Instrumentation

Engineering Performance Report

EPR 4230/4233.1 Rev. 2

CPI™ & A-LOK® Tube Fittings ASTM F 1387 Test Summary

Standard Specification for Performance of Mechanically Attached Fittings

Purpose

To show Parker CPI™ and A-LOK® comply with ASTM[1] F 1387 – 99(2005)[a], *Standard Specification for Performance of Mechanically Attached Fittings.*

Test Conditions

All tests were performed at Parker Hannifin test facilities in Alabama and Ohio and/or Wyle Labs in Huntsville Alabama.

Test Method

All fittings were assembled in accordance with Parker's published instruction.

All tests were performed in accordance with *ASTM F 1387 Annex A1* including the *Supplementary Requirements* as applicable.

The sequence of testing was performed in accordance with the flow chart presented in Appendix A. The flow chart was derived from the ASTM F1387 test specification.

Test Results

See attached individual test reports. CPI™ and A-LOK® Data Collection Sheets are maintained on file at Parker Hannifin Corp., Instrumentation Products Division.

Conclusion

Parker CPI™ and A-LOK® Tube Fittings meet the requirements of ASTM F 1387 – 99(2005)

Referenced and Related Documents

SAE[2] MA2003-01, Rotary Flexure Testing of Hydraulic Tubing Joints and Fittings.

This Report contains 16 pages and should only be distributed in its entirety.

[a] The original test was performed to the 1993 edition. The test procedure and results have been reconciled and validated for compliance with the 1999 (2005) edition.

Parker Instrumentation

Parker Hannifin Corporation
Instrumentation Products Division
Huntsville, AL

Title

Qualification Test of Parker CPI™ & A-LOK® Tube Fittings in accordance with ASTM F1387- 99(2005)

Product Tested

Table 1 Fitting Type, size and material

Parker Fitting	Size	Material
CPI™ Tube Fittings	1/4”	Stainless Steel
CPI™ Tube Fittings	1/2”	Stainless Steel
CPI™ Tube Fittings	3/4”	Stainless Steel
CPI™ Tube Fittings	1”	Stainless Steel
A-LOK® Tube Fittings	1/4”	Stainless Steel
A-LOK® Tube Fittings	1/2”	Stainless Steel
A-LOK® Tube Fittings	3/4”	Stainless Steel
A-LOK® Tube Fittings	1”	Stainless Steel

Table 2 Description of Tests and Number of Test Specimens per Test for each Fitting Type

Description of Test	Number of Specimens Tested	ASTM F 1387 Section
Examination of Specimens	60	A2
Pneumatic Proof Test	60	A3
Hydrostatic Proof Test	60	A4
Impulse Test	6	A5
Flexure Fatigue Test	6	A6
Tensile Test	6	A7
Hydrostatic Burst Test	8	A8
Repeated Assembly Test	6	A9
Rotary Flexure Test	6	A10
Thermal Cycling Test	29	S2
Elevated Temperature Soak Test	23	S3
Vibration Test	6	S8

Title
Examination of Specimen

Product Tested
¼, ½, ¾ and 1" Parker CPI™ & A-LOK® Stainless Steel Tube Fittings

Purpose
To show compliance with *ASTM F 1387 Annex A2. Examination of Specimen.*

Test Conditions
All tests were performed at Parker Hannifin Test facilities in Huntsville and Boaz Alabama

Test Method
All fittings were selected from stock inventory. All parts were produced in accordance with Instrumentation Products Division's Quality System. Parker's Quality System meets the requirements of ISO 9000, 10CFR50 Appendix B and ASME NCA 3800.

Fittings were produced from material in compliance with ASTM F1387, Table 1, Grade B or Section 6.1.

