TMK UP PF

ISO 13679 FDIS: 2011 CAL IV

REPORT #

RD-105-14-094

REVISION #

1

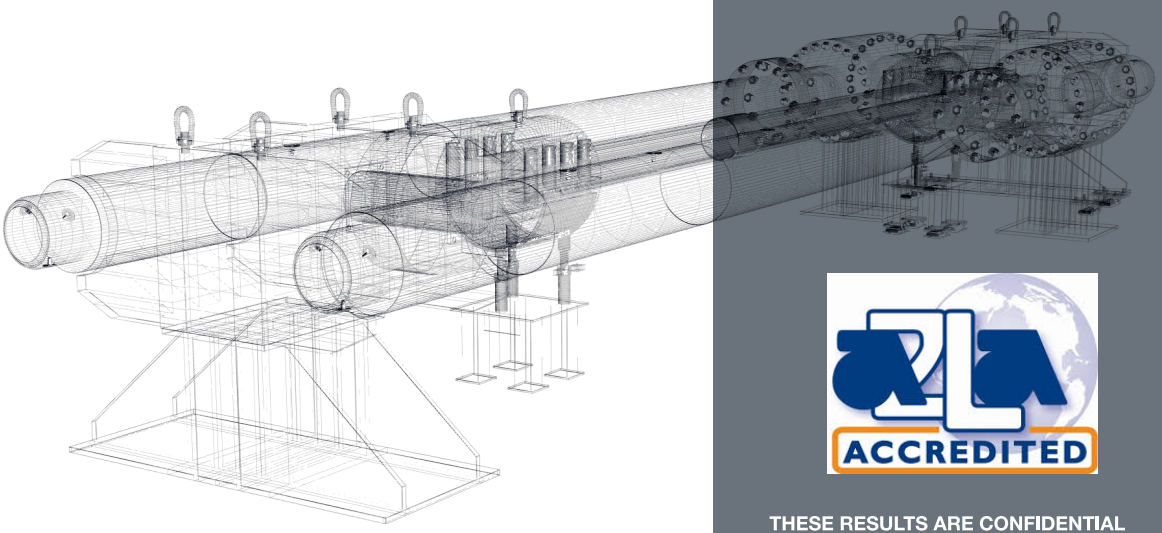
SIZE	WT	GRD
9-5/8	53.5	P110

CONNECTION

TMK UP PF

TEST PROTOCOL

ISO 13679 FDIS: 2011 CAL IV



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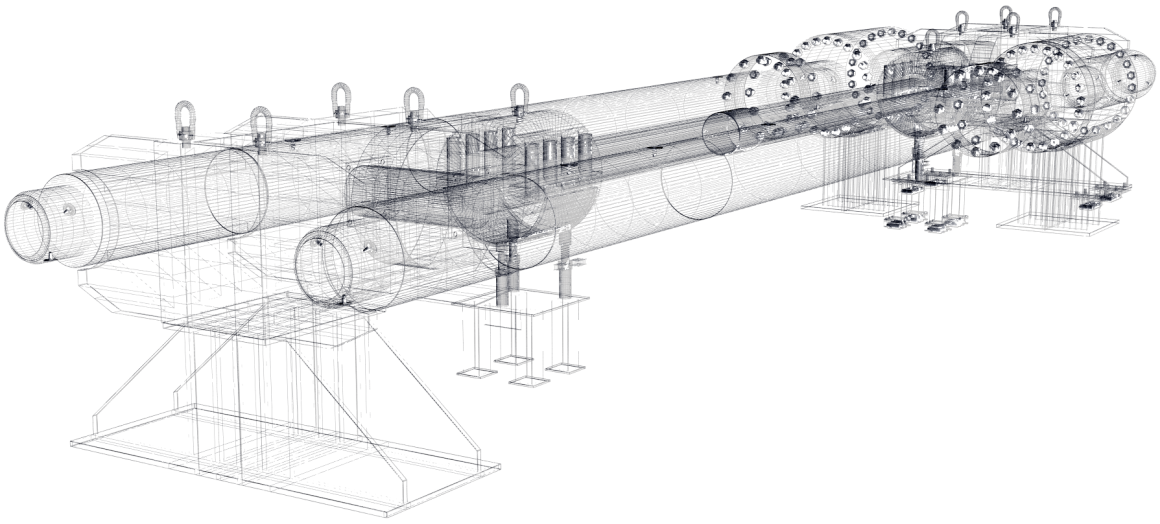
EXECUTIVE
SUMMARY



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1 CERTIFICATE OF TEST

REPORT DATE:	August 31, 2015
PROJECT NUMBER:	RD–105–14–094
CLIENT:	TMK–Premium Services Morozova Str. 30, Taganrog, RUSSIA 347928
TEST DATES:	February 20, 2015 – July 18, 2015
CONNECTION IDENTIFICATION:	TMK UP PF
PIPE SIZE / GRADE:	9.625 in. OD–53.5 lb–P110
TEST PROCEDURE:	Test Proposal Edition 9 (TP PS–01–03–2014)
TEST TYPE:	ISO 13679: FDIS 2011 CAL IV
NUMBER OF SPECIMEN:	7 (Specimen 1, 2, 3R2, 4, 5, 5R4 and 5R5)
SURFACE TREATMENTS:	Specimen 1, 2, 3R2, 4, 5: As machined Pins and Zn. Phosphate Coupling Specimen 5R4: Zn. Phosphate Pins and Couplings Specimen 5R5: Sand Blast and Moly Pins and Zn. Phosphate Coupling
TEMPERATURES USED:	27°C (80°F) for Ambient Temperature Testing 52 °C (126 °F)/180 °C (356 °F) for Elevated Temperature Testing
IDENTIFICATION OF TEST PERSONNEL:	Engineer In–Charge: Pavel Sidorenko Project Manager: Manish Nawal **For Tests performed at TMK–IPSCO R&D** Test Engineers: Antonio Martinez III, Mazen Alameddine and Kevin Henry Technicians: Brian Baker, Andrico Henderson, Arjun Dhir, Benjamin Parent, Jose Zapata, Kenneth Brown, Aaron Wallace, Travis Dent, Zef Hernandez and Khoi Nicholson **For Tests performed at Stress Engineering Services (SES)** Project Manager: Ryan Schmidt Technicians: Tod Phillips, Taylor Fitzgerald, Rafael Valentin, Justin Cumberledge, Jeremy Nail, Jimmy Beseda, Steve Waters, Jason Park, Ethan Williams, Steve Busa, Josh Snearly, Josh Dowdican and David Turner
THIRD PARTY MONITORING:	Texas International Engineering Consultants (TIEC): Chris Harris, Bruce Perkins, Dave Walker, Randy Cox and Ken Amason SICA–SOCOTEC: Billy Day

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2 CONNECTION SPECIFICATIONS & RATINGS

The 9–5/8 x 53.5 P–110 TMK UP PF connection was qualified to ISO 13679: FDIS 2011 CAL IV requirements. Qualification test was performed to the ratings and specifications listed below.

Coupling OD: 10.625 in.

Coupling Length: 11.693 in.

Make – Up Loss: 5.110 in.

Drift: 8.500 in.

Pipe ID: 8.535 in.

Thread Compound Used: Best of Life 72733

Torque (min. /opt. /max.): 29,900 / 33,200 / 36,500 ft–lbs

	Connection data sheet ratings	Min. Test Rating (% of PBYS)			
		SP1	SP2	SP3R2	SP4
API Burst Pressure:	10,890 psi (100% PBYS)	94.5*	95.0	93.6*	95.0
API Collapse Pressure:	7,950 psi (100% PBYS)	100.0	100.0	100.0	100.0
Tensile Load:	1,710,000 lbs (100% PBYS)	95.0	95.0	95.0	95.0
Compression Load:	1,026,000 lbs (60% PBYS)	60.0	60.0	60.0	60.0
Bending (Dogleg):	30.9^{o} / 100 ft	19.3^{o} / 100 ft			

* 95% of specified WT used instead the actual min. wall thickness (customer agreed amendment)

3 SPECIMEN PREPARATION & TEST LOCATIONS

Mechanical Property Testing: MTEC Mechanical Testing Services,
8676 Taub Road, Houston, TX. 77064

Specimen Machining and Surface Treatments: Superior Threaded Products (STP),
9405 E. Sam Houston Pkwy N. Houston, TX 77044

Make and Breaks: Stress Engineering Services Waller Testing Facility,
42403 Old Houston Highway, Waller, TX 77484

Series B and C Sealability: TMK–IPSCO R&D Center,
10120 Houston Oaks Dr., Houston, TX 77064

Series A Sealability and Limit Loads: Stress Engineering Services (SES) Facilities at:
a) Waller Testing Facility,
42403 Old Houston Highway, Waller, TX 77484
b) Mohr Division Test Lab,
13602 Westland East Blvd, Houston, TX 77041
c) Main Test Lab,
13800 Westfair East Drive, Houston, TX 77041

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4 PHYSICAL TESTING SUMMARY

Specimen 1, 2, 3R2, 4 and 5 successfully met all ISO 13679: FDIS 2011 CAL IV requirements and additional requirements defined in the test protocol (TP PS–01–03–2014, NINTH EDITION). Make and break trials were performed on Specimen 5R3, 5R4 and 5R5 for the purpose of testing alternative pin surface finish. A summary of test locations and dates are provided in Table A.1. Specimens 3 and 3R1 failed during Series B testing, as summarized in Table A.2.

Specimen	Make & Break	Bake-Out	Series B	Series C	Series A	Limit Loads
Location	SES	TMK–IPSCO	TMK–IPSCO	TMK–IPSCO	SES	SES
1	03/23/2015	03/25/2015	04/09/2015	04/11/2015	05/15/2015	07/18/2015
2	05/01/2015	05/08/2015	05/21/2015	05/28/2015	06/17/2015	06/17/2015
3	03/24/2015	04/06/2015	Failed near the end cap	N/A	N/A	N/A
3R1	05/21/2015	05/29/2015	Failed near the end cap	N/A	N/A	N/A
3R2	06/17/2015	06/19/2015	06/25/2015	06/27/2015	07/15/2015	07/17/2015
4	04/10/2015	04/27/2015	05/07/2015	05/08/2015	06/03/2015	07/18/2015
5	04/09/2015	N/A	N/A	N/A	N/A	07/16/2015
5R3[+]	06/18/2015[*]	N/A	N/A	N/A	N/A	N/A
5R4	06/19/2015	N/A	N/A	N/A	N/A	N/A
5R5	06/19/2015	N/A	N/A	N/A	N/A	N/A

Table A.1: Test Summary

[+] – Test performed outside the test proposal scope at the customer's request.
[*] – Make and break test performed at TMK–IPSCO using horizontal make up tongs.

Specimen 5R1: The test scope was modified as follows:
Re–machined pins 5AR1 and 5BR1 were used in Specimen 5R3 as 5AR3 and 5BR3.
Coupling 5R1 was used in specimen 5R3 with the same identification.

Specimen 5R2: The test scope was modified as follows:
Re–machined pin 5AR2 was used in Specimen 3R1 as 3AR1.
Pin 5AR2 was used in specimen 5 as–is.
Coupling 5R1 was used in specimen 5R5 as–is.

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Specimen	Failure Location	Load Step/Load Point	Type of Failure	Root Cause	Further Details
3	Pipe body near end cap (A Side)	Series B 232/13b (1,160 kips Tension, 10,500 psi, 0°/100 ft Bending)	Pin Parted	Wall thickness not captured	Refer Section CC
3R1	Pipe body near end Cap (A Side)	Series B 18/10 (1,520 kips Tension, 0 psi, 0°/100 ft Bending)	Pin Parted	Improper load cell set up resulting in specimen overload	Refer Section CC

Table A.2: Specimen Failure Summary (During Series B Testing)

The surface finish on the specimen seal and thread areas were in accordance with Table A.3.

Specimen/Side	Coupling	Pin
1A	Zinc phosphate	As machined
1B	Zinc phosphate	As machined
2A	Zinc phosphate	As machined
2B	Zinc phosphate	As machined
3A	Zinc phosphate	As machined
3B	Zinc phosphate	As machined
4A	Zinc phosphate	As machined
4B	Zinc phosphate	As machined
5A	Zinc phosphate	As machined
5B	Zinc phosphate	As machined
5AR3	Zinc phosphate	As machined
5BR3	Zinc phosphate	As machined
5AR4	Zinc phosphate	Zinc phosphate*
5BR4	Zinc phosphate	Zinc phosphate*
5AR5	Zinc phosphate	Sand blasting + Moly*
5BR5	Zinc phosphate	Sand blasting + Moly*
* – Additional specimens with alternate surface treatments for make/brake test		

Table A.3: Surface Finish Conditions on Field End

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5 CUSTOMER AGREED AMENDMENTS TO ISO 13679: FDIS 2011:

The following amendments were made to the ISO 13679: FDIS 2011 based on customer's request prior to the commencement of the test.

1. ISO 13679: FDIS 2011 permits a 20% range for the specified high and low torque loads. This range was reduced to 10%. Consequently, the "High Torque" was defined as 90% of maximum+10% of minimum and "Low Torque" as 90% of minimum+10% of maximum.
2. For XH and XL sample interference combination, 5% tolerance range was used instead of the ISO 13679: FDIS 2011 limit of 0.002" (0.05 mm), making the tolerance ranges more severe.
3. Make/Break cycles increased from 2 to 3. This amendment adds an additional cycle.
4. The actual minimum wall thickness (but not more than 95% of specified WT) was used to determine the pressures as indicated in Table A.8.
5. The average wall thickness (but not more than specified WT) was used to determine the axial loads as indicated in Table A.8.
6. Bake out time was increased from 12 hours to 24 hours.
7. Porting of the couplings.

6 TEST RESULTS:

6.1 Specimen Preparation

Test specimens were machined from Vallourec (Heat# DX0157) casing stock and Tenaris (Heat# 70421) coupling stock. The pins were machined according to drawing no: *TMK UP PF 9 5/8. 001, Revision 2* and couplings were machined according to drawing no: *TMK UP PF 9 5/8. 001, Revision 2*. All the test specimen satisfied the thread and seal interference ranges outlined in ISO 13679: FDIS 2011.

6.2 Make and Breaks

Test samples were made up using vertical tongs with 2.0 RPM. API modified thread compound (Best of Life 72733) per the quantities listed in Table A.4 were used.

	Dope quantity on pin, grams	Dope quantity on box, grams
Minimum	20±1	40±1
Maximum	29±1	55±1

Table A.4: Quantity of Dope Used During Make and Break Trials

Recommended torque values ranged between 29,900 and 36,500 ft-lb (40,500 and 49,500 N.m). A detailed description of the recommended make–up torque ranges are indicated in Table A.5. The minimum, optimum and maximum make–up torques in Table A.5 match the corresponding values listed in the connection data sheet. The shoulder torques on all samples was within acceptable limits. All torque shoulders were grooved prior to FMU.

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	N.m		ft–lb	
Minimum recommended torque	40,500		29,900	
Optimum recommended torque	45,000		33,200	
Maximum recommended torque	49,500		36,500	
	Minimum	**Maximum**	**Minimum**	**Maximum**
High Make–Up Torque range	48,600	49,500	35,800	36,500
Low Make–Up Torque range	40,500	41,400	29,900	30,500

Table A.5: Make–Up Torque Ranges

Specimen 2, a final make–up only specimen, was broken out and made–up again. This was done since the plug in the coupling on 2A was not tightened causing it to come out during make–up. Plug was tightened. Pin was broken–out and made up again. Further details are provided in Section 7 (Deviations/Anomalies). Specimen 1B, 5A, 5B and 5AR4 exhibited acceptable and repairable levels of galling during make and break trials. A short summary on the observed galling and the repair action is included in Table A.6 and Figure A.1.

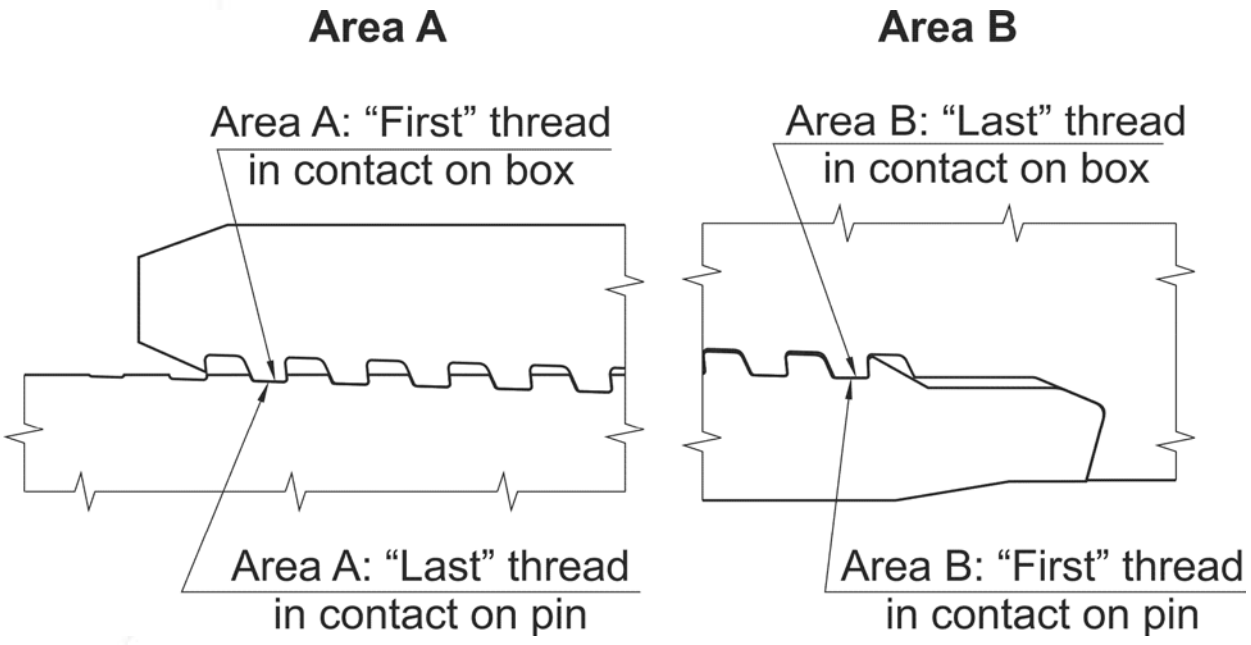

Figure A.1: Galling Locations

All galling events listed in Table A.6 were evaluated by TMK–PS personnel and deemed acceptable. All repairs were performed by TMK–PS authorized personnel.

