# ENGINEERING REPORT	REPORT NO.: **C1-2000**	
	REPORT DATE: 29 October 2007	CHANGE: **A**

Amphenol Corporation	Amphenol Aerospace Operations	Sidney, New York 13838-1395

TITLE: **AMPHENOL LOAD BEARING RACK & PANEL BRUSH CONNECTOR QUALIFICATION**	REPORT TYPE: Qualification

Introduction:
This report summarizes the qualification of the Amphenol Load Bearing Rack & Panel Brush connector to the performance and qualification specification, L-29105-137 Rev. D, and is approved for unlimited distribution.

Module Connector: 10-504913-010
Backplane Connector: 10-504912-020
Backplane Cover: 10-504912-001

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Date: 29 October 2007	**Date: 29 October 2007**	**Date: 29 October 2007**

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REFERENCES

Military Specifications

1. AR 70-75, Survivability of Army Personnel and Material
2. MIL-C-55302E, General Specification For Printed Circuit Subassemblies And Accessories Connectors
3. MIL-D-12468B, STB Decontaminant
4. MIL-DTL-38999, Military Specification Sheet, Connectors, Electrical
5. MIL-DTL-55302, Detail Specification, Connectors
6. MIL-STD-202G, Test Methods For Electronics and Electrical Component Parts
7. MIL-STD-810, Environmental Engineering Considerations and Laboratory Tests
8. MIL-STD-1344A, Test Methods For Electrical Connectors

Commercial Specifications

1. ANSI/EIA-364, Test Methods For Electronics And Electrical Components Parts
2. IEC 61000-4-2, Electromagnetic Compatibility Testing and Measurement

Other References

1. Amphenol L-29105-137 Rev. C, Amphenol Load Bearing Rack & Panel Brush Connector Performance & Qualification Specification
2. ER-8936, Amphenol Engineering Report Qualification
3. 10-504912-001, Backplane Cover Specification Drawing
4. 10-504912-020, Backplane Connector Specification Drawing
5. 10-504913-010, Module Connector Specification Drawing

1.0 PURPOSE

This testing effort was undertaken to qualify the Amphenol Load Bearing Rack & Panel Brush Connector. The connector is as specified in L-29105-137, Amphenol Load Bearing Rack & Panel Brush Connector Performance & Qualification Specification.

2.0 BACKGROUND

The load bearing rack and panel brush connector is suitable for both power and high-speed digital signal capability. It can also serve as a structural support for the system. Both the backplane and module connector are specially equipped with ESD protection devices designed to divert personnel borne ESD events. When properly installed and fully mated, the mated connectors as well as the backplane connector and cover provide EMI and environmental protection to the system.

2.1 Backplane Connector

The backplane connector, 10-504912-020, consists of a conductive shell, an ESD protective shield, an insert, a conductive static gasket, a non-conductive dynamic gasket, and 126 brush contacts. The backplane connector is designed to be rear mounted and retained by four screws. See Figure 1.

2.2 Module Connector

The module connector, 10-504913-010, consists of a conductive shell, an EMI grounding strap, a conductive static gasket, an insert, 108 brush contacts, 18 ESD intercepting brush contacts, and two ground contacts. The module connector is designed to be front panel mounted and retained by four screws. See Figure 2.

2.3 Cover

The backplane cover, 10-504912-001, consists of a conductive shell and an EMI ground strap. The cover is designed to be mounted to the front face of the backplane over the backplane connector and be retained by two of the backplane connector screws. See Figure 3.

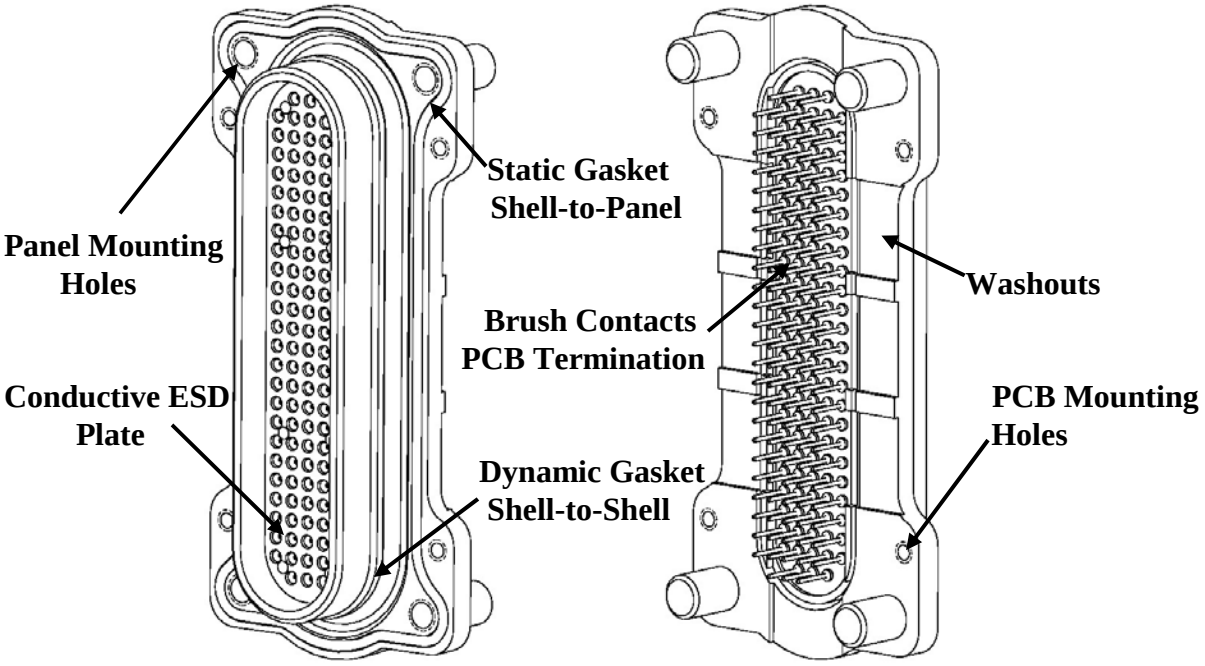


Figure 1: Backplane Connector, front and back isometric views

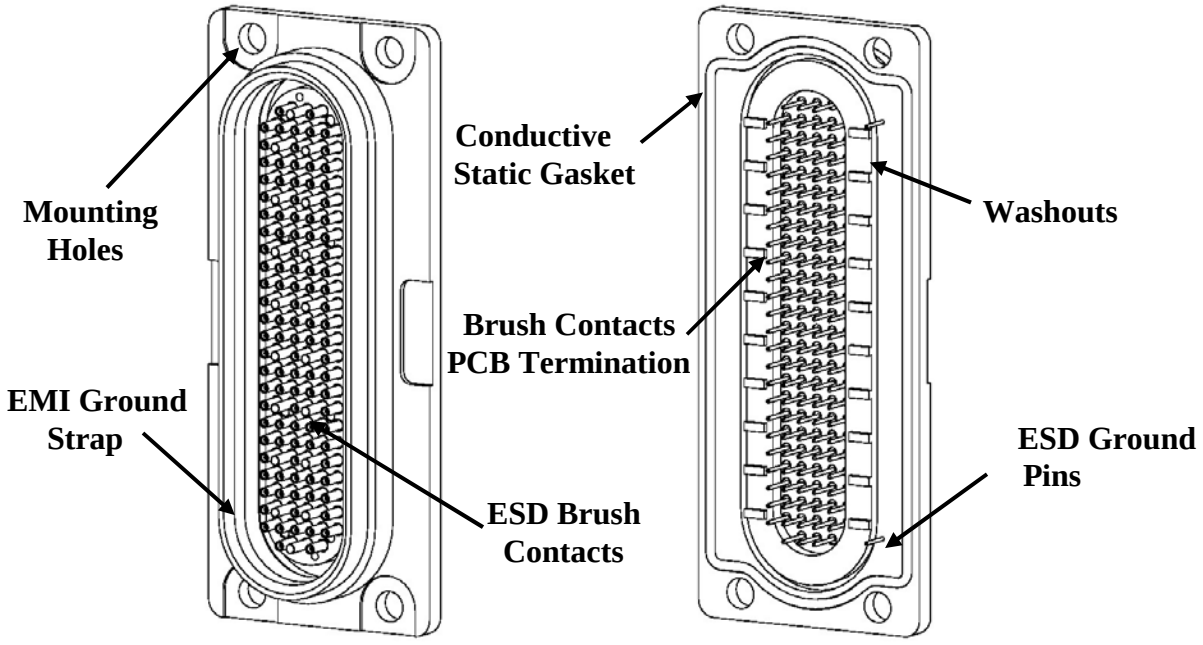


Figure 2: Module connector, front and back isometric views

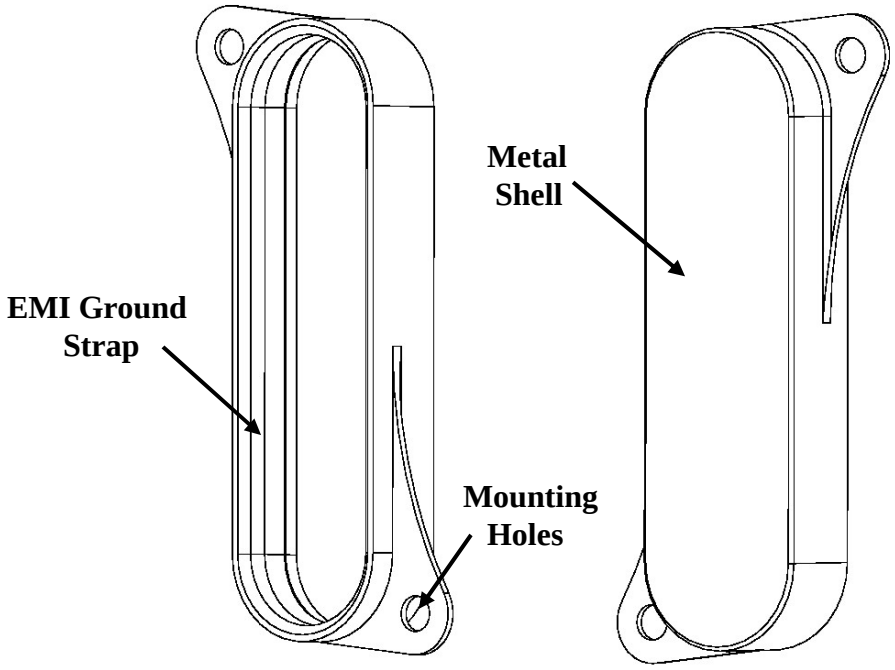


Figure 3: Backplane cover, front and back isometric views

3.0 CONCLUSIONS

The Amphenol Load Bearing Rack & Panel Brush Connector successfully met all qualification requirements of the L-29105-137 Rev. D connector specification. Tables 1 and 2 provide an overview of the requirements that were met.

Table 1
Summary of Empirical Qualification Results

Group/Requirement Description	Pass/ Fail	L-29105-137 Requirement
Group 1: Electrical		(2 Mated Pair)
Initial Visual and Mechanical Inspection	Pass	Acceptable to L-29105-137 sections 3.1-3.1.3
Magnetic Permeability	Pass	2μ max.
Electrical Bonding	Pass	1 milliOhm max.
Temperature Life	Pass	125°C max. int. temp., 16 contacts , 5 Amperes/contact, 1000 hours, 32 contacts, 2.5 Amperes/contact, 1000 hours
Contact Resistance	Pass	6 milliOhms max. initial, 10 milliOhms max. per contact and 8.5 milliOhms average over array after conditioning
Insulation Resistance at Ambient Temperature	Pass	5000 megaOhms min.
Insulation Resistance at Elevated Temperature	Pass	1,000 megaOhms min. after 30 minutes at 125°C
Final Visual and Mechanical Inspection	Pass	Acceptable to L-29105-137 sections 3.1-3.1.3
Group 2: High Speed Digital Signal		(2 Mated Pair)
Initial Visual and Mechanical Inspection	Pass	Acceptable to L-29105-137 sections 3.1-3.1.3
Characteristic Impedance Single Ended Config.	Pass	50 Ohm ± 10%
Characteristic Impedance Differential Config.	Pass	100 Ohm ± 10%
Reflections	Pass	12% max., rise time 200 picoseconds min.
Propagation Delay	Pass	150 pSec max. mated pair, 10 pSec max. adjacent circuits
Signal Attenuation	Pass	.5dB max. for 500MHz max. signal bandwidth
Electrical Isolation	Pass	50dB for 30Hz to 500MHz frequencies
Final Visual and Mechanical Inspection	Pass	Acceptable to L-29105-137 sections 3.1-3.1.3
Group 3: Durability		(2 Mated Pair)
Initial Visual and Mechanical Inspection	Pass	Acceptable to L-29105-137 sections 3.1-3.1.3
Contact Resistance	Pass	6 milliOhms initial, 10 milliOhms per contact and 8.5 milliOhms average over array following conditioning
Insulation Resistance at Ambient Temperature	Pass	5000 megaOhms min.
Dielectric Withstanding Voltage at Sea Level	Pass	500Vac (RMS), 60 Hz, leakage current < 2.0 milliAmperes
Insertion and Extraction Force	Pass	Insertion 95 lbs. max., Extraction 25 lbs. max.
Prevailing Force After Mating	Pass	10 lbs. max.
Immersion	Pass	30 minutes at 1 meter
Operational and Storage Temperature	Pass	25 cycles, -57°C to 125°C @ 5-10°C/min. transition with 15 minute dwell at extremes
Insulation Resistance at Ambient Temperature	Pass	100 megaOhms min. after immersion/humidity
Immersion	Pass	30 minutes at 1 meter
Durability	Pass	500 mate/demate cycles @ 100 cycles/hour min.
Contact Resistance	Pass	6 milliOhms initial, 10 milliOhms per contact and 8.5 milliOhms average over array following conditioning
Insulation Resistance at Ambient Temperature	Pass	100 megaOhms min. after immersion/humidity
Dielectric Withstanding Voltage at Sea Level	Pass	500Vac (RMS), 60 Hz, leakage current < 2.0milliAmperes
Insertion and Extraction Force	Pass	Insertion 95 lbs. max., Extraction 25 lbs. max.
Immersion	Pass	30 minutes at 1 meter
Final Visual and Mechanical Inspection	Pass	Acceptable to L-29105-137 sections 3.1-3.1.3

