AMPSEAL 16 Hybrid Mini-Lever Connector System

1. INTRODUCTION

1.1. Purpose

Testing was performed on AMPSEAL 16 hybrid mini-lever lever connector system to determine conformance to the requirements given in Product Specification 108-151063.

1.2. Scope

This report covers the mechanical, electrical, and environmental sealing performance of the AMPSEAL 16 hybrid mini-lever lever connector system. Testing was performed at the Winston-Salem Electronic Components Test Laboratory in 2018 and 2019. The test file numbers are 20130107ACL, 20130190ACL, 20130191ACL, and 20140234ACL. This documentation is on file at, and available from, the Global Automotive Division Product Reliability Center.

1.3. Conclusion

The AMPSEAL 16 hybrid mini-lever lever connectors conformed to the mechanical, electrical, and environmental sealing performance requirements given in Product Specification 108-151063.

1.4. Test Specimens

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

PART NUMBER	DESCRIPTION
2203882-1	16 Position Plug Assembly Key A
2203882-4	24 Position Plug Assembly Key D
2272889-1	16 Position Cap Assembly Key A
2272889-4	24 Position Cap Assembly Key D
2203876-2	Mounting Clip - 4mm Panel
1060-12-0222	Size 12 Pin, 10 AWG
1062-12-0222	Size 12 Socket, 10 AWG
1060-12-0166	Size 12 Pin, 12-14 AWG
1062-12-0166	Size 12 Socket, 12-14 AWG
2098252-3	AMPSEAL 16 Pin, 14 AWG
2098253-2	AMPSEAL 16 Socket, 14 AWG
1924463-3	AMPSEAL 16 Pin, 18-20AWG
1924464-2	AMPSEAL 16 Socket, 18-20AWG
1060-20-0222	Size 20 Pin, 16-22 AWG
1062-20-0222	Size 20 Socket, 16-22 AWG

Figure 1. Test Specimen Part Numbers and Description

1.5. Environmental Conditions

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

Temperature: 15° to 35°C
Relative humidity (RH): 25 to 75%

1.6 Qualification Test Sequence

Electrical Test Sequences		
Test or Examination	Test Group (a)	
	1	2
	Test Sequence (b)	
Initial Examination of Product	1,10	1,11
Low Voltage Resistance - Dry Circuit	2,5,8	
Connection Resistance - Voltage Drop	3,6,9	
Insulation Resistance		2,4,6,8,10
Thermal shock	4	
Random Vibration	7	
Pressure Wash		5
Temperature Life		7
Pressure Vacuum Leak		3,9

(a) See paragraph 4.1.A
(b) Numbers indicate sequence in which the tests are performed

Figure 2

Environmental Sealing Test Sequences				
Test or Examination	Test Group (a)			
	1	2	3	4
	Test Sequence (b)			
Initial Examination of Product	1,5	1,5	1,5	1,2
Insulation Resistance	2,4	2,4		
Maintance Aging			2	
IP 6K7	3			
IP 6K9K		3		
Fluid Immersion			3	
Pressure Wash - Flange Seal				3(c)
Unmate-Mate			4	

(a) See paragraph 4.1.A
(b) Numbers indicate sequence in which the tests are performed
(c) Sequence tests the integrity of the flange seal, sealing between the cap assembly and the panel.

Figure 3

Mechanical Test Sequences				
Test or Examination	Test Group (a)			
	1	2	3	4
	Test Sequence (b)			
Initial Examination of Product	1,4	1,4	1,2	1,11
Low Voltage Resistance - Dry Circuit				2,5,8
Connection Resistance - Voltage Drop				3,6,9
Mating Forces	2			
Unmating Forces	3			
Terminal Insertion		2		
Terminal Retention		3 (c)		10 (c)
Polarization			3	
Temperature Life				4
Durability				7

(a) See paragraph 4.1.A
(b) Numbers indicate sequence in which the tests are performed
(c) All circuit cavities must be tested

Figure 4

2. SUMMARY OF TESTING

2.1 Electrical Test Sequences

A. Initial Examination of Product—All Test Groups

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

B. Low Voltage Resistance Dry Circuit – Test Group 1

All samples tested less than 6.7 milliohms

C. Connection Resistance Voltage Drop – Test Group 1

All samples tested less than 100 millivolts

D. Insulation Resistance – Test Group 2

All samples tested greater than 20 Megaohms

E. Thermal Shock – Test Group 1

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

F. Random Vibration Test Group 1

Discontinuities were monitored during vibration testing, none were recorded. Following vibration testing, no cracks, breaks, or loose parts on the specimens were visible

G. Pressure Wash – Test Group 2

No evidence of water ingress or physical damage was visible as a result of pressure washing.