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Specimen	Cycle #	Galling Severity	Location (Refer Figure A.1)		Repair Area	Repair Equipment	Repair Time (min.)
			Pin	Box			
Specimen 1B	1	N/A	N/A	N/A	N/A	N/A	N/A
	2	Light	Area A: Last thread	Area A: First thread	N/A	N/A	N/A
	3	Moderate	Area A: Last two threads	Area A: First thread	Pin and Box	File, Sand–paper, emory cloth	10
Specimen 5A	1	Light	Area A: Last three threads	Area A: First thread	Pin and box	Sand–paper	15
	2	Moderate	Area A: Last four threads	Area A: First two threads	Pin and box	File, Sand–paper, Scotch brite	20
	3	Moderate	Area A: Last four threads	Area A: First four threads	Pin and box	File, Sand–paper, Scotch brite	20
Specimen 5B	1	N/A	N/A	N/A	N/A	N/A	N/A
	2	Moderate	Area A: Last five threads	Area A: First two threads	Pin and box	File, Sand–paper, Scotch brite	20
	3	Moderate	Area A: Last five threads	Area A: First three threads	Pin and box	File, Sand–paper, Scotch brite	20
Specimen 5AR4	1	Light	Area A: Last thread	Area A: First thread	Box	Sand–paper	10
	2	Light	Area A: Last two threads	Area A: First thread	N/A	N/A	N/A
	3	Light	Area A: Last two threads	Area A: First thread	N/A	N/A	N/A

Table A.6: Make and Break Galling Summary

6.3 Specimen Bake Out

All test samples were baked out at 356^{o}F for 24 hours.

6.4 Sealability Tests

Ported couplings were used for external pressure and booted couplings for internal pressure. The coupling was ported to allow external pressure to reach the seal. Ported couplings were included at customer's request and are not mandated by ISO 13679: FDIS 2011. The port was drilled into Specimen 1 after completion of Series B and C and after FMU for Specimen 4. Specimen 2 and 3 were ported prior to make and breaks trials. The port was drilled in the connection's dope relief groove. The external pressure port status during the test for each specimen is indicated in Table A.7. The mediums used for internal and external pressure is listed in Table A.8. The minimum material yield strength from mechanical tests, the gauged wall thickness and nominal pipe OD

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was used to calculate test loads. The variables used to calculate individual loads are listed in Table A.8.

Test Phase	External Coupling Pressure Port Status				
	Specimen 1	Specimen 2	Specimen 3	Specimen 4	Specimen 5
Make and Breaks	N/A	Closed	Closed	N/A	-
Sample Bake Out	N/A	Closed	Closed	N/A	-
Series B Test	N/A	Closed	Closed	Closed	-
Series C Test	N/A	Closed	Closed	Closed	-
Series A Test	Open	Open	Open	Open	-
Limit Load Test	Closed	Open	Closed	Closed	Closed

Table A.7: External Pressure Port Status

	Series A	Series B	Series C
Internal Pressure	Nitrogen	Nitrogen	Nitrogen
External Pressure Elevated	High Temperature Oil	N/A	N/A
External Pressure Ambient	Water	N/A	N/A

Table A.8: Fluid / Air Mediums for Leak Detection

Temperature	Variable	Internal Pressure		External Pressure		
		Hoop	Axial	Hoop	Axial	API collapse
Ambient	*D*	Specified	Specified	Specified	Specified	Specified
	wall	Min.	Avg.	Min.	Avg.	Specified
	MYS	Actual min. YS	Actual min. YS	Actual min. YS	Actual min. YS	Specified
Elevated	*D*	Specified	Specified	Specified	Specified	Specified
	wall	Min.	Avg.	Min.	Avg.	Specified
	MYS	Actual min. YS	Actual min. YS	Actual min. YS	Actual min. YS	Collapse YS

Table A.9: Variables Used to Determine Loads

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The variables in Table A.8 defined for individual specimen are included in Table A.10.

Specimen	OD (D)	Wall Thickness (wall)									
		Actual Minimum		95% of Specified	Actual Average		Specified	Used Minimum		Used Average	
		mm	in		mm	in		mm	in	mm	in
1	244.48 (mm) / 9.625 (in.)	13.23	0.521	13.16 (mm) / 0.518 (in.)	13.79	0.543	13.84 (mm) / 0.545 (in)	13.16	0.518	13.79	0.543
2		13.23	0.521		13.61	0.536		13.23	0.521	13.61	0.536
3R2		13.36	0.526		13.77	0.542		13.16	0.518	13.77	0.542
4		13.00	0.512		13.51	0.532		13.00	0.512	13.51	0.532
5		13.36	0.526		13.64	0.537		13.36	0.526	13.64	0.537

Specimen	Material Yield Strength (MYS)*							
	Ambient Temperature				Elevated Temperature			
	Minimum		Specified		Minimum		Collapse	
	MPa	ksi	MPa	ksi	MPa	ksi	MPa	ksi
1	830	121	758	110	754	109	688	100
2	830	121			754	109	688	100
3R2	813	118			728	106	680	99
4	830	121			754	109	688	100
5	827	120			728	106	668	97

Table A.10: Measured Dimensions and Material Properties For Individual Test Specimen

* – Material yield strengths are rounded off to the nearest whole number for representation. Load schedules were generated using values rounded off to the second decimal place.

The load ratings specified on Section 2 were used on all tested specimen (1, 2, 3R2 and 4). The applied loads (tension/compression) and pressures (internal/external) for each specimen assembly are provided in Figure A.2–Figure A.33. All test loads followed the test procedure as specified, except as described in Section 7. All specimens met the displacement requirements per ISO 13679: FDIS 2011.

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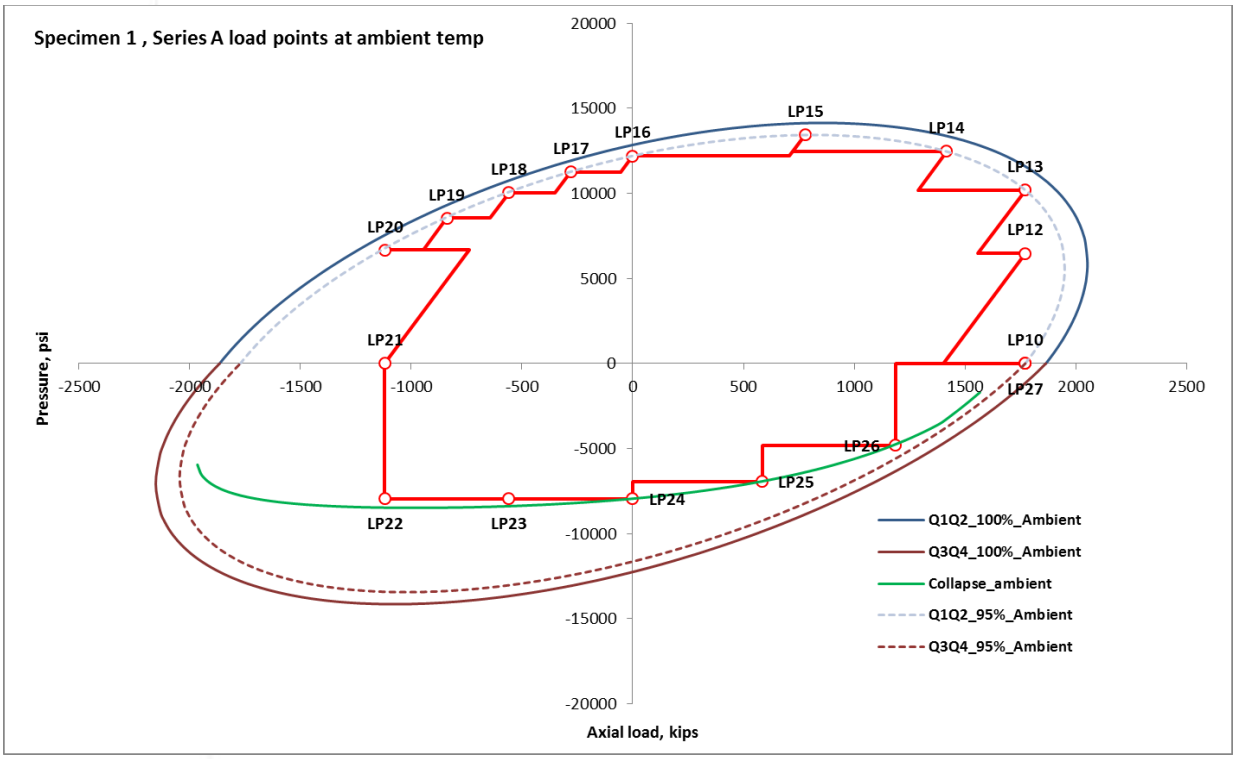

Figure A.2: Test Envelope for TMK UP PF Specimen 1 Series A (Ambient Temperature)

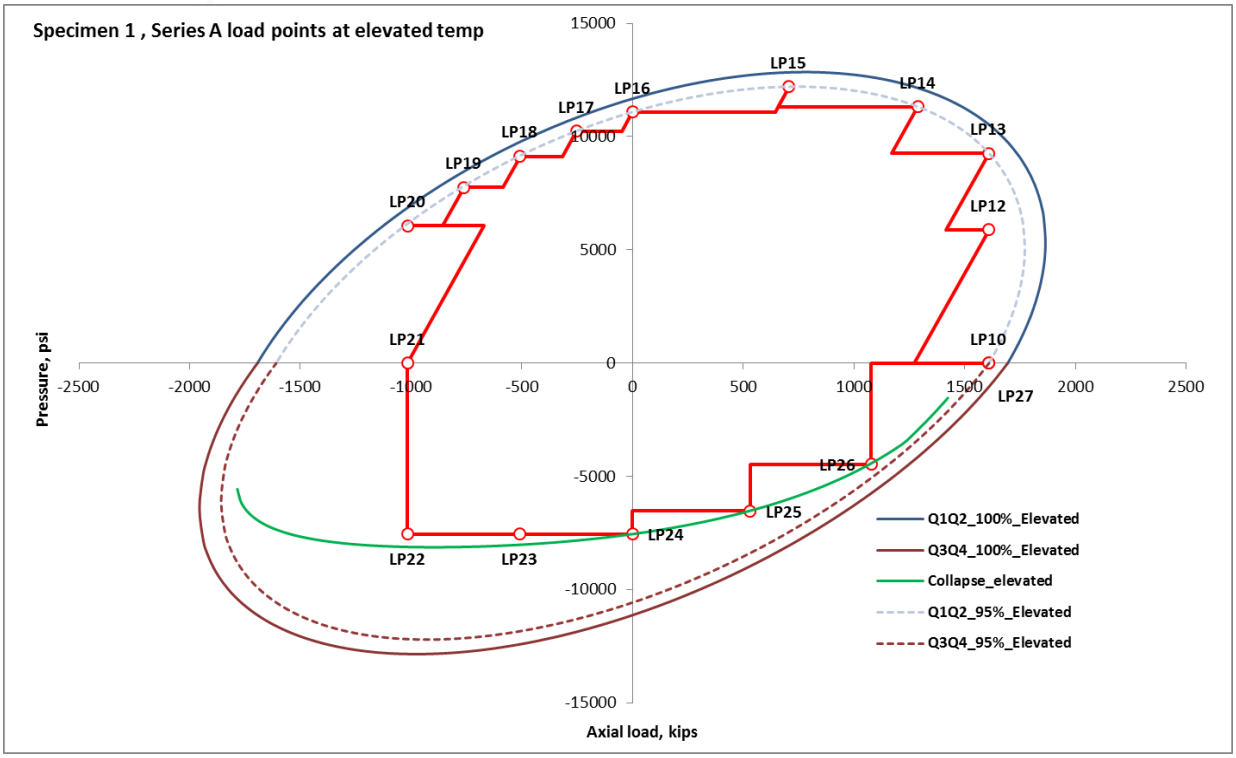

Figure A.3: Test Envelope for TMK UP PF Specimen 1 Series A (Elevated Temperature)

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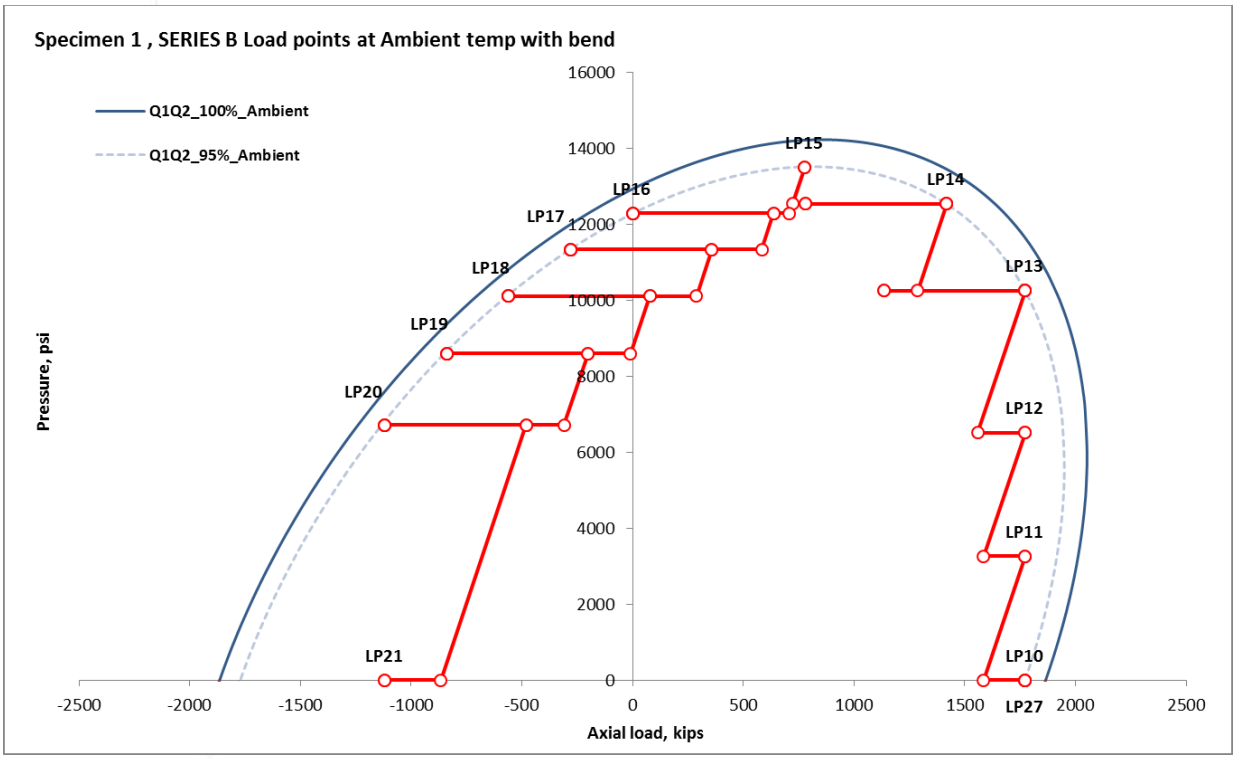

Figure A.4: Test Envelope for TMK UP PF Specimen 1 Series B (Ambient with Bending)

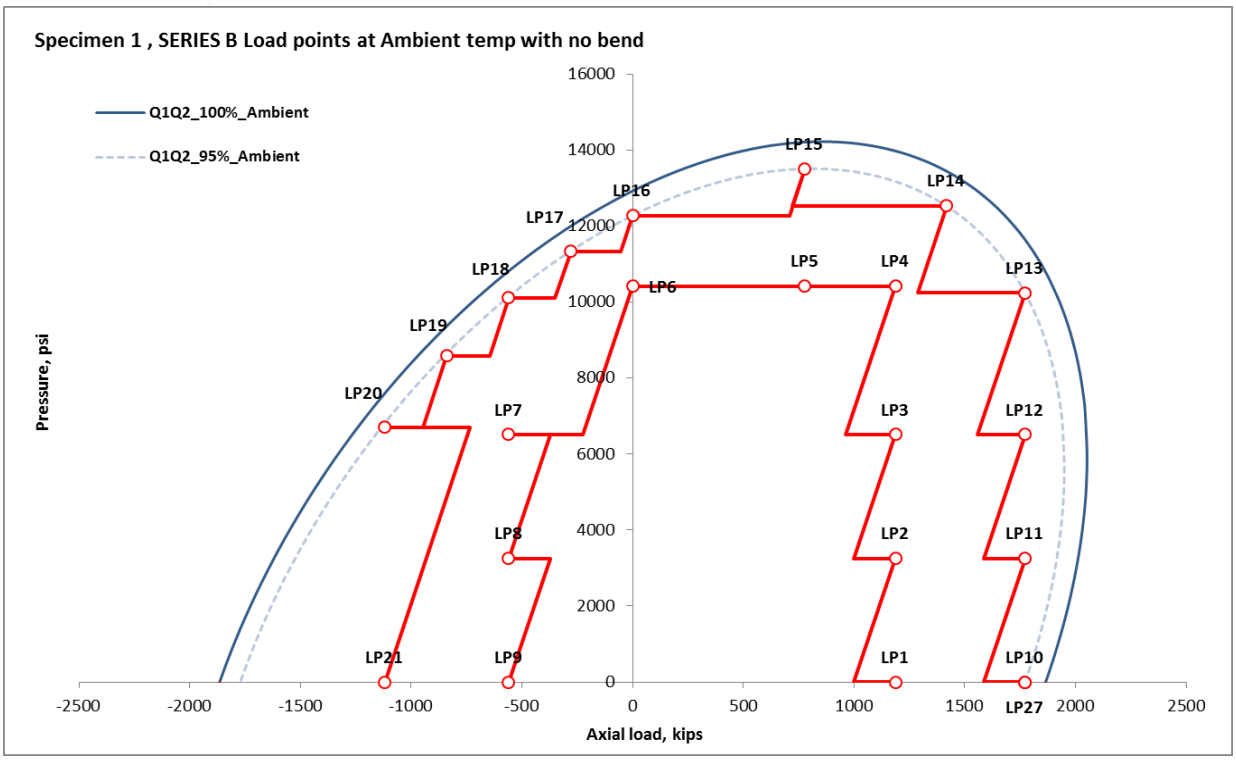

Figure A.5: Test Envelope for TMK UP PF Specimen 1 Series B (Ambient with No Bending)

