



T M K U P C E N T U M T E S T

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1 CERTIFICATE OF TEST

REPORT DATE: December 04, 2017

PROJECT NUMBER: RDP-105-17-044

CLIENT: TMK-Premium Services
Morozova Str. 30, Taganrog, RUSSIA 347928

TEST DATES: October 30, 2017 – November 9, 2017

CONNECTION IDENTIFICATION: TMK UP CENTUM

PIPE SIZE / GRADE: 7.000 in. OD-29 lb-P110

TEST PROCEDURE: Test Proposal Edition 6 (TP PS-07-01-2017)

TEST TYPE: API 5C5: 2017 CAL IV

NUMBER OF SPECIMEN: 4 (Specimen 1V1, 3V1, 5V1, 5R1V1)

SURFACE TREATMENTS: Specimen 1V1, 5R1V1:
Zn. Phosphate Pins and Mn. Phosphate Coupling
Specimen 3V1, 5V1:
Bead Blast + Zn. Phosphate Pins and Bead Blast + Mn. Phosphate Coupling

TEMPERATURES USED: 27°C (80°F) for Ambient Temperature Testing
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: Kevin Henry

Technicians: Brian Baker, Andrico Henderson, Steve Waters, Jose Zapata, Kenneth Brown, Mohammed Alshaikly, Donald Anderson, Alex Ruiz, Harold Sanford, Jason Ward, Guy Forester, Chris Coode, David Tchamanzar.

For Tests performed at Stress Engineering Services (SES)

Test Engineers: Ryan Schmidt

Technicians: Josh Snearly, Steve Busa, Ethan Williams

THIRD PARTY MONITORING: Not Applicable

2 CONNECTION SPECIFICATIONS & RATINGS

The 7 x 29# P110 TMK UP CENTUM connection was tested per API 5C5: 2017 CAL IV. Qualification tests were performed to the ratings and specifications listed below.

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Coupling OD:	7.875 in.	
Coupling Length:	10.827 in.	
Make – Up Loss:	4.744 in.	
Drift:	6.059 in.	
Pipe ID:	6.184 in.	
Thread Compound Used:	BestOLife 72733	
Torque (min. /opt. /max.):	16,600 / 18,400 / 20,300 ft–lbs	
	Connection data sheet ratings	Min. Test Rating (% of PBYS)
		SP1V1
API Burst Pressure:	11,210 psi (100% PBYS)	95.0
API Collapse Pressure:	8,530 psi (100% PBYS)	100.0
Tensile Load:	929,000 lbs (100% PBYS)	90.0
Compression Load:	929,000 lbs (100% PBYS)	90.0
Bending (Dogleg):	70.9° / 100 ft	20.0° / 100 ft

3 SPECIMEN PREPARATION & TEST LOCATIONS

Mechanical Property Testing:	TMK–IPSCO R&D Center, 10120 Houston Oaks Dr., Houston, TX 77064
Specimen Machining and Surface Treatments:	Superior Threaded Products (STP), 9405 E. Sam Houston Pkwy N. Houston, TX 77044
Make and Breaks:	TMK–IPSCO R&D Center, 10120 Houston Oaks Dr., Houston, TX 77064
Series B Sealability:	SES Waller Building D, 42403 Old Houston Highway, Waller, TX 77484

4 PHYSICAL TESTING SUMMARY

Specimen 1V1 successfully met all API 5C5: 2017 CAL IV Series B requirements as defined in the test protocol (TP PS–07–01–2017, SIXTH EDITION). Make and break trials were performed on Specimen 1V1, 3V1, 5V1, and 5R1V1 for the purpose of testing galling resistance. A summary of test locations and dates are provided in Table A.1.

Specimen	Make & Break	Bake-Out	Series B
Location	TMK–IPSCO	SES	SES
1V1	10/03/2017	10/12/2017	11/05/2017

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3V1	09/20/2017	N/A	N/A
5V1	09/21/2017	N/A	N/A
5R1V1	10/06/2017	N/A	N/A

Table A.1: Test Summary

The surface finish on the specimen seal and thread areas were in accordance with Table A.2.

