



Autoshrink Immersion Insulation Resistance Testing

Date

9/7/16

GT-16-153

Rev. 1

Qualification Test Report

Conducted by:	Preston Clover
Approved by:	Sam Farhat

1. Scope

The intention of this testing is to measure the immersed insulation resistance (IR) effectiveness of Glenair's Autoshrink material when installed over damaged TurboFlex cable with and without adhesive.

2. Summary of Results

The table below contains a chronological summary of all testing and their results:

QUALIFICATION TEST

Nature of the test	RESULT		
	Completed	WAIVE	FAIL
Visual Inspection	X		
Immersion IR Testing	X		
Autoshrink Installation	X		
Immersion IR Testing	X		

3. Description of Samples

- **Group 1:** TurboFlex cable PN: 961-003-T-H-3, size 2/0 AWG with 0.062". Duraelectric jacket, nominal OD .607". Autoshrink PN: 777-004-02-4-8, nominal recovered ID .375" installed with no adhesive.
- **Group 2:** TurboFlex cable PN: 961-003-T-H-3, size 2/0 AWG with 0.062". Duraelectric jacket, nominal OD .607". Autoshrink PN: 777-004-02-4-8, nominal recovered ID .375" installed with adhesive.

Test Report: Autoshrink IR Testing**Client: Sam Farhat****Glenair****1211 Air Way, Glendale, CA 91201****Laboratory Report #: RPC090616-3-3463****Singer Laboratories Report #: RPC090616-1-3463****Prepared by:** Preston Clover**Date:** 9/6/16**Test Report Approved by:** Claribel Gamboa, Quality Representative**Purpose of Test**

The intention of this testing is to measure the immersed insulation resistance (IR) effectiveness of Glenair's Autoshrink material when installed over damaged TurboFlex cable with and without adhesive.

Summary of Test Results

All six test samples were measured for IR before and after the installation of Autoshrink material on the TurboFlex cables. In all cases the insulation resistance was measured as 10 Gigaohms or greater. The Autoshrink selected for testing has a nominal recovered ID of .375" and the TurboFlex selected for testing has a nominal OD of .607". This results in a 38% compression rate.

Deviation of Test

There were no deviations during testing.

Important Reference Documents

1. *EIA-364-03C "Altitude Immersion Test Procedure for Electrical Connectors"*
2. *EIA-364-21E "Insulation Resistance Test Procedure for Electrical Connectors, Sockets and Coaxial Contacts"*

Test Criteria

Per Glenair Inc.'s instructions, there are no pass/fail criteria for this testing. All six samples are to be tested pre and post Autoshrink installation and insulation resistance values are to be documented in this report.

The results stated on this report relate only to the items specifically identified.
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Revision 2 (4/14/2016)

Doc #: QMS510-F2	Title: Test Report	Date: 5-24-16
Created By: QMS Rep.	Approved By: P. Clover	Rev: B

Test Equipment

1. Hi-Pot Tester Serial #: 9633786
Calibrated 6/17/2016
Calibration due 6/17/2017
Singer Labs # EM00012

2. Load Cell #: 223913/1445182
Calibrated 5/12/2016
Calibration due 5/12/2017
Singer Labs # CP00004

Calibration certificates for all Singer Laboratories owned equipment are attached to this report.

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TABLE 1 - Test Sample Identification

Test Group Number	Test Item Identification Numbers	Description	Test Item Qty.
1	001-003	TurboFlex cable PN: 961-003-T-H-3, size 2/0 AWG with 0.062" Duraelectric jacket, nominal OD .607". Autoshrink PN: 777-004-02-4-8, nominal recovered ID .375" installed with no adhesive.	3
2	004-006	TurboFlex cable PN: 961-003-T-H-3, size 2/0 AWG with 0.062" Duraelectric jacket, nominal OD .607". Autoshrink PN: 777-004-02-4-8, nominal recovered ID .375" installed with adhesive.	3

TABLE 2 - Order of Testing

Test	Test Group #1	Test Group #2
Tag and Inspect	COMPLETED	COMPLETED
Immersion IR testing	COMPLETED	COMPLETED
Install Autoshrink	COMPLETED	COMPLETED
48 hour cure @ 40C and 50% RH	N/A	COMPLETED
Immersion IR testing	COMPLETED	COMPLETED

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Test Procedure

1. Start all testing with virgin TurboFlex cable samples.
2. Immerse all test samples in 1 meter of salt water solution for 1 hour. Salt water solution prepared in accordance with *EIA-364-03C*.
3. Perform IR testing in accordance with *EIA-364-21E*. Apply 500 volts DC for 2 minutes, then conduct IR measurement. Record results.
4. Cut 1 inch section out of TurboFlex cable material out of each sample.
5. Install Autoshrink on samples 001-003 with no adhesive.
6. Install Autoshrink on samples 004-006 with adhesive.
7. Cure Autoshrink samples 004-006 in environmental chamber for 48 hours at 40C and 50% RH.
8. Immerse all test samples in 1 meter of salt water solution for 1 hour. Salt water solution prepared in accordance with *EIA-364-03C*.
9. Perform IR testing in accordance with *EIA-364-21E*. Apply 500 volts DC for 2 minutes, then make IR measurement. Record results.
10. Testing complete.