Group/Requirement Description	Pass/ Fail	L-29105-137 Requirement
Group 4: Altitude		(2 Mated Pair)
Initial Visual and Mechanical Inspection	Pass	Acceptable to L-29105-137 sections 3.1-3.1.3
Insulation Resistance at Ambient Temperature	Pass	5000 megaOhms min.
Dielectric Withstanding Voltage at Sea Level	Pass	500Vac (RMS), 60 Hz, leakage current < 2.0 milliAmperes
Immersion	Pass	30 minutes at 1 meter
Storage at Altitude	Pass	1 hr. @ 20000 ft., sealed fixtures
Immersion	Pass	30 minutes at 1 meter
Rapid Decompression at Altitude	Pass	Sealed fixtures, 20000 ft.
Immersion	Pass	30 minutes at 1 meter
Operation at Altitude	Pass	1 hr. @ 20000 ft., sealed fixtures with DWV @ Alt.
Dielectric Withstanding Voltage at Altitude	Pass	500Vac (RMS), 60 Hz, leakage current < 2.0 milliAmperes
Immersion	Pass	30 minutes at 1 meter
Insulation Resistance at Ambient Temperature	Pass	100 megaOhms min. after immersion/humidity
Final Visual and Mechanical Inspection	Pass	Acceptable to L-29105-137 sections 3.1-3.1.3
Group 5: Shock and Vibration		(2 Mated Pair without mass simulation)
Initial Visual and Mechanical Inspection	Pass	Acceptable to L-29105-137 sections 3.1-3.1.3
Insulation Resistance at Ambient Temperature	Pass	5000 megaOhms min.
Dielectric Withstanding Voltage at Sea Level	Pass	500Vac (RMS), 60 Hz, leakage current < 2.0 milliAmperes
Vibration	Pass	8 hrs. per axis per composite curve (see 7.5.4)
Insulation Resistance at Ambient Temperature	Pass	5000 megaOhms min.
Dielectric Withstanding Voltage at Sea Level	Pass	500Vac (RMS), 60 Hz, leakage current < 2.0 milliAmperes
Functional Shock	Pass	18 shocks, no discontinuity
Insulation Resistance at Ambient Temperature	Pass	5000 megaOhms min.
Dielectric Withstanding Voltage at Sea Level	Pass	500Vac (RMS), 60 Hz, leakage current < 2.0 milliAmperes
Bench Handling	Pass	All faces, no damage allowed
Final Visual and Mechanical Inspection	Pass	Acceptable to L-29105-137 sections 3.1-3.1.3
Group 6: Environmental		(2 Mated Pair)
Initial Visual and Mechanical Inspection	Pass	Acceptable to L-29105-137 sections 3.1-3.1.3
Insulation Resistance at Ambient Temperature	Pass	5000 megaOhms min.
Dielectric Withstanding Voltage at Sea Level	Pass	500Vac (RMS), 60 Hz, leakage current < 2.0 milliAmperes
Shell to Shell Conductivity	Pass	1 milliVolt max. drop for 1.0 ± .01 Ampere
Humidity	Pass	240 hours at 94 ± 4% cycling
Insulation Resistance at Ambient Temperature	Pass	100 megaOhms min. after immersion/humidity
Dielectric Withstanding Voltage at Sea Level	Pass	500Vac (RMS), 60 Hz, leakage current < 2.0 milliAmperes
Salt Fog	Pass	48 hours with 5 ± 1% solution and polarization
Insulation Resistance at Ambient Temperature	Pass	100 megaOhms min. after immersion/humidity
Dielectric Withstanding Voltage at Sea Level	Pass	500Vac (RMS), 60 Hz, leakage current < 2.0 milliAmperes
Rain and Wind	Pass	1.8 in./hr. rain with 40 mph wind for 40 min. 4 in./hr. vertical rain for 30 min.
Insulation Resistance at Ambient Temperature	Pass	100 megaOhms min. after immersion/humidity
Dielectric Withstanding Voltage at Sea Level	Pass	500Vac (RMS), 60 Hz, leakage current < 2.0 milliAmperes
Sand and Dust	Pass	3450 ft./min. dust, 5700 ft./min. sand, ambient temperature
Insulation Resistance at Ambient Temperature	Pass	100 megaOhms min. after immersion/humidity
Dielectric Withstanding Voltage at Sea Level	Pass	500Vac (RMS), 60 Hz, leakage current < 2.0 milliAmperes
Shell to Shell Conductivity	Pass	2 milliVolt max. drop for 1.0 ± .01 Ampere
Final Visual and Mechanical Inspection	Pass	Acceptable to L-29105-137 sections 3.1-3.1.3
Group 7: Destructive (10 Mated Pair for Fluid Immersion, 1 Mated Pair per each remaining test)		
Initial Visual and Mechanical Inspection	Pass	Acceptable to L-29105-137 sections 3.1-3.1.3
Contact Retention	Pass	2 lbs. min. per contact, test 30 individual contacts
Insert Retention	Pass	60 lbs. min.

Group/Requirement Description	Pass/ Fail	L-29105-137 Requirement
Group 7 Continued		
Crash Hazard	Pass	6 shocks per axis, 75 g, no mass simulation
Ballistic Shock	Pass	1 5 ft. hammer drop, longitudinal axis, no mass simulation
ESD	Pass	4kV max. across 50 Ohm resistor
EMI Shielding Effectiveness	Pass	See Table 7
Fluid Immersion	Pass	10 fluid types, mated with Insertion/Extraction and DWV

Table 2
Summary of Non-Empirical Qualification Results

Requirement Description	Method	L-29105-137 Requirement
Off-Axis Initial Connector Engagement	C	5˚ initial misalignment
Final Connector Engagement	C	.5˚ final misalignment
Staged Engagement	C	Shells, grounds, contacts sequential mate
Solderabilty	C	Pretinned
Explosive Atmosphere	C	Ignition free in fuel-air explosive atmosphere
Acceleration	C	9g in each direction of three axis
Fungus	C	Withstand and not support fungal growth
Chemical and Biological Decontamination	C	Withstand DS2 and STB
Environmental Test Profile	A & C	Storage and Operation at Temperature Extremes
Connector Covers	C	EMI and Immersion when attached to Backplane Connector

Notes: N/A=Not Applicable, T=Test, D=Demonstrate, A=Analysis, I=Inspection, C=Certification

4.0 SAMPLES

Sample connectors 1-1RP through 1-2RP were mounted to test boards L-39887-871 (Module) and L-39887-870 (Backplane) with the contacts soldered. These boards were configured so that, when mated, the contacts in a row formed a continuous series circuit out to two test points to facilitate obtaining the measurements needed for Heat Rise requirements testing. Sample connectors 2-1RP through 2-2RP were mounted to test boards 3594-075-3 (Module) and 3594-075-4 (Backplane) with the contacts soldered. These boards were configured so that, when mated, the contacts formed a controlled impedance circuit to facilitate obtaining the measurements needed for High Speed Digital Signal Integrity requirements testing. Sample connectors 3-1RP through 6-2RP, 7-2RP through 7-4RP, and 7-7RP through 7-16RP were mounted to test boards L-39887-869 (Module) and L-39887-868 (Backplane) with the contacts soldered. These boards were configured so that, when mated, the contacts in a row formed a continuous series circuit out to two test points to facilitate obtaining the measurements needed for various electrical and mechanical requirements testing. Sample connectors 7-1RP, 7-5RP, and 7-6RP were not mounted to test boards to facilitate obtaining the measurements needed for mechanically destructive requirements testing.

Table 3
Samples

Sample	Module Connector	Backplane Connector	Group 1	Group 2	Group 3	Group 4	Group 5	Group 6	Group 7
1-1RP	10-504913-010	10-504912-020	X						
1-2RP	10-504913-010	10-504912-020	X						
2-1RP	10-504913-010	10-504912-020		X					
2-2RP	10-504913-010	10-504912-020		X					
3-1RP	10-504913-010	10-504912-020			X				
3-2RP	10-504913-010	10-504912-020			X				
4-1RP	10-504913-010	10-504912-020				X			
4-2RP	10-504913-010	10-504912-020				X			
5-1RP	10-504913-010	10-504912-020					X		
5-2RP	10-504913-010	10-504912-020					X		
6-1RP	10-504913-010	10-504912-020						X	
6-2RP	10-504913-010	10-504912-020						X	
7-1RP	10-504913-010	10-504912-020							X
7-2RP	10-504913-010	10-504912-020							X
7-3RP	10-504913-010	10-504912-020							X
7-4RP	10-504913-010	10-504912-020							X
7-5RP	10-504913-010	10-504912-020							X
7-6RP	10-504913-010	10-504912-020							X
7-7RP	10-504913-010	10-504912-020							X
7-8RP	10-504913-010	10-504912-020							X
7-9RP	10-504913-010	10-504912-020							X
7-10RP	10-504913-010	10-504912-020							X
7-11RP	10-504913-010	10-504912-020							X
7-12RP	10-504913-010	10-504912-020							X
7-13RP	10-504913-010	10-504912-020							X
7-14RP	10-504913-010	10-504912-020							X
7-15RP	10-504913-010	10-504912-020							X
7-16RP	10-504913-010	10-504912-020							X

5.0 TEST EQUIPMENT, SEQUENCE, AND METHODS

5.1 Equipment and Facility Conditions

5.1.1 Equipment Calibration

Equipment used to measure test conditions and product characteristics was calibrated in accordance with ISO 10012-1 or equivalent contractor standard.

5.1.2 Equipment Accuracy

Equipment capable of measuring or testing to accuracy representing at least one-tenth of the prescribed product tolerance was used when available. Compensation must be made for inspection measurement and test equipment accuracy representing greater than one-forth of the prescribed accuracy.

5.1.3 Facility Conditions

Unless otherwise specified, all measurements of performance were made within ranges of standard ambient temperature, humidity and barometric pressure as specified in MIL-STD-810.

5.2 Equipment Used

Table 4
Equipment Used

ID	Cal. In	Cal. Out	Description	Manufacturer	Model
IC-4538	10/05/06	09/18/07	Magnetic Permeability Tester	-	-
IC-4089	07/20/06	03/20/07	DVM	Keithley	2000
IC-3991	01/10/07	04/11/07	Power Supply	HP	6038A
IC-4484	02/05/07	08/06/07	Digital Thermometer	-	-
IC-4544	04/09/07	10/08/07	Digital Multimeter	-	-
IC-4486	02/05/07	08/06/07	Temp Monitor	-	-
IC-4489	05/03/07	09/20/07	Meg-Ohmmeter	QuadTech	1867
N/A	N/A	N/A	Stereo Microscope (10X)	Bausch & Lomb	Zoom 3
IC-4571	11/07/06	10/25/07	TDR	TEK	CSA8200
IC4572	11/07/06	10/25/07	Sampling Module	TEK	80E04
IC-4630	05/23/07	04/10/08	Sampling Module	TEK	80E04
IC-4459	05/02/07	10/31/07	Network Analyzer	Agilent	-
IC 3994	01/26/07	07/27/07	Multimeter	Keithley	2000
IC 3990	01/16/07	04/17/07	Power Supply	HP	6031A
IC-4502	03/07/07	12/05/07	High Pot	Research Associates	Ultra-Hypot
IC-4504	09/05/06	08/22/07			
PG-3143	09/27/06	09/18/07	Force Measure Machine	Zwick	-
IC-1451	N/A	N/A	Weight 10lb.	N/A	N/A
F-2617	10/23/06	04/23/07	Timer	-	-
PG-2677	02/06/07	07/07/07	Pressure Gage	-	-
IC-8891	N/A	N/A	Temperature Chamber	Sun	-
N/A	N/A	N/A	Linear Durability Machine	Amphenol	-
F-2591	08/27/07	11/26/07	Circuit Monitor (Event Detector)	Bendix	-
IC-4573	08/23/07	02/21/08	Digital O-scope	TEK	-
F-1444	05/21/07	11/19/07	Charge Amp	Kistler	504
F-2561	10/03/07	02/20/08	Accelerometer	Endvco	-
IC-3833	02/23/07	08/25/07	Salt Spray Chamber	-	-
Vendor	12/27/06	12/27/07	Thermal Anemometer	Dwyer	-
Vendor	N/A	N/A	Rain Gage	Cole-Palmer	03319-00
PG-3141	03/28/07	09/18/07	Force Measure Machine	Zwick	-
F-2376	08/27/07	11/26/07	Discontinuity Monitor	-	-
Vendor	10/16/07	10/17/07	Light Weight Shock Mach.	New Eng. Trawler	-
IC-4537	10/02/06	09/17/07	Digital Oscilloscope	TEK	DPO-7254
IC-4622	06/21/07	12/19/07	ESD Simulator	Electro-Tech Sys	-

ID	Cal. In	Cal. Out	Description	Manufacturer	Model
N/A	N/A	N/A	Mode Stir Chamber	Anritsu	-
N/A	N/A	N/A	Source	HP	8341B
F-0011	04/14/07	09/25/07	Thermometer	-	-
IC-0386	12/14/06	06/14/07	Timer	-	-
N/A	N/A	N/A	Nikon Microscope/Camera	Nikon	-
Vendor	05/25/07	05/25/08	Stop Watch	Accusplit	705X
Vendor	N/A	N/A	Rain Apparatus	Sypris	-
Vendor	N/A	N/A	Blower	Dayton	FD10011CA
Vendor	01/24/07	01/24/08	Dust Chamber	Bethlehem Co.	SD64
Vendor	N/A	N/A	Sand Chamber	EWT	-
Vendor	08/08/07	08/08/08	Chart Recorder	Honeywell	Y455
Vendor	08/24/06	08/24/08	Manometer	Dwyer	440-5
Vendor	12/18/06	12/18/07	Controller	Omega	CNi3244

6.0 QUALIFICATION METHODS AND SEQUENCE

6.1 Requirements Qualified by Non-Empirical Methods

Table 5 summarizes the requirements that were met by Analysis or Certification.

Requirement/Test	L-29105-137 Requirement	L-29105-137 Method	Verification Method	Supplemental Specification
Off-Axis Initial Connector Engagement	3.3.4	4.3.4	A	
Final Connector Engagement	3.3.5	4.3.5	A	
Staged Engagement	3.3.6	4.3.6	A	
Solderabilty	3.3.9	4.3.9	C	
Explosive Atmosphere	3.4.7	4.4.7	C	
Acceleration	3.4.10	4.4.10	C	
Fungus	3.4.13	4.4.13	C	
Chemical and Biological Decontamination	3.4.14	4.4.14	C	
Environmental Test Profile	3.4.15	4.4.15	A & C	
Connector Covers	1.2.3	-	C	

Notes: N/A=Not Applicable, T=Test, D=Demonstrate, A=Analysis, I=Inspection, C=Certification

Table 5
Summary of Non-Empirically Qualified Requirements

6.2 Requirements Qualified by Empirical Methods

Table 6 summarizes the requirements that were met by Testing, Demonstration, or Inspection.

