



**QUALIFICATION TEST REPORT**  
**Power Load Connectors**

No.: GT-21-155 Abstract  
Date: May 4, 2021  
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1 INTRODUCTION

1.1 Purpose

Testing was performed on Glenair Power Load circular connectors to demonstrate their performance and viability for use in harsh aerospace environments.

1.2 Scope

This report summarizes electrical, mechanical and environmental performance testing of Glenair Power Load circular connectors (972 series). The information in this report was obtained from tests conducted by Environmental Associates (Santa Ana, CA), Experior Laboratories (Oxnard, CA) and DNB Engineering (Fullerton, CA).

Testing Agency	Location	Date	Test Report Title	Test Report Number (Ref. QTR 513)
Environment Associates	Santa Ana, CA	9/19/17	ENVIRONMENTAL TEST REPORT FOR THE CONNECTORS, ELECTRICAL, CIRCULAR, HIGH CURRENT, FIREWALL AND NON-FIREWALL	OC26416-1219281 Groups 1 & 3
Experior Laboratories	Oxnard, CA	9/20/17	Group 2 High Current Circular Connector Qualification per QTP 513	SPN 14729 Group 2
DNB Engineering	Fullerton, CA	8/16/17	ENVIRONMENTAL TEST REPORT FOR THE CIRCULAR ELECTRICAL CONNECTORS	TR043874A Group 4

1.3 Conclusion

Glenair Power Load circular connectors have been shown to be capable of meeting the performance requirements as listed herein.

1.4 Product Description

Glenair Power Load circular connectors are electrical connectors designed for harsh environment, high power and high frequency aerospace applications. The Power Load family offers higher current carrying capacity, higher voltage, higher temperature ratings and in some cases, higher contact densities than its direct competitors, such as AS50151. Power Load series 972-10X also offers a compression seal grommet for use with and sealing of tape wrapped wire. All test specimens in this report employed the compression seal grommet and “band-in-a-can” type backshells with saddle clamp wire strain relief. See Glenair series 972 drawings and brochures for additional information.



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1.5 Test Specimens

Group	Glenair Sales Drawing Part Numbers	Test Unit Part Numbers	Material Finish	Mated Pair Qty.
1	972-101Z128-6P1-LB MATED TO 972-102Z128-6S1-LB	2570S1XXXZ1-G6-28A6PN MATED TO 2570S1XXXZ1-00-28A6SN	Passivated Stainless Steel (Z1)	1
	972-101Z128-6S1-LB MATED TO 972-102Z128-6P1-LB	2570B1XXXZ1-G6-28A6SN MATED TO 2570B1XXXZ1-00-28A6PN	Passivated Stainless Steel (Z1)	1
	972-101NF28-6S1-LB MATED TO 972-102NF28-6P1-LB	2570S1XXXNF-G6-28A6SN MATED TO 2570S1XXXNF-00-28A6PN	OD Cad Plated Aluminum (NF)	1
	972-101NF28-6P1-LB MATED TO 972-102NF28-6S1-LB	2570B1XXXNF-G6-28A6PN MATED TO 2570B1XXXNF-00-28A6SN	OD Cad Plated Aluminum (NF)	1
2	972-101Z128-6S1-LB MATED TO 972-102Z128-6P1-LB	2570S1XXXZ1-G6-28A6SN MATED TO 2570S1XXXZ1-00-28A6PN	Passivated Stainless Steel (Z1)	1
	972-101Z128-6S1-LB MATED TO 972-102Z128-6P1-LB	2570B1XXXZ1-G6-28A6SN MATED TO 2570B1XXXZ1-00-28A6PN	Passivated Stainless Steel (Z1)	1
3	972-101Z128-6S1-LB MATED TO 972-102Z128-6P1-LB	2570S1XXXZ1-G6-28A6SN MATED TO 2570S1XXXZ1-00-28A6PN	Passivated Stainless Steel (Z1)	5
	972-101NF28-6S1-LB MATED TO 972-102NF28-6P1-LB	2570S1XXXNF-G6-28A6SN MATED TO 2570S1XXXNF-00-28A6PN	OD Cad Plated Aluminum (NF)	6
4	972-101Z128-6S1-LB MATED TO 972-102Z128-6P1-LB	2570S1XXXZ1-G6-28A6SN MATED TO 2570S1XXXZ1-00-28A6PN	Passivated Stainless Steel (Z1)	1
	972-101Z128-6S1-LB MATED TO 972-102Z128-6P1-LB	2570B1XXXZ1-G6-28A6SN MATED TO 2570B1XXXZ1-00-28A6PN	Passivated Stainless Steel (Z1)	1
	972-101NF28-6S1-LB MATED TO 972-102NF28-6P1-LB	2570S1XXXNF-G6-28A6SN MATED TO 2570S1XXXNF-00-28A6PN	OD Cad Plated Aluminum (NF)	1
	972-101NF28-6S1-LB MATED TO 972-102NF28-6P1-LB	2570B1727NF-G6-28A6SN MATED TO 2570B1XXXNF-00-28A6PN	OD Cad Plated Aluminum (NF)	1

