Type III+ Contacts

1. INTRODUCTION

1.1. Purpose

Testing was conducted to measure the performance of Type III+ contacts using the requirements of product specification 108-10042.

1.2. Scope

This report covers the electrical, mechanical, and environmental performance of Type III+ contacts.

Testing was performed between 06Jul87 and 26Jan88 using 30 through 14 AWG wire. The test file number is CTL5022-030. Additional testing was performed between 08Jan10 and 29Mar10 to evaluate mating Pd Ni-plated and Au-plated contacts. The test file number is EA20100017T.

Testing was performed between 9Jan15 and 20Feb15 using 0.75-mm^2 and 1.0-mm^2 wire. The test file number is EA20140773T.

1.3. Conclusion

Type III+ contacts met the electrical, mechanical, and environmental performance requirements given in 108-10042.

1.4. Product Description

Type III+ contacts are precision formed signal contacts used in Multimate connector cavities. The contacts are made of brass with either tin or precious metal over nickel plating and are assembled with stainless steel springs.

1.5. Test Samples

Samples were taken randomly from current production. The following samples were used:

TEST GROUP	PART NUMBER	DESCRIPTION	QUANTITY EACH
1,2	66099-1	Pin Contact	10
	66099-2	Pin Contact	
	66101-1	Socket Contact	
	66101-2	Socket Contact	
	66103-1	Pin Contact	
	66103-2	Pin Contact	
	66105-1	Socket Contact	
	66105-2	Socket Contact	
	66107-1	Pin Contact	
	66107-2	Pin Contact	
2,3	66098-4 (Rev AP)	Pin Contact	120
	66100-4 (Rev BJ)	Socket Contact	

Figure 1 (Cont'd)

1,2	66109-1	Socket Contact	10
	66109-2	Socket Contact	
	66360-1	Socket Contact	
	66360-2	Socket Contact	
	66361-1	Pin Contact	
	66361-2	Pin Contact	
	66428-1	Socket Contact	
	66428-2	Socket Contact	
	66429-1	Pin Contact	
	66429-2	Pin Contact	

Figure 1 (End)

1.6. Environmental Conditions

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

Temperature: 15° to 35°C
Relative humidity: 20 to 80%

1.7. Qualification Test Sequence

TEST OR EXAMINATION	TEST GROUP (a)		
	1	2	3(b)
	TEST SEQUENCE (c)		
Examination of Product	1,10	1	1,8
Termination Resistance, Specified Current		2,4	
Termination Resistance, Dry Circuit	2,7		2,5,7
Current Cycling		3	
Contact Engaging Force	8		
Contact Separating Force	9		
Crimp Tensile		5	
Durability	3		
Thermal Shock	4		6
Humidity/Temperature Cycling	6(d)		3
Industrial Mixed Flowing Gas	6(e)		
Temperature Life	5		4

(a) See paragraph 1.5
(b) Test group 3 was used for 0.75-mm^2 and 1.0-mm^2 wire only.
(c) Numbers indicate sequence that tests were performed.
(d) Tin-plated samples only.
(e) Precious metal-plated samples only.

Figure 2

2. SUMMARY OF TESTING

2.1. Examination of Product—All Test Groups

All pin and socket contacts were selected from production lots. They were inspected and accepted by the Product Assurance department and were delivered to the Corporate Test Laboratory on 26Jan87 (30 through 14 AWG wire) and 18Dec14 (0.75-mm^2 and 1.0-mm^2 wire).

2.2. Termination Resistance, Specified Current—Test Group 2

All contacts met the initial and final maximum requirements given in Figure 3.

WIRE SIZE (AWG, mm^2)	RESISTANCE (milliohms) (Max)
30	43.00
26	19.00
24	14.50
20	9.00
18, 0.75	7.50
16, 1.0	6.50
14	6.00