All tests were performed in accordance with *ASTM F 1387 Annex A2.*

Conclusion
Parker CPI™ and A-LOK® Tube Fittings meet the examination requirements of *ASTM F 1387 - 99(2005) Annex A2. Examination of Specimen.*

Parker Hannifin Corporation
Instrumentation Products Division
Huntsville, AL

Title
Pneumatic Proof Test

Product Tested
¼, ½, ¾ and 1" Parker CPI™ & A-LOK® Stainless Steel Tube Fittings

Purpose
To show compliance with *ASTM F 1387 Annex A3. Pneumatic Proof Test.*

Test Conditions
All tests were performed at Parker Hannifin Test facilities in Huntsville, Alabama

Test Method
All fittings were assembled in accordance with Parker's published instruction.

All tests were performed in accordance with *ASTM F 1387 Annex A3.*

Test Results

Table 3 Pneumatic Proof Test Results

Size	Type	Number of Test Specimens	Tubing	Pressure Rating, Air (psig)	100 psig	500 psig
1/4"	CPI™	60	1/4" x .049	7,500	Pass	Pass
1/4"	A-LOK®	60	1/4" x .049	7,500	Pass	Pass
1/2"	CPI™	60	1/2" x .065	5,100	Pass	Pass
1/2"	A-LOK®	61	1/2" x .065	5,100	Pass	Pass
3/4"	CPI™	60	3/4" x .095	4,900	Pass	Pass
3/4"	A-LOK®	62	3/4" x .095	4,900	Pass	Pass
1"	CPI™	60	1" x .095	3,600	Pass	Pass
1"	A-LOK®	60	1" x .095	3,600	Pass	Pass

Conclusion
Parker CPI™ and A-LOK® Tube Fittings meet the requirements of *ASTM F 1387 - 99(2005) Annex A3. Pneumatic Proof Test.*

Parker Instrumentation

Parker Hannifin Corporation
Instrumentation Products Division
Huntsville, AL

Title
Hydrostatic Proof Test

Product Tested
¼, ½, ¾ and 1" Parker CPI™ & A-LOK® Stainless Steel Tube Fittings

Purpose
To show compliance with *ASTM F 1387 Annex A4. Hydrostatic Proof Test.*

Test Conditions
All tests were performed at Parker Hannifin Test facilities in Huntsville, Alabama

Test Method
All fittings were assembled in accordance with Parker's published instruction.

All test were performed in accordance with *ASTM F 1387 Annex A4.*

Test Results

Table 4 Hydrostatic Proof Test Results

Size	Type	Number of Test Specimens	Tubing	Pressure Rating, Water (psig)	100 psig	150% of the Rated Pressure
1/4"	CPI™	60	1/4" x .049	7,500	Pass	Pass
1/4"	A-LOK®	60	1/4" x .049	7,500	Pass	Pass
1/2"	CPI™	60	1/2" x .065	5,100	Pass	Pass
1/2"	A-LOK®	61	1/2" x .065	5,100	Pass	Pass
3/4"	CPI™	60	3/4" x .095	4,900	Pass	Pass
3/4"	A-LOK®	62	3/4" x .095	4,900	Pass	Pass
1"	CPI™	60	1" x .095	3,600	Pass	Pass
1"	A-LOK®	60	1" x .095	3,600	Pass	Pass

Conclusion
Parker CPI™ and A-LOK® Tube Fittings meet the requirements of *ASTM F 1387 - 99(2005) Annex A4. Hydrostatic Proof Test.*

Parker Hannifin Corporation
Instrumentation Products Division
Huntsville, AL

Title
Hydraulic Impulse & Repeated Assembly Test

Product Tested
¼, ½, ¾ and 1" Parker CPI™ & A-LOK® Stainless Steel Tube Fittings

Purpose
To show compliance with *ASTM F 1387 Annex A5. Hydraulic Impulse Test* and *Annex A9.Repeated Assembly Test*.

Test Conditions
All tests were performed at Parker Hannifin Test facilities in Huntsville, Alabama and Columbus, Ohio.

Test Method
All fittings were assembled in accordance with Parker's published instruction.

All tests were performed in accordance with *ASTM F 1387 Annex A5 and Annex A9.*

In accordance with Annex A5 and A9, impulse specimens were subject to repeated assemblies at 25%, 50%, 75% and 100% of the 1 million impulse cycles. After completion of the impulse test the test specimens were subject to a proof test per Annex A4.

