Multi-Beam XL* Cable Plug

1. INTRODUCTION

1.1. Purpose

Testing was performed on the Tyco Electronics Multi-Beam XL* Cable Plugs to determine their conformance to the requirements of Product Specification 108-2157-1 Revision A.

1.2. Scope

This report covers the electrical, mechanical, and environmental performance of the Multi-Beam XL Cable Plugs. Testing was performed at the Engineering Assurance Product Test Laboratory between 23Sep05 and 31Jan06. The test file numbers for this testing are CTLB055885-006 and CTLB055885-008. This documentation is on file at and available from the Engineering Assurance Product Test Laboratory.

1.3. Conclusion

The Multi-Beam XL Cable Plugs listed in paragraph 1.4., conformed to the electrical, mechanical, and environmental performance requirements of Product Specification 108-2157-1 Revision A.

1.4. Test Specimens

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

Part Number	Description	Quantity per Test Group					
		1	2	3	4	5	6
1600236-2	Cable plug kit, panel		3	5		3	
1600236-3	Cable plug kit, panel	6	10		5	8	
1600238-1	Cable plug kit, STR		1	5			
1600238-2	Cable plug kit, STR		2		5		
6450370-6	Right angle receptacle assembly	6	13	5	5	11	
6450740-2	Receptacle assembly, STR		3	5	5		
1761385-3	Power contact, 8-10 AWG	24	76	120	40	24	48
1761386-3	Power contact, 12-14 AWG	48	56		80	24	36
1-104480-3	Short point receptacle contact, 22-26 AWG	144	264	240	240		36
104482-3	8 short point receptacle housing	18	33	30	30		
1600914-1	Panel mount hardware	6	13	5	5		

Figure 1

1.5. Environmental Conditions

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

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

* Trademark
| Indicates change

1.6. Qualification Test Sequence

Test or Examination	Test Group (a)					
	1	2	3	4	5	6
	Test Sequence (b)1					
Initial examination of product	1	1	1	1	1	1
Low level contact resistance, signal and power contacts	2,5	3,7		2,4		
Low level contact resistance, power contacts only					2,6,8,10	
Contact resistance at rated current, power contacts					12	
Insulation resistance			2,6			
Withstanding voltage			3,7			
Temperature rise vs current, initial					4	
Temperature rise vs current, end of life					11	
Vibration, random		5			9(c)	
Mechanical shock		6				
Durability	3(d)	4			3(e)	
Mating force		2				
Unmating force		8				
Contact retention, straight pull			10			
Contact retention, angled pull			11			
Housing lock strength, straight pull			8			
Housing lock strength, angled pull			9			
Crimp tensile						2
Thermal shock			4			
Humidity-temperature cycling			5			
Temperature life				3	7	
Mixed flowing gas	4				5	
Final examination of product	6	9	12	5	13	3

NOTE
(a) See paragraph 1.4.
(b) Numbers indicate sequence in which tests are performed.
(c) Energize at current for 18˚C temperature rise.
(d) Precondition specimens with 5 durability cycles.
(e) Precondition specimens with 50 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. 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, 2, 4 and 5

All low level contact resistance measurements, taken at 100 milliamperes maximum and 20 millivolts maximum open circuit voltage were less than 10 milliohms initially and 20 milliohms after testing for power contacts and 15 milliohms initially and 20 milliohms after testing for signal contacts.

2.3. Contact Resistance At Rated Current - Test Group 5

All contact resistance measurements, taken at rated current were less than 1.25 milliohms after testing.

2.4. Insulation Resistance - Test Group 3

All insulation resistance measurements were greater than 500 megohms for signal contacts and 1000 megohms for power contacts.

2.5. Withstanding Voltage - Test Group 3

No dielectric breakdown or flashover occurred.

2.6. Temperature Rise vs Current, Initial and End of Life - Test Group 5

All specimens had a temperature rise of less than 30°C above ambient when tested using the baseline rated current and wiring configurations shown in Figure 3.

Signal Contacts	
Single Contact	System (24 contacts, 22 AWG)
5	1.5

Power Contacts					
Module (Contact Pitch)	Wire Size	Single Contact	2 Adjacent Contacts	4 Adjacent Contacts	8 Adjacent Contacts
.300	8	45	37	31	-----
.250	10	41	-----	27	24
.250	14	28	-----	19	17

Figure 3

2.7. Vibration - Test Groups 2 and 5

No discontinuities were detected during vibration testing (Test Group 2 only). Following vibration testing, no cracks, breaks, or loose parts on the specimens were visible.

2.8. Mechanical Shock - Test Group 2

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

2.9. Durability - Test Groups 1, 2 and 5

No physical damage occurred as a result of mating and unmating the specimens 250 times.

2.10. Mating Force - Test Group 2

All average mating force measurements were less than 28 ounces per contact for power contacts and 6 ounces per contact for signal contacts.

2.11. Unmating Force - Test Group 2

All unmating force measurements were greater than 6 ounces per power contact and .7 ounce per signal contact.

2.12. Contact Retention, Straight Pull - Test Group 3

All straight pull contact retention measurements were greater than 30 pounds per power contact and 3 pounds per signal contact.

2.13. Contact Retention, Angled Pull - Test Group 3

All angled pull contact retention measurements were greater than 30 pounds per power contact and 3 pounds per signal contact.

2.14. Housing Lock Strength, Straight Pull - Test Group 3

All straight pull housing lock strength measurements were greater than 25 pounds.

2.15. Housing Lock Strength, Angled Pull - Test Group 3

All angled pull housing lock strength measurements were greater than 25 pounds.

