Direction: COMPRESSION

Model: 500FH

Serial #: 47247

External Cell: N/A

Indicator: DIGITAL

Shunt #: N/A

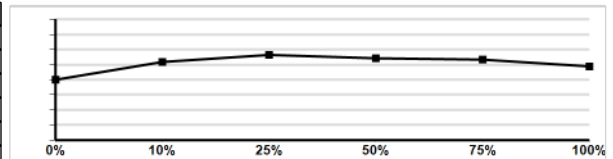
Temp Variance: 0.7

Range: 500000 LBS Resolution: 100.0 Accuracy +/- 1.0%

FS %	Reading	As Found	As Adj.	As Left	Repeat %	Max Error	Error %	Uncert
0.00	0	0.0	0.0	0.0	0.000	0.000	0.000	0.29
10.00	50000	49,853.5	0.0	49,907.2	-0.108	146.500	0.294	0.29
25.00	125000	124,488.4	0.0	124,739.2	-0.201	511.600	0.411	0.29
50.00	250000	249,115.9	0.0	249,164.3	-0.019	884.100	0.355	0.29
75.00	375000	373,756.2	0.0	374,071.5	-0.084	1,243.800	0.333	0.29
100.00	500000	498,898.1	0.0	498,923.2	-0.005	1,101.900	0.221	0.29

Zero Return: 0.00% 0.00% 0.00%

Linearity Profile (Percent Full Scale)

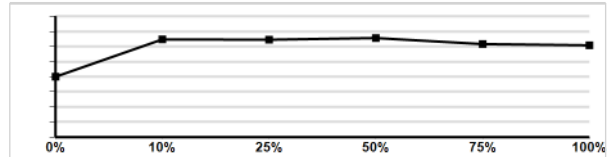


Range: 250000 LBS Resolution: 100.0 Accuracy +/- 1.0%

FS %	Reading	As Found	As Adj.	As Left	Repeat %	Max Error	Error %	Uncert
0.00	0	0.0	0.0	0.0	0.000	0.000	0.000	0.29
10.00	25000	24,846.4	0.0	24,873.9	-0.111	153.600	0.618	0.29
25.00	62500	62,119.0	0.0	62,128.3	-0.015	381.000	0.613	0.29
50.00	125000	124,204.3	0.0	124,373.5	-0.136	795.700	0.641	0.29
75.00	187500	186,491.2	0.0	186,569.9	-0.042	1,008.800	0.541	0.29
100.00	250000	248,704.2	0.0	248,882.8	-0.072	1,295.800	0.521	0.29

Zero Return: 0.00% 0.00% 0.00%

Linearity Profile (Percent Full Scale)

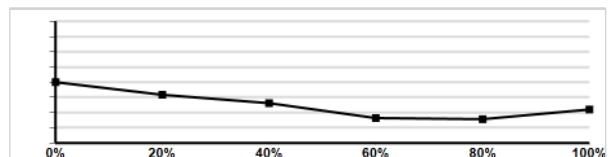


Range: 100000 LBS Resolution: 100.0 Accuracy +/- 1.0%

FS %	Reading	As Found	As Adj.	As Left	Repeat %	Max Error	Error %	Uncert
0.00	0	0.0	0.0	0.0	0.000	0.000	0.000	0.29
20.00	20000	20,041.5	0.0	20,023.2	0.091	-41.500	-0.207	0.29
40.00	40000	40,138.3	0.0	40,073.7	0.161	-138.300	-0.345	0.29
60.00	60000	60,338.2	0.0	60,356.2	-0.030	-356.200	-0.590	0.29
80.00	80000	80,465.4	0.0	80,489.5	-0.030	-489.500	-0.608	0.29
100.00	100000	100,451.0	0.0	100,423.8	0.027	-451.000	-0.449	0.29

Zero Return: 0.00% 0.00% 0.00%

Linearity Profile (Percent Full Scale)

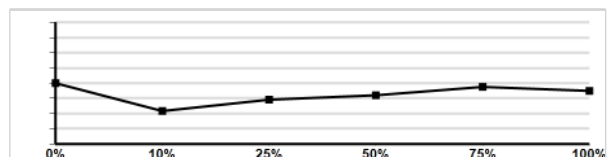


Range: 20000 LBS Resolution: 10.0 Accuracy +/- 1.0%

FS %	Reading	As Found	As Adj.	As Left	Repeat %	Max Error	Error %	Uncert
0.00	0	0.0	0.0	0.0	0.000	0.000	0.000	0.29
10.00	2000	2,009.2	0.0	2,005.9	0.164	-9.200	-0.458	0.29
25.00	5000	5,001.7	0.0	5,013.6	-0.238	-13.600	-0.271	0.29
50.00	10000	10,010.3	0.0	10,019.9	-0.096	-19.900	-0.199	0.29
75.00	15000	15,001.5	0.0	15,009.2	-0.051	-9.200	-0.061	0.29
100.00	20000	19,996.2	0.0	20,025.3	-0.146	-25.300	-0.126	0.29

Zero Return: 0.00% 0.00% 0.00%

Linearity Profile (Percent Full Scale)



Calibrating Apparatus Used

Manufacture	Serial Number	Capacity	Class A	Dir	Cal Date	Cal Due	Calibrated By
STRAINSENSE	940215D	600000	15377.6	C	9/14/2022	9/14/2024	Tovey
STRAINSENSE	120314	60000	2025	C	12/16/2022	12/16/2024	CAL-RITE
MOREHOUSE	C-8314(HI)	10000	200	C	1/16/2023	1/16/2025	CAL-RITE

☐ 7.3 Interchangeability Established

☐ REPAIRED:

☐ ADJUSTED:

Specification: ASTM E 4-21

☒ SPECIFICATION COMPLIANT

CONDITION: Good

Calibration Procedure: CR100 Rev 16

Service Order #: 19502 - 25

NATHAN HATHAWAY

SERVICE ENGINEER

As a mutual protection to the purchaser, the public, and ourselves, all Cal-Rite calibration reports are submitted as the confidential property of the purchaser, and any authorization for publication of statements, conclusions, or extractions from or regarding our reports is reserved pending our prior written approval.



Certificate Of Calibration

Equipment Calibration was performed at the address below for



WISS, JANNEY, ELSTNER ASSOC.

330 PFINGSTEN ROAD
NORTHBROOK, IL 60062



Certificate # 866.01
Calibration

Issue Date:
03/27/2023

Date of Calibration

Monday, March 20, 2023

Instrument Profile

Manufacturer:	EPSILON	Mach/Rec#:	47247	G.L. Measurement:	DIRECT
Model #:	3543-0400-400T-ST	Scaling #:	N/A	G.L. Measure(1/2):	23.9500/23.950
Serial #:	E101718-24	Customer #:	5388	G.L. Error (1/2):	0.21% / 0.21%

Instrument Calibration Results

Range Capacity in/in	Verified Range in/in	Uncertainty in	Maximum Error in/in	ASTM Class
0.05	0.001 - 0.05	0.000059	-0.000080	B-1
Range Capacity in/in	Verified Range in/in	Uncertainty in	Maximum Error in/in	ISO Class
0.05	0.001 - 0.05	0.000059	-0.000080	1

Calibration Apparatus Used

Inst.	Manufacturer	Serial Number	Model	Calib By	Cert Date	Date Due
106	MITUTOYO	504959	164-162	QCSS	7/12/2022	7/12/2023
356	MITUTOYO	08423105	500-197-20	QCSS	7/31/2022	7/31/2024

Cal-Rite Corporation has calibrated the testing equipment described above in accordance with ISO/IEC 17025:2017, ANSI/NCSL Z540-1-1994 and 10-CFR-21. All calibration measurements are traceable to the International System of Units (SI) through NIST. The accuracy of the calibrating apparatus meets or exceeds ISO 9513 Annex B.

The uncertainty of the calibration process was estimated approximately at the 95% confidence level ($k=2$).

When a decision rule is stated in the governing specification, the prescribed decision rule was used in the pass/fail determination unless otherwise noted. In all other cases where a statement of conformance is made, the determination of conformance is made solely on the measurements falling in or out of the applied tolerance. Measurement uncertainty is stated, but not used to determine pass/fail status.

This certificate relates only to the item calibrated.

Specification: ASTM E 83-23 / EN ISO 9513-12

QMS Revision: 01-22

Service Comments: Calibrated extensometer at a 24 inch gauge length in accordance with ASTM and ISO requirements. All readings found and left within Class B-1/Class 1 tolerances. Extensometer is in good condition and functioning properly at this time. NOTE - Readings taken using Datalogger 385.

As Found Condition: In Tolerance

Service Order #: 19502 - 45

NATHAN HATHAWAY

SERVICE ENGINEER

As a mutual protection to the purchaser, the public, and ourselves, all Cal-Rite calibration reports are submitted as the confidential property of the purchaser, and any authorization for publication of statements, conclusions, or extractions from or regarding our reports is reserved pending our prior written approval.

