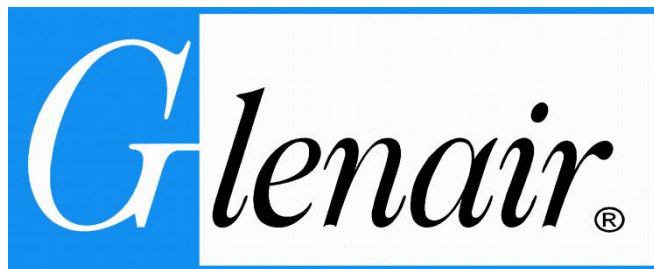


Glenair Test Report

ArmorLite CF Braid (103-126-016)
Thermal Shock and Endurance

GT-20-766

Revision B
12/16/20



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TEST REPORT

Cage Code: 06324	ArmorLite CF Braid (103-126-016) Thermal Shock and Endurance	Document #: GT-20-766 Revision: B Page 2 of 3
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Revision Status	Description of Change	Date	Approval
A	Release	12/08/20	JNN
B	Revised per DCN 84374	12/16/20	JNN



TEST REPORT

Cage Code: 06324	ArmorLite CF Braid (103-126-016) Thermal Shock and Endurance	Document #: GT-20-766 Revision: B Page 3 of 3
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Summary of Test Results:

Group 1: Pull Test (EN 6059-404)

Sample	Pull Test (lbf)
001	308
002	246
003	400
Avg.	318.0

Group 2: Thermal Shock (EN 6059-308); -150°C to 300°C; 10 cycles, 30 minute durations

Sample	Pre-Test Resistance (mΩ/ft)	Post-Test Resistance (mΩ/ft)	Post-Test Pull (lbf)
004	4.565	4.562	322
005	4.523	4.512	313
006	4.545	4.655	317
Avg.	4.544	4.576	317.3

Group 3: Thermal Endurance (EN 6059-302); 300°C for 1000 hours

Sample	Pre-Test Resistance (mΩ/ft)	Post-Test Resistance (mΩ/ft)	Post-Test Pull (lbf)
007	4.646	4.226	254
008	4.543	4.544	274
009	4.554	4.899	259
Avg.	4.581	4.556	262.3

Group 4: Thermal Endurance (EN 6059-302); 400°C for 1000 hours

Sample	Pre-Test Resistance (mΩ/ft)	Post-Test Resistance (mΩ/ft)	Post-Test Pull (lbf)
010	4.638	4.313	218
011	4.606	4.653	175
012	4.665	4.98	232
Avg.	4.636	4.649	208.3

Reference the following Test Report 20197R1KLV3 for full testing details.

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Version History

Version	Date	Comments	Prepared By	Reviewed By	Approved By
1	11/16/2020	Initial release	Kenneth Liberato	Brian Morales	Kane Liang
2	11/18/2020	Updated Resistance Measurements on Test Results page	Kenneth Liberato	Brian Morales	Kane Liang
3	12/16/2020	Per Customer Request: Updated Thermal Shock Test Parameters and Engineering Notes	Kenneth Liberato	Brian Morales	Kane Liang

Test Deviations

Deviation No.	Test Name	Description
-	-	-

Job Name	Armorlite CF Temp Testing
Job No.	20197
Client	Glenair
Address	1211 Air Way, Glendale, CA 91201
Contact Name	John Nguyen
Telephone No.	(818) 247-6000
Email	johnnguyen@glenair.com
Controlling Document	Customer Specification

Test Name	Serial No.	Start Date	End Date	Pass	Fail	Record
Pull Test	Group 1	8/17/2020	8/17/2020	-	-	X
Resistance Testing	Group 2-4	8/19/2020	8/21/2020	-	-	X
Thermal Shock	Group 2	9/4/2020	9/4/2020	-	-	X
Thermal Endurance	Group 3	9/1/2020	10/13/2020	-	-	X
Thermal Endurance	Group 4	9/1/2020	10/13/2020	-	-	X
Resistance Testing	Group 2-4	10/13/2020	10/13/2020	-	-	X
Pull Test	Group 2-4	10/13/2020	10/13/2020	-	-	X

Summary of Testing

Samples that are to be tested are 12 braided cable sleeves that are 26" in length and will be divided into four groups. Samples will be tested to European Standards; EN 6059-404 (Pull Test), EN 3475-301 (Resistance), EN 6059-308 (Thermal Shock) and EN 6059-302 (Thermal Endurance). Each sample group will go through a different order of testing specified by the customer.

Test Sample Groups 2-4 went through resistance testing under European Standard EN 3475 Test Method 301. Samples were placed in a chamber at 20°C and was attached to a Micro-Ohmmeter with voltage probes spaced at a distance of 12" ±0.12". Samples were tested at a current of 20 millivolts.

Test Sample Group 2 went through thermal shock and was tested in accordance with European Standard EN 6059 Test Method 308. Test Samples were installed onto a test fixture then went through thermal cycling from -150°C to 300°C for 30 minute durations until 10 cycles have been completed at each temperature.

Test Sample Groups 3 and 4 were put through thermal endurance and tested in accordance with European Standard EN 6059 Test Method 302. Samples were within minimum length of 600mm per specification. Per customer specifications, a stainless steel mandrel was not installed and groups will undergo thermal endurance for 1000 hours at 300°C for group 3 and 1000 hours at 400°C for group 4. Temperature tolerances will be ±5°C of the maximum temperature as stated in EN 6059-302.

All Test Sample Groups underwent tensile strength testing through European Standard 6059 Test Method 404. Samples were installed onto a tensile tester and put under tension at a rate of 25mm/min. Group 1's only specified test sequence was the pull test, Groups 2-4 were pull tested after post resistance testing.

All test sequences were completed with no known deviations or failures.

Date Received	8/14/2020
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Test Group	Part Name	Part No.	Serial No.
Group 1	Armorlite CF	103-126-016-G101	001
Group 1	Armorlite CF	103-126-016-G102	002
Group 1	Armorlite CF	103-126-016-G103	003
Group 2	Armorlite CF	103-126-016-G201	004
Group 2	Armorlite CF	103-126-016-G202	005
Group 2	Armorlite CF	103-126-016-G203	006
Group 3	Armorlite CF	103-126-016-G301	007
Group 3	Armorlite CF	103-126-016-G302	008
Group 3	Armorlite CF	103-126-016-G303	009
Group 4	Armorlite CF	103-126-016-G401	010
Group 4	Armorlite CF	103-126-016-G402	011
Group 4	Armorlite CF	103-126-016-G403	012

#	Test Name	Serial No.	Group 1	Group 2	Group 3	Group4
1	Pull Test EN 6059-404:1997	001-003	X			
2	Resistance EN 3475-301:2002	002-012		X	X	X
3	Thermal Shock EN 6059-308:2014	004-006		X		
4	Thermal Endurance EN 6059-302:2017	007-009			X	
5	Thermal Endurance EN 6059-302:2017	010-012				X
6	Resistance EN 3475-301:2002	002-012		X	X	X
7	Pull Test EN 6059-404:1997	002-012		X	X	X

ID No.	Equipment Name	Manufacturer	Model No.	Cal. Date	Cal. Due
CE002	TENSILE TESTER (5K LBF)	MTS	QTEST 5	10/29/2020	10/31/2021
CE034	ENVIRONMENTAL CHAMBER	DELTA	9076	4/20/2020	4/30/2021
EM001	MICRO-OHMMETER	IET LABS	LOM-510A	7/8/2020	7/31/2021
CE040	CONVECTION OVEN	BLUE M ELECTRIC	DC-256-B-MP350	10/29/2020	10/31/2021
CE050	ENVIRONMENTAL CHAMBER	TEST EQUITY	FOV2	Verify Before Use	
TC014	TEMPERATURE METER	EXTECH INSTRUMENTS	SDL200	6/22/2020	6/30/2021
CE009	ENVIRONMENTAL CHAMBER	SENTROTECH	ST-1700C-121216-OT	6/26/2020	6/30/2021
TC025	TEMPERATURE & HUMIDITY MONITOR	DICKSON	DWE / RTRH	3/3/2020	3/31/2021

Test Parameters

Test Name	Pull Test
Specification	European Standard EN 6059:1997
Method / Procedure	
Figure / Table	

Test Requirements

Pull Test

Test Samples will undergo tensile strength testing through European Standard 6059 Test Method 404. Samples will be installed onto tensile tester and put under tension at a rate of 25mm/min.

Test Parameters

Test Name	Resistance Testing
Specification	European Standard EN 3475:2002
Method / Procedure	
Figure / Table	

Test Requirements

Resistance Testing

Test samples will be tested under European Standard EN 3475 Test Method 301. Samples will be placed in chamber CE034 @ 20°C and will be attached to Micro-Ohmmeter with voltage probes spaced at a distance of 12" \pm 0.12". Samples will be tested at a current of 20 millivolts.

Test Parameters

Test Name	Thermal Shock
Specification	European Standard EN 6059:2014
Method / Procedure	
Figure / Table	

Test Requirements

Thermal Shock

Samples will be tested in accordance with European Standard EN 6059 Test Method 308. Assemblies will undergo thermal cycling from -150°C to 300°C for 30 minute durations until 10 cycles have been completed at each temperature.