Test Results

Table 5 Hydraulic Impulse Test & Repeated Assembly Test Results

Size	Type	Number of Test Specimens	Tubing	Pressure Rating, SAE 10W (PSIG)	Impulse Cycle (60 cycles/min)			Remake Test
					>20% Rated Pressure	>133% Rated Pressure	1 Million Cycles Minimum	
1/4"	CPI™	6	1/4" x .049	7,500	1,500	9,975	Pass	Pass
1/4"	A-LOK®	6	1/4" x .049	7,500	1,500	9,975	Pass	Pass
1/2"	CPI™	6	1/2" x .065	5,100	1,120	6,783	Pass	Pass
1/2"	A-LOK®	6	1/2" x .065	5,100	1,120	6,783	Pass	Pass
3/4"	CPI™	6	3/4" x .095	4,900	980	6,517	Pass	Pass
3/4"	A-LOK®	6	3/4" x .095	4,900	980	6,517	Pass	Pass
1"	CPI™	6	1" x .095	3,600	720	4,788	Pass	Pass
1"	A-LOK®	6	1" x .095	3,600	720	4,788	Pass	Pass

Conclusion
Parker CPI™ and A-LOK® Tube Fittings meet the requirements of *ASTM F 1387 - 99(2005) Annex A5. Hydraulic Impulse Test and Annex A9. Repeated Assembly Test*.

Parker Instrumentation

Parker Hannifin Corporation
Instrumentation Products Division
Huntsville, AL

Title
Flexure Fatigue Test & Repeated Assembly Test

Product Tested
¼, ½, ¾ and 1" Parker CPI™ & A-LOK® Stainless Steel Tube Fittings

Purpose
To show compliance with *ASTM F 1387 Annex A6. Flexure Fatigue Test* and *Annex A9.Repeated Assembly Test*

Test Conditions
All tests were performed at Parker Hannifin and Wyle Labs test facilities in Huntsville, Alabama.

Test Method
All fittings were assembled in accordance with Parker's published instruction.

All tests were performed in accordance with *ASTM F 1387 Annex A6.*

Test Results

Table 6 Flexure Fatigue Test Results

SIZE	TYPE	NUMBER OF TEST SPECIMENS	TUBING	Minimum Combined Total Axial Stress (ksi)	Cycles [3]	Proof Test per A4 (PSIG)	Remake Test
1/4"	CPI™	6	1/4" x .049	38.0	30,000	Pass	Pass
1/4"	A-LOK®	6	1/4" x .049	38.0	30,000	Pass	Pass
1/2"	CPI™	6	1/2" x .065	38.0	30,000	Pass	Pass
1/2"	A-LOK®	6	1/2" x .065	38.0	30,000	Pass	Pass
3/4"	CPI™	6	3/4" x .095	38.0	30,000	Pass	Pass
3/4"	A-LOK®	6	3/4" x .095	38.0	30,000	Pass	Pass
1"	CPI™	6	1" x .095	38.0	30,000	Pass	Pass
1"	A-LOK®	6	1" x .095	38.0	30,000	Pass	Pass

50% of the specimens were subjected to the Repeated Assembly Test A9.

Conclusion
Parker CPI™ and A-LOK® Tube Fittings meet the requirements of *ASTM F 1387 - 99(2005) Annex A8. Flexure Fatigue Test* and *Annex A9.Repeated Assembly Test.*

Title
Tensile Test

Product Tested
¼, ½, ¾ and 1” Parker CPI™ & A-LOK® Stainless Steel Tube Fittings

Purpose
To show compliance with *ASTM F 1387 Annex A7. Tensile Test.*

Test Conditions
All tests were performed at Parker Hannifin Test facilities in Huntsville, Alabama.

Test Method
All fittings were assembled in accordance with Parker’s published instruction.