WISS, JANNEY, ELSTNER ASSOC.
 330 PFINGSTEN ROAD
 NORTHBROOK, IL 60062

Calibration Date: 3/20/2023
Next Calibration: 3/20/2024
Temp/Humidity: 69.7F/24.5%

ISO 9513 REPORT

Unit Under Test Full Travel		Unit Under		Nominal	#1 Gage Length		#2 Gage Length		Measurement
Strain	Displacement	Test Resolution		Gage Length	Error		Error		Uncertainty
(in/in)	(in)	(in/in)	(Class)	(in)	%	(Class)	%	(Class)	(in)
0.05	1.2	0.00001	0.5	24.0000	0.208	0.5	0.208	0.5	0.0018

AS FOUND

Nominal Strain	Nominal Displacement	As Found Strain	As Found Displacement	Bias Error - Absolute	Bias Error - Relative	ISO 9513
(in/in)	(in)	(in/in)	(in)	(in/in)	(% of Reading)	Class
0.000000	0.000000	0.00000	0.00000	0.00000	N/A	0.2
0.001000	0.024000	0.00099	0.02376	0.00001	1.00	0.5
0.002000	0.048000	0.00199	0.04776	0.00001	0.50	0.5
0.004000	0.096000	0.00399	0.09576	0.00001	0.25	0.5
0.007000	0.168000	0.00695	0.16680	0.00005	0.71	0.5
0.010000	0.240000	0.00998	0.23952	0.00002	0.20	0.5
0.020000	0.480000	0.02002	0.48048	-0.00002	-0.10	0.5
0.040000	0.960000	0.04002	0.96048	-0.00002	-0.05	0.5
0.050000	1.200000	0.05003	1.20072	-0.00003	-0.06	0.5

AS LEFT

Nominal Strain	Nominal Displacement	As Left Strain	As Left Displacement	Bias Error - Absolute	Bias Error - Relative	Repeat	ISO 9513
(in/in)	(in)	(in/in)	(in)	(in/in)	(% of Reading)	%	Class
0.000000	0.000000	0.00000	0.00000	0.00000	N/A	0.00	0.2
0.001000	0.024000	0.00098	0.02352	0.00002	2.00	1.02	0.5
0.002000	0.048000	0.00197	0.04728	0.00003	1.50	1.01	0.5
0.004000	0.096000	0.00395	0.09480	0.00005	1.25	1.01	0.5
0.007000	0.168000	0.00693	0.16632	0.00007	1.00	0.29	1
0.010000	0.240000	0.00996	0.23904	0.00004	0.40	0.20	0.5
0.020000	0.480000	0.02004	0.48096	-0.00004	-0.20	-0.10	0.5
0.040000	0.960000	0.04008	0.96192	-0.00008	-0.20	-0.15	0.5
0.050000	1.200000	0.05006	1.20144	-0.00006	-0.12	-0.06	0.5

Calibration Procedure: CR101 Rev 16

NATHAN HATHAWAY

SERVICE ENGINEER

Service Order #: 19502 - 45

As a mutual protection to the purchaser, the public, and ourselves, all Cal-Rite calibration reports are submitted as the confidential property of the purchaser, and any authorization for publication of statements, conclusions, or extractions from or regarding our reports is reserved pending our prior written approval.

WISS, JANNEY, ELSTNER ASSOC.
 330 PFINGSTEN ROAD
 NORTHBROOK, IL 60062

Calibration Date: 3/20/2023
Next Calibration: 3/20/2024
Temp/Humidity: 69.7F/24.5%

ASTM E83 REPORT

Unit Under Test Full Travel		Unit Under		Nominal	#1 Gage Length		#2 Gage Length		Measurement
Strain	Displacement	Test Resolution		Gage Length	Measurement		Measurement		Uncertainty
(in/in)	(in)	(in/in)	(Class)	(in)	(in)	(Class)	(in)	(Class)	(in)
0.05	1.2	0.00001	B-1	24.0000	23.9500	B-1	23.9500	B-1	0.0018

AS FOUND

Nominal Strain	Nominal Displacement	As Found Strain	As Found Displacement	Fixed Error	Relative Error	ASTM E-83
(in/in)	(in)	(in/in)	(in)	(in/in)	(% of Reading)	Class
0.000000	0.000000	0.00000	0.00000	0.00000	N/A	B-1
0.001000	0.024000	0.00099	0.02376	0.00001	1.00	B-1
0.002000	0.048000	0.00199	0.04776	0.00001	0.50	B-1
0.004000	0.096000	0.00399	0.09576	0.00001	0.25	B-1
0.007000	0.168000	0.00695	0.16680	0.00005	0.71	B-1
0.010000	0.240000	0.00998	0.23952	0.00002	0.20	B-1
0.020000	0.480000	0.02002	0.48048	-0.00002	-0.10	B-1
0.040000	0.960000	0.04002	0.96048	-0.00002	-0.05	B-1
0.050000	1.200000	0.05003	1.20072	-0.00003	-0.06	B-1

AS LEFT

Nominal Strain	Nominal Displacement	As Left Strain	As Left Displacement	Fixed Error	Relative Error	Repeat	ASTM E-83
(in/in)	(in)	(in/in)	(in)	(in/in)	(% of Reading)	%	Class
0.000000	0.000000	0.00000	0.00000	0.00000	N/A	0.00	B-1
0.001000	0.024000	0.00098	0.02352	0.00002	2.00	1.02	B-1
0.002000	0.048000	0.00197	0.04728	0.00003	1.50	1.01	B-1
0.004000	0.096000	0.00395	0.09480	0.00005	1.25	1.01	B-1
0.007000	0.168000	0.00693	0.16632	0.00007	1.00	0.29	B-1
0.010000	0.240000	0.00996	0.23904	0.00004	0.40	0.20	B-1
0.020000	0.480000	0.02004	0.48096	-0.00004	-0.20	-0.10	B-1
0.040000	0.960000	0.04008	0.96192	-0.00008	-0.20	-0.15	B-1
0.050000	1.200000	0.05006	1.20144	-0.00006	-0.12	-0.06	B-1

Calibration Procedure: CR101 Rev 16

NATHAN HATHAWAY

SERVICE ENGINEER

Service Order #: 19502 - 45

As a mutual protection to the purchaser, the public, and ourselves, all Cal-Rite calibration reports are submitted as the confidential property of the purchaser, and any authorization for publication of statements, conclusions, or extractions from or regarding our reports is reserved pending our prior written approval.



Customer Address:
330 Pfingsten Road
Northbrook, IL 60062U
SA

MTS Field Service

MTS Systems Corporation
14000 Technology Drive
Eden Prairie, MN 55344-2290



Certificate of Calibration

Customer Name: Wiss, Janney, Elstner Associates, Inc. Page: 1 of 5
System ID: Seismic Frame MTS System No: Seismic Certificate Number: 2394-14549
Machine ID: Seismic Frame Location: Anchor Testing Lab Site: 508308
Country: SA

Equipment

Device Type: Force	Model: 661.23A-01	Serial No.: 1194
Device ID: N/A		
Conditioner Model: 494.26 DC A	Serial No.: 1261214	
Readout Device Model: COMPUTER	Serial No.: Serial	Channel: Port

MTS Field Service is accredited by the American Association for Laboratory Accreditation (A2LA Cert. No. 1145.01).

The basis for this accreditation is the international standard for calibration laboratories, ISO/IEC 17025

"General Requirements for the Competence of Testing and Calibration Laboratories".

Defined and documented measurement assurance techniques or uncertainty analyses are used to verify the adequacy of the measurement processes.

Calibrations are performed with standards whose values and measurements are traceable to the International System of Units (SI) through a National Metrology Institute (NMI).

MTS Reference Force Transducers are calibrated in compliance with ASTM E74.

The results of this calibration relate only to the items calibrated.

When parameter(s) are reported to be within specified tolerance(s), the measured value(s) shall fall within the appropriate specification limit and the uncertainty of the measured value(s) shall be stated.

CALIBRATION INFORMATION

As Found: Out of Tolerance	Calibration Date: 11-Nov-2022
As Left: In Tolerance	Calibration Due: 30-Nov-2023
Tolerance: +/-1.0% of Applied Force	
Calibration Procedure: FS-CA 2122 Rev. G	ASTM E4-20
Full Scale Ranges: 55000 lbf	
Note:	

STANDARDS USED FOR CALIBRATION

<u>MTS Asset Number</u>	<u>Manufacturer</u>	<u>Model Number</u>	<u>Description</u>	<u>Cal. Date</u>	<u>Cal. Due</u>
16970	Interface	9840	Interface Readout	24-Aug-21	22-Dec-22
26923	Rotronic	HL-20D	Temp and Humidity Meter	23-Jun-22	16-Jun-23
16803	Interface Inc.	CX-0330-1	Bridge Simulator	11-Aug-21	9-Dec-22
20980	Interface	50kip	Load Cell	18-Aug-22	16-Aug-24

Performed by:

James Rieder

Issued on: 11-Nov-22

ACS Version: 12.1

ACSRepRevBL



MTS Systems Corporation
14000 Technology Drive
Eden Prairie, MN 55344-2290

Calibration Report



Page: 2 of 5
Report Number: 2394-14549
Site: 508308
Country: SA

Customer

Name: Wiss, Janney, Elstner Associates, Inc.
System ID: Seismic Frame MTS System No: Seismic
Machine ID: Seismic Frame Location: Anchor Testing Lab

Equipment

Device Type: Force Model: 661.23A-01 Serial No.: 1194
Device ID: N/A
Conditioner Model: 494.26 DC A Serial No.: 1261214
Readout Device Model: COMPUTER Serial No.: Serial Channel: Port

Procedure

MTS Procedure: FS-CA 2122 Rev. G ACS Version: 12.1
Calibration has been performed in accordance with: ASTM E4-20
Method of Verification: Follow-the-Force Method using Elastic Calibration Devices

Calibration Equipment Asset No.