Table 6
Summary of Empirically Qualified Requirements

Group/Requirement Description	L-29105-137 Requirement	L-29105-137 Method	Supplemental Specification
Group 1: Electrical		(2 Mated Pair)	
Initial Visual and Mechanical Inspection	3.1-3.1.3	N/A	N/A
Magnetic Permeability	3.2.9	4.2.9	EIA-364-54A
Electrical Bonding	3.2.7	4.2.7	EIA-364-83
Temperature Life	3.2.1	4.2.1	EIA-364-17B
Contact Resistance	3.2.2	4.2.2	EIA-364-06C
Insulation Resistance at Ambient Temperature	3.2.4.1	4.2.4.1	EIA-364-21C
Insulation Resistance at Elevated Temperature	3.2.4.2	4.2.4.2	EIA-364-21C
Final Visual and Mechanical Inspection	3.1-3.1.3	N/A	N/A
Group 2: High Speed Digital Signal		(2 Mated Pair)	
Initial Visual and Mechanical Inspection	3.1-3.1.3	N/A	N/A
Characteristic Impedance Single End Config.	3.2.5.1.1	4.2.5.1	IEEE 802.3/ARINC-664, EIA-644
Characteristic Impedance Differential Config,	3.2.5.1.2	4.2.5.1	IEEE 802.3/ARINC-664, EIA-644
Reflections	3.2.5.2	4.2.5.2	IEEE 802.3/ARINC-664, EIA-644
Propagation Delay	3.2.5.3	4.2.5.3	IEEE 802.3/ARINC-664, EIA-644
Signal Attenuation	3.2.5.4	4.2.5.4	IEEE 802.3/ARINC-664, EIA-644
Electrical Isolation	3.2.5.5	4.2.5.5	IEEE 802.3/ARINC-664, EIA-644
Final Visual and Mechanical Inspection	3.1-3.1.3	N/A	N/A
Group 3: Durability		(2 Mated Pair)	
Initial Visual and Mechanical Inspection	3.1-3.1.3	N/A	N/A
Contact Resistance	3.2.2	4.2.2	EIA-364-06C
Insulation Resistance at Ambient Temperature	3.2.4.1	4.2.4.1	EIA-364-21C
Dielectric Withstanding Voltage at Sea Level	3.2.3.1	4.2.3.1	MIL-STD-1344, Method 3001
Insertion and Extraction Force	3.3.1	4.3.1	EIA-364-13B
Prevailing Force After Mating	3.3.2	4.3.2	EIA-364-13B
Immersion	3.4.11	4.4.11	MIL-STD-810 Method 512.4 Proc. I Cond. 2
Operational and Storage Temperature	3.4.2	4.4.2	N/A
Insulation Resistance at Ambient Temperature	3.2.4.1	4.2.4.1	EIA-364-21C
Immersion	3.4.11	4.4.11	MIL-STD-810 Method 512.4 Proc. I Cond. 2
Durability	3.3.3	4.3.3	N/A
Contact Resistance	3.2.2	4.2.2	EIA-364-06C
Insulation Resistance at Ambient Temperature	3.2.4.1	4.2.4.1	EIA-364-21C
Dielectric Withstanding Voltage at Sea Level	3.2.3.1	4.2.3.1	MIL-STD-1344, Method 3001
Insertion and Extraction Force	3.3.1	4.3.1	EIA-364-13B
Immersion	3.4.11	4.4.11	MIL-STD-810 Method 512.4 Proc. I Cond. 2
Final Visual and Mechanical Inspection	3.1-3.1.3	N/A	N/A
Group 4: Altitude		(2 Mated Pair)	
Initial Visual and Mechanical Inspection	3.1-3.1.3	N/A	N/A
Insulation Resistance at Ambient Temperature	3.2.4.1	4.2.4.1	EIA-364-21C
Dielectric Withstanding Voltage at Sea Level	3.2.3.1	4.2.3.1	MIL-STD-1344, Method 3001
Immersion	3.4.11	4.4.11	MIL-STD-810 Method 512.4 Proc. I Cond. 2
Storage at Altitude	3.4.1	4.4.1.1	MIL-STD-810, Method 512.4, Proc. I
Immersion	3.4.11	4.4.11	MIL-STD-810 Method 512.4 Proc. I Cond. 2
Rapid Decompression at Altitude	3.4.1	4.4.1.3	MIL-STD-810, Method 500.1, Procedure III

Group/Requirement Description	L-29105-137 Requirement	L-29105-137 Method	Supplemental Specification
Group 4 Continued			
Immersion	3.4.11	4.4.11	MIL-STD-810 Method 512.4 Proc. I Cond. 2
Operation at Altitude	3.4.1	4.4.1.2	MIL-STD-810, Method 500.1, Procedure II
Dielectric Withstanding Voltage at Altitude	3.2.3.2	4.2.3.2	MIL-STD-1344, Method 3001
Immersion	3.4.11	4.4.11	MIL-STD-810 Method 512.4 Proc. I Cond. 2
Insulation Resistance at Ambient Temperature	3.2.4.1	4.2.4.1	EIA-364-21C
Final Visual and Mechanical Inspection	3.1-3.1.3	N/A	N/A
Group 5: Shock and Vibration		(2 Mated Pair)	
Initial Visual and Mechanical Inspection	3.1-3.1.3	N/A	N/A
Insulation Resistance at Ambient Temperature	3.2.4.1	4.2.4.1	EIA-364-21C
Dielectric Withstanding Voltage at Sea Level	3.2.3.1	4.2.3.1	MIL-STD-1344, Method 3001
Vibration	3.4.8	4.4.8	MIL-STD-810 Meth. 514.5 Proc. I Cat. 20-A
Insulation Resistance at Ambient Temperature	3.2.4.1	4.2.4.1	EIA-364-21C
Dielectric Withstanding Voltage at Sea Level	3.2.3.1	4.2.3.1	MIL-STD-1344, Method 3001
Functional Shock	3.4.9.1	4.4.9.1	EIA-364-27B Condition A
Insulation Resistance at Ambient Temperature	3.2.4.1	4.2.4.1	EIA-364-21C
Dielectric Withstanding Voltage at Sea Level	3.2.3.1	4.2.3.1	MIL-STD-1344, Method 3001
Bench Handling	3.4.9.3	4.4.9.3	MIL-STD-810, Method 516.5, Procedure VI
Final Visual and Mechanical Inspection	3.1-3.1.3	N/A	N/A
Group 6: Environmental		(2 Mated Pair)	
Initial Visual and Mechanical Inspection	3.1-3.1.3	N/A	N/A
Insulation Resistance at Ambient Temperature	3.2.4.1	4.2.4.1	EIA-364-21C
Dielectric Withstanding Voltage at Sea Level	3.2.3.1	4.2.3.1	MIL-STD-1344, Method 3001
Shell to Shell Conductivity	3.2.8	4.2.8	EIA-364-83
Humidity	3.4.3	4.4.3	EIA-364-31B
Insulation Resistance at Ambient Temperature	3.2.4.1	4.2.4.1	EIA-364-21C
Dielectric Withstanding Voltage at Sea Level	3.2.3.1	4.2.3.1	MIL-STD-1344, Method 3001
Salt Fog	3.4.4	4.4.4	MIL-STD-810, Method 509.4
Insulation Resistance at Ambient Temperature	3.2.4.1	4.2.4.1	EIA-364-21C
Dielectric Withstanding Voltage at Sea Level	3.2.3.1	4.2.3.1	MIL-STD-1344, Method 3001
Rain and Wind	3.4.5	4.4.5	MIL-STD-810, Meth. 506.4, Proc. I & II
Insulation Resistance at Ambient Temperature	3.2.4.1	4.2.4.1	EIA-364-21C
Dielectric Withstanding Voltage at Sea Level	3.2.3.1	4.2.3.1	MIL-STD-1344, Method 3001
Sand and Dust	3.4.6	4.4.6	MIL-STD-810, Meth. 510.4, Proc. I & II
Insulation Resistance at Ambient Temperature	3.2.4.1	4.2.4.1	EIA-364-21C
Dielectric Withstanding Voltage at Sea Level	3.2.3.1	4.2.3.1	MIL-STD-1344, Method 3001
Shell to Shell Conductivity	3.2.8	4.2.8	EIA-364-83
Final Visual and Mechanical Inspection	3.1-3.1.3	N/A	N/A
Group 7: Destructive (10 Mated Pair for Fluid Immersion, 1 Mated Pair per each remaining test)			
Initial Visual and Mechanical Inspection	3.1-3.1.3	N/A	N/A
Contact Retention	3.3.8	4.3.8	N/A
Insert Retention	3.3.7	4.3.7	N/A
Crash Hazard	3.4.9.2	4.4.9.2	EIA-364-27B, Condition B
Ballistic Shock	3.4.9.4	4.4.9.4	MIL-STD-810, Method 522.4, Procedure III
ESD	3.2.10	4.2.10	IEC-61000-4-2
EMI Shielding Effectiveness	3.2.6	4.2.6	MIL-DTL-38999, Paragraph 4.5.27.1 & EIA-364-66
Fluid Immersion	3.4.12	4.4.12	EIA-364-10D

7.0 QUALIFICATION RESULTS

7.1 Results for Requirements Qualified by Testing

7.1.1 Group 1 Results, Electrical

7.1.1.1 Initial Visual and Mechanical Examination

Group 1 samples were inspected at 10X and met the requirements of L-29105-137 sections 3.1 to 3.1.3. No defects were found.

7.1.1.2 Magnetic Permeability

The magnetic permeability of the connectors was tested in accordance with EIA-364-54A. The relative permeability of the fully mated connector assembly was found to be less than 2 μ and met all requirements.

7.1.1.3 Electrical Bonding

Electrical bonding of the connector to a nickel-plated chassis was tested with a calibrated milliOhm meter in accordance with EIA-364-83. The following details and exceptions applied.

a. The test current was 1.0 ± 0.1 Amperes.
b. Both the backplane and module shell connectors were tested.
c. Test probes were not to damage shell and panel finish.
d. Test was also performed with a chromate panel with no requirement. Data is provided for comparison purposes only.

The electrical bonding resistance between connector and a nickel-plated chassis was found to be less than 1 milliOhm. All requirements were met. The electrical bonding resistance between connector and a chromate chassis was found to be .27 milliOhm max.

7.1.1.4 Temperature Life

The temperature life of the module connector was tested in accordance with EIA-364-17B (MIL-STD-1344, Method 1005, test condition 4, time condition D). The following details and exceptions applied.

a. The applied currents were 2.5 and 5.0 Amperes.
b. The maximum internal temperature allowed was 125°C.
c. 32 mated pair of contacts were tested at 2.5 Amperes for 1000 hours and then 16 mated pair (8 untested contacts combined with 8 contacts selected from the original 32 contacts) were tested at 5 Amperes for 1000 hours.
d. Contacts were tested in series.
e. Printed circuit boards L-39887-870 and L-39887-871 were soldered to connectors.

Maximum internal temperature limits were not exceeded and all requirements were met.

7.1.1.5 Contact Resistance

All samples were tested on milliVolt drop bench, which is a computer controlled test system comprised of a power supply, a micro-Ohmmeter, a multimeter and a switch box. The switch box connected the four probe Kelvin clips to either the micro-Ohmmeter or the multimeter as well as reversed the polarity of the applied currents. Contact resistance was tested in accordance with EIA-364-06C. The following details and exceptions applied.

a. Test current was 2.5 Amperes.
b. Measurements were taken on all contacts.
c. Measurements were taken at termination into board

The typical initial resistance between any mated pair of contacts was 6 milliOhms max. Resistance following conditioning was 10 milliOhms maximum per contact and 8.5 milliOhms max. average over the whole array. All requirements were met.

7.1.1.6 Insulation Resistance at Ambient Temperature

The insulation resistance of the module connector at ambient temperature was tested in accordance with EIA-364-21C. The following details and exceptions applied.

a. Connectors were fully mated during test.

b. The applied test Voltage was 500 Vdc ± 10%.
c. Printed circuit boards were soldered to connectors.
d. Contacts in each Row, A-D, were wired in series.
e. Measurements were taken between adjacent rows and each contact row and shell.
f. The electrification time for this test was 2 minutes with the measurement taken at the end of the specified period. However, if the instrument reading indicated that the specified limit for the insulation resistance was met and was steady or increasing, the test was terminated before the end of the specified period.

When tested at ambient temperature the insulation resistance between adjacent contacts and between contacts and shell was greater than 5,000 megaOhms. Insulation resistance after conditioning (immersion, humidity) was greater than 100 megaOhms. All requirements were met.

7.1.1.7 Insulation Resistance at Elevated Temperature

The insulation resistance of the module connector at elevated temperature was tested in accordance with EIA-364-21C. The following details and exceptions applied

a. Connectors were fully mated during test.
b. The applied test Voltage was 500 Vdc ± 10%.
c. Printed circuit boards were soldered to connectors.
d. Contacts in each Row, A-D, were wired in series.
e. Measurements were taken between adjacent rows and each contact row and shell.
f. Measurements were taken after a 30-minute exposure to 125 $^{+5}/_{-0}$°C. Insulation resistance was measured while connectors were still at elevated temperature.

When tested after 30 minutes at 125°C, the insulation resistance between adjacent contacts and between any contact and shell was greater than 1,000 megaOhms. All requirements were met.

7.1.1.8 Final Visual and Mechanical Inspection

Group 1 samples were inspected at 10X and met the requirements of L-29105-137 sections 3.1 to 3.1.3. No defects that had an adverse effect on the testing, or that were relevant to the scope of the testing were found.

7.1.2 Group 2 Results, High Speed Digital Signal

The high speed digital signal characteristics of the module connector were analyzed using CST Microwave Studio, a full wave, 3-D electromagnetic field solver. Simplifications may be made to non-critical features to reduce complexity and run time. High speed digital signal were also tested per the following paragraphs. Contacts were able to transmit:

1. 100 Base TX Ethernet signals in accordance with IEEE 802.3/ARINC-664.

2. LVDS signals at 1Gbps in accordance with EIA-644. Rise times were as fast as 200 picoseconds. The component of differential skew that is related to the mated pair connector was less than 10 picoseconds.

7.1.2.1 Initial Visual and Mechanical Examination

Group 2 samples were inspected at 10X and met the requirements of L-29105-137 sections 3.1 to 3.1.3. No defects were found.

7.1.2.2 Characteristic Impedance Single Ended Configuration

Characteristic impedance of a single circuit and differential pair were measured using Time Domain Reflectometry (TDR) method and with remote termination to 50 Ohm as shown in Figure 4.