1.6 Test Specimen Images



Receptacle 972-102Z128-6S1-LB with strain relief backshell



Plug 972-101Z128-6P1-LB with strain relief backshell

1.7 Inspection Conditions

All tests were performed with the test specimens at standard laboratory conditions as defined below unless otherwise required by the procedure.

1. Temperature between 15°C and 35°C
2. Relative humidity 90% Maximum
3. Barometric pressure between 28 and 32 inches of mercury absolute



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1.8 Qualification Test Summary

**Group 1** (Altitude Immersion, Shock and Vibe)

TEST OR INSPECTION	PARAGRAPH	QTY	RESULTS
Visual, Mechanical, and Workmanship Inspection	2.1	4	PASS
Contact Retention	2.2	4	PASS
Contact Insertion and Removal Force	2.3	4	PASS
Contact Resistance	2.16	4	PASS
Contact Engagement and Separation Forces	2.4	4	PASS
Insulation Resistance at Ambient Temperature	2.18	4	PASS
Shell-To-Shell Conductivity	2.13	4	PASS
Backshell-To-Connector Shell Conductivity	2.14	4	PASS
Coupling and Uncoupling Torque	2.17	4	PASS
Temperature Cycling (thermal shock)	2.7	4	PASS
Insulation Resistance at Ambient Temperature	2.18	4	PASS
Dielectric Withstanding Voltage at Sea Level	2.19	4	PASS
Maintenance Aging	2.6	4	PASS
Altitude Immersion	2.12	4	PASS
Shell-To-Shell Conductivity <sup>2</sup>	2.13	4	PASS
Backshell-To-Connector Shell Conductivity <sup>2</sup>	2.14	4	PASS
Coupling and Uncoupling Torque	2.17	4	PASS
Vibration, Random, Ambient <sup>2</sup>	2.9	2 <sup>1</sup>	PASS
Vibration, Random, Elevated Temperature <sup>2</sup>	2.10	2 <sup>1</sup>	PASS
Physical Shock	2.11	4	PASS
Corrosion (Dynamic)	2.23	4	PASS
Shell-To-Shell Conductivity <sup>2</sup>	2.13	4	PASS
Backshell-To-Connector Shell Conductivity <sup>2</sup>	2.14	4	PASS
Backshell & Connector Durability	2.8	4	PASS
Backshell Coupling Strength	2.15	4	PASS
Contact Engagement and Separation Forces <sup>2</sup>	2.4	4	PASS
Insert Retention	2.5	4	PASS
Contact Resistance <sup>2</sup>	2.16	4	PASS
Post Test Examination	2.26	4	PASS

Note 1: One mated pair of Z1 (Stainless Steel) and NF (Aluminum) connectors were subject to Random Vibration at Ambient and one mated pair of Z1 (Stainless Steel) and NF (Aluminum) connectors were subject to Random Vibration at Elevated Temperature

Note 2: After Conditioning values/requirements applied



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**Group 2** (High Temperature Cyclic Endurance)