Dead Weight Set: N/A Standard Asset No.: 20980
DW Compensation: N/A DMM: N/A Digital Indicator: 16970 Lower Limit: 1000 lbf
Temperature Readout: 26923 Additional Equipment: N/A Standardizer: 16803

Conditions

Initial Temperature: 71 F Final Temperature: 72 F Bidirectional: N/A Cable Length: 50 Feet
Initial Humidity: 30 % Final Humidity: 32 % Polarity(+): Tension

In Tolerance ☐ **As Found:** ☒ **Maximum Relative Error:** 28.78 %
Out of Tolerance ☒ **As Adjusted:** ☐ **Tolerance: +/-1.0% of Applied Force**
As Found System Condition: Good

Conditioner Parameters

Total Gain: 475.94514 Fine zero: -0.02972 Shunt Cal (+): 0.0 lbf.
Polarity: Normal Pre-amp gain: 285.98
Excitation: 10.0 Volts Post-amp gain: 1.66426

Calibration Data

Range: 1
Compression Resolution: 4.3 Full Scale: 55000
Report Units: lbf

Applied Percent of Full Scale Force	Series 1		Series 1 Errors				Series 2		Series 2 Errors				Repeatability Percent Error	
	Indicated Reading	Indicated Reading	Indicated Error	Percent Error	Units Error	Percent Error	Indicated Reading	Indicated Reading	Units Error	Percent Error	Units Error	Percent Error	Asc	Desc
	Ascending	Descending	Asc	Asc	Desc	Desc	Ascending	Descending	Asc	Asc	Desc	Desc		
0	-14.3	8.1	-14.3	-0.03	-	-	10.8	1.9	10.8	0.02	-	-	-	-
-2	-1398.4	-	298.4	27.13	-	-	-1360.2	-	260.2	23.65	-	-	3.47	-
-4	-2772.8	-	572.8	26.04	-	-	-2744.6	-	544.6	24.75	-	-	1.28	-
-6	-4156.0	-	856.0	25.94	-	-	-4135.4	-	835.4	25.32	-	-	0.62	-
-8	-5509.5	-	1109.5	25.22	-	-	-5499.2	-	1099.2	24.98	-	-	0.23	-
-10	-6897.3	-	1397.3	25.41	-	-	-6874.7	-	1374.7	24.99	-	-	0.41	-
-20	-13786.0	-	2786.0	25.33	-	-	-13756.0	-	2756.0	25.05	-	-	0.27	-
-40	-27536.0	-	5536.0	25.16	-	-	-27518.0	-	5518.0	25.08	-	-	0.08	-
-70	-48173.0	-	9673.0	25.12	-	-	-48171.0	-	9671.0	25.12	-	-	0.01	-
-100	-68841.0	-	13841.0	25.17	-	-	-68811.0	-	13811.0	25.11	-	-	0.05	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Range: 1

Tension

Applied Percent of Full Scale Force	Series 1		Series 1 Errors				Series 2		Series 2 Errors				Repeatability Percent Error	
	Indicated Reading	Indicated Reading	Units Error	Percent Error	Units Error	Percent Error	Indicated Reading	Indicated Reading	Units Error	Percent Error	Units Error	Percent Error	Asc	Desc
	Ascending	Descending	Asc	Asc	Desc	Desc	Ascending	Descending	Asc	Asc	Desc	Desc		
0	13.9	9.2	13.9	0.03	-	-	-22.8	-32.4	-22.8	-0.04	-	-	-	-
2	1416.6	-	316.6	28.78	-	-	1372.8	-	272.8	24.80	-	-	3.98	-
4	2809.6	-	609.6	27.71	-	-	2736.8	-	536.8	24.40	-	-	3.31	-
6	4179.7	-	879.7	26.66	-	-	4148.3	-	848.3	25.71	-	-	0.95	-
8	5534.8	-	1134.8	25.79	-	-	5488.0	-	1088.0	24.73	-	-	1.06	-
10	6931.2	-	1431.2	26.02	-	-	6901.6	-	1401.6	25.48	-	-	0.54	-
20	13868.0	-	2868.0	26.07	-	-	13813.0	-	2813.0	25.57	-	-	0.50	-
40	27701.0	-	5701.0	25.91	-	-	27651.0	-	5651.0	25.69	-	-	0.23	-
70	48450.0	-	9950.0	25.84	-	-	48390.0	-	9890.0	25.69	-	-	0.16	-
100	69204.0	-	14204.0	25.83	-	-	69141.0	-	14141.0	25.71	-	-	0.11	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Errors at Zero are computed in % of Range.

Uncertainty of the data supplied is equal to or less than $\pm 0.25\%$ of reading for a coverage factor of $k=2$ and an approximate confidence level of 95%.

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MTS Reference Force Transducers are temperature compensated over the range of use.

American Association of Laboratory Accreditation Certificate Number: 1145.01

Table entries with a (-) are left intentionally blank.

 Out of Tolerance in % column

Performed By: Jim Rieder

Field Service Engineer

Date: 11-Nov-22

Signature: *James Rieder*

Next Customer Agreed Upon Calibration Date: 30-Nov-23

ACSRepRevBL

Page: 3 of 5

Report Number: 2394-14549

Site: 508308

Country: SA

Customer

Name: Wiss, Janney, Elstner Associates, Inc.

System ID: Seismic Frame

MTS System No: Seismic

Machine ID: Seismic Frame

Location: Anchor Testing Lab

Equipment

Device Type: Force

Model: 661.23A-01

Serial No.: 1194

Device ID: N/A

Conditioner Model: 494.26 DC A

Serial No.: 1261214

Readout Device Model: COMPUTER

Serial No.: Serial

Channel: Port

Range:

1

Full Scale: 55000

Units: lbf

Linearization Table

As Found:

X

As Adjusted:

[illegible]



MTS Systems Corporation
14000 Technology Drive
Eden Prairie, MN 55344-2290

Calibration Report



Page: 4 of 5
Report Number: 2394-14549
Site: 508308
Country: SA

Customer Name: Wiss, Janney, Elstner Associates, Inc.
System ID: Seismic Frame MTS System No: Seismic
Machine ID: Seismic Frame Location: Anchor Testing Lab

Equipment
Device Type: Force Model: 661.23A-01 Serial No.: 1194
Device ID: N/A
Conditioner Model: 494.26 DC A Serial No.: 1261214
Readout Device Model: COMPUTER Serial No.: Serial Channel: Port

Procedure
MTS Procedure: FS-CA 2122 Rev. G ACS Version: 12.1
Calibration has been performed in accordance with: ASTM E4-20
Method of Verification: Follow-the-Force Method using Elastic Calibration Devices

Calibration Equipment Asset No.
Dead Weight Set: N/A Standard Asset No.: 20980
DW Compensation: N/A DMM: N/A Digital Indicator: 16970 Lower Limit: 1000 lbf
Temperature Readout: 26923 Additional Equipment: N/A Standardizer: 16803

Conditions
Initial Temperature: 71 F Final Temperature: 71.2 F Bidirectional: N/A Cable Length: 50 Feet
Initial Humidity: 31 % Final Humidity: 28 % Polarity(+): Tension

In Tolerance ☒ **As Found:** ☐
Out of Tolerance ☐ **As Adjusted:** ☒
Customer agreed to adjustment: ☒
Maximum Relative Error: 0.90 %
Tolerance: +/-1.0% of Applied Force
As Found System Condition: Good

Conditioner Parameters
Total Gain: 378.68847 Fine zero: -0.02972 Shunt Cal (+): 0.0 lbf.
Polarity: Normal Pre-amp gain: 285.98
Excitation: 10.0 Volts Post-amp gain: 1.32418

Calibration Data
Range: 1
Compression Resolution: 4.3 Full Scale: 55000
Report Units: lbf

Applied Percent of Full Scale Force	Series 1		Series 1 Errors				Series 2		Series 2 Errors				Repeatability Percent Error	
	Indicated Reading Ascending	Indicated Reading Descending	Indicated Error Asc	Percent Error Asc	Units Error Desc	Percent Error Desc	Indicated Reading Ascending	Indicated Reading Descending	Units Error Asc	Percent Error Asc	Units Error Desc	Percent Error Desc	Asc	Desc
0	-8.0	-0.2	-8.0	-0.01	-	-	5.7	-0.4	5.7	0.01	-	-	-	-
-2	-1104.8	-	4.8	0.44	-	-	-1099.2	-	-0.8	-0.07	-	-	0.51	-
-4	-2207.6	-	7.6	0.35	-	-	-2187.9	-	-12.1	-0.55	-	-	0.90	-
-6	-3297.2	-	-2.8	-0.08	-	-	-3281.5	-	-18.5	-0.56	-	-	0.48	-
-8	-4386.0	-	-14.0	-0.32	-	-	-4387.8	-	-12.2	-0.28	-	-	0.04	-
-10	-5478.8	-	-21.2	-0.39	-	-	-5469.7	-	-30.3	-0.55	-	-	0.17	-
-20	-10975.0	-	-25.0	-0.23	-	-	-10968.0	-	-32.0	-0.29	-	-	0.06	-
-40	-21926.0	-	-74.0	-0.34	-	-	-21933.0	-	-67.0	-0.30	-	-	0.03	-
-70	-38357.0	-	-143.0	-0.37	-	-	-38355.0	-	-145.0	-0.38	-	-	0.01	-
-100	-54878.0	-	-122.0	-0.22	-	-	-54870.0	-	-130.0	-0.24	-	-	0.01	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Range: 1

Tension

Applied Percent of Full Scale Force	Series 1		Series 1 Errors				Series 2		Series 2 Errors				Repeatability Percent Error	
	Indicated Reading Ascending	Indicated Reading Descending	Units Error Asc	Percent Error Asc	Units Error Desc	Percent Error Desc	Indicated Reading Ascending	Indicated Reading Descending	Units Error Asc	Percent Error Asc	Units Error Desc	Percent Error Desc	Asc	Desc
0	-5.6	-9.1	-5.6	-0.01	-	-	-9.4	-10.9	-9.4	-0.02	-	-	-	-
2	1097.2	-	-2.8	-0.25	-	-	1096.9	-	-3.1	-0.28	-	-	0.03	-
4	2199.8	-	-0.2	-0.01	-	-	2196.9	-	-3.1	-0.14	-	-	0.13	-
6	3285.1	-	-14.9	-0.45	-	-	3293.6	-	-6.4	-0.19	-	-	0.26	-
8	4394.8	-	-5.2	-0.12	-	-	4393.6	-	-6.4	-0.15	-	-	0.03	-
10	5494.6	-	-5.4	-0.10	-	-	5500.9	-	0.9	0.02	-	-	0.11	-
20	10989.0	-	-11.0	-0.10	-	-	10995.0	-	-5.0	-0.05	-	-	0.05	-
40	22006.0	-	6.0	0.03	-	-	22002.0	-	2.0	0.01	-	-	0.02	-
70	38517.0	-	17.0	0.04	-	-	38517.0	-	17.0	0.04	-	-	0.00	-
100	55015.0	-	15.0	0.03	-	-	55030.0	-	30.0	0.05	-	-	0.03	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Errors at Zero are computed in % of Range.

