.187 and .250 Series AMPLIVAR* FASTON* Flag Receptacle

1. INTRODUCTION

1.1. Purpose

Testing was performed on the .187 and .250 Series AMPLIVAR* FASTON* Flag Receptacles to determine their conformance to the requirements of Product Specification 108-2086 Revision F.

1.2. Scope

This report covers the electrical, mechanical, and environmental performance of the .187 and .250 Series AMPLIVAR FASTON Flag Receptacles. Testing was performed at the Engineering Assurance Product Test Laboratory between 19Feb02 and 31Mar03. Additional testing was performed between 20Mar04 and 05Oct04; 05Oct04 and 13Jan05; and 17May05 and 16Aug05; and 01Dec11 and 08Mar12. The test file numbers for this testing are CTL 1089-012, CTL 1089-031, CTL 1089-034, CTL 1089-036 and EA20110869T Rev B respectively. This documentation is on file at and available from the Engineering Assurance Product Test Laboratory.

1.3. Conclusion

The .187 and .250 Series AMPLIVAR FASTON Flag Receptacles listed in paragraph 1.5., conformed to the electrical, mechanical, and environmental performance requirements of Product Specification 108-2086 Revision F.

1.4. Product Description

These receptacles will accept magnet wire in sizes between 500 and 4050 CMA. No wire preparation is required. Part numbers 63940-1, 63941-1 and 63942-1 will accept tab dimensions of 4.75 X 0.51 mm [.187 X .020 in] thick. Part number 1217417-1 will accept tab dimensions of 4.75 X 0.81 mm [.187 X .032 in] thick. Part numbers 1742881-1 and 1742882-1 will accept tab dimensions of 6.35 X 0.81 mm (.250 X .032).

1.5. Test Specimens

Test specimens were representative of normal production lots. Specimens identified with the following part numbers were used for test:

Test Group	Quantity	Part Number	Description
1,2,3,4	6 each	63942-1	24 AWG Al magnet wire at .041 inch crimp height
	6 each		24 AWG Cu magnet wire at .041 inch crimp height
	6 each		20 AWG Al magnet wire at .046 inch crimp height
	6 each		20 AWG Cu magnet wire at .046 inch crimp height
	6 each	63941-1	18.5 AWG Al magnet wire at .053 inch crimp height
	6 each		18.5 AWG Cu magnet wire at .053 inch crimp height
	6 each		16.5 AWG Al magnet wire at .059 inch crimp height
	6 each		16.5 AWG Cu magnet wire at .059 inch crimp height
	6 each		20 AWG Cu magnet wire at .049 inch crimp height
	6 each		20 AWG Al Magnet wire at .049 inch crimp height
	6 each	63940-1	17.5 AWG Al magnet wire at .058 inch crimp height
	6 each		17.5 AWG Cu magnet wire at .058 inch crimp height
	6 each		14.5 AWG Al magnet wire at .070 inch crimp height
	6 each		14.5 AWG Cu magnet wire at .070 inch crimp height
1,2,3,4	6 each	1217899-1	14.5 AWG Al magnet wire and 18 AWG lead wire at .078 crimp height
	6 each		15.5 AWG Al magnet wire and 18 AWG lead wire at .074 crimp height
	6 each		18 AWG Cu magnet wire and 18 AWG lead wire at .066 crimp height
1,2,3,4	6 each	1217955-1	22.5 and 18 AWG Al magnet wire at .057 crimp height
	6 each		17.5 and 21 AWG Al magnet wire at .059 crimp height
	6 each		18 and 21 AWG Al magnet wire at .059 crimp height
1,2,4	6 each	1217417-1	17.5 AWG magnet wire at .058 inch crimp height
	6 each		17.5 AWG Cu magnet wire at .058 inch crimp height
	6 each		14.5 AWG Al magnet wire at .070 inch crimp height
	6 each		14.5 AWG Cu magnet wire at .070 inch crimp height
1,2,4	6 each	1742093-1	18 AWG Cu magnet wire and 18 AWG lead wire at .067 crimp height
1,2,4	6 each		17 AWG Cu magnet wire and 18 AWG lead wire at .069 crimp height
3	5 each		18 AWG Cu magnet wire and 18 AWG lead wire at .067 crimp height

| Indicates Change

Test Group	Quantity	Part Number	Description
3	5 each		17 AWG Cu magnet wire and 18 AWG lead wire at .069 crimp height
Test Group	**Quantity**	**Part Number**	**Description**
1,2,3,4	10 each	1742881-1	0.6mm Cu magnet wire at .064 inch crimp height
	10 each		1.1mm Cu magnet wire at .057 inch crimp height
1,2,3,4	10 each	1742882-1	0.6 + 0.6mm Cu magnet wire at .049 inch crimp height
	10 each		0.85 + 1.00mm Cu magnet wire at .059 inch crimp height