TEST OR INSPECTION	PARAGRAPH	QTY	RESULTS
Visual, Mechanical, and Workmanship Inspection	2.1	2	PASS
Contact Resistance	2.16	2	PASS
Insulation Resistance at Ambient Temperature	2.18	2	PASS
Dielectric Withstanding Voltage at Sea Level	2.19	2	PASS
Dielectric Withstanding Voltage at Altitude	2.20	2	PASS
Shell-To-Shell Conductivity	2.13	2	PASS
Backshell-To-Connector Shell Conductivity	2.14	2	PASS
Coupling and Uncoupling Torque	2.17	2	PASS
High Temperature Cyclic Endurance	2.21	2	PASS
Insulation Resistance at Elevated Temperature	2.21	2	PASS
Contact Resistance at Elevated Temperature	2.16	2	PASS
Dielectric Withstanding Voltage at Sea Level	2.20	2	PASS
Shell-To-Shell Conductivity <sup>1</sup>	2.13	2	PASS
Backshell-To-Connector Shell Conductivity <sup>1</sup>	2.14	2	PASS
Post Test Examination	2.26	2	PASS

Note 1: After Conditioning values/requirements applied

**Group 3** (Fluid Immersion)

TEST OR INSPECTION	PARAGRAPH	QTY	RESULTS
Visual, Mechanical, and Workmanship Inspection	2.1	11	PASS
Insulation Resistance at Ambient Temperature	2.18	11	PASS
Dielectric Withstanding Voltage at Sea Level	2.19	11	PASS
Coupling and Uncoupling Torque	2.17	11	PASS
Fluid Immersion	2.24	11	PASS
Insulation Resistance at Ambient Temperature	2.18	11	PASS
Dielectric Withstanding Voltage at Sea Level	2.19	11	PASS
Coupling and Uncoupling Torque	2.17	11	PASS
Proof Torque	2.25	11	PASS
Post Test Examination	2.26	11	PASS

**Group 4** (Resistance to Indirect Lightning Strikes)

TEST OR INSPECTION	PARAGRAPH	QTY	RESULTS
Visual, Mechanical, and Workmanship Inspection	2.1	4	PASS
Coupling Torque	2.17	4	PASS
Shell-To-Shell Conductivity	2.13	4	PASS
Backshell-To-Connector Shell Conductivity	2.14	4	PASS
Resistance to Indirect Lightning Strikes	2.22	4	PASS
Shell-To-Shell Conductivity	2.13	4	PASS
Backshell-To-Connector Shell Conductivity	2.14	4	PASS
Uncoupling Torque	2.17	4	PASS
Visual Examination	2.22	4	PASS
Coupling Torque	2.17	4	PASS
Shell-To-Shell Conductivity	2.13	4	PASS
Backshell-To-Connector Shell Conductivity	2.14	4	PASS
Dielectric Withstanding Voltage at Sea Level	2.19	4	PASS
Post Test Examination	2.26	4	PASS

**2.0 SUMMARY OF QUALIFICATION TESTING**

**2.1 Visual, Mechanical, and Workmanship Inspection**

All specimens submitted for testing were subject to an AS9102 FAI inspection. All specimens **passed** and were accepted by Glenair Quality Assurance prior to submittal for testing.

**2.2 Contact Retention**

Test Method: EIA-364-29, method B, applying 50-53 pounds to mating end of all contacts  
Requirement: .025 inch maximum displacement, no dislodging or damage  
Results: **PASS**. All contacts met the requirements.

**2.3 Contact Insertion and Removal Force**

Test Method: EIA-364-05 (as applicable)  
Requirement: 30 lbf maximum  
Results: **PASS**. All contacts met the requirements.

**2.4 Contact Engagement and Separation Forces**

Test Method: EIA-364-37, method A (sockets only)  
Requirement: Initial, 5 ounces minimum separation and 160 ounces maximum engagement. After Conditioning, 4 ounces minimum separation and 190 ounces maximum engagement.  
Results: **PASS**. All contacts met the requirements.

**2.5 Insert Retention**

Test Method: EIA-364-35, applying 132-146 lbf to mating face of insert  
Requirement: Insert not to be dislocated or damaged  
Results: **PASS**. All inserts met the requirements.