NUMBER OF CONTACTS	WIRE SIZE	TEST CURRENT (amperes)	RESISTANCE (milliohms)				
			Reading	Minimum	Maximum	Mean	Standard Deviation
10	30 AWG	1.2	Initial	2.63	8.10	4.87	2.152
			Final	3.13	15.22	7.30	4.420
20	26 AWG	2.0	Initial	2.10	2.71	2.30	0.127
			Final	2.13	2.83	2.44	0.179
20	24 AWG	3.0	Initial	1.73	2.65	1.98	0.239
			Final	1.84	4.03	2.37	0.472
10	20 AWG	7.5	Initial	1.81	2.19	2.04	0.153
			Final	1.82	2.38	2.12	0.223
35	0.75 mm^2	10.0	Initial	4.66	5.04	4.85	0.08
			Final	3.57	3.88	3.70	0.06
20	18 AWG	10.0	Initial	1.77	2.14	1.91	0.099
			Final	1.87	2.39	2.11	0.145
35	1.0 mm^2	13.0	Initial	5.33	5.75	5.55	0.10
			Final	4.05	4.37	4.22	0.08
10	16 AWG	13.0	Initial	1.73	2.15	1.88	0.126
			Final	1.76	2.12	1.93	0.112
10	14 AWG	17.0	Initial	1.69	2.23	1.85	0.152
			Final	1.76	2.90	2.30	0.443

Figure 3

2.3. Termination Resistance, Dry Circuit—Test Groups 1 and 3

All contacts met the initial and final maximum requirements given in Figure 4.

WIRE SIZE (AWG, mm^2)	RESISTANCE (milliohms) (Max)
30	43.00
26	19.00
24	14.50
20	9.00
18, 0.75	7.50
16, 1.0	6.50
14	6.00

TEST GROUP 1

NUMBER OF CONTACTS	WIRE SIZE	TEST CURRENT (amperes)	RESISTANCE (milliohms)				
			Reading	Minimum	Maximum	Mean	Standard Deviation
10	30 AWG	1.2	Initial	2.18	9.15	4.17	2.508
			Final	2.89	19.83	5.64	5.083
20	26 AWG	2.0	Initial	1.81	2.34	2.08	0.146
			Final	1.93	5.57	2.45	0.760
20	24 AWG	3.0	Initial	1.94	2.28	2.07	0.083
			Final	2.02	3.64	2.51	0.475
10	20 AWG	7.5	Initial	1.84	1.96	1.90	0.036
			Final	1.97	2.99	2.28	0.391
20	18 AWG	10.0	Initial	1.54	2.01	1.73	0.112
			Final	1.74	3.18	2.15	0.414
10	16 AWG	13.0	Initial	1.54	1.86	1.69	0.115
			Final	1.64	2.18	2.01	0.181
10	14 AWG	17.0	Initial	1.55	1.86	1.73	0.093
			Final	1.78	4.03	2.43	0.648

TEST GROUP 3

NUMBER OF CONTACTS	WIRE SIZE	RESISTANCE (milliohms)				
		Reading	Minimum	Maximum	Mean	Standard Deviation
34	0.75 mm^2	Initial	4.50	4.70	4.58	0.06
		After Temp Life	4.23	5.23	4.52	0.22
		Final	4.30	4.99	4.54	0.18
35	1.0 mm^2	Initial	3.85	4.11	3.94	0.07
		After Temp Life	3.59	4.45	3.90	0.17
		Final	3.71	4.31	3.97	0.14

Figure 4

2.4. Current Cycling—Test Group 2

The crimp resistance after current cycling was less than the maximum limit for all contacts.

2.5. Contact Engaging Force—Test Group 1

The force required to engage the test gage pin was less than 36 oz per contact.

DESCRIPTION	NUMBER OF CONTACTS	CONTACT ENGAGING FORCE (oz)			
		Minimum	Maximum	Mean	Standard Deviation
After Humidity/Temperature Cycling	50	8.0	24.5	14.57	3.530
After Mixed Flowing Gas		5.4	15.4	10.95	1.856

Figure 5

2.6. Contact Separating Force—Test Group 1

The force required to remove a gage pin was greater than 1.5 oz per contact.

DESCRIPTION	NUMBER OF CONTACTS	CONTACT ENGAGING FORCE (oz)			
		Minimum	Maximum	Mean	Standard Deviation
After Humidity/Temperature Cycling	50	4.7	16.6	9.28	2.973
After Mixed Flowing Gas		2.2	8.2	4.80	1.163

Figure 6

2.7. Crimp Tensile—Test Group 2

WIRE SIZE	CRIMP TENSILE (Greater Than, lbs)
30 AWG	1.5
26 AWG	5
24 AWG	8
20 AWG	20
0.75 mm^2	32
18 AWG	38
1.0 mm^2	39
16 AWG	41
14 AWG	50

NUMBER OF CONTACTS	WIRE SIZE	CONTACT	CONTACT ENGAGING FORCE (oz)			
			Minimum	Maximum	Mean	Standard Deviation
30	0.75 mm^2	Pin	33.35	39.39	36.97	1.64
		Socket	32.63	38.93	37.13	1.52
	1.00 mm^2	Pin	39.88	46.10	43.10	1.30
		Socket	39.07	44.18	41.09	1.08

Figure 7

2.8. Durability—Test Group 1

There was no mechanical damage to the precious metal-plated contacts after 500 cycles and no damage to tin-plated contacts after 50 cycles.

