Alternate Material Two Circuit Heavy Duty Burner Connector

1. INTRODUCTION

1.1. Purpose

Testing was performed on the Tyco Electronics Alternate Material Two Circuit Heavy Duty Burner Connector to determine its conformance to the requirements of Product Specification 108-1056-2, Revision A. Testing was performed on an alternate material (phosphor bronze, part number 640748-7) and the existing material (copper alloy part number 640748-1).

1.2. Scope

This report covers the electrical, mechanical, and environmental performance of the Alternate Material Two Circuit Heavy Duty Burner Connector. Testing was performed at the Engineering Assurance Product Testing Laboratory between 17Feb06 and 15Dec06. The test file number for this testing is CTL1353-033-1. This documentation is on file at and available from the Engineering Assurance Product Testing Laboratory.

1.3. Conclusion

The Alternate Material Two Circuit Heavy Duty Burner Connector in both materials, as listed in paragraph 1.5, conformed to the electrical, mechanical, and environmental performance requirements of Product Specification 108-1056-2, Revision A.

1.4. Product Description

The Alternate Material Two Circuit Heavy Duty Burner Connector provides a reliable means of connect/disconnect for range surface burner units. The contacts tested were either phosphor bronze or a high temperature copper alloy. The housing material was black phenolic, heat resistant grade, UL 94V-0. Wire gage and crimp configuration are shown in Figure 1.

1.5. Test Specimens

Specimens of part number 640748-7 were phosphor bronze. Specimens of part number 640748-1 were high temperature copper alloy. All test groups utilized the same two position phenolic housing. Test specimens were representative of normal production lots. Specimens identified with the following part numbers and configurations were used for testing:

Test Group ID	Quantity	Terminal Part Number	Material	Wire Size (AWG) and Quantity
1-1	10	640748-7	Phosphor Bronze	One 18 AWG and one 16 AWG
1-2	10	640748-1	Copper Alloy	One 18 AWG and one 16 AWG
2-1	10	640748-7	Phosphor Bronze	One 18 AWG in each terminal
2-2	10	640748-1	Copper Alloy	One 18 AWG in each terminal
2-3	10	640748-7	Phosphor Bronze	One 14 AWG in each terminal
2-4	10	640748-1	Copper Alloy	One 14 AWG in each terminal

Figure 1 (continued)

Test Group ID	Quantity	Terminal Part Number	Material	Wire Size (AWG) and Quantity
3-1	10	640748-7	Phosphor Bronze	One 18 AWG in each terminal
3-2	10	640748-1	Copper Alloy	One 18 AWG in each terminal
3-3	10	640748-7	Phosphor Bronze	One 16 AWG in each terminal
3-4	10	640748-1	Copper Alloy	One 16 AWG in each terminal
3-5	10	640748-7	Phosphor Bronze	One 14 AWG in each terminal
3-6	10	640748-1	Copper Alloy	One 14 AWG in each terminal

Figure 1 (end)

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 Groups (a)		
	1	2	3
	Test Sequence (b)		
Initial examination of product	1	1	1
Low level contact resistance	3,7	3,8	
Current cycling			3
Temperature rise vs current		4,9	2,4
Vibration, random	5	7(c)	
Mechanical shock	6		
Mating force	2		
Unmating force	8		
Contact insertion force		2	
Contact retention		11	
Crimp tensile (d)	9		
Durability	4		
Humidity/temperature cycling		5(e)	
Temperature life		6	
Final examination of product		10	5

NOTE

(a) See paragraph 1.5.
(b) Numbers indicate sequence in which tests were performed.
(c) Discontinuities not measured.
(d) Terminal removed from housing.
(e) Precondition specimens with 10 durability cycles.

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. Where specified, 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 had a change in resistance (ΔR) of less than 5.0 milliohms after testing (see Figure 3). All measurements are total system termination resistance and include 1.0 inches of wire bulk resistance.