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Test Setup

Test samples were received, inspected, measured and marked. For IR immersion testing samples were placed in 1 meter of salt solution and allowed to soak for 1 hour. Samples were immediately IR tested at the 1 hour mark.



Image 1: Singulating, measuring and marking of samples.

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Image 2: Immersion insulation resistance tank.

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Image 3: 1 inch of duraelectric jacket removed for Autoshrink installation.



Image 4: Example of Autoshrink installed on test sample.

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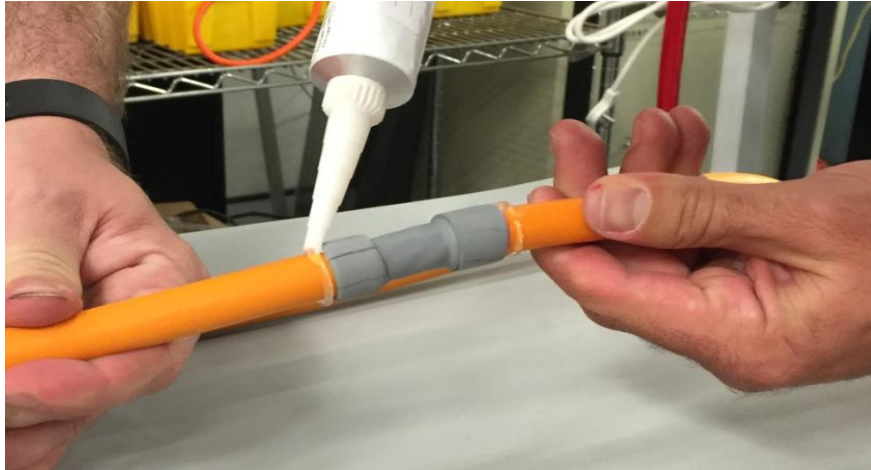


Image 5 : Example of Autoshrink installed with adhesive.



Image 6 : Curing of Autoshrink samples with adhesive. 40C @ 50% RH for 48 hours.

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Temp and Humidity #1

Showing at 15min resolution

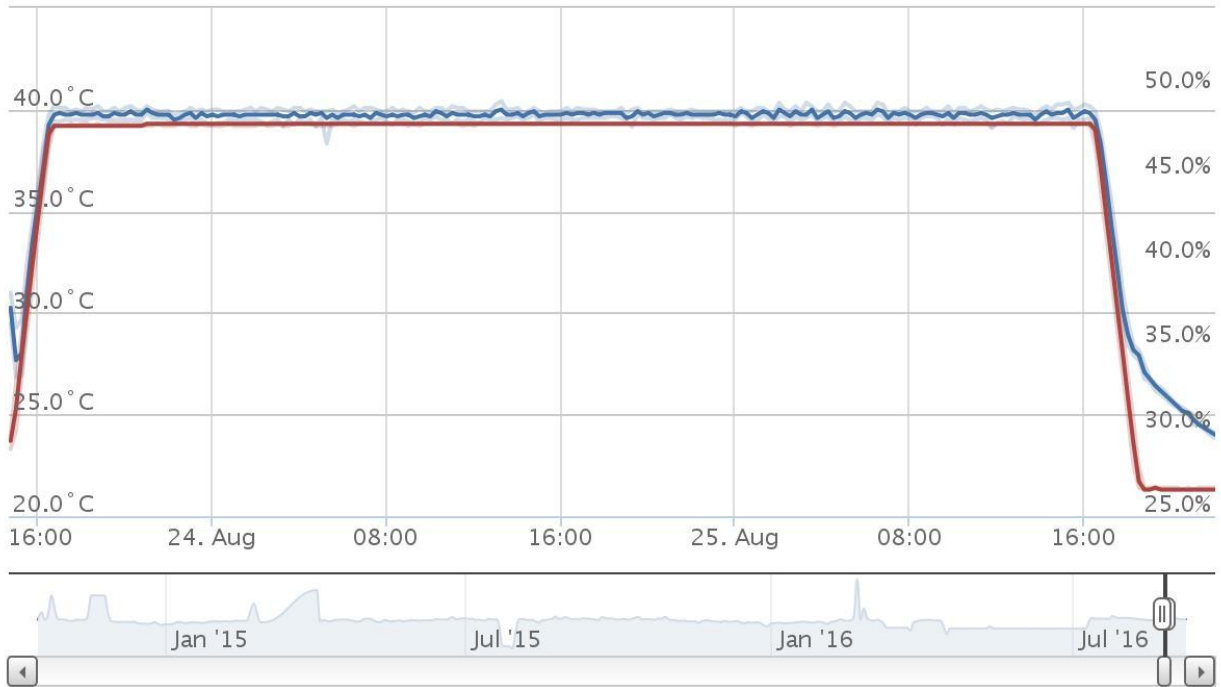


Image 7 : Curing temperature profile of Autoshrink samples with adhesive.