H. Temperature Life – Test Group 2

No evidence of physical damage was visible as a result of temperature life testing

I. Pressure/Vacuum Leak – Test Group 2

No bubbles were observed when the samples were subject to an internal pressure of 48 kPa initial and 28 kPa final for 15 seconds

J. Final Examination of Product – All Test Groups

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

2.2 Environmental Test Sequences

A. Initial Examination of Product – All Test Groups

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

B. Insulation Resistance – Test Groups 1 and 2

All samples tested greater than 20 Megaohms

C. Maintenance Aging – Test Group 3

No evidence of physical damage was visible as a result of removing and inserting the terminals 10 times

D. IP 6K7 – Test Group 1

No dust or water ingress was noted nor was physical damage visible as a result of testing

E. IP 6K9K – Test Group 2

No dust or water ingress was noted nor was physical damage visible as a result of testing

F. Fluid Immersion – Test Group 3

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

G. Pressure Wash – Flange Seal – Test Group 4

No evidence of water ingress or physical damage was visible as a result of pressure washing

H. Unmate-Mate Fluid Immersion – Test Group 3

All samples passed the unmating and mating cycle for all fluids tested

I. Final Examination of Product – All Test Groups

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

2.3 Mechanical Test Sequences

A. Initial Examination of Product – All Test Groups

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

B. Low Voltage Resistance, Dry Circuit – Test Group 10

All samples tested less than 6.7 milliohms

C. Connection Resistance, Voltage Drop – Test Group 10

All samples tested less than 100 millivolts

D. Connector Mating Forces – Test Group 7

All samples tested less than 200N for the 16 position connector and less than135N for the 24 position connector

E. Connector Unmating Forces – Test Group 7

All samples tested less than 120N for the 16 position connector and less than 160N for the 24 position connector

F. Terminal Retention – Test Group 8

Size 16 Terminal – All samples passed 111N axial load with 6 second hold
Size 12 Terminal – All samples passed 134N minimum pull to failure load
Size 20 Terminal - All samples passed 60N minimum pull to failure load

G. Polarization – Test Group 9

No specimen could be mated against the polarizing or keying feature when subjected to an axial force of 178 N

H. Temperature Life – Test Group 10

No evidence of physical damage was visible as a result of temperature life testing

I. Durability – Test Group 10

No physical damage occurred as a result of manually mating and un-mating the specimens 50 times

J. Final Examination of Product – All Test Groups

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

3. TEST METHODS

3.1. Initial Examination of Product

All samples were visually examined for identification, torn seals, and cracked plastic or any other defect detrimental to the performance of the product.

3.2. Insulation Resistance

Insulation resistance was measured between adjacent contacts. A test voltage of 1000 V DC was applied for 2 minutes and the resistance was measured. See Figure 5 for test setup.

Figure 5. Insulation Resistance Test

3.3 Low-Voltage Resistance

Each mated assembly was subjected to a maximum of 20 mV open-circuit voltage at 100 mA. Measurements were taken on the data acquisition system using the voltage and current probe bundles (4-wire probe method). The overall resistance included 6 inches of wire, pin terminal crimp resistance, bulk resistance of the pin terminal, terminal interface, bulk resistance of the socket terminal, socket terminal crimp resistance, and 6 inches of wire. The resistance of the 12 inches of wire was subtracted out of the final measurements so that the reported data only included the crimps, bulk resistance of the terminals, and the interface.

3.4 Connection Resistance

The mated assemblies were placed on a non-conductive surface. Measurements were taken on the data acquisition systems using the voltage probe bundles (2-wire probe method). All mated assemblies were placed in series. The current was set at 25 A for the 12 AWG wire, 10 A for the 14 AWG wire and 7.5 A for the 16 AWG wire. The circuits were allowed to stabilize for 60 minutes before measurements were taken. The overall resistance included 6 inches of wire, pin terminal crimp resistance, bulk resistance of the pin terminal, terminal interface, bulk resistance of the socket terminal, socket terminal crimp resistance, and 6 inches of wire. The resistance of the 12 inches of wire was subtracted out of the final measurements so that the reported data only included the crimps, bulk resistance of the terminals, and the interface.

