Fuse and Relay Box Assembly

1. INTRODUCTION

1.1. Purpose

Testing was performed on the Fuse and Relay Box to determine conformance to the requirements given in Product Specification 108-151059.

1.2. Scope

This report covers the performance of the Fuse and Relay Box. Testing was performed at the Winston-Salem Electronic Components Test Laboratory in 2018 through 2020. The test file numbers for this testing are WE-20170841ACL, WE-20190049ACL, WE-20190050ACL, WE-20190051ACL, WE-20200870, WE-20201107ACL, and WE-20201253ACL. This documentation is on file at, and available from, the Global Automotive Division Product Reliability Center.

1.3. Conclusion

The Flanged Fuse and Relay Box conformed to the mechanical, electrical, and environmental performance requirements given in Product Specification 108-151059.

1.4. Test Specimens

Test specimens were representative of normal production lots. Specimen part numbers listed in Figure 1 were used for the tests.

PART NUMBER	DESCRIPTION
2304643-1	49POS,HYBRID,REC HSG ASSY,SLD
2304643-2	38POS,HYBRID,REC HSG ASSY,SLD
2304643-3	27POS,HYBRID,REC HSG ASSY,SLD
2304643-4	60POS,AMP MCP 2.8,REC HSG ASSY,SLD
2098164-3	Cover, 60 Pos, No Top Side Fuse Graphic
0297030.WXNV	Littlefuse, 30A MINI Blade Fuse
VF4-15F21-Z22	TE 90 Ohm Relay
1-1719506-1	AMP MCP 2.8 Receptacle Contact, 12 AWG TXL, Pre-tin Plated
1-968855-1	AMP MCP 2.8 Receptacle Contact, 20 AWG TXL, Pre-tin Plated
1241418-4	AMP MCP 6.3 Receptacle Contact, 10 AWG TXL, Pre-tin Plated
1241412-1	AMP MCP 6.3 Receptacle Contact, 18 AWG TXL, Pre-tin Plated
828905-1	AMP MCP 2.8 Wire Seal, 12 AWG TXL
828904-1	AMP MCP 2.8 Wire Seal, 20 AWG TXL
1719043-1	AMP MCP 6.3 Wire Seal, 10 AWG TXL
2177018-1	AMP MCP 6.3 Wire Seal, 18 AWG TXL

Figure 1. Test Specimen Part Numbers and Description

1.5. Environmental Conditions

Unless otherwise stated, the following environmental conditions prevailed during testing.
Temperature: 15°C to 35°C
Relative humidity (RH): 25 to 75%

1.6. Qualification Test Sequence

Test or Examination	Test Group (a)						
	1	2	3	4	5	6	7
	Test Sequence (b)						
Visual examination	1,8	1,5	1,4	1,7	1,7	1,5	1,5
Connection Resistance	2,4,6						
Insulation Resistance				2,4,6	2,4,6		
Withstanding voltage						2,4	2,4
Random vibration	3						
Mechanical shock	5						
Housing locking mechanism strength		4					
Housing locking mechanism retention force to failure			3				
Connector cover durability at room ambient		3					
Connector cover durability at -40°C	7						
Durability, misaligned hinges		2					
Contact retention			2				
Degree of protection, IP6K6				5			
Degree of protection, IP6K7					5		
Salt fog							3
Thermal shock				3(c)	3(c)		
Humidity-temperature cycling						3	

Figure 2

NOTE

(a) *See paragraph 1.4*

(b) *Numbers indicate sequence in which tests are performed*

(c) *Samples allowed to vent to atmosphere during exposure via an unpopulated circuit cavity or through wire ends.*

2. SUMMARY OF TESTING

2.1. Visual Examination of Product – All Test groups

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

2.2. Connection Resistance – Test group 1

All voltage drop measurements were less than 100 mV after subtracting the bulk resistance of equal wire length.

2.3. Insulation Resistance – Test group 4 and 5

All insulation resistance measurements were greater than 100 MΩ.

2.4. Withstanding voltage – Test groups 6 and 7

No dielectric breakdown or flashover occurred.

2.5. Random Vibration – Test group 1

No discontinuities were detected during vibration testing. Following vibration testing, no cracks, breaks, or loose parts on the specimens were visible.

2.6. Mechanical Shock – Test group 1

No discontinuities were detected during mechanical shock testing. Following mechanical shock testing, no cracks, breaks, or loose parts on the specimens were visible.

2.7. Housing locking mechanism strength – Test group 2

No physical damage occurred as a result of the samples subjected to 100N force.

2.8. Housing locking mechanism strength force to failure – Test group 3

All disengagement forces were greater than 250N.

2.9. Connector Cover Durability at Room Ambient – Test Group 2

No physical damage occurred as a result of manually mounting and dismounting the specimens 50 times.

2.10. Connector Cover Durability at -40°C – Test Group 1

No physical damage occurred as a result of manually mounting and dismounting the specimens 5 times.

2.11. Durability, misaligned hinges – Test group 2

No physical damage occurred as a result of the samples subjected to 100N force.

