Fine Magnet Wire Open Barrel Pigtail Splice Terminal

1. INTRODUCTION

1.1 Purpose

Testing was performed on TE Connectivity's (TE) Fine Magnet Wire Open Barrel Pigtail Splice Terminal to determine its conformance to the requirements of Product Specification 108-64051, Revision C.

1.2 Scope

This report covers the environmental, electrical and mechanical performance of the TE Fine Magnet Wire Open Barrel Pigtail Splice Terminal that were submitted for testing. Testing was performed at the TE Shanghai Electrical Components Test Laboratory between April 23, 2019 and Jan 21, 2020. This documentation is on file and maintained at the TE Shanghai Electrical Components Test Laboratory under TP-19-00837 and TP-19-03618.

1.3 Conclusion

The TE Connectivity Fine Magnet Wire Open Barrel Pigtail Splice Terminal listed in paragraph 1.5 conformed to the electrical, mechanical, and environmental performance requirements of Product Specification 108-64051, Revision C.

1.4 Product Description

The Fine Magnet Wire Open Barrel Pigtail Splice Terminal is designed to splice unstripped aluminum or copper magnet wires together with stranded lead wire within a combined total range of 400 to 1500CMA.

1.5 Test Specimens

The test specimens were representative of normal production lots, and the following part numbers were used for test program (refer to Table 1):

Table 1 – Test Specimens

Test Group	Qty.	Part Number	Description
1	5	2825180-2 Rev B	Fine Magwire Splice, Mini MAG-MATE Serration 400-1500 CMA on (1) 0.32mm Cu MAGNET WIRE + (1) #26 AWG LEAD WIRE 403 TOTAL CMA, 2.03mm CW, 1.04mm CH
1	5	2825180-2 Rev B	Fine Magwire Splice, Mini MAG-MATE Serration 400-1500 CMA on (1) 0.32mm Cu MAGNET WIRE + (1) #20 AWG LEAD WIRE 1191 TOTAL CMA, 2.03mm CW, 1.19mm CH
1	5	2825180-2 Rev B	Fine Magwire Splice, Mini MAG-MATE Serration 400-1500 CMA on (1) 0.18mm Cu MAGNET WIRE + (1) #20 AWG LEAD WIRE 1077 TOTAL CMA, 2.03mm CW, 1.17mm CH
1	5	2825180-2 Rev B	Fine Magwire Splice, Mini MAG-MATE Serration 400-1500 CMA on (1) 0.18mm Cu MAGNET WIRE + (1) #24 AWG LEAD WIRE 429 TOTAL CMA, 2.03mm CW, 1.05mm CH
1	5	2825180-2 Rev B	Fine Magwire Splice, Mini MAG-MATE Serration 400-1500 CMA on (1) 0.14mm Cu MAGNET WIRE + (1) #24 AWG LEAD WIRE 414 TOTAL CMA, 2.03mm CW, 1.05mm CH
1	5	2825180-2 Rev B	Fine Magwire Splice, Mini MAG-MATE Serration 400-1500 CMA on (1) 0.14mm Cu MAGNET WIRE + (1) #20 AWG LEAD WIRE 1062 TOTAL CMA, 2.03mm CW, 1.16mm CH
1	5	2825180-2 Rev B	Fine Magwire Splice, Mini MAG-MATE Serration 400-1500 CMA on (1) 0.24mm Cu MAGNET WIRE + (1) #22 AWG LEAD WIRE 794 TOTAL CMA, 2.03mm CW, 1.12mm CH
2	5	2825180-2 Rev B	Fine Magwire Splice, Mini MAG-MATE Serration 400-1500 CMA on (1) 0.32mm Cu MAGNET WIRE + (1) #26 AWG LEAD WIRE 403 TOTAL CMA, 2.03mm CW, 1.04mm CH
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1.6 Qualification Test Sequence

Table 2-Test Sequence

TEST OR EXAMINATION	TEST GROUP (a)		
	1	2	3
	TEST SEQUENCE (b)		
Initial examination of product	1	1	1
Low level contact resistance	2,6,9	2,4	
Temperature rise vs. current	3,10		
Current cycling		3	
Vibration, random	8		
Termination tensile strength			2
Thermal shock	5		
Humidity exposure	7		
Temperature life	4		
Final examination of product	11	5	3

Note: (a) Numbers indicate sequence in which tests are performed

1.7 Environmental Conditions

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

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

2. SUMMARY OF TESTING

2.1 Initial Visual Examination – All Test Groups

A Certificate of Conformance stating that all specimens submitted for testing were representative of normal production lots and met the requirements of the applicable product drawing was provided. Where specified, 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 and 2

All low level contact resistance measurements recorded were less than the corresponding requirement listed in Table 3 per wire size and material.