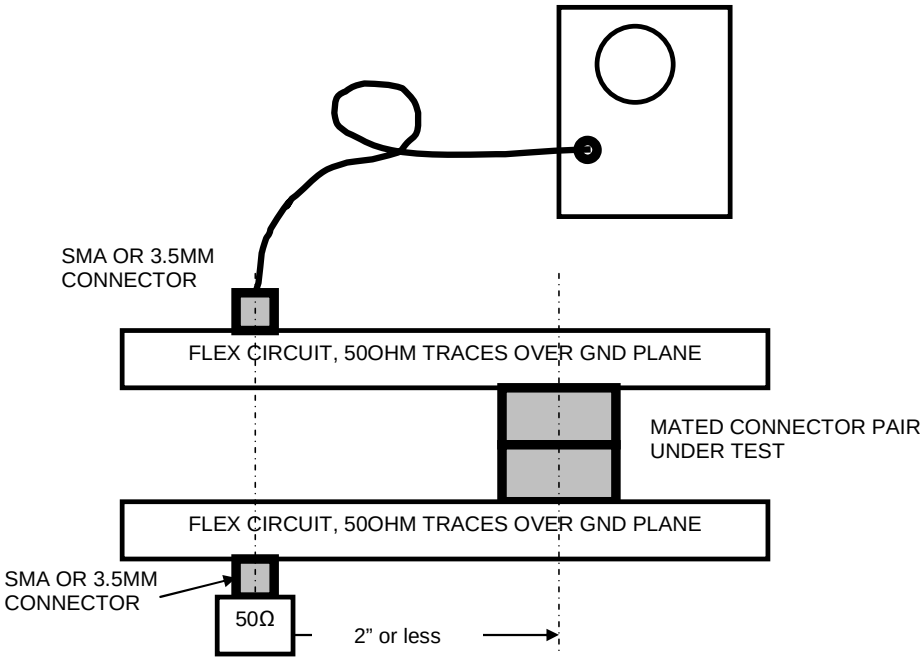


Figure 4: Time Domain Reflectometry (TDR) Test Setup

The characteristic impedance of a single circuit was 50 Ohm ± 10%. All requirements were met.

7.1.2.3 Characteristic Impedance Differential Configuration

Characteristic impedance of a single circuit and differential pair were measured using Time Domain Reflectometry (TDR) method and with remote termination to 50 Ohm as shown in Figure 4. The characteristic impedance of a differential pair circuit was 100 Ohm ± 10%. All requirements were met.

7.1.2.4 Reflections

Signal reflection was tested using Time Domain Reflectometry (TDR) method with test configuration as shown in Figure 4 and with remote end termination to 50 Ohm.
The amplitude of signal reflection measured on a mated pair of connectors did not exceed 12% for signals of LVDS (EIA–644) type with rise/fall time not less than 200 picoseconds. All requirements were met.

7.1.2.5 Propagation Delay

Propagation delay was measured using Time Domain Transmission (TDT) method with test configuration as shown in Figure 5.

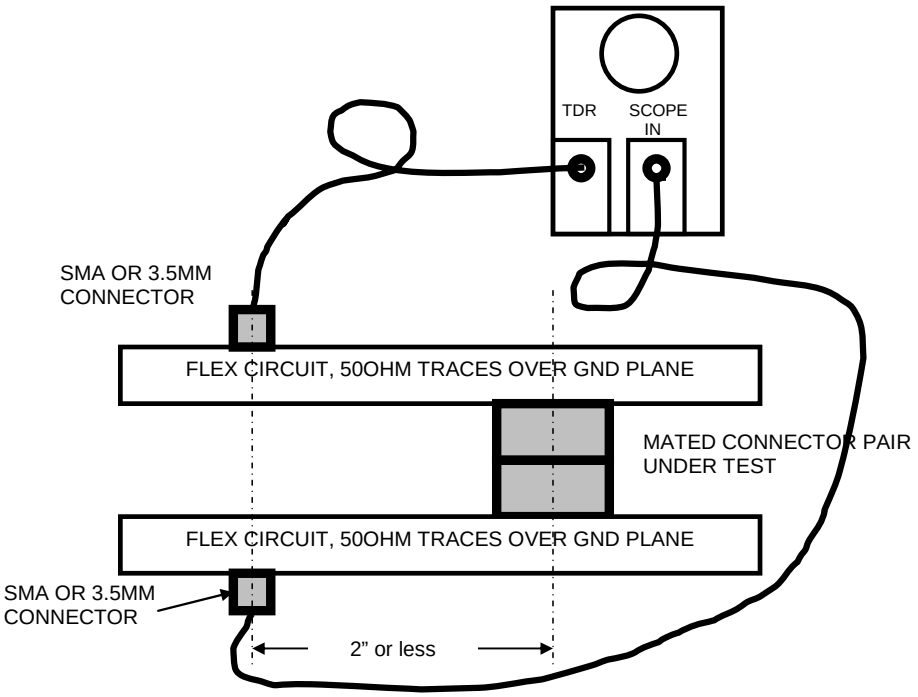


Figure 5: Time Domain Transmission (TDT) Test Setup

The propagation delay on any mated pair of contacts did not exceed 150pS. The difference of propagation delays on any two adjacent contact circuits did not exceed 10 picoseconds. All requirements were met.

7.1.2.6 Signal Attenuation

Signal attenuation was measured using VNA with test configuration similar to one as shown in Figure 4, except instead of scope with TDR head a VNA was used. The signal attenuation due to conductor and dielectric losses on mated connector pairs for up to 500 MHz signal bandwidth did not exceed .5 decibels. All requirements were met.

7.1.2.7 Electrical Isolation

Electrical isolation for single circuit and differential pairs was measured using Time Domain Transmission (TDT) method with test configuration as shown in Figure 5. The connectors demonstrated 50dB isolation between any two adjacent contact pairs separated by grounds over the frequency range of 30 Hz to 500 MHz. All requirements were met.

7.1.2.8 Final Visual and Mechanical Inspection

Group 2 samples were inspected at 10X and met the requirements of L-29105-137 sections 3.1 to 3.1.3. No defects were found.

7.1.3 Group 3 Results, Durability

7.1.3.1 Initial visual and Mechanical Inspection

Group 3 samples were inspected at 10X and met the requirements of L-29105-137 sections 3.1 to 3.1.3. No defects were found.

7.1.3.2 Contact Resistance

All samples were tested on a milliVolt drop bench, which is a computer controlled test system comprised of a power supply, a micro-Ohmmeter, a multimeter and a switch box. The switch box connected the four probe Kelvin clips to either the micro-Ohmmeter or the multimeter as well as reversed the polarity of the applied currents. Contact resistance was tested in accordance with EIA-364-06C. The following details and exceptions applied.

a. Test current was 2.5 Amperes.
b. Measurements were taken on all contacts.

c. Measurements were taken at termination into board

The typical initial resistance between any mated pair of contacts was 6 milliOhms max. Resistance following conditioning was 10 milliOhms maximum per contact and 8.5 milliOhms maximum average over the whole array. All requirements were met.

7.1.3.3 Insulation Resistance at Ambient Temperature

The insulation resistance of the connector at ambient temperature was tested in accordance with EIA-364-21C. The following details and exceptions applied.

a. Connectors were fully mated during test.
b. The applied test Voltage was 500 Vdc ± 10%.
c. Printed circuit boards were soldered to connectors.
d. Contacts in each Row, A-D, were wired in series.
e. Measurements were taken between adjacent rows and each contact row and shell.
f. The electrification time for this test was 2 minutes with the measurement taken at the end of the specified period. However, if the instrument reading indicated that the specified limit for the insulation resistance was met and was steady or increasing, the test was terminated before the end of the specified period.

When tested at ambient temperature the insulation resistance between adjacent contacts and between contacts and shell was greater than 5,000 megaOhms. All requirements were met.

7.1.3.4 Dielectric Withstand Voltage at Sea Level

Dielectric Withstanding Voltage was tested in accordance with MIL-STD-1344, Method 3001. The following details and exceptions applied.

a. The maximum leakage current was 2 milliAmperes.
b. The magnitude of the test Voltage was 500 Vac (RMS), 60 Hz.
c. Connectors were fully mated during test.
d. Printed circuit boards were soldered to connectors.
e. Contacts in each Row, A-D, were wired in series.
f. Measurements were taken between adjacent rows and each row of contacts and shell.

When tested at sea level with an applied Voltage of 500 Vac (RMS) at 60 Hz there was no evidence of electrical breakdown, flashover, or leakage current greater than 2.0 milliAmperes. All requirements were met.

7.1.3.5 Insertion and Extraction Force

Insertion and extraction force was measured in accordance with EIA-364-13B. The following details and exceptions applied.

a. Connectors were subjected to three unmonitored mating cycles prior to data acquisition.
b. Measurements were taken to within .010 inches of full mate.
c. Connectors were mounted to appropriate test fixtures.
d. Immediately following Insertion and Extraction Force testing, Prevailing Force After Mating was measured (results per 7.3.6).

When mating, the maximum insertion force was less than 95 lbs. This force includes forces generated by contact engagement, gaskets, grounding strap, shell-to-shell alignment, and pressure generated by a sealed system. The extraction force was less than 25 lbs. All requirements were met.

7.1.3.6 Prevailing Force After Mating

The prevailing force after mating was measured in accordance with EIA-364-13B. Connectors were mounted to appropriate test fixtures. After the connectors were fully mated, the prevailing force required to maintain performance requirements of this specification was less than 10 lbs. All requirements were met.

7.1.3.7 Immersion

The connectors were tested in accordance with MIL-STD-810, Test Method 512.4, Procedure I, Test Condition 2, for fluid immersion at a temperature differential. The following details and exceptions applied.

a. Test duration was 30 minutes.
b. Water depth was 1 meter minimum.

c. Connectors were tested in the mated and unmated condition. For the unmated condition the connectors were mounted such that the mating faces were exposed to water to test flange seal and mating face integrity. For the mated condition the connectors were mounted such that shell towers (the exterior shell portions between the mated connectors) were exposed to water to test for shell to shell seal and flange seal integrity.
d. To maintain full mate 10 lbs. (Prevailing Force After Mate) was applied to connectors.

The connectors withstood immersions in 1 meter of water. Insulation resistance was tested after Immersion conditioning (results per 7.3.9). All requirements were met.

7.1.3.8 Operational and Storage Temperature

Connectors were exposed to thermal cycling with high and low temperatures of $125^{+3}/_{-0}$ and $-57^{+0}/_{-3}$°C respectively. Number of cycles was 25. Transition rate was 5 to 10°C per minute. Dwell time at temperature extremes was 15 minutes. The connectors were found to be capable of operating and being stored in environments where temperatures range from -57°C to 125°C. All requirements were met.

7.1.3.9 Insulation Resistance at Ambient Temperature

The insulation resistance of the module connector at ambient temperature was tested in accordance with EIA-364-21C. The following details and exceptions applied.

a. Connectors were fully mated during test.
b. The applied test Voltage was 500 Vdc ± 10%.
c. Printed circuit boards were soldered to connectors.
d. Contacts in each Row, A-D, were wired in series.
e. Measurements were taken between adjacent rows and each contact row and shell.
f. The electrification time for this test was 2 minutes with the measurement taken at the end of the specified period. However, if the instrument reading indicated that the specified limit for the insulation resistance was met and was steady or increasing, the test was terminated before the end of the specified period.

When tested at ambient temperature the insulation resistance between adjacent contacts and between contacts and shell after conditioning (immersion, humidity) was greater than 100 megaOhms. All requirements were met.

7.1.3.10 Immersion

The connectors were tested in accordance with MIL-STD-810, Test Method 512.4, Procedure I, Test Condition 2, for fluid immersion at a temperature differential. The following details and exceptions applied.

a. Test duration was 30 minutes.
b. Water depth was 1 meter minimum.
c. Connectors were tested in the mated and unmated condition. For the unmated condition the connectors were mounted such that the mating faces were exposed to water to test flange seal and mating face integrity. For the mated condition the connectors were mounted such that shell towers (the exterior shell portions between the mated connectors) were exposed to water to test for shell to shell seal and flange seal integrity.
d. To maintain full mate 10 lbs. (Prevailing Force After Mate) was applied to connectors.

The connectors withstood immersions in 1 meter of water. Insulation resistance was tested after Immersion conditioning (results per 7.3.13). All requirements were met.

7.1.3.11 Durability

The connectors are capable of being mated and unmated 500 times at a rate of 200+/- 100 cycles per hour with no mechanical or electrical defects affecting connector performance. All requirements were met.

7.1.3.12 Contact Resistance

All samples were tested on a milliVolt drop bench, which is a computer controlled test system comprised of a power supply, a micro-Ohmmeter, a multimeter and a switch box. The switch box connected the four probe Kelvin clips to either the micro-Ohmmeter or the multimeter as well as reversed the polarity of the applied currents. Contact resistance was tested in accordance with EIA-364-06C. The following details and exceptions applied.

a. Test current was 2.5 Amperes.
b. Measurements were taken on all contacts.

c. Measurements were taken at termination into board.

The typical initial resistance between any mated pair of contacts was 6 milliOhms max. Resistance following conditioning was 10 milliOhms maximum per contact and 8.5 milliOhms max. average over the whole array. All requirements were met.

7.1.3.13 Insulation Resistance at Ambient Temperature

The insulation resistance of the module connector at ambient temperature was tested in accordance with EIA-364-21C. The following details and exceptions applied.

a. Connectors were fully mated during test.
b. The applied test Voltage was 500 Vdc ± 10%.
c. Printed circuit boards were soldered to connectors.
d. Contacts in each Row, A-D, were wired in series.
e. Measurements were taken between adjacent rows and each contact row and shell.
f. The electrification time for this test was 2 minutes with the measurement taken at the end of the specified period. However, if the instrument reading indicated that the specified limit for the insulation resistance was met and was steady or increasing, the test was terminated before the end of the specified period.

When tested at ambient temperature the insulation resistance between adjacent contacts and between contacts and shell after conditioning (immersion, humidity) was greater than 100 megaOhms. All requirements were met.

7.1.3.14 Dielectric Withstand Voltage at Sea Level

Dielectric Withstanding Voltage was tested in accordance with MIL-STD-1344, Method 3001. The following details and exceptions applied.

a. The maximum leakage current was 2 milliAmperes.
b. The magnitude of the test Voltage was 500 Vac (RMS), 60 Hz.
c. Connectors were fully mated during test.
d. Printed circuit boards were soldered to connectors.
e. Contacts in each Row, A-D, were wired in series.
f. Measurements were taken between adjacent rows and each row of contacts and shell.

When tested at sea level with an applied Voltage of 500 Vac (RMS) at 60 Hz there was no evidence of electrical breakdown, flashover, or leakage current greater than 2.0 milliAmperes. All requirements were met.

7.1.3.15 Insertion and Extraction Force

Insertion and extraction force was measured in accordance with EIA-364-13B. The following details and exceptions applied.

a. Connectors were subjected to three unmonitored mating cycles prior to data acquisition.
b. Measurements were taken to within .010 inches of full mate.
c. Connectors were mounted to appropriate test fixtures.

When mating, the maximum insertion force was less than 95 lbs. This force includes forces generated by contact engagement, gaskets, grounding strap, shell-to-shell alignment, and pressure generated by a sealed system. The extraction force was less than 25 lbs. All requirements were met.

7.1.3.16 Immersion

The connectors were tested in accordance with MIL-STD-810, Test Method 512.4, Procedure I, Test Condition 2, for fluid immersion at a temperature differential. The following details and exceptions applied.

a. Test duration was 30 minutes.
b. Water depth was 1 meter minimum.
c. Connectors were tested in the mated and unmated condition. For the unmated condition the connectors were mounted such that the mating faces were exposed to water to test flange seal and mating face integrity. For the mated condition the connectors were mounted such that shell towers (the exterior shell portions between the mated connectors) were exposed to water to test for shell to shell seal and flange seal integrity.
d. To maintain full mate 10 lbs. (Prevailing Force After Mate) was applied to connectors.