Specimen/Side	Coupling	Pin
1V1A	Mn phosphate	Zn phosphate
1V1B	Mn phosphate	Zn phosphate
3V1A	Bead Blast + Mn phosphate	Bead Blast + Zn phosphate
3V1B	Bead Blast + Mn phosphate	Bead Blast + Zn phosphate
5V1A	Bead Blast + Mn phosphate	Bead Blast + Zn phosphate
5V1B	Bead Blast + Mn phosphate	Bead Blast + Zn phosphate
5R1V1A	Mn phosphate	Zn phosphate
5R1V1B	Mn phosphate	Zn phosphate

Table A.2: Surface Finish Conditions on Field End

5 LIST OF AMENDMENTS TO API 5C5:2017

The following amendments were made to API 5C5:2017 per the test protocol (TP PS-07-01-2017, SIXTH EDITION):

1. Volume of tests was reduced (Section 6.1 of the test protocol)
2. The actual minimum wall thickness (but not more than 95% of specified WT) shall be used to determine loads as indicated in Table 15 (Section 6.3 of the test protocol)
3. The actual minimum average wall thickness (but not more than specified WT) shall be used to determine loads as indicated in Table 15 (Section 6.3 of the test protocol)
4. Additional Make and Break Cycle (see section 6.2 of the test protocol)
5. Exercising specimen during bake-out (see section 6.4 of the test protocol)

6 TEST RESULTS:

6.1 Specimen Preparation

Test specimens were machined from Tenaris (Heat# 71292) casing stock and Tenaris (Heat# 943546) coupling stock. The pins were machined according to drawing no: *TMK UP CENTUM 007.001, Revision 1* and couplings were machined according to drawing no: *TMK UP CENTUM 007.002, Revision 1*. All the test specimen satisfied the thread and seal interference ranges outlined in API 5C5:2017.

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6.2 Make and Breaks

Test samples were made up using horizontal tongs with 2.48 RPM max. API modified thread compound (BestOLife 72733) per the quantities listed in Table A.3 were used.

	Dope quantity on pin, grams	Dope quantity on box, grams
Minimum	15±1	30±1
Maximum	18±1	35±1

Table A.3: Quantity of Dope Used During Make and Break Trials

Recommended torque values ranged between 16,600 and 20,300 ft-lb (22,500 and 27,500 N.m). A detailed description of the recommended make-up torque ranges are indicated in Table A.4. The minimum, optimum and maximum make-up torques in Table A.4 match the corresponding values listed in the connection data sheet. The shoulder torques on all specimens were within acceptable limits. The torque shoulder of specimen 1V1A was grooved prior to FMU. Details of all Make and Breaks are shown in Table A.5 – Table A.12 below.

	N.m		ft-lb	
Minimum recommended torque	22,500		16,600	
Optimum recommended torque	25,000		18,500	
Maximum recommended torque	27,500		20,300	
	Minimum	Maximum	Minimum	Maximum
High Make-Up Torque range	26,500	27,500	19,600	20,300
Low Make-Up Torque range	22,500	23,500	16,600	17,400

Table A.4: Make-Up Torque Ranges for All Specimens

Specimen 1V1 Make & Break Side A							
BOX: 1002A/ PIN:101							
Make Up	MU Torque ft-lbs	BO Torque ft-lbs	Gauling (Y/N)	Dope Pin grams	Dope Box grams	Delta Turns	Shoulder Torque
FMU	17,359	-	-	18.7	35.3	0.026	9,916

Table A.5: Specimen 1V1 Make & Break Side A

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Specimen 1V1 Make & Break Side B							
BOX: 1002B/ PIN:103							
Make Up	MU Torque ft-lbs	BO Torque ft-lbs	Gauling (Y/N)	Dope Pin grams	Dope Box grams	Delta Turns	Shoulder Torque
1	20,227	20914	N	14.9	30.1	0.023	10,802
2	20,461	21286	N	15.0	29.2	0.027	9,733
3	20,380	20807	N	15.9	29.6	0.025	9,974
FMU	17,232	-	-	18.9	34.6	0.023	9,632