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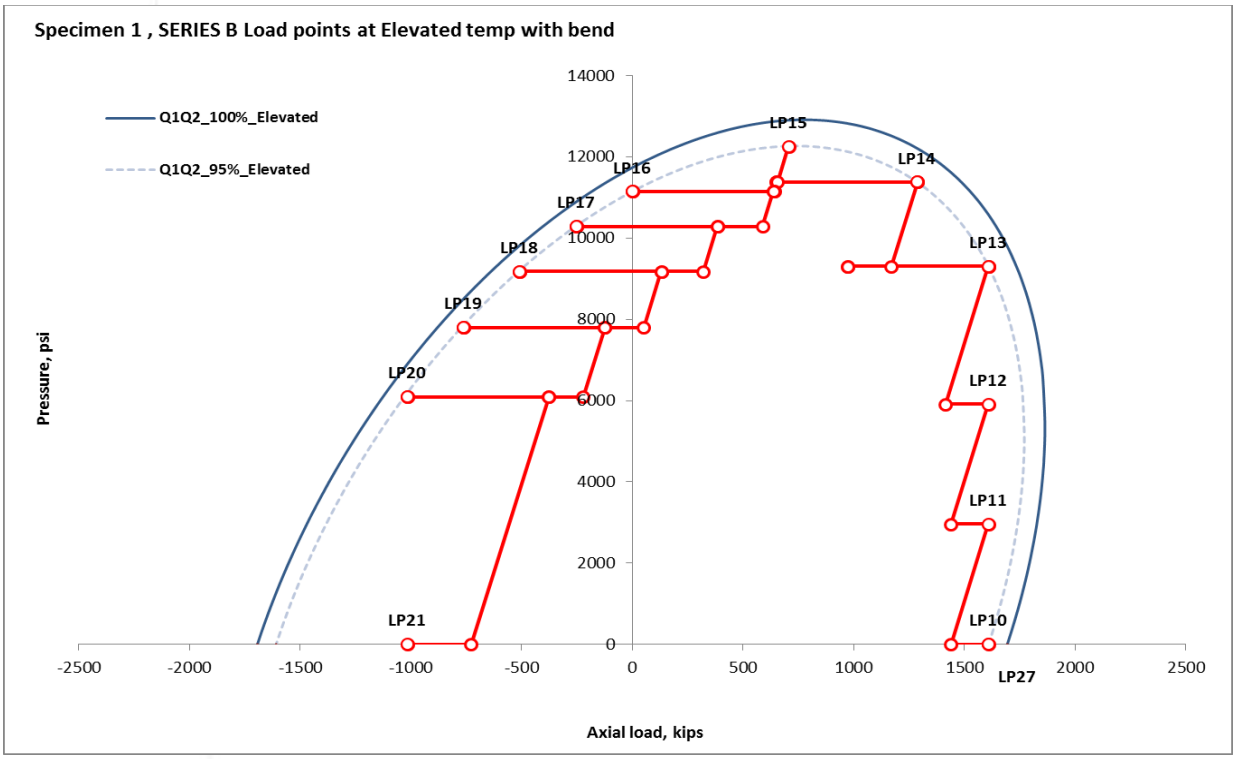

Figure A.6: Test Envelope for TMK UP PF Specimen 1 Series B (180°C with No Bending)

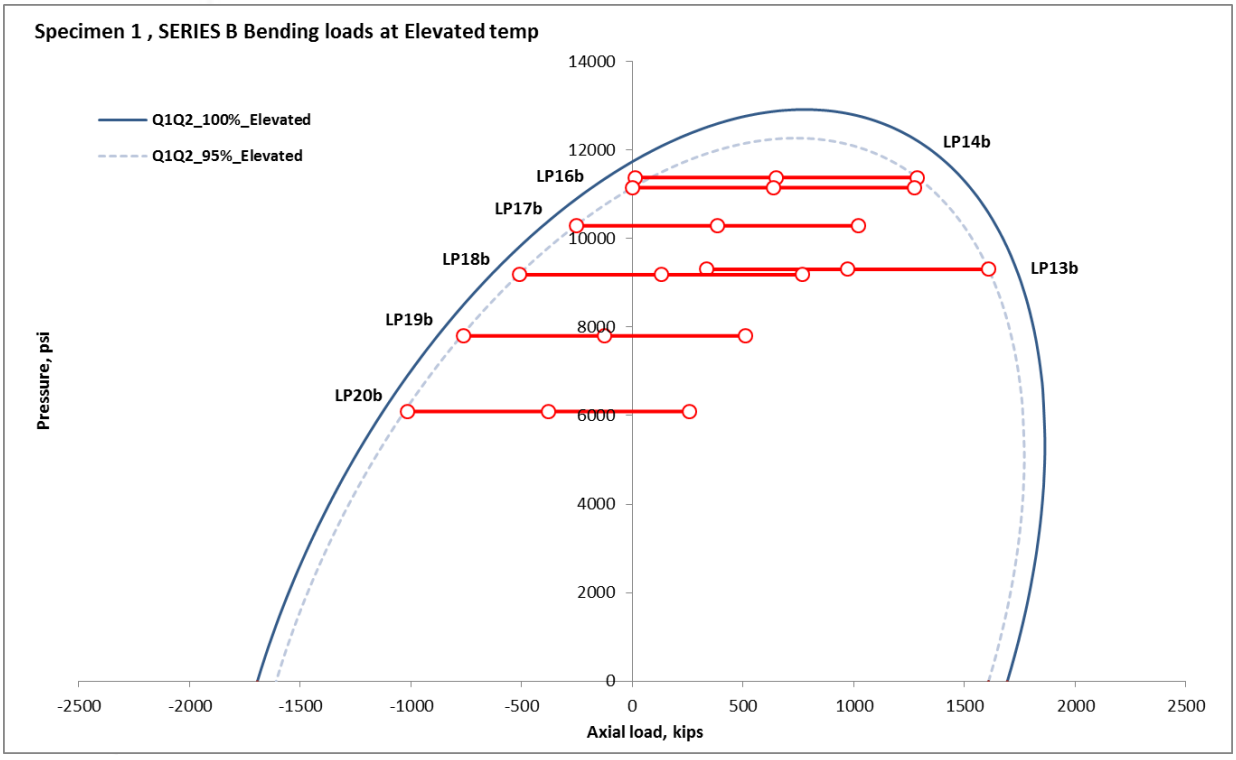

Figure A.7: Test Envelope for TMK UP PF Specimen 1 Series B (Bending at Elevated Temperature)

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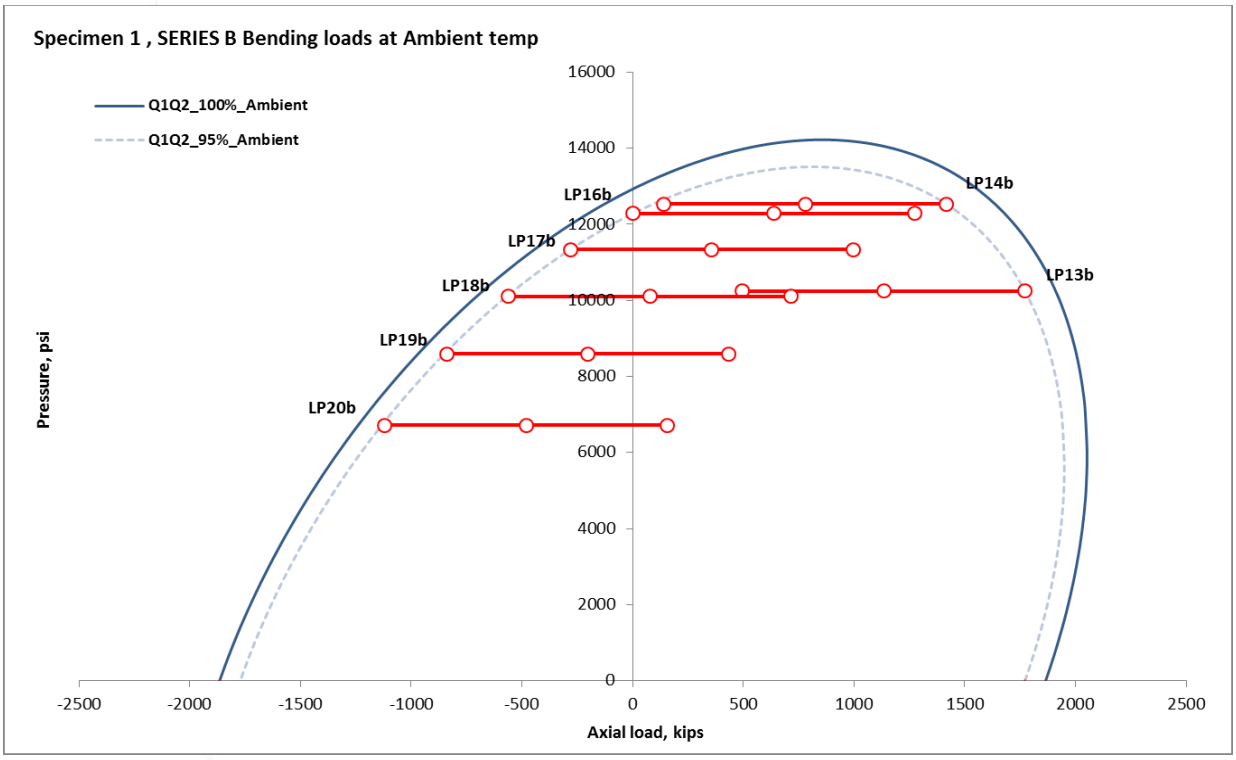

Figure A.8: Test Envelope for TMK UP PF Specimen 1 Series B (Bending at Ambient Temperature)

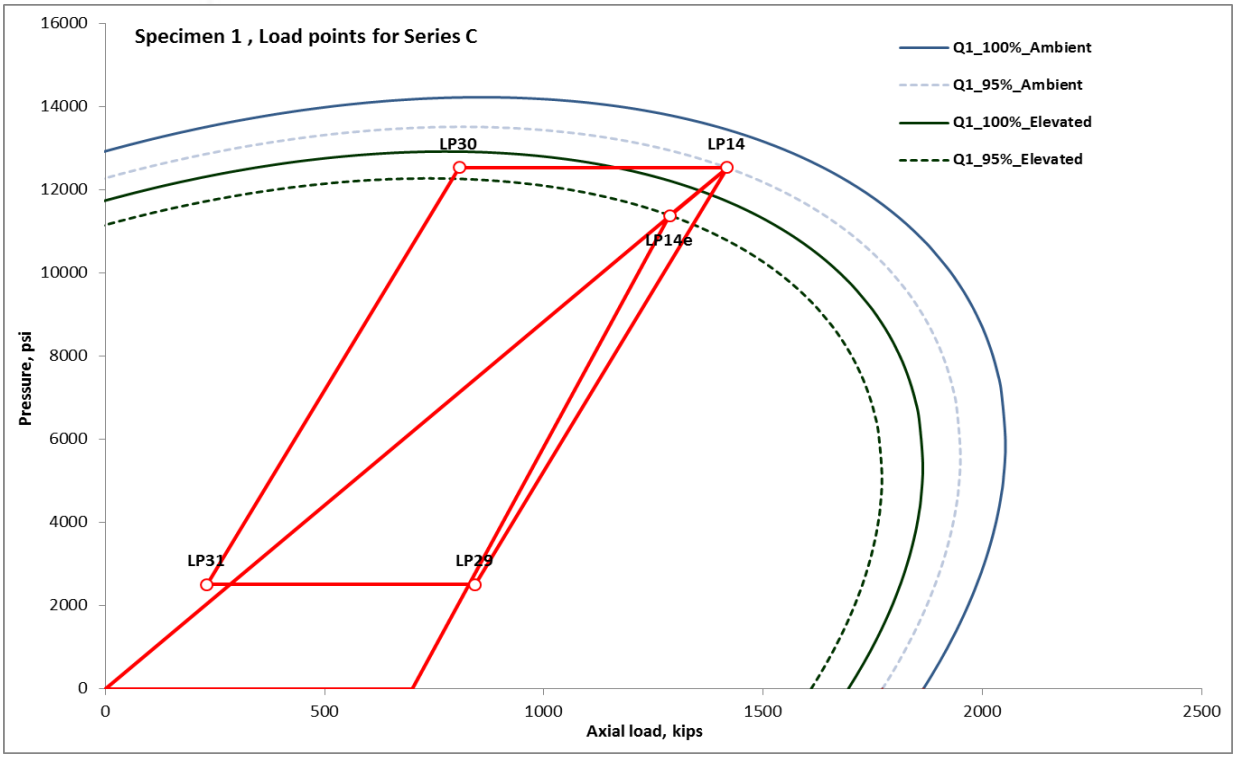

Figure A.9: Test Envelope for TMK UP PF Specimen 1 Series C

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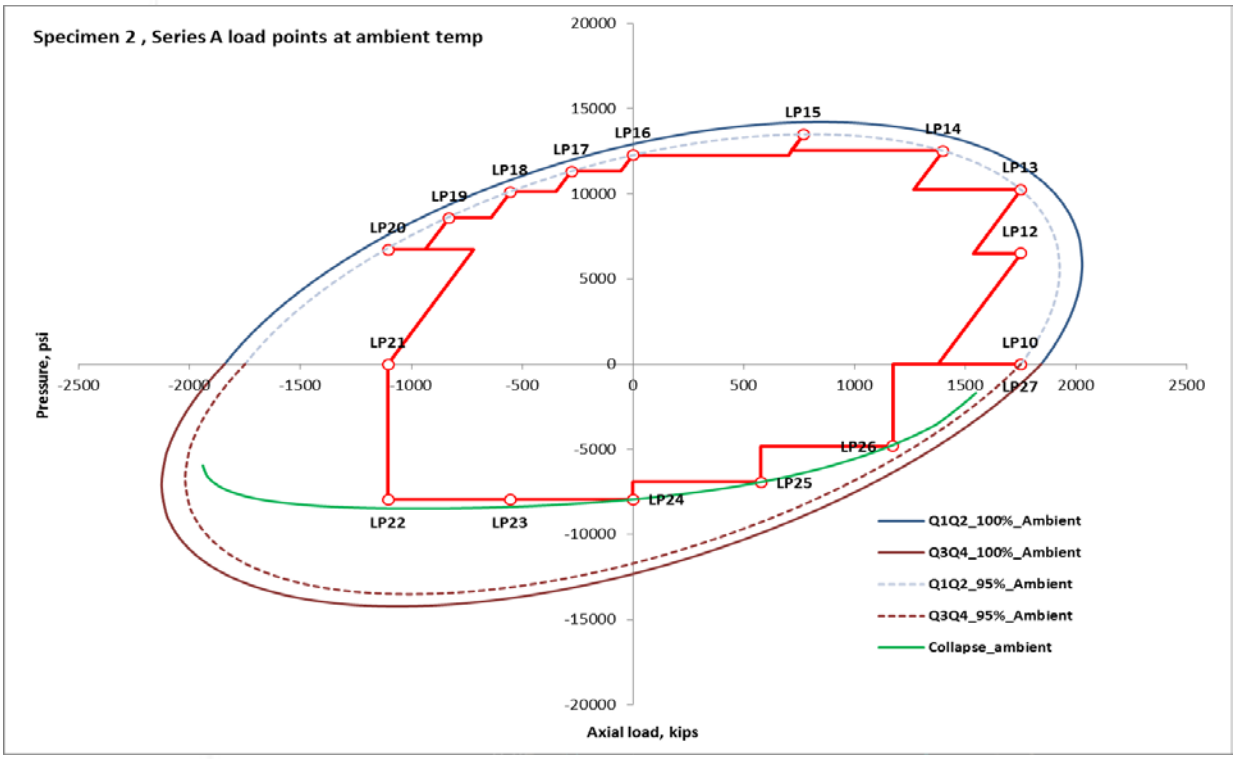

Figure A.10: Test Envelope for TMK UP PF Specimen 2 Series A (Ambient Temperature)

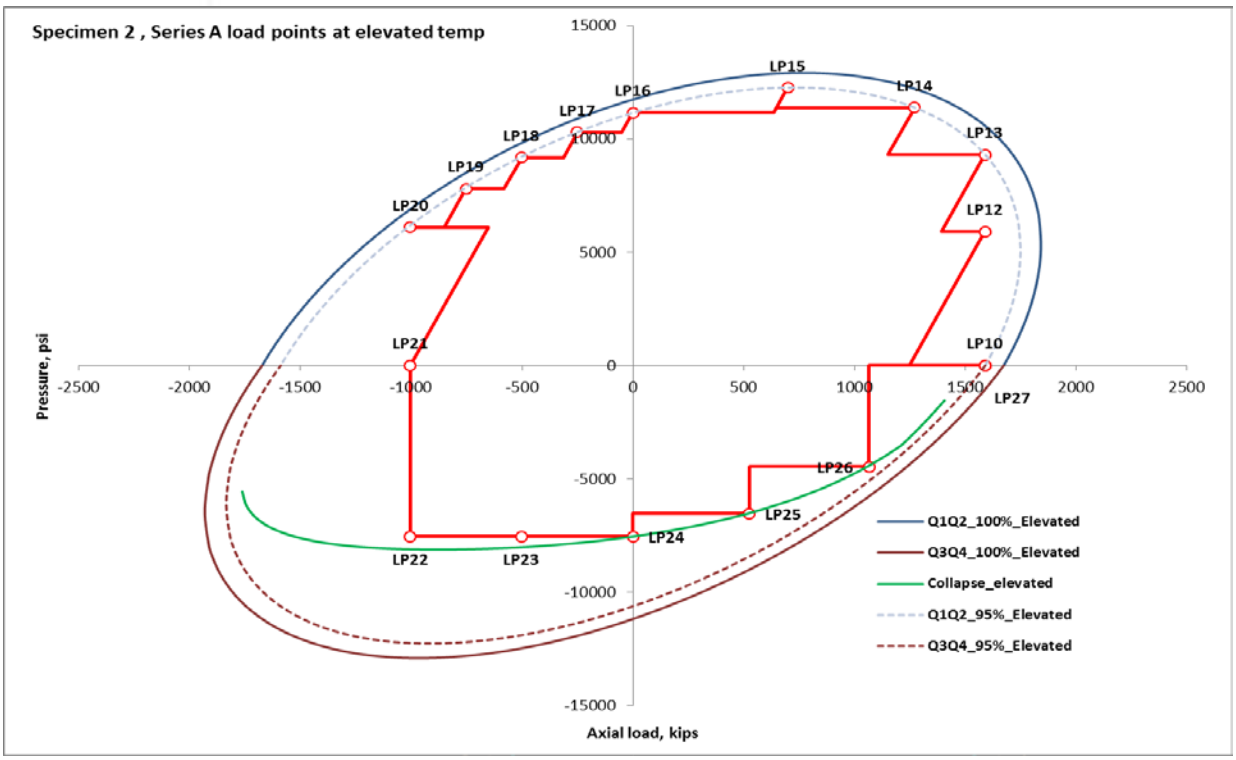

Figure A.11: Test Envelope for TMK UP PF Specimen 2 Series A (Elevated Temperature)