The connectors withstood immersions in 1 meter of water. All requirements were met.

7.1.3.17 Final Visual and Mechanical Inspection
Group 3 samples were inspected at 10X and met the requirements of L-29105-137 sections 3.1 to 3.1.3. No defects were found.

7.1.4 Group 4 Results, Altitude

7.1.4.1 Initial Visual and Mechanical Examination
Group 4 samples were inspected at 10X and met the requirements of L-29105-137 sections 3.1 to 3.1.3. No defects were found.

7.1.4.2 Insulation Resistance at Ambient Temperature
The insulation resistance of the module connector at ambient temperature was tested in accordance with EIA-364-21C. The following details and exceptions applied.

a. Connectors were fully mated during test.
b. The applied test Voltage was 500 Vdc ± 10%.
c. Printed circuit boards were soldered to connectors.
d. Contacts in each Row, A-D, were wired in series.
e. Measurements were taken between adjacent rows and each contact row and shell.
f. The electrification time for this test was 2 minutes with the measurement taken at the end of the specified period. However, if the instrument reading indicated that the specified limit for the insulation resistance was met and was steady or increasing, the test was terminated before the end of the specified period.

When tested at ambient temperature the insulation resistance between adjacent contacts and between contacts and shell was greater than 5,000 megaOhms. All requirements were met.

7.1.4.3 Dielectric Withstand Voltage at Sea Level
Dielectric Withstanding Voltage was tested in accordance with MIL-STD-1344, Method 3001. The following details and exceptions applied.

a. The maximum leakage current was 2 milliAmperes.
b. The magnitude of the test Voltage was 500 Vac (RMS), 60 Hz.
c. Connectors were fully mated during test.
d. Printed circuit boards were soldered to connectors.
e. Contacts in each Row, A-D, were wired in series.
f. Measurements were taken between adjacent rows and each row of contacts and shell.

When tested at sea level with an applied Voltage of 500 Vac (RMS) at 60 Hz there was no evidence of electrical breakdown, flashover, or leakage current greater than 2.0 milliAmperes. All requirements were met.

7.1.4.4 Immersion
The connectors were tested in accordance with MIL-STD-810, Test Method 512.4, Procedure I, Test Condition 2, for fluid immersion at a temperature differential. The following details and exceptions applied.

a. Test duration was 30 minutes.
b. Water depth was 1 meter minimum.
c. Connectors were tested in the mated and unmated condition. For the unmated condition the connectors were mounted such that the mating faces were exposed to water to test flange seal and mating face integrity. For the mated condition the connectors were mounted such that shell towers (the exterior shell portions between the mated connectors) were exposed to water to test for shell to shell seal and flange seal integrity.
d. To maintain full mate 10 lbs. (Prevailing Force After Mate) was applied to connectors.

The connectors withstood immersions in 1 meter of water. All requirements were met.

7.1.4.5 Storage At Altitude
The mated connectors were tested in accordance with MIL-STD-810, Method 500.4, Procedure I, for storage at high altitude. The following details and exceptions applied.

a. Connectors were tested in the unmated condition without the use of covers.
b. Connectors were mounted within enclosed, sealed test fixtures.
c. Pressure was maintained for a minimum of 1 hour.
d. Connectors were tested at an altitude of 20,000 ft.
e. Based on MIL-STD-810 500.4, paragraph 2.3.2, an altitude change rate of 10 m/sec. (33 ft./sec.) for both climb and descent was used.

The connectors were found to be capable of withstanding exposure to altitudes up to 20,000 ft. above sea level, pressurized and unpressurized, in operation and transit without experiencing physical damage or deterioration to performance. Connectors may permit air movement through connector interfaces when exposed to the pressure differential of altitude excursions and a sealed system. When brought back to equilibrium, gaskets provided a water immersion seal. All requirements were met.

7.1.4.6 Immersion

The connectors were tested in accordance with MIL-STD-810, Test Method 512.4, Procedure I, Test Condition 2, for fluid immersion at a temperature differential. The following details and exceptions applied.

a. Test duration was 30 minutes.
b. Water depth was 1 meter minimum.
c. Connectors were tested in the mated and unmated condition. For the unmated condition the connectors were mounted such that the mating faces were exposed to water to test flange seal and mating face integrity. For the mated condition the connectors were mounted such that shell towers (the exterior shell portions between the mated connectors) were exposed to water to test for shell to shell seal and flange seal integrity.
d. To maintain full mate 10 lbs. (Prevailing Force After Mate) was applied to connectors.

The connectors withstood immersions in 1 meter of water. All requirements were met.

7.1.4.7 Rapid Decompression at Altitude

The mated connectors were tested in accordance with MIL-STD-810, Method 500.4, Procedure III, for exposure to rapid decompression at high altitude. The following details and exceptions applied.

a. Connectors were tested in the mated condition only.
b. Connectors were mounted within enclosed, sealed test fixtures.
c. Connectors were tested at an altitude of 20,000 ft.

The connectors were found to be capable of withstanding exposure to altitudes up to 20,000 ft. above sea level, pressurized and unpressurized, in operation and transit without experiencing physical damage or deterioration to performance. Connectors may permit air movement through connector interfaces when exposed to the pressure differential of altitude excursions and a sealed system. When brought back to equilibrium, gaskets provided a water immersion seal. All requirements were met.

7.1.4.8 Immersion

The connectors were tested in accordance with MIL-STD-810, Test Method 512.4, Procedure I, Test Condition 2, for fluid immersion at a temperature differential. The following details and exceptions applied.

a. Test duration was 30 minutes.
b. Water depth was 1 meter minimum.
c. Connectors were tested in the mated and unmated condition. For the unmated condition the connectors were mounted such that the mating faces were exposed to water to test flange seal and mating face integrity. For the mated condition the connectors were mounted such that shell towers (the exterior shell portions between the mated connectors) were exposed to water to test for shell to shell seal and flange seal integrity.
d. To maintain full mate 10 lbs. (Prevailing Force After Mate) was applied to connectors.

The connectors withstood immersions in 1 meter of water. All requirements were met.

7.1.4.9 Operation at Altitude

The mated connectors were tested (DWV at Altitude was tested with results per 7.4.9.1) in accordance with MIL-STD-810, Method 500.4, Procedure II, for operation at high altitude. The following details and exceptions applied.

a. Connectors were tested in the mated condition only.
b. Connectors were mounted within enclosed, sealed test fixtures.
c. Pressure was maintained for a minimum of 1 hour.
d. Connectors were tested at an altitude of 20,000 ft.

The connectors were found to be capable of withstanding exposure to altitudes up to 20,000 ft. above sea level, pressurized and unpressurized, in operation and transit without experiencing physical damage or deterioration to performance. Connectors may permit air movement through connector interfaces when exposed to the pressure differential of altitude excursions and a sealed system. When brought back to equilibrium, gaskets provided a water immersion seal. All requirements were met.

7.1.4.9.1 DWV at Altitude

Dielectric Withstanding Voltage at Altitude was tested (as measurement to determine compliance to Operation at Altitude requirements with results per 7.4.9) in accordance with MIL-STD-1344, Method 3001. The following details and exceptions applied.

a. The maximum leakage current was 2 milliAmperes.
b. The magnitude of the test Voltage was 500 Vac (RMS), 60 Hz.
c. Connectors were fully mated during test.
d. Printed circuit boards were soldered to connectors.
e. Contacts in each Row, A-D, were wired in series.
f. The leads of all test circuits were brought out through the walls of the chamber. There were no wire splices inside the chamber.
g. Measurements were taken between adjacent rows and each contact row and shell.

When tested at an elevated altitude of 20,000 ft with an applied Voltage of 250 Vac (RMS) at 60 Hz there was no evidence of electrical breakdown, flashover, or leakage current greater than 2.0 milliAmperes. All requirements were met.

7.1.4.10 Immersion

The connectors were tested in accordance with MIL-STD-810, Test Method 512.4, Procedure I, Test Condition 2, for fluid immersion at a temperature differential. The following details and exceptions applied.

a. Test duration was 30 minutes.
b. Water depth was 1 meter minimum.
c. Connectors were tested in the mated and unmated condition. For the unmated condition the connectors were mounted such that the mating faces were exposed to water to test flange seal and mating face integrity. For the mated condition the connectors were mounted such that shell towers (the exterior shell portions between the mated connectors) were exposed to water to test for shell to shell seal and flange seal integrity.
d. To maintain full mate 10 lbs. (Prevailing Force After Mate) was applied to connectors.

The connectors withstood immersions in 1 meter of water. All requirements were met.

7.1.4.11 Insulation Resistance at Ambient Temperature

The insulation resistance of the module connector at ambient temperature was tested in accordance with EIA-364-21C. The following details and exceptions applied.

a. Connectors were fully mated during test.
b. The applied test Voltage was 500 Vdc $\pm$ 10%.
c. Printed circuit boards were soldered to connectors.
d. Contacts in each Row, A-D, were wired in series.
e. Measurements were taken between adjacent rows and each contact row and shell.
f. The electrification time for this test was 2 minutes with the measurement taken at the end of the specified period. However, if the instrument reading indicated that the specified limit for the insulation resistance was met and was steady or increasing, the test was terminated before the end of the specified period.

When tested at ambient temperature the insulation resistance between adjacent contacts and between contacts and shell after conditioning (immersion, humidity) was greater than 100 megaOhms. All requirements were met.

7.1.4.12 Final Visual and Mechanical Inspection

Group 4 samples were inspected at 10X and met the requirements of L-29105-137 sections 3.1 to 3.1.3. No defects were found.

7.1.5 Group 5 Results, Shock and Vibration

7.1.5.1 Initial Visual and Mechanical Examination

Group 5 samples were inspected at 10X and met the requirements of L-29105-137 sections 3.1 to 3.1.3. No defects were found.

7.1.5.2 Insulation Resistance at Ambient Temperature

The insulation resistance of the module connector at ambient temperature was tested in accordance with EIA-364-21C. The following details and exceptions applied.

a. Connectors were fully mated during test.
b. The applied test Voltage was 500 Vdc ± 10%.
c. Printed circuit boards were soldered to connectors.
d. Contacts in each Row, A-D, were wired in series.
e. Measurements were taken between adjacent rows and each contact row and shell.
f. The electrification time for this test was 2 minutes with the measurement taken at the end of the specified period. However, if the instrument reading indicated that the specified limit for the insulation resistance was met and was steady or increasing, the test was terminated before the end of the specified period.

When tested at ambient temperature the insulation resistance between adjacent contacts and between contacts and shell was greater than 5,000 megaOhms. All requirements were met.

7.1.5.3 Dielectric Withstand Voltage at Sea Level

Dielectric Withstanding Voltage was tested in accordance with MIL-STD-1344, Method 3001. The following details and exceptions applied.

a. The maximum leakage current was 2 milliAmperes.
b. The magnitude of the test Voltage was 500 Vac (RMS), 60 Hz.
c. Connectors were fully mated during test.
d. Printed circuit boards were soldered to connectors.
e. Contacts in each Row, A-D, were wired in series.
f. Measurements were taken between adjacent rows and each row of contacts and shell.

When tested at sea level with an applied Voltage of 500 Vac (RMS) at 60 Hz there was no evidence of electrical breakdown, flashover, or leakage current greater than 2.0 milliAmperes. All requirements were met.

7.1.5.4 Vibration

The connectors were tested in accordance with MIL-STD-810, Method 514.5, Procedure I, Category 20-A for 8 hours along each of three mutually perpendicular axes. Connectors were tested in the mated condition without dummy weight. For test configuration and fixtures see L-29105-137, Appendix B. During and after testing, there were no electrical discontinuities, disengagement of connectors, evidence of cracking, breaking, or loosening of parts.

A reference copy of the vibration composite curve may be found in Appendix A. This was used in place of MIL-STD-810 Method 514.5 profiles.

The connectors were found to be able to survive vibration induced according to the vibration composite curve while supporting no dummy weight (simulating a 10 lb. system level module). The connectors showed no signs of electrical discontinuity greater than 1.0 microsecond or disengagement of mated connectors. When viewed under 10X magnification there was no evidence of cracking, breaking, or loosening of parts during or after testing. Parts did not break free under shock and no bending or distortion was observed. All connector level qualification requirements were met.

Testing to determine the connector's ability to meet vibration requirements while supporting a 10 lb. module was conducted as a separate system level test. The results of that testing is outside of the scope of this connector level qualification.

7.1.5.5 Insulation Resistance at Ambient Temperature

The insulation resistance of the module connector at ambient temperature was tested in accordance with EIA-364-21C. The following details and exceptions applied.

a. Connectors were fully mated during test.
b. The applied test Voltage was 500 Vdc ± 10%.
c. Printed circuit boards were soldered to connectors.
d. Contacts in each Row, A-D, were wired in series.
e. Measurements were taken between adjacent rows and each contact row and shell.
f. The electrification time for this test was 2 minutes with the measurement taken at the end of the specified period. However, if the instrument reading indicated that the specified limit for the insulation resistance was met and was steady or increasing, the test was terminated before the end of the specified period.

When tested at ambient temperature the insulation resistance between adjacent contacts and between contacts and shell was greater than 5,000 megaOhms. All requirements were met.

7.1.5.6 Dielectric Withstand Voltage at Sea Level

Dielectric Withstanding Voltage was tested in accordance with MIL-STD-1344, Method 3001. The following details and exceptions applied.

a. The maximum leakage current was 2 milliAmperes.
b. The magnitude of the test Voltage was 500 Vac (RMS), 60 Hz.
c. Connectors were fully mated during test.
d. Printed circuit boards were soldered to connectors.
e. Contacts in each Row, A-D, were wired in series.
f. Measurements were taken between adjacent rows and each row of contacts and shell.

When tested at sea level with an applied Voltage of 500 Vac (RMS) at 60 Hz there was no evidence of electrical breakdown, flashover, or leakage current greater than 2.0 milliAmperes. All requirements were met.

7.1.5.7 Functional Shock

The connector's ability to withstand functional shock was tested in accordance with EIA-364-27B Condition A. Three shocks in each direction were applied along each of three mutually perpendicular axes for a total of 18 shocks. Connectors were tested in the mated condition, with 100 milliAmperes current applied, and without dummy weight. For test configuration and fixtures see L-29105-137, Appendix B.

The connectors withstood 18 impact shocks of 50 g's, consisting of six shocks along three mutually perpendicular axes while supporting no dummy weight (simulating a 10 lb. system level module). The connectors showed no signs of electrical discontinuity greater than 1.0 microsecond or disengagement of mated connectors. When viewed under 10X magnification there was no evidence of cracking, breaking, nor loosening of parts during or after testing. Parts did not break free under shock and no bending or distortion was observed. All connector level qualification requirements were met.