All tests were performed in accordance with *ASTM F 1387 Annex A7.*

Test Results

Table 7 Tensile Test Results

SIZE	TYPE	NUMBER OF TEST SPECIMENS	TUBING	CALCULATED MINIMUM TENSILE LOAD (lbf)	AVERAGE TEST LOAD WITH OUT FAILURE (lbf)	TEST RESULTS
1/4”	CPI™	6	1/4” x .049	928	1,216	Pass
1/4”	A-LOK®	6	1/4” x .049	928	1,340	Pass
1/2”	CPI™	6	1/2” x .065	2,665	2,952	Pass
1/2”	A-LOK®	6	1/2” x .065	2,665	2,913	Pass
3/4”	CPI™	6	3/4” x .095	5,865	6,511	Pass
3/4”	A-LOK®	6	3/4” x .095	5,865	6,331	Pass
1”	CPI™	6	1” x .095	8,103	8,899	Pass
1”	A-LOK®	6	1” x .095	8,103	8,936	Pass

Conclusion
Parker CPI™ and A-LOK® Tube Fittings meet the requirements of *ASTM F 1387 - 99(2005) Annex A7. Tensile Test.*

Parker Hannifin Corporation
Instrumentation Products Division
Huntsville, AL

Title
Hydraulic Burst Test

Product Tested
¼, ½, ¾ and 1" Parker CPI™ & A-LOK® Stainless Steel Tube Fittings

Purpose
To show compliance with *ASTM F 1387 Annex A8. Hydrostatic Burst Test.*

Test Conditions
All tests were performed at Parker Hannifin Test facilities in Huntsville, Alabama.

Test Method
All fittings were assembled in accordance with Parker's published instruction.

All tests were performed in accordance with *ASTM F 1387 Annex A8.*

Test Results

Table 8 Hydrostatic Burst Test Results

SIZE	TYPE	NUMBER OF TEST SPECIMENS	TUBING	PRESSURE RATING, (PSIG)	4X RATED PRESSURE, WATER (PSIG)	ACTUAL TUBE BURST PRESSURE (PSIG)	
1/4"	CPI™	8	1/4" x .049	7,500	30,000	30,400	Pass
1/4"	A-LOK®	8	1/4" x .049	7,500	30,000	30,450	Pass
1/2"	CPI™	8	1/2" x .065	5,100	20,400	20,800	Pass
1/2"	A-LOK®	8	1/2" x .065	5,100	20,400	20,600	Pass
3/4"	CPI™	8	3/4" x .095	4,900	19,600	19,150	Pass[4]
3/4"	A-LOK®	8	3/4" x .095	4,900	19,600	19,050	Pass[4]
1"	CPI™	8	1" x .095	3,600	14,400	14,550	Pass
1"	A-LOK®	8	1" x .095	3,600	14,400	14,700	Pass

Conclusion
Parker CPI™ and A-LOK® Tube Fittings meet the requirements of *ASTM F 1387 - 99(2005) Annex A8. Hydrostatic Burst Test.*

Parker Hannifin Corporation
Instrumentation Products Division
Huntsville, AL

Title
Rotary Flex Test

Product Tested
¼, ½, ¾ and 1" Parker CPI™ & A-LOK® Stainless Steel Tube Fittings

Purpose
To show compliance with *ASTM F 1387 Annex A10 Rotary Flex Test.*

Test Conditions
All tests were performed at Parker Hannifin Test facilities in Huntsville, Alabama and Columbus, Ohio.

Test Method
All fittings were assembled in accordance with Parker's published instruction.

All tests were performed in accordance with *ASTM F 1387 Annex A10* and *SAE MA2003-01, Rotary Flexure Testing of Hydraulic Tubing Joints and Fittings.*