Table A.6: Specimen 1V1 Make & Break Side B

Specimen 3V1 Make & Break Side A							
BOX: 2001A/ PIN:106							
Make Up	MU Torque ft-lbs	BO Torque ft-lbs	Gauling (Y/N)	Dope Pin grams	Dope Box grams	Delta Turns	Shoulder Torque
1	20,401	21710	N	15.8	30.4	0.028	11,197
2	20,390	25425	N	14.9	30.5	0.032	12,699
3	20,392	24463	N	16.0	30.1	0.024	12,710
4	20,395	23810	N	15.8	29.9	0.023	12,337
5	20,372	22930	N	14.7	29.6	0.036	12,703
6	20,385	21797	N	14.9	29.1	0.021	12,272
7	20,367	22729	N	13.6	30.0	0.025	11,942
8	20,397	23444	N	16.0	30.2	0.024	11,799
9	20,360	23415	N	14.9	31.0	0.022	11,907
10	20,409	28682	N	15.5	29.0	0.025	12,304

Table A.7: Specimen 3V1 Make & Break Side A

Specimen 3V1 Make & Break Side B							
BOX: 2001B/ PIN:107							
Make Up	MU Torque ft-lbs	BO Torque ft-lbs	Gauling (Y/N)	Dope Pin grams	Dope Box grams	Delta Turns	Shoulder Torque
1	20,336	28200	N	15.2	30.5	0.031	10,835
2	20,356	23212	N	14.0	30.0	0.020	13,296
3	20,124	22773	N	15.6	30.5	0.027	11,225
4	20,312	22808	N	15.8	30.5	0.026	11,735
5	20,374	22197	N	15.5	29.5	0.023	11,874
6	20,383	26475	N	14.3	29.1	0.023	12,189
7	20,282	23024	N	15.5	30.8	0.023	11,811
8	20,092	22394	N	15.0	29.7	0.025	12,071
9	20,272	22883	N	14.1	30.5	0.026	11,592
10	20,401	23069	N	15.5	29.1	0.026	11,835

Table A.8: Specimen 3V1 Make & Break Side B

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Specimen 5V1 Make & Break Side A							
BOX: 2002A/ PIN:108							
Make Up	MU Torque ft-lbs	BO Torque ft-lbs	Gauling (Y/N)	Dope Pin grams	Dope Box grams	Delta Turns	Shoulder Torque
1	20,288	23601	N	14.4	30.2	0.025	12,928
2	20,289	24128	N	15.4	30.7	0.021	14,527
3	20,337	23696	N	15.0	30.0	0.023	14,600
4	20,382	25126	N	15.4	29.3	0.027	14,547
5	20,181	25428	N	14.4	30.2	0.015	16,483
6	20,265	25727	N	15.7	29.2	0.020	15,892
7	20,320	23723	N	15.3	29.3	0.019	16,129
8	20,330	23846	N	14.4	29.6	0.011	17,016
9	20,245	25596	N	15.9	30.1	0.013	16,468
10	20,283	33353	N	14.6	29.2	0.015	16,046

Table A.9: Specimen 5V1 Make & Break Side A

Specimen 5V1 Make & Break Side B							
BOX: 2002B/ PIN:109							
Make Up	MU Torque ft-lbs	BO Torque ft-lbs	Gauling (Y/N)	Dope Pin grams	Dope Box grams	Delta Turns	Shoulder Torque
1	20,316	30166	N	15.7	29.6	0.024	13,249
2	20,334	24036	N	14.2	29.1	0.014	16,034
3	20,204	23462	N	16.0	30.2	0.011	16,338
4	20,464	24226	N	15.8	29.9	0.035	13,898
5	20,321	23555	N	14.9	29.9	0.023	14,416
6	20,380	24165	N	15.4	29.7	0.017	14,885
7	19,912	22762	N	16.0	29.5	0.018	14,227
8	20,310	25801	N	16.0	29.4	0.022	15,168
9	20,251	24143	N	14.4	30.4	0.017	14,975
10	20,358	24558	N	15.9	30.2	0.023	14,028