Figure 1

1.6. Environmental Conditions

Unless otherwise stated, the following environmental conditions prevailed during testing:

- Temperature: 15 to 35°C
- Relative Humidity: 25 to 75%

1.7. Qualification Test Sequence

Test or Examination	Test Group (a)			
	1	2	3	4
	Test Sequence (b)			
Initial examination of product	1	1	1	1
Low level contact resistance	3,7	2,8		
Temperature rise vs current		4,9		2,4
Current cycling				3
Vibration	5	7[VK1]		
Mechanical shock	6			
Durability	4	3		
Mating force	2			
Unmating force	8			
Termination tensile strength			2	
Humidity-temperature cycling		5[VK2]		
Temperature life		6		
Final examination of product	9	10	3	5

[VK3]

NOTE

(a) See paragraph 1.5.
(b) Numbers indicate sequence in which tests are performed.

Figure 2

2. SUMMARY OF TESTING

2.1. Initial Examination of Product - All Test Groups

All specimens submitted for testing were representative of normal production lots. A Certificate of Conformance was issued by Product Assurance. Specimens were visually examined and no evidence of physical damage detrimental to product performance was observed.

2.2. Low Level Contact Resistance - Test Groups 1 and 2

All low level contact resistance measurements, taken at 100 milliamperes maximum and 20 millivolts maximum open circuit voltage were less than 2.5 milliohms initially and had a change in resistance (ΔR) of less than 2.0 milliohms after testing.

Specimen ID	Number of Data Points	Condition	LLCR			Condition	LLCR		
			Min	Max	Mean		Min	Max	Mean
		Test Group 1				Test Group 2			
100	6	Initial	1.734	1.958	1.868	Initial	1.616	1.839	1.743
	5	After mechanical (ΔR)	0.071	0.235	0.187	After environmental (ΔR)	0.104	0.555	0.322
101	6	Initial	1.300	1.482	1.410	Initial	1.246	1.407	1.333
		After mechanical (ΔR)	-0.016	0.220	0.074	After environmental (ΔR)	0.121	0.345	0.205
102	6	Initial	1.093	1.204	1.151	Initial	1.063	1.131	1.100
		After mechanical (ΔR)	0.089	0.363	0.209	After environmental (ΔR)	0.135	0.403	0.251
103	6	Initial	0.882	0.957	0.925	Initial	0.883	0.914	0.899
		After mechanical (ΔR)	0.063	0.294	0.195	After environmental (ΔR)	0.035	0.355	0.210
104	6	Initial	0.917	1.161	1.009	Initial	0.885	0.966	0.934
		After mechanical (ΔR)	0.107	0.377	0.237	After environmental (ΔR)	0.116	0.844	0.497
105	6	Initial	0.775	0,854	0.810	Initial	0.768	0.889	0.817
		After mechanical (ΔR)	0.099	0.488	0.311	After environmental (ΔR)	0.057	0.423	0.216
106	6	Initial	0.816	1.059	0.869	Initial	0.774	1.008	0.862
		After mechanical (ΔR)	0.076	0.536	0.308	After environmental (ΔR)	0.109	0.414	0.264
107	6	Initial	0.755	0.825	0.788	Initial	0.750	0.885	0.794
		After mechanical (ΔR)	0.273	0.386	0.334	After environmental (ΔR)	0.101	0.683	0.309
108	6	Initial	0.896	0.935	0.917	Initial	0.763	0.832	0.791
		After mechanical (ΔR)	0.126	0.218	0.173	After environmental (ΔR)	0.085	0.166	0.130
109	6	Initial	0.753	0.787	0.763	Initial	0.723	0.770	0.753
		After mechanical (ΔR)	0.115	0.453	0.220	After environmental (ΔR)	0.107	0.284	0.177
110	6	Initial	0.692	0.809	0.740	Initial	0.674	0.734	0.697
		After mechanical (ΔR)	0.096	0.425	0.216	After environmental (ΔR)	0.188	0.995	0.519
111	6	Initial	0.621	0.671	0.642	Initial	0.625	0.682	0.646
		After mechanical (ΔR)	0.016	0.250	0.131	After environmental (ΔR)	0.032	0.156	0.079
112	6	Initial	0.741	0.788	0.757	Initial	0.736	0.766	0.753
		After mechanical (ΔR)	0.059	0.180	0.123	After environmental (ΔR)	0.121	0.268	0.193
113	6	Initial	0.614	0.631	0.623	Initial	0.631	0.657	0.646
		After mechanical (ΔR)	0.060	0.360	0.148	After environmental (ΔR)	0.076	0.302	0.183
114	6	Initial	0.636	0.674	0.654	Initial	0.644	0.658	0.652
		After mechanical (ΔR)	0.137	0.281	0.206	After environmental (ΔR)	0.186	0.307	0.230
115	6	Initial	0.560	0.593	0.578	Initial	0.579	0.597	0.586
		After mechanical (ΔR)	0.103	0.334	0.263	After environmental (ΔR)	0.107	0.240	0.167
TG 1 (Cu)	6	Initial	0.86	0.89	0.88	Initial	0.78	0.84	0.81
		After mechanical (ΔR)	0.18	0.28	0.24	After environmental (ΔR)	0.15	0.54	0.31
TG 2 (Al)	6	Initial	1.10	1.04	1.02	Initial	0.93	0.99	0.96
		After mechanical (ΔR)	0.13	0.37	0.20	After environmental (ΔR)	0.18	0.42	0.26
1 – 0.6mm	5**	Initial	1.53	1.73	1.61	Initial	1.55	1.76	1.67
		After mechanical (ΔR)	-0.04	0.10	0.02	After environmental (ΔR)	-0.08	0.08	0.02
1 – 1.1mm	5**	Initial	1.13	1.25	1.19	Initial	1.10	1.27	1.19
		After mechanical (ΔR)	-0.03	0.10	0.03	After environmental (ΔR)	0.01	0.22	0.07
2 -0.6mm	5**	Initial	1.53	1.77	1.65	Initial	1.67	1.80	1.73
		After mechanical (ΔR)	-0.01	0.07	0.02	After environmental (ΔR)	-0.08	0.09	0.03
0.85+ 1.00mm	5**	Initial	0.99	1.14	1.05	Initial	1.02	1.15	1.10
		After mechanical (ΔR)	-0.04	0.09	0.04	After environmental (ΔR)	0.01	0.38	0.14