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## 2.6 Maintenance Aging

Test Method: EIA-364-24, including installation and removal of wire sealing grommet from wires

Requirement: Connectors to meet requirements of all subsequent testing

Results: **PASS.** All connectors met the requirements.

## 2.7 Temperature Cycling (Thermal Shock)

Test Method: Mated connectors tested per EIA-364-32, Test Condition I, for 5 cycles, 2 hour dwell with the following exceptions:

- Step 2 and 4 were 2 minutes maximum
- Low temperature was -54 C +0/-5 C
- High temperature was 230 +0/-5°C for Z1 (Stainless Steel) and 175 +0/-5°C for NF (Aluminum) connectors

Requirement: Connectors to meet requirements of all subsequent testing. No damage detrimental to operation of connectors. No evidence of blistering, peeling or separation of plating.

Results: **PASS.** All connectors met the requirements.

## 2.8 Backshell and Connector Durability

Test Method: Backshell was fully engaged, and disengaged 10 cycles, onto mating connector. Cycle speed did not exceed one full turn per second. Each time backshell was engaged, applied 307-317 in-lbs of torque.

Requirement: No evidence of uneven wear, galling or removal of plating on the connector and backshell shells and samples to meet requirements of all subsequent testing

Results: **PASS.** All connectors and backshells met the requirements.

## 2.9 Random Vibration at Ambient

Test Method: Mated connectors tested per EIA-364-28, Test Condition V, Letter J (43.9 grms).

Duration of test, 8 hours each in longitudinal axis and perpendicular axis.

Requirement: No electrical discontinuity in excess of 1.0 microsecond and no disengagement of mated connectors, backing off of coupling mechanism, evidence of cracking, breaking, or loosening of parts. After vibration, shell-to-shell conductivity to meet After Conditioning values. Connector coupling mechanism to operate smoothly. No indication of excessive wear or breakage, and connectors to meet requirements of all subsequent testing.

Results: **PASS.** All connectors met the requirements.

## 2.10 Random Vibration at Elevated Temperature

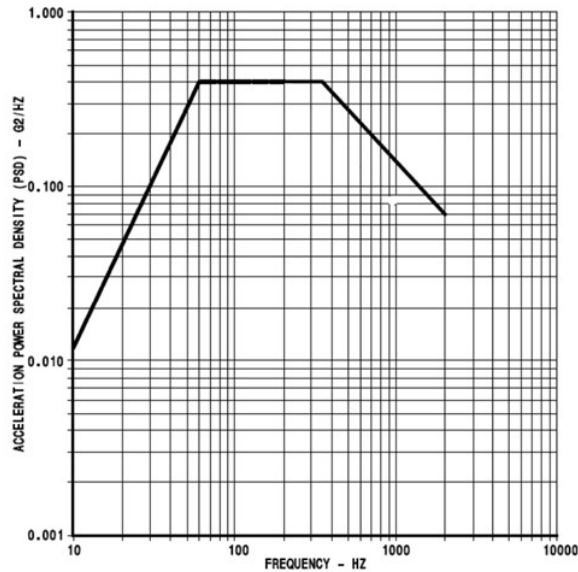
Test Method: Mated connectors tested per EIA-364-28 per vibration profile below (19.2 grms).

Duration of test, 5 hours in each of three mutually perpendicular axes, at 175°C (all connectors).

Requirement: No electrical discontinuity in excess of 1.0 microsecond and no disengagement of mated connectors, backing off of coupling mechanism, evidence of cracking, breaking, or loosening of parts. After vibration, shell-to-shell conductivity to meet After Conditioning values. Connector coupling mechanism to operate smoothly. No indication of excessive wear or breakage, and connectors to meet requirements of all subsequent testing.

Results: **PASS.** All connectors met the requirements.

Frequency (Hz)	Power Spectral Density (g <sup>2</sup> /Hz)
10	0.012
60	0.4
350	0.4
2000	0.07



### 2.11 Physical Shock

Test Method: Mated connectors tested per EIA-364-27, Test Condition A (50g, 11.3 ft/s half-sine, 11ms duration).