Table A.10: Specimen 5V1 Make & Break Side B

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Specimen 5R1V1 Make & Break Side A							
BOX: 2003A/ PIN:201							
Make Up	MU Torque ft-lbs	BO Torque ft-lbs	Gauling (Y/N)	Dope Pin grams	Dope Box grams	Delta Turns	Shoulder Torque
1	20,310	22273	N	15.8	29.3	0.023	13,401
2	20,204	22426	N	15.6	29.7	0.021	14,146
3	20,179	22963	N	15.1	29.8	0.020	14,083
4	20,169	22917	N	15.9	29.8	0.031	12,703
5	20,370	22319	N	14.7	29.6	0.023	12,520
6	20,447	21628	N	15.8	29.5	0.056	11,388
7	20,342	24651	N	15.9	29.5	0.022	12,699
8	20,442	21439	N	15.9	29.3	0.036	11,990
9	20,325	21277	N	14.7	29.0	0.026	12,092
10	20,168	29295	N	14.5	29.8	0.034	12,972

Table A.11: Specimen 5R1V1 Make & Break Side A

Specimen 5R1V1 Make & Break Side B							
BOX: 2003B/ PIN:202							
Make Up	MU Torque ft-lbs	BO Torque ft-lbs	Gauling (Y/N)	Dope Pin grams	Dope Box grams	Delta Turns	Shoulder Torque
1	20,329	37951	N	15.6	29.6	0.023	13,523
2	20,257	22401	N	15.0	29.4	0.029	12,483
3	20,163	22436	N	15.1	29.6	0.021	13,115
4	20,249	23209	N	15.9	29.3	0.024	12,225
5	20,324	22504	N	15.1	30.3	0.023	12,167
6	20,084	21901	N	15.4	30.5	0.023	12,208
7	20,400	22362	N	14.4	30.1	0.023	12,923
8	20,408	21734	N	16.0	29.0	0.023	12,528
9	20,435	24320	N	14.6	29.6	0.018	12,947
10	20,278	22056	N	14.2	29.7	0.022	14,149

Table A.12: Specimen 5R1V1 Make & Break Side B

6.3 Specimen Bake Out

Samples were baked out at 356°F for 24 hours with 5 tension/compression cycles to ±300 kips with a 1 hour hold at each load.

6.4 Sealability Tests

The medium used for internal pressure was Nitrogen gas. The minimum material yield strength from mechanical tests, the gauged wall thickness and nominal pipe OD was used to calculate test loads. The variables used to calculate individual loads are listed in Table A.10.

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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.13: Variables Used to Determine Loads

The variables in Table A.10 defined for individual specimen are included in Table A.14.

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
1V1	177.80 (mm) / 7.000 (in.)	10.34	0.407	9.84 (mm) / 0.388 (in.)	10.87	0.428	10.36 (mm) / 0.408 (in)	9.84	0.388	10.36	0.408
Specimen	Material Yield Strength (MYS)*										
	Ambient Temperature					Elevated Temperature					
	Minimum		Specified			Minimum			Collapse		
	MPa	ksi	MPa	ksi	MPa	ksi	MPa	ksi	MPa	ksi	
1V1	889	129	758	110	820	119	696	101			

Table A.14: 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.

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The load ratings specified in Section 2 were used on all tested specimens (1V1). The applied loads (tension/compression) and internal pressure for each specimen assembly are provided in Figure A.1–Figure A.4. All test loads followed the test procedure as specified, except as described in Section 7. All specimens met the displacement requirements per API 5C5: 2017.