Uncertainty of the data supplied is equal to or less than $\pm 0.25\%$ of reading for a coverage factor of $k=2$ and an approximate confidence level of 95%.

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American Association of Laboratory Accreditation Certificate Number: 1145.01

Table entries with a (-) are left intentionally blank.

 Out of Tolerance in % column

Performed By: Jim Rieder

Field Service Engineer

Date: 11-Nov-22

Signature: *James Rieder*

Next Customer Agreed Upon Calibration Date: 30-Nov-23

ACSRepRevBL

Page: 5 of 5

Report Number: 2394-14549

Site: 508308

Country: SA

Customer

Name: Wiss, Janney, Elstner Associates, Inc.

System ID: Seismic Frame

MTS System No: Seismic

Machine ID: Seismic Frame

Location: Anchor Testing Lab

Equipment

Device Type: Force

Model: 661.23A-01

Serial No.: 1194

Device ID: N/A

Conditioner Model: 494.26 DC A

Readout Device Model: COMPUTER

Serial No.: 1261214

Serial No.: Serial

Channel: Port

Range:

1

Full Scale: 55000

Units: lbf

Linearization Table

As Found:

As Adjusted:

Standard

Conditioner

[illegible]



Customer Address:
330 Pfingsten Road
Northbrook, IL 60062U
SA

MTS Field Service

MTS Systems Corporation
14000 Technology Drive
Eden Prairie, MN 55344-2290



Certificate of Calibration

Customer Name: Wiss, Janney, Elstner Associates, Inc. Page: 1 of 3
System ID: Seismic Frame MTS System No: Seismic Certificate Number: 2394-14547
Machine ID: Seismic Frame Location: Anchor Testing Lab Site: 508308
Country: SA

Equipment
Device Type: Length Model: 204.71 Serial No.: 494
Device ID: N/A
Conditioner Model: 494.16 AC Serial No.: 1149814
Readout Device Model: 494.16_AC Serial No.: 1149814 Channel: Displacement

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"General Requirements for the Competence of Testing and Calibration Laboratories".
Defined and documented measurement assurance techniques or uncertainty analyses are used to verify
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Calibrations are performed with standards whose values and measurements are traceable to the
International System of Units (SI) through a National Metrology Institute (NMI).

The results of this calibration relate only to the items calibrated.
When parameter(s) are reported to be within specified tolerance(s), the measured value(s) shall fall within the appropriate
specification limit and the uncertainty of the measured value(s) shall be stated.

CALIBRATION INFORMATION

As Found: In Tolerance Calibration Date: 11-Nov-2022
As Left: In Tolerance Calibration Due: 30-Nov-2023
Class: B
Calibration Procedure: FS-CA 2124 Rev. G ASTM E2309/E2309M-20
Full Scale Ranges: 5 in
Note: Return to zero errors are not included in the Classification Criteria.

STANDARDS USED FOR CALIBRATION

MTS Asset Number	Manufacturer	Model Number	Description	Cal. Date	Cal. Due
26923	Rotronic	HL-20D	Temp and Humidity Meter	23-Jun-22	16-Jun-23
26297	MTS	MTS 1800	Displacement Calibrator	10-Mar-22	10-Jul-23

Performed by: *James Rieder* Issued on: 11-Nov-22

ACS Version: 12.1

ACSRepRevBL



MTS Systems Corporation
14000 Technology Drive
Eden Prairie, MN 55344-2290

Calibration Report



Page: 2 of 3
Report Number: 2394-14547
Site: 508308
Country: SA

Customer Name: Wiss, Janney, Elstner Associates, Inc.
System ID: Seismic Frame MTS System No: Seismic
Machine ID: Seismic Frame Location: Anchor Testing Lab

Equipment
Device Type: Length Model: 204.71 Serial No.: 494
Device ID: N/A
Conditioner Model: 494.16 AC Serial No.: 1149814
Readout Device Model: 494.16_AC Serial No.: 1149814 Channel: Displacement

Procedure
MTS Procedure: FS-CA 2124 Rev. G ACS Version: 12.1
Calibration has been performed in accordance with: ASTM E2309/E2309M-20
Method of Verification: Follow-the-Displacement Method

Calibration Equipment Asset No.
Dead Weight Set: N/A Standard Asset No.: 26297
DW Compensation: N/A DMM: N/A Digital Indicator: N/A Lower Limit: N/A
Temperature Readout: 26923 Additional Equipment: N/A Standardizer: N/A

Conditions
Initial Temperature: 71 F Final Temperature: 71 F Bidirectional: N/A Cable Length: 75 Feet
Initial Humidity: 31 % Final Humidity: 28 % Polarity(+): Retraction

In Tolerance

X

As Found:

X

ASTM E2309 Classification: B
Out of Tolerance

--

As Adjusted:

--

As Found System Condition: Good

Conditioner Parameters
Polarity: Normal Total Gain: 1.28607 Fine zero: 0.0
Excitation: 10.0 Volts Pre-amp gain: 0.9025
Post-amp gain: 1.425 Phase: 63.0 deg

Calibration Data
Range: 1
Extension Resolution: 0.0002 Full Scale: 5
Report Units: in

Applied Percent of Full Scale Length	Series 1		Series 1 Errors				Series 2		Series 2 Errors				Repeatability Percent Error	
	Indicated Reading	Indicated Reading	Indicated Error	Percent Error	Units Error	Percent Error	Indicated Reading	Indicated Reading	Units Error	Percent Error	Units Error	Percent Error	Asc	Desc
	Ascending	Descending	Asc	Asc	Desc	Desc	Ascending	Descending	Asc	Asc	Desc	Desc		
0	0.00001	-0.00024	0.00001	0.00	-	-	-0.00010	-0.00020	-0.00010	0.00	-	-	-	-
-2	-0.09937	-	-0.00063	-0.63	-	-	-0.09961	-	-0.00039	-0.39	-	-	0.25	-
-4	-0.19908	-	-0.00092	-0.46	-	-	-0.19939	-	-0.00061	-0.31	-	-	0.15	-
-6	-0.29876	-	-0.00124	-0.41	-	-	-0.29899	-	-0.00101	-0.34	-	-	0.08	-
-8	-0.39859	-	-0.00141	-0.35	-	-	-0.39855	-	-0.00145	-0.36	-	-	0.01	-
-10	-0.49821	-	-0.00179	-0.36	-	-	-0.49837	-	-0.00163	-0.33	-	-	0.03	-
-20	-0.99805	-	-0.00195	-0.20	-	-	-0.99802	-	-0.00198	-0.20	-	-	0.00	-
-40	-2.00090	-	0.00090	0.05	-	-	-2.00060	-	0.00060	0.03	-	-	0.01	-
-60	-3.02690	-	0.02690	0.90	-	-	-3.02650	-	0.02650	0.88	-	-	0.01	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Range: 1 Crosshead Start Position: N/A

Applied Percent of Full Scale Length	Series 1		Series 1 Errors				Series 2		Series 2 Errors				Repeatability Percent Error	
	Indicated Reading	Indicated Reading	Units Error	Percent Error	Units Error	Percent Error	Indicated Reading	Indicated Reading	Units Error	Percent Error	Units Error	Percent Error	Asc	Desc
	Ascending	Descending	Asc	Asc	Desc	Desc	Ascending	Descending	Asc	Asc	Desc	Desc		
0	-0.00023	-0.00007	-0.00023	0.00	-	-	-0.00013	0.00011	-0.00013	0.00	-	-	-	-
2	0.09973	-	-0.00027	-0.27	-	-	0.09973	-	-0.00027	-0.27	-	-	0.00	-
4	0.19967	-	-0.00033	-0.16	-	-	0.19974	-	-0.00026	-0.13	-	-	0.03	-
6	0.29984	-	-0.00016	-0.05	-	-	0.29986	-	-0.00014	-0.05	-	-	0.01	-
8	0.39991	-	-0.00009	-0.02	-	-	0.39963	-	-0.00037	-0.09	-	-	0.07	-
10	0.49937	-	-0.00063	-0.13	-	-	0.49965	-	-0.00035	-0.07	-	-	0.06	-
20	0.99815	-	-0.00185	-0.19	-	-	0.99813	-	-0.00187	-0.19	-	-	0.00	-
40	1.99630	-	-0.00370	-0.19	-	-	1.99640	-	-0.00360	-0.18	-	-	0.01	-
60	3.01070	-	0.01070	0.36	-	-	3.01060	-	0.01060	0.35	-	-	0.00	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Errors at Zero are computed in % of Range. Table entries with a (-) are left intentionally blank.
Uncertainty of the calibration data supplied is equal to or less than the greater of, $\pm 0.25\%$ of reading or $\pm 50\mu$ inches, for a coverage factor of $k=2$ and an approximate confidence level of 95%.
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Out of Tolerance in % column

American Association of Laboratory Accreditation Certificate Number: 1145.01

Performed By: Jim Rieder

Field Service Engineer

Date: 11-Nov-22

Signature: *James Rieder*

Next Customer Agreed Upon Calibration Date: 30-Nov-23

ACSRepRevBL

Page: 3 of 3

Report Number: 2394-14547

Site: 508308

Country: SA

Customer

Name: Wiss, Janney, Elstner Associates, Inc.

