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**Circular Metal (CMC) Connector**

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**1. SCOPE**

## 1.1. Content

This specification covers the performance, tests and quality requirements for the Circular Metal Connector (CMC) using removable crimp contacts. Connectors are used in electronic power and control circuits.

## 1.2. Classification

## A. Series

- Standard using size 16 (.062 pin diameter) contacts
- High density using size 20 (.040 pin diameter) contacts
- Power using type XII contacts
- Combination of standard and power

## B. Class

- General Purpose
- Environmental resisting
- Shielded for EMI ( Requires shielded back shell hardware, not manufactured by AMP Incorporated)

## C. Shell Sizes

- 14
- 22
- 28

## 1.3. Qualification

When tests are performed on the subject product line, the procedures specified in 109-Series Test Specifications shall be used. All inspections shall be performed using the applicable inspection plan and product drawing.

**2. APPLICABLE DOCUMENTS**

The following documents form a part of this specification to the extent specified herein. In the event of conflict between the requirements of this specification and the product drawing, the product drawing shall take precedence. In the event of conflict between the requirements of this specification and the referenced documents, this specification shall take precedence.

## 2.1. TE Connectivity (TE) Documents

- A. 109-1: General Requirements for Test Specifications
- B. 109 Series: Test Specifications as indicated in Figure 1.
- C. 108-10037: Type XII Stamped and Formed Contact
- D. 108-10042: Type III+ Stamped and Formed Contact
- E. 108-40005: Connector, AMPLIMITE\* HDP-20, Subminiature D, with Removable F Crimp Contacts
- F. 114-10000: 20 DM, 20 DF Application Specification
- G. 114-10004: Type III+ Application Specification
- H. 114-10005: Type XII Application Specification
- I. 501-105: Test Report

## 2.2. Commercial Specification

IEC 144: Degree of Protection of Enclosures for Low-Voltage Switch Gear and Control Gear

- 2.3. Military Specification  
MIL-W-16878/4: Wire, Electrical, Insulated, High Temperature

**3. REQUIREMENTS**

- 3.1. Design and Construction  
Product shall be of the design, construction and physical dimensions specified on the applicable product drawing.
- 3.2. Materials
  - A. Shell: Zinc or aluminum alloy, nickel plated over copper
  - B. Insert: Thermoplastic, black, UL 94V-0
- 3.3. Ratings
  - A. Current: Maximum current shall be determined by contacts used, see Para 3.5 (a) and Figure 5.
  - B. Operating temperature: -55° to 125°C
- 3.4. Performance and Test Description  
The product is designed to meet the electrical, mechanical and environmental performance requirements specified in Figure 1. All tests are performed at ambient temperature unless otherwise specified.
- 3.5. Test Requirements and Procedures Summary

Test Description	Requirement	Procedure
Examination of Product	Meets requirements of product drawing and applicable TE Application Specification.	Visual, dimensional and functional per applicable quality inspection plan.
<b>ELECTRICAL</b>		
Termination Resistance, Dry Circuit	See Figure 5 for maximum resistance values	Subject mated contacts assembled in housing to 50 mv open circuit at 100 ma maximum, see Figure 6; Test Specification 109-6-1.
Dielectric Withstanding Voltage	1.5 kvac (rms) dielectric withstanding voltage. 1 minute hold. 2 milli- amperes maximum leakage current.	Test between adjacent contacts of mated connector and contacts to shell; Test Specification 109-29-1.
Insulation Resistance	5000 megohms minimum.	Test between adjacent contacts of mated connector assembly and contacts to shell; Test Specification 109-28-4.
Shell Resistance (c)	.05 ohms maximum DC. resistance from rear of plug to receptacle square flange.	Apply .1 ampere maximum to mated connector. Probes shall not puncture or damage finish
<b>MECHANICAL</b>		
Vibration (b)	No discontinuities greater than 10 microseconds.	Subject mated connectors to 15 G's, 10-2000 Hz with 100 ma current applied; Test Specification 109-23-3.

Figure 1 (continued)

Test Description	Requirement	Procedure
Physical Shock (b)	No discontinuities greater	Subject mated connectors to 50