Testing to determine the connector's ability to meet function shock requirements while supporting a 10 lb. module was conducted as a separate system level test. The results of that testing is outside of the scope of this connector level qualification.

7.1.5.8 Insulation Resistance at Ambient Temperature

The insulation resistance of the module connector at ambient temperature was tested in accordance with EIA-364-21C. The following details and exceptions applied.

a. Connectors were fully mated during test.
b. The applied test Voltage was 500 Vdc ± 10%.
c. Printed circuit boards were soldered to connectors.
d. Contacts in each Row, A-D, were wired in series.
e. Measurements were taken between adjacent rows and each contact row and shell.
f. The electrification time for this test was 2 minutes with the measurement taken at the end of the specified period. However, if the instrument reading indicated that the specified limit for the insulation resistance was met and was steady or increasing, the test was terminated before the end of the specified period.

When tested at ambient temperature the insulation resistance between adjacent contacts and between contacts and shell was greater than 5,000 megaOhms. All requirements were met.

7.1.5.9 Dielectric Withstand Voltage at Sea Level

Dielectric Withstanding Voltage was tested in accordance with MIL-STD-1344, Method 3001. The following details and exceptions applied.

a. The maximum leakage current was 2 milliAmperes.
b. The magnitude of the test Voltage was 500 Vac (RMS), 60 Hz.
c. Connectors were fully mated during test.
d. Printed circuit boards were soldered to connectors.
e. Contacts in each Row, A-D, were wired in series.
f. Measurements were taken between adjacent rows and each row of contacts and shell.

When tested at sea level with an applied Voltage of 500 Vac (RMS) at 60 Hz there was no evidence of electrical breakdown, flashover, or leakage current greater than 2.0 milliAmperes. All requirements were met.

7.1.5.10 Bench Handling

The connectors were tested in the unmated state for bench handling in accordance with MIL-STD-810, Test Method 516.5, Procedure VI. Testing was all faces of each connector except those faces that have contact tails protruding from surface, which may be damaged by test.
The connectors withstood the shock associated with typical bench maintenance and repair along all faces except those faces where contact tails may come in contact with bench surface.

7.1.5.11 Final Visual and Mechanical Inspection

Group 5 samples were inspected at 10X and met the requirements of L-29105-137 sections 3.1 to 3.1.3. No defects that had an adverse effect on the testing, or that were relevant to the scope of the testing were found.

7.1.6 Group 6, Environmental

7.1.6.1 Initial Visual and Mechanical Examination

Group 6 samples were inspected at 10X and met the requirements of L-29105-137 sections 3.1 to 3.1.3. No defects were found.

7.1.6.2 Insulation Resistance at Ambient Temperature

The insulation resistance of the module connector at ambient temperature was tested in accordance with EIA-364-21C. The following details and exceptions applied.

a. Connectors were fully mated during test.
b. The applied test Voltage was 500 Vdc $\pm$ 10%.
c. Printed circuit boards were soldered to connectors.
d. Contacts in each Row, A-D, were wired in series.
e. Measurements were taken between adjacent rows and each contact row and shell.
f. The electrification time for this test was 2 minutes with the measurement taken at the end of the specified period. However, if the instrument reading indicated that the specified limit for the insulation resistance was met and was steady or increasing, the test was terminated before the end of the specified period.

When tested at ambient temperature the insulation resistance between adjacent contacts and between contacts and shell was greater than 5,000 megaOhms. All requirements were met.

7.1.6.3 Dielectric Withstand Voltage at Sea Level

Dielectric Withstanding Voltage was tested in accordance with MIL-STD-1344, Method 3001. The following details and exceptions applied.

a. The maximum leakage current was 2 milliAmperes.
b. The magnitude of the test Voltage was 500 Vac (RMS), 60 Hz.
c. Connectors were fully mated during test.
d. Printed circuit boards were soldered to connectors.
e. Contacts in each Row, A-D, were wired in series.

f. Measurements were taken between adjacent rows and each row of contacts and shell.

When tested at sea level with an applied Voltage of 500 Vac (RMS) at 60 Hz there was no evidence of electrical breakdown, flashover, or leakage current greater than 2.0 milliAmperes. All requirements were met.

7.1.6.4 Shell to Shell Conductivity

Conductivity of mated connectors was tested in accordance with EIA-364-83. The following details and exceptions applied.

a. Connectors were fully mated.
b. To maintain full mate 10 lbs. (Prevailing Force After Mate) was applied to connectors.
c. Measurements were taken from the mounting flange of both connectors.
d. Test probes did not to damage shell finish.

When fully mated, a maximum potential drop of 1 milliVolt was measured across the assembly given a current of 1.0 ± 0.1 Amperes. Following salt fog the potential drop limit was allowed to increase 100%. All requirements were met.

7.1.6.5 Humidity

Wired, mated connectors were subjected to the humidity test specified by EIA-364-31B (MIL-STD-1344 method 1002 Type II). The following details and exceptions applied.

a. Test condition letter B (240 hours).
b. Method V (cycling saw tooth temperature/humidity) without optional cold shock.
c. Polarization current per EIA-364-31B paragraph 4.2.4 (100 Vdc, negative).
d. Connectors were tested in the mated condition only.
e. Connectors were mounted within enclosed, sealed test fixtures.

When mated, the connectors, in operating conditions, withstood a the specified exposure to a relative humidity of 90 to 98%, including conditions wherein condensation occurred, without experiencing physical damage or deterioration in performance. All requirements were met.

7.1.6.6 Insulation Resistance at Ambient Temperature

The insulation resistance of the module connector at ambient temperature was tested in accordance with EIA-364-21C. The following details and exceptions applied.

a. Connectors were fully mated during test.
b. The applied test Voltage was 500 Vdc ± 10%.
c. Printed circuit boards were soldered to connectors.
d. Contacts in each Row, A-D, were wired in series.
e. Measurements were taken between adjacent rows and each contact row and shell.
f. The electrification time for this test was 2 minutes with the measurement taken at the end of the specified period. However, if the instrument reading indicated that the specified limit for the insulation resistance was met and was steady or increasing, the test was terminated before the end of the specified period.

When tested at ambient temperature the insulation resistance between adjacent contacts and between contacts and shell after conditioning (immersion, humidity) was greater than 100 megaOhms. All requirements were met.

7.1.6.7 Dielectric Withstand Voltage at Sea Level

Dielectric Withstanding Voltage was tested in accordance with MIL-STD-1344, Method 3001. The following details and exceptions applied.

g. The maximum leakage current was 2 milliAmperes.
a. The magnitude of the test Voltage was 500 Vac (RMS), 60 Hz.
b. Connectors were fully mated during test.
c. Printed circuit boards were soldered to connectors.
d. Contacts in each Row, A-D, were wired in series.
e. Measurements were taken between adjacent rows and each row of contacts and shell.

When tested at sea level with an applied Voltage of 500 Vac (RMS) at 60 Hz there was no evidence of electrical breakdown, flashover, or leakage current greater than 2.0 milliAmperes. All requirements were met.

7.1.6.8 Salt Fog

The connectors were subjected to a 48 hour salt fog test with a 5 ± 1% salt concentration in accordance with MIL-STD-810, Method 509.4. The following details and exceptions applied.

a. Polarization current per EIA-364-31B paragraph 4.2.4 (100 Vdc, negative).
b. Connectors were tested in the mated condition only.
c. Connectors were mounted within enclosed, sealed test fixtures.

When mated, the connectors withstood the 48 hour exposure to a 5 ± 1% salt atmosphere, in an operating condition, without experiencing physical damage or deterioration in performance. All requirements were met.

7.1.6.9 Insulation Resistance at Ambient Temperature

The insulation resistance of the module connector at ambient temperature was tested in accordance with EIA-364-21C. The following details and exceptions applied.

a. Connectors were fully mated during test.
b. The applied test Voltage was 500 Vdc ± 10%.
c. Printed circuit boards were soldered to connectors.
d. Contacts in each Row, A-D, were wired in series.
e. Measurements were taken between adjacent rows and each contact row and shell.
f. The electrification time for this test was 2 minutes with the measurement taken at the end of the specified period. However, if the instrument reading indicated that the specified limit for the insulation resistance was met and was steady or increasing, the test was terminated before the end of the specified period.

When tested at ambient temperature the insulation resistance between adjacent contacts and between contacts and shell after conditioning (immersion, humidity) was greater than 100 megaOhms. All requirements were met.

7.1.6.10 Dielectric Withstand Voltage at Sea Level

Dielectric Withstanding Voltage was tested in accordance with MIL-STD-1344, Method 3001. The following details and exceptions applied.

a. The maximum leakage current was 2 milliAmperes.
b. The magnitude of the test Voltage was 500 Vac (RMS), 60 Hz.
c. Connectors were fully mated during test.
d. Printed circuit boards were soldered to connectors.
e. Contacts in each Row, A-D, were wired in series.
f. Measurements were taken between adjacent rows and each row of contacts and shell.

When tested at sea level with an applied Voltage of 500 Vac (RMS) at 60 Hz there was no evidence of electrical breakdown, flashover, or leakage current greater than 2.0 milliAmperes. All requirements were met.

7.1.6.11 Rain and Wind

The rain and wind requirement was tested in accordance with MIL-STD-810, test Method 506.4, Procedure I and III. Connectors were mounted within enclosed, sealed test fixtures. When mated, the connectors were capable of operating in 1.8 inches of rain per hour and 40 mph wind for 40 minutes. The connectors were also capable of operating during and after exposure to a vertical rainfall rate of 4 inches per hour for 30 minutes without experiencing physical damage or deterioration in performance. All requirements were met.

7.1.6.12 Insulation Resistance at Ambient Temperature

The insulation resistance of the module connector at ambient temperature was tested in accordance with EIA-364-21C. The following details and exceptions applied.

a. Connectors were fully mated during test.
b. The applied test Voltage was 500 Vdc ± 10%.
c. Printed circuit boards were soldered to connectors.
d. Contacts in each Row, A-D, were wired in series.
e. Measurements were taken between adjacent rows and each contact row and shell.

f. The electrification time for this test was 2 minutes with the measurement taken at the end of the specified period. However, if the instrument reading indicated that the specified limit for the insulation resistance was met and was steady or increasing, the test was terminated before the end of the specified period.

When tested at ambient temperature the insulation resistance between adjacent contacts and between contacts and shell after conditioning (immersion, humidity) was greater than 100 megaOhms. All requirements were met.

7.1.6.13 Dielectric Withstand Voltage at Sea Level

Dielectric Withstanding Voltage was tested in accordance with MIL-STD-1344, Method 3001. The following details and exceptions applied.

a. The maximum leakage current was 2 milliAmperes.
b. The magnitude of the test Voltage was 500 Vac (RMS), 60 Hz.
c. Connectors were fully mated during test.
d. Printed circuit boards were soldered to connectors.
e. Contacts in each Row, A-D, were wired in series.
f. Measurements were taken between adjacent rows and each row of contacts and shell.

When tested at sea level with an applied Voltage of 500 Vac (RMS) at 60 Hz there was no evidence of electrical breakdown, flashover, or leakage current greater than 2.0 milliAmperes. All requirements were met.

7.1.6.14 Sand and Dust

The mated connectors were tested in accordance with MIL-STD-810, Test Method 510.4, Procedure I and II. The following details and exceptions applied.

a. Connectors were mounted within enclosed, sealed test fixtures.
b. Wind speed for Procedure I was 3,450 ft./min.
c. Wind speed for Procedure II was 5,700 ft./min.
d. Testing was performed at ambient conditions only.

When mated, the connectors operated when exposed to fine dust particles in wind speeds of 3,450 ft./min. and to sand particles in wind speeds of 5,700 ft./min. without experiencing physical damage or deterioration in performance.

7.1.6.15 Insulation Resistance at Ambient Temperature

The insulation resistance of the module connector at ambient temperature was tested in accordance with EIA-364-21C. The following details and exceptions applied.

a. Connectors were fully mated during test.
b. The applied test Voltage was 500 Vdc $\pm$ 10%.
c. Printed circuit boards were soldered to connectors.
d. Contacts in each Row, A-D, were wired in series.
e. Measurements were taken between adjacent rows and each contact row and shell.
f. The electrification time for this test was 2 minutes with the measurement taken at the end of the specified period. However, if the instrument reading indicated that the specified limit for the insulation resistance was met and was steady or increasing, the test was terminated before the end of the specified period.

When tested at ambient temperature the insulation resistance between adjacent contacts and between contacts and shell after conditioning (immersion, humidity) was greater than 100 megaOhms. All requirements were met.

7.1.6.16 Dielectric Withstand Voltage at Sea Level

Dielectric Withstanding Voltage was tested in accordance with MIL-STD-1344, Method 3001. The following details and exceptions applied.

a. The maximum leakage current was 2 milliAmperes.
b. The magnitude of the test Voltage was 500 Vac (RMS), 60 Hz.
c. Connectors were fully mated during test.
d. Printed circuit boards were soldered to connectors.
e. Contacts in each Row, A-D, were wired in series.
f. Measurements were taken between adjacent rows and each row of contacts and shell.

When tested at sea level with an applied Voltage of 500 Vac (RMS) at 60 Hz there was no evidence of electrical breakdown, flashover, or leakage current greater than 2.0 milliAmperes. All requirements were met.

7.1.6.17 Shell to Shell Conductivity

Conductivity of mated connectors was tested in accordance with EIA-364-83. The following details and exceptions applied.

a. Connectors were fully mated.
b. To maintain full mate 10 lbs. (Prevailing Force After Mate) was applied to connectors.
c. Measurements were taken from the mounting flange of both connectors.
d. Test probes did not to damage shell finish.

When fully mated, a maximum potential drop of 2 milliVolt was measured across the assembly given a current of 1.0 $\pm$ 0.1 Amperes. All requirements were met.

7.1.6.18 Final Visual and Mechanical Inspection

Group 6 samples were inspected at 10X and met the requirements of L-29105-137 sections 3.1 to 3.1.3. No defects were found.

7.1.7 Group 7 Results, Destructive

7.1.7.1 Initial Visual and Mechanical Examination

Group 7 samples were inspected at 10X and met the requirements of L-29105-137 sections 3.1 to 3.1.3. No defects were found.

7.1.7.2 Contact Retention

Contact retention was tested using a force gauge. Force was applied to the mating face of the contact. Testing was performed on at least 30 randomly selected contacts from each connector half. Contacts were retained in the insert with a minimum extraction force of 2 lbs. All requirements were met.

7.1.7.3 Insert Retention

Both the backplane and module connectors in the unmated condition were subjected to an insert push-out test. Force was applied uniformly to the mating face of the insert until the insert was completely detached from shell. The insert was unsupported during test. Inserts were retained within the connector shells by 60 lbs. minimum force. All requirements were met.