NOTE

All values in milliohms.
*** Measurements include 2 crimp and 2 interface measurement*s; approx. 5.75 inches of wire bulk were removed from each measurement.

Figure 3

2.3. Temperature Rise vs Current - Test Groups 2 and 4

All specimens had a temperature rise less than 30℃ above ambient when tested using the baseline rated current specified in Figure 4.

.187 Series

Wire Size		Current (amperes)		Tensile (N [lbf])	
Wire Gage	CMA	Copper	Aluminum	Copper	Aluminum
24	455	2.3	1.5	22.24 [5]	6.67 [1.5]
23.5	511	2.5	1.6	25.58 [5.75]	7.78 [1.75]
23	566	2.6	1.7	28.91 [6.5]	8.90 [2]
22.5	635	2.8	1.8	32.25 [7.25]	10.01 [2.25]
22	708	3	1.9	35.59 [8]	11.12 [2.5]
21.5	795	3.2	2.1	41.15 [9.25]	13.34 [3]
21	888	3.4	2.2	46.71 [10.5]	15.57 [3.5]
20.5	992	3.6	2.3	52.27 [11.75]	16.68 [3.75]
20	1116	4	2.6	57.83 [13]	17.79 [4]
19.5	1246	4.6	3	66.72 [15]	21.13 [4.75]
19	1391	5.3	3.4	73.40 [16.5]	24.47 [5.5]
18.5	1560	6.1	3.9	83.40 [18.75]	27.85 [6.26]
18	1747	7	4.5	93.41 [21]	31.14 [7]
17.5	1962	7.7	5	104.10 [23.4]	34.47 [7.75]
17	2190	8.3	5.4	117.88 [26.5]	37.81 [8.5]
16.5	2460	9	5.8	133.45 [30]	43.37 [9.75]
16	2746	10	6.5	147.90 [33.25]	48.93 [11]
15.5	3136	11.3	7.3	169.03 [38]	56.05 [12.6]
15	3446	12.4	8	186.83 [42]	62.28 [14]
14.5	3869	13.6	8.8	211.29 [47.5]	69.39 [15.6]
14	4330	15	9.7	235.76 [53]	77.84 [17.5]

