Evaluation of .040/2.8 mm Contact Systems

1. INTRODUCTION

1.1. Purpose

Testing was performed on the Tyco Electronics .040 and 2.8 mm Contact Systems to determine their performance when subjected to selected tests of SAE/USCAR (see Figure 2).

1.2. Scope

This report covers specimens tested under test reports ACS2107019, 19990281ACL, 19990282ACL, ACL04170016, 19990257ACL and ACL2107009 performed by the Global Automotive Division Product Reliability Center.

1.3. Test Specimens

Test specimens were representative of normal production lots. Specimens identified with the following part numbers were used for test:

Part Number	Description
175265-1	.040 II Series S receptacle w/18 AWG wire
178801-6	.040/.070 Hybrid I/O connector 26 position plug housing
776172-1	.040/.070 Hybrid I/O connector 64 position cap housing assembly
1326029-1	Unsealed 2.8 mm blade w/22 AWG wire
1326029-2	Unsealed 2.8 mm blade w/20 AWG wire
1326029-2	Unsealed 2.8 mm blade w/18 AWG wire
1326029-3	Unsealed 2.8 mm blade w/14 AWG wire
1326029-4	Unsealed 2.8 mm blade w/12 AWG wire
1326030-1	Unsealed 2.8 mm receptacle w/22 AWG wire
1326030-2	Unsealed 2.8 mm receptacle w/20 AWG wire
1326030-2	Unsealed 2.8 mm receptacle w/18 AWG wire
1326030-3	Unsealed 2.8 mm receptacle w/14 AWG wire
1326030-3	Unsealed 2.8 mm receptacle w/16 AWG wire
1326030-4	Unsealed 2.8 mm receptacle w/12 AWG wire
1326030-4	Unsealed 2.8 mm receptacle w/10 AWG wire

Figure 1

1.4. Environmental Conditions

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

- Temperature: 15 to 35°C
- Relative Humidity: 25 to 75%

2. PRODUCT TEST SEQUENCE

Test or Examination	Test Group					
	1	2	3	4	5	6
	Test Sequence (see Note)					
Visual examination	1	1	1	1	1	1
Dry circuit resistance			2,7,9,11,13,15,17	2,5	2,5	2,5
Voltage drop at specified current			5,18	6	6	6
Maximum current capability at 20˚C temperature rise		2	4			
Current cycling			16			
Terminal-to-terminal engaging force	2					
Terminal-to terminal disengaging force	3					
Connector durability			3	3	3	3
Vibration			10			
Mechanical shock			12			
High temperature exposure, Class I (.040 II terminals)			6			
High temperature exposure, Class III (2.8 mm terminals)						4
Thermal shock, Class I (.040 II terminals)			8			
Thermal shock, Class III (2.8 mm terminals)				4		
Temperature/humidity cycling, Class I (.040 II terminals)			14			
Temperature/humidity cycling, Class III (2.8 mm terminals)					4	

NOTE *Numbers indicate sequence in which tests were performed.*

Figure 2

3. SUMMARY OF TESTING

3.1. Visual Examination

All specimens submitted for testing were representative of normal production lots. Visual examination was performed using the naked eye under cool white fluorescent lighting. Each housing assembly was examined for cracks, delamination, warpage, deformation, discoloration, latching and mating functions. Each crimped terminal was examined for correct wire size, wire brush, burrs on the terminal, insulation in the wire crimp, insulation tears, and bulging of insulation or penetration of the insulation crimp.

3.2. Dry Circuit Resistance

All low level contact resistance measurements, taken at 100 milliamperes maximum and 20 millivolts maximum open circuit voltage were less than 20 milliohms after testing.

3.3. Voltage Drop at Specified Current

All voltage drop measurements at a specified current were less than 5 milliohms.

3.4. Maximum Current Capability at 20˚C Temperature Rise

Test results are shown in Figure 3.