7.1.7.4 Crash Hazard

The connectors were tested for crash hazard shock in accordance with EIA-364-27B Condition B. Three shocks in each direction were applied along each of three mutually perpendicular axes for a total of 18 shocks. Connectors were tested mated, with 100milliAmperes current applied, and without dummy weight. For test configuration and fixtures see L-29105-137, Appendix B.

The connectors withstood 18 impact shocks of 75 g's, consisting of six shocks along three mutually perpendicular axes while supporting no dummy weight (simulating a 10 lb. system level module). The connectors showed no signs of electrical discontinuity greater than 1.0 microsecond or disengagement of mated connectors. When viewed under 10X magnification there was no evidence of cracking, breaking, or loosening of parts during or after testing. Parts did not break free under shock and no bending or distortion was observed. All connector level qualification requirements were met.

Testing to determine the connector's ability to meet crash hazard shock requirements while supporting a 10 lbs. module was conducted as a separate system level test. The results of that testing is outside of the scope of this connector level qualification.

7.1.7.5 Ballistic Shock

Connectors were subjected to ballistic shock in accordance with MIL-STD-810, Method 522.4, Procedure III, omitting steps 3, 4, and 6. The shock was applied parallel to the longitudinal axis (longest length) of the connectors. Connectors were tested mated, with 100milliAmperes current applied, and without dummy weight. For test configuration and fixtures see L-29105-137, Appendix B.

The connectors withstood a 5 ft. hammer drop impact shock, applied parallel to the longitudinal axis (longest length) of the connectors, while supporting no dummy weight (simulating a 10 lb. system level module). The connectors showed no signs of electrical discontinuity greater than 1.0 microsecond or disengagement of mated connectors. When viewed under 10X magnification there was no evidence of cracking, breaking, or loosening of parts during or after testing. Parts did not break free under shock and no bending or distortion was observed. All connector level qualification requirements were met.

Testing to determine the connector's ability to meet ballistic shock requirements while supporting a 10 lb. module was conducted as a separate system level test. The results of that testing is outside of the scope of this connector level qualification.

7.1.7.6 ESD

The backplane and module of the module connector were tested in accordance with IEC 61000-4-2, for ESD protection. For ESD test setup see Figure 6. The following details and exceptions applied.

a. Testing was performed at 4kV, 8kV, 15kV, 20kV, and 25kV. Testing was conducted at both polarities (positive and negative) for the Voltages given.
b. The discharge network consisted of a 500 pF capacitor with both 500 Ohm and 5000 Ohm resistors.
c. The bandwidth of the measurement equipment was reduced to 500 MHz.
d. A minimum of 60 air discharges were randomly executed across the mating interface of the connector under test for each test Voltage, and for each discharge resistor network.
e. Power/signal contacts were bussed together and terminated to a 50 Ohm resistor to ground. ESD intercepting contacts were terminated directly to ground.
f. A failure was defined as a discharge exceeding 4kV as measured across the 50 Ohm resistor.

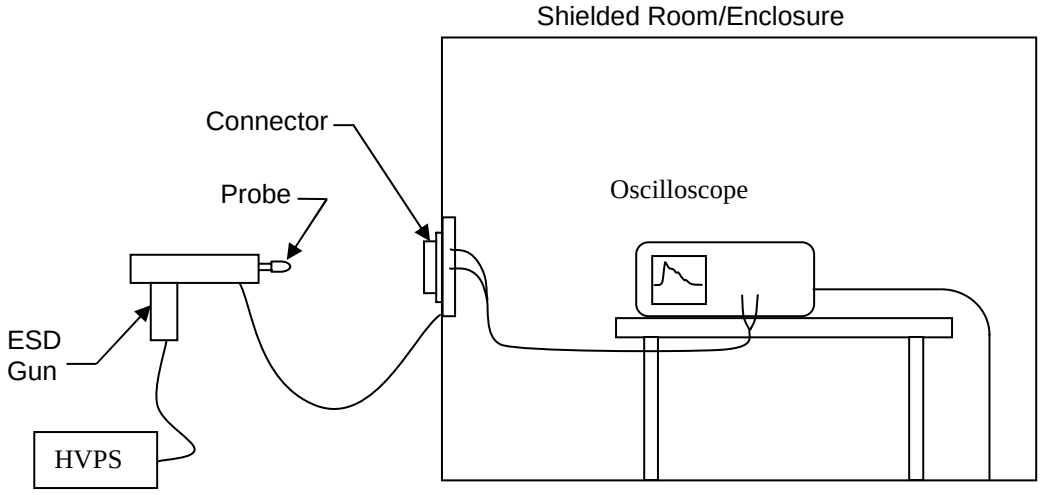


Figure 6: ESD Test Setup

The connectors were designed to divert any electrical discharge to chassis ground via either dedicated ESD intercepting pins (terminated to chassis ground externally by buyer), an ESD Shield (faraday cage structure), or the connector shell such that no signal/power contact would directly receive a discharge exceeding +/- 4000 Volts when exposed to air discharges up to +/- 25,000 Volts at the mating interface. All requirements were met.

7.1.7.7 EMI Shielding Effectiveness

EMI shielding effectiveness of mated connectors was tested in accordance with the following paragraphs. The EMI shielding capabilities of a fully mated pair of connectors were not less than the values specified at the frequencies given in Table 7. All requirements were met.

Frequency MHz	Minimum Leakage Attenuation dB
100	90
200	88
300	88
400	87
800	85
1000	85
1500	76
2000	70
3000	69
4000	68
6000	66
10000	65

Table 7
EMI Shielding Effectiveness

7.1.7.8 EMI Shielding Effectiveness - 100 to 1000MHz

The EMI shielding effectiveness of the mated connectors with appropriate test panels was tested in accordance with Paragraph 4.5.27.1 of MIL-DTL-38999. For test setup and fixtures see Figures 7 and 8 and drawing 44-192549 in Appendix B of L-29105-137. The following details and exceptions applied.

a. Appropriate test panels were used in place of back shells.
b. Test panels were not soldered to the connectors.
c. Testing was performed on all three interfaces simultaneously.

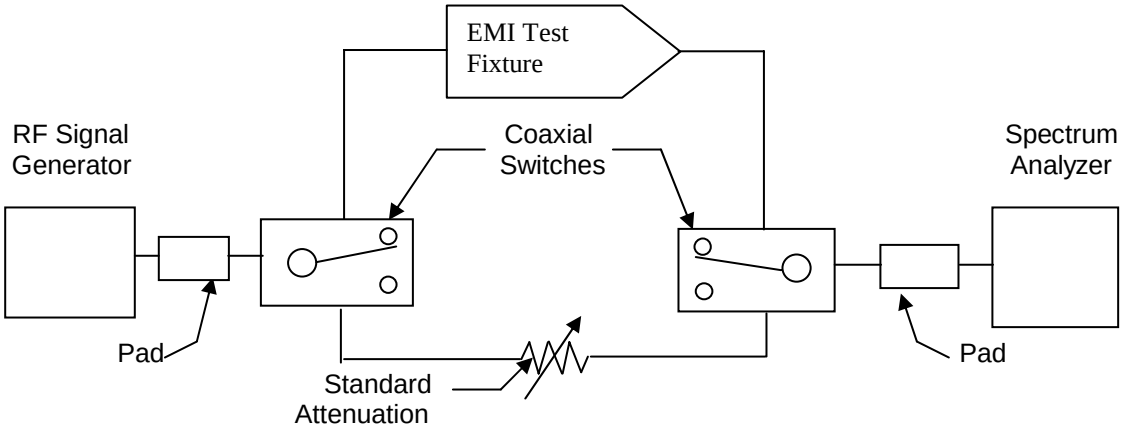


Figure 7: EMI Schematic Test System

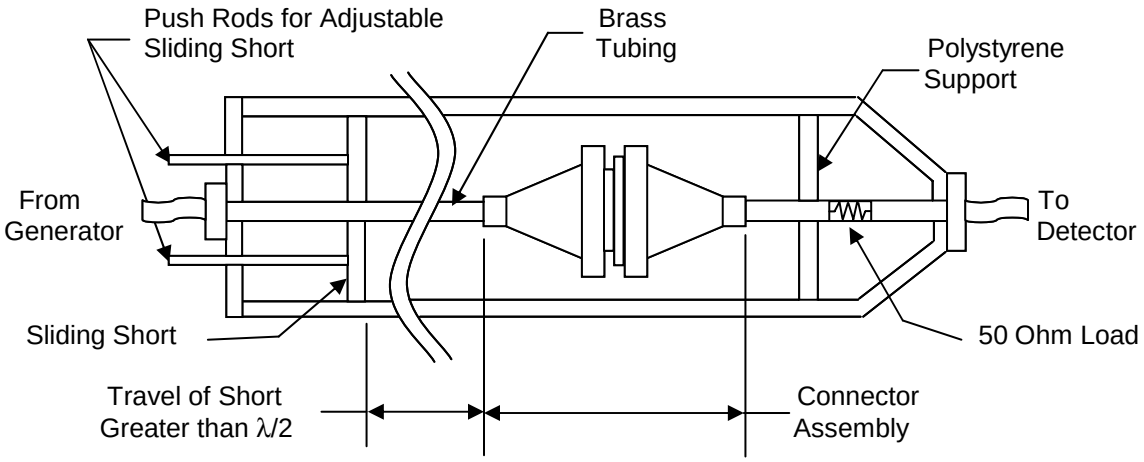


Figure 8: EMI Test Fixture

7.1.7.9 EMI Shielding Effectiveness - 1000 to 10000MHz

The EMI shielding effectiveness of the mated connectors with appropriate test panels was measured using the mode stirred technique specified in EIA-364-66. For mode stirred schematic see Figure 9. The following details and exceptions applied.

a. Appropriate test panels were used in place of back shells.
b. Test panels were not soldered to connectors.
c. Testing was performed on all three interfaces simultaneously.

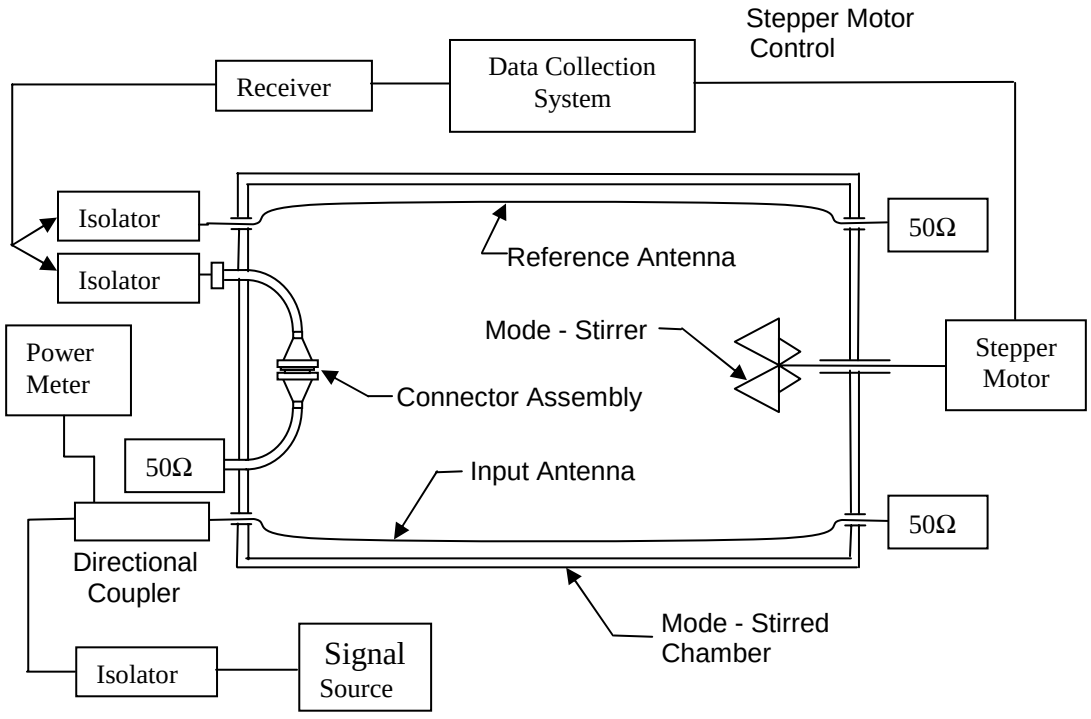


Figure 9: Mode Stirred Schematic

7.1.7.10 Fluid Immersion

Mated connector pairs were tested for swelling resistance when immersed in oil and other fluids in accordance with EIA-364-10D. The following details and exceptions applied.

a. One mated connector was tested per fluid type.
b. The mated connectors were mounted such that shell towers (the exterior shell portions between the mated connectors) are exposed to the fluids to test for shell to shell seal and flange seal integrity. Connectors were mounted within enclosed, sealed test fixtures.
c. To maintain full mate 10 lbs. (Prevailing Force After Mate) was applied to connectors.
d. Fluid types, test cycle duration, number of cycles, and fluid temperatures were according to EIA-364-10D Table I with no deletions, substitutions, or additions.
e. Insertion and Extraction Forces testing was performed prior to and following Fluid Immersion. All requirements were met.
f. DWV at sea level testing was performed within three hours after immersion testing. All requirements were met.

The connectors in the mated state withstood immersion in fluids commonly found in rotary wing aircraft and ground vehicles (wheeled and tracked). All requirements were met.

7.2 Results for Requirements Qualified by Non-Empirical Means

7.2.1 Off-Axis Initial Connector Engagement

The module connector shall demonstrate an initial off-axis alignment of 5° and display no evidence of damage to the connector or its components when mating. The connectors allow for an initial off-axis mate of up to 5° without damage to the connectors or its components. Lead-in chamfers and extended connector length are capable of correcting initial misalignment.

7.2.2 Final Connector Engagement

Amphenol certifies that when fully engaged, the connectors meet or exceed the requirements of this specification with a final off-axis misalignment of 0.5°.

7.2.3 Staged Engagement

Amphenol certifies that the connector exhibits a three-staged engagement. When mating, the connectors incorporate three stages of engagement. First the shells engage and align the connectors, then ground contacts engage, then contacts engage.

7.2.4 Solderabilty

Amphenol certifies that connectors manufactured under this specification meet solderability requirements of MIL-STD-202, Method 208. Printed circuit board terminations are pre-tinned to meet the requirements of MIL-STD-202, method 208 for solderability.

7.2.5 Explosive Atmosphere

Amphenol certifies that the connectors will not cause ignition to a fuel-air explosive atmosphere in accordance with MIL-STD-810, Test Method 511.4. The connectors are capable of exposure to a fuel-air explosive atmosphere without causing ignition to such gases with the connectors operating in the mated condition, with backplane cover installed, or with power off in the mated and unmated condition only.

7.2.6 Acceleration

Amphenol certifies that the connectors meet the acceleration requirements of this specification based on the more stringent requirements of shock. The connectors are able to withstand an acceleration of 9 g’s in both directions of each of three perpendicular axes while not supporting a 10 lb. module.