2.16. Crimp Tensile - Test Group 6

All crimp tensile measurements were greater than those shown in Figure 4.

Power Contacts	
Wire Size (AWG)	Tensile (lbs min)
8	80
10	80
14 (dual crimp)	80
12 (dual crimp)	80
12	70
16 (dual crimp)	50
14	50

Signal Contacts	
Wire Size (AWG	Tensile (lbs min)
22	11
24	7
26	4

Figure 4

2.17. Thermal Shock - Test Group 3

No evidence of physical damage was visible as a result of exposure to thermal shock.

2.18. Humidity-temperature Cycling - Test Group 3

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

2.19. Temperature Life - Test Groups 4 and 5

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

2.20. Mixed Flowing Gas - Test Groups 1 and 5

No evidence of physical damage was visible as a result of exposure to the pollutants of mixed flowing gas.

2.21. 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. The test current was maintained at 100 milliamperes maximum with a 20 millivolt maximum open circuit voltage. All wire bulk was removed from the measurements.

3.3. Contact Resistance At Rated Current

Contact resistance measurements at rated current were made using a 4 terminal measuring technique. The test current was maintained at the current specified in Figure 5. All wire bulk was removed from the measurements.

Wire Size (AWG)	Contacts Energizes	Current (amperes)
14	8	17
10	8	24
8	4	31

Figure 5

3.4. Insulation Resistance

Insulation resistance was measured between adjacent contacts of mated specimens. A test voltage of 500 volts DC was applied for 2 minutes before the resistance was measured.

3.5. Withstanding Voltage

A test potential of 1000 volts DC for signal contacts and 2500 volts for power contacts was applied between adjacent contacts. This potential was applied for 1 minute and then returned to zero.

3.6. Temperature Rise vs Current, Initial and End of Life

Temperature rise was measured on both unstressed and stressed specimens using infrared imaging. Specimens were prepared by drilling a small hole in the housing to expose the contact and consisted of the following configurations:

- Three specimens with 8 contacts crimped on 10 AWG wire
- Three specimens with 8 contacts crimped on 14 AWG wire
- Five specimens with 4 contacts crimped on 8 AWG wire

Temperature rise curves were established for 14 AWG and 10 AWG specimens having a single circuit, 4 adjacent contacts, 8 adjacent contacts and all contacts energized at 5 different current levels. Temperature rise curves were established for 8 AWG specimens having a single circuit, 2 adjacent contacts, and all contacts energized at 5 different current levels. Specimens were allowed to stabilize before the temperature was measured. The Specimen was imaged using standard optics after applying an emissivity correction coating. The emittance of the emissivity correction factor is 0.93. Raising this emittance value allows for accurate temperature measurements. ThermaGRAM thermal image processing was used for data analysis. The software has a temperature box measurement feature to determine maximum temperature of the contact. This software feature allows a measurement of the area inside the box when placed on an area of interest. The specimens were placed in a stable air environment of a temperature rise enclosure.

3.7. 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 root-mean square amplitude of the excitation was 4.90 GRMS. This was performed for 15 minutes in each of 3 mutually perpendicular planes for a total vibration time of 45 minutes. Specimens were monitored for discontinuities of 1 microsecond or greater using a current of 100 milliamperes DC.

3.8. Mechanical Shock, Half-sine

Mated specimens were subjected to a mechanical shock test having a half-sine waveform of 50 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.

3.9. Durability

Specimens were mated and unmated 250 times at a maximum rate of 500 cycles per hour.

3.10. 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 0.5 inch per minute. Power contacts were measured with signal contacts removed while signal contacts were measured with power contacts removed.

3.11. 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 0.5 inch per minute. Power contacts were measured with signal contacts removed. Signal contacts were measured using a .024 inch square gage after sizing 3 times using a .026 inch gage.

3.12. Contact Retention, Straight Pull

Power contacts were measured by applying a 30 pound weight to the wire and holding for 6 seconds. Signal contacts were measured by applying a 3 pound weight to the wire and holding for 6 seconds.

3.13. Contact Retention, Angled Pull

Power contacts were measured by applying a 30 pound weight to the wire and holding for 6 seconds. Signal contacts were measured by applying a 3 pound weight to the wire and holding for 6 seconds.

3.14. Housing Lock Strength, Straight Pull

Housing lock strength was measured by applying a 25 pound weight to the wire bundle and holding for 6 seconds.

3.15. Housing Lock Strength, Angled Pull

Housing lock strength was measured by applying a 25 pound weight to the wire bundle and holding for 6 seconds.

3.16. Crimp Tensile

A small metal fixture was inserted into the socket to assist in clamping the contact during test. Specimens were clamped in a vise at the contact and air jaws were used to grip the wire end and apply the load in a vertical motion. This load was applied at the rate of .5 inch per minute until failure.

3.17. Thermal Shock

Mated specimens were subjected to 36 cycles of thermal shock with each cycle consisting of 30 minute dwells at -20 and 105˚C. The transition between temperatures was less than 1 minute.

3.18. 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˚C twice while maintaining high humidity.

3.19. Temperature Life

Mated specimens were exposed to a temperature of 105˚C for 504 hours (21 days).

3.20. Mixed Flowing Gas, Class IIA

Mated specimens were exposed for 14 days to a mixed flowing gas Class IIA exposure. Class IIA exposure is defined as a temperature of 30˚C and a relative humidity of 70% with the pollutants of Cl_2 at 10 ppb, NO_2 at 200 ppb, H_2S at 10 ppb and SO_2 at 100 ppb.

3.21. Final Examination of Product

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