Test Parameters

Test Name	Thermal Endurance
Specification	European Standard EN 6059:2017
Method / Procedure	
Figure / Table	

Test Requirements
<p>Thermal Endurance</p> <p>Samples will be tested in accordance with European Standard EN 6059 Test Method 302. Samples are within minimum length of 600mm per specification. Per customer specifications, a stainless steel mandrel will not be installed and will undergo thermal endurance for 1000 hours at 300°C. Temperature tolerances will be $\pm 5^{\circ}\text{C}$ of the maximum temperature as stated in EN 6059-302.</p>

Date	Time	Notes
08/15/2020	1500	Test Samples Received
8/17/2020	0700	Test Articles inspected, serialized and photographed. No damage found during initial inspection.
	1330	Began preparations for pull test
		Pull Test EN 6059-404: Test Samples will undergo tensile strength testing through European Standard 6059 Test Method 404. Samples will be installed onto tensile tester and put under tension at a rate of 25mm/min
	1443	Began Pull Test EN 6059-404 on Group 1 Test Samples
	1514	Group 1 Pull Test complete
8/19/2020	0830	Preparing test equipment and test samples for Resistance Testing
		Resistance Testing: Test samples will be tested under European Standard EN 3475 Test Method 301. Samples will be placed in chamber CE034 @ 20°C and will be attached to Micro-Ohmmeter with voltage probes spaced at a distance of 12" ±0.12". Samples will be tested at a current of 20 millivolts.
	1039	Began Resistance Testing Groups 2-4
	1313	Resistance Testing completed (See Resistance Test Data Sheet(1) for test results)
8/21/2020	0715	Began Resistance Testing Groups 2-4. Voltage probes placed 12-24" per customer specifications.
	0732	Resistance Testing completed (See Resistance Test Data Sheet(2) for test results)
8/24/2020	0830	Began fabricating fixture for Group 2 Thermal Shock Testing
	1300	Installing Group 2 Test Samples onto test fixture

Test Operator	Kenneth Liberato
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**Ambient environmental data controlled and maintained by Vertical Laboratories. Specific data can be provided upon customer request.*

Date	Time	Notes
8/25/2020		Thermal Shock: Samples will be tested in accordance with European Standard EN 6059 Test Method 308.
		Assemblies will undergo thermal cycling from -150°C to 300°C for 30 minute durations until 10 cycles have been completed at each temperature.
	0655	Chambers for thermal shock testing powered on, test profiles running
	0714	Chambers in spec. Begin thermal cycling
	1940	Thermal Shock Testing completed.
		(See Armorlite Group 2 Thermal Shock Data for test results)
8/31/2020	0700	Install Group 3 onto Test Fixture, prep Thermal Chamber/Test Equipment
9/1/2020	0630	Group 3 installed into thermal chamber
		Thermal Endurance: Samples will be tested in accordance with European Standard EN 6059 Test Method 302. Samples are within minimum length of 600mm per specification. Per customer specifications, a stainless steel mandrel will not be installed and will undergo thermal endurance for 1000 hours at 300°C. Temperature tolerances will be $\pm 5^{\circ}\text{C}$ of the maximum temperature as stated in EN 6059-302.
	0655	Thermal Chamber(CE050)/Data Logger(TC014) powered on. Group 3 profile started
	0810	Thermal Chamber temperature in spec
	0900	Install Group 4 onto Test Fixture, prep Thermal Chamber/Test Equipment
		Thermal Endurance: Samples will be tested in accordance with European Standard EN 6059 Test Method 302. Samples are within minimum length of 600mm per specification. Per customer specifications, a stainless steel mandrel will not be installed and will undergo thermal endurance for 1000 hours at 400°C. Temperature tolerances will be $\pm 5^{\circ}\text{C}$ of the maximum temperature as stated in EN 6059-302.
	1335	Thermal Chamber(CE009) powered on. Group 4 profile started

Test Operator	Kenneth Liberato
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**Ambient environmental data controlled and maintained by Vertical Laboratories. Specific data can be provided upon customer request.*

Date	Time	Notes
9/3/2020		Resistance Testing: Test samples will be tested under European Standard EN 3475
		Test Method 301. Samples will be placed in chamber CE034 @ 20°C and will be attached to
		Micro-Ohmmeter with voltage probes spaced at a distance of 12" ±0.12". Samples will be
		tested at a current of 20 millivolts.
	1300	Began Pre-Resistance Testing Group 2
	1310	Resistance Testing completed
		(See Resistance Test Data Sheet(G2) for test results)
	1430	Install Group 4 onto Test Fixture
9/4/2020		Thermal Shock: Samples will be tested in accordance with European Standard EN 6059
		Test Method 308. Assemblies will undergo thermal cycling from -150°C to 300°C
		for 30 minute durations until 10 cycles have been completed at each temperature.
	0630	Chambers for thermal shock testing powered on, test profiles running
	0656	Chambers in spec. Begin thermal cycling
	1700	Thermal Cycling complete
		(See Armorlite Group 2 Thermal Shock Data (2) for test results)
9/8/2020		Resistance Testing: Test samples will be tested under European Standard EN 3475
		Test Method 301. Samples will be placed in chamber CE034 @ 20°C and will be attached to
		Micro-Ohmmeter with voltage probes spaced at a distance of 6" ±0.12". Samples will be
		tested at a current of 20 millivolts.
	0737	Began Post-Resistance Testing Group 2
	0741	Resistance Testing completed
		(See Resistance Test Data Sheet(G2) for test results)

Test Operator	Kenneth Liberato
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**Ambient environmental data controlled and maintained by Vertical Laboratories. Specific data can be provided upon customer request.*

Pre-test sample conditions

Test samples were received in good condition. No damage or irregularities noted.

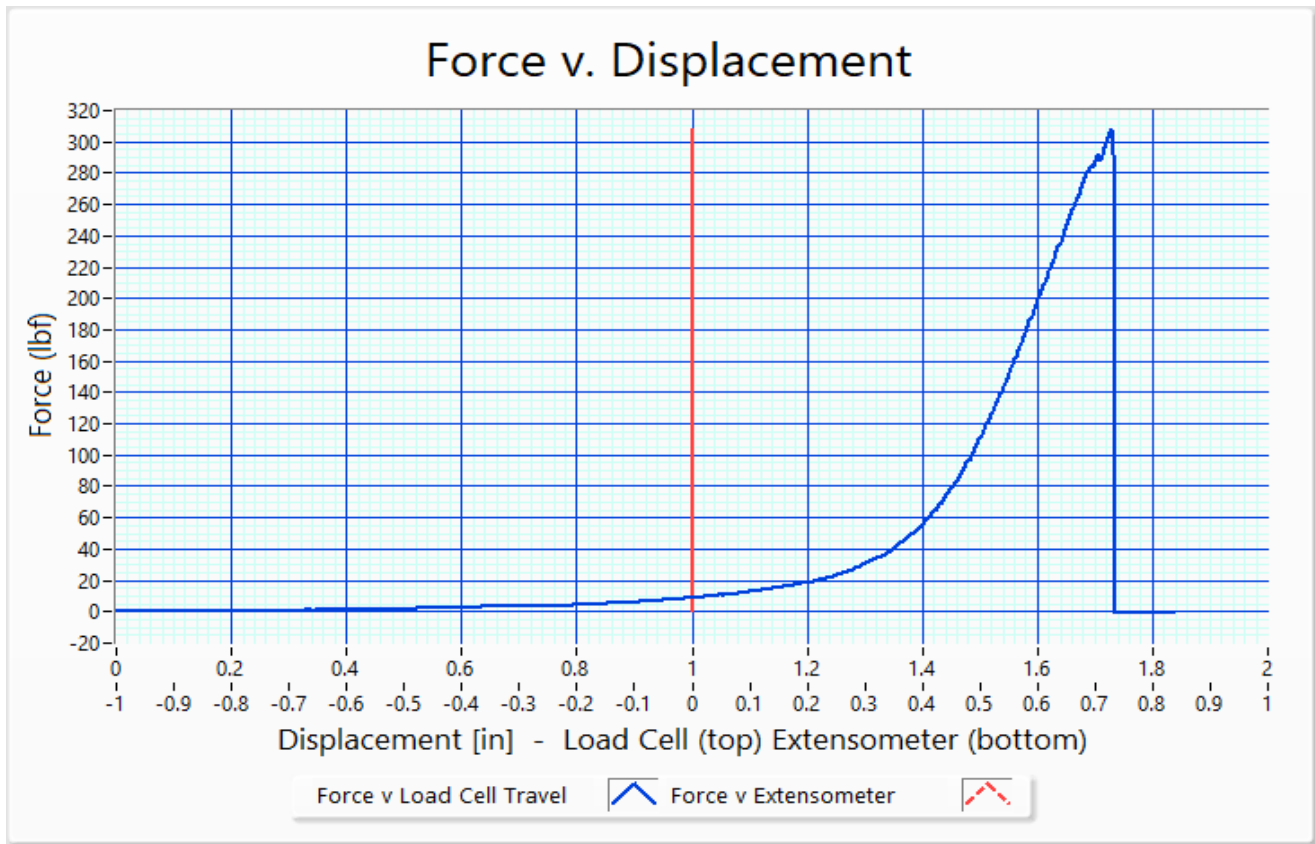
Post-test sample conditions

No unexpected damage or irregularities noted.