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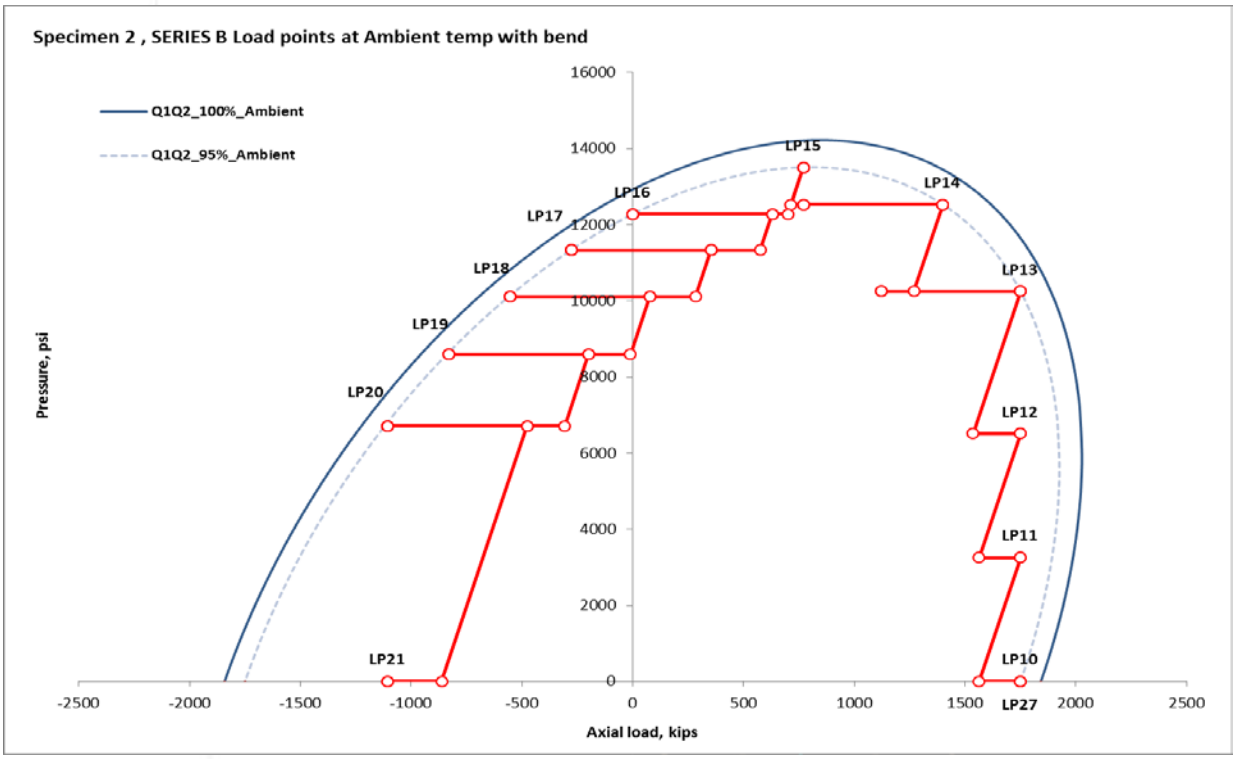

Figure A.12: Test Envelope for TMK UP PF Specimen 2 Series B (Ambient with Bending)

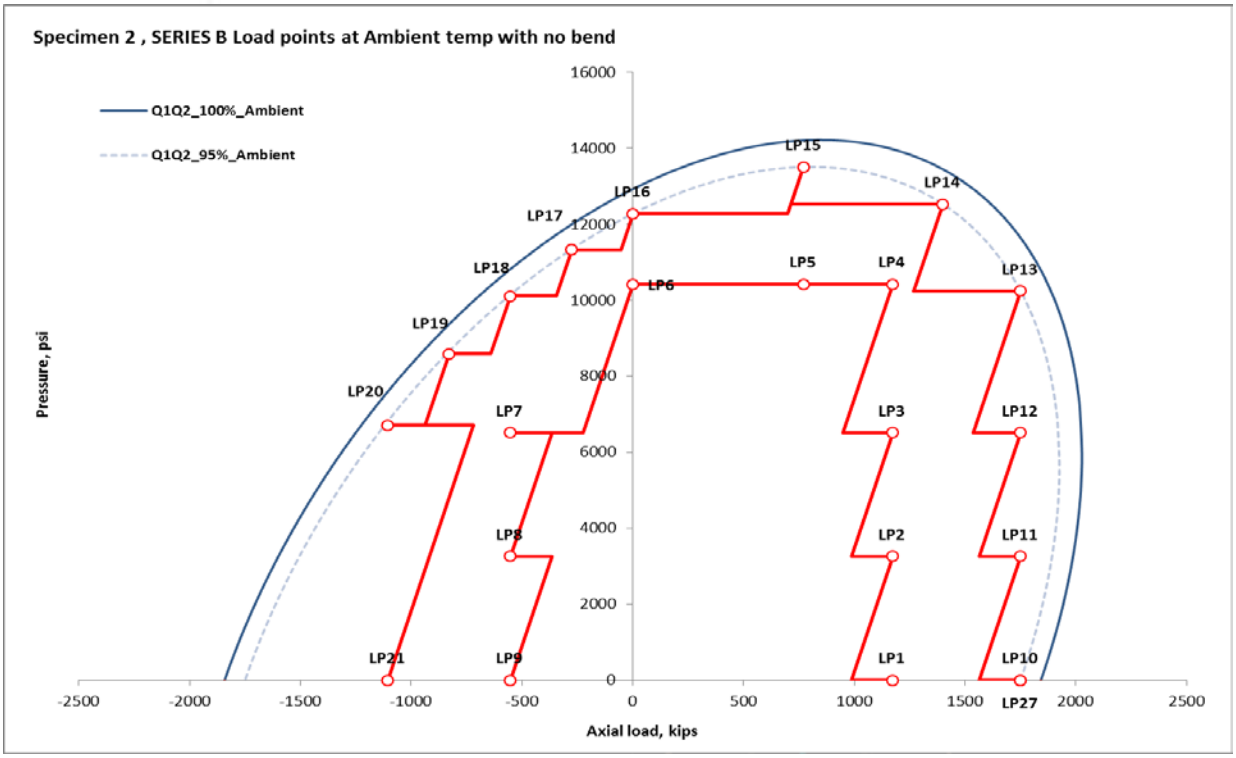

Figure A.13: Test Envelope for TMK UP PF Specimen 2 Series B (Ambient with No Bending)

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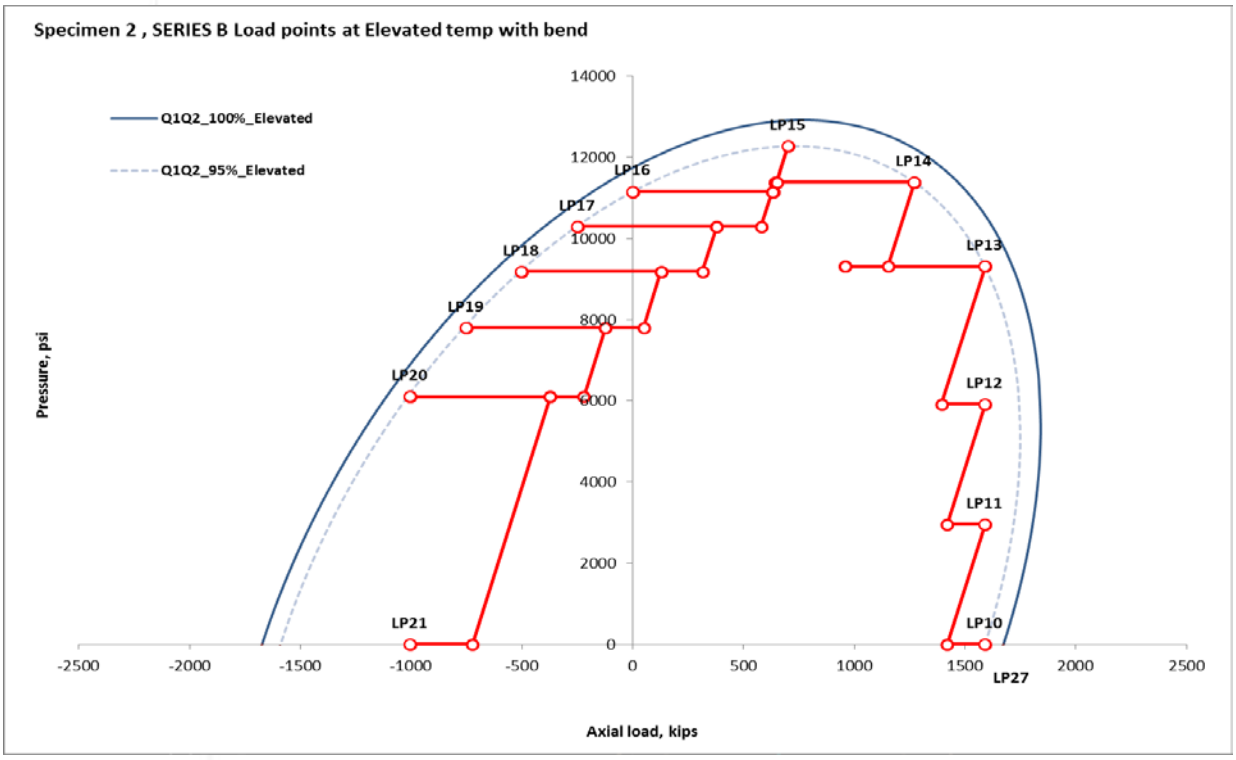

Figure A.14: Test Envelope for TMK UP PF Specimen 2 Series B (180°C with Bending)

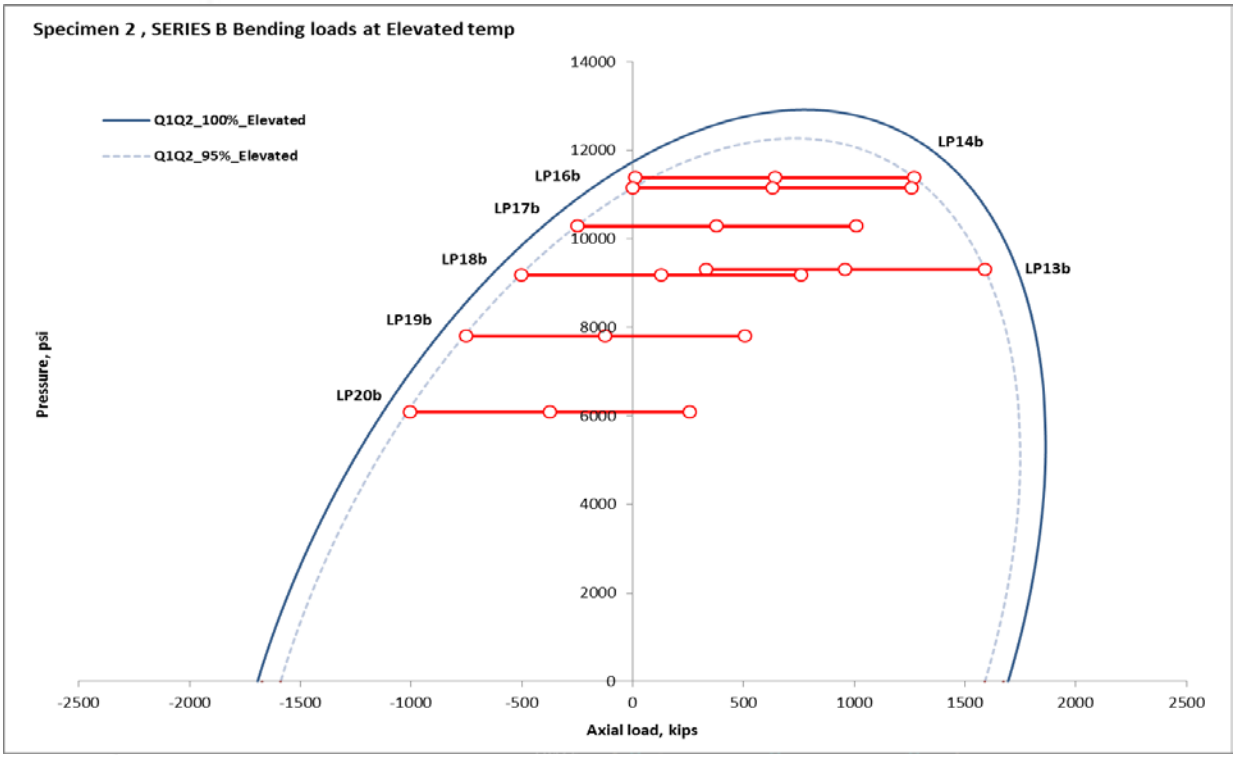

Figure A.15: Test Envelope for TMK UP PF Specimen 2 Series B (Bending at Elevated Temperature)

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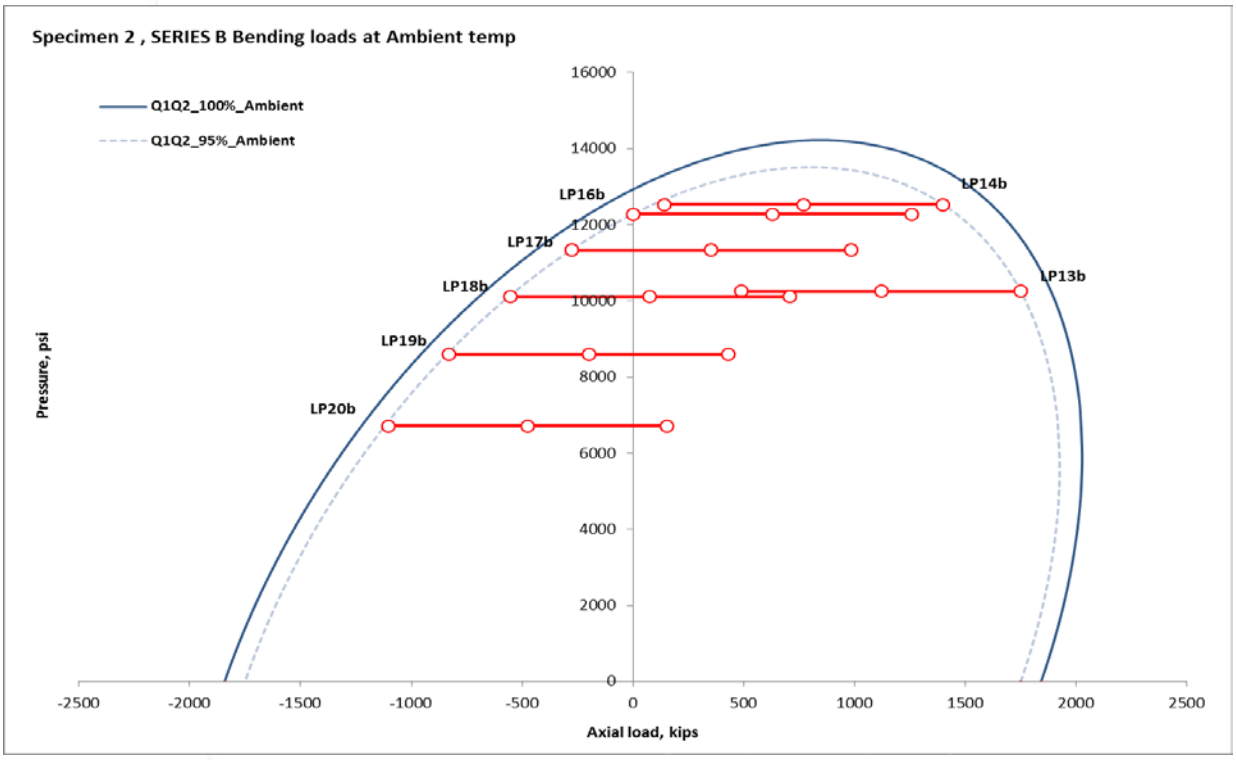

Figure A.16: Test Envelope for TMK UP PF Specimen 2 Series B (Bending at Ambient Temperature)