Certifying, or testing to determine, the connector’s ability to meet acceleration requirements while supporting a 10 lb. module would be conducted as a separate system level effort. Such an effort is outside of the scope of this connector level qualification.

7.2.7 Fungus

Amphenol certifies that materials used in the manufacture of the connectors are non-fungus nutrient in accordance with MIL-STD-810, Method 508.5. The connectors in both operating and non-operating conditions can withstand exposure to fungus growth as encountered in tropical climates and not support fungal growth.

7.2.8 Chemical and Biological Decontamination

Amphenol certifies that exposure to the two chemical biological decontamination solvents listed below will not degrade performance or cause physical damage to the connectors.

Decontamination solvents in accordance with AR 70-75:

a. DS2 Decontaminant (2% Sodium Hydroxide, 28% Monoethyl Ether, 70% Diethylenetriamine).
b. STB Decontaminant MIL-D-12468B (Chlorinated Lime-Calcium Hypochlorite and Calcium Oxide) Super Tropical Bleach/White Powder.

The connectors in the mated condition can withstand exposure to DS2 and STB decontamination solvents commonly used to clean equipment following a chemical or biological attack.

7.2.9 Environmental Test Profile

Amphenol certifies that mated connectors can withstand operation with 100 Vdc applied to contacts and storage while exposed to temperature fluctuating according to the profiles and cycling requirements presented in Appendix B. Based on the test results presented in sections 7.1.1.4 and 7.1.3.8., the mated connectors can withstand operation and storage while exposed to fluctuating low and high temperature temperatures.

7.2.10 Connector Covers

Amphenol certifies that while installed on the Backplane connector, the connector cover shall meet EMI and Immersion requirements. Based on the similarity between the Connector Cover and the Module connector designs, and the EMI and Immersion test results presented in this report, mounted Connector Covers will meet EMI and Immersion requirements.

Appendix A
Vibration Composite Curve

Composite Broadband Profile	
Frequency (Hz)	**APSD (g^2/Hz)**
5	0.250154022
8	0.867012057
9	0.431957341
14	0.081926961
16	0.116205762
18	0.076417339
20	0.083145412
23	0.064242723
25	0.0636
28	0.045491768
31	0.042514891
33	0.038427015
35	0.032603494
79	0.001000667
115.4	0.000318075
211.2	7.01956E-05
224	0.000139955
235.7	0.000140132
247	0.000243955
252.3	5.66758E-05
262.1	4.37189E-05
278	8.08269E-05
286.4	3.59968E-05
291.9	4.64133E-05
293	4.88151E-05
336	4.66367E-05
353	8.65227E-05
379	2.56793E-05
431	5.18475E-05
433	2.1092E-05
456.2	1.35881E-05
500	1.12585E-05

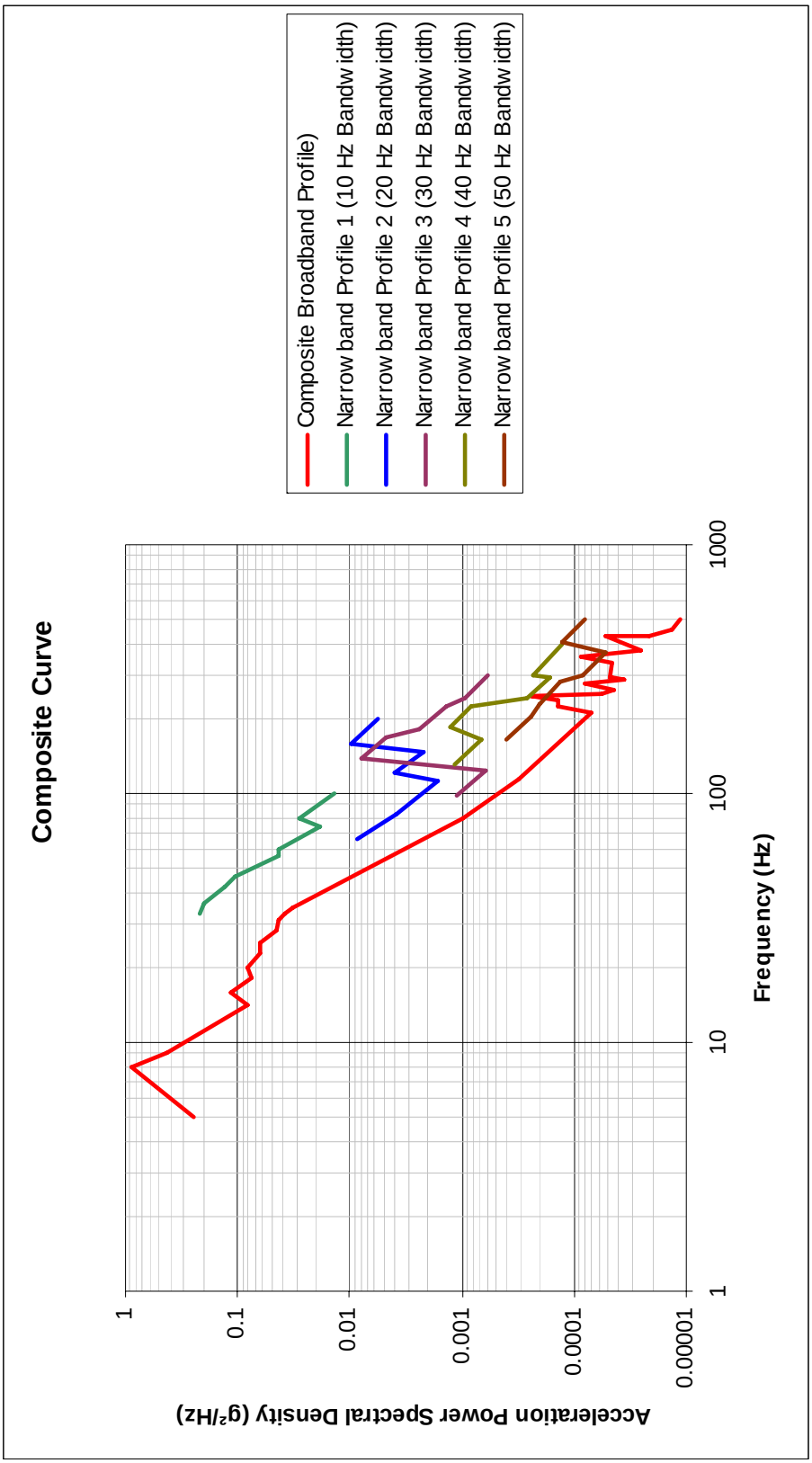
COMPOSITE BROADBAND PROFILE

Narrowband Profile 1 (10 Hz Bandwidth)		Narrowband Profile 2 (20 Hz Bandwidth)	
Frequency (Hz)	**APSD (g^2/Hz)**	**Frequency (Hz)**	**APSD (g^2/Hz)**
33	0.21878707	66	0.008470913
36	0.201866621	82	0.003805685
42	0.127871541	112	0.001606656
46	0.106957021	120	0.003928688
56	0.042625411	148	0.002229232
60	0.042702741	160	0.009625993
74	0.01879669	200	0.005675043
80	0.028231471	[redacted]	
100	0.013828065		

Narrowband Profile 3 (30 Hz Bandwidth)		Narrowband Profile 4 (40 Hz Bandwidth)	
Frequency (Hz)	**APSD (g^2/Hz)**	**Frequency (Hz)**	**APSD (g^2/Hz)**
99	0.001108955	132	0.001151347
123	0.00061455	164	0.000659841
138	0.007918679	184	0.001274808
168	0.004833539	224	0.000813136
180	0.002376099	240	0.000258073
224	0.001397822	293	0.000167477
240	0.000960272	300	0.000233959
300	0.0005923	400	0.000127989
[redacted]			

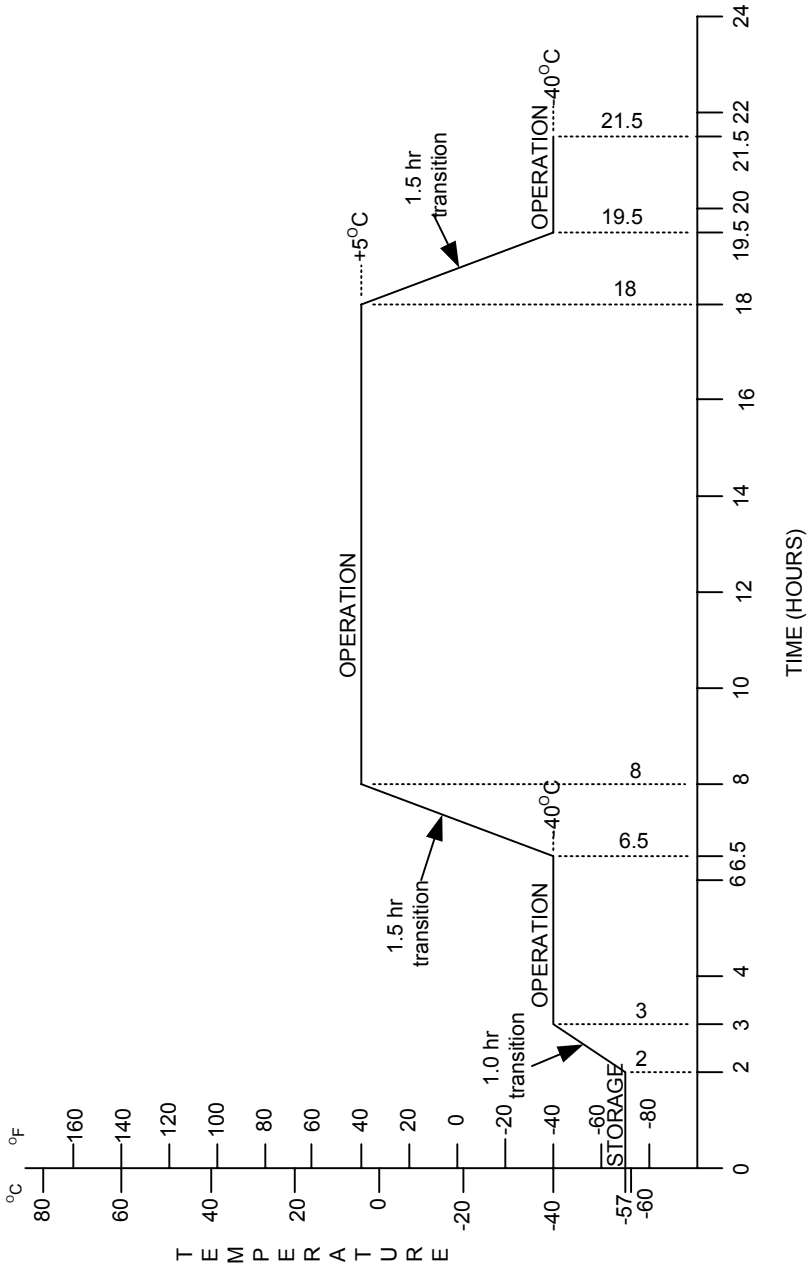
Narrowband Profile 5 (50 Hz Bandwidth)	
Frequency (Hz)	**APSD (g^2/Hz)**
165	0.000394791
205	0.000236957
230	0.000207176
280.2	0.000134226
300	8.2922E-05
370	5.3359E-05
402	0.000126678
500	8.08568E-05
[redacted]	

NARROWBAND PROFILE



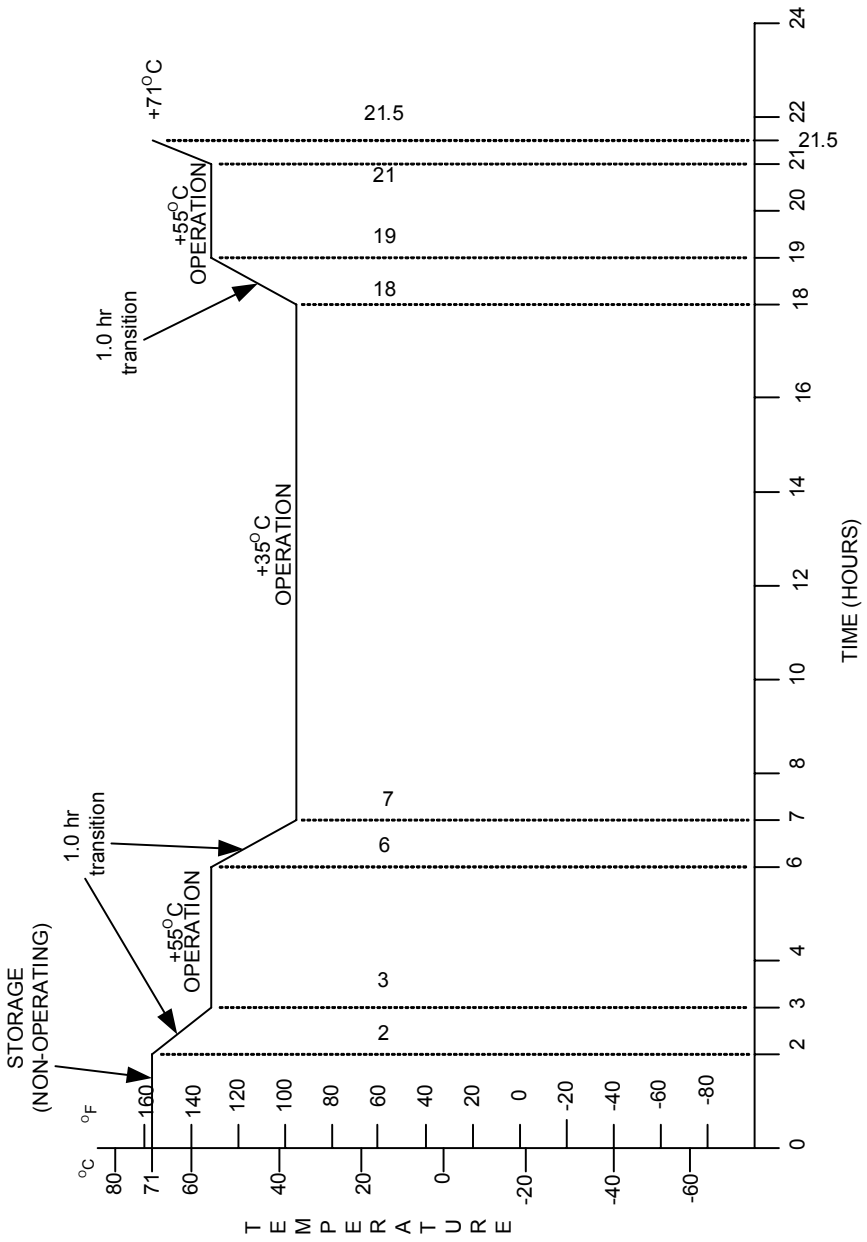
COMPOSITE CURVE

Appendix B
Environmental Test Profiles



Low Temperature Profile

Hot and cold temperature profiles will be alternated on a 14-day basis.



Hot and cold temperature profiles will be alternated on a 14-day basis.

High Temperature Profile