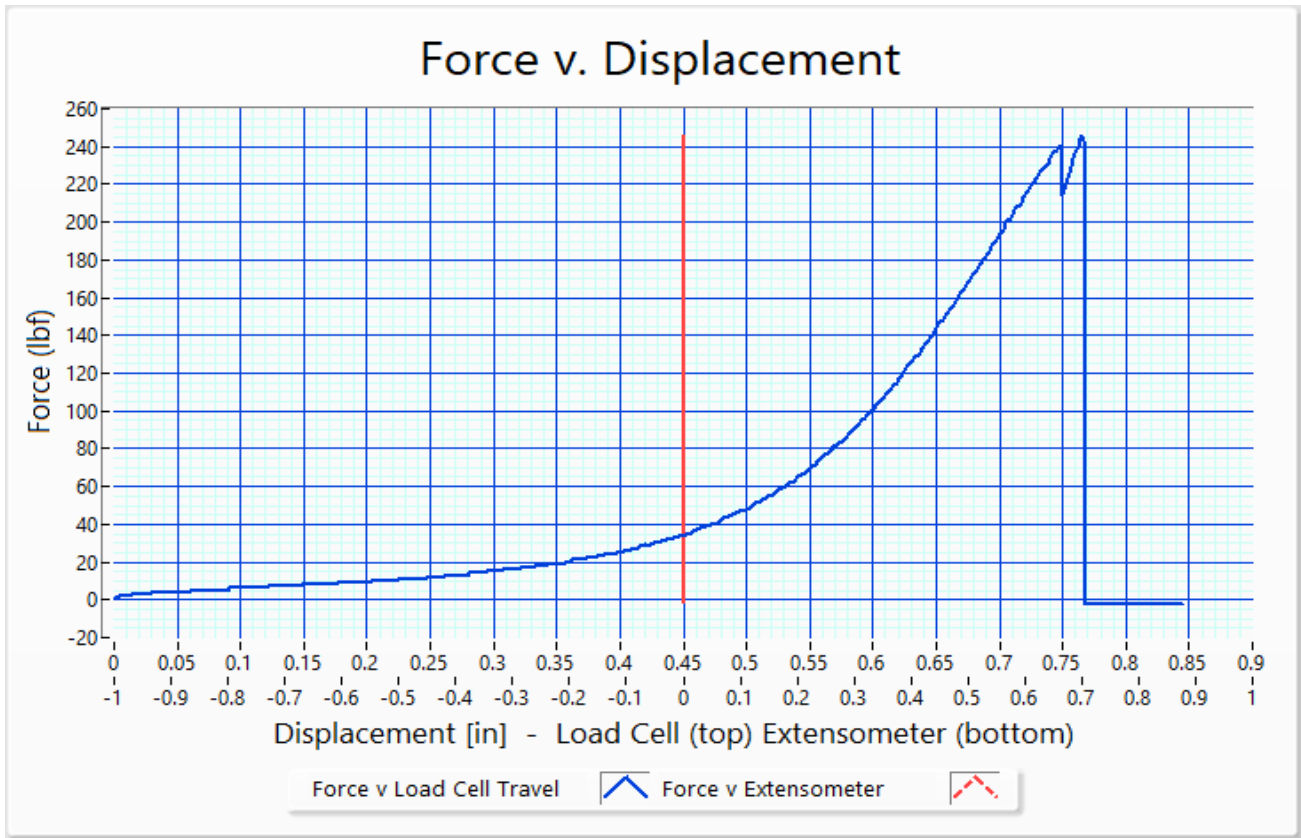
Test Results

P/N	Temperature	Current	Resistance	Notes
103-126-016-G201(004)	20°C	20A	4.565mΩ	Pre-Thermal Shock Values
103-126-016-G202(005)	20°C	20A	4.523mΩ	Pre-Thermal Shock Values
103-126-016-G203(006)	20°C	20A	4.545mΩ	Pre-Thermal Shock Values
103-126-016-G301(007)	20°C	20A	4.646mΩ	Pre-Thermal Endurance Values
103-126-016-G302(008)	20°C	20A	4.543mΩ	Pre-Thermal Endurance Values
103-126-016-G303(009)	20°C	20A	4.554mΩ	Pre-Thermal Endurance Values
103-126-016-G401(010)	20°C	20A	4.638mΩ	Pre-Thermal Endurance Values
103-126-016-G402(011)	20°C	20A	4.606mΩ	Pre-Thermal Endurance Values
103-126-016-G403(012)	20°C	20A	4.665mΩ	Pre-Thermal Endurance Values

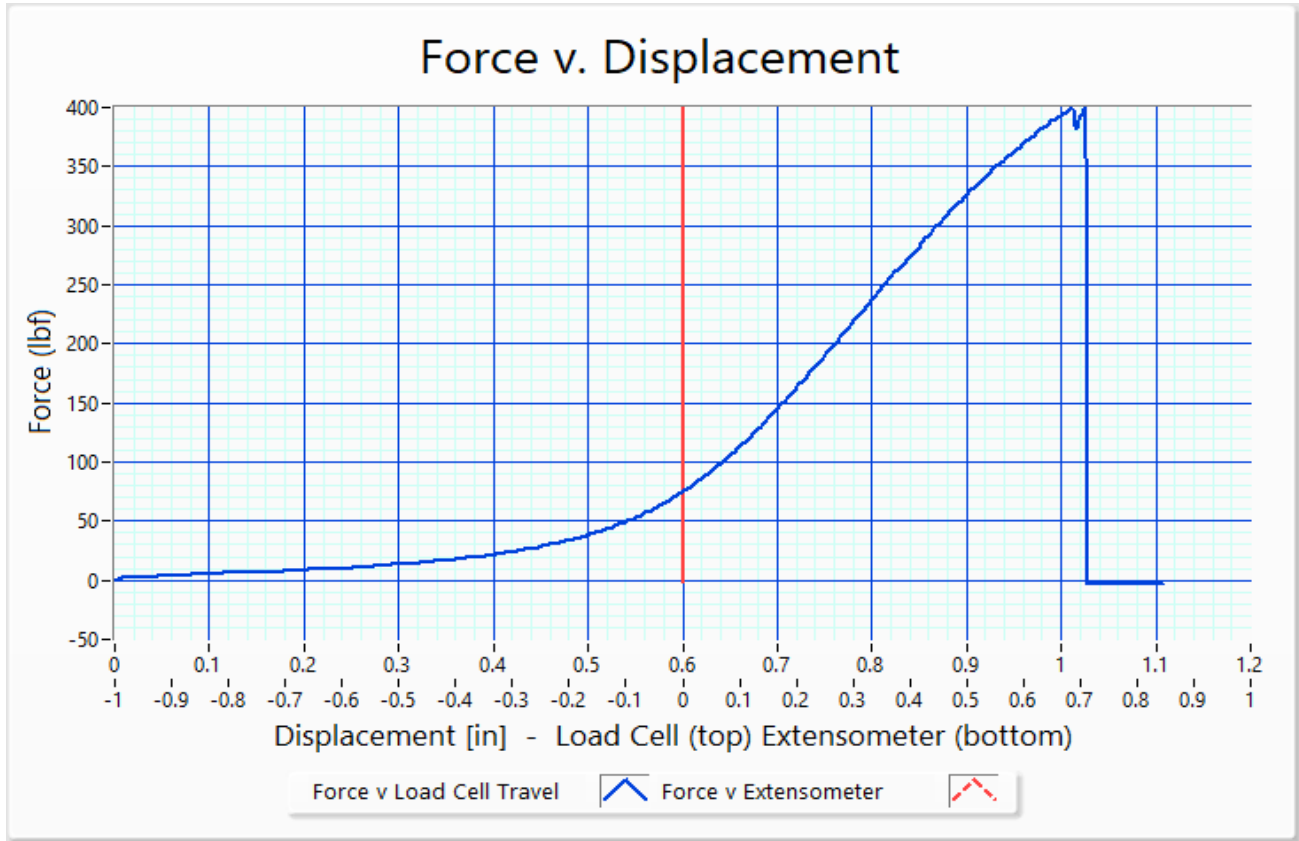
P/N	Temperature	Current	Resistance	Notes
103-126-016-G201(004)	20°C	20A	4.562mΩ	Post-Thermal Shock Values
103-126-016-G202(005)	20°C	20A	4.512mΩ	Post-Thermal Shock Values
103-126-016-G203(006)	20°C	20A	4.655mΩ	Post-Thermal Shock Values
103-126-016-G301(007)	20°C	20A	4.226mΩ	Post-Thermal Endurance Values
103-126-016-G302(008)	20°C	20A	4.544mΩ	Post-Thermal Endurance Values
103-126-016-G303(009)	20°C	20A	4.899mΩ	Post-Thermal Endurance Values
103-126-016-G401(010)	20°C	20A	4.313mΩ	Post-Thermal Endurance Values
103-126-016-G402(011)	20°C	20A	4.653mΩ	Post-Thermal Endurance Values
103-126-016-G403(012)	20°C	20A	4.98mΩ	Post-Thermal Endurance Values



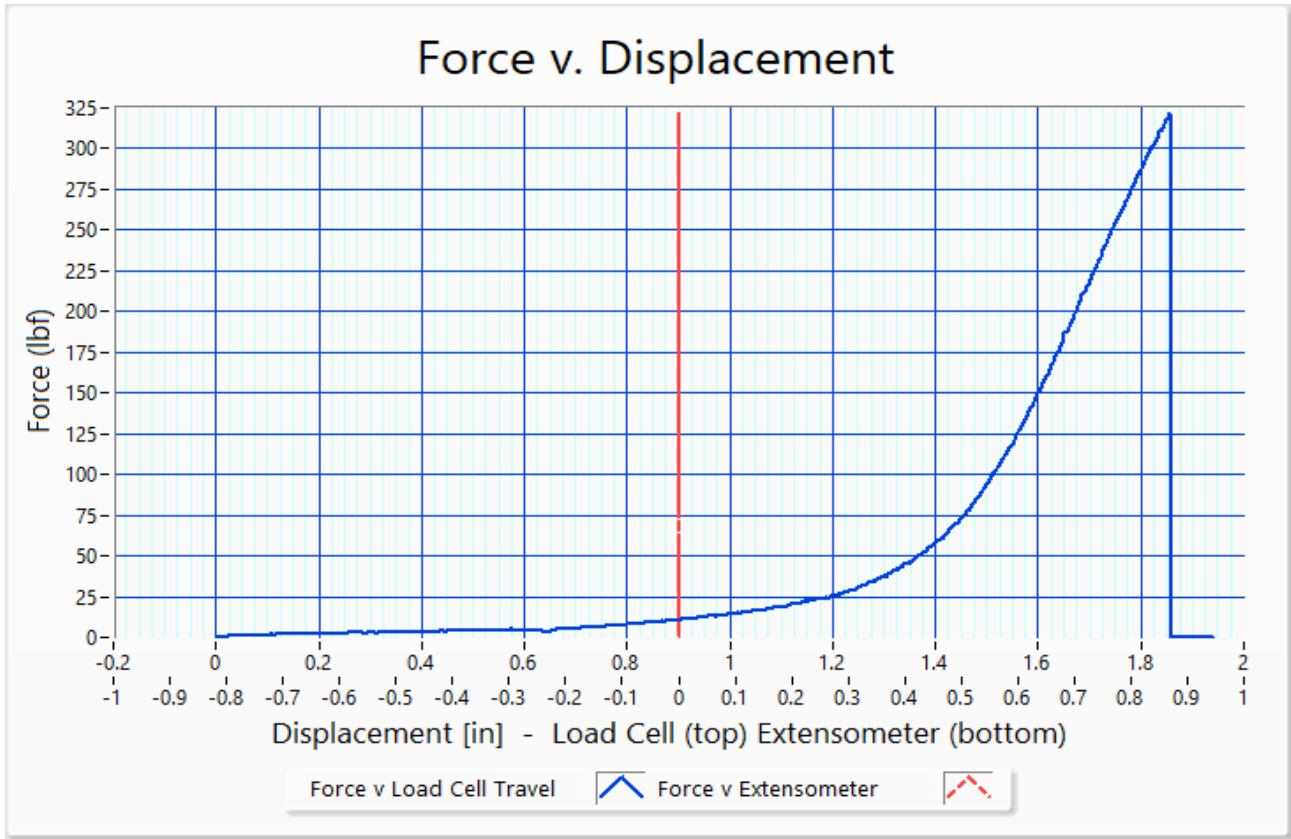
Description	Max Force: 308 lbf
Test Name	Pull Test EN 6059-404
Part Name	Armorlite CF
Test Group	Group 1
Part No.	103-126-016-G101
Serial No.	001