3.5 Connector Mating Forces

The plug and cap assemblies were placed in a holding fixture to keep them secure. The forces necessary to engage the connector to the preset position and from the preset to fully seated position was tested. See Figure 6 for sample setup

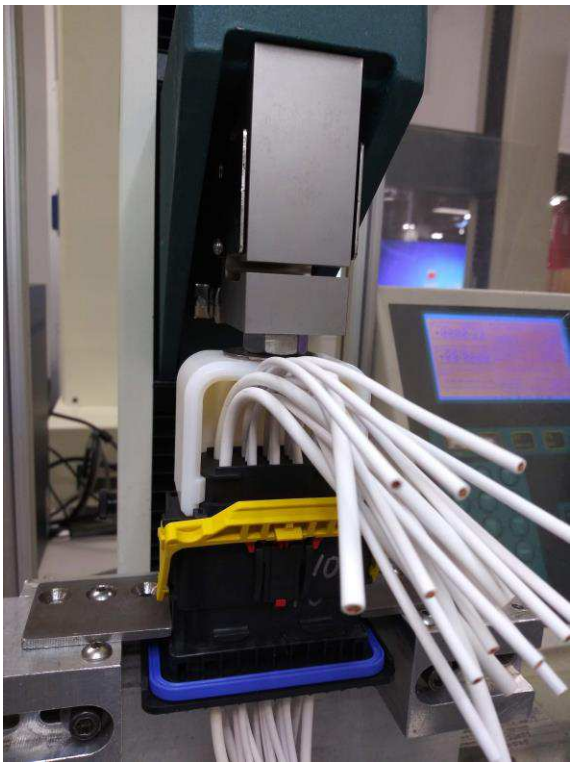

Figure 6. Connector Mating

3.6 Connector Unmating Forces

The plug and cap assemblies were placed in a holding fixture to keep them secure. The forces necessary to disengage the connector from the fully seated position to the preset position and from the preset position to fully removed were tested. See Figure 7 for sample setup

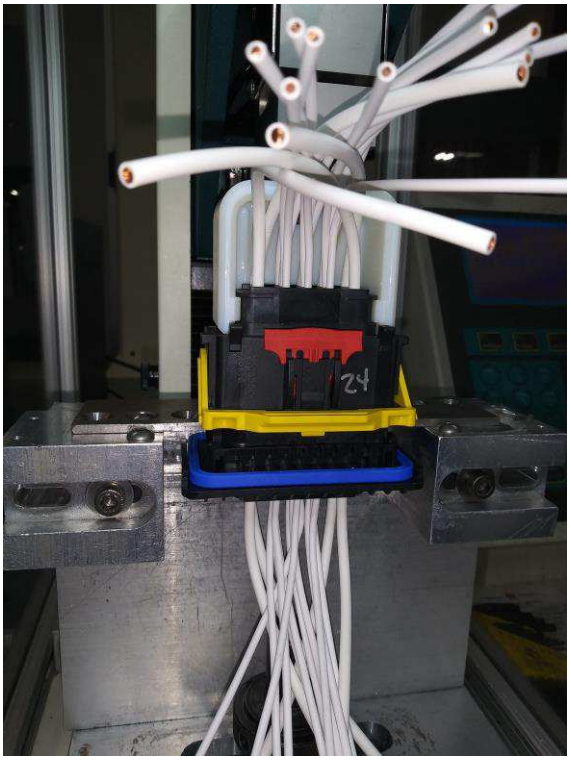

Figure 7. Connector Unmating

3.7 Terminal Insertion

The plug and cap assemblies were placed in a holding fixture to keep them secure. The terminals were inserted one at a time with axial alignment maintained and sufficient force applied to insert the terminal into its normal position in the connector

3.8 Terminal Retention

The plug and cap assemblies were placed in a holding fixture to keep them secure. The terminals were pressed out using a pin held in a vice attached to the testing equipment. The terminals were pushed out in order starting at circuit 1. See Figure 8 for sample setup