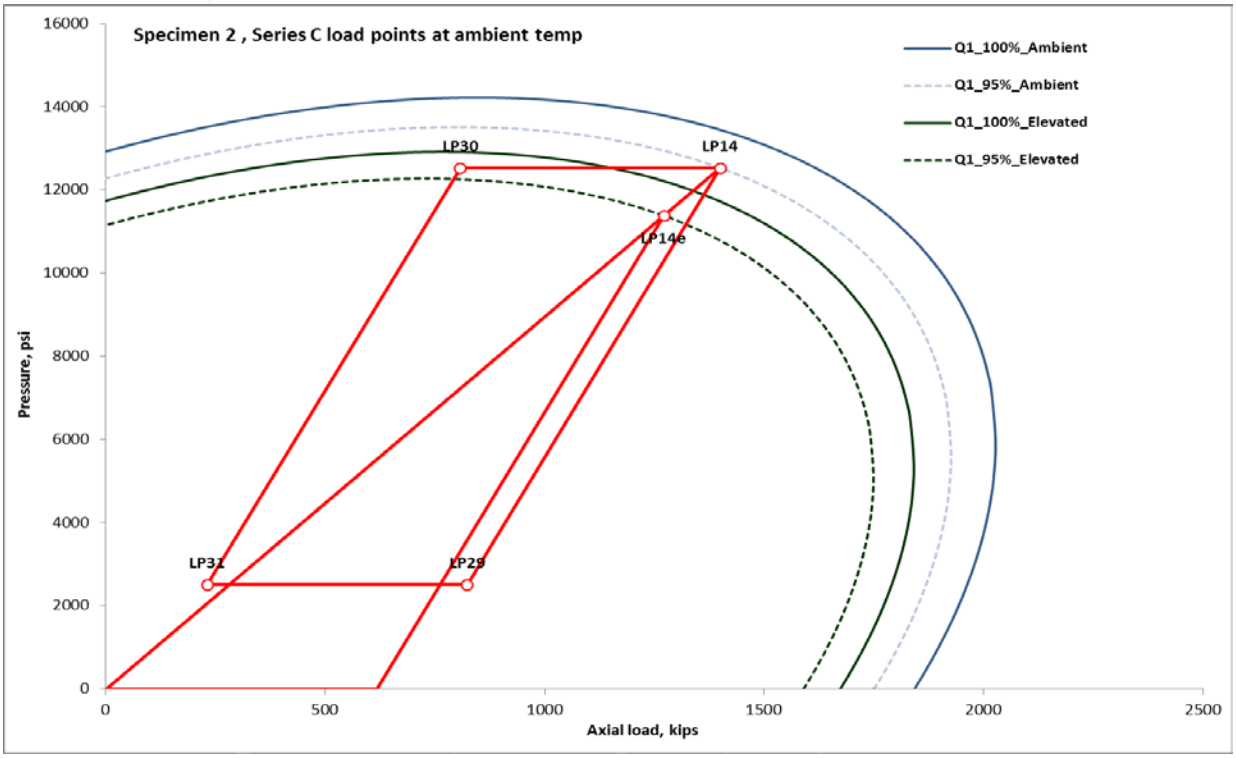

Figure A.17: Test Envelope for TMK UP PF Specimen 2 Series C

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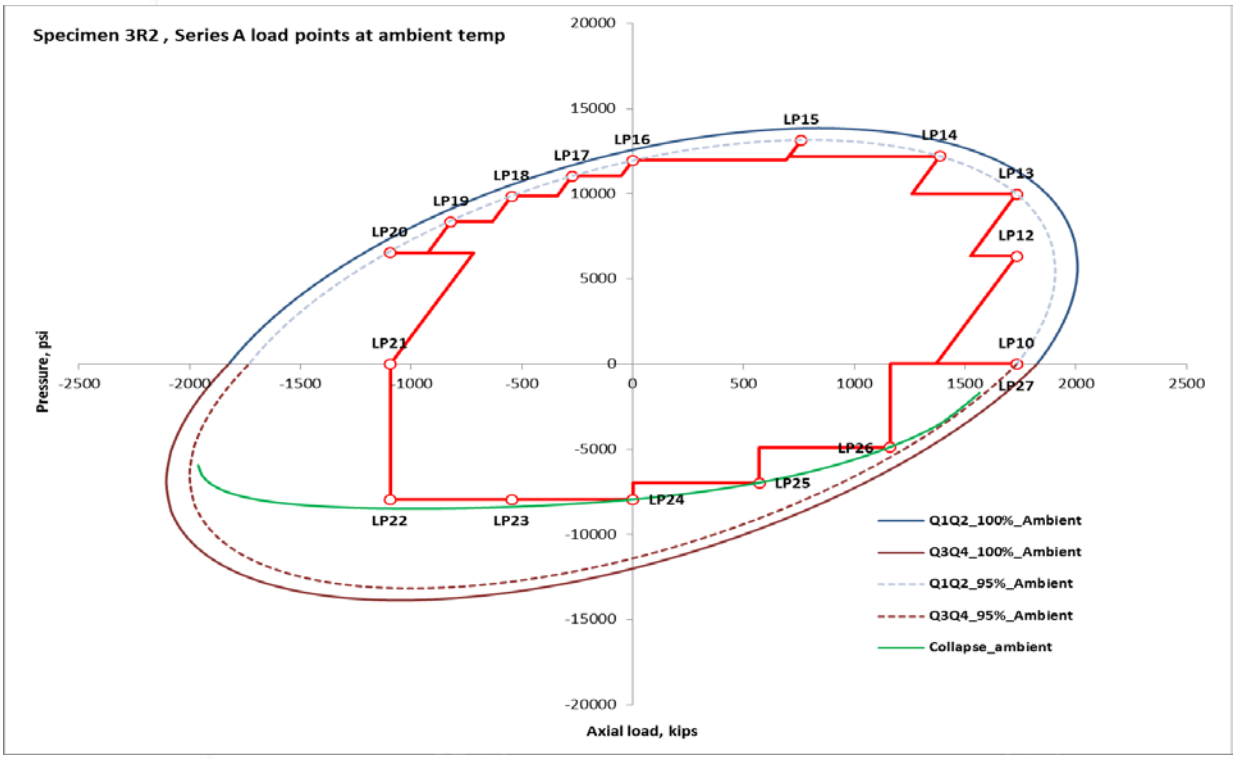

Figure A.18: Test Envelope for TMK UP PF Specimen 3R2 Series A (Ambient Temperature)

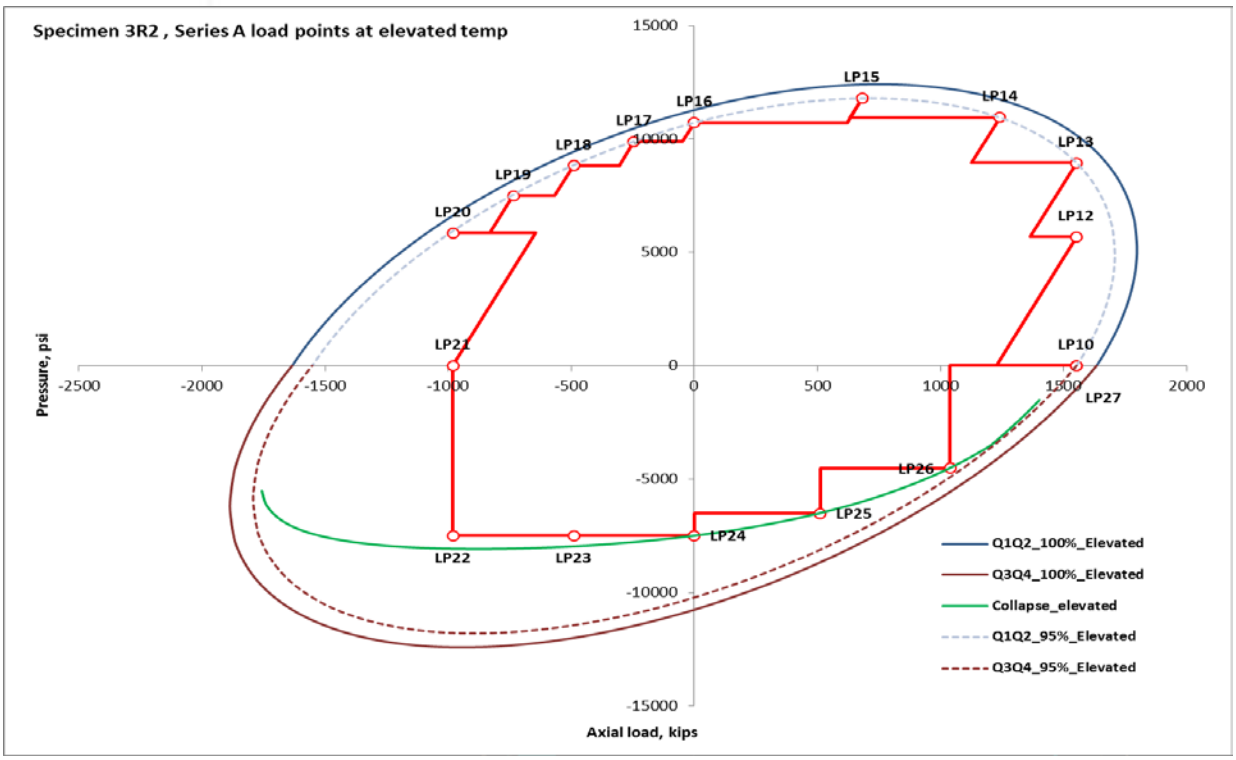

Figure A.19: Test Envelope for TMK UP PF Specimen 3R2 Series A (Elevated Temperature)

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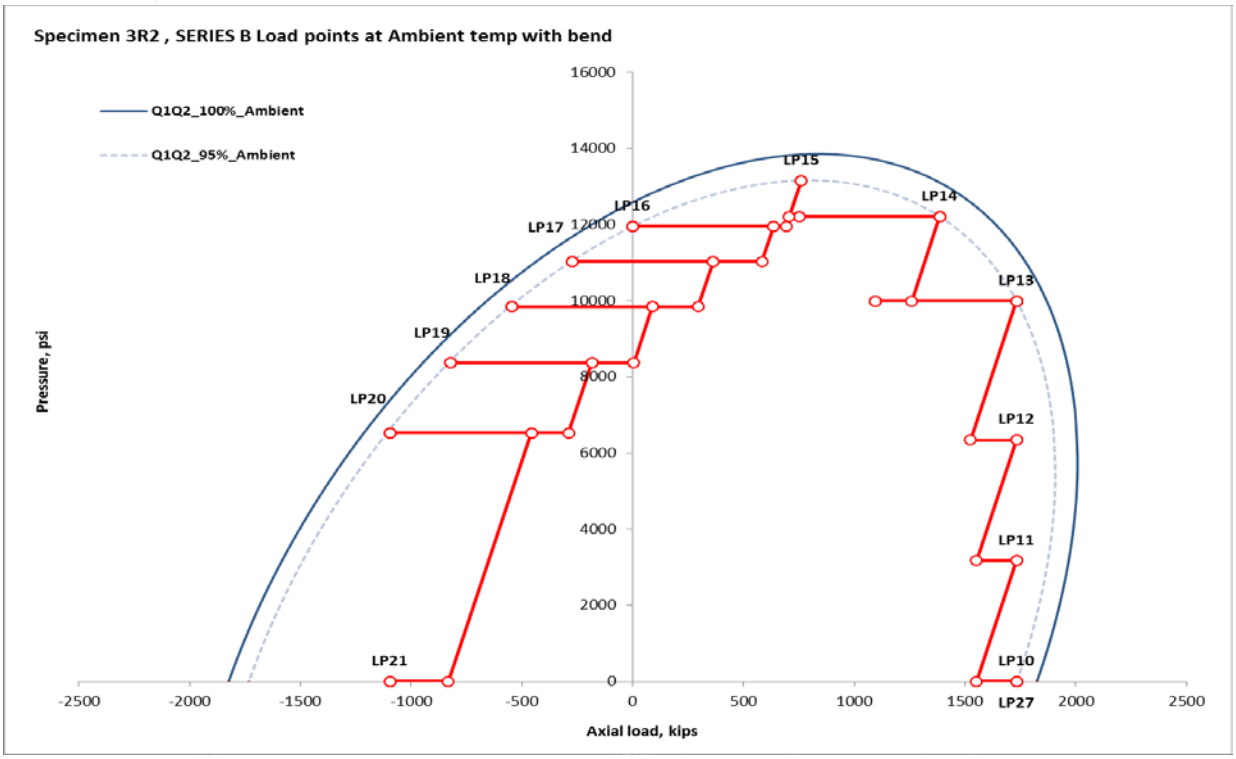

Figure A.20: Test Envelope for TMK UP PF Specimen 3R2 Series B (Ambient with Bending)

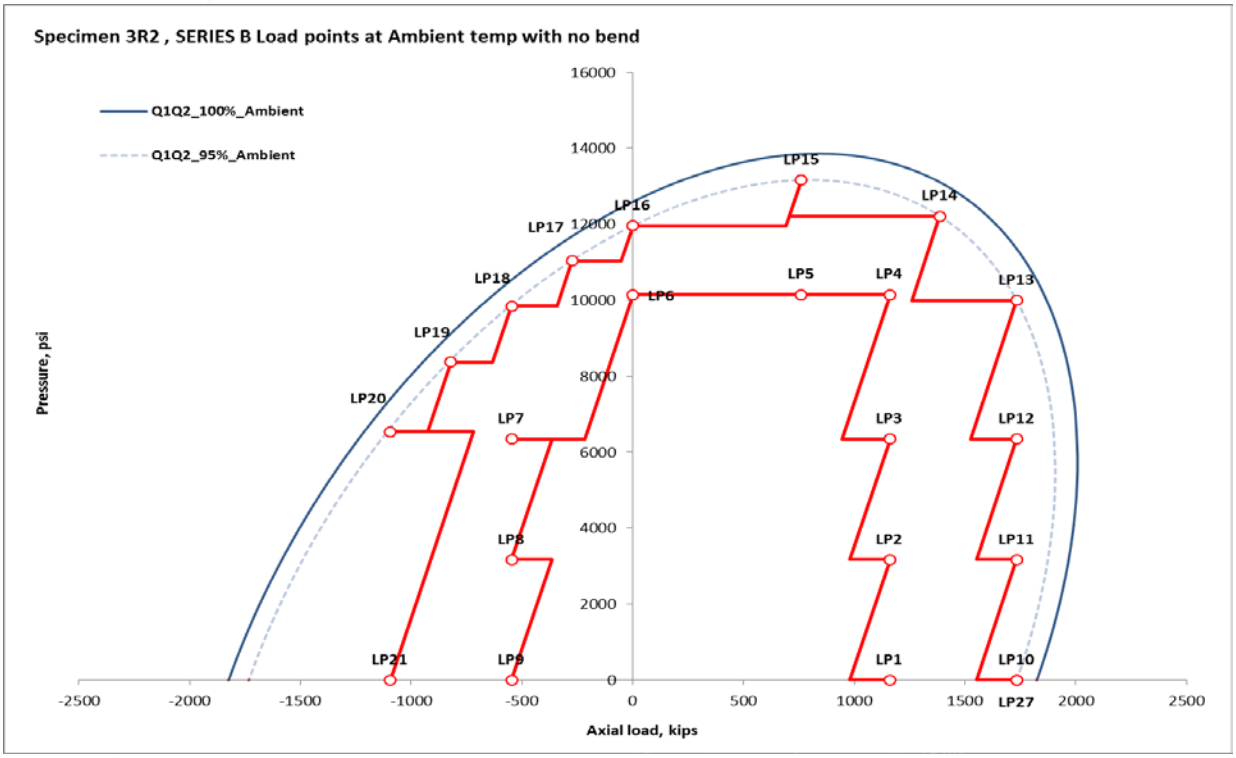

Figure A.21: Test Envelope for TMK UP PF Specimen 3R2 Series B (Ambient with No Bending)

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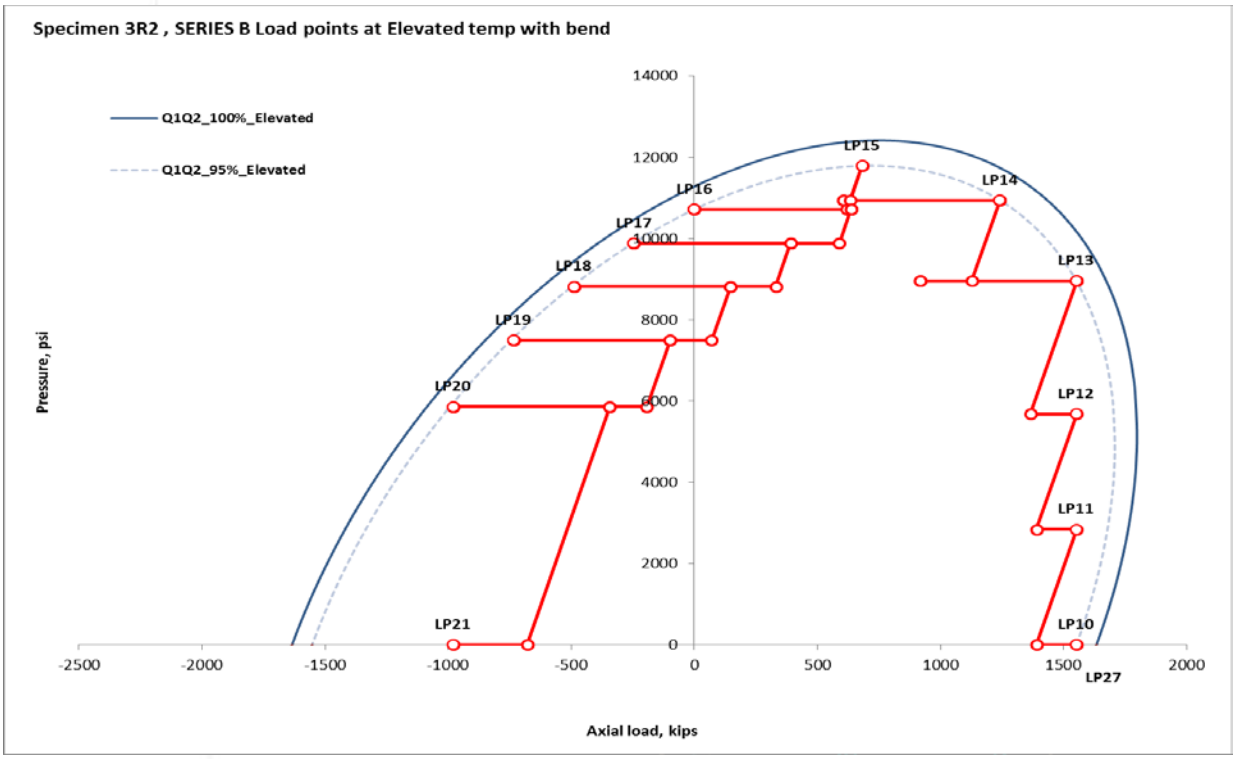

Figure A.22: Test Envelope for TMK UP PF Specimen 3R2 Series B (180°C with Bending)