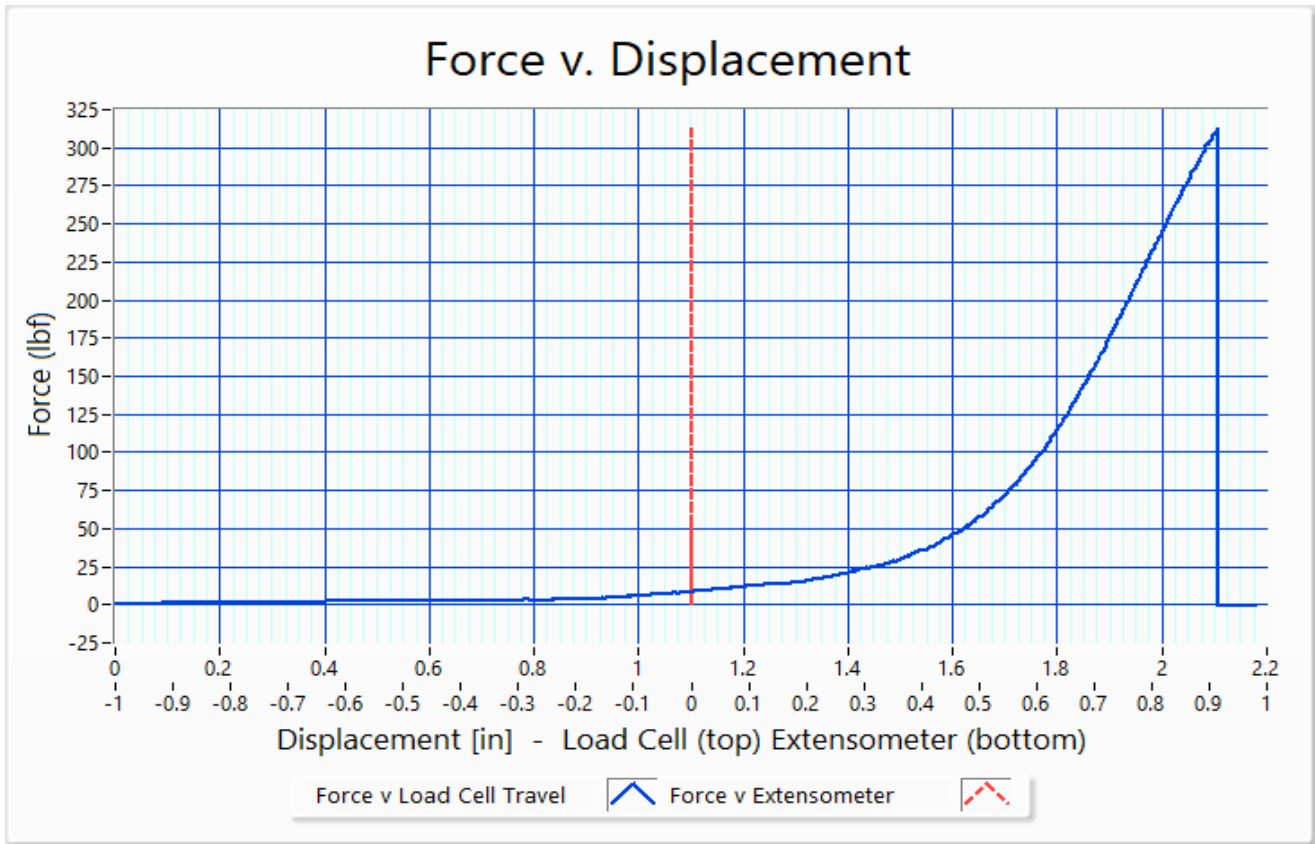
Description	Max Force: 246 lbf
Test Name	Pull Test EN 6059-404
Part Name	Armorlite CF
Test Group	Group 1
Part No.	103-126-016-G102
Serial No.	002



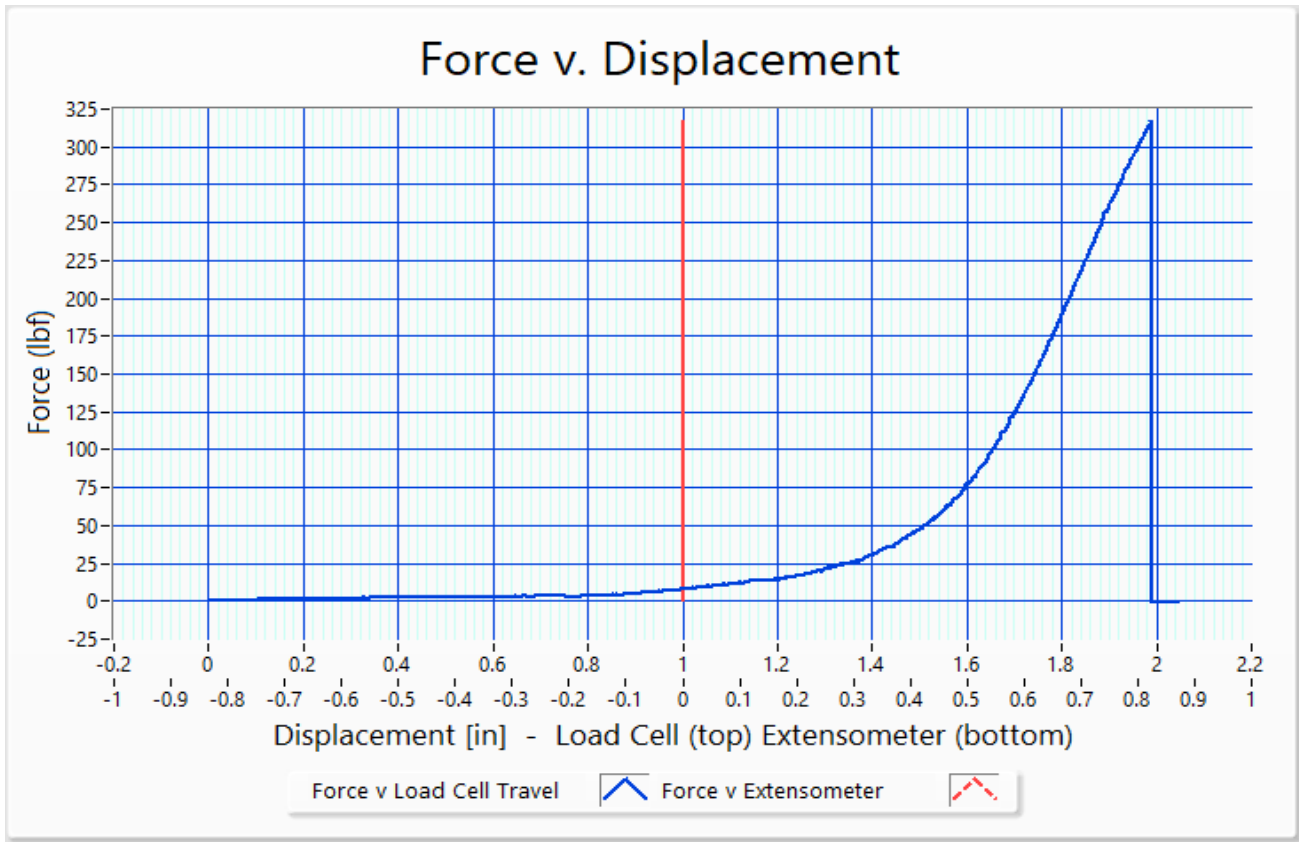
Description	Max Force: 400 lbf
Test Name	Pull Test EN 6059-404
Part Name	Armorlite CF
Test Group	Group 1
Part No.	103-126-016-G103
Serial No.	003