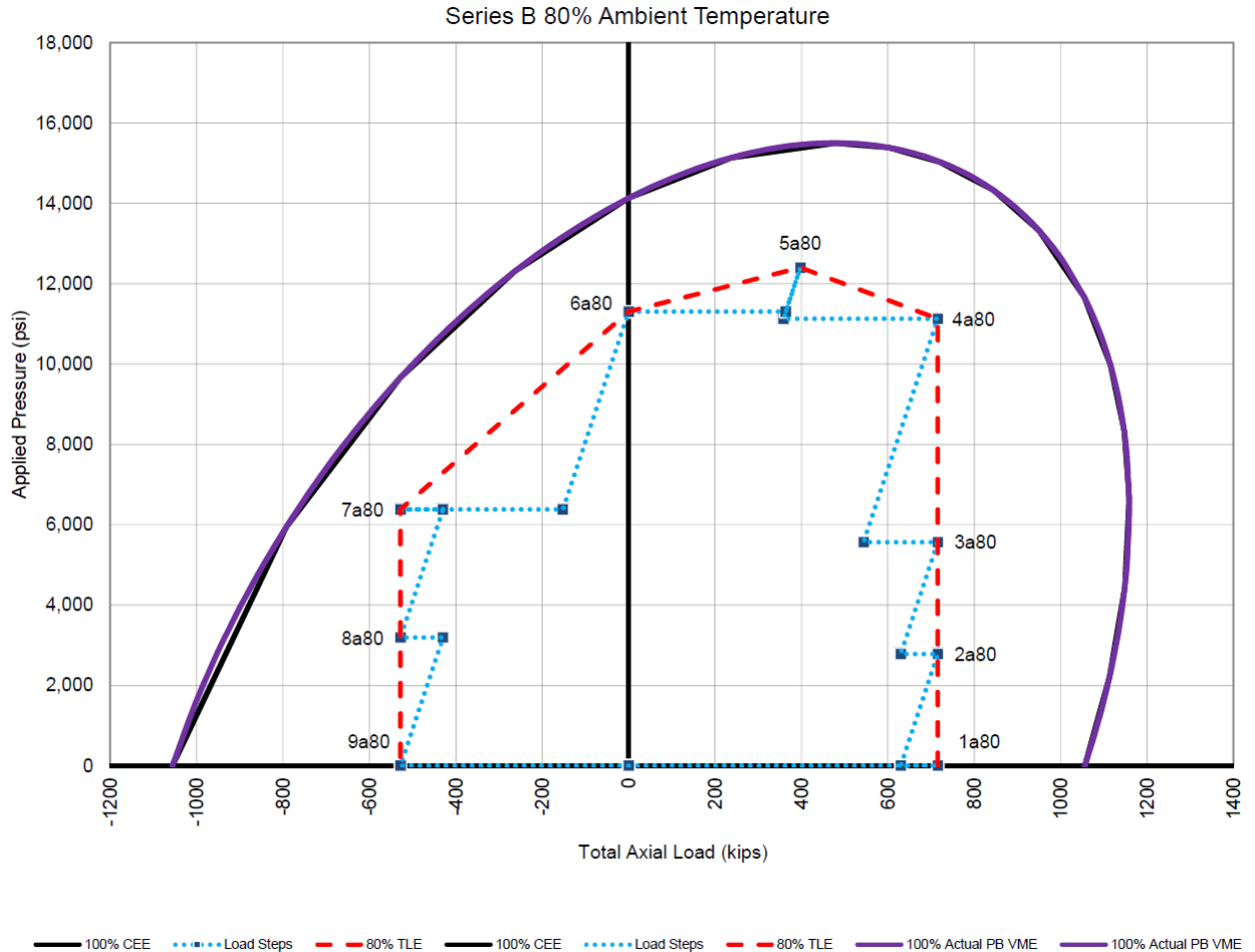


Figure A.1: Test Envelope for 7” 29# P110 TMK UP CENTUM Specimen 1V1 Series B (80% Ambient)