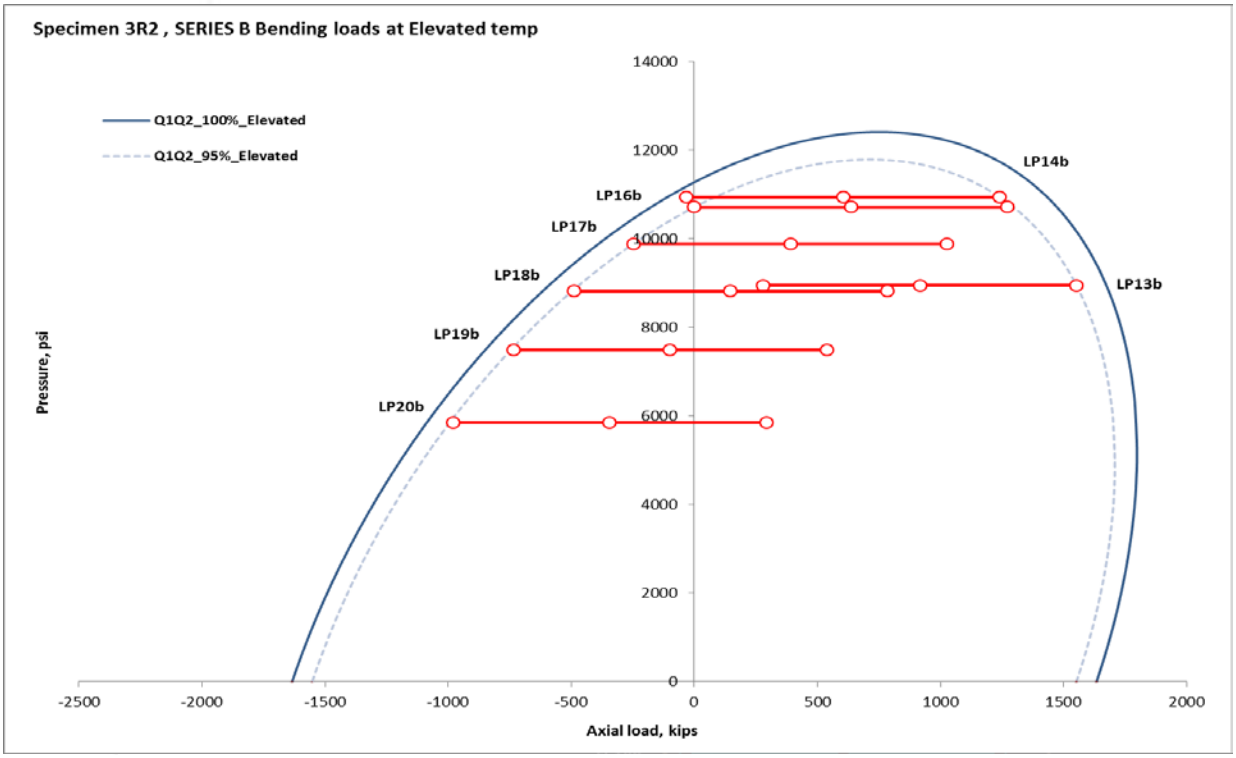

Figure A.23: Test Envelope for TMK UP PF Specimen 3R2 Series B (Bending at Elevated Temperature)

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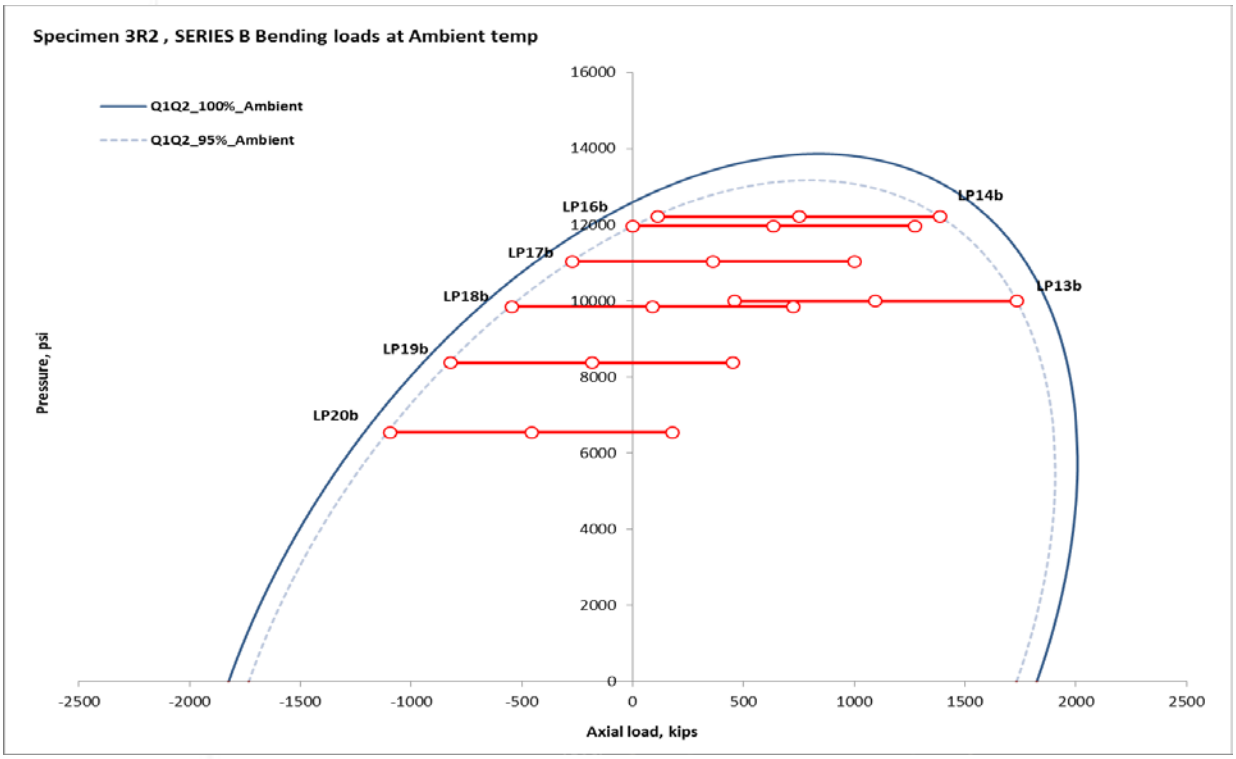

Figure A.24: Test Envelope for TMK UP PF Specimen 3R2 Series B (Bending at Ambient Temperature)

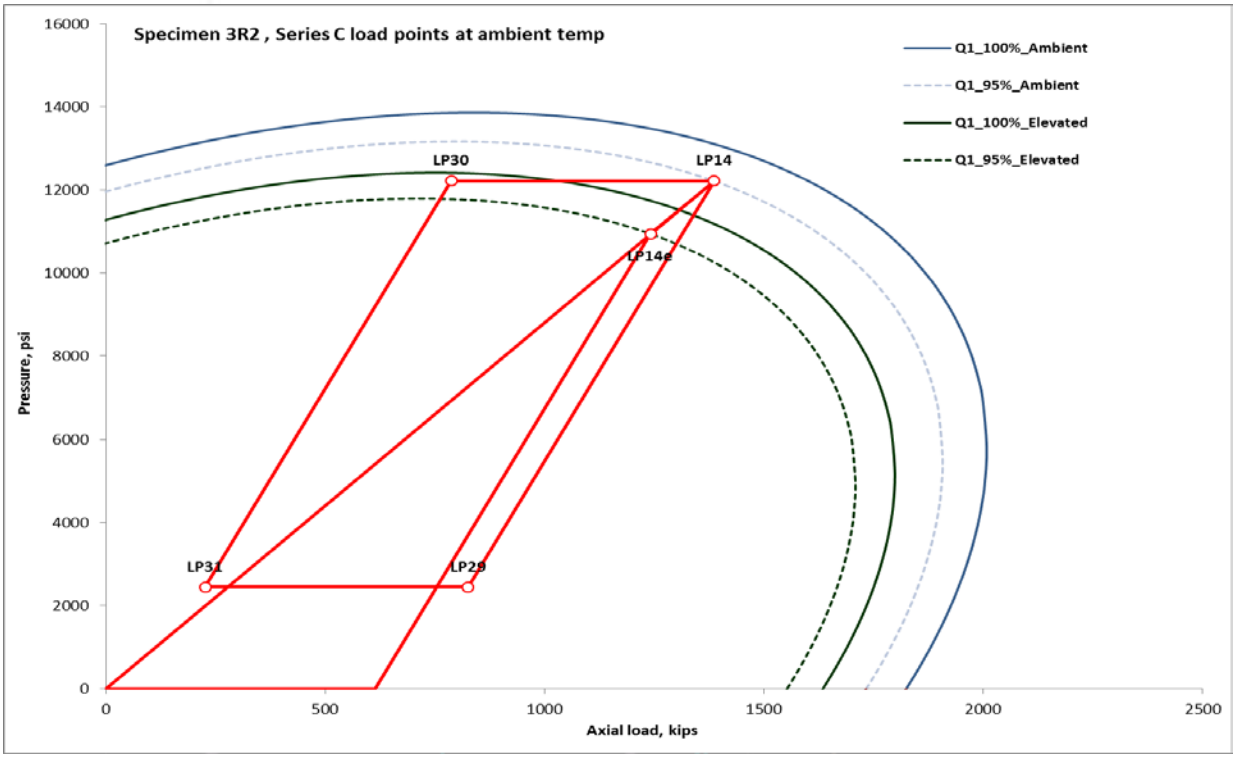

Figure A.25: Test Envelope for TMK UP PF Specimen 3R2 Series C

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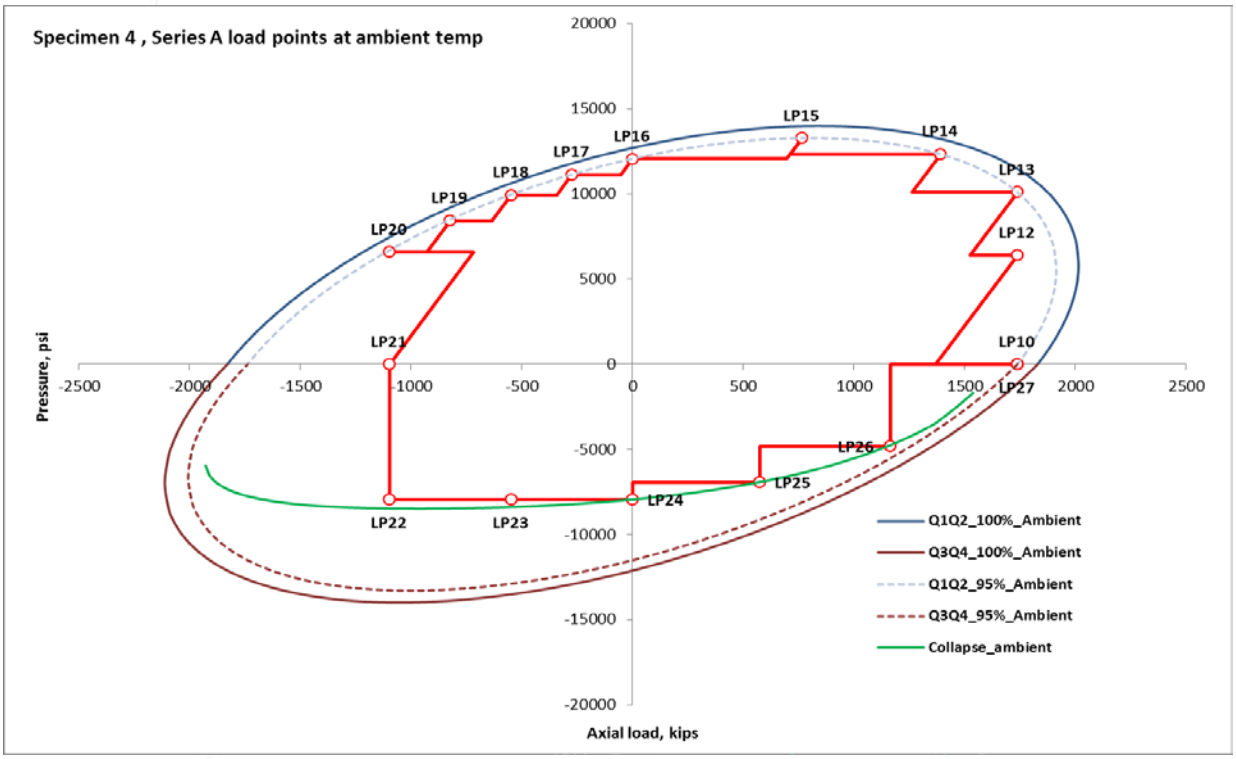

Figure A.26: Test Envelope for TMK UP PF Specimen 4 Series A (Ambient Temperature)

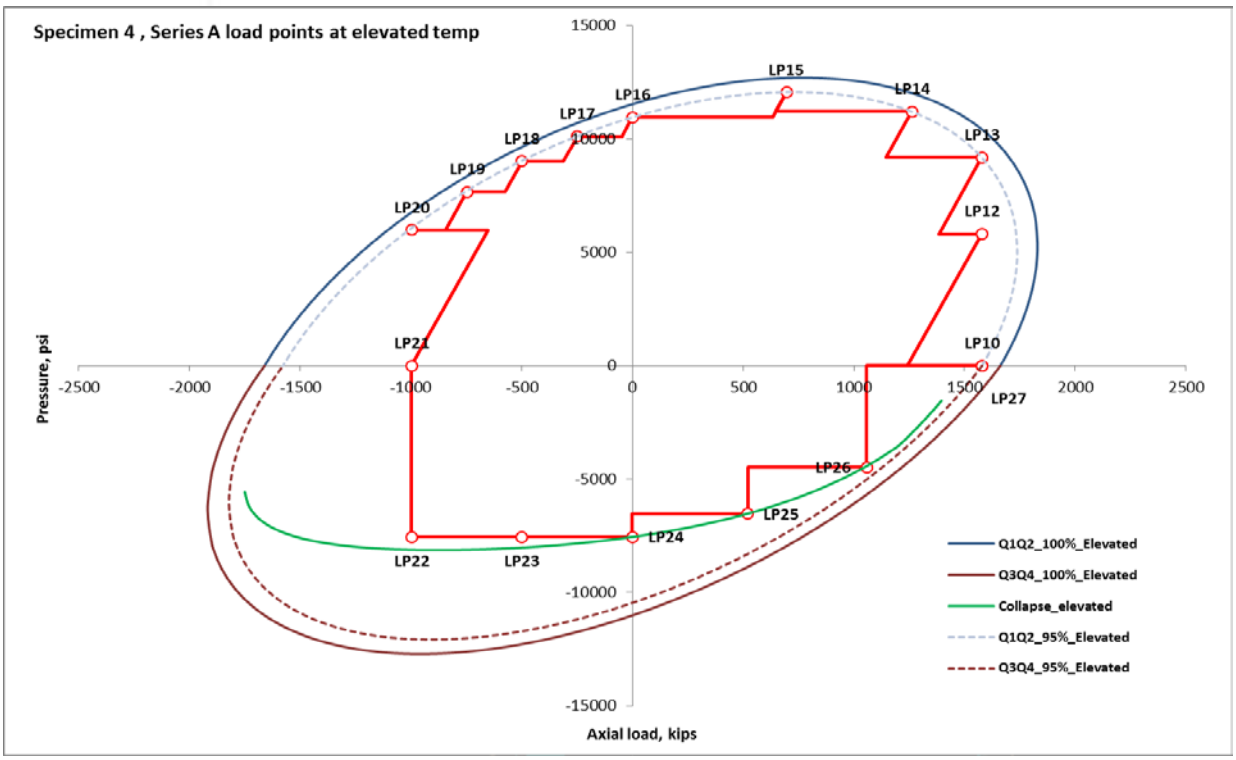

Figure A.27: Test Envelope for TMK UP PF Specimen 4 Series A (Elevated Temperature)

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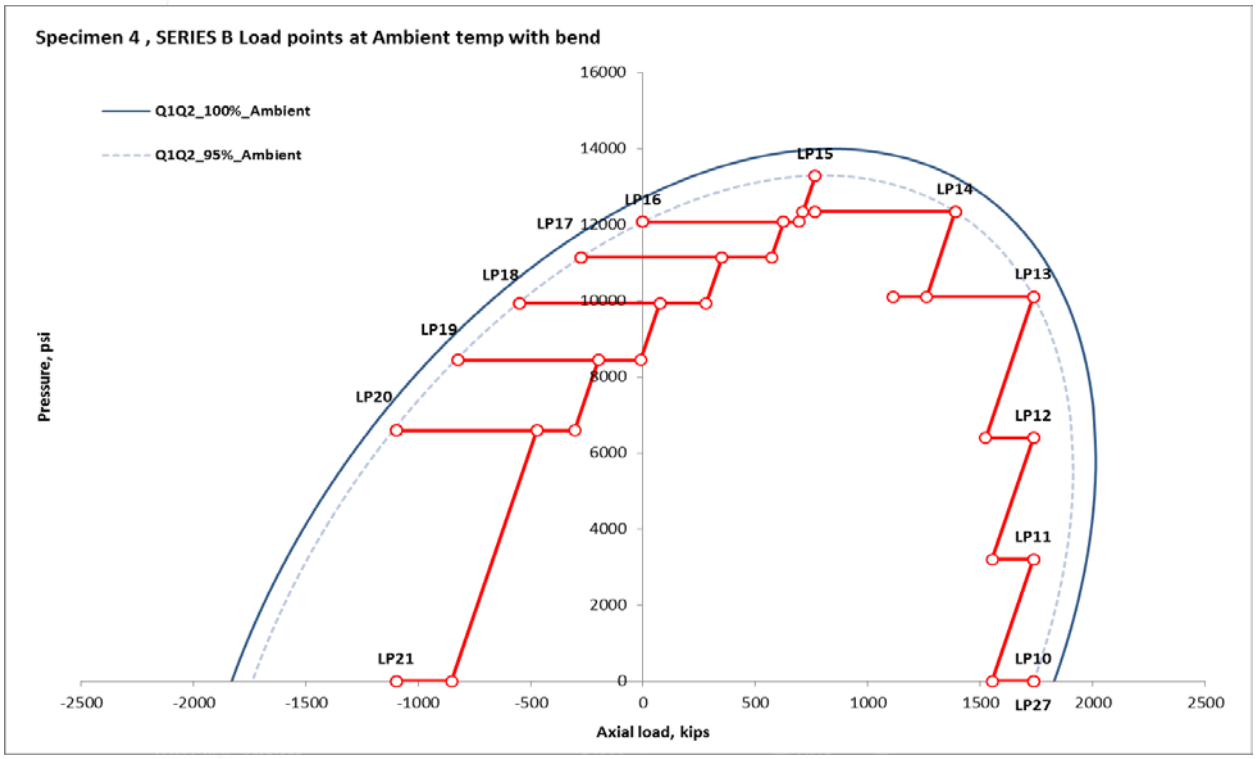

Figure A.28: Test Envelope for TMK UP PF Specimen 4 Series B (Ambient with Bending)