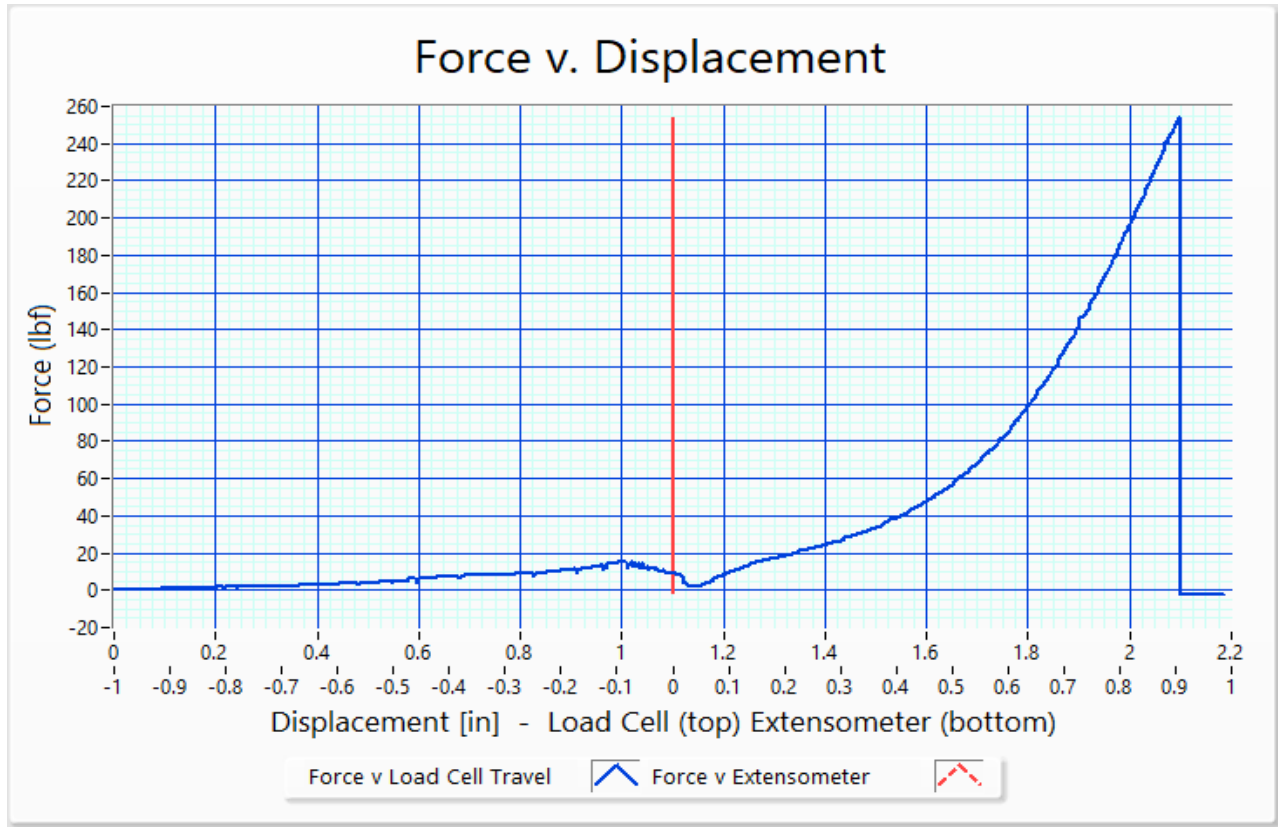
Description	Max Force: 322 lbf (Thermal Cycling -150°C to 300°C, 10 Cycles)
Test Name	Pull Test EN 6059-404
Part Name	Armorlite CF
Test Group	Group 2
Part No.	103-126-016-G201
Serial No.	004



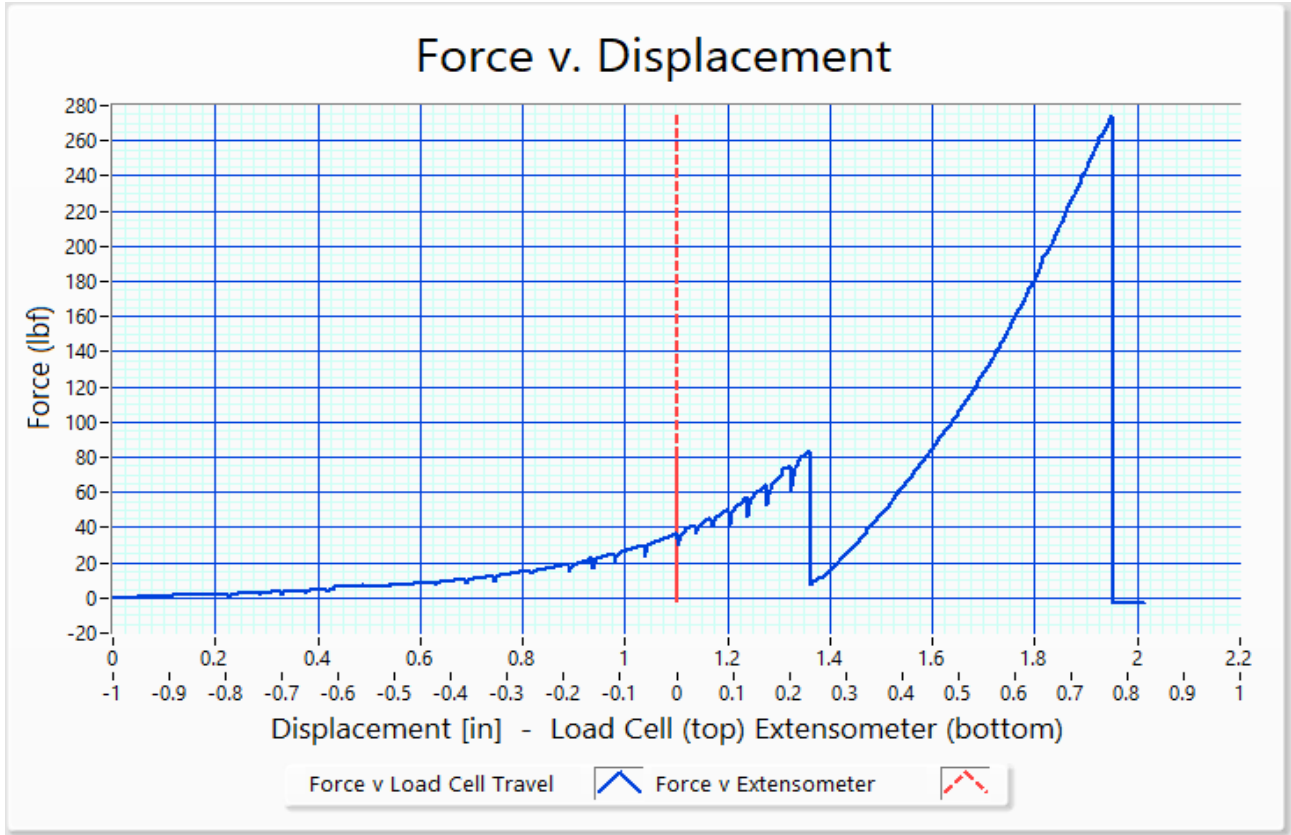
Description	Max Force: 313 lbf (Thermal Cycling -150°C to 300°C, 10 Cycles)
Test Name	Pull Test EN 6059-404
Part Name	Armorlite CF
Test Group	Group 2
Part No.	103-126-016-G202
Serial No.	005



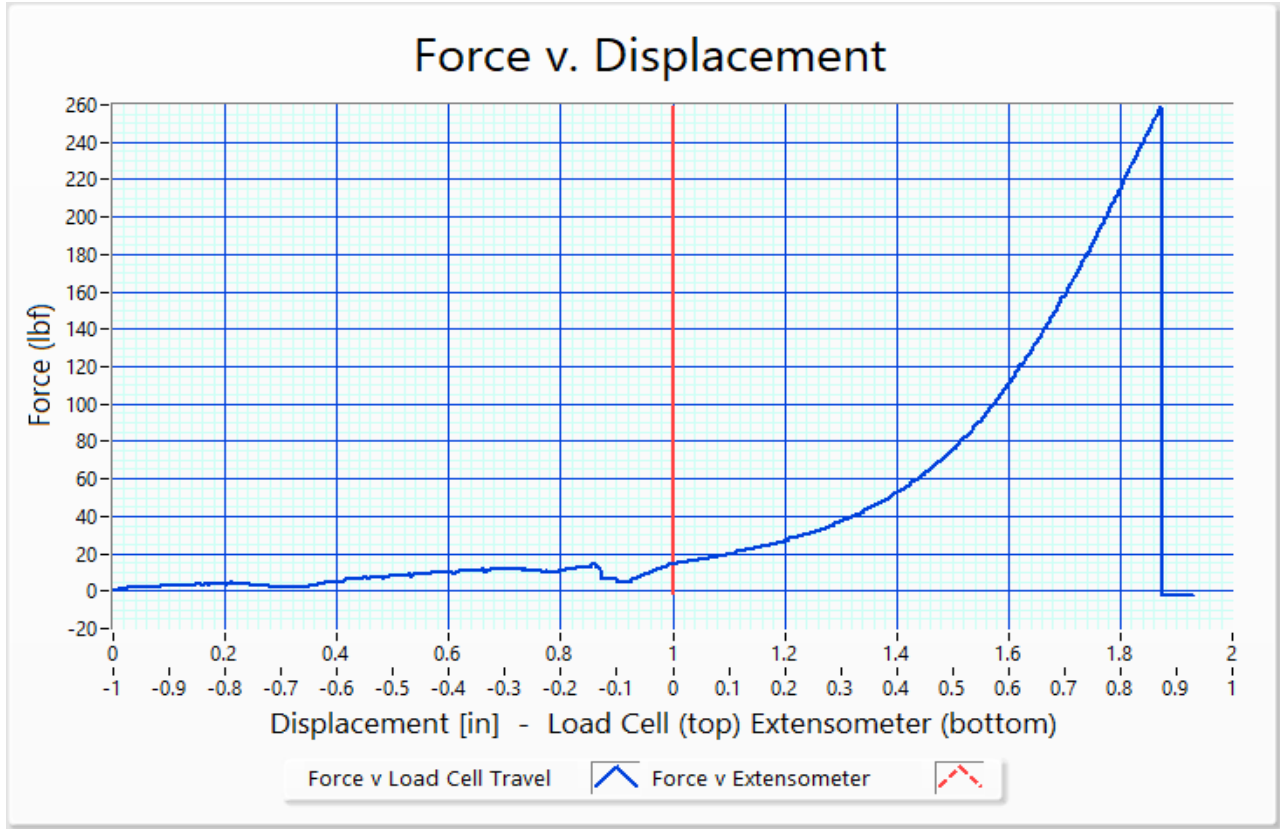
Description	Max Force: 317 lbf (Thermal Cycling -150°C to 300°C, 10 Cycles)
Test Name	Pull Test EN 6059-404
Part Name	Armorlite CF
Test Group	Group 2
Part No.	103-126-016-G203
Serial No.	006