Cap Assembly

Plug Assembly

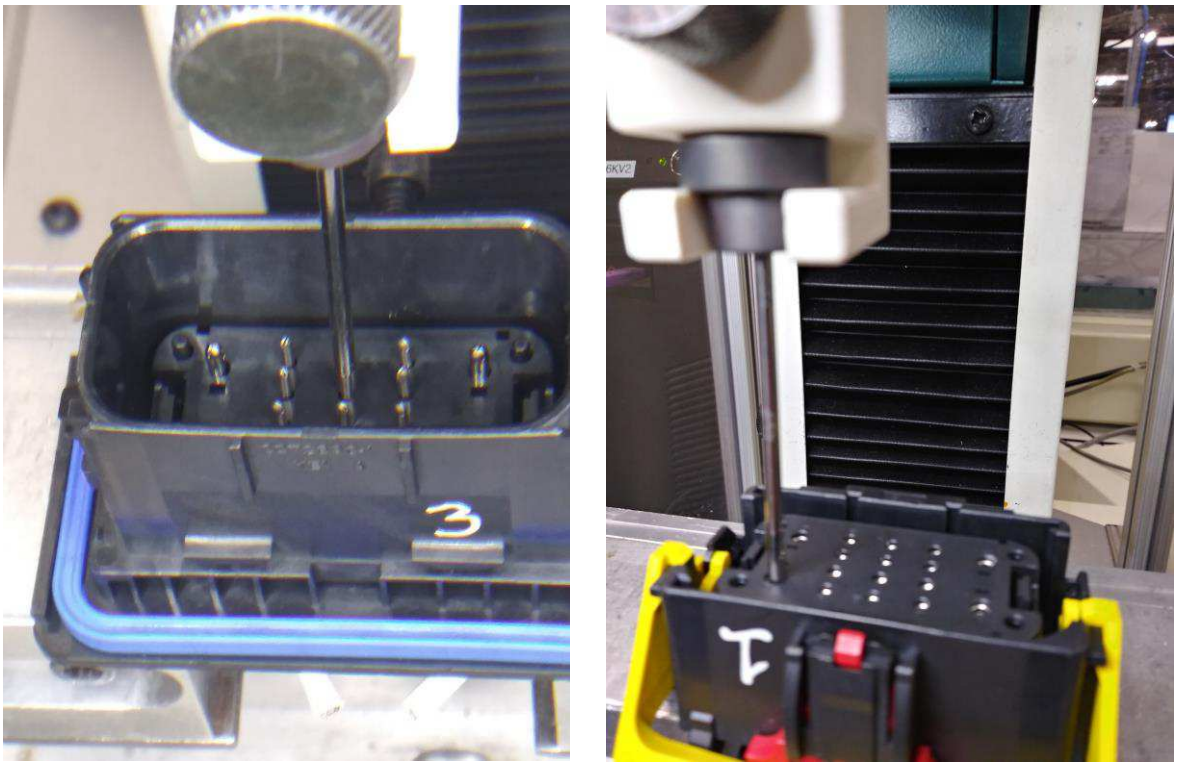

Figure 8. Terminal Retention Setup

3.9 Polarization

Attempt to incorrectly mate two connector halves with the same keying – The plug assembly was rotated 180 degrees from the normal mating position and a 178N force was applied in an attempt to mate the two halves.

Attempt to correctly mate two connector halves with different keying – The plug and cap assemblies with different keys were held together and a force of 178N was applied in an attempt to mate the two halves. See Figure 9 for sample setup