Milliohms	Test Group 1-1 N=5 (phosphor bronze)				Test Group 1-2 N=5 (copper alloy)			
	16 AWG		18 AWG		16 AWG		18 AWG	
	Initial	ΔR	Initial	ΔR	Initial	ΔR	Initial	ΔR
Minimum	3.41	-0.49	3.74	-0.53	3.14	0.24	3.47	0.21
Maximum	3.92	1.51	4.31	0.95	4.28	0.68	4.33	1.94
Mean	3.70	0.78	3.97	0.17	3.59	0.39	3.82	0.95
Standard Deviation	0.20	0.78	0.27	0.59	0.55	0.17	0.36	0.74

Milliohms	Test Group 2-1 N=10 (phosphor bronze)		Test Group 2-2 N=10 (copper alloy)		Test Group 2-3 N=10 (phosphor bronze)		Test Group 2-4 N=10 (copper alloy)	
	18 AWG		18 AWG		14 AWG		14 AWG	
	Initial	ΔR	Initial	ΔR	Initial	ΔR	Initial	ΔR
Minimum	3.26	-0.04	3.48	-0.43	2.38	1.30	2.81	0.26
Maximum	5.08	1.95	5.28	1.72	3.56	4.40	3.61	2.52
Mean	3.86	0.79	4.27	0.53	3.08	2.75	3.26	1.45
Standard Deviation	0.62	0.65	0.56	0.74	0.43	1.10	0.27	0.76

Figure 3

2.3. Current Cycling - Test Group 3

No evidence of physical damage detrimental to product performance was observed. Specimens were energized with a current of 11.25 amperes DC.

2.4. Temperature Rise vs Current - Test Groups 2 and 3

All specimens had a temperature rise of less than 30˚C above ambient when tested using a baseline rated current of 9 amperes.

2.5. Vibration, Random - Test Groups 1 and 2

Following vibration testing, no cracks, breaks, or loose parts on the specimens were visible.

2.6. Mechanical Shock - Test Group 1

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

2.7. Mating Force - Test Group 1

All mating force measurements were less than 12 pounds.

2.8. Unmating Force - Test Group 1

All unmating force measurements were greater than 1.5 pounds.

2.9. Contact Insertion Force - Test Group 2

All contact insertion force measurements were less than 6 pounds.

2.10. Contact Retention - Test Group 2

No contacts became dislodged when subjected to an axial force of 25 pounds for 60 seconds.

2.11. Crimp Tensile - Test Group 1

All crimp tensile measurements were greater than the 30 pounds for 18 AWG wire.

2.12. Durability - Test Group 1

No physical damage occurred to as a result of mating and unmating the specimens 3500 times.

2.13. Humidity/temperature Cycling - Test Group 2

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

2.14. Temperature Life - Test Group 2

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

2.15. Final Examination of Product - Test Groups 2 and 3

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 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 4). The test current was maintained at 100 milliamperes maximum with a 20 millivolt maximum open circuit voltage. The crimp measurement was made from a point on the wire 1.5 inches from the back of the crimp to the transition area of the terminal. The Interface measurement was made from the same point on the transition area of the terminal to a point on the surface burner tang just outside of the housing. Crimp and interface resistance was then combined for the total system termination resistance. The rational behind breaking the termination resistance down to the contributory level is for forensic analysis.

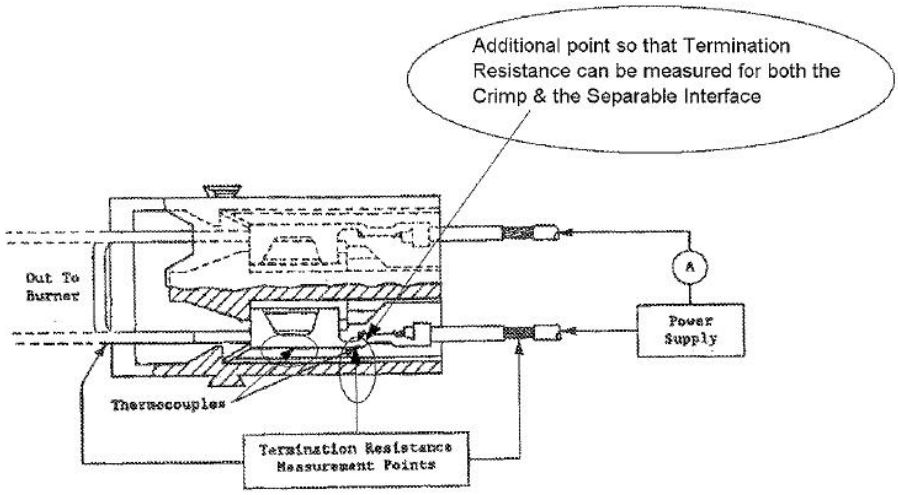

Figure 4

3.3. Current Cycling

Specimens were connected in series circuit and subjected to 3500 cycles of current cycling, with each cycle having current ON for 15 minutes and current OFF for 15 minutes. Test current was 11.25 amperes DC. Temperatures were measured just prior to the completion of the energized portion of the cycle.