Specimen Description	Current Capability (amperes)	Resistance (milliohms)	Data Points
2.8 mm w/10 AWG	25.13	.76	30
2.8 mm w/12 AWG	21.15	.76	36
2.8 mm w/14 AWG	17.27	.91	36
2.8 mm w/16 AWG	14.17	.90	36
2.8 mm w/18 AWG	12.40	.74	36
2.8 mm w/20 AWG	10.43	1.0	36
2.8 mm w/22 AWG	8.29	1.19	36
.040 w/18 AWG	8.5	---	3
.040 w/22 AWG	7.1	---	3

Figure 3

3.5. Current Cycling

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

3.6. Terminal-to-terminal Engaging Force

Test results are shown in Figure 4.

Specimen Description	Engaging Force (N)			Disengaging Force (N)		
	Min	Max	Mean	Min	Max	Mean
1st Cycle						
2.8 mm Unsealed Receptacle	2.56	5.49	3.768	2.27	5.5	3.725
.040 II Unsealed Receptacle	2.05	3.53	2.828	2.05	3.24	2.694

Figure 4

3.7. Terminal-to-terminal Disengaging Force

Test results are shown in Figure 4.

3.8. Connector Durability

No physical damage occurred as a result of mating and unmating the specimens 10 times.

3.9. Vibration

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

3.10. Mechanical Shock

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

3.11. High Temperature Exposure, Class I (.040 II terminals)

No evidence of physical damage was visible as a result of Class I high temperature exposure.

3.12. High Temperature Exposure, Class III (2.8 mm terminals)

No evidence of physical damage was visible as a result of Class III high temperature exposure.

3.13. Thermal Shock, Class I (.040 II terminals)

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

3.14. Thermal Shock, Class III (2.8 mm terminals)

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

3.15. Temperature/humidity Cycling, Class I (.040 II terminals)

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

3.16. Temperature/humidity Cycling, Class III (2.8 mm terminals)

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

4. TEST METHODS

4.1. Visual Examination

Visual examination was performed using the naked eye under cool white fluorescent lighting. Each housing assembly was examined for cracks, delamination, warpage, deformation, discoloration, latching and mating functions. Each crimped terminal was examined for correct wire size, wire brush, burrs on the terminal, insulation in the wire crimp, insulation tears, and bulging of insulation or penetration of the insulation crimp.

4.2. Dry Circuit Resistance

Low level contact resistance measurements were made using a 4 terminal measuring technique. The test current was maintained at 100 milliamperes maximum with a 20 millivolt maximum open circuit voltage.

4.3. Voltage Drop at Specified Current

Specimens were energized for 30 minutes to allow for thermal stability at the current specified in Figure 3. After stabilization, measurements were made using a 4 terminal measuring technique.

4.4. Maximum Current Capability at 20˚C Temperature Rise

Temperature rise curves were produced by measuring individual contact temperatures at different current levels. These measurements were plotted to produce a temperature rise vs current curve. Thermocouples were attached to individual contacts 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. The .040 receptacles were tested with terminals crimped to wire, and inserted into 26 position plug housings that were mated to 26 position headers soldered to printed circuit boards. One circuit in the plug was energized. The 2.8 receptacles were tested in free-air, crimped to wire and mated to male blade terminals crimped to wire.

4.5. Current Cycling

Testing consisted of 312 cycles of current cycling, with each cycle having current ON for 45 minutes and current OFF for 15 minutes. The test current was 3.3 amperes AC for 18 AWG wire and 5.8 amperes for 16 AWG wire.

4.6. Terminal-to-terminal Engaging Force

The force required to engage terminals was measured using a tensile/compression device with a free floating fixture and a rate of travel of 50 mm [2 in] per minute.

4.7. Terminal-to-terminal Disengaging Force

The force required to disengage terminals was measured using a tensile/compression device with a free floating fixture and a rate of travel of 50 mm [2 in] per minute.

4.8. Connector Durability

Specimens were manually mated and unmated 10 times.

