CeeLok FAS-X* Connector

1. INTRODUCTION

1.1 Purpose

Testing was performed on the TE Connectivity* CeeLok FAS-X connector to determine its conformance to the requirements of Product Specification 108-160094, Rev. A.

1.2 Scope

This report covers the electrical, mechanical, and environmental performance of the CeeLok FAS-X connector. Testing was performed at the Harrisburg Electrical Components Test Laboratory between 08/31/2018 and 06/17/2020. All supporting test documentation is maintained by the Harrisburg Electrical Components Laboratory under test number EA20180297T. Tests considered qualified by similarity to MIL-DTL-38999 as shown in 108-160094 Rev. A, Figure 2, note (c) were not included in the scope of test program EA20180297T.

1.3 Conclusion

The CeeLok FAS-X connector listed in paragraph 1.4 conformed to the electrical, mechanical, and environmental performance requirements of Product Specification 108-160094, Rev. A.

1.4 Product Description

The CeeLok FAS-X connector is a ruggedized high-speed circular connector suitable for aerospace and military applications. Data transmission rates of 10G Ethernet are achieved when terminated to CAT6A or CAT7 cable.

1.5 Test Specimens

The test specimens were representative of normal production lots, and the following part numbers were used for test:

Table 1 – Test Specimens

Test Group	Test Set	Mated Pair Qty	Military Part Number	Manufacturer Part Number	Description
1	1A, 1B	2	M32546/01FB11-08PN M32546/02FB11-08SN	CFX20F1108PZN CFX26F1108SZN	Nickel Plated Aluminum Size 11, Class F
1	1C, 1D	2	M32546/01FF11-08PN M32546/02FF11-08SN	CFX20F2532PZN CFX26F2532SZN	Nickel Plated Aluminum Size 25, Class F
1	1E, 1F	2	M32546/01MB11-08PN M32546/02MB11-08SN	CFX20M1108PZN CFX26M1108SZN	Nickel Plated Composite Size 11, Class M
1	1G, 1H	2	M32546/01MF11-08PN M32546/02MF11-08SN	CFX20M2532PZN CFX26M2532SZN	Nickel Plated Composite Size 25, Class M
2	2A, 2B	2	M32546/01FB11-08PN M32546/02FB11-08SN	CFX20F1108PZN CFX26F1108SZN	Nickel Plated Aluminum Size 11, Class F
2	2C, 2D	2	M32546/01FF11-08PN M32546/02FF11-08SN	CFX20F2532PZN CFX26F2532SZN	Nickel Plated Aluminum Size 25, Class F
2	2E, 2F	2	M32546/01MB11-08PN M32546/02MB11-08SN	CFX20M1108PZN CFX26M1108SZN	Nickel Plated Composite Size 11, Class M
2	2G, 2H	2	M32546/01MF11-08PN M32546/02MF11-08SN	CFX20M2532PZN CFX26M2532SZN	Nickel Plated Composite Size 25, Class M

* Trademark

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Table 1 – Test Specimens (*continued*)

Test Group	Test Set	Mated Pair Qty	Military Part Number	Manufacturer Part Number	Description
12	3A, 3B	2	M32546/01FB11-08PN	CFX20F1108PZN	Nickel Plated Aluminum Size 11, Class F
			M32546/02FB11-08SN	CFX26F1108SZN	
12	3C, 3D	2	M32546/01FF11-08PN	CFX20F2532PZN	Nickel Plated Aluminum Size 25, Class F
			M32546/02FF11-08SN	CFX26F2532SZN	
12	3E, 3F	2	M32546/01MB11-08PN	CFX20M1108PZN	Nickel Plated Composite Size 11, Class M
			M32546/02MB11-08SN	CFX26M1108SZN	
12	3G, 3H	2	M32546/01MF11-08PN	CFX20M2532PZN	Nickel Plated Composite Size 25, Class M
			M32546/02MF11-08SN	CFX26M2532SZN	

1.6 Qualification Test Sequence

Table 2 - Test Sequence

Test or Examination	Test Group (a)		
	1	2	12
	Test Sequence (b)		
Initial Examination of Product	1	1	
Maintenance Aging	2		
Temperature Cycling	3	7	
Coupling Torque	4,12	8	
Durability	5	12	
Altitude Immersion	6		
Insulation Resistance at Ambient	7	5,16	
Dielectric Withstanding Voltage at Sea Level	8	6,10,17	
Shell to Shell Conductivity	9,13	14	
Salt Spray (Corrosion)	10		
Low Level Contact Resistance	11	13	
Electrical Engagement	14		
Insert Retention	15		
Gauge Location		2	
Gauge Retention		3	
Contact Retention		4,18	
Insulation Resistance at Elevated Temperature		9	
Dielectric Withstanding Voltage at Altitude		11	
High Temperature Exposure		15	
Insertion Loss			1
Return Loss			2
Near-End Cross Talk			3
Far-End Cross Talk			4
Propagation Delay			5
Propagation Delay Skew			6
Final Examination of Product	16	19	

Note: *(a) See paragraph 1.5*
(b) Numbers indicate sequence which tests were 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 Examination of Product – Groups 1 & 2

All specimens submitted for testing were representative of normal production lots. Certificates of Conformance were issued by Product Assurance. Specimens were visually examined and showed no signs of damage or defects.

2.2 Maintenance Aging – Group 1

The contact insertion and removal forces did not exceed the maximum requirement of 10 pounds.

2.3 Temperature Cycling – Groups 1 & 2

Test specimens showed no signs of blistering, peeling, flaking, separation plating or other damage detrimental to the operation of the connectors as a result of Temperature Cycling exposure.

2.4 Coupling Torque – Groups 1 & 2

Size 11 specimens met the 12 lbf-in maximum engagement and 2 lbf-in minimum disengagement requirements. Size 25 specimens met the 40 lbf-in maximum engagement and 5 lbf-in minimum disengagement requirements.