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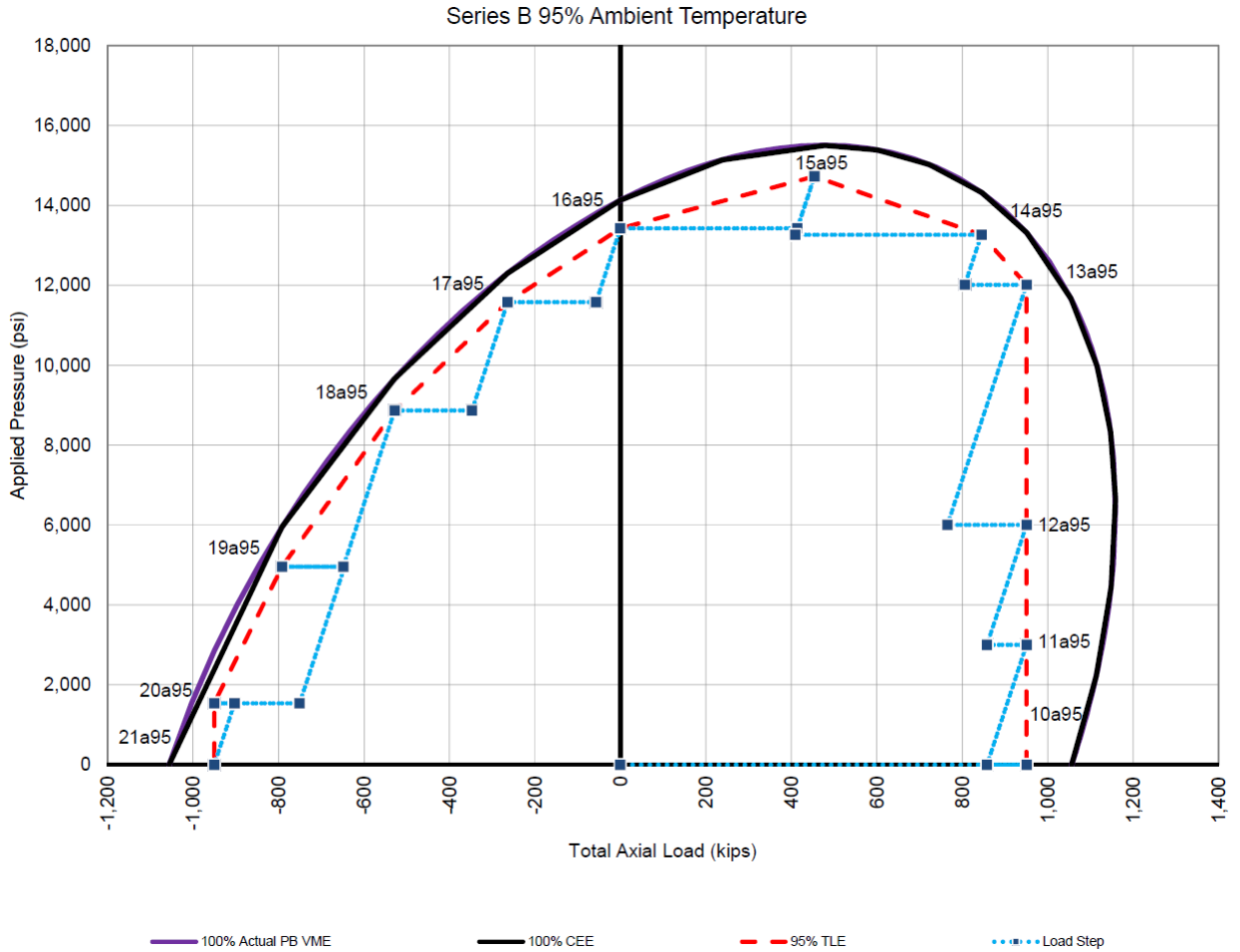


Figure A.2: Test Envelope for 7" 29# P110 TMK UP CENTUM Specimen 1V1 Series B (95% Ambient)