Test Results

Figure 1 Rotary Flex Test, CPI™

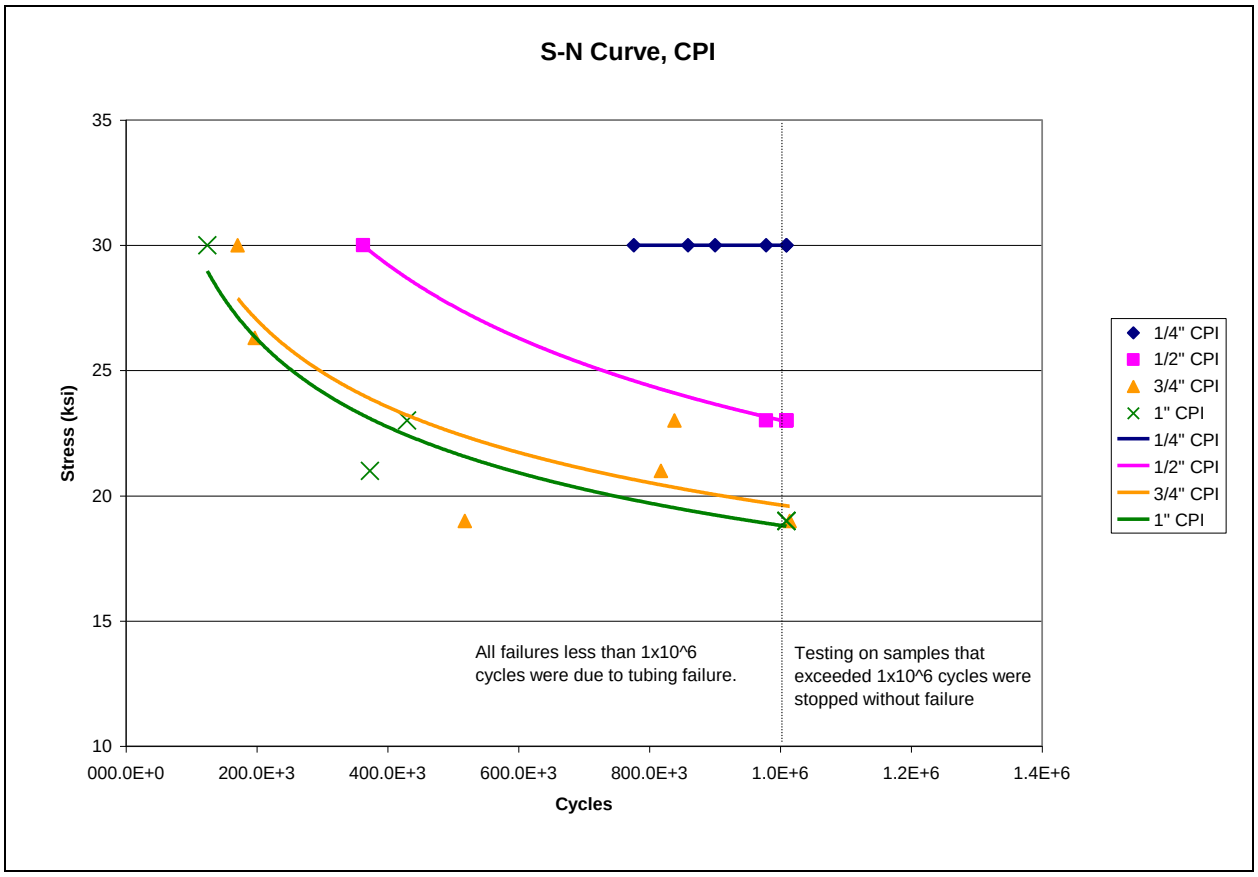

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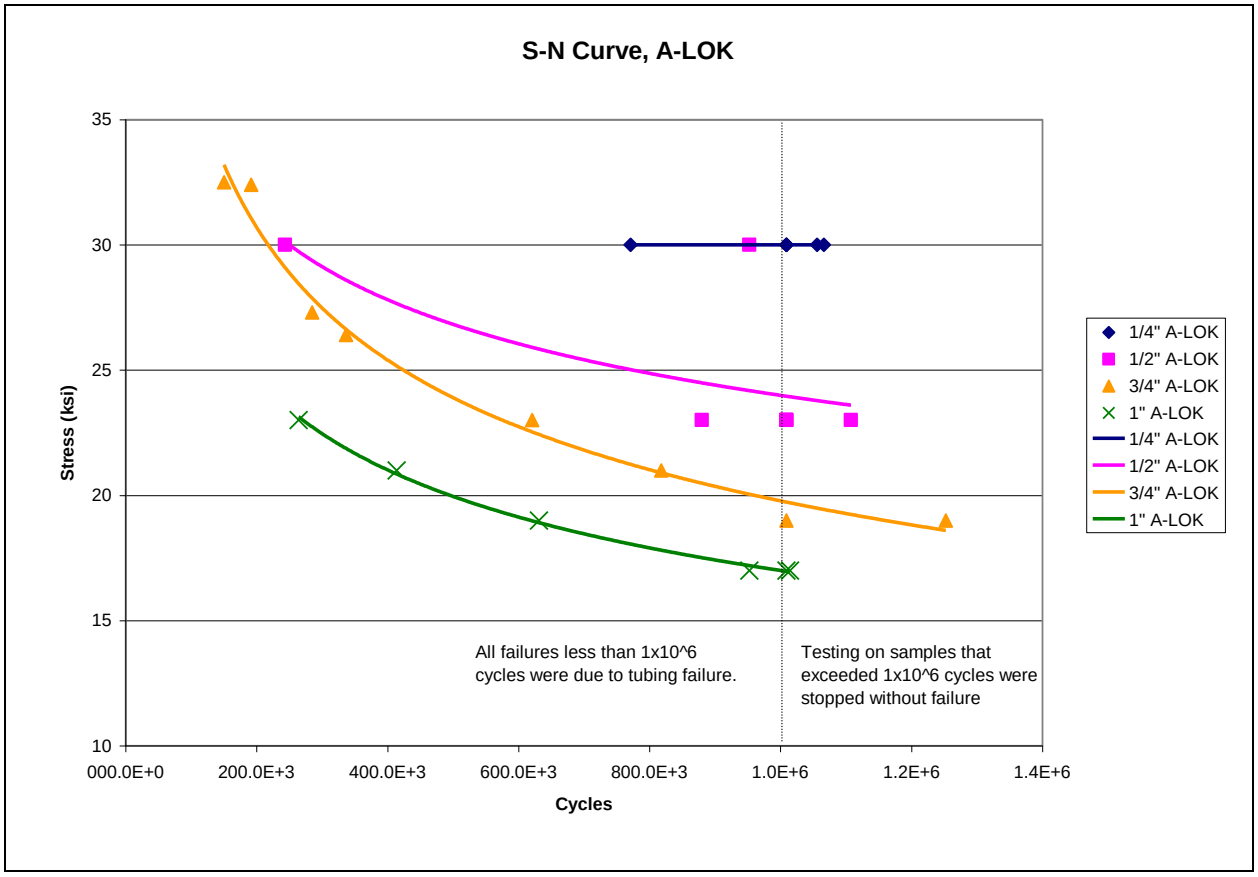
Figure 2 Rotary Flex Test, A-LOK®



Conclusion

Parker CPI™ and A-LOK® Tube Fittings meet the requirements of *ASTM F 1387 - 99(2005) Annex A10. Rotary Flex Test.* Samples that failed to reach 1 million cycles were the result of tubing failure. All fittings were leak free up to 1 million cycles or tubing failure whichever occurred first.

