Sealed COPALUM* Terminals & Splices, Copper Wire

1. INTRODUCTION

1.1. Purpose

Testing was performed on Sealed COPALUM* Terminals and Splices to determine their conformance to the requirements of AMP* Product Specification 108-11011-1 Revision A.

1.2. Scope

This report covers the electrical, mechanical, and environmental performance of the Sealed COPALUM Terminals and Splices. Testing was performed at the Americas Regional Laboratory between 23May93 and 25Apr95. The test file number for this testing is CTL 3014-000-042. This documentation is on file at and available from the Americas Regional Laboratory.

1.3. Conclusion

The Sealed COPALUM Terminals and Splices, terminated to copper wire, listed in paragraph 1.5., conformed to the electrical, mechanical, and environmental performance requirements of AMP Product Specification 108-11011-1 Revision A.

1.4. Product Description

The Sealed COPALUM Terminals and Splices are designed especially for solving the inherent problems of terminating both copper and aluminum conductors. These terminals and splices, available for terminating and splicing stranded aluminum and stranded copper wire, are made of high conductivity ETP copper and are especially suited for the aerospace industry.

1.5. Test Samples

The test samples were representative of normal production lots, samples identified with the following part numbers were used for test:

Test Group	Quantity	Part Nbr	Description
1,2	10 ea.	277151-1	Terminal with AWG 2 copper wire, applied with standard pressure crimp.
1,2	6 ea.	277160-1	Splice with AWG 2 copper wire, applied with standard pressure crimp.
1,2	10 ea.	277152-4	Terminal with AWG 1/0 copper wire, applied with standard pressure crimp.
1,2	10 ea.	277152-4	Terminal with AWG 1/0 copper wire, applied with low pressure crimp.
1,2	6 ea.	277161-1	Splice with AWG 1/0 copper wire, applied with standard pressure crimp.
1,2	6 ea.	277161-1	Splice with AWG 1/0 copper wire, applied with low pressure crimp.
1,2	10 ea.	55995-1	Terminal with AWG 3/0 copper wire, applied with standard pressure crimp.
1,2	10 ea.	55995-1	Terminal with AWG 3/0 copper wire, applied with low pressure crimp.

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 Groups (a)	
	1	2
	Test Sequence (b)	
Examination of product	1,12	1,5
Millivolt Drop	2,10	2,4
Temperature rise vs current	3,9	
Current cycling		3
Vibration	4	
Crimp tensile	11	
Thermal shock	5	
Humidity-temperature cycling	7	
Salt spray corrosion	8	
Temperature life	6	

NOTE

(a) See Para 1.5.
(b) The numbers indicate sequence in which tests were performed.

2. SUMMARY OF TESTING

2.1. Examination of Product - All Groups

All samples submitted for testing were representative of normal production lots. A Certificate of Conformance was issued by the Product Assurance Department of the General Products Business Unit. Where specified, samples were visually examined and no evidence of physical damage detrimental to product performance was observed.

Form 404-34 20Nov96

2.2. Millivolt Drop - Groups 1 and 2

All millivolt drop measurements, taken at specified test current, were less than requirements specified in Figure 3 of AMP Product Specification 108-11011-1 Revision A.

Test Group	# of Data Points	Condition	Wire Gage (AWG)	Test Current (amperes)	Millivolt Drop			Specified Maximum Millivolts
					Min	Max	Mean	
Terminals								
1 (a)	10	Initial	2	181	2.97	3.20	3.11	5
		Final			3.05	3.42	3.17	6
2 (a)	10	Initial	2	181	3.01	3.11	3.06	5
		Final			3.10	3.21	3.15	6
1 (a)	10	Initial	1/0	245	3.07	3.77	3.41	5
		Final			3.42	3.70	3.58	6
2 (a)	10	Initial	1/0	245	3.16	4.05	3.61	5
		Final			3.47	3.98	3.69	6
1 (b)	10	Initial	1/0	245	3.22	3.65	3.45	5
		Final			3.37	3.49	3.43	6
2 (b)	10	Initial	1/0	245	3.27	3.52	3.39	5
		Final			3.41	3.88	3.61	6
1 (a)	10	Initial	3/0	328	3.22	3.49	3.33	4
		Final			3.30	3.53	3.42	6
2 (a)	10	Initial	3/0	328	3.22	3.42	3.31	4
		Final			3.38	3.55	3.49	6
1 (b)	10	Initial	3/0	328	2.83	3.04	2.93	4
		Final			2.90	3.36	3.15	6
2 (b)	10	Initial	3/0	328	2.61	3.09	2.93	4
		Final			3.00	3.28	3.13	6
Half Splice								
1 (a)	12	Initial	2	181	3.25	3.46	3.35	5
		Final			3.12	3.26	3.19	7
2 (a)	12	Initial	2	181	3.24	3.46	3.34	5
		Final			3.37	3.59	3.48	7
1 (a)	12	Initial	1/0	245	2.76	3.33	3.09	5
		Final			2.93	3.37	3.19	7
2 (a)	12	Initial	1/0	245	2.74	3.25	2.92	5
		Final			2.92	3.36	3.13	7
1 (b)	12	Initial	1/0	245	2.55	3.00	2.73	5
		Final			2.88	3.16	2.99	7
2 (b)	12	Initial	1/0	245	2.55	3.01	2.80	5
		Final			2.70	3.31	2.98	7