System ID: Seismic Frame

MTS System No: Seismic

Machine ID: Seismic Frame

Location: Anchor Testing Lab

Equipment

Device Type: Length

Model: 204.71

Serial No.: 494

Device ID: N/A

Conditioner Model: 494.16 AC

Readout Device Model: 494.16_AC

Serial No.: 1149814

Serial No.: 1149814

Channel: Displacement

Range: 1

Full Scale: 5

Units: in

Linearization Table

As Found:

X

As Adjusted:

1

Standard

Conditioner

[illegible]



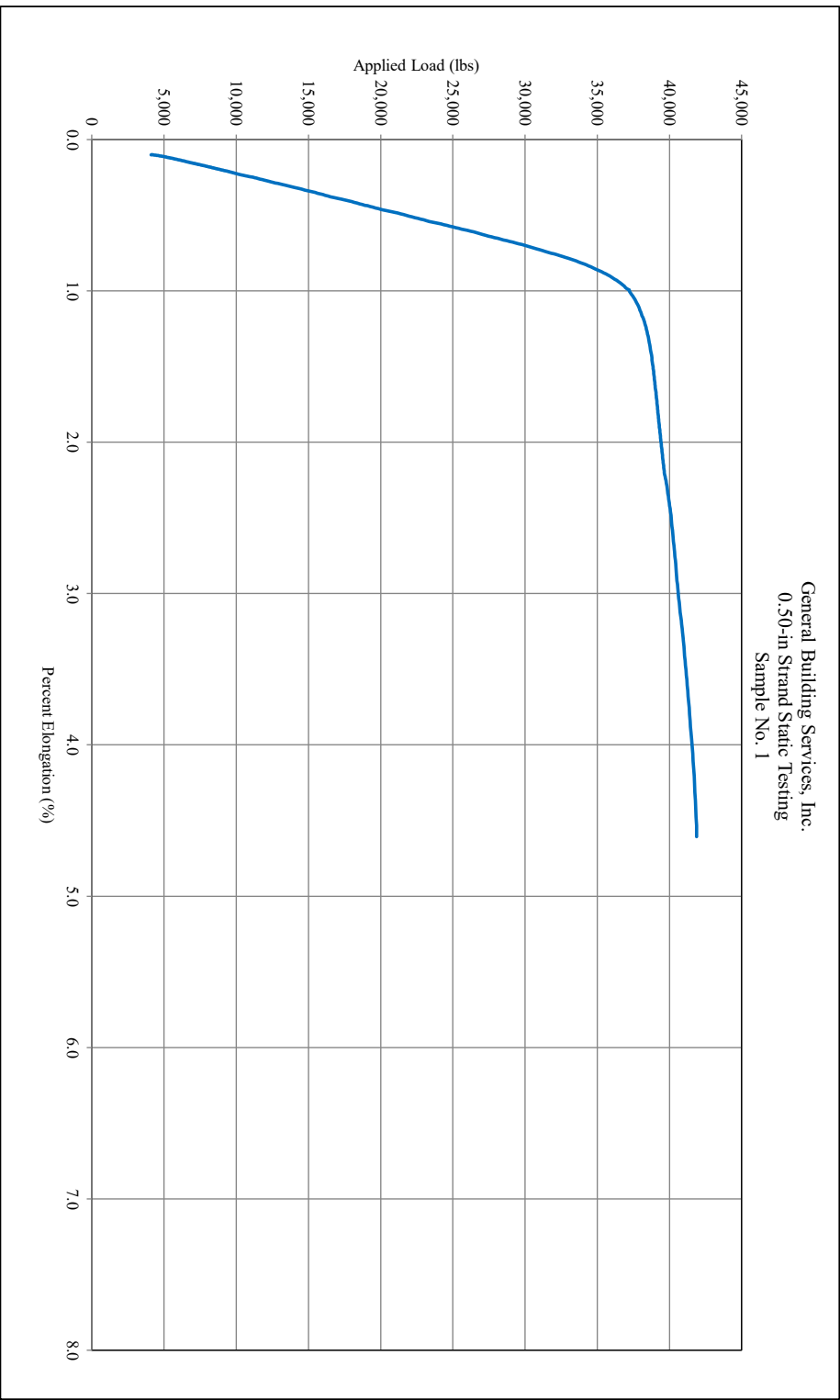
Static and Fatigue Testing of 0.5-in Barrier Cable Anchorages

PTI M10 Static Testing of Post-Tensioned Products, Inc. Barrier Cable Anchorages

APPENDIX C. STRAND CONTROL TESTS

Verified Dimensions	
Strand Diameter	0.500 in
Weight	236.3 grams
Length	11.943 in
Area	0.153 in ²

Measured Values	
Load at 1% Elongation	37,220 lbs
Breaking Load	41,890 lbs
Elongation @ Max Load	4.61 percent
Modulus of Elasticity	27,531 ksi

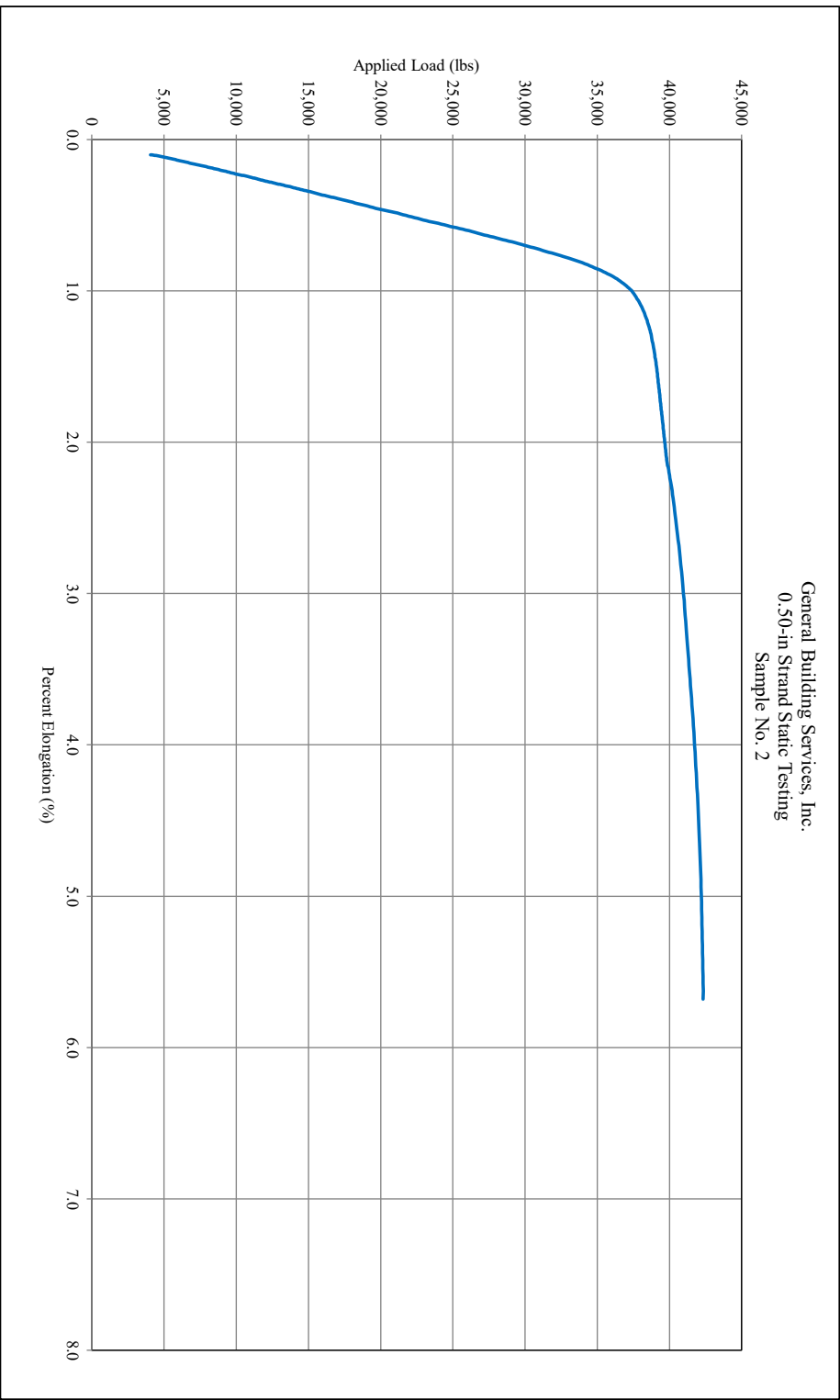


WJE Project Number	2021.3293	Test Location	Northbrook, IL
Client	General Building Services, Inc.	Test Operator	B Easton
Sample Tested	0.50-in, 270 ksi, 7-wire strand	Test Date	5/17/2023
Notes	0.50-in Strand Sample No. 1	Test Methods	ASTM A1061, A416

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Verified Dimensions	
Strand Diameter	0.500 in
Weight	236.3 grams
Length	11.943 in
Area	0.153 in ²

Measured Values	
Load at 1% Elongation	37,370 lbs
Breaking Load	42,340 lbs
Elongation @ Max Load	5.68 percent
Modulus of Elasticity	27,755 ksi