2.5 Durability – Groups 1 & 2

Specimens showed no signs of defects detrimental to operation and met subsequent test requirements.

2.6 Altitude Immersion – Group 1

Specimens met the post altitude immersion insulation resistance and dielectric withstanding requirements (see paragraphs 2.7 and 2.8).

2.7 Insulation Resistance at Ambient – Groups 1 & 2

The insulation resistance between any pair of contacts and between any contact and the shell was greater than 5,000 megohms.

After altitude immersion, insulation resistance between any pair of contacts and between any contact and the shell was greater than 1,000 megohms.

2.8 Dielectric Withstanding Voltage at Sea Level – Groups 1 & 2

Test specimens showed no evidence of electric breakdown or flashover. All leakage current was less than 2.0 milliamperes.

2.9 Shell to Shell Conductivity – Groups 1 & 2

Shell to shell conductivity did not exceed the maximum requirements of 5 millivolts initial or 10 millivolts final.

2.10 Salt Spray (Corrosion) – Group 1

The test specimens showed no signs of lifting of plated coating or exposure of basis material which would adversely affect performance.

2.11 Low Level Contact Resistance – Groups 1 & 2

Test specimens did not exceed the maximum low level contact resistance requirement of 30 milliohms.

2.12 Electrical Engagement – Group 1

Test specimens met the minimum requirement of 0.050 inch electrical engagement.

2.13 Insert Retention – Group 1

Test specimen inserts retained their proper location in the shell with the minimum required 25 lbf force.

2.14 Gauge Location – Group 2

Test specimens met the gauge location requirements as specified in Figure 9 of MIL-DTL-32546A dated 11 July 2018.

2.15 Gauge Retention – Group 2

The test gauges were retained in the contact cavities and all axial displacement was less than the maximum requirement of 0.012 inches.

2.16 Contact Retention – Group 2

The contacts were retained in the contact cavities and all axial displacement was less than the maximum requirement of 0.012 inches.

2.17 Insulation Resistance at Elevated Temperature – Group 2

The insulation resistance between any pair of contacts and between any contact and the shell was greater than 1000 megaohms.

2.18 Dielectric Withstanding Voltage at Altitude – Group 2

Test specimens showed no evidence of breakdown or flash over. All leakage current was less than 2.0 milliamperes.

2.19 High Temperature Exposure – Group 2

Test specimens showed no defects detrimental to the operation of the connectors as a result of High Temperature Exposure.

2.20 Insertion Loss – Group 12

Specimens met TIA-568-C.2 connector insertion loss from 1 to 500 MHz.

2.21 Return Loss – Group 12

Specimens met TIA-568-C.2 connector return loss from 1 to 500 MHz.

2.22 Near-End Cross Talk – Group 12

Specimens met TIA-568-C.2 connector NEXT loss from 1 to 500 MHz.

2.23 Far-End Cross Talk – Group 12

Specimens met TIA-568-C.2 connector FEXT loss from 1 to 500 MHz.

2.24 Propagation Delay – Group 12

Specimens met 2.5 nanoseconds maximum from 1 MHz to 500 MHz.

2.25 Propagation Delay Skew – Group 12

Specimens met 1.25 nanoseconds maximum from 1 MHz to 500 MHz

2.26 Final Examination of Product – Groups 1 & 2

Test specimens showed no evidence of cracking, loosening of parts, carbon tracking, excessive wear, or missing parts.

3. TEST METHODS

3.1 Initial Examination of Product

Certificates of Conformance were 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 Maintenance Aging

Maintenance aging was performed in accordance with EIA-364-24B as per 108-160094 Rev. A. Test specimens were subjected to 10 insertion and removal cycles. The insertion and removal forces were measured on the 1st and 10th cycles. A wired pin/socket assembly was used for insertion and removal forces (Figure 1). During measurement cycles, the wired pin/socket assembly was inserted into the connector housing using insertion/extraction tool part number M81969/14 attached to the force meter (Figure 2). The peak force required to insert the contact into the insert cavity was recorded. The extraction tool M81969/14 was then inserted into the loaded cavity. The force meter was attached to the looped end of wired pin/socket assembly to pull out the contact from the cavity (Figure 3). The peak force required to remove the contact from the insert cavity was recorded. A minimum of 20 percent, but not less than four contacts of each connector were tested. Four positions were tested on shell size 11 connectors, and seven positions on shell size 25 were tested. No lubricant was used during testing.

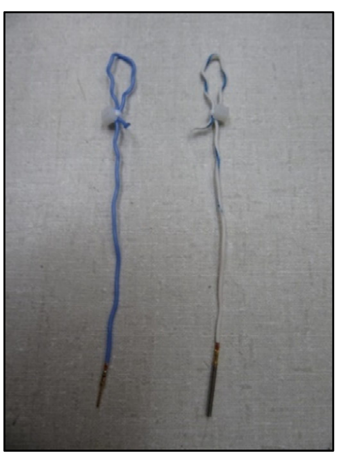

Figure 1 – Pin/Socket Assmebly

Figure 2 – Insertion Force

Figure 3 – Removal Force

3.3 Temperature Cycling

Temperature Cycling was performed in accordance with EIA-364-32G as per 108-160094 Rev. A. Mated test specimens were subjected to 5 cycles of temperature cycling consisting of 1-hour dwells at -65°C and +175°C. The transition between temperatures was less than 2 minutes.

3.4 Coupling Torque

Coupling Torque was performed in accordance with MIL-DTL-32546A para. 4.6.3 and EIA-364-114 as per 108-160094 Rev. A. Test specimens were mounted to a test fixture that was attached to the load cell of the torque meter as shown in Figure 4. Test specimens were fully mated and unmated 10 times, at an approximate rate of one inch-pound per second Engagement and disengagement torque forces were measured and recorded on the first and tenth cycles.