2.12. Contact retention – Test group 3

All 6.3 AMP MCP contacts withstood an 80 N removal force and 2.8 AMP MCP contacts withstood a 60 N removal force before failing.

2.13. Degree of protection, IP6K6 – Test groups 4

No evidence of physical damage was visible as a result of exposure to dust and water spray.

2.14. Degree of protection, IP6K7 – Test group 5

No evidence of physical damage was visible as a result of dust and water immersion.

2.15. Salt fog – Test group 7

No evidence of physical damage was visible as a result of exposure to a salt-laden atmosphere.

2.16. Thermal Shock – Test group 4 and 5

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

2.17. Humidity-temperature cycling – Test group 6

No evidence of physical damage was visible as a result of humidity/temperature cycling.

3. TEST METHODS

3.1. Visual Examination of Product

All samples were visually examined for identification, torn seals, and cracked plastic or any other defect.

3.2. Connection Resistance

The samples were placed on a non-conductive surface. Measurements were taken on the data acquisition systems using the voltage probe bundles (2-wire probe method). The current was set at 40 A for the size 10 AWG TXL wire and 15 A for the size 12 AWG TXL wire. The circuits were allowed to stabilize for 30 minutes before measurements were taken. The overall resistance included 8.5 inches of wire, terminal crimp resistance, bulk resistance of the terminal, and the terminal to fuse interface. The resistance of the 8.5 inches of wire was subtracted out of the final measurements so that the reported data only included the crimp, bulk resistance of the terminal, and the interface.

3.3. Insulation Resistance

Insulation resistance was measured between adjacent contacts. A test voltage of 500 V DC was applied for 2 minutes, and the resistance was measured.

3.4. Dielectric Withstanding Voltage

A test potential of 500 volts DC was applied between adjacent circuit positions. This potential was applied for 2 minutes and then returned to zero.

3.5. Random Vibration

Specimens were subjected to 3.2 Grms, per the vibration profile in Figure 3. Eight hours in each of 3 mutually perpendicular planes. Specimens were monitored for discontinuities of 10 microseconds or greater using a current of 100 milliamperes at less than 20 millivolts DC.

Breakpoint Frequency (Hz)	Magnitude (G^2/Hz)	Slope Between Breakpoint (dB/Octave)
10	.070	0.0
20	.070	-5.42
40	.020	0.0
350	.020	-9.20
550	.005	-20.02
700	.001	-100.12
750	.0001	0.0
2000	.0001	0.0

Figure 3: Vibration Profile

NOTE

(a) *Tolerance: ± 4 db from 10 to 2000 Hz*

(b) *Wires to be firmly supported within 100 mm from wire exits*

VIBRATION FIXTURE SETUP SHOWN FOR Z-AXIS WITH WIRE BUNDLE CLAMPED

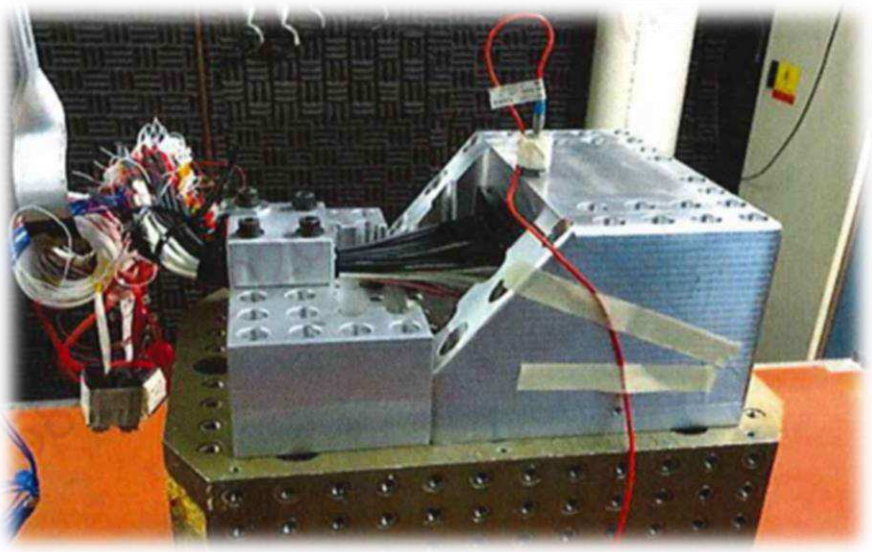

Figure 4

3.6. Mechanical Shock

Specimens were subjected to a mechanical shock test having a half-sine waveform of 30 gravity units (g peak) and a duration of 11 milliseconds. Three shocks in each direction were applied along the 3 mutually perpendicular planes for a total of 18 shocks. Specimens were monitored for discontinuities of 10 microseconds or greater using a current of 100 milliamperes DC.

3.7. Housing locking mechanism strength

Specimens were subjected to a force of 100 N for 1 minute.