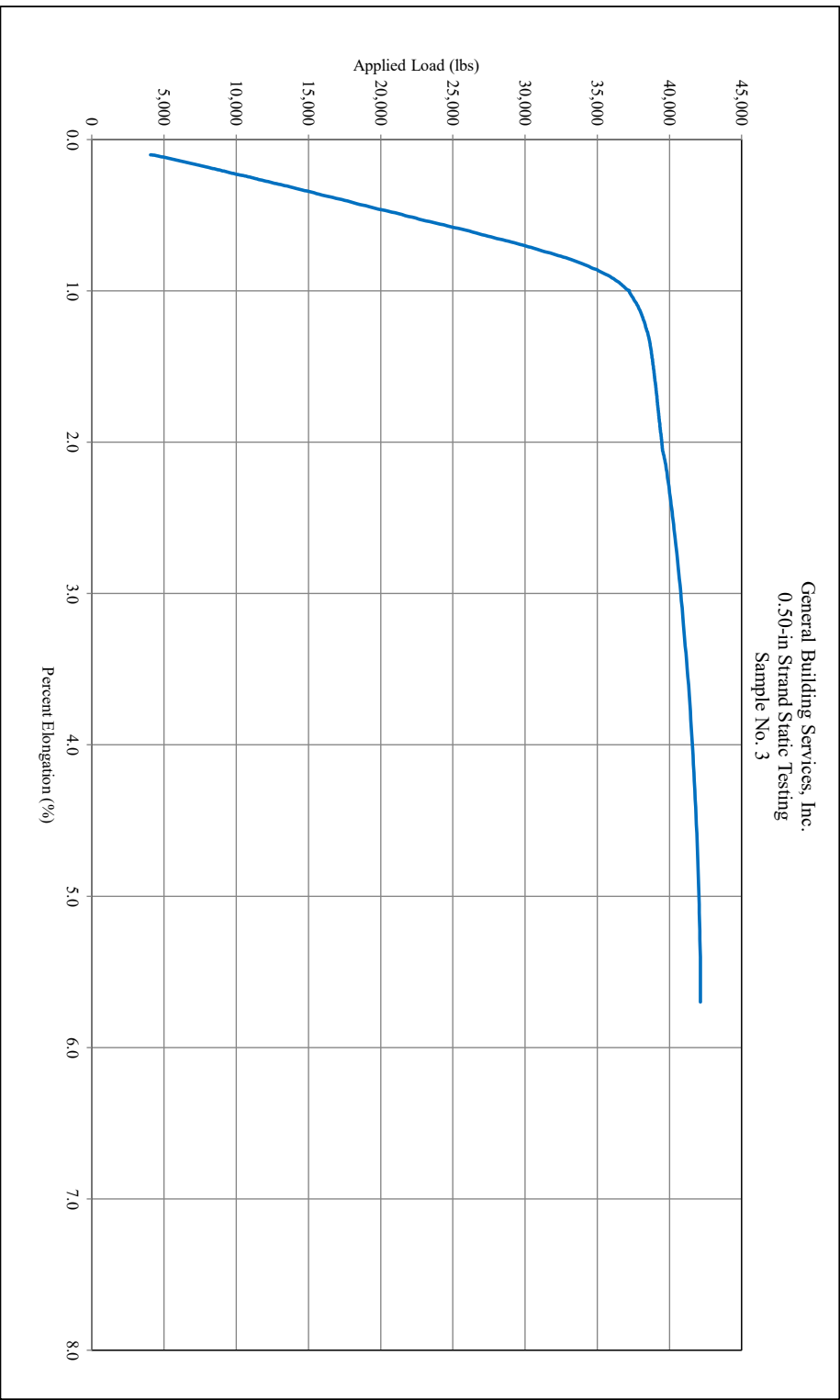


WJE Project Number	2021.3293	Test Location	Northbrook, IL
Client	General Building Services, Inc.	Test Operator	B Easton
Sample Tested	0.50-in, 270 ksi, 7-wire strand	Test Date	5/17/2023
Notes	0.50-in Strand Sample No. 2	Test Methods	ASTM A1061, A416

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Verified Dimensions	
Strand Diameter	0.500 in
Weight	236.3 grams
Length	11.943 in
Area	0.153 in ²

Measured Values	
Load at 1% Elongation	37,210 lbs
Breaking Load	42,150 lbs
Elongation @ Max Load	5.70 percent
Modulus of Elasticity	27,642 ksi



WJE Project Number	2021.3293	Test Location	Northbrook, IL
Client	General Building Services, Inc.	Test Operator	B Easton
Sample Tested	0.50-in, 270 ksi, 7-wire strand	Test Date	5/17/2023
Notes	0.50-in Strand Sample No. 3	Test Methods	ASTM A1061, A416

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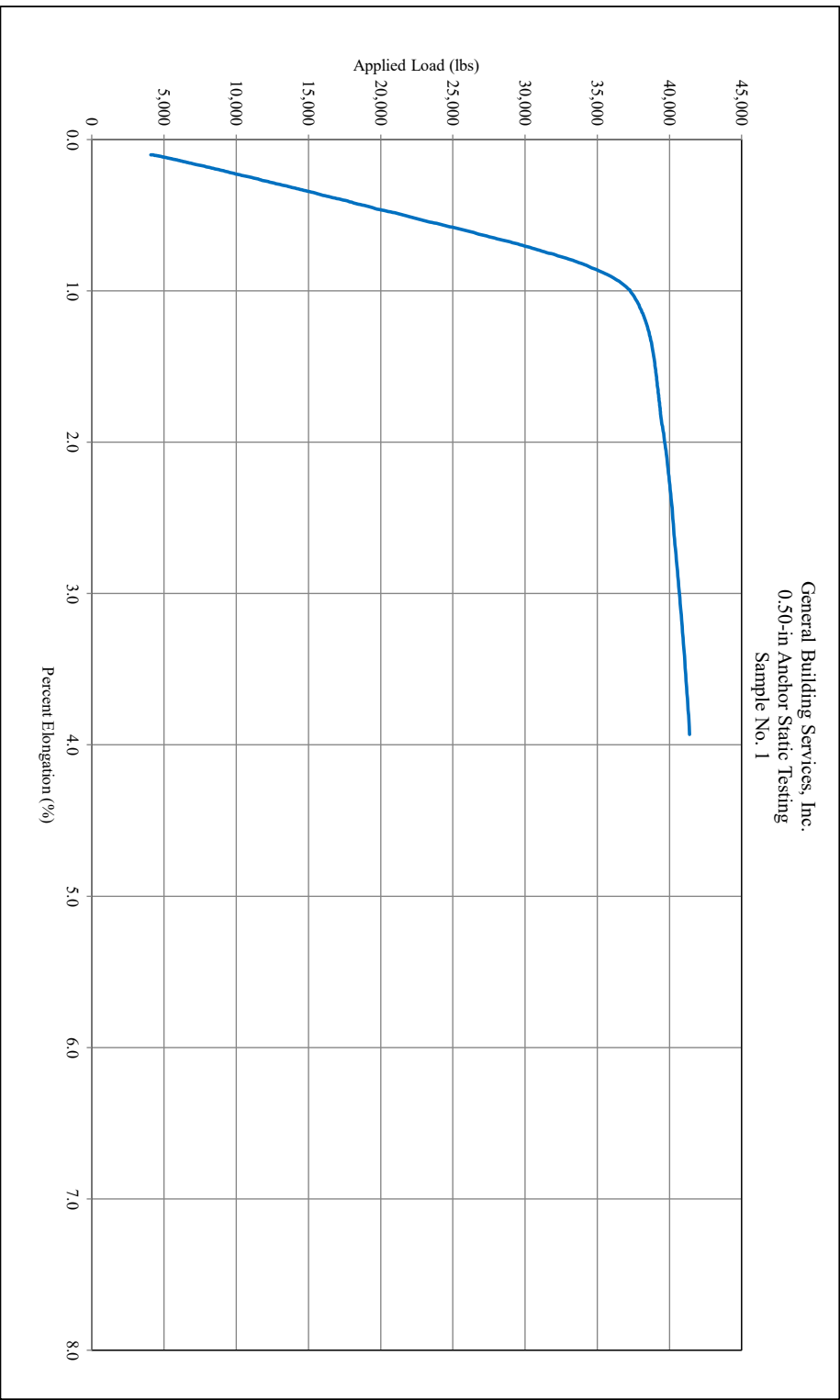
Static and Fatigue Testing of 0.5-in Barrier Cable Anchorages

PTI M10 Static Testing of Post-Tensioned Products, Inc. Barrier Cable Anchorages

APPENDIX D. ANCHORAGE STATIC TESTS

Verified Dimensions	
Strand Diameter	0.500 in
Weight	236.3 grams
Length	11.943 in
Area	0.153 in ²

Measured Values	
Load at 1% Elongation	37,250 lbs
Breaking Load	41,400 lbs
Elongation @ Max Load	3.93 percent
Modulus of Elasticity	27,483 ksi

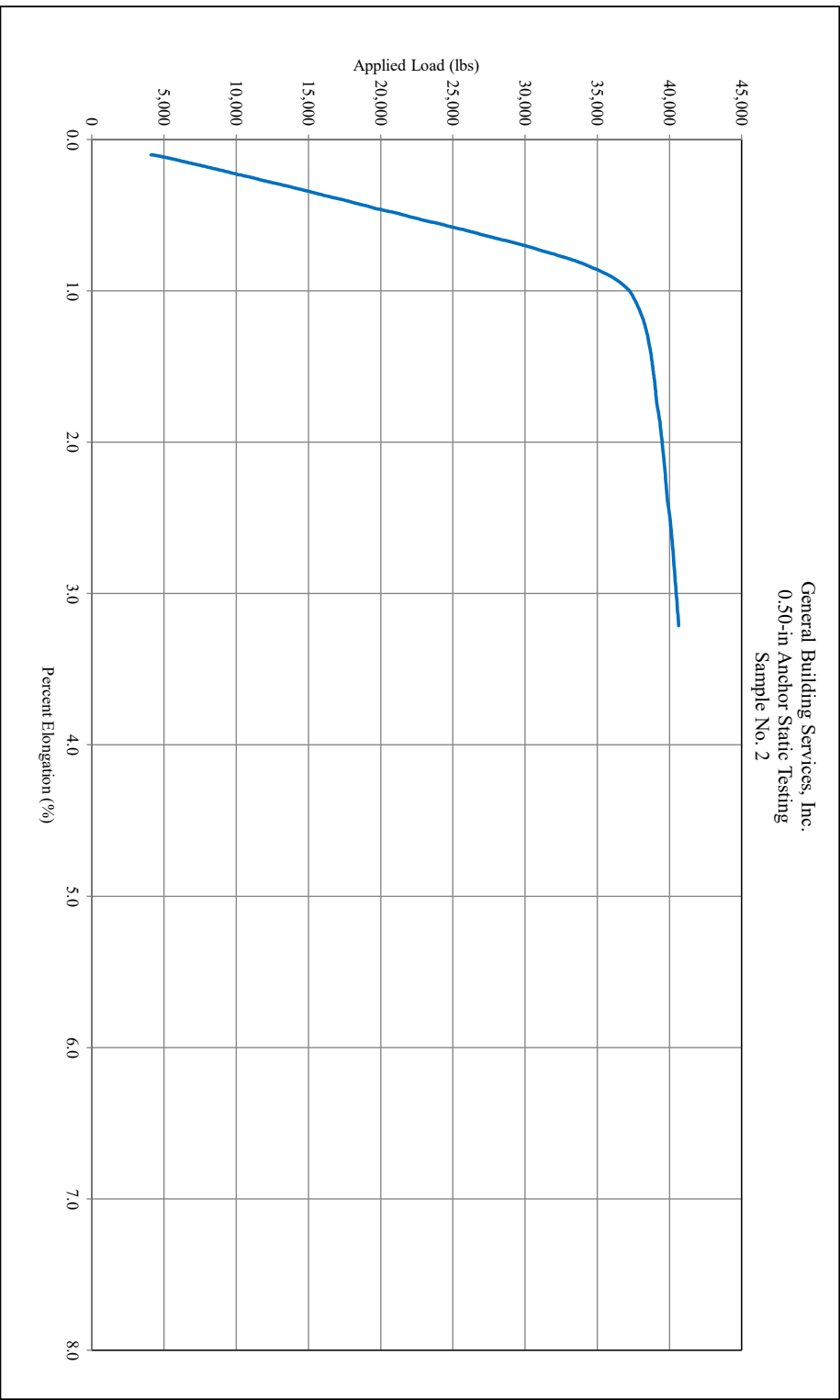


WJE Project Number	2021.3293	Test Location	Northbrook, IL
Client	General Building Services, Inc.	Test Operator	B Easton
Sample Tested	0.50-in, 270 ksi, 7-wire strand with Anchorage	Test Date	5/17/2023
Notes	0.50-in Anchor Sample No. 1	Test Methods	ASTM A1061, A416