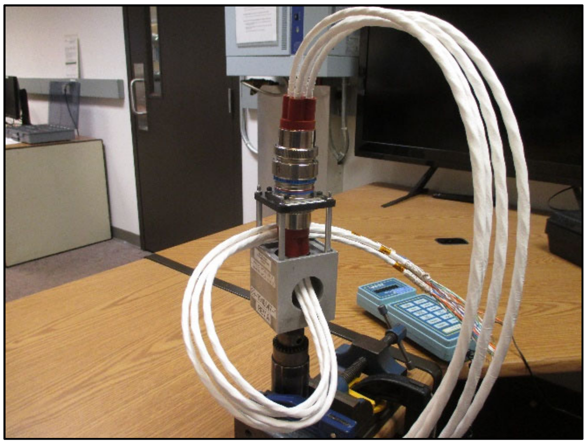

Figure 4 – Typical Coupling Torque Test Set Up

3.5 Durability

Durability was performed in accordance with 108-160094 Rev. A. Class F plug, and receptacle assemblies were fully mated and unmated for 500 cycles at a rate of 300 cycles per hour maximum. Class M plug and receptacle assemblies were fully mated and unmated for 1500 cycles at a rate of 300 cycles per hour maximum. The plug and receptacle were completely separated during each cycle. Durability test set up shown in Figure 5.

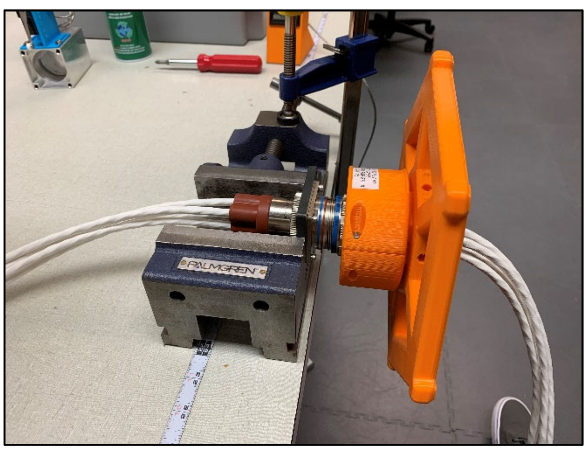

Figure 5 – Durability Test Set Up

3.6 Altitude Immersion

Altitude immersion was performed in accordance with EIA-364-03D as per 108-160094 Rev. A. Mated test specimens were mounted to a test fixture and placed in a container. Test specimens were fully immersed in a 5% salt solution. All wired ends were in the chamber and exposed to the atmosphere. The specimens were subjected to 3 cycles of the following:

Step 1 – 5 Minutes transfer from ambient pressure to 75,000 feet above sea level
Step 2 – 30 Minute dwell at 75,000 feet above sea level
Step 3 – 1 Minute transfer from 75,000 feet above sea level to ambient pressure
Step 4 – 30 Minute dwell at ambient pressure

At the end of the 3rd cycle of altitude immersion, the mated connectors remained immersed in the salt solution and were subjected to insulation resistance test and dielectric withstanding voltage at sea level (See paras 3.7 and 3.8). After the altitude immersion test, the test specimens were rinsed then dried at ambient conditions for approximately 24 hours. Test specimens were uncoupled, and both halves were examined for signs of water ingress.

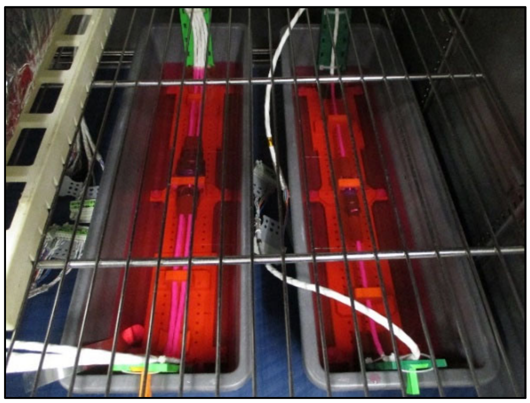

Figure 6 – Altitude Immersion Test Set Up

3.7 Insulation Resistance at Ambient

Insulation Resistance at Ambient was performed in accordance with EIA-364-21E as per 108-160094 Rev. A.

While Test Group 1 specimens were fully mated and immersed in salt solution, a minimum of 5 adjacent contact pairs per connector and all contacts to shell were tested. A voltage potential of 500 volts DC was applied and maintained for a maximum of 120 seconds (Figure 7 & Figure 8). The insulation resistance was recorded within 1 hour of completing altitude immersion.

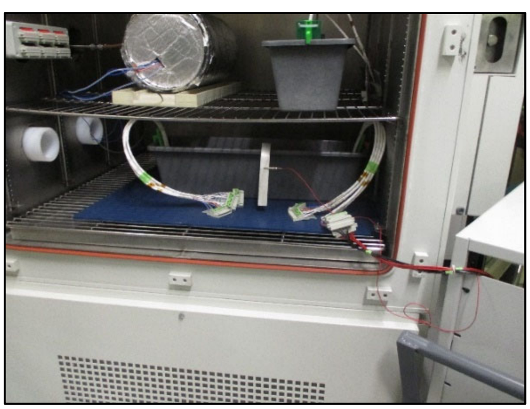

Figure 7 – Post Altitude Immersion, IR & DWV

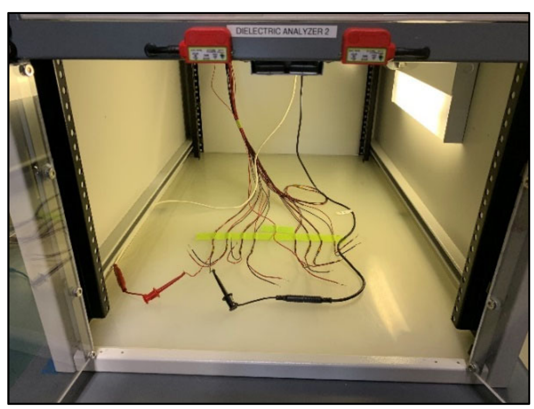

Figure 8 – Post Altitude Immersion, IR & DWV

3.7 Insulation Resistance at Ambient *(continued)*

Unmated Test Group 2 specimens were subjected to insulation resistance testing. A minimum of 5 adjacent contact pairs per connector and all contacts to shell were tested. A voltage potential of 500 volts DC was applied and maintained for a maximum of 120 seconds (Figure 9 & Figure 10). The insulation resistance was then recorded.