3.4. Temperature Rise vs Current

Temperature rise curves were produced by measuring individual contact temperatures at 5 different current levels. These measurements were plotted to produce a temperature rise vs current curve. Thermocouples were attached to individual contacts 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˚C, the temperature measurement was recorded. Only the measurements obtained at 9 amperes (product rated current) were included in this report.

3.5 Vibration, Random

Parameters of this test condition are specified by a random vibration spectrum with excitation frequency bounds of 5 and 500 Hz. The Power Spectral Density (PSD) at 5 Hz is 0.000312 G^2/Hz. The spectrum slopes up to a PSD of 0.01 G^2/Hz at 11 Hz. The spectrum is flat at 0.01 G^2/Hz from 11 Hz to the upper bound frequency of 500 Hz. The root-mean square amplitude of the excitation was 2.22 GRMS. The mated test specimens were subjected to this test for 2 hours in each of the 3 mutually perpendicular axes, for a total test time of 6 hours per test specimen.

3.6. Mechanical Shock

Parameters of this test condition are a half-sine waveform with an acceleration amplitude of 50 gravity units (g's peak) and a duration of 11 milliseconds. Three shocks in each direction were applied along the 3 mutually perpendicular axes of the test specimens, for a total of 18 shocks.

3.7. Mating Force

The force required to mate individual specimens was measured using a tensile/compression device with the rate of travel at 1.0 inch per minute and a free floating fixture. The peak force was recorded.

3.8. Unmating Force

The force required to unmate individual specimens was measured using a tensile/compression device with the rate of travel at 1.0 inch per minute and a free floating fixture. The peak force was recorded.

3.9. Contact Insertion Force

Contact Insertion force was measured by applying an increasing force to each contact until the contact was properly seated in the housing.

3.10. Contact Retention

An axial load of 25 pounds was applied to each contact, and held for 60 seconds in a direction that would tend to cause removal of the contacts from the housing.

3.11. Crimp Tensile

The force load was applied to each specimen using a tensile/compression device with the rate of travel at 1.0 inch per minute until the wire became dislodged from the terminal.

3.12. Durability

Specimens were mated and unmated 3500 times at a maximum rate of 600 cycles per hour.

3.13. Humidity/temperature Cycling

Specimens were preconditioned with 10 durability cycles. 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˚C twice while maintaining high humidity (see Figure 5).

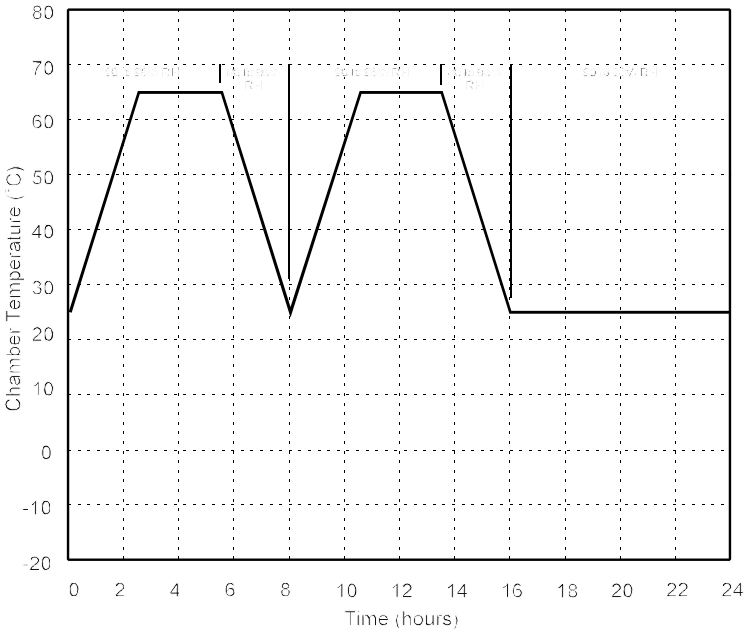

Figure 5

3.14. Temperature Life

Mated specimens were exposed to a temperature of 200˚C for 500 hours.

3.15. Final Examination of Product

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