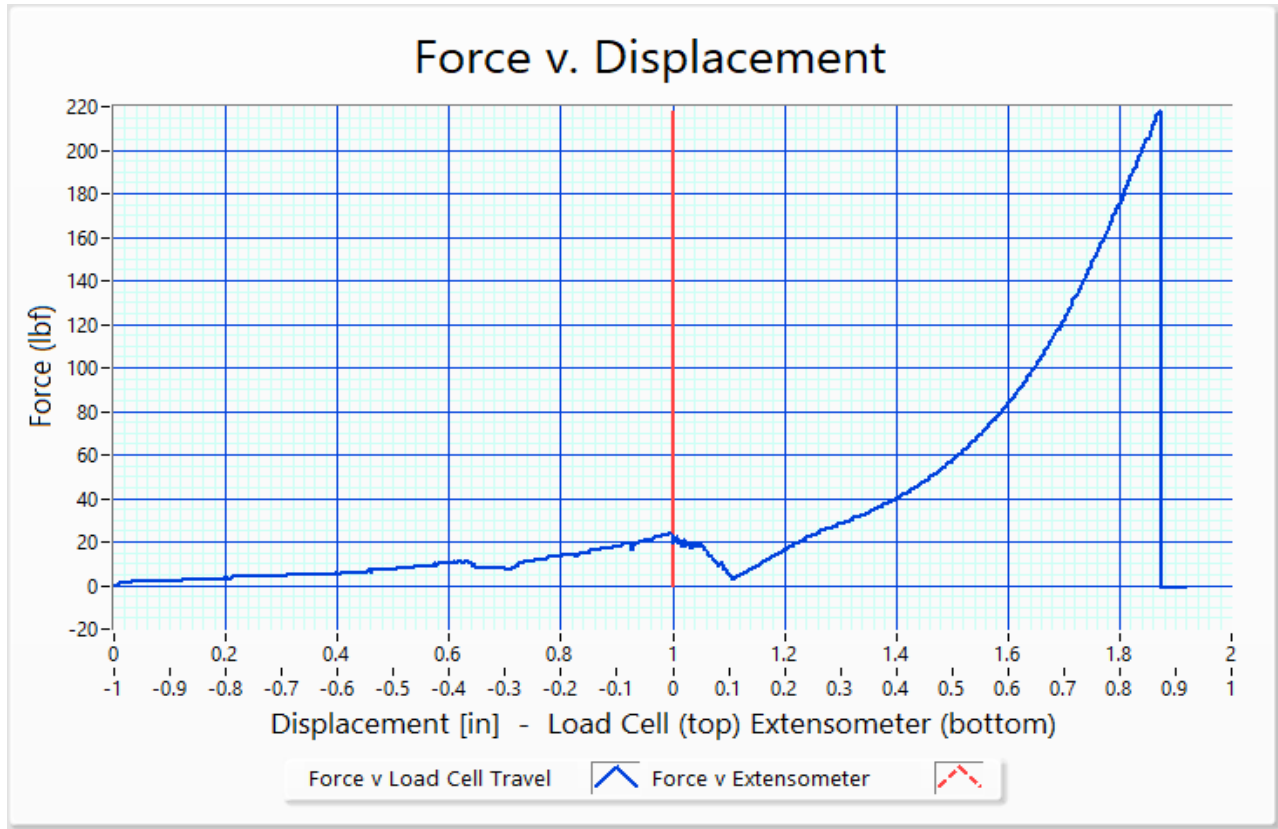
Description	Max Force: 254 lbf (Thermal Endurance: 1000 hrs at 300°C)
Test Name	Pull Test EN 6059-404
Part Name	Armorlite CF
Test Group	Group 3
Part No.	103-126-016-G301
Serial No.	007



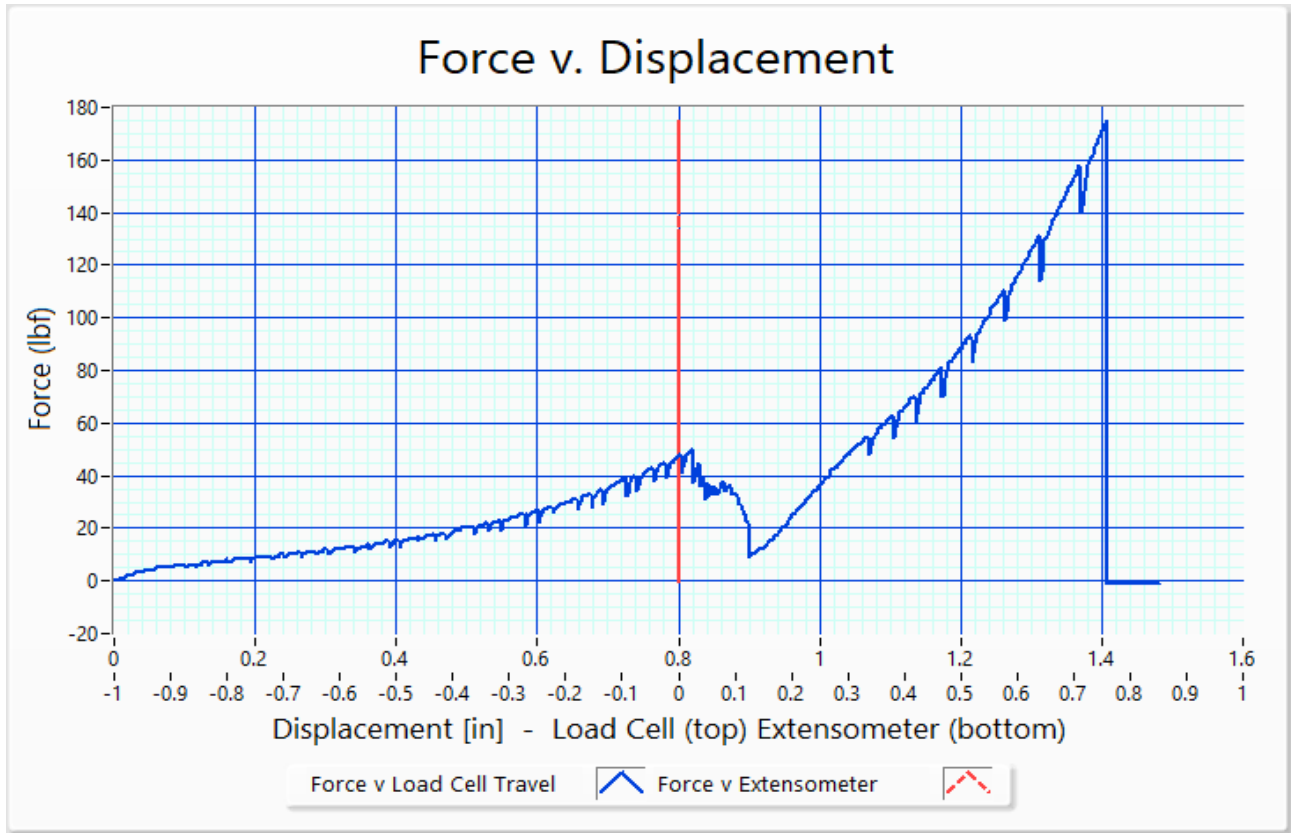
Description	Max Force: 274 lbf (Thermal Endurance: 1000 hrs at 300°C)
Test Name	Pull Test EN 6059-404
Part Name	Armorlite CF
Test Group	Group 3
Part No.	103-126-016-G302
Serial No.	008