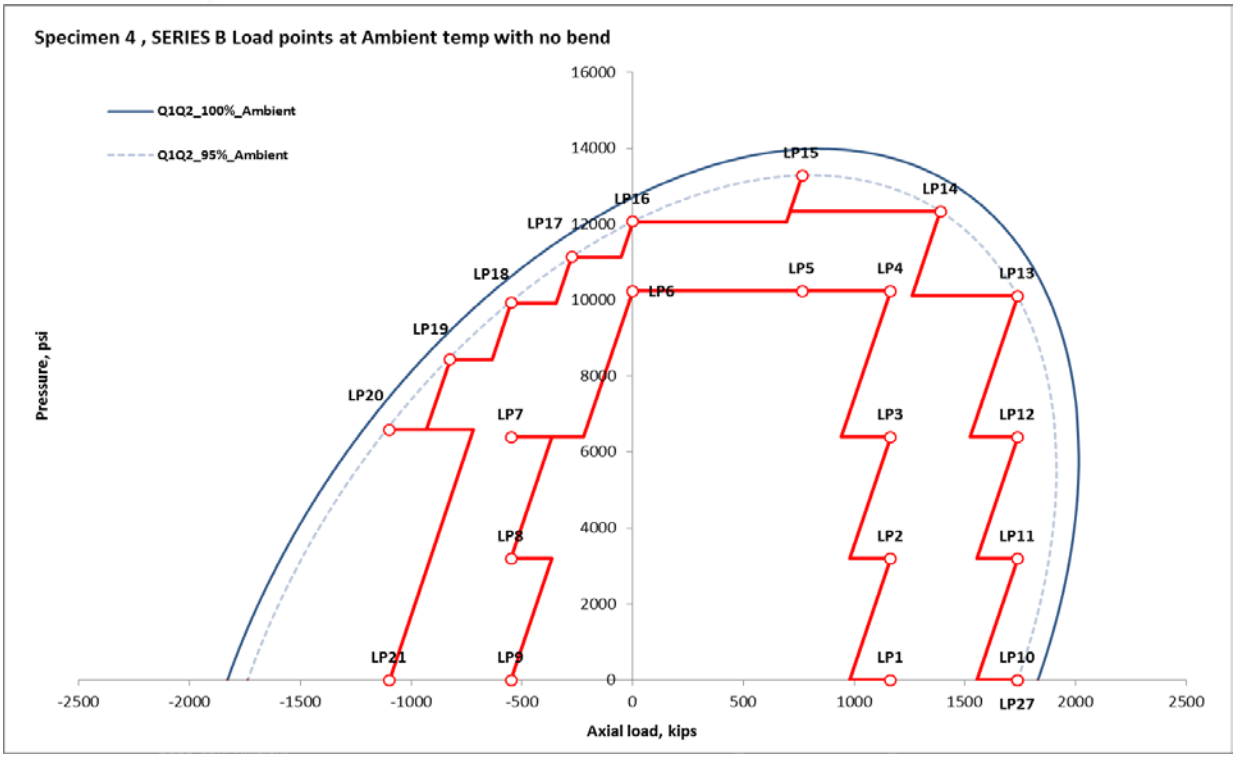

Figure A.29: Test Envelope for TMK UP PF Specimen 4 Series B (Ambient with No Bending)

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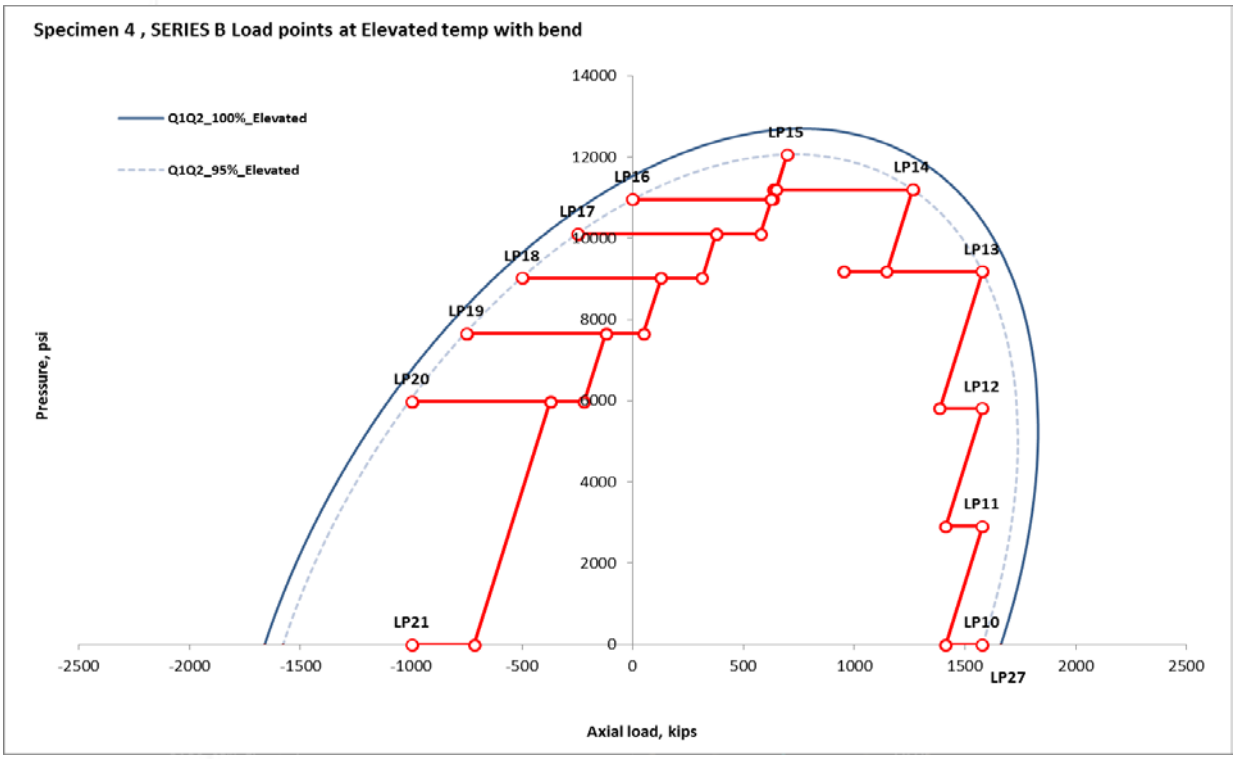

Figure A.30: Test Envelope for TMK UP PF Specimen 4 Series B (180°C with Bending)

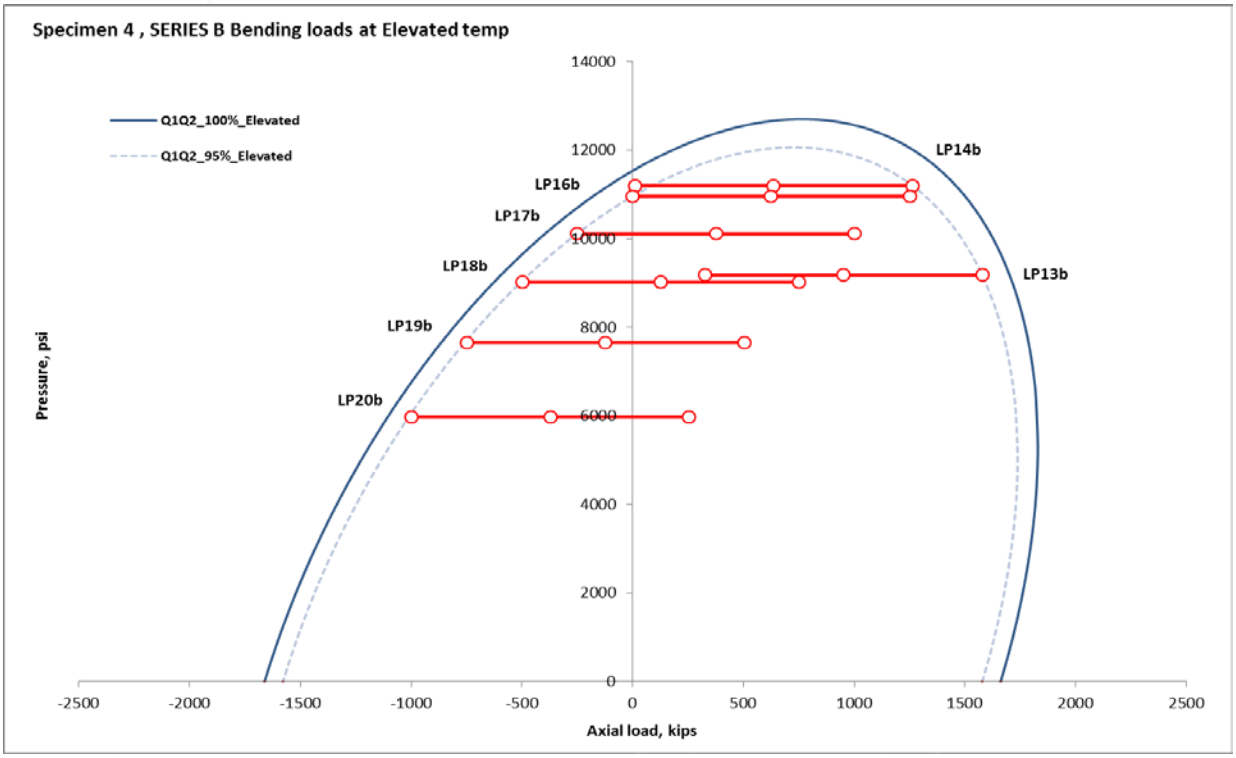

Figure A.31: Test Envelope for TMK UP PF Specimen 4 Series B (Bending at Elevated Temperature)

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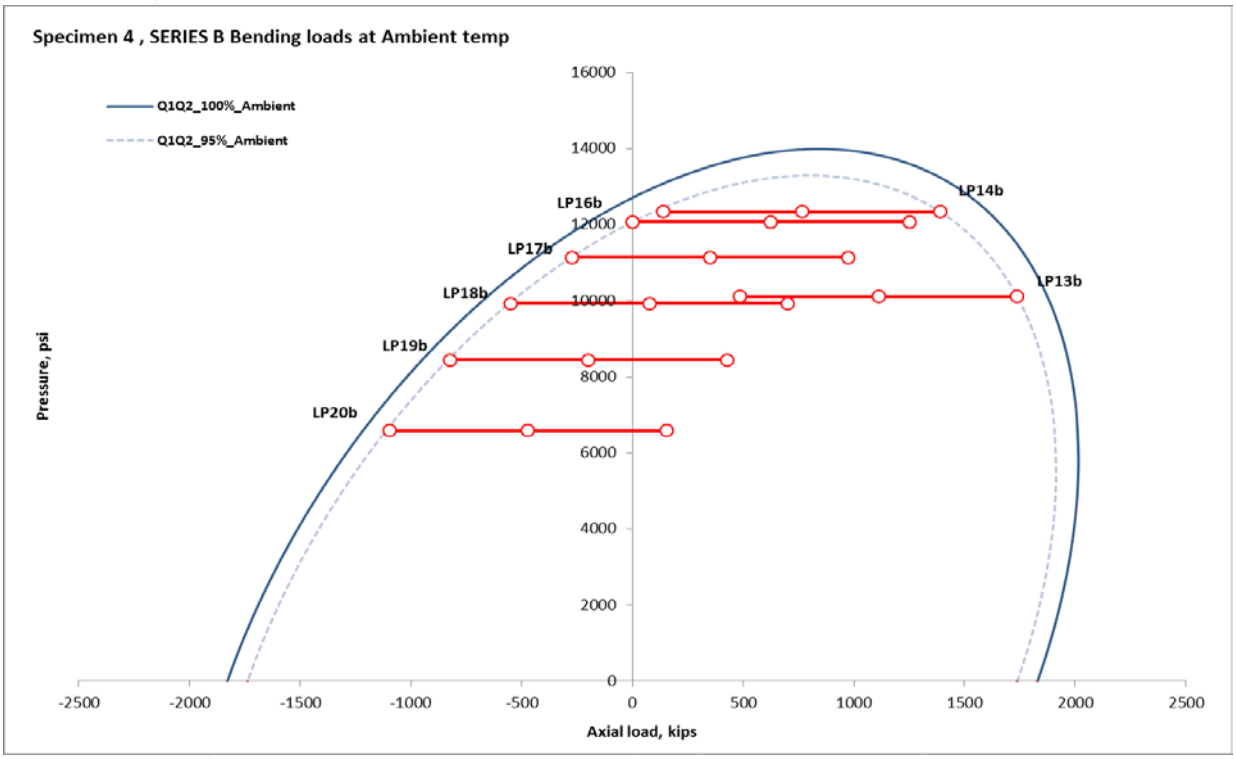

Figure A.32: Test Envelope for TMK UP PF Specimen 4 Series B (Bending at Ambient Temperature)

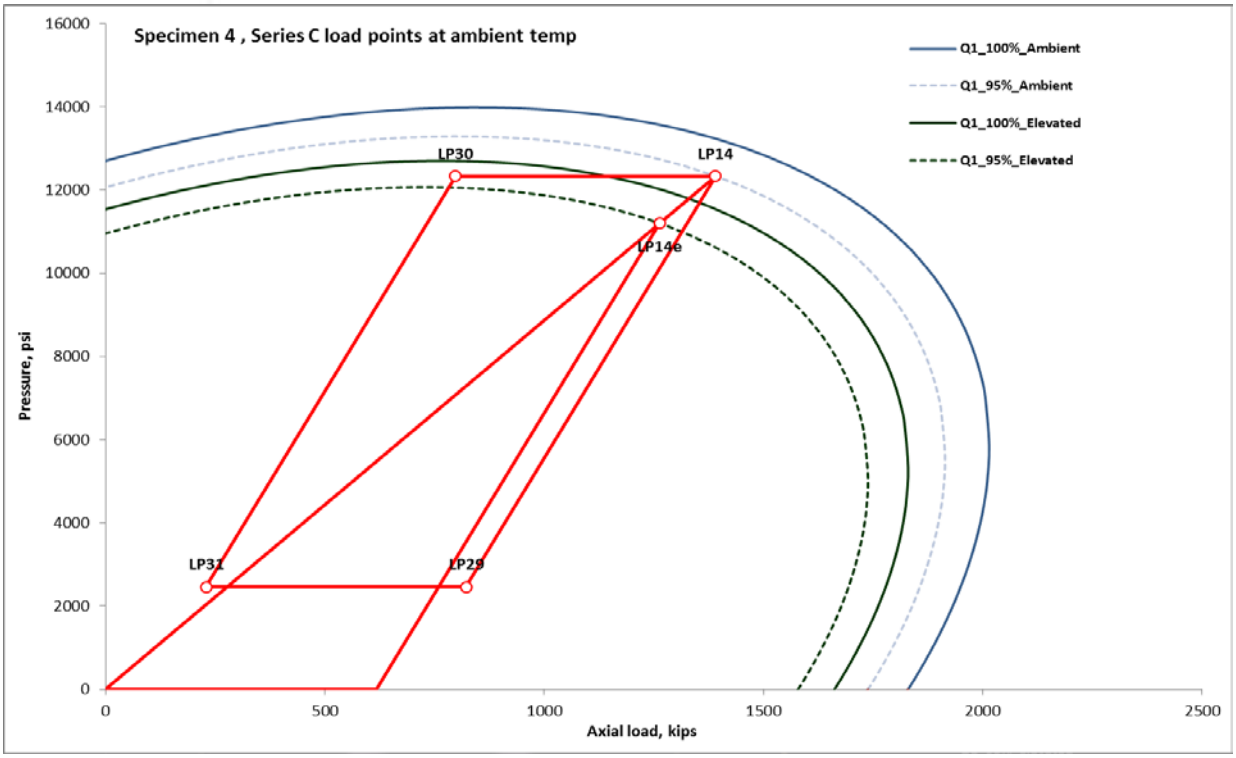

Figure A.33: Test Envelope for TMK UP PF Specimen 4 Series C

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6.5 Limit Load Tests

The failure loads and loading mechanisms for all specimens are listed in Table A.11. All test specimens met the ISO 13679: FDIS 2011 requirements. In Table A.11, a negative load denotes compression and negative pressure denotes external pressure.

Specimen	Loading Mechanism	Failure Load (kips)		Failure Pressure (psi)	%VME (%)
		Frame Load	Total Axial Load		
1	Increase Tension to Failure	1,905	1,905	N/A	102
2	Compression + External Pressure to Failure	–876	–876	–13,775	97
3R2	Internal Pressure + Tension to Failure	1,173	1,852	11,772	105
4	Internal Pressure + Compression to Failure	–1,599	–1,111	8,413	107
5	Tension + Internal Pressure to Failure	873	1,710	14,474	112

Table A.11: Failure Loads and Mechanisms From Limit Load Tests

The applied loads (tension/compression) and pressures (internal/external) for each specimen assembly are provided in Figure A.34–Figure A.38.