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Verified Dimensions	
Strand Diameter	0.500 in
Weight	236.3 grams
Length	11.943 in
Area	0.153 in ²

Measured Values	
Load at 1% Elongation	37,210 lbs
Breaking Load	40,640 lbs
Elongation @ Max Load	3.21 percent
Modulus of Elasticity	27,631 ksi



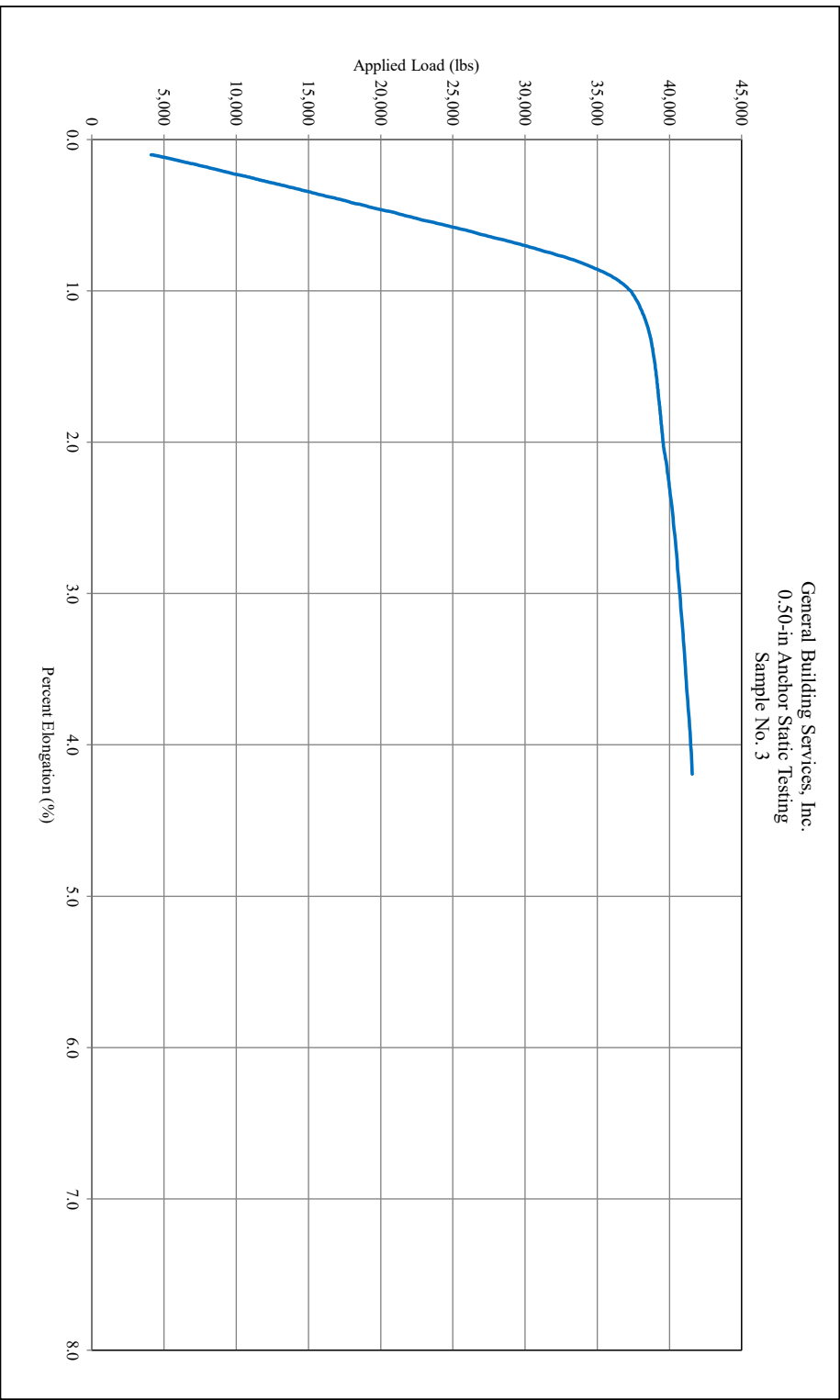
WJE Project Number	2021.3293
Client	General Building Services, Inc.
Sample Tested	0.50-in, 270 ksi, 7-wire strand with Anchorage
Notes	0.50-in Anchor Sample No. 2

Test Location	Northbrook, IL
Test Operator	B Easton
Test Date	5/17/2023
Test Methods	ASTM A1061, A416

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Verified Dimensions	
Strand Diameter	0.500 in
Weight	236.3 grams
Length	11.943 in
Area	0.153 in ²

Measured Values	
Load at 1% Elongation	37,320 lbs
Breaking Load	41,580 lbs
Elongation @ Max Load	4.19 percent
Modulus of Elasticity	28,118 ksi



WJE Project Number	2021.3293	Test Location	Northbrook, IL
Client	General Building Services, Inc.	Test Operator	B Easton
Sample Tested	0.50-in, 270 ksi, 7-wire strand with Anchorage	Test Date	5/17/2023
Notes	0.50-in Anchor Sample No. 3	Test Methods	ASTM A1061, A416

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Static and Fatigue Testing of 0.5-in Barrier Cable Anchorages

PTI M10 Static Testing of Post-Tensioned Products, Inc. Barrier Cable Anchorages

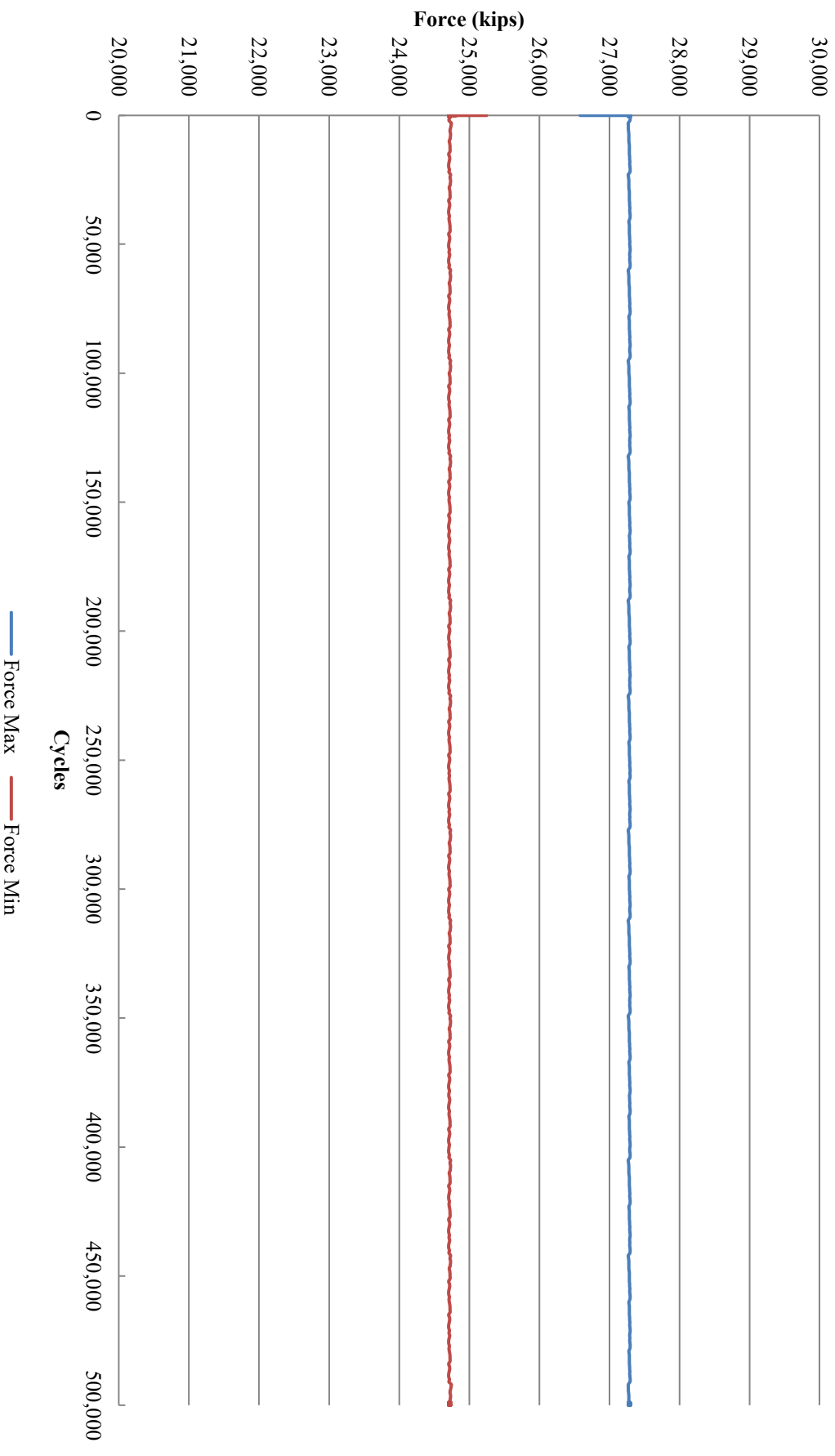
APPENDIX E. ANCHORAGE FATIGUE TESTS



ENGINEERS
ARCHITECTS
MATERIALS SCIENTISTS

Wiss, Janney, Elstner Associates, Inc.
330 Pfingsten Road
Northbrook, Illinois 60062