.250 Series

Wire Size		Current (amperes)	Tensile (N [lbf])
Wire Diam. (mm)	CMA	Copper	Copper
0.60	566	2.6	30 (6.5)
0.85	1120	4	59 (13)
1.00	1550	6.1	83 (18.8)
1.10	1875	8.1	116 (26)

NOTE

1. CMA values are based on standard magnet wire with single film coating.
2. Current values for standard copper wire gages are from UL 310, others are rated based on their respective CMA.
3. Current values for aluminum wires are 64.5% of the copper wire of equivalent gage.
4. Tensile values are calculated at 50% of the bare wire tensile.

Figure 4

2.4. Current Cycling - Test Group 4

No physical damage occurred as a result of current cycling for 500 cycles at the baseline rated current specified in Figure 4. The temperature rise of the conductor during the 500th cycle was not more than 15℃ higher than the temperature rise during the 24 th cycle, and neither rise was more than 85℃.

2.5. Vibration - Test Groups 1 and 2

No discontinuities were detected during vibration testing. Following vibration testing, no cracks, breaks, or loose parts on the specimens were visible[VK4].

2.6. Mechanical Shock - Test Group 1

No discontinuities were detected during mechanical shock testing. Following mechanical shock testing, no cracks, breaks, or loose parts on the specimens were visible.

2.7. Durability - Test Groups 1 and 2

No physical damage occurred as a result of mating and unmating the specimens 6 times.

2.8. Mating Force - Test Group 1

All mating force measurements were less than 66.72 N [15 lbf].

2.9. Unmating Force - Test Group 1

All unmating force measurements were greater than 22.24 N [5 lbf] for the 1st unmating and 13.3 N [3 lbf] for the 6th unmating.

2.10. Termination Tensile Strength - Test Group 3

All termination tensile strength measurements were greater than the tensile values specified in Figure 4.

2.11. Humidity-temperature Cycling - Test Group 2

No evidence of physical damage was visible as a result of humidity-temperature cycling.

2.12. Temperature Life - Test Group 2

No evidence of physical damage was visible as a result of temperature life testing.

2.13. Final Examination of Product - All Test Groups

Specimens were visually examined and no evidence of physical damage detrimental to product performance was observed.

3. TEST METHODS

3.1. Initial Examination of Product

A Certificate of Conformance was issued stating that all specimens in this test package were produced, inspected, and accepted as conforming to product drawing requirements, and were manufactured using the same core manufacturing processes and technologies as production parts.

3.2. Low Level Contact Resistance

Low level contact resistance measurements were made using a 4 terminal measuring technique (Figure 5). The test current was maintained at 100 milliamperes maximum with a 20 millivolt maximum open circuit voltage.

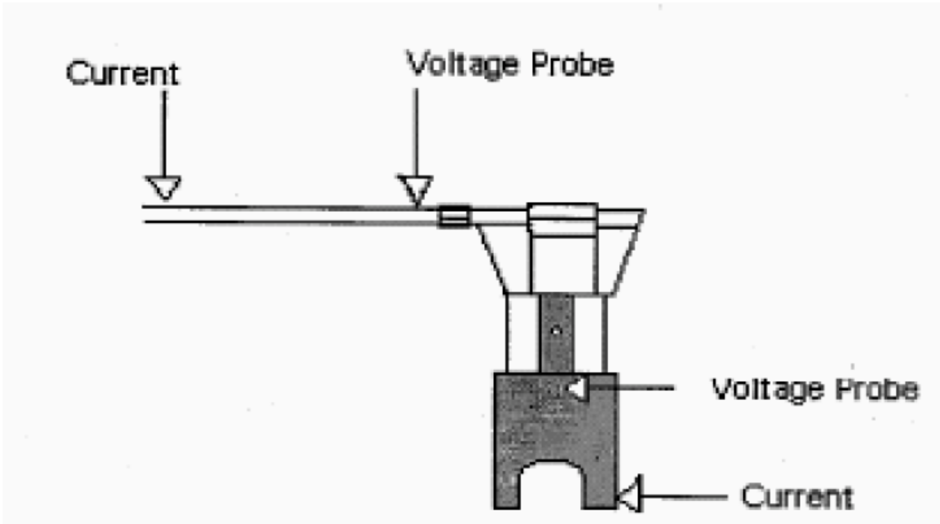

Figure 5
Low Level Contact Resistance Measurement Points

3.3. Temperature Rise vs Current

Temperature rise was measured at the current level specified in Figure 4. Thermocouples were attached to individual contacts on the back of the wire crimp to measure their temperatures. The ambient temperature was then subtracted from this measured temperature to find the temperature rise. When the temperature rise of 3 consecutive readings taken at 5 minute intervals did not differ by more than 1℃, the temperature measurement was recorded.