2.9. Thermal Shock—Test Groups 1 and 3

There was no evidence of damage to the contacts after 10 cycles of thermal shock.

2.10. Humidity/Temperature Cycling—Test Groups 1 and 3

There was no evidence of damage to the tin-plated contacts after 10 days of humidity/temperature cycling.

2.11. Mixed Flowing Gas—Test Group 1

There was no evidence of damage to the precious metal-plated contacts after exposure to mixed flowing gas.

2.12. Temperature Life—Test Groups 1 and 3

There was no evidence of damage to the contacts after exposure to temperature life.

3. TEST METHODS

3.1. Examination of Product

The product drawing and inspection plans were used to examine the contacts visually, dimensionally, and functionally.

3.2. Termination Resistance, Specified Current

Termination resistance was measured on all mated contact pairs using a 4-terminal measuring method. The following current was maintained for each wire size:

WIRE SIZE (AWG, mm^2)	CURRENT (amperes)
30	1.2
26	2.0
24	3.0
20	7.5
18, 0.75	10
16, 1.0	13
14	17

Figure 8

3.3. Termination Resistance, Dry Circuit

Termination resistance was measured on all mated contact pairs using a 4-terminal measuring method. Current and maximum open circuit voltage during the test was maintained at the data given in Figure 9.

WIRE SIZE	CURRENT (milliamperes)	MAXIMUM OPEN CIRCUIT VOLTAGE (millivolts)
30-14 AWG	100	50
0.75 and 1.0 mm^2		20

Figure 9

3.4. Current Cycling

All mated contact pairs were subjected to 500 current cycles at 125% of specified current. Each cycle consisted of 30 minutes of current on followed by 15 minutes of current off. The following current was applied to each wire size as follows:

WIRE SIZE (AWG, mm^2)	CURRENT (amperes)
30	1.5
26	2.5
24	3.75
20	9.375
18, 0.75	12.5
16, 1.0	16.25
14	21.25

Figure 10

3.5. Contact Engaging Force

The force required to engage a .0635-in. diameter gage pin with each socket contact was measured. The gage pin was mated approximately .230 in. from the top of the socket. Testing was performed at a rate of .5 in. per minute using a free floating fixture to mount the gage pin.

3.6. Contact Separating Force

The force required to separate a .0615-in. diameter gage pin was measured after sizing 3 times with a .0635-in. diameter gage pin. The gage pin was unmated approximately .230 in. Testing was performed at a rate of .5 in. per minute using a free-floating fixture to mount the gage pin.

3.7. Crimp Tensile

An axial load was applied to each contact at a rate of 1.0 in. per minute.

3.8. Durability

All pin and socket contacts were loaded into corresponding connector inserts and mated and unmated 500 cycles for precious metal-plated contacts and 50 cycles for tin-plated contacts. Testing was performed at a rate of 300 cycles per hour.

3.9. Thermal Shock

Mated precious metal-plated contacts were subjected to 10 cycles of thermal shock with each cycle consisting of 30-minute dwells at -55 and 150°C with less than 5 minutes transition between temperatures. Mated tin-plated contacts were subjected to 10 cycles of thermal shock with each cycle consisting of 30-minute dwells at -55 and 90°C with less than 5 minutes transition between temperatures.

3.10. Humidity/Temperature Cycling

Mated tin-plated contacts were exposed to 10 humidity/temperature cycles. Each cycle lasted 24 hours and consisted of cycling the temperature between 25° and 65°C twice while maintaining 95% humidity. Samples were pre-conditioned in a 50°C dry oven.

3.11. Mixed Flowing Gas

All mated precious metal-plated contacts were exposed to 10 days of class II exposure. Class II exposure is defined as a temperature of 30°C and a relative humidity of 70%. Pollutants are CL_2 at 10 ppb, NO_2 at 200 ppb, and H_2S at 10 ppb.

3.12. Temperature Life

All mated contacts were exposed to 240 hours of heat exposure. Tin-plated contacts were subjected to 90°C, and the precious metal-plated contacts were subjected to 150°C for the exposure time specified.