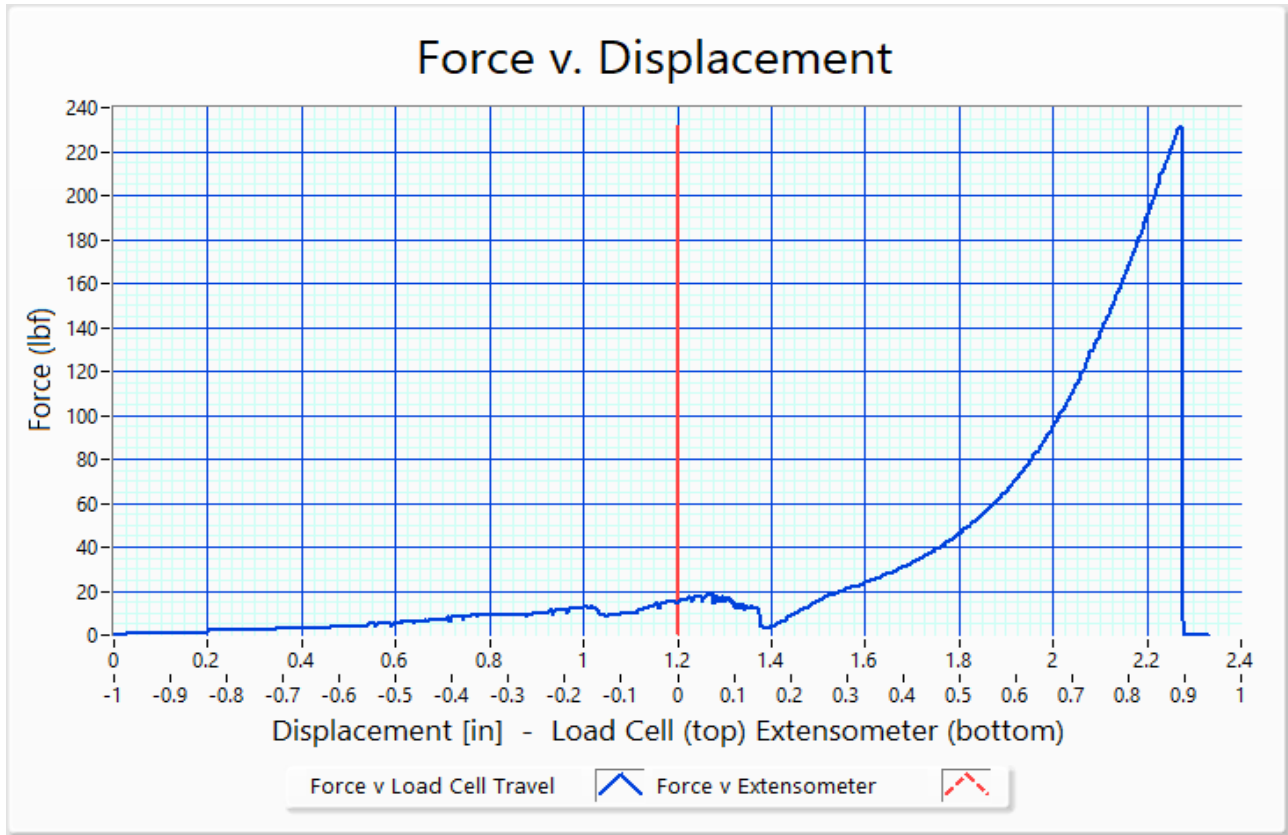
Description	Max Force: 259 lbf (Thermal Endurance: 1000 hrs at 300°C)
Test Name	Pull Test EN 6059-404
Part Name	Armorlite CF
Test Group	Group 3
Part No.	103-126-016-G303
Serial No.	009



Description	Max Force: 218 lbf (Thermal Endurance: 1000 hrs at 400°C)
Test Name	Pull Test EN 6059-404
Part Name	Armorlite CF
Test Group	Group 4
Part No.	103-126-016-G401
Serial No.	010



Description	Max Force: 175 lbf (Thermal Endurance: 1000 hrs at 400°C)
Test Name	Pull Test EN 6059-404
Part Name	Armorlite CF
Test Group	Group 4
Part No.	103-126-016-G402
Serial No.	011



Description	Max Force: 232 lbf (Thermal Endurance: 1000 hrs at 400°C)
Test Name	Pull Test EN 6059-404
Part Name	Armorlite CF
Test Group	Group 4
Part No.	103-126-016-G403
Serial No.	012



Test Name	Pull Test EN 6059-404
Equipment Name	Tensile Tester (Load Cell 40 - 5,000 lb)
Manufacturer	MTS
Model No.	QTest 5
ID No.	CE002



Test Name	Resistance Testing EN 3475-301
Equipment Name	Micro-Ohmmeter
Manufacturer	IET Labs
Model No.	LOM-510A
ID No.	EM001



Test Name	Thermal Shock EN 6059-308
Equipment Name	Environmental Chamber
Manufacturer	Delta
Model No.	9076
ID No.	CE034



Test Name	Thermal Endurance EN 6059-302
Equipment Name	Environmental Chamber
Manufacturer	Test Equity
Model No.	FOV2
ID No.	CE050



Test Name	Thermal Endurance EN 6059-302
Equipment Name	Environmental Chamber
Manufacturer	SentroTech
Model No.	ST-1700C-121216-OT
ID No.	CE009



Test Name	Thermal Endurance EN 6059-302
Equipment Name	Temperature Meter
Manufacturer	Extech Instruments
Model No.	SDL200
ID No.	TC014

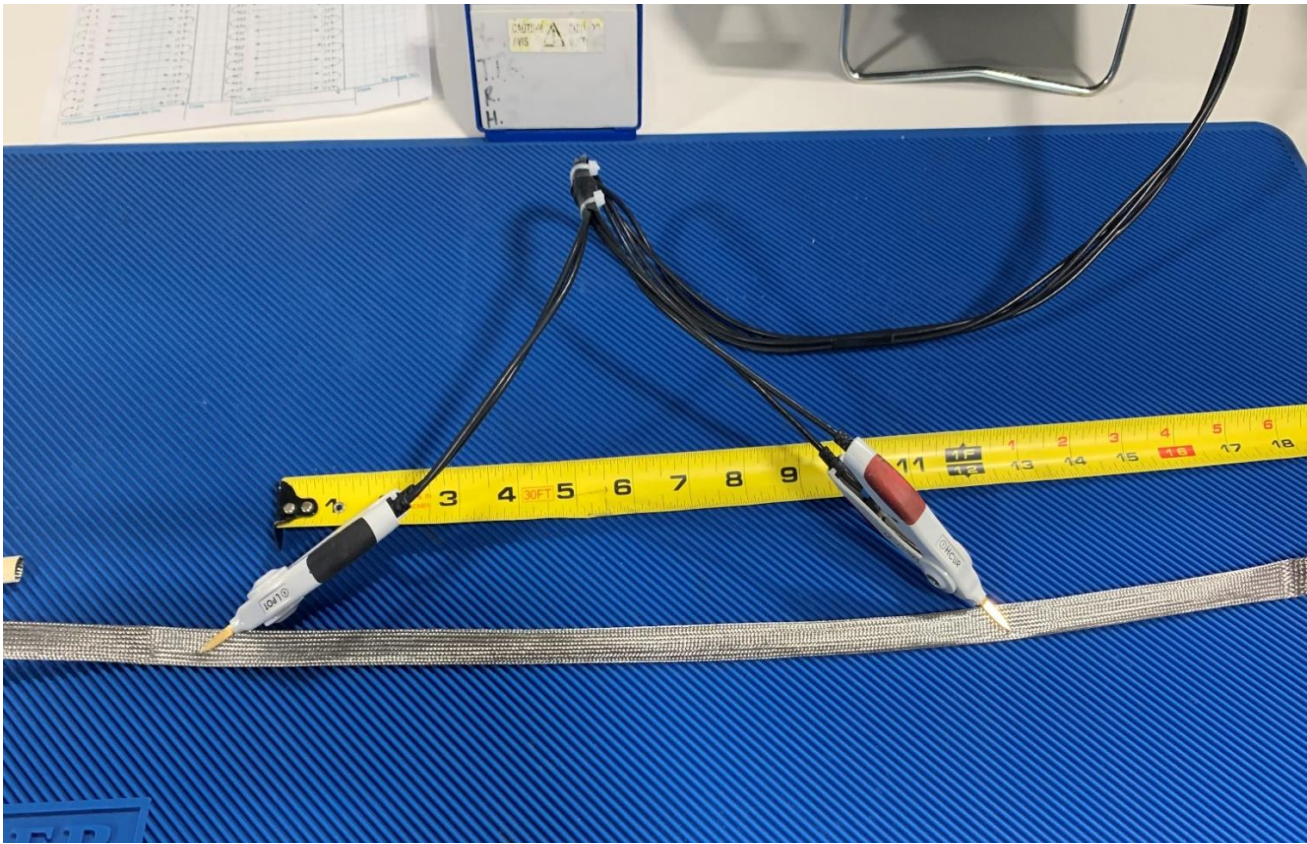


Test Name	Thermal Endurance EN 6059-302
Equipment Name	Convection Oven
Manufacturer	Blue M Electric
Model No.	DC-256-B-MP350
ID No.	CE040



Description	Samples installed onto tensile tester and were put under tension at a rate of 25mm/min.
Test Name	Pull Test EN 6059-404
Part Name	Aarmorlite CF
Test Group	Groups 1-4
Part No.	103-126-016
Serial No.	001-012

Pre-Test Photos

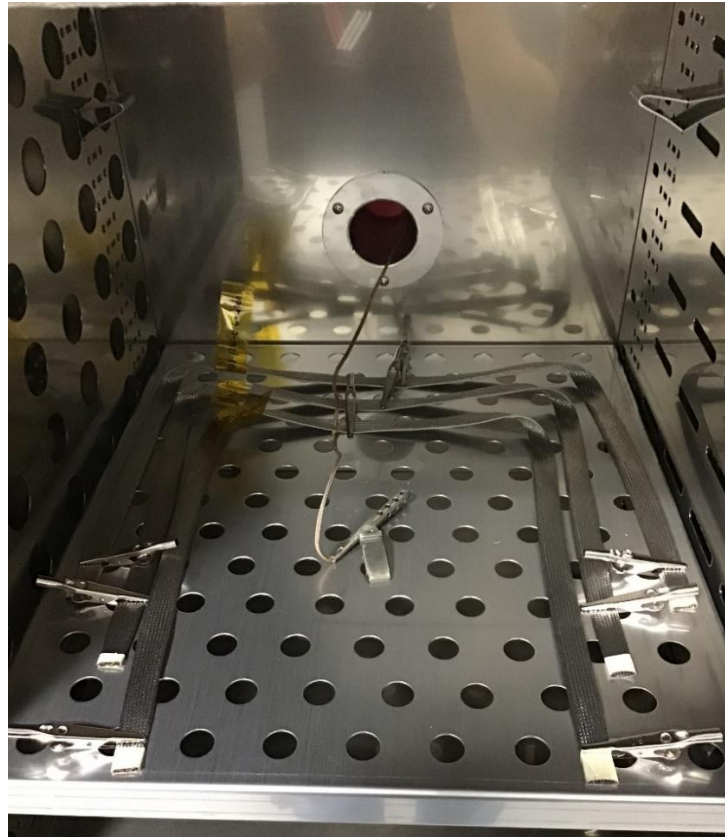


Description	Sample Groups 2-4 tested at 20 millivolts. Voltage probes spaced at a distance of 12"
Test Name	Resistance EN 3475-301
Part Name	Aarmorlite CF
Test Group	Groups 2-4
Part No.	103-126-016
Serial No.	004-012