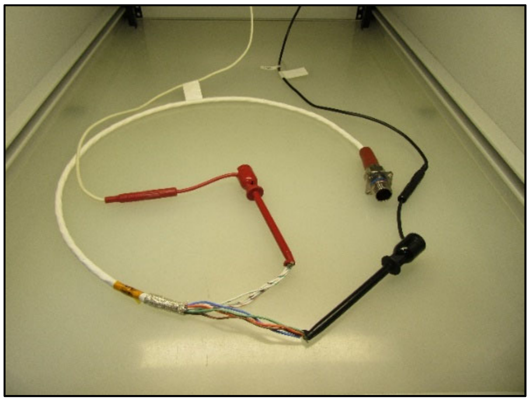

Figure 9 – IR & DWV, Adjacent Contacts

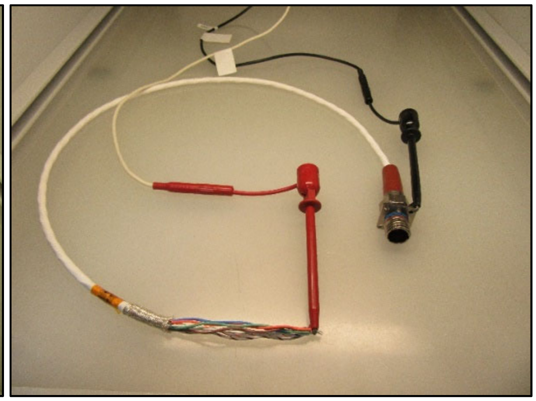

Figure 10 – IR & DWV, Contacts to Shell

3.8 Dielectric Withstanding Voltage at Sea Level

Dielectric Withstanding Voltage at Sea Level was performed in accordance with EIA-364-20F as per 108-160094 Rev. A.

While Test Group 1 specimens were fully mated and immersed in salt solution, a minimum of 5 adjacent contact pairs per connector and all contacts to shell were tested. A voltage potential of 1300 volts AC was applied to the connectors at a rate of 500 volts per second and was maintained for a minimum of 2 seconds (Figure 7 and Figure 8).

Unmated Test Group 2 specimens were subjected dielectric withstanding voltage testing. A minimum of 50%, but no less than six adjacent contacts were tested (Figure 9). All contacts to shell were tested. (Figure 10). A voltage potential of 1300 volts AC was applied at a rate of 500 volts per second and was maintained for a minimum of 2 seconds.

3.9 Shell to Shell Conductivity

Test specimens were subjected to Shell to Shell Conductivity test, in accordance with EIA-364-83A as per 108-160094 Rev. A. A test current of 1.0 ampere and a maximum open circuit voltage of 1.5 volts was applied to the mated connectors. The voltage drop across the mated connectors was measured from a point on the rear accessory thread on the plug to a point adjacent to the mounting hole on the square flange receptacle (Figure 11).

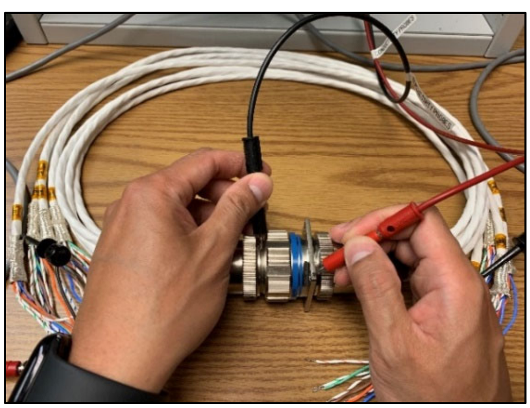

Figure 11 – Shell to Shell Conductivity

3.10 Salt Spray (Corrosion)

All Class F connectors were subjected to Salt Spray exposure, in accordance with EIA-364-26C as per 108-160094 Rev. A. The unmated test specimens were placed in the chamber with the mating interfaces on a horizontal axis (Figure 12). The chamber was operated for a total of 48 hours. See Table 3 for chamber run intervals. Upon completion of the test the specimens were rinsed by immersing in running tap water (not warmer than 38C) for 5 minutes maximum, then dried in an air-circulating oven at 38C for a period of 16 hours.

The chamber operating parameters were as follows:

Salt Fog Chamber Operating Parameters:

- Chamber Temperature: 35°C.
- Aeration Tower temperature: 48°C.
- 5% Brine Solution Purity: Sodium Chloride with no more than .3% impurities.
- Aeration Tower Pressure: 15 PSI.
- Brine Solution pH Range: 6.5 to 7.2.
- Specific Gravity Range: 1.031 to 1.037.
- Collection rate: .5 to 3ml per hour.

Table 3 – Collection Data

DATE	TECHNICIAN	TOTAL HOURS	AIR PRESSURE	COLLECTION								PH				SPECIFIC GRAVITY				SOLUTION TEMP (°C)				COMMENTS
				TOTAL (ml)				RATE (ml/hr)																
				LF	LR	RF	RR	LF	LR	RF	RR	LF	LR	RF	RR	LF	LR	RF	RR	LF	LR	RF	RR	
6/2/2020	Zuvich	48	15	61	73	62	54	1.27	1.52	1.29	1.13	6.51	6.57	6.52	6.59	1.035	1.035	1.033	1.033	25.1	24.8	25	24.9	5/27/20 to 5/29/20

Figure 12 – Salt Spray Test Set Up

3.11 Low Level Contact Resistance

Test specimens were subjected to Low Level Contact Resistance test in accordance with EIA-364-23C as per 108-160094 Rev. A. Measurements were made using a four terminal measuring technique (Figure 13). The test current was maintained at 100 milliamperes maximum with a 20 millivolt maximum open circuit voltage.