3.4. Current Cycling

Testing consisted of 500 cycles of current cycling, with each cycle having current ON for 45 minutes and current OFF for 15 minutes. Test current specified in Figure 4.

3.5. Vibration, Random

Mated specimens were subjected to a random vibration test, specified by a random vibration spectrum, with excitation frequency bounds of 20 and 500 Hz. The spectrum remains flat at 0.02 G2/Hz from 20 Hz to the upper boundary frequency of 500 Hz. The root-mean square amplitude of the excitation was 3.10 GRMS. This was performed for 15 minutes in each of 3 mutually perpendicular planes for a total vibration time of 45 minutes. Specimens in test group 1 were monitored for discontinuities of 1 microsecond or greater using a current of 100 milliamperes DC[VK5].

3.6. Mechanical Shock, Half-sine

Mated specimens were subjected to a mechanical shock test having a half-sine waveform of 30 gravity units (g peak) and a duration of 11 milliseconds. Three shocks in each direction were applied along the 3 mutually perpendicular planes for a total of 18 shocks. Specimens were monitored for discontinuities of 1 microsecond or greater using a current of 100 milliamperes DC.

3.7. Durability

Specimens were mated and unmated 6 times at a maximum rate of 600 cycles per hour.

3.8. Mating Force

The force required to mate individual specimens was measured using a tensile/compression device with a free floating fixture and a rate of travel of 12.7 mm [.5 in] per minute.

3.9. Unmating Force

The force required to unmate individual specimens was measured using a tensile/compression device with a free floating fixture and a rate of travel of 12.7 mm [.5 in] per minute.

3.10. Termination Tensile Strength

The force load was applied to the specimens using a tensile/compression device at a rate of travel of 25.4 mm [1 in] per minute. The maximum tensile force at crimp failure was recorded.

3.11. Humidity-temperature Cycling

Mated specimens were exposed to 10 cycles of humidity-temperature cycling. Each cycle lasted 24 hours and consisted of cycling the temperature between 25 and 65℃ twice while maintaining high humidity (Figure 6).

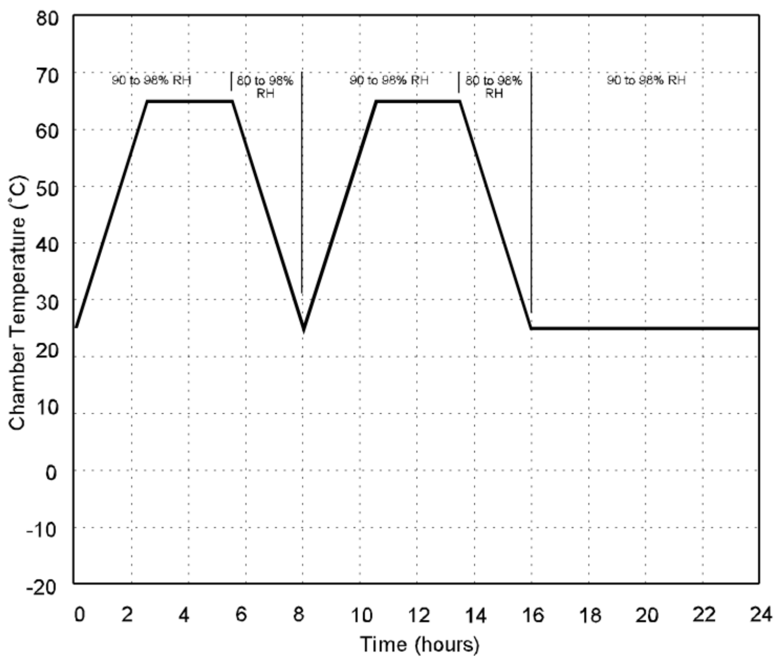

Figure 6

Typical Humidity-Temperature Cycling Profile

3.12. Temperature Life

Mated specimens were exposed to a temperature of 105℃ for 500 hours.

3.13. Final Examination of Product

Specimens were visually examined for evidence of physical damage detrimental to product performance.