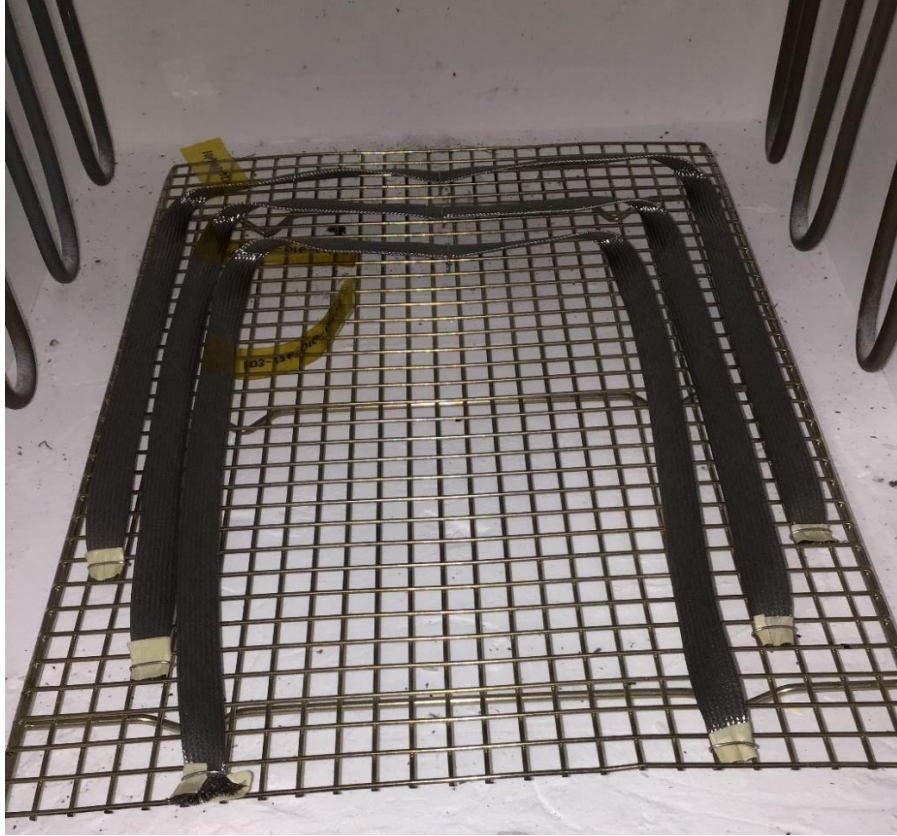
Pre-Test Photos



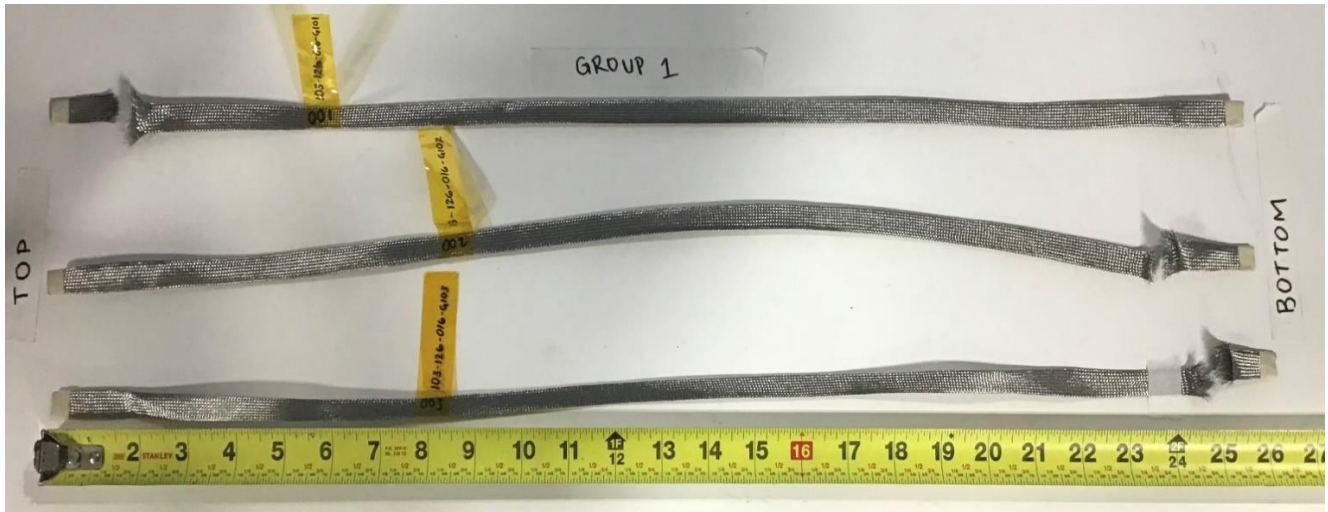
Description	-150°C to 300°C, 10 Cycles
Test Name	Thermal Shock EN 6059-308
Part Name	Armorlite CF
Test Group	Group 2
Part No.	103-126-016-G201,103-126-016-G202,103-126-016-G203
Serial No.	004,005,006



Description	1000 hours at 300°C
Test Name	Thermal Endurance EN 6059-302
Part Name	Armorlite CF
Test Group	Group 3
Part No.	103-126-016-G301,103-126-016-G302,103-126-016-G303
Serial No.	007,008,009



Description	1000 hours at 400°C
Test Name	Thermal Endurance EN 6059-302
Part Name	Aarmorlite CF
Test Group	Group 4
Part No.	103-126-016-G401,103-126-016-G402,103-126-016-G403
Serial No.	010,011,012



Description	All Test Sequences Completed
Test Name	Armorlite CF Temp Testing
Part Name	Armorlite CF
Test Group	Group 1
Part No.	103-126-016-G101,103-126-016-G102,103-126-016-G103
Serial No.	001,002,003



Description	All Test Sequences Completed
Test Name	Armorlite CF Temp Testing
Part Name	Armorlite CF
Test Group	Group 2
Part No.	103-126-016-G201,103-126-016-G202,103-126-016-G203
Serial No.	004,005,006



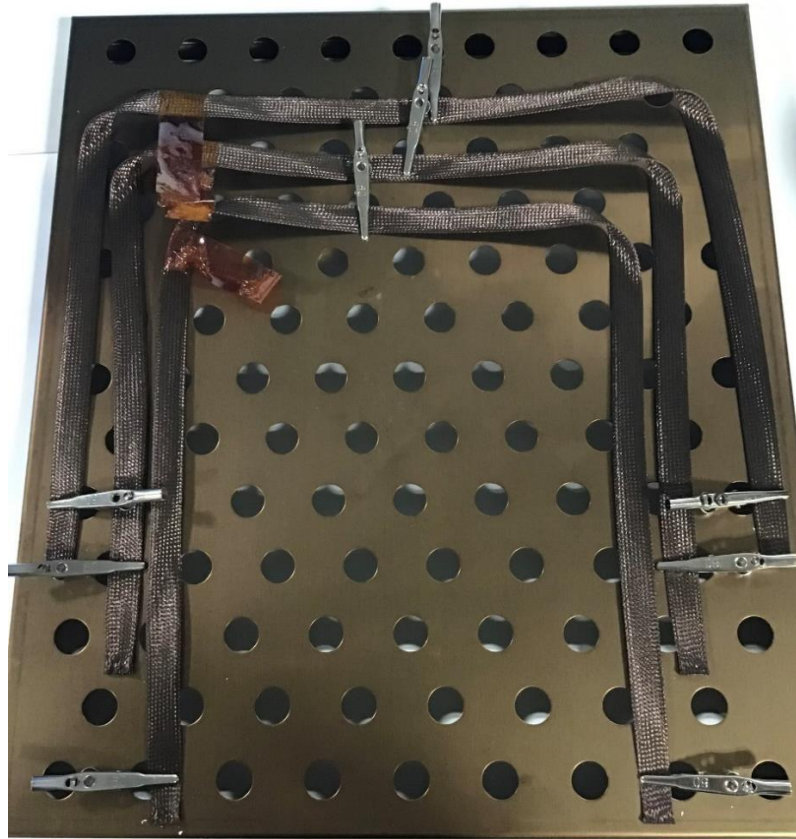
Description	All Test Sequences Completed
Test Name	Armorlite CF Temp Testing
Part Name	Armorlite CF
Test Group	Group 3
Part No.	103-126-016-G301,103-126-016-G302,103-126-016-G303
Serial No.	007,008,009



Description	All Test Sequences Completed
Test Name	Armorlite CF Temp Testing
Part Name	Armorlite CF
Test Group	Group 4
Part No.	103-126-016-G401,103-126-016-G402,103-126-016-G403
Serial No.	010,011,012



Description	-150°C to 300°C, 10 Cycles
Test Name	Thermal Shock EN 6059-308
Part Name	Armorlite CF
Test Group	Group 2
Part No.	103-126-016-G201,103-126-016-G202,103-126-016-G203
Serial No.	004,005,006



Description	1000 hours at 300°C
Test Name	Thermal Endurance EN 6059-302
Part Name	Armorlite CF
Test Group	Group 3
Part No.	103-126-016-G301,103-126-016-G302,103-126-016-G303
Serial No.	007,008,009



Description	1000 hours at 400°C
Test Name	Thermal Endurance EN 6059-302
Part Name	Aarmorlite CF
Test Group	Group 4
Part No.	103-126-016-G401,103-126-016-G402,103-126-016-G403
Serial No.	010,011,012

End of Report