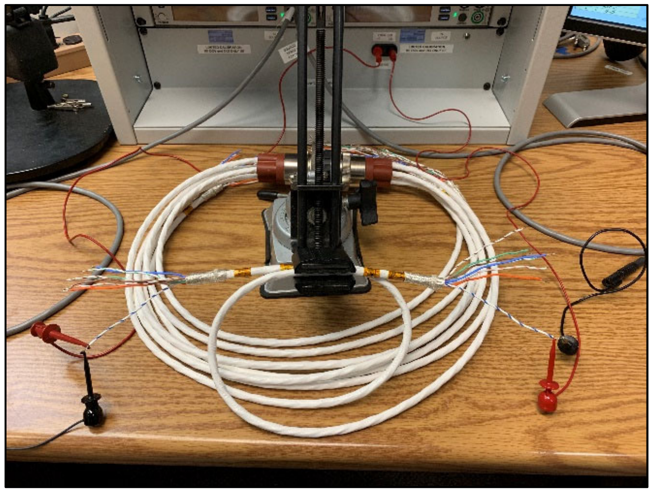

Figure 13 – Low Level Contact Resistance Test Set Up

3.12 Electrical Engagement

Test specimens were subjected to Electrical Engagement test in accordance with 108-160094 Rev. A. Test specimens were wired to provide a complete series circuit through all contacts of the mated connector. The series circuit was connected to a discontinuity monitor to indicate the earliest point, at which the circuit was completed (Figure 14). Connector halves were slowly mated by hand until the first indication of a completed circuit was observed. At this point and the overall connector length was measured and recorded from a solid reference point on the connector halves (Figure 15). The mating operation was continued until the connector halves were fully mated. A second overall length measurement was taken and recorded from the same reference points (Figure 16). Calculating the difference between the two measurements provided the amount of electrical engagement.

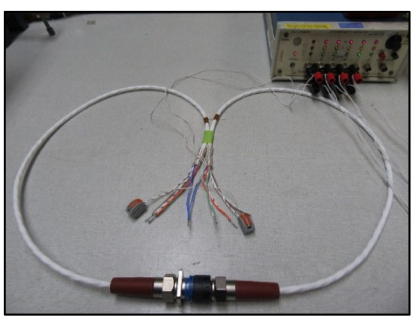

Figure 14 – Electrical Engagement Test Set Up

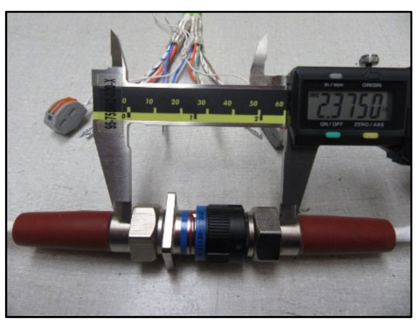

Figure 15 – Typical Initial Completed Circuit

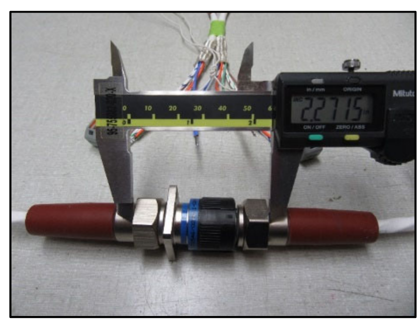

Figure 16 – Typical Fully Mated Connector

3.13 Insert Retention

Test specimens were subjected to Insert Retention test in accordance with EIA-364-35C as per 108-160094 Rev. A. The wired contacts were removed from all connectors so that force could be applied in both directions. For size 25 shells to properly retain the inserts the connectors were reassembled without the wired contacts. The back shell used to complete the shell size 25 assembly had the rear seal removed to allow for access to the rear of the inserts. (Figure 17). The minimum required load of 25-pound force was applied at a rate of approximately 10 pounds per square inch per second and held for approximately 5 to 10 seconds in both directions (Figure 18 & Figure 19).

Figure 17 –Back Shell without Rear Seal

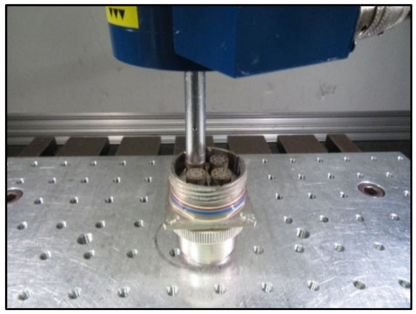

Figure 18 – Insert Retention Test Size 25, Towards Rear

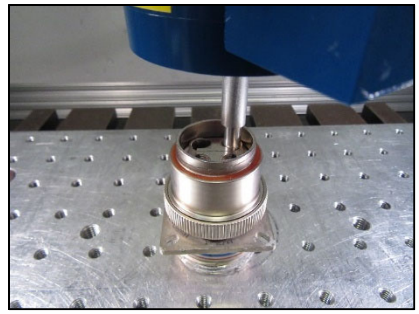

Figure 19 – Insert Retention Test Size 25, Towards Front

3.14 Gauge Location

Test specimens were subjected to Gauge Location, in accordance with paragraphs 3.43 and 4.6.35 of MIL-DTL-32546A, 11 July 2018 as per 108-160094 Rev. A. Test specimens were placed on a test fixture with mounting plate. The applicable pin or socket test gauge was installed in 3 cavities of each connector. With the gauge fully seated back against its contact retention device, the axial location of the front end if each gauge was measured relative to its reference point identified in Figure 9 of MIL-DTL-32546A, 11 July 2018 (Figure 20). The test was repeated on pin assemblies using the gauge specified in Figure 13 of MIL-DTL-32546A, 11 July 2018, except the gauge was seated forward in the contact cavity. This was done by lifting the gauge from the fully seated rear position to the forward position (Figure 21). Since the testing was conducted on unassembled Size 25 connectors, a blank Size 11 receptacle shell test fixture was used to hold loose inserts (Figure 22).