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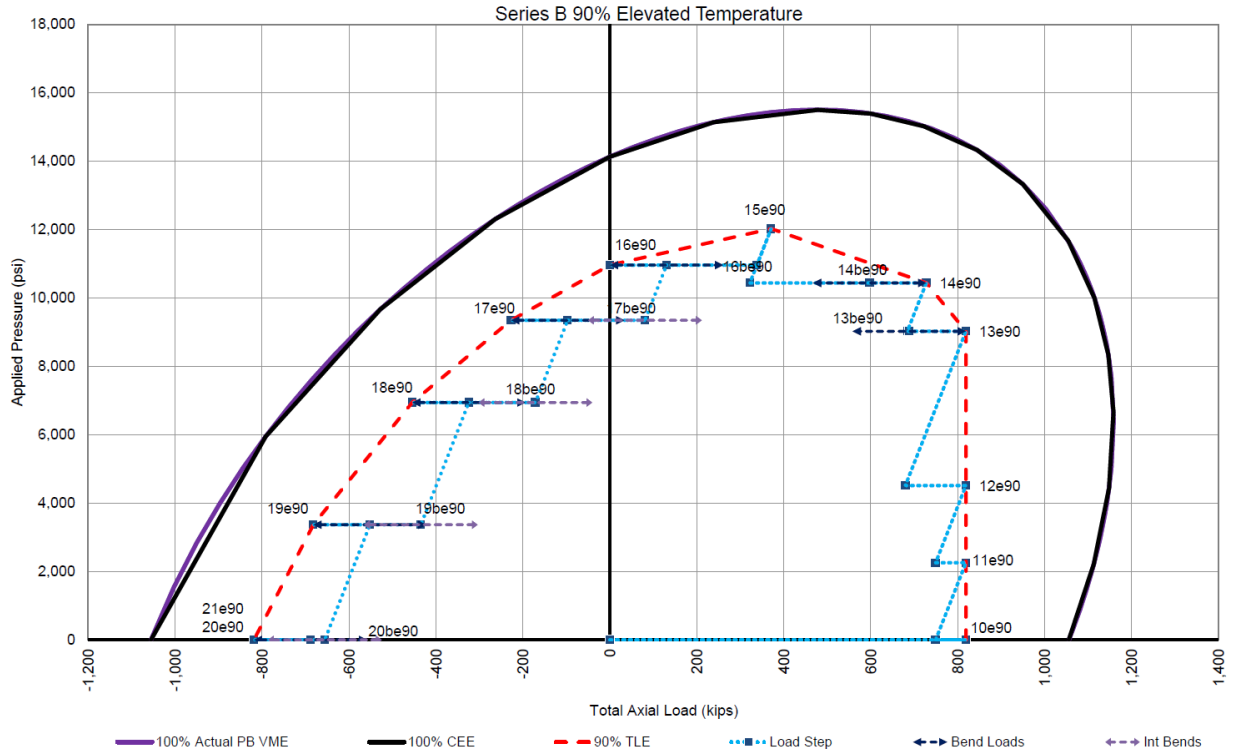


Figure A.3: Test Envelope for 7" 29# P110 TMK UP CENTUM Specimen 1V1 Series B (90% Elevated with Bending)