HOUSING LOCKING MECHANISM STRENGTH PULL SETUP

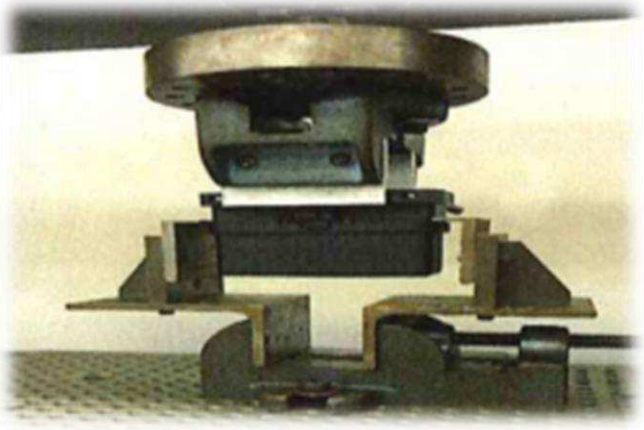

Figure 5

3.8. Housing locking mechanism strength force to failure

Specimens with latches engaged were pulled to failure.

3.9. Connector Cover Durability at Room Ambient

Covers were manually mounted and dismounted 50 times at ambient temperature.

3.10. Connector Cover Durability at -40°C

Covers were manually mounted and dismounted 5 times at -40°C.

3.11. Durability, misaligned hinges

Misaligned covers (1 hinge latched in the correct position with the other outside the base latch) were subjected to 3 cycles of a 100 N force applied for 1 minute at a maximum rate of 20 mm per minute.

3.12. Contact retention

AMP MCP 6.3 Receptacle terminals were subjected to a force of 80 N and AMP MCP 2.8 Receptacle terminals were subjected to a force of 60 N applied at a maximum rate of 25 mm per minute.

CONTACT RETENTION SETUP

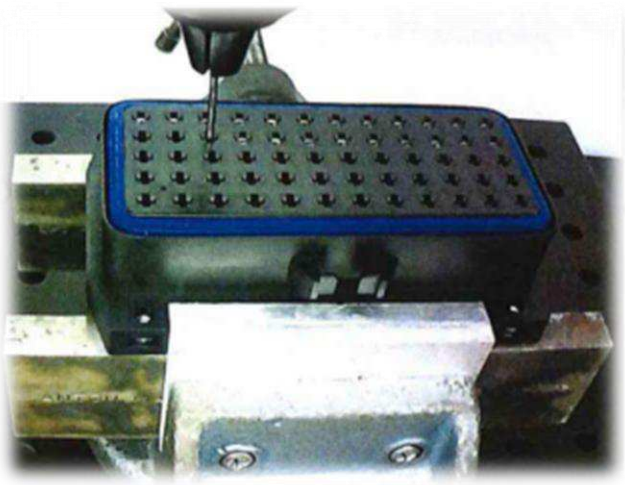

Figure 6

3.13. Degree of protection, IP6K6

Specimens were subjected to a water flow rate of approximately 100 litres per minute for approximately 3 minutes 15 seconds at a distance of 2.5-3 meters. Water flow will not be directed at the wire seals. Specimens were subjected to a mixture of 50% Portland Cement and 50% Fly Ash with an agitation of 6 seconds every 15 minutes for 5 hours.

3.14. Degree of protection, IP6K7

Specimens were submerged in water to a depth of 1 meter and held for 30 minutes. Specimens were subjected to a mixture of 50% Portland Cement and 50% Fly Ash with an agitation of 6 seconds every 15 minutes for 5 hours.

3.15. Salt fog

Specimens were exposed to a 5% salt concentration for 1000 hours at 35°C and 95% RH.

3.16. Resistance to thermal shocks

Specimens were subjected to 50 cycles of thermal shock with each cycle consisting of 60-minute dwells at -55°C and 85°C for a total test time of 100 hours.

3.17. Humidity-temperature cycling

Specimens 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, with a cold shock (-10°C) during the 7th cycle.

4. TEST SEQUENCE-TO-TEST NUMBER CROSS-REFERENCE

Part Number	Test Group	Report Number
2304643-1	3	WE-20201100
	4	WE-20200870
	5	WE-20200870
	6	WE-20201101
	7	WE-20201101
2304643-2	1	WE-20190050ACL
	2	WE-20190049ACL
	3	WE-20190049ACL
	4	WE-20200870
	5	WE-20200870
	6	WE-20190051ACL
	7	WE-20190051ACL
2304643-3	1	WE-20190594ACL
	3	WE-20190592ACL
	4	WE-20200870
	5	WE-20200870
	6	WE-20201101
	7	WE-20201101
2304643-4	1	WE-20170841ACL
	2	WE-20190049ACL
	3	WE-20190049ACL
	4	WE-20200870
	5	WE-20200870
	6	WE-20190051ACL
	7	WE-20190051ACL

Figure 7

5. REVISION HISTORY

Revision	Date	Revision Description
A	October 29, 2020	Initial Release
B	March 1, 2021	2304643-1 and 2304643-3 test groups added, formatting updated.