Requirement: No electrical discontinuity in excess of 1.0 microsecond and no disengagement of mated connectors, backing off of coupling mechanism, evidence of cracking, breaking, or loosening of parts.

Results: **PASS.** All connectors met the requirements.

### 2.12 Altitude Immersion

Test Method: Wired mated connectors tested per EIA-364-03 at 50,000 ft altitude. Wire ends were located inside chamber (exposed to chamber atmosphere) but not submerged or sealed.

Requirement: At end of third cycle, with mated connectors submerged, connectors to meet dielectric withstanding voltage and insulation resistance testing per paragraph 2.19 and 2.18

Results: **PASS.** All connectors met the requirements.

### 2.13 Shell-To-Shell Conductivity

Test Method: Mated connectors tested per EIA-364-83. Using voltmeter-ammeter method, voltage drop between rear of plug shell and point on front face of receptacle mounting flange was measured

Requirement: Maximum voltage drop: 10 millivolts for Z1 (Stainless Steel) and 2.5 millivolts for NF (Aluminum) connectors. After Conditioning values to be doubled.

Results: **PASS.** All connectors met the requirements.

### 2.14 Backshell-To-Connector Shell Conductivity

Test Method: Backshell assembled to connector tested per EIA-364-83. Using voltmeter-ammeter method, voltage drop between the rearmost accessible point of connector shell and backshell shield termination was measured.

Requirement: Maximum voltage drop: 5.0 millivolts for Z1 (Stainless Steel) and 2.5 millivolts for NF (Aluminum) connectors. After Conditioning values to be doubled.

Results: **PASS.** All connectors/backshells met the requirements.



**2.15 Backshell Coupling Strength**

Test Method: Backshell torqued to connector with 390 in-lbs for Z1 (Stainless Steel) or 240 in-lbs for NF (Aluminum) connectors. Torque held for 1 minute minimum. Backshell then removed and inspected at 3X magnification for damage or breakage.

Requirement: Connector accessory threads to withstand torque without damage

Results: **PASS.** All connectors/backshells met the requirements.

**2.16 Contact Resistance**

Test Method: Contacts of mated connectors tested per EIA-364-06. Appropriate compensation was made for resistance in measured value, which was due to additional length of wire included in measurement, beyond 6 inch point to point baseline (EIA-364-06).

Requirement: Maximum voltage drop: 65mV Initial, 80mV After Conditioning and 113mV at 230°C (for Z1 connectors)

Results: **PASS.** All contacts met the requirements.

**2.17 Coupling and Uncoupling Torque**

Test Method: Torque to completely couple/uncouple each connector pair was measured.

Requirement: Maximum torque to couple or uncouple counterpart plugs and receptacles to be 66 in-lbs. Minimum uncoupling torque to be 10 in-lbs.

Results: **PASS.** All connectors met the requirements.

**2.18 Insulation Resistance**

Test Method: Unmated connectors tested per EIA-364-21, all contacts were tested.

Requirement: Insulation resistance between any pair of contacts and between any contact and shell to be greater than 5000 MΩ at 500 VDC ± 10%.

Results: **PASS.** All connectors/contacts met the requirements.

**2.19 Dielectric Withstanding Voltage at Sea Level**

Test Method: Wired mated connectors tested per EIA-364-20, Method A, all contacts were tested. Test voltages as shown in table below. Test voltage was maintained for 60 seconds.

Requirement: Maximum leakage current to be 5 milliamperes, and no evidence of electric breakdown or flashover.

Results: **PASS.** All connectors/contacts met the requirements.

ALTITUDE	INSERT ARRANGEMENT	MEASUREMENT POINTS	VOLTAGE (VRMS)
Sea level	28-6	Contact to contact	3500
Sea level	28-6	Contact to shell	2500
50000 feet	28-6	Contact to contact	1200
50000 feet	28-6	Contact to shell	750

**2.20 Dielectric Withstanding Voltage at Altitude**

Test Method: Wired mated connectors tested per EIA-364-20, Method A, all contacts were tested. Test voltages as shown in table above. Test voltage was maintained for 60 seconds while at simulated altitude of 50,000 ft. Wire ends brought outside of chamber walls and wire ends unsealed.