General Building Services, Inc.
0.50-in Galvanized Barrier Cable Anchorage with Galvanized Three-Piece Wedge Fatigue Testing
Sample 1 - 500,000 Cycles
WJE No. 2021.3293

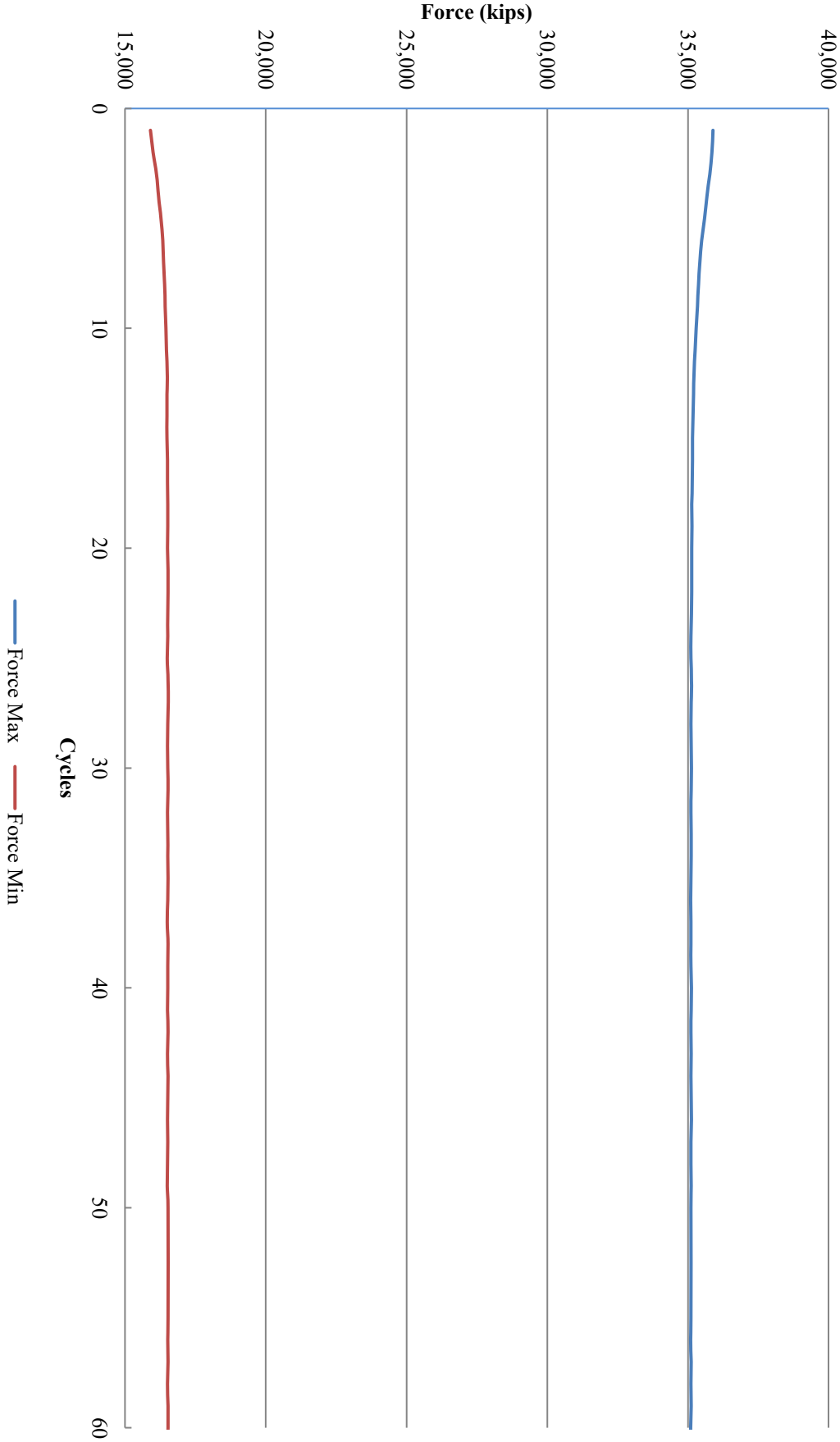




ENGINEERS
ARCHITECTS
MATERIALS SCIENTISTS

Wiss, Janney, Elstner Associates, Inc.
330 Pfingsten Road
Northbrook, Illinois 60062

General Building Services, Inc.
0.50-in Galvanized Barrier Cable Anchorage with Galvanized Three-Piece Wedge Fatigue Testing
Sample 1 - 50 Cycles
WJE No. 2021.3293

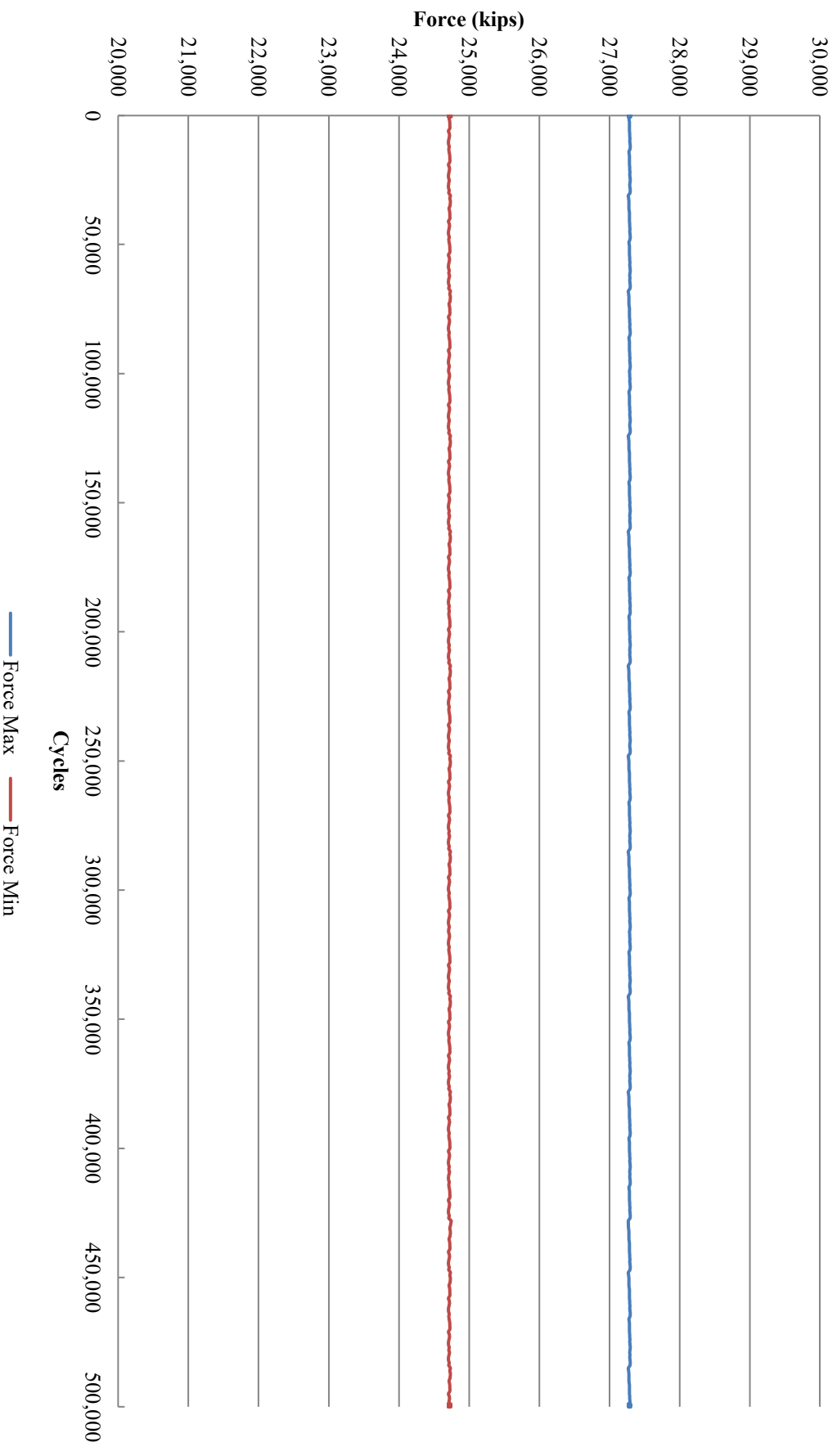




ENGINEERS
ARCHITECTS
MATERIALS SCIENTISTS

Wiss, Janney, Elstner Associates, Inc.
330 Pfingsten Road
Northbrook, Illinois 60062

General Building Services, Inc.
0.50-in Galvanized Barrier Cable Anchorage with Galvanized Three-Piece Wedge Fatigue Testing
Sample 2 - 500,000 Cycles
WJE No. 2021.3293





ENGINEERS
ARCHITECTS
MATERIALS SCIENTISTS

Wiss, Janney, Elstner Associates, Inc.
330 Pfingsten Road
Northbrook, Illinois 60062

General Building Services, Inc.
0.50-in Galvanized Barrier Cable Anchorage with Galvanized Three-Piece Wedge Fatigue Testing
Sample 2 - 50 Cycles
WJE No. 2021.3293