NOTE

(a) Terminals or splices applied with standard pressure crimp.
(b) Terminals or splices applied with low pressure crimp.

2.3. Temperature Rise vs Current - Group 1

All samples had a temperature rise of less than 30°C above the control wire temperature when tested using the test current specified in Figure 3 of AMP Product Specification 108-11011-1 Revision A.

2.4. Current Cycling - Group 2

No evidence of physical damage was visible as a result of current cycling.

2.5. Vibration - Group 1

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

2.6. Crimp Tensile - Group 1

All tensile values were greater than specification minimum.

2.7. Thermal Shock - Group 1

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

2.8. Humidity-temperature Cycling - Group 1

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

2.9. Corrosion, Salt Spray - Group 1

No evidence of physical damage to the terminals was visible as a result of exposure to a salt spray atmosphere.

2.10. Temperature Life - Group 1

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

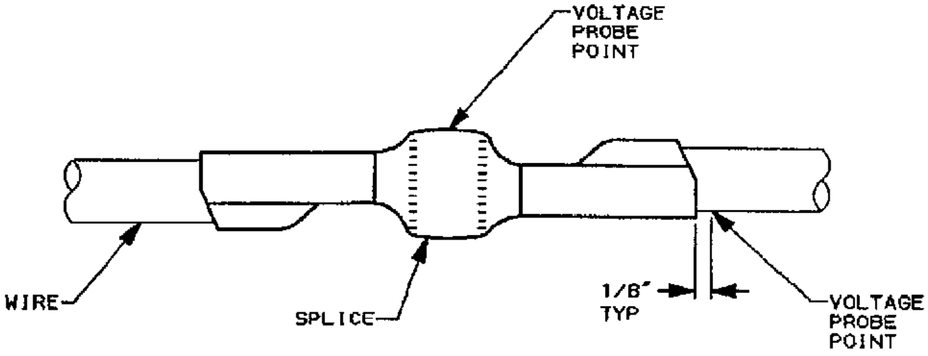
3. TEST METHODS

3.1. Examination of Product

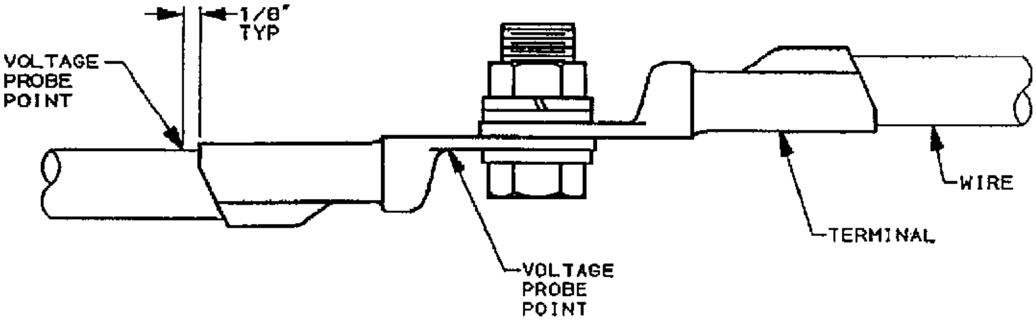
Where specified, samples were visually examined for evidence of physical damage detrimental to product performance.