Table 3 – Current, Resistance and Crimp Tensile Strength Specifications

Current, Resistance and Crimp Tensile Requirements										
Wire Size			Current and Resistance Specifications						Tensile Strength Specs [lbs]	
AWG	MM	CMA	Copper		Low Level Resistance*	Aluminum		Low Level Resistance*	Copper	Aluminum
			Current (amps)		(mΩ max)	Current (amps)		(mΩ max)		
			T-Rise	Cycled		T-Rise	Cycled			
28	0.32	159	2.5	5	14.4	2	3.5	28.9	2.8	0.9
28½	0.3	144	2.2	4.7	16	1.8	3.2	32.5	2.5	0.84
29	0.29	128	2	4.5	18	1.7	3	36	2.1	0.77
29 ½	0.27	115	1.7	4	21	1.5	2.6	41	1.8	0.69
30	0.25	100	1.5	3.5	23	1.3	2.3	46	1.4	0.6
30½	0.24	90	1.3	2.6	25	1	1.8	52	1.2	0.54
31	0.23	79	1	2	26	0.7	1.3	58	1	0.48
32	0.2	64	0.8	1.5	36	0.6	1	72	0.7	0.39
32½	0.19	56	0.6	1.2	45	0.5	0.8	81	0.7	0.35
33	0.18	50	0.5	0.8	55	0.4	0.7	91.5	0.7	0.3
34	0.16	40	0.4	0.7	64	0.2	0.3	116	0.6	0.24
35	0.14	31	0.3	0.5	73	0.1	0.2	146	0.5	0.19

**** Resistance measurement includes crimp + 1.5 inches of wire.***

2.3 Temperature Rise Vs. Current – Test Group 1

All specimens had values of less than 30°C for temperature rise vs. current measurements at their respective current levels, initially and finally. Refer to Table 3 for the listing of T-rise currents per wire size and material.

2.4 Current Cycling – Test Group 2

No evidence of physical damage detrimental to product performance was observed during or after current cycling. Low level contact resistance measurements were taken initially, and after every 5,000 cycles. Refer to Table 3 for the listing of cycled currents per wire size and material.

2.5 Vibration, random – Test Group 1

No apparent physical damage or discontinuities of one microsecond or greater occurred during testing.

2.6 Termination tensile strength – Test Group 3

All termination tensile strength measurements recorded were greater than the corresponding requirement listed in Table 3 per wire size and material.

2.7 Thermal Shock – Test Group 1

No evidence of physical damage detrimental to product performance was observed.

2.8 Humidity Exposure – Test Group 1

No evidence of physical damage detrimental to product performance was observed.

2.9 Temperature Life – Test Group 1

No evidence of physical damage detrimental to product performance was observed.

2.10 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 taken at a current level of 100 milliamperes maximum and 20 millivolts maximum open circuit voltage. Measurements were taken from the center of the AMPLIVAR Splice to a point on the magnet wire that was 1.5 inches from the center of the splice. Figure 1 illustrates the measurement points.

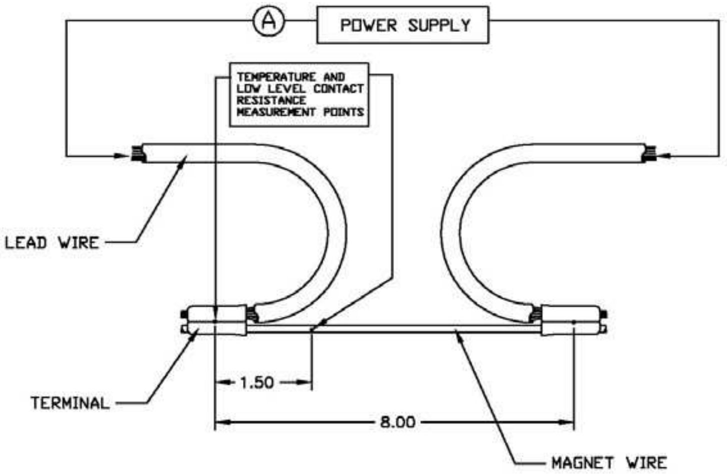

Figure 1 – Low Level Contact Resistance Measurement Points

3.3 Temperature Rise vs. Current

Temperature rise was measured at the current level specified in Table 3. Thermocouples were attached to individual contacts on the back of the wire crimp to measure their temperatures. The ambient temperature was then subtracted from this measured temperature to find the temperature rise. 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. Refer to Figure 2 for an image of the typical test setup.