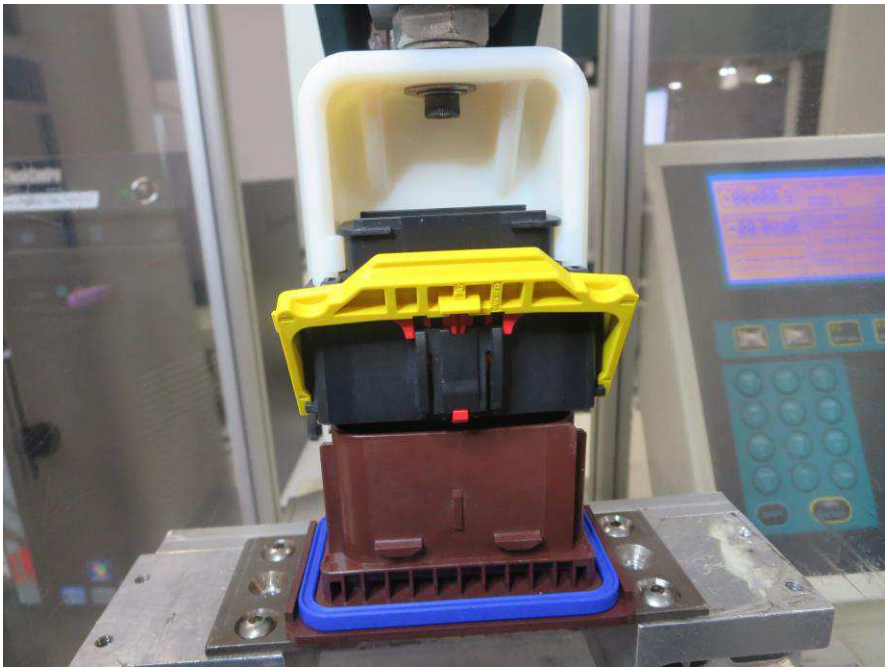

Figure 9. Attempt to correctly mate two connector halves with different keying

3.10 Temperature Life with Terminal Retention

Temperature Life - Samples were exposed to conditioning of 125°C for 500 hours.

Terminal Retention - The plug and cap assemblies were placed in a holding fixture to keep them secure. The terminals were pushed at 111N for 6 seconds using a pin held in a vice attached to the testing equipment. The terminals were pushed on in order starting at circuit 1. See Figure 8 for sample setup

3.11 Durability

Specimens were manually mated and unmated 50 times

3.12 Vibration

10 Gs between 10 to 500 Hz with 1 octave minimum sweep rate. Sixteen hours in 3 mutually perpendicular planes. See Figure 9 for test setup.

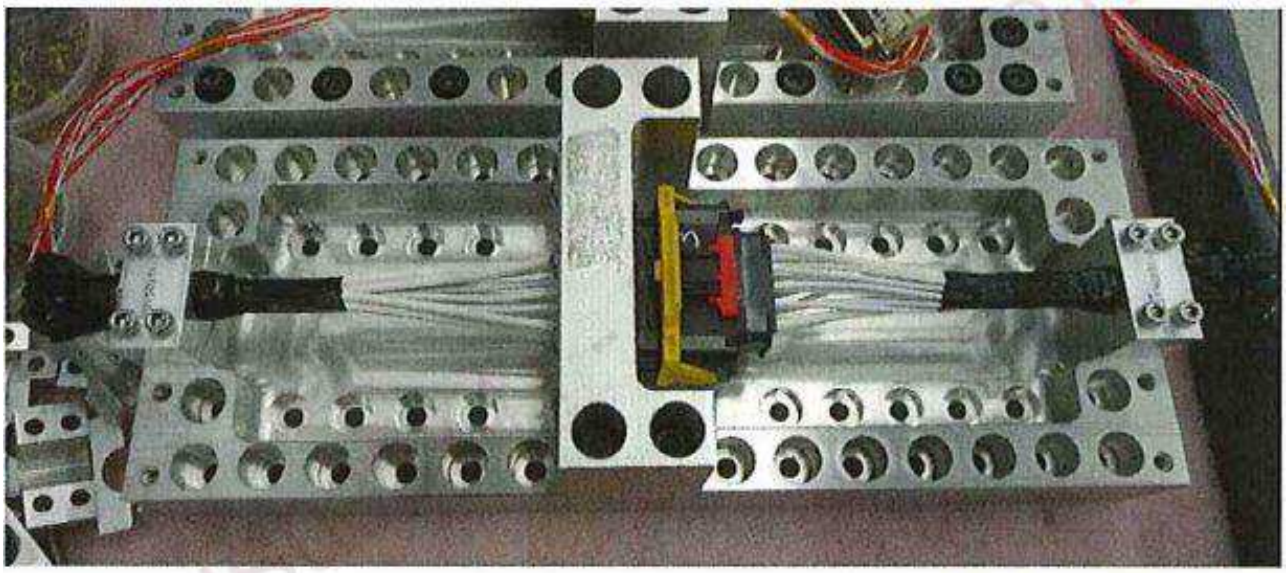

Figure 9. Vibration Setup

3.13 IP 6K7 One Meter Immersion with Dust

Dust – One cycle shall be 6 seconds of dust movement, 15-minute break for 20 cycles.
Immersion – 1-meter immersion for 30 minutes

3.14 IP 6K9K High Pressure Spray with Dust

Dust – One cycle shall be 6 seconds of dust movement, 15-minute break for 20 cycles.
High Pressure Spray – Samples were mounted on a turn table with a speed of 5 ±1 revolution per minute. A fan jet nozzle was used, the samples were sprayed at 0°, 30°, 60°, 90° at a distance of 100-150mm. The water flow rate was 14-16 l/min at 8000 to 10000 kPa pressure at 80 ±5 °C. The time at each position was 30 seconds. See Figure 10 for test setup.