Parker Hannifin Corporation
Instrumentation Products Division
Huntsville, AL

Title
Thermal Cycling Test

Product Tested
¼, ½, ¾ and 1" Parker CPI™ & A-LOK® Stainless Steel Tube Fittings

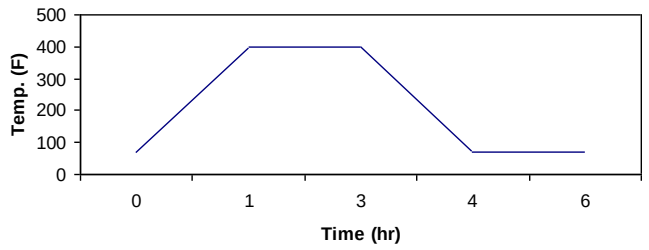
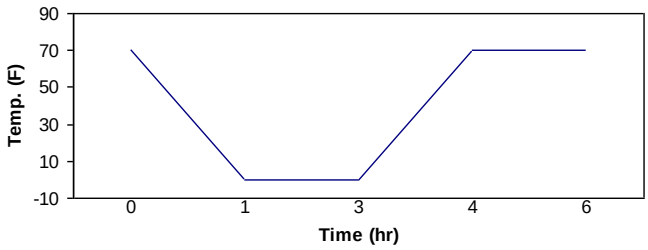
Purpose
To show compliance with *ASTM F 1387 Supplementary Requirement S2. Thermal Cycling Test* and *Annex A4*

Test Conditions
All tests were performed at Parker Hannifin Test facilities in Huntsville & Jacksonville, Alabama.