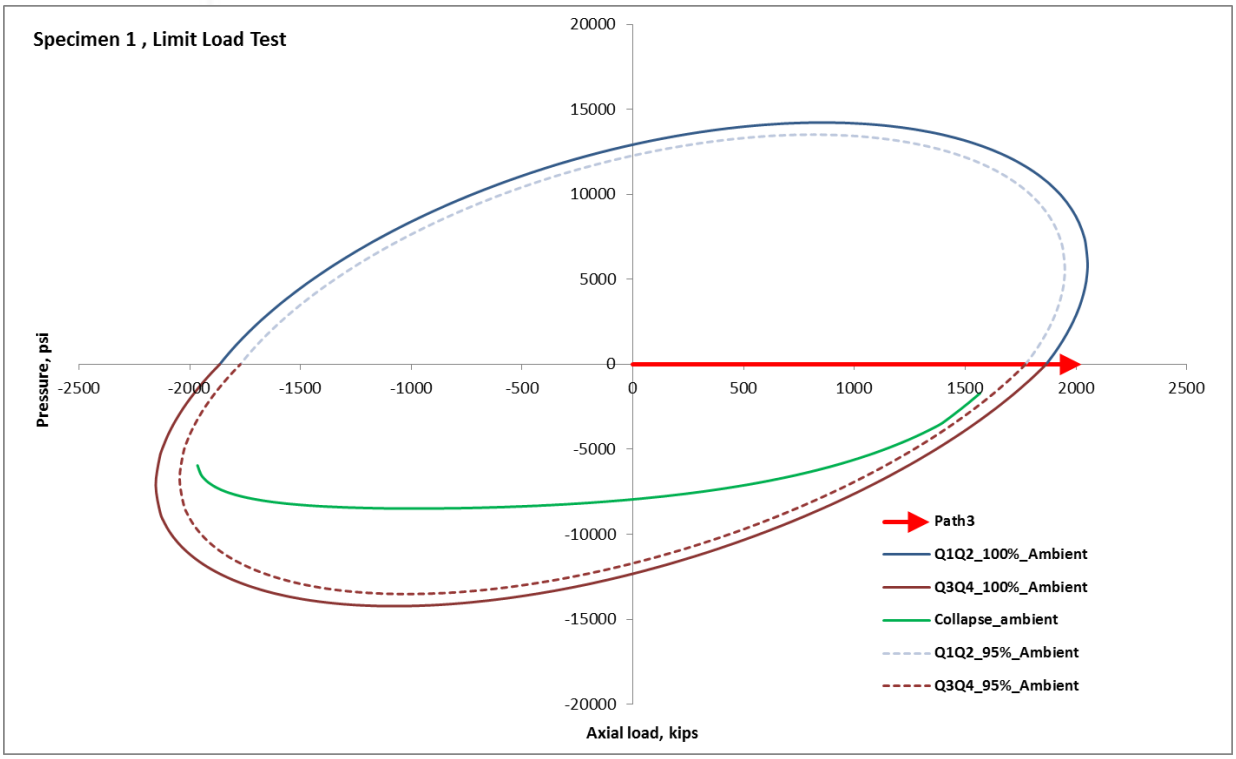

Figure A.34: Test Envelope for TMK UP PF Specimen 1 Limit Load

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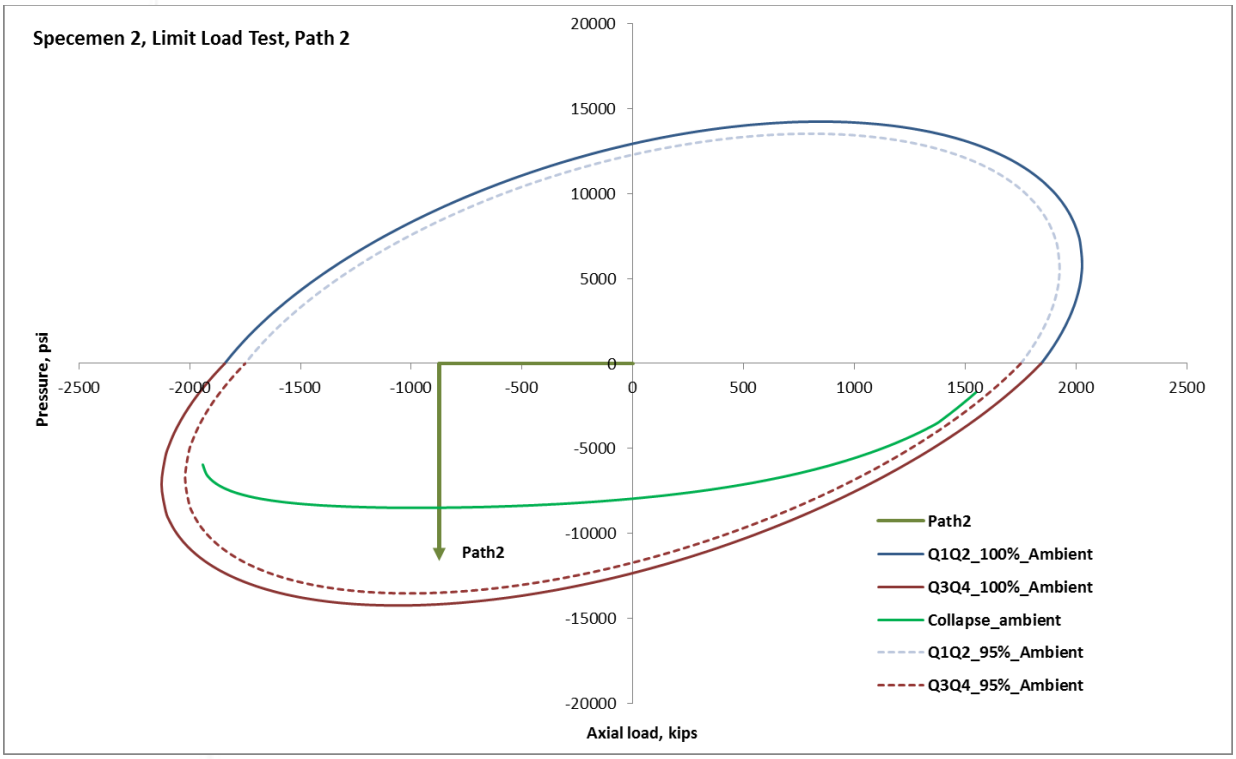

Figure A.35: Test Envelope for TMK UP PF Specimen 2 Limit Load

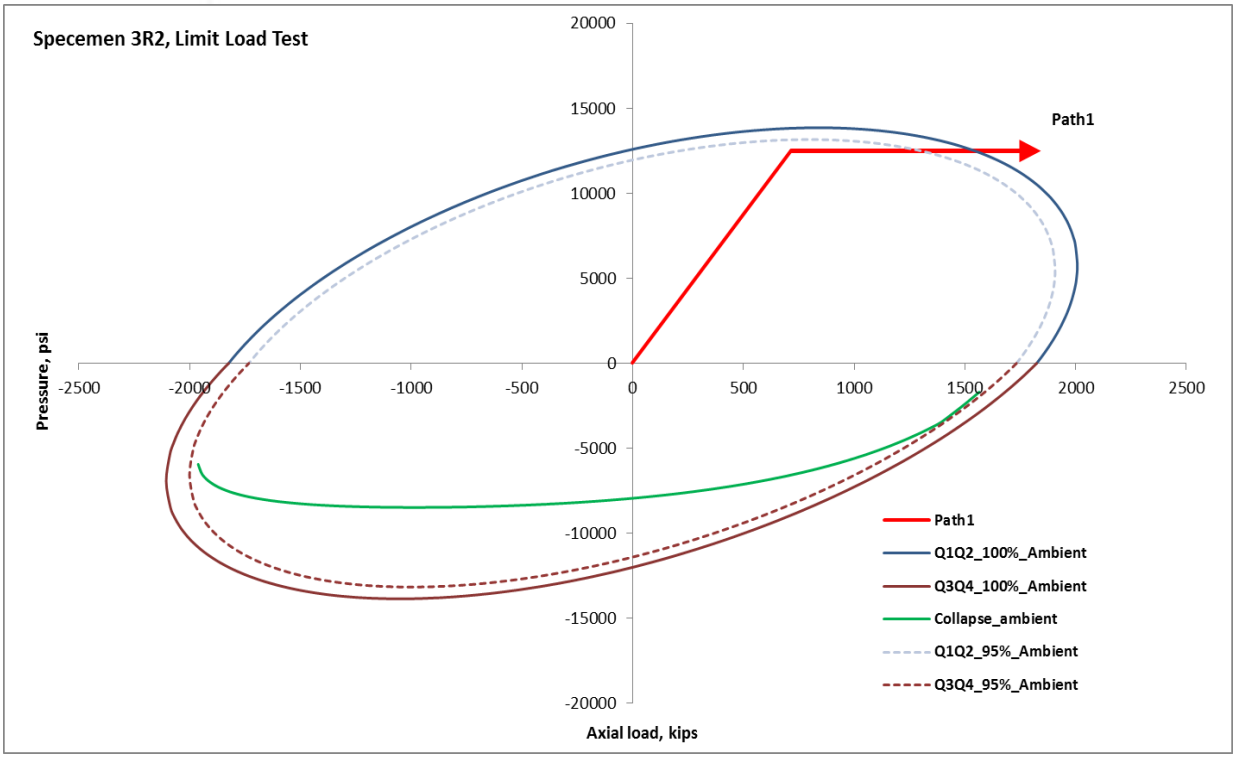

Figure A.36: Test Envelope for TMK UP PF Specimen 3R2 Limit Load

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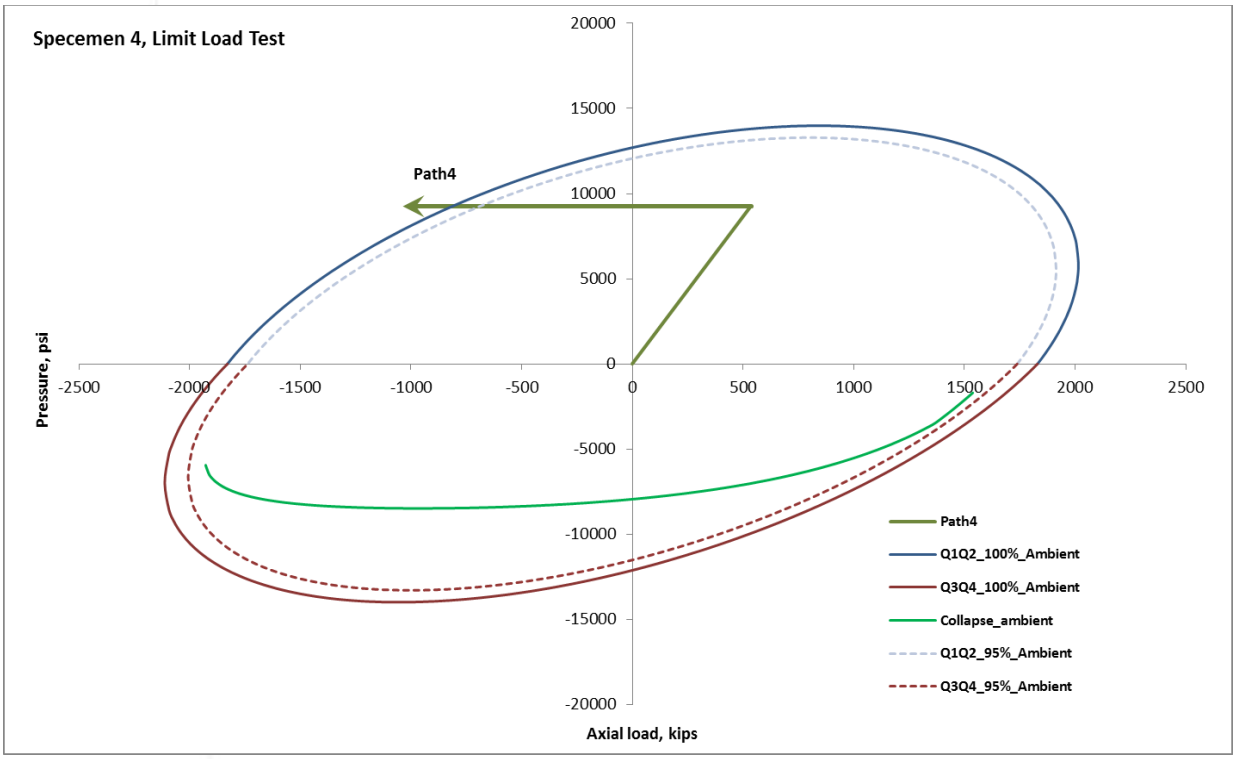

Figure A.37: Test Envelope for TMK UP PF Specimen 4 Limit Load

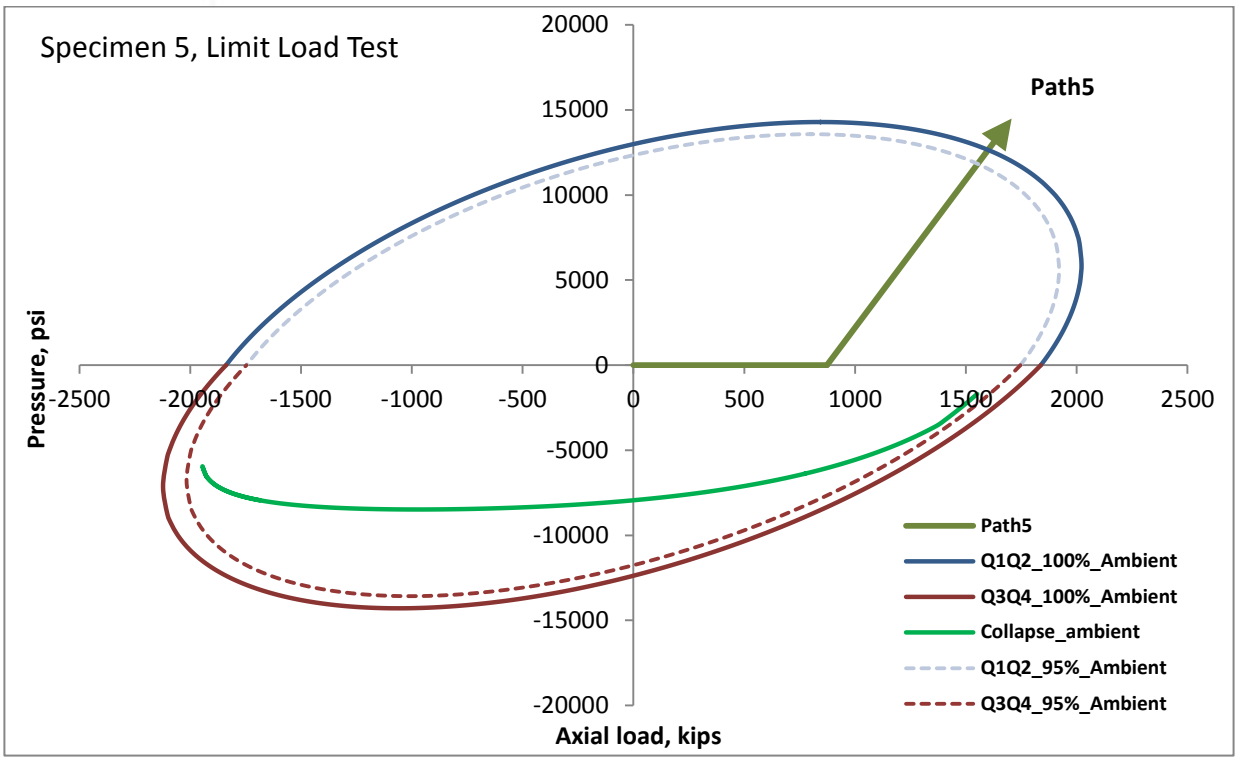

Figure A.38: Test Envelope for TMK UP PF Specimen 5 Limit Load

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7 DEVIATIONS/ANOMALIES:

7.1 Make and Break

1. The FMU torque on Side A of Specimen 5 was 44 ft–lb lower than the target torque (Target Torque = 35,800 ft–lb; Achieved Torque = 35,756 ft–lb).
2. The plug in the coupling on 2A was not tightened causing it to come out during make–up. Plug was tightened. Pin was broken–out and made up again. The FMU torque was 25 ft–lb lower than the minimum torque (Minimum Torque = 29,900 ft–lb; Achieved Torque = 29,875 ft–lb).
3. Specimen 2 was a final make up only sample and as described above, it was broken out and made up twice.

7.2 Sealability Testing

Sample 2 Series A:

1. LS8 (LP14) was initially performed with the wrong pressure. The target pressure was 11,383 psi and the initial pressure was 9,314 psi. The load step was revisited after 2 additional steps were completed successfully (LS10 and LP15) resulting in a change in load path. After this incident, the specimen followed the prescribed load path.
2. LS211 (LP20) was not stabilizing. The technician dropped the pressure from 6,801 psi to 4,720 psi and observed a displacement of 10.8 cc over 60 minutes. Load and pressure were reduced to 0 and specimen was left over–night. Following day, the test was resumed at LS209 (LP21). Subsequently, LS211 (LP20) was completed successfully.

Sample 3R2 Series A:

1. LS111 (LP13) pressure was specified as 9,686 psi. The 15 min hold was performed with a pressure starting at 9,669 psi and ending with 9,673 psi.
2. After LS158, the Side B axial strain gage at 0°, “B0A”, malfunctioned. Subsequently, bending was recorded off Side A only.
3. LS175 (LP18) had leak tube displacements that were outside of the acceptable ISO limits. A 60 min. hold satisfying the ISO requirements was performed. The hold is specified as a 2 min. hold with a frame load of –1,112 kips and pressure of 9,846 psi. Below is a summary of events:
    a. During the initial specified 2 min. hold, leak tube displacements were outside of the ISO acceptable limits with 0.3 cc / 2 min.
    b. The hold was extended for a total time of 5 min. The displacement was still outside ISO acceptable limits with 0.7 cc / 5 min.
    c. The hold was extended for a total of 10 min. The displacement was still outside ISO acceptable limits with 1.4 cc / 10 min.
    d. The hold was extended for total of 15 min. with displacements outside of acceptable ISO limits with 1.8 cc / 15 min.
    e. The hold was extended for an additional 60 min. with displacements outside of acceptable ISO limits during the first 15 min. with 1.0 cc / 15 min. Additionally, the pressure dropped below the specified pressure at 45 min. into the hold and

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went to 9,843 psi by the end of the hold. The displacement was 0.4 cc for the last 15 minutes of the hold.

f. The pressure was bumped to 9,865 psi and the technician emptied the leak tube.
g. The hold was extended for 15 additional min. with displacements of 0.4 cc / 15 min.

Sample 4 Series A:

1. LS211 (LP20) was performed as one 60 min. hold without 15 or 5 min. increments. Total displacement for the entire 60 min. increment was acceptable with 0.9 cc.

7.3 Limit Load Testing

1. Specimen 1 test was terminated when the end cap side pin failed; limit load requirements met (102% of VME).
2. Specimen 3R2 test was terminated when the end cap side pin failed; limit load requirements met (105% of VME).

8 ADDITIONAL TESTS:

Make and Breaks on Specimen 5R3 was performed outside the scope of the test proposal.

9 CONCLUSION:

The 9.625 x 53.5 P110 TMK UP PF connection was successfully qualified in accordance with ISO 13679: FDIS 2011 with 100% tension and 60% compression efficiencies. The internal and external pressures correspond to 93.6% and 100% PBYS respectively.

10 APPROVAL SIGNATURES:

Prepared By:	Johnny Roberts — Digitally signed by Johnny Roberts DN: cn=Johnny Roberts, o=R&D, ou, email=jroberts@tmk-ipsco.com, c=US Date: 2016.02.08 16:50:42 -06'00'	02-08-2016
Manager of Connection Testing	Johnny Roberts Jr.	Date
Reviewed By:	Dhiren Panda — Digitally signed by Dhiren Panda DN: cn=Dhiren Panda, o=TMK IPSCO, ou=General Manager Technology, email=dpanda@tmk-ipsco.com, c=US Date: 2016.02.11 09:10:50 -06'00'	02-11-2016
General Manager of R&D	Dr. Dhiren Panda	Date
Test Witnessed By:	Chris Harris — Digitally signed by Chris Harris DN: cn=Chris Harris, o=TIEC, Inc., ou, email=charris@tiec.com, c=US Date: 2016.02.08 13:58:58 -06'00'	02-08-2016
T.I.E.C Representative	Chris Harris	Date
Test Witnessed By:	Richard B Wild — Digitally signed by Richard B Wild DN: cn=Richard B Wild, o=SOCOTEC Oil & Gas, ou=SICA North America, email=richard.wild@sica-socotec.com, c=US Date: 2016.02.08 13:48:47 -06'00'	02-08-2016
S.I.C.A Representative	Richard B. Wild (For: Billy Day)	Date