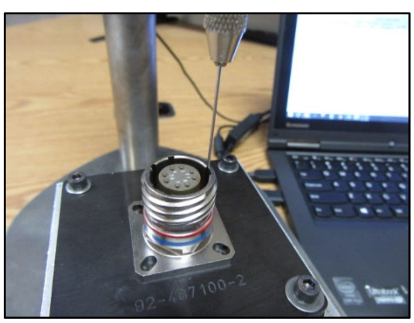

Figure 20 – Gauge Location Measurement

Figure 21 – Gauge Location Forward Bias

Figure 22 – Test Fixture

3.15 Gauge Retention

Test specimens were subjected to Gauge Retention test, in accordance with paragraphs 3.44 and 4.6.36 of MIL-DTL-32546A, 11 July 2018 as per 108-160094 Rev. A. Test specimens were placed on a test fixture with mounting plate. The applicable test gauge was installed in 3 cavities of each connector. A test probe was used to apply an axial load to the gauge at an approximate rate of 1 pound per inch until the specified load of 10 pounds was reached. The load was applied in both directions. Gauge displacement was measured after an initial preload of 2 pounds was. Since the testing was conducted on unassembled connectors a blank Size 11 receptacle shell test fixture was used to hold loose inserts from the Size 25 connectors (Figure 22).

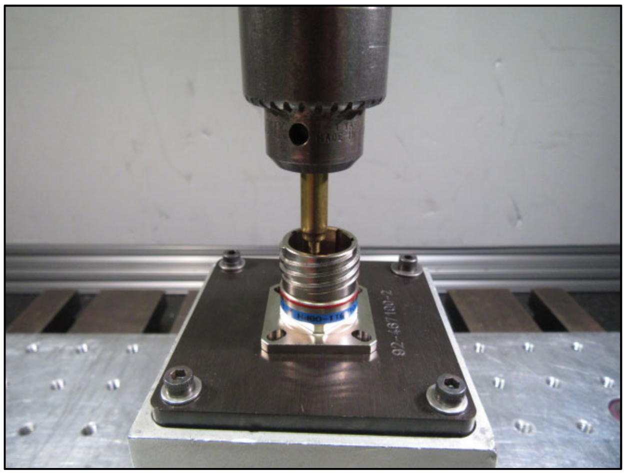

Figure 23 – Gauge Retention Setup Receptacle

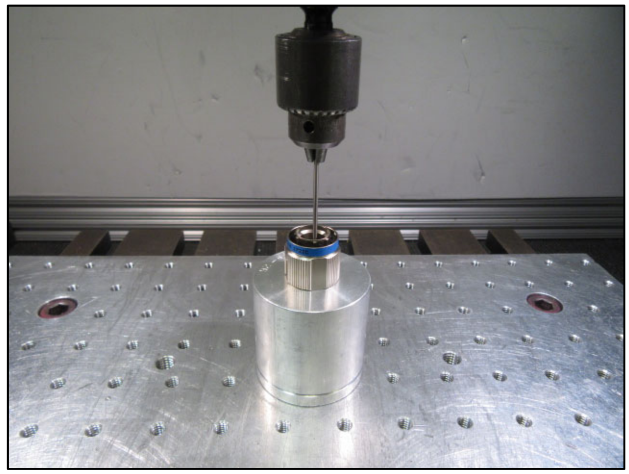

Figure 24 – Gauge Retention Setup Plug

3.16 Contact Retention

Test specimens were subjected to Contact Retention, in accordance with paragraphs 3.19 and 4.6.12 of MIL-DTL-32546A, 11 July 2018 as per 108-160094 Rev. A. Test specimens were placed on a test fixture or mounting plate. A test probe was used to apply an axial load to the contact at a rate of 0.10 inches per minute until the specified load of 10 pounds was reached. The load was applied in both directions. Contact displacement was measured after an initial preload of 3 pounds was applied. Since the testing was conducted on unassembled connectors a blank Size 11 receptacle shell test fixture was used to hold loose inserts from the Size 25 connectors (Figure 22). A minimum of 4 contacts were tested in shell size 11 specimens. A minimum of 7 contacts were tested in shell size 25 specimens.