Test Method
All fittings were assembled in accordance with Parker's published instruction.

All tests were performed in accordance with *ASTM F 1387 Supplementary Requirement S2* and *Annex A4.*

Figure 3 Thermal Cycling Test

	
During the cool down cycle, the test media must go from the high temperature to ambient within 2 minutes. Chilled pressurized water, delivered to the test manifold by a diverter valve was used to accomplish this.	During the heating cycle, the test media must go from the low temperature to ambient within 2 minutes. Warm pressurized water, delivered to the test manifold by a diverter valve was used to accomplish this.

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Huntsville, AL

Test Results

Table 9 High Temperature Thermal Cycling

Size	Type	Number of Test Specimens	Tubing	Test Pressure[5] (PSIG)	High Temperature Cycle			
					Low Temp.	High Temp.[6]	Number of Cycles	Test Results
1/4”	CPI™	29	1/4” x .049	200	70°F	400°F	3	Pass
1/4”	A-LOK®	29	1/4” x .049	200	70°F	400°F	3	Pass
1/2”	CPI™	29	1/2” x .065	200	70°F	400°F	3	Pass
1/2”	A-LOK®	29	1/2” x .065	200	70°F	400°F	3	Pass
3/4”	CPI™	29	3/4” x .095	200	70°F	400°F	3	Pass
3/4”	A-LOK®	29	3/4” x .095	200	70°F	400°F	3	Pass
1”	CPI™	29	1” x .095	200	70°F	400°F	3	Pass
1”	A-LOK®	29	1” x .095	200	70°F	400°F	3	Pass

Table 10 Low Temperature Thermal Cycling

Size	Type	Number of Test Specimens	Tubing	Test Pressure[5] (PSIG)	High Temperature Cycle			
					Low Temp.	High Temp.	Number of Cycles	Test Results
1/4”	CPI™	29	1/4” x .049	200	0°F	70°F	3	Pass
1/4”	A-LOK®	29	1/4” x .049	200	0°F	70°F	3	Pass
1/2”	CPI™	29	1/2” x .065	200	0°F	70°F	3	Pass
1/2”	A-LOK®	29	1/2” x .065	200	0°F	70°F	3	Pass
3/4”	CPI™	29	3/4” x .095	200	0°F	70°F	3	Pass
3/4”	A-LOK®	29	3/4” x .095	200	0°F	70°F	3	Pass
1”	CPI™	29	1” x .095	200	0°F	70°F	3	Pass
1”	A-LOK®	29	1” x .095	200	0°F	70°F	3	Pass

Conclusion

Parker CPI™ and A-LOK® Tube Fittings meet the requirements of *ASTM F 1387 - 99(2005) Supplementary Requirement S2. Thermal Cycling Test.*

Parker Hannifin Corporation
Instrumentation Products Division
Huntsville, AL

Title
Elevated Temperature Soak Test

Product Tested
¼, ½, ¾ and 1" Parker CPI™ & A-LOK® Stainless Steel Tube Fittings

Purpose
To show compliance with *ASTM F 1387 Supplementary Requirement S3. Elevated Temperature Soak Test.*

Test Conditions
All tests were performed at Parker Hannifin Test facilities in Huntsville & Jacksonville, Alabama.

Test Method
All fittings were assembled in accordance with Parker's published instruction.

