Evaluation Testing of PdNi and Au Plated Type III+ Multimate Contacts

1. INTRODUCTION

1.1. Purpose

Testing was performed on Tyco Electronics Type III+ Multimate Contact to evaluate the mating of PdNi and Au plated contacts.

1.2. Scope

This report covers the electrical, mechanical, and environmental performance of PdNi and Au plated Type III+ Multimate contacts. Testing was performed at the Harrisburg Electrical Components Test Laboratory between 08Jan10 and 29Mar10. The test file number for this testing is EA20100017T. This documentation is on file at and available from the Harrisburg Electrical Components Test Laboratory.

1.3. Test Specimens

Specimens identified with the following part numbers were used for test. All specimen were constructed using 14 AWG wire and hand tool part number 90310-1.

Test Group	Quantity	Part Number	Description
1	10	66361-4	Type III+ PdNi plated brass pin assembly
	10	66360-4	Type III+ Au plated brass socket assembly
2	10	66361-4	Type III+ Au plated brass pin assembly
	10	66360-4	Type III+ Au plated brass socket assembly
3	10	1-66361-4	Type III+ PdNi plated silicone/nickel alloy pin assembly
	10	66360-4	Type III+ Au plated silicone/nickel alloy socket assembly
4	10	1-66361-4	Type III+ Au plated silicone/nickel alloy pin assembly
	10	66360-4	Type III+ Au plated silicone/nickel alloy socket assembly

Figure 1

1.4. Environmental Conditions

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

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

1.5 Test Sequence

Test	Test Group (a)			
	1	2	3	4
	Test Sequence (b)			
Initial examination of product	1	1	1	1
Contact engaging force	2,6	2,6	2,6	2,6
Low Level Contact Resistance (LLCR)	3,8,10,12,14	3,8,10,12,14	3,8,10,12,14	3,8,10,12,14
Contact separating force	4,7	4,7	4,7	4,7
Durability	5	5	5	5
Temperature life	9	9	9	9
Mixed Flowing Gas (MFG)	11	11	11	11
Thermal shock	13	13	13	13

NOTE *(a) See paragraph 1.3.*
(b) Numbers indicate sequence in which tests were performed.

Figure 2

2. SUMMARY OF TESTING

2.1. Initial Examination of Product

All specimens submitted for testing were visually examined and no evidence of physical damage detrimental to product performance was observed.

2.2. Contact Engaging Force

A summary of contact engaging force measurements is shown in Figure 3.

Reading	Initial	After Durability
Test Group 1		
Minimum	9.15	9.32
Maximum	11.38	11.47
Mean	9.90	10.46
Standard Deviation	0.62	0.77

Reading	Initial	After Durability
Test Group 2		
Minimum	8.38	10.65
Maximum	11.55	13.49
Mean	9.81	11.63
Standard Deviation	0.81	1.00

Reading	Initial	After Durability
Test Group 3		
Minimum	10.31	11.60
Maximum	12.80	19.33
Mean	11.26	15.05
Standard Deviation	0.81	3.13

Reading	Initial	After Durability
Test Group 4		
Minimum	11.12	10.70
Maximum	20.88	13.75
Mean	14.61	11.82
Standard Deviation	3.01	1.10

NOTE *All values in ounces.*

Figure 3

2.3. LLCR

All LLCR measurements were taken using a 4 terminal system at 100 milliamperes maximum and 20 millivolts maximum open circuit voltage. All measurements are total system termination resistance and include 3.0 inches of wire bulk resistance.

Reading	Initial	After 2nd Separation	After Temperature Life	After MFG	Final
Test Group 1					
Minimum	2.44	-0.11	-0.20	0.21	0.24
Maximum	3.04	0.35	0.56	2.49	1.18
Mean	2.64	0.06	0.34	0.72	0.58
Standard Deviation	0.17	0.15	0.22	0.68	0.33
Test Group 2					
Minimum	2.37	0.01	0.15	0.54	0.53
Maximum	2.82	0.35	1.66	1.83	1.89
Mean	2.52	0.14	0.84	1.13	1.00
Standard Deviation	0.13	0.11	0.57	0.45	0.40
Test Group 3					
Minimum	1.36	-0.05	0.01	0.07	0.07
Maximum	1.51	0.47	4.16	1.51	2.07
Mean	1.44	0.14	0.85	0.61	0.67
Standard Deviation	0.04	0.15	1.23	0.50	0.60
Test Group 4					
Minimum	1.36	-0.22	0.06	0.11	0.00
Maximum	1.64	0.40	3.23	4.24	0.91
Mean	1.42	0.08	0.81	1.18	0.49
Standard Deviation	0.08	0.16	0.93	1.40	0.26

NOTE *All values in milliohms.*

Figure 4

2.4. A summary of contact separating measurements is shown in Figure 5.

Reading	Initial	Final
Test Group 1		
Minimum	5.67	6.87
Maximum	9.54	8.59
Mean	6.76	7.97
Standard Deviation	1.20	0.54

Reading	Initial	Final
Test Group 2		
Minimum	4.42	4.42
Maximum	8.85	8.08
Mean	6.42	5.70
Standard Deviation	1.28	1.07

Reading	Initial	Final
Test Group 3		
Minimum	5.93	6.40
Maximum	8.72	9.96
Mean	7.17	8.06
Standard Deviation	0.80	1.23

Reading	Initial	Final
Test Group 4		
Minimum	7.43	6.83
Maximum	10.09	10.74
Mean	8.55	8.28
Standard Deviation	1.07	1.36

NOTE *All values in ounces.*

Figure 5

2.5. Durability

No evidence of physical damage was visible as a result of mating and unmating the specimens 500 times.