	than 10 microseconds.	G's half-sine in 11 milliseconds; 3 shocks in each direction applied along the 3 mutually perpendicular planes total 18 shocks; Test Specification 109-26-1.																
Contact Retention	Axial displacement of contacts shall not exceed .012 inch.	Apply axial load as specified to crimped contacts at their engaging end; Test Specification 109-30.																
	<table border="1"> <thead> <tr> <th>Contact Size</th> <th>Axial Load Pounds</th> </tr> </thead> <tbody> <tr> <td>20</td> <td>7</td> </tr> <tr> <td>16</td> <td>10</td> </tr> <tr> <td>8</td> <td>25</td> </tr> </tbody> </table>		Contact Size	Axial Load Pounds	20	7	16	10	8	25								
Contact Size	Axial Load Pounds																	
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Durability	Measure torque initially and final; no physical damage.	Mate and unmate to completely separate connector assemblies for 500 cycles; Test Specification 109-27.																
Maintenance Aging	No physical damage to connector or locking device.	Subject crimp contacts in the connector to 5 cycles using appropriate tool; Test Specification 109-17.																
Retention, Plastic/Insert	Shell Size	Retention pounds minimum																
	<table border="1"> <tbody> <tr> <td>14</td> <td>40</td> </tr> <tr> <td>22</td> <td>75</td> </tr> <tr> <td>28</td> <td>100</td> </tr> </tbody> </table>		14	40	22	75	28	100										
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Torque	Shell Size	Torque Inch pounds																
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<b>ENVIRONMENTAL</b>																		
Thermal Shock (b)	No physical damage which would interfere with mechanical or electrical performance.	Subject mated connectors to 5 cycles between -55° and 125°C; Test Specification 109-22.																
Humidity-Temperature Cycling	100 megohms final insulation resistance, after 24 hours drying period at ambient; dielectric withstanding voltage.	Subject mated connectors to 10 humidity-temperature cycles between 25° and 65°C at 95% RH; Test Specification 109-23, method III, cond B, less steps 7a and 7b.																
Industrial Mixed Flowing Gas	Shell resistance; visual examination.	Subject mated connectors to environmental class III; Test Specification 109-85-3.																
Temperature Life (b)	100 megohms final insulation resistance; contact retention	Subject mated connectors to 125°C for 300 hours; Test Specification 109-43, test level 4, test duration B.																
Dust, Powder	No penetration of powder that will effect the mechanical properties of the connector.	Subject mated connector mounted in a closed chamber to talcum powder for a maximum of 6 hours; IEC 144, IP 34.																

Figure 1 (continued)

Test Description	Requirement	Procedure
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Water Splashing	Water shall not interfere with satisfactory operation and shall not enter cable or accumulate near cable end.	Subject mated connector and cable mounted on a turn table to water splashing for a duration of 10 minutes; IEC 144, IP 54.
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- (a) *The continuous current rating for individual contacts cannot be applied directly to the number of contacts as they are dependent on the thermal and physical properties of the material. System design shall assure that continuous current rating does not create internal hot spots that exceed the temperature designated by the connector specification, during steady-state or transient conditions.*
- (b) *Shall remain mated and show no evidence of damage, cracking or chipping.*
- (c) *Probes with spherical ends of .05 inch minimum radius shall be used.*

Figure (end)

3.6. Connector Tests and Sequences

	Test Group (a)				
	1	2	3	4	5
	Test Sequence (b)				
Examination of Product	1, 9	1, 5	1, 11	1, 6	1, 5
Termination Resistance, Dry Circuit	2, 8	2, 4	3, 8	2, 5	
Dielectric Withstanding Voltage			7		
Insulation Resistance			6		4
Shell Resistance				4	
Vibration	6				
Physical Shock	7				
Contact Retention			9		
Durability	4				
Maintenance Aging			2		
Retention, Plastic/Insert			10		
Torque	3, 5				
Thermal Shock			4		
Humidity-Temperature Cycling			5		
Industrial Mixed Flowing Gas				3	
Temperature Life		3			
Dust Powder (c)					2
Water Splashing (c)					3

**NOTE**

- (a) *See Para 4.1.A.*
- (b) *Numbers indicate sequence in which tests are performed.*
- (c) *This test for sealed connectors only.*
- (d) *Unless specifically noted, test 20% or minimum of 7 contacts in each connector for following tests: Termination resistance, insulation resistance, dielectric withstanding voltage, contact retention and maintenance aging.*

Figure 2

3.7. Retention of Qualification

Test or Examination	Test Group (a)	
	1 (c)	2
	Test Sequence (b)	
Examination of Product	1, 8	1, 6
Termination Resistance, Dry Circuit		3, 5
Dielectric Withstanding Voltage	3, 7	
Insulation Resistance	2, 6	
Torque		2
Thermal Shock	4	
Humidity-Temperature Cycling	5	
Industrial Mixed Flowing Gas		4 (d)

- NOTE**
- (a) See Para 4.1.A.
  - (b) Numbers indicate sequence in which tests are performed
  - (c) Group 1 applies only to products with an insulating system
  - (d) Precondition samples with 10 cycles durability.

Figure 3

4. QUALITY ASSURANCE PROVISIONS

4.1. Qualification Testing

A. Sample Selection

Connector housings and contacts shall be prepared in accordance with applicable Instruction Sheets. They shall be selected at random from current production. Test groups 1, 2, 4 and 5 shall consist of 8 connectors, one of each configuration listed in Figure 4. Test group 2 shall consist of 16 contacts, two of each configuration listed in Figure 4. The shell size and type contacts are indicated in Figure 4. Test group 5 consist of sealed connectors. All contacts shall be crimped to 3 feet of wire conforming to MIL-C-16878/4 in accordance with applicable TE Application Specification.