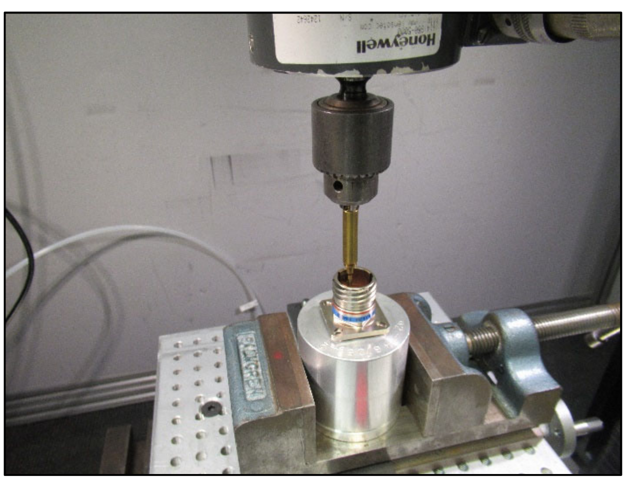

Figure 25 – Typical Contact Retention Setup Receptacle

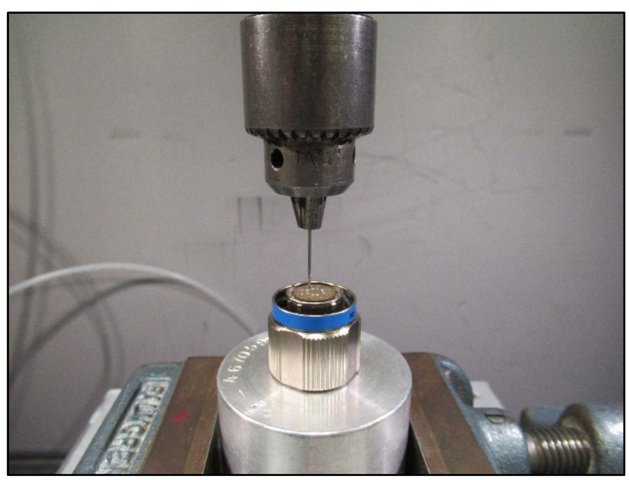

Figure 26 – Typical Contact Retention Setup Plug

3.17 Insulation Resistance at Elevated Temperature

Test specimens were subjected to Insulation Resistance at Elevated Temperature exposure in accordance with EIA-364-21F as per 108-160094 Rev. A. Unmated connectors were exposed to a temperature of 175°C (Figure 27). A minimum of 5 adjacent contact pairs per connector and all contacts to shell were tested. A voltage potential of 500 volts DC was applied and maintained for a minimum of 120 seconds.

Figure 27 – IR at Elevated Temperature Test Set Up

3.18 Dielectric Withstanding Voltage at Altitude

Test specimens were subject to Dielectric Withstanding Voltage at Altitude test, in accordance with EIA-364-20F as per 108-160094 Rev. A. Specimens were placed in the altitude chamber and leads were passed through a port in the chamber. Any wire splices needed to extend the leads were attached outside the chamber. Mated specimens were tested at altitudes of 50,000 ft. and 70,000 ft. (Figure 28). A voltage potential of 800 volts AC was applied at a rate of 500 volts per second and was maintained for a minimum of 2 seconds. Specimens were unmated and the unmated connector halves with pin contacts were tested at altitudes of 50,000 ft. and 70,000 ft. (Figure 29). While at 50,000 ft. a voltage potential of 550 volts AC was applied at a rate of 500 volts per second and was maintained for a minimum of 2 seconds. While at 70,000 ft a voltage potential of 350 volts AC was applied at a rate of 500 volts per second and was maintained for a minimum of 2 seconds. A minimum of 50%, but no less than six adjacent contacts were tested. All contacts to shell were tested.

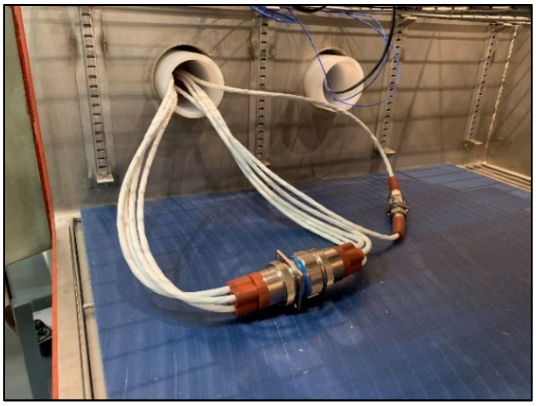

Figure 28 – DWV at 50K & 70K ft. Mated

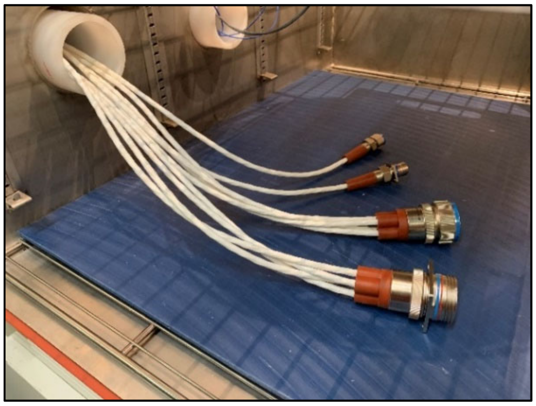

Figure 29 – DWV at 50K & 70K ft. Unmated

* Trademark

3.19 High Temperature Exposure

Test specimens were subjected to High Temperature Exposure in accordance with 108-160094 Rev. A. Mated connectors for Class (F) and (M) were exposed to a temperature of 200°C (Figure 30). The temperature was maintained for 1000 hours.

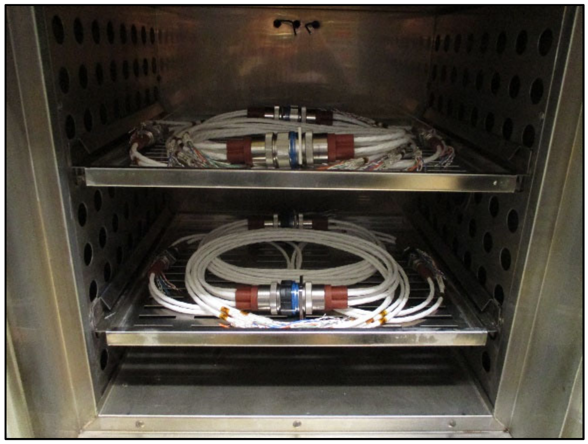

Figure 30 – High Temperature Exposure Test Set Up

3.20 Insertion Loss

Test specimens were subjected to Insertion Loss in accordance with EIA-364-101, Method A as per 108-160094 Rev. A. The 3.5 mm to 3.5 mm (f) adapters and TE test port cables were connected to port 1, 2, 3, and 4 of the network analyzer. The SMA at the ends of the cables was connected to the appropriate balun on the CAT6A test tower. The network analyzer was set to collect 801 data points across a frequency range of 1 to 801 MHz using a bandwidth of 1 kHz. A full 4 port calibration was performed using the open, short, load, and thru calibration standards.

The samples were assembled with Madison Turbo Twin Cable. The pairs were identified on the connector as 1-2 (green), 3-4 (brown), 5-6 (blue), and 7-8 (orange). The wires from the sample were placed in the slots of two adapter boards making sure the polarity was the same.