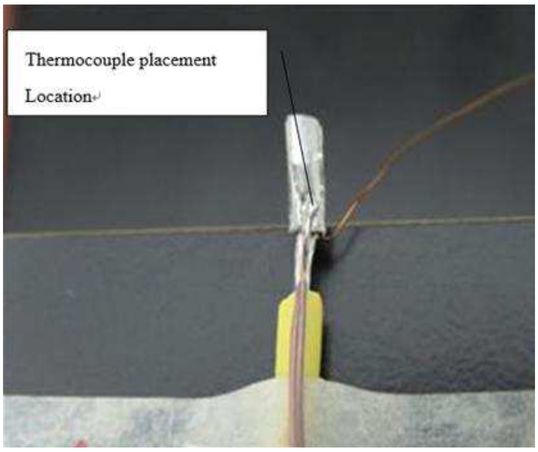

Figure 2 – Typical Test Setup

3.4 Current Cycling

Testing consisted of 10,000 cycles of current cycling, with each cycle having current on for 3 minutes and current off for 3 minutes. The test current was followed the table 3. Low level contact resistance measurements were taken after 5000 cycles and at the completion of the 10,000 cycles.

3.5 Vibration, random

The test specimens were subjected to a random vibration test. The parameters of this test condition are specified by a random vibration spectrum with excitation frequency bounds of 20 and 500 Hertz (Hz). The spectrum remains flat at 0.02 G^2/Hz from 20 Hz to the upper bound frequency of 500 Hz. The root-mean square amplitude of the excitation was 3.10 GRMS. The test specimens were subjected to this test for 3 hours in each of the three mutually perpendicular axes, for a total test time of 9 hours per test specimen. The test specimens were monitored for discontinuities of 1 microsecond or greater using an energizing current of 100milliamperes.

3.6 Termination Tensile Strength

A floating caliper was secured to the base of the tensile machine. A slotted plate fixture was fastened to the caliper. A mandrel was attached to the crosshead of the tensile machine. The magnet wire of the test specimen was wrapped around the mandrel and the crimp was held in the slotted plate for test. The magnet wire of each test specimen was placed in the clamp and the crimp was held in the slotted plate. The crosshead was then raised at a speed of 1 inch per minute until failure. A photo of the test setup for test sets in Figure 3 below.

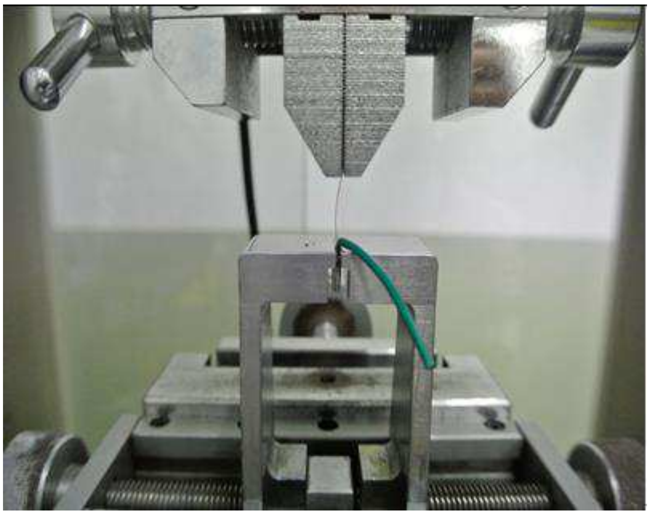

Figure 3 – Crimp Tensile Setup

3.7 Thermal Shock

Test specimens were subjected to fifty cycles of thermal shock testing from -65°C to 150°C with 30 minute dwells at each extreme.

3.8 Humidity Exposure

Specimens were subjected to 40°C at 90-95% relative humidity for 96 hours in an environmental chamber.

3.9 Temperature Life

Specimens were subjected to 150°C for 96 hours in an air circulating oven.

3.10 Final Examination of Product

Specimens were visually examined and no evidence of physical damage detrimental to product performance was observed.