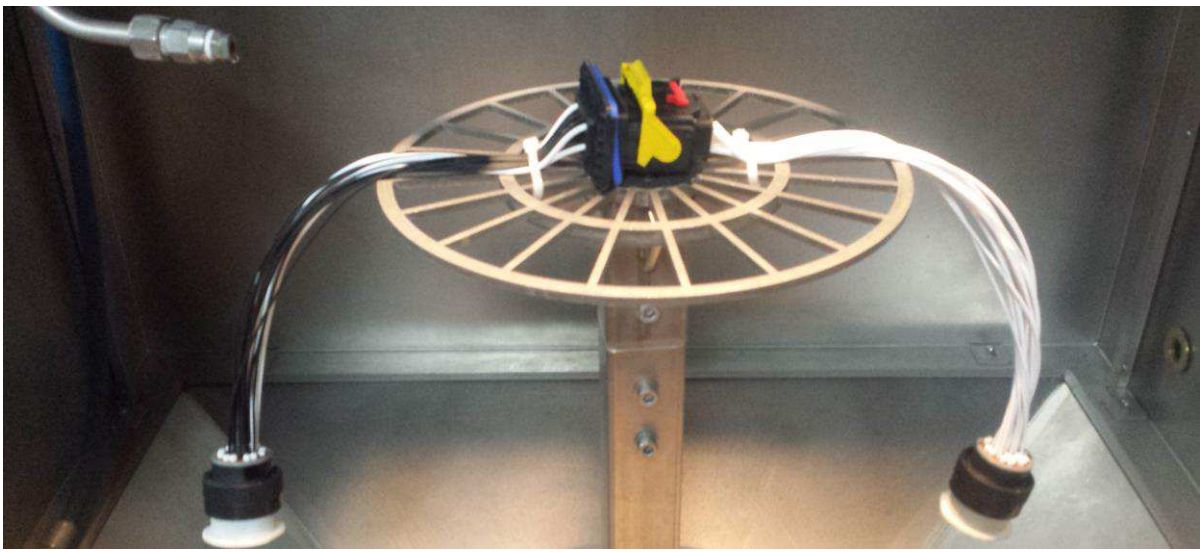

Figure 10. High Pressure Spray

3.15 Fluid Immersion

Each mated connector was exposed to one fluid only. Mated samples were submerged for 5 minutes in the fluid and allow to air dry for 24 hours. This constituted one cycle. Specimens were exposed to the fluid for a total of five cycles. Samples were exposed to the fluids listed in Figure 11

Fluid	Temperature (°C)
Motor Oil (30 Weight)	85
Brake Fluid	85
Diesel Fuel	60
50/50 Antifreeze Mixture	85
Roundup Original	23
Gear Oil (90 Weight)	85
Aqueous Urea	23

Figure 11

3.16 Pressure Wash

Subject specimens to spray for 3 seconds of a 6 second cycle for a total of 375 cycles from a distance of 20 to 30 cm. Water pressure approximately 7000 kPa gage with a flow rate of 9.46 liters per minute and a temperature of 40°C. No detergent.

3.17 Thermal Shock

Samples were exposed to 10 cycles between -55 and 125°C with 2 hour dwells at temperature extremes. Two min max transition time.

3.18 Temperature Life

Samples were exposed to conditioning of 125°C for 500 hours.

3.19 Pressure Leak

The samples were submerged into a container of room temperature salt water solution prepared using tap water and 15-16 grams of table salt per liter. The air pressure of the regulated pressure source was increased until the gage read the required pressure. Samples were observed for 15 seconds to verify that there are no bubbles. The samples were removed from the salt water solution, the excess fluids shaken off and then all exterior surfaces of the sample were carefully dried