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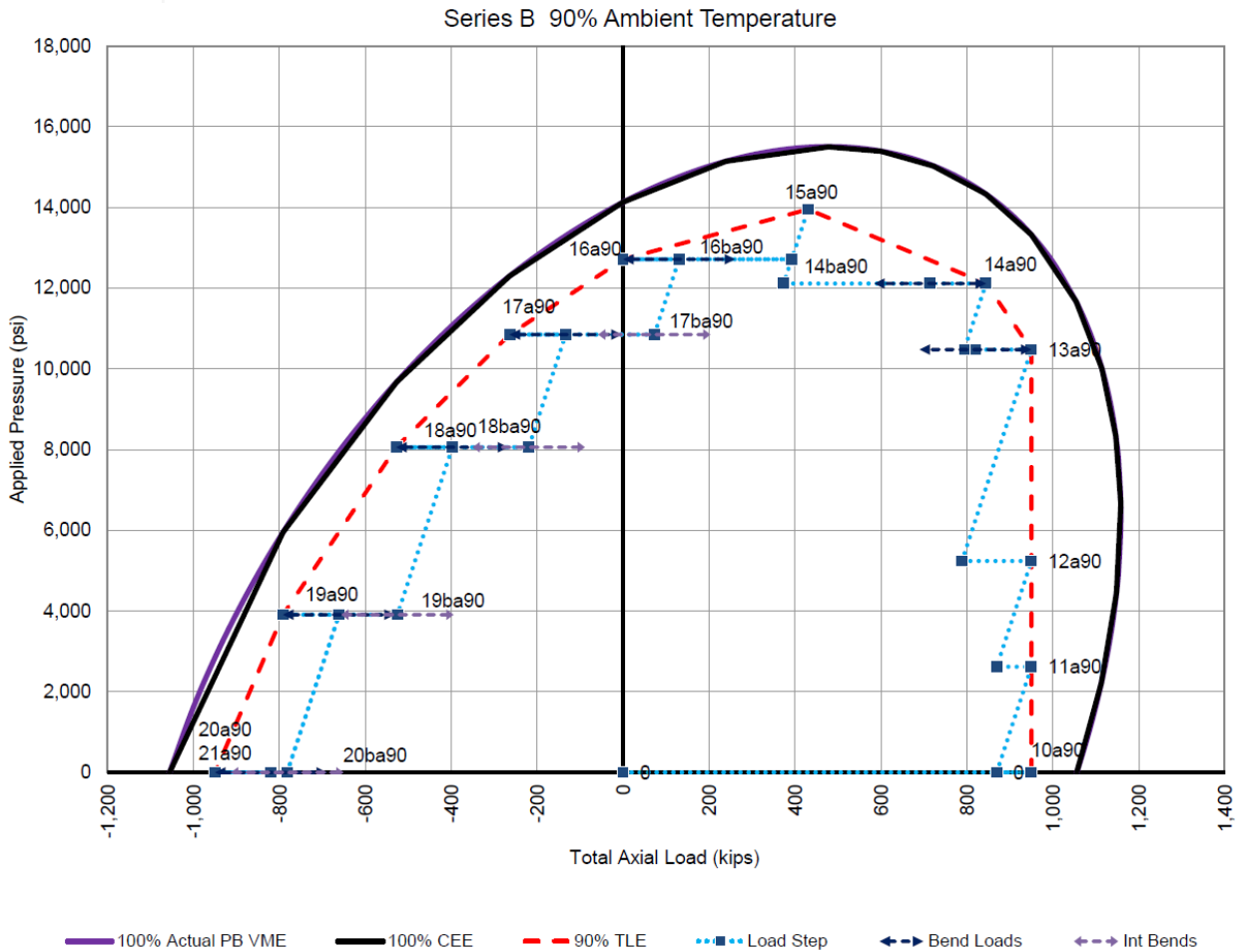


Figure A.4: Test Envelope for 7” 29# P110 TMK UP Centum Specimen 1V1 Series B (90% Ambient with Bending)

7 DEVIATIONS/ANOMALIES:

7.1 Machining and Surface Finish

Specimen 3V1, 5V1, and 5R1V1 Surface Finish:

1. Specimens 3V1 and 5V1 were bead blasted prior to Phosphate coating.
2. GW coating was omitted from specimen 5R1V1 to make sure that the successful 10MBG cycles on Specimen 3V1 and 5V1 were not due to the bead blast.

7.2 Sealability Testing

Specimen 1V1 Bake out with Mechanical Cycles:

1. During the 60 minute hold for the fifth (final) compression cycle, the system lost power and shut down. After the system was reset, temperature was allowed to stabilize above the set point. The hold with compression was restarted and completed as planned.

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Specimen 1V1 Series B:

1. At Load Step (LS) 260, tension load was released before the 2 minute hold was completed. Tension was reapplied and the hold was repeated and completed as planned.

8 ADDITIONAL TESTS:

No additional tests were performed

9 CONCLUSION:

The 7.000 x 29 P110 TMK UP CENTUM connection was successfully qualified in accordance with API 5C5:2017 CAL IV Series B per the test Proposal with 100% tension and 100% compression efficiencies. The internal pressure correspond to 100% PBYS.

10 APPROVAL SIGNATURES:

Prepared By:
Connection Testing Engineer _____ _____
Kevin Henry Date

Approved By:
Engineer in Charge _____ _____
Pavel Sidorenko Date

Reviewed By:
General Manager of R&D _____ _____
Dr. Dhiren Panda Date

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