All tests were performed in accordance with *ASTM F 1387 Supplementary Requirement S3.*

Test Results

Table 11 Elevated Temperature Soak Test

Size	Type	Number of Test Specimens	Tubing	Test Pressure (PSIG)	Temp.[6]	Duration (hr)	Test Results
1/4"	CPI™	23	1/4" x .049	250	400°F	100	Pass
1/4"	A-LOK®	23	1/4" x .049	250	400°F	100	Pass
1/2"	CPI™	23	1/2" x .065	250	400°F	100	Pass
1/2"	A-LOK®	23	1/2" x .065	250	400°F	100	Pass
3/4"	CPI™	23	3/4" x .095	250	400°F	100	Pass
3/4"	A-LOK®	23	3/4" x .095	250	400°F	100	Pass
1"	CPI™	23	1" x .095	250	400°F	100	Pass
1"	A-LOK®	23	1" x .095	250	400°F	100	Pass

Conclusion
Parker CPI™ and A-LOK® Tube Fittings meet the requirements of *ASTM F 1387 - 99(2005) Supplementary Requirement S3. Elevated Temperature Soak Test.*

Title
Vibration Test

Product Tested
¼, ½, ¾ and 1" Parker CPI™ & A-LOK® Stainless Steel Tube Fittings

Purpose
To show compliance with *ASTM F 1387 Supplementary Requirement S8. Vibration Test.*

Test Conditions
All tests were performed at Parker Hannifin and Wyle Labs test facilities in Huntsville, Alabama.

Test Method
All fittings were assembled in accordance with Parker's published instruction.

All tests were performed in accordance with *ASTM F 1387 Supplementary Requirement S8*.

Table 12 Variable Frequency Test Requirements

	Frequency Range (Hz)	Table Amplitude (inch)
Fitting assembly shall be vibrated from 4 Hz to 60 Hz in 1Hz increments at the amplitude shown. At each frequency, the vibration shall be held for 5 minutes.	4 to 15	.031 ± .006
	16 to 25	.020 ± .004
	26 to 33	.010 ± .002
	34 to 40	.005 ± .001
	41 to 50	.003 ± .000
	50 to 60	.002 ± .000

Endurance Test Requirements

After passing the Variable Frequency Test, Vibrate the fitting assembly at the resonant frequency or 60Hz for 2 hours.

Test Results

Table 13 Vibration Test Results

Size	Type	Number of Test Specimens	Tubing	Test Pressure (PSIG)	Test Results		Hydrostatic Proof Test per A4
					Variable Frequency	Endurance Test	
1/4"	CPI™	6	1/4" x .049	7500	Pass	Pass	Pass
1/4"	A-LOK®	6	1/4" x .049	7500	Pass	Pass	Pass
1/2"	CPI™	6	1/2" x .065	5100	Pass	Pass	Pass
1/2"	A-LOK®	6	1/2" x .065	5100	Pass	Pass	Pass
3/4"	CPI™	6	3/4" x .095	4900	Pass	Pass	Pass
3/4"	A-LOK®	6	3/4" x .095	4900	Pass	Pass	Pass
1"	CPI™	6	1" x .095	3600	Pass	Pass	Pass
1"	A-LOK®	6	1" x .095	3600	Pass	Pass	Pass

Conclusion
Parker CPI™ and A-LOK® Tube Fittings meet the requirements of *ASTM F 1387 - 99(2005) Supplementary Requirement S8. Vibration Test.*

Parker Hannifin Corporation
Instrumentation Products Division
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Notes:

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[1] ASTM. 1916 Race Street., Philadelphia, PA 19103
[2] SAE International. 400 Commonwealth Drive, Warrendale, PA 15096-0001
[3] Section A6.3.9 requires 80,000 cycles. The test was originally run to 30,000 cycles by the specification from the customer who commissioned the test.
[4] Sample was determined to have passed the Hydrostatic Burst Test because the fitting assembly held to the burst of the tubing without fitting failure.
[5] System used both nitrogen and water as the test media.
[6] The limit of the test equipment is 400°F. Parker CPI™ & A-LOK® Tube Fittings can be used at higher temperatures. See Catalog 4230/4233 for further details.

Parker Instrumentation

Parker Hannifin Corporation
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