Connector Shell Size Configuration	Contact Type	Wire Size per Test Group				
		1	2	3	4	5
14-7	III+	22	30-14	22	22	22
22-16	III+	22	30-14	22	22	22
22-28	20 DF	24	28-20	24	24	
23-3	XII	12	16-8	12	12	12
28-37	III+	22	30-14	22	22	22
28-63	20 DF	24	28-20	24	24	
28-7	XII	12	16-8	12	12	12
28-22M	III+	22	30-14	22	22	22
	XII	12	16-8	12	12	12

- NOTES**
- 1. All connector sizes are standard sex.
  - 2. All contacts are selected gold over nickel plated.
  - 3. All connectors are fully loaded.

Figure 4

B. Test Sequence

Qualification inspection shall be verified by testing samples as specified in Figure 2.

4.2. Retention of Qualification

If, in a five-year period, no changes to the product or process occur, the product shall be subjected to the groups of the testing described in the test sequence, see Figure 3. Justification for exceeding this time limit must be documented and approved by the division manager.

4.3. Requalification Testing

If changes significantly affecting form, fit, or function are made to the product or to the manufacturing process, product assurance shall coordinate requalification testing, consisting of all or part of the original testing sequence as determined by development/product, quality, and reliability engineering.

4.4. Acceptance

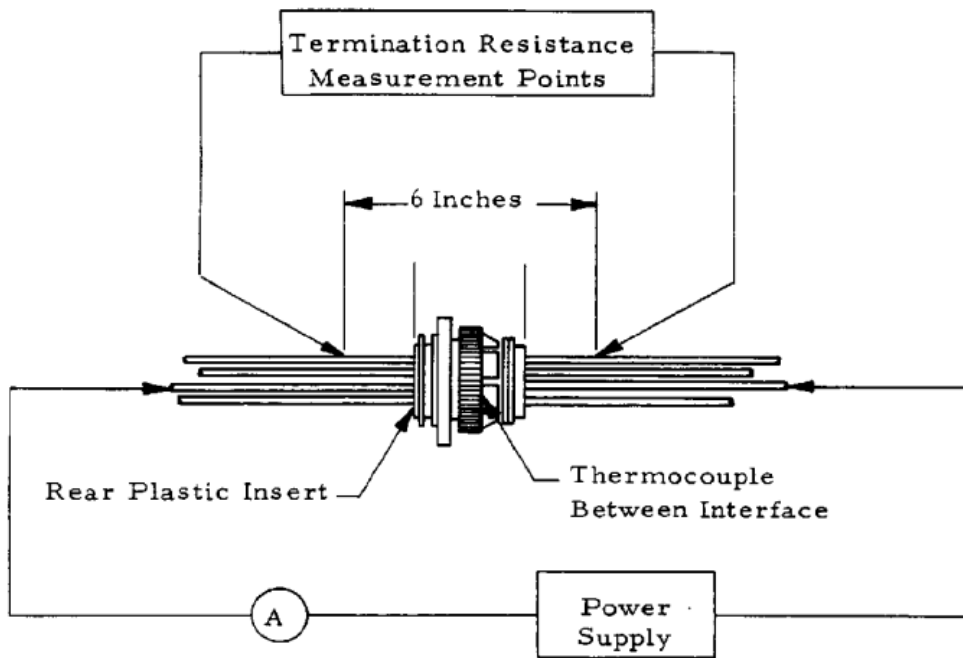
Acceptance is based on verification that the product meets the requirements of Figure 1. Failures attributed to equipment, test setup, or operator deficiencies shall not disqualify the product. When product failure occurs, corrective action shall be taken and samples resubmitted for qualification. Testing to confirm corrective action is required before resubmittal.

4.5. Quality Conformance Inspection

The applicable quality inspection plan will specify the sampling acceptable quality level to be used. Dimensional and functional requirements shall be in accordance with the applicable product drawing and this specification.

Contact Size	Wire Size	Termination Resistance	
		Test Current Amperes	Resistance, Milliohms maximum
20	20	7.5	10.0
	22	5.0	12.0
	24	3.0	15.0
	26	2.0	21.0
	28	1.5	32.5
16	14	17	6.0
	16	13	6.5
	18	10	7.5
	20	7.5	9.0
	22	5.0	9.5
	24	3.0	14.5
	26	2.0	19.0
	28	1.5	30.0
	30	1.2	43.0
8 Type XII Contacts	8	35	.80
	10	33	.95
	12	23	1.25
	14	17	1.50
	16	13	2.70

Figure 5



**NOTE** *Termination resistance equals millivolts divided by test current. (Subtract resistance of wire leads).*

Figure 6  
Resistance Measurement Points, Typical