The appropriate DMCM 3 port resister termination board was placed on top of the CAT6A test tower. The adapter boards, with sample, were placed on top of the termination board on the test tower. The far end adapter board was terminated using a 4-port DMCM termination mini board. A 2 port calibration was performed using the open, short, load, and thru calibration standards on ports 1 and 4. Insertion loss and FEXT measurements were taken driven from port 1 of the network analyzer from the pins direction of the mated connector. All 4 pairs were measured for insertion loss.

3.21 Return Loss

Test specimens were subjected to Return Loss in accordance with EIA-364-108A, Test Procedure 4.2 as per 108-160094 Rev. A. The 3.5 mm to 3.5 mm (f) adapters and TE test port cables were connected to port 1, 2, 3, and 4 of the network analyzer. The SMA at the ends of the cables was connected to the appropriate balun on the CAT6A test tower. The network analyzer was set to collect 801 data points across a frequency range of 1 to 801 MHz using a bandwidth of 1 kHz. A full 4 port calibration was performed using the open, short, load, and thru calibration standards.

The samples were assembled with Madison Turbo Twin Cable. The pairs were identified on the connector as 1-2 (green), 3-4 (brown), 5-6 (blue), and 7-8 (orange). The wires from the sample were placed in the slots of two adapter boards making sure the polarity was the same.

The large adapter board was placed on top of the CAT6A test tower. The adapter boards, with sample, were placed on top of the large adapter board on the test tower. The far end adapter board was terminated using DM 4 Port resistor termination board for return loss and DMCM 4 port resister termination board for NEXT. All pairs were measured driven from port 1 from both directions of the mated connector, pins and sockets, for return loss.

3.22 Near-End Cross Talk

Test specimens were subjected to Near-End Cross Talk in accordance with EIA-364-90A as per 108-160094 Rev. A. The 3.5 mm to 3.5 mm (f) adapters and TE test port cables were connected to port 1, 2, 3, and 4 of the network analyzer. The SMA at the ends of the cables was connected to the appropriate balun on the CAT6A test tower. The network analyzer was set to collect 801 data points across a frequency range of 1 to 801 MHz using a bandwidth of 1 kHz. A full 4 port calibration was performed using the open, short, load, and thru calibration standards.

The samples were assembled with Madison Turbo Twin Cable. The pairs were identified on the connector as 1-2 (green), 3-4 (brown), 5-6 (blue), and 7-8 (orange). The wires from the sample were placed in the slots of two adapter boards making sure the polarity was the same.

The large adapter board was placed on top of the CAT6A test tower. The adapter boards, with sample, were placed on top of the large adapter board on the test tower. The far end adapter board was terminated using DM 4 Port resistor termination board for RL and DMCM 4 port resister termination board for NEXT. All 12 pair combinations were measured driven from port 1 of the mated connector from both directions, pins and sockets, for NEXT.

3.23 Far-End Cross Talk

Test specimens were subjected to Far-End Cross Talk in accordance with EIA-364-90A as per 108-160094 Rev. A. The 3.5 mm to 3.5 mm (f) adapters and TE test port cables were connected to port 1, 2, 3, and 4 of the network analyzer. The SMA at the ends of the cables was connected to the appropriate balun on the CAT6A test tower. The network analyzer was set to collect 801 data points across a frequency range of 1 to 801 MHz using a bandwidth of 1 kHz. A full 4 port calibration was performed using the open, short, load, and thru calibration standards.

The samples were assembled with Madison Turbo Twin Cable. The pairs were identified on the connector as 1-2 (green), 3-4 (brown), 5-6 (blue), and 7-8 (orange). The wires from the sample were placed in the slots of two adapter boards making sure the polarity was the same.

The appropriate DMCM 3 port resister termination board was placed on top of the CAT6A test tower. The adapter boards, with sample, were placed on top of the termination board on the test tower. The far end adapter board was terminated using a 4-port DMCM termination mini board. A 2 port calibration was performed using the open, short, load, and thru calibration standards on ports 1 and 4. Insertion loss and FEXT measurements were taken driven from port 1 of the network analyzer from the pins direction of the mated connector. All 12 pair combinations were measured for FEXT.

3.24 Propagation Delay

Test specimens were subjected to Propagation Delay in accordance with EIA-364-103 as per 108-160094 Rev. A. The test port cables were connected to channels 1 through 4 on the sampling heads. The cables were connected to the test head base on channel 1 and 2 and channel 3 and 4. Channels 3 and 4 were de-skewed at the end of the test head base. The TDR function was turned on at channel 1 and 2. The receive function was turned on for channel 3 and 4. The samples were driven differentially from C1 and C2 and received in channel 3 and 4. The math function for channel 3 and 4 was turned on as M1=C3-C4. The test head bases were connected with the back to back thru test board. This waveform was saved on the screen as R1. The thru board was removed and the test sample was connected to the two test head bases. A delay measurement was turned on for R1 and M1 at 50%. This delay measurement is the propagation delay for the samples under test. All 4 pairs for each sample were measured.

3.25 Propagation Delay Skew

Test specimens were subjected to Propagation Delay in accordance with EIA-364-103 as per 108-160094 Rev. A. The test port cables were connected to channels 1 through 4 on the sampling heads. The cables were connected to the test head base on channel 1 and 2 and channel 3 and 4. Channels 3 and 4 were de-skewed at the end of the test head base. The TDR function was turned on at channel 1 and 2. The receive function was turned on for channel 3 and 4. The samples were driven differentially from C1 and C2 and received in channel 3 and 4. The math function for channel 3 and 4 was turned on as M1=C3-C4. The test head bases were connected with the back to back thru test board. This waveform was saved on the screen as R1. The thru board was removed and the test sample was connected to the two test head bases. A delay measurement was turned on for R1 and M1 at 50%. This delay measurement is the propagation delay for the samples under test. All 4 pairs for each sample were measured. The difference between the minimum and maximum within the sample is the propagation delay skew.

3.26 Final Examination of Product

Specimens were visually examined for evidence of cracking, loosening of parts, carbon tracking, excessive wear, or missing parts.