4.9. Vibration

Mated specimens were subjected to 1.26 GRMS for 8 hours in each axis.. Specimens were monitored for discontinuities of 1 microsecond or greater using a current of 100 milliamperes DC.

4.10. Mechanical Shock

Specimens were subjected to 10 half-sine wave impulses of 10 millisecond duration at 35 Gs in each of 3 mutually perpendicular axes.

4.11. High Temperature Exposure, Class I (.040 II terminals)

Specimens were exposed to a temperature of 85˚C for 312 hours.

4.12. High Temperature Exposure, Class III (2.8 mm terminals)

Specimens were exposed to a temperature of 125˚C for 1008 hours.

4.13. Thermal Shock, Class I (.040 II terminals)

Specimens were subjected to 15 cycles of thermal shock with each cycle consisting of 2 hour dwells at -40 and 85˚C.

4.14. Thermal Shock, Class III (2.8 mm terminals)

Specimens were subjected to 50 cycles of thermal shock with each cycle consisting of 2 hour dwells at -40 and 125˚C.

4.15. Temperature/humidity Cycling, Class I (.040 II terminals)

Specimens were exposed to 15 cycles of humidity-temperature cycling. Each cycle lasted 8 hours and consisted of cycling the temperature between -40 and 85˚C while maintaining high humidity.

4.16. Temperature/humidity Cycling, Class III (2.8 mm terminals)

Specimens were exposed to 40 cycles of humidity-temperature cycling. Each cycle lasted 8 hours and consisted of cycling the temperature between -40 and 85/125˚C while maintaining high humidity (see Figure 5).

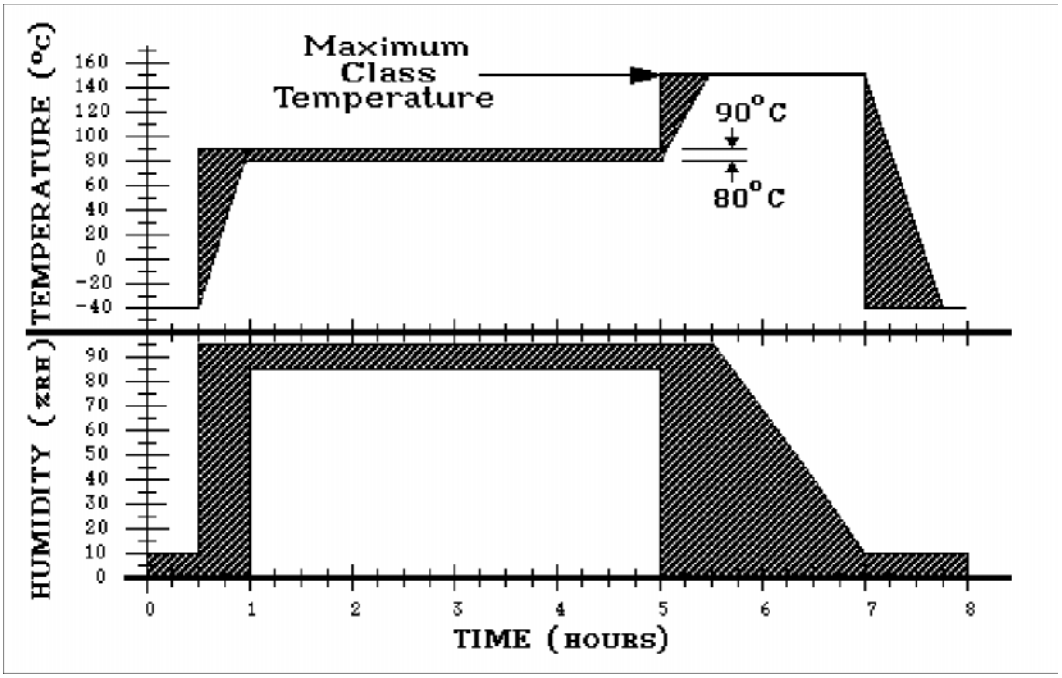

Figure 5