Requirement: Maximum leakage current to be 5 milliamperes, and no evidence of electric breakdown or flashover.

Results: **PASS.** All connectors/contacts met the requirements.

**2.21 High Temperature Cyclic Endurance (Z1, Stainless Steel connectors only)**

Test Method: Mated connector pair subject to 1500 cycles of 1 hour duration per cycle, 30 minutes at 175°C and 30 minutes at 230°C. Separate chambers were used for each temperature. Chamber to chamber transfer time was less than 10 seconds and transfer was not made through ambient temperature. At last cycle while at maximum temperature, insulation resistance and contact resistance was measured on all contacts.

Requirement: Insulation resistance between any pair of contacts and between any contact and shell to be greater than 400 MΩ at 500 VDC ± 10%. Contact resistance shall meet requirements of paragraph 2.16, using 230°C value (113mV max).

Results: **PASS.** All connectors/contacts met the requirements.

**2.22 Resistance To Indirect Lightning Strikes**

Test Method: Wired mated connectors were subjected to testing per EIA 364-75. Test Type B, level 2, 10,000 Amps. 10 strikes positive and 10 strikes negative polarity.

Requirement: Connectors and backshells to show no damage (Visual Examination) and to pass subsequent testing

Results: **PASS.** All connectors/backshells met the requirements.

**2.23 Corrosion (Dynamic)**

Test Method: Connectors tested per EIA 364-26. 50 cycles of mate/demate prior to corrosion. Corrosion testing: 452 hours mated followed by 48 hours unmated. 100 cycles of mate/demate after corrosion.

Requirement: Connectors and backshells to show no evidence of corrosion detrimental to its operation and to pass subsequent testing

Results: **PASS.** All connectors/backshells met the requirements.

**2.24 Fluid Immersion**

Test Method: Mated connectors tested per EIA 364-10 using fluids in table below

Requirement: Connectors to be capable of being mated and unmated properly. No damage to connectors that will affect performance. No cracking, loose or missing parts. Dielectric Withstanding Voltage shall meet requirements of paragraph 2.19. Coupling torque shall be as specified in paragraph 2.17.

Results: **PASS.** All connectors/backshells met the requirements.

**Fluid Immersion Fluids Table**

TEST FLUID	TEST CYCLE					
	TEST FLUID TEMPERATURE (DEGREES CENTRIGRADE)		DRAINAGE TIME	OVEN CURE (MATED)		NUMBER OF CYCLES
	TEMP ± 3C	TIME MINUTES	FREE AIR HOURS	TIME HOURS	TEMP ± 3C	
Hydraulic Fluid, Fire Resistant BMS3-11, Type IV, Class 1	70	5	1	6	100	7
Isopropyl Alcohol, TT-I-735	23	5	23	--	--	5
Methyl Propyl Ketone, BMS11-9, Grade 1	23	5	1	--	--	7
Anti-Icing Fluid <sup>a</sup>	23	60	1	6	100	7
Lubricating Oil, MIL-PRF-23699, any class	120	5	1	6	100	7
Alkaline Detergent, (pH 10.0 – 10.5) <sup>b</sup>	23	5	1	6	100	7
Fuel, Jet A, ASTM D 1655	23	5	1	6	55	7
Hydraulic Fluid, MIL-PRF-5606	70	5	1	6	100	7
Hydraulic Fluid, MIL-PRF-87257	70	5	1	6	100	7
Heat Transfer Fluid, Dow Frost 60	23	5	1	6	100	7
Potassium Formate Runway De-icer <sup>c</sup>	23	5	1	6	55	7

**2.25 Proof Torque**

Test Method: Connectors were mated to torque of 132 in-lbs, 3 cycles

Requirement: No damage or binding to connector coupling ring and coupling mechanism.

Connectors to meet Coupling and Uncoupling Torque requirements of paragraph 2.17.

Results: **PASS.** All connectors met the requirements.

**2.26 Post Test Examination**

All test specimens were visually examined for cracks, loosening of parts, carbon tracking, excess wear, or missing parts. All specimens **passed** requirements.