2.6. Temperature Life

No evidence of physical damage was visible as a result of exposing the specimens to elevated temperature.

2.7. MFG

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

2.8. Thermal Shock

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

3. TEST METHODS

3.1. Initial Examination of Product

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

3.2. Contact Engaging Force (EIA-364-37)

Specimens were clamped in a vise attached to a floating X-Y table to ensure axial alignment and then leveled. A pin vice holding the #16 contact size gage pin #2 (.0635 ± .0001 inch diameter) was attached to the moving crosshead of a tensile compression machine. The gage pin was aligned with the contact socket and lowered at a rate of .5 inch per minute and the value recorded (Figure 6).

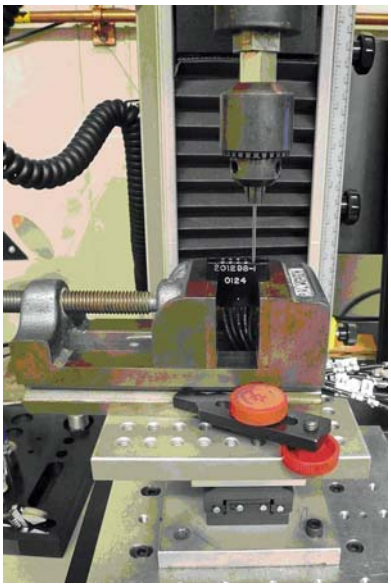

Figure 6

3.3. LLCR (EIA-364-23)

Termination resistance measurements at low level current were made using a 4 terminal measuring technique (Figure 7). The test current was maintained at 100 milliamperes maximum with a 20 millivolt maximum open circuit voltage. All measurements include the crimp and interface resistance and 3 inches of wire bulk (1.5 inches per side).

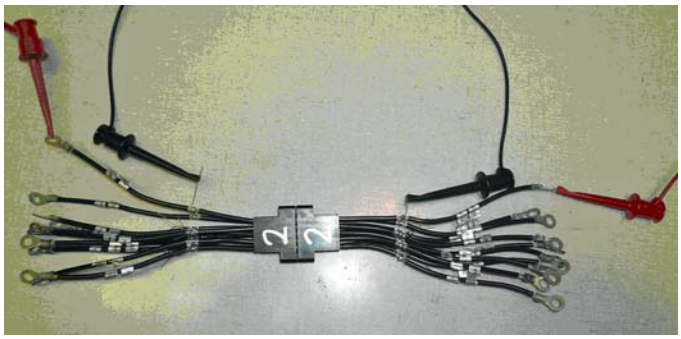

Figure 7

3.4. Contact Separation Force (EIA-364-37)

Specimens were preconditioned 3 times using the #16 contact size gage pin #2 (.0635 ± .0001 inch diameter). Specimens were clamped in a vise attached to a floating X-Y table to ensure axial alignment and then leveled. A pin vice holding the #16 contact size gage pin #1 (.0615 ± .0001 inch diameter) was attached to the moving crosshead of a tensile compression machine. The gage pin was aligned with the contact socket and lowered at a rate of .5 inch per minute to a distance .230 inch from the top of the socket. The gage pin was then extracted from the socket and the value recorded. Test setup is identical to Figure 6.

3.5. Durability (EIA-364-9)

Specimens were mated and unmated 500 times at a maximum rate of 300 cycles per hour using a tensile/compression device with a free floating fixture (Figure 8).

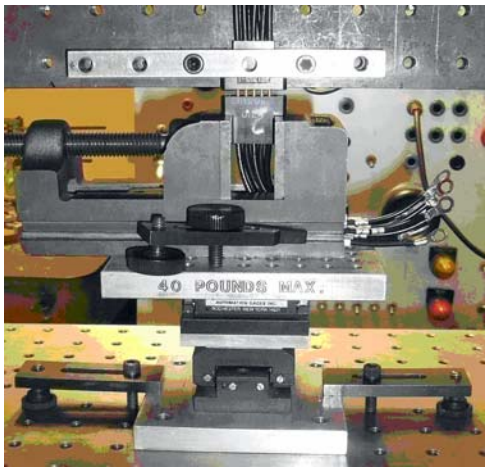

Figure 8

3.6. Temperature Life (EIA-364-17)

Mated specimens were exposed to a temperature of 105°C for 624 hours. The standard exposure of 150°C for 240 hours was lowered to 105°C for 624 hours due to the Relative Thermal Index (RTI) of the wire insulation being to low for the standard exposure. To incur an equal amount of stress relaxation, the Larson-Miller number for Type III+ Multimate sockets was calculated for the correct duration and temperature, this number was compared to a fixed temperature of 105°C and different durations to find an equivalent Larson-Miller number (see Figure 9 for details).

Temperature (°C)	Duration (hours)	Larson-Miller Number	Percent Stress Left
150	240.0	6083	≈75.0
105	12400.0	6083	≈75.0
105	624.0	5593	≈80.0
90	240.0	5220	≈82.5
57	87600.0	5591	≈82.5

Figure 9

3.7. Mixed Flowing Gas (EIA-364-65)

Mated specimens were exposed for 10 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.

3.8. Thermal Shock (EIA-364-32)

Mated specimens were subjected to 10 cycles of thermal shock with each cycle consisting of 30 minute dwells at -55 and 105°C with 1 minute transition between temperatures.