3.2. Millivolt Drop

Millivolt drop measurements at specified current were made using a 4 terminal measuring technique at the specified probe points, see Figure 1. See Figure 2 for specified currents for millivolt drop measurements.



Voltage Probe Points for Splices



Voltage Probe Points For Terminals

Figure 1
Typical Voltage Drop Measurement Points

Wire Size	Test Current
2 AWG Copper	181 Amperes
1/0 AWG Copper	245 Amperes
3/0 AWG Copper	328 Amperes

Figure 2
Specified Current for Millivolt Drop and Temperature Rise Measurements

3.3. Temperature Rise vs Specified Current

Connector and control conductor temperatures were measured while energized at the specified currents indicated in Figure 2. Thermocouples were attached to the terminals and to the middle of the control conductor to measure their temperatures. 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. This temperature was then compared to the control conductor temperature to determine if the requirement to not exceed 30°C temperature rise above the control conductor temperature was met.

3.4. Current Cycling

Test samples were configured into a chain and subjected to 80 current cycles with each cycle being 60 minutes current on followed by 30 minutes current off. The current level was as required to achieve the control conductor temperature requirement listed below. Temperature measurements of samples and the control conductor were taken at the end of the current on cycle, after every 10 cycles. At the end of 60, 70, and 80 current cycles, millivolt drop measurements were taken using the specified current in Figure 2.

Current Cycle Number	1-10	11-20	21-30	31-40	41-50	51-60	61-70	71-80
Control Conductor Temperature °C	130	140	150	160	170	180	180	180

NOTE *After completion of this testing, the current cycling test requirement was revised to the 50 cycle test requirement contained in AMP Product Specification 108-11011-1, Revision A.*

3.5. Vibration, Sinusoidal

Mated samples were subjected to sinusoidal vibration, having a simple harmonic motion with an amplitude of 0.06 inch, double amplitude, or 15 g's peak, whichever is less. The vibration frequency was varied uniformly between the limits of 10 and 2000 Hz and returned to 10 Hz in 20 minutes. This cycle was performed 12 times in each of 2 planes for a total vibration time of 8 hours.

3.6. Crimp Tensile

An increasing axial force was applied to each sample, using a tensile/compression device, at a crosshead rate of 1 inch/minute, until the conductor became separated from the sample.

3.7. Thermal Shock

Terminals and splices were subjected to 5 cycles of thermal shock with each cycle consisting of 60 minute dwells at -55C and 150°C. The transition between temperatures was less than 1 minute.

3.8. Humidity-temperature Cycling

Terminals and splices 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. (Figure 3)

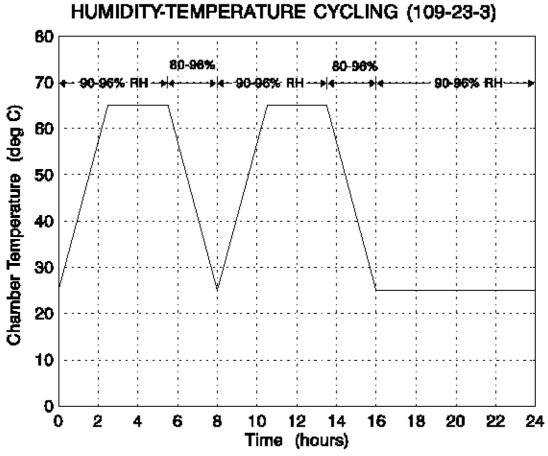


Figure 3
Typical Humidity-Temperature Cycling Profile

3.9. Corrosion, Salt Spray

Samples were subjected to a 5% salt spray environment for 96 hours. The temperature of the box was maintained at 95 +2 -3°C, and the pH of the salt solution was between 6.5 and 7.2.

3.10. Temperature Life

Samples were exposed to a temperature of 150°C for 120 hours.

4. VALIDATION

Prepared by:

Robert J. Rosen 5/14/98

Robert J. Rosen
Test Engineer
Product Qualification Team
Americas Regional Laboratory

Reviewed by:

L. W. Schaeffer 5/18/98

Lee W. Schaeffer
Supervisor
Test Engineering
Americas Regional Laboratory

Approved by:

John Assini 6/11/98

John E. Assini
Manager
Advanced Quality Planning
U.S. Products Business Office