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Test Results:

All samples were visually inspected before testing; no defects of any kind were found that would be harmful to the performance of the test samples. All six test samples reported insulation resistance values greater than 10 Gohms during all testing. Please see recorded results below for pre and post insulation resistance testing.

TABLE 3 – Results of Testing

Test	Pre-Autoshrink Insulation Resistance	Post-Autoshrink Insulation Resistance
001	>10 Gohms	>10 Gohms
002	>10 Gohms	>10 Gohms
003	>10 Gohms	>10 Gohms
004	>10 Gohms	>10 Gohms
005	>10 Gohms	>10 Gohms
006	>10 Gohms	>10 Gohms


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CERTIFICATE OF CALIBRATION
MICRO QUALITY CALIBRATION, INC

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Western Commercial Laboratory Designed Exclusively For Precision Measurement.

ISO/IEC 17025 2005
ACCREDITED



Calibration Laboratory
CENTR134601

Customer # SIN084	SINGER LABORATORIES 139 W. WALNUT AVENUE MONROVIA, CA 91016	Calibrated: At MQC			
Barcode 177270	Cert Number 1000735158	Purchase Order CG061316-2-3203	Cal Date 06/17/2016	Next Cal 06/17/2017	Recall 12 M
Instrument Type HIPOT TESTER, ASR 3770		Manufacturer ASSOCIATED RESEARCH	Model Number 3770	Measuring Range 5 KVAC, 6 KVDC	
Cust. Instrument ID EM00012	Manufacturer S/N 9633786	Procedure 1001	Tech HDN	Temperature 68 deg F	Humidity 40%

CONDITION RECEIVED: WITHIN TOLERANCE
 CONDITION RETURNED: WITHIN TOLERANCE
 REASON FOR SERVICES: CALIBRATION AND CERTIFICATION

All calibrations conform to ISO 10012-1:2003, ANSI/NCSL Z-540.1-1994.

ADDITIONAL INFORMATION

Accuracy
 VOLTAGE : $\pm(2\% \text{ of setting} + 5 \text{ V})$, CURRENT : $\pm(2\% \text{ of setting} + 2 \text{ counts})$
 TIMER : $\pm(0.1\% \text{ of reading} + 0.05 \text{ sec})$, CONTINUITY : $\pm(3\% \text{ of setting} + 0.02 \text{ Ohm})$

Analysis
 MEASUREMENT UNCERTAINTY ESTIMATED AT 95% CONFIDENCE LEVEL (K=2)

Nominal	Actual	Minimum	Maximum	Deviation	Meas. Unc.
1000 VDC	1000	975	1025	0	± 4
3000 VDC	2998	2935	3065	-2	± 4
5000 VDC	4997	4895	5105	-3	± 4
1000 VAC	999	975	1025	-1	± 4
3000 VAC	3000	2935	3065	0	± 4
5000 VAC	5004	4895	5105	4	± 4
10 NChm (4500 V)	9.962	9.798	10.202	-0.038	± 0.04
100 NChm	100.50	97.98	102.02	0.50	± 0.4
1000 NChm	996.2	975.8	1016.2	-3.8	± 4
5 mADC	5.01	4.88	5.12	0.01	± 0.02
5 mAAC	5.00	4.88	5.12	0.00	± 0.02

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Customer # SIN084

9168 De Soto Avenue, Chatsworth, California 91311
 Tel: (818)701-4969 Fax: (818)818-6285

Cert Number 1000735158

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ISO/IEC 17025-2005
ACCREDITED

Customer # SINC84		SINGER LABORATORIES 139 W. WALNUT AVENUE MONROVIA, CA 91016		Calibrated: At MQC	
Barcode 177497	Cert Number 1000727085	Purchase Order CG050916-1-3203	Cal Date 05/12/2016	Next Cal 05/12/2017	Recall 12 M
Instrument Type LOAD CELL 0-500,±0.5% W/DIG. READOUT		Manufacturer OMEGA ENG.	Model Number LC-402-500 DP25B-S-A	Measuring Range 0-500 LBP	
Instrument Id CP00004	Serial Number 223513/1445182	Procedure 17-ZCMP-34	Tech PCK	Temperature 72 deg F	Humidity 35%

Condition Received: Within Tolerance Condition Returned: Within Tolerance Reason For Service: Calibration, and Certification

All calibrations conform to ISO 10012-1:2003, ANSI/NCSL Z-540.1-1994, ANSI/NCSL Z-540.3-1994.

ADDITIONAL INFORMATION

Accuracy
±0.5% Full Scale

Nominal	Actual	Minimum	Maximum	Deviation
100.0 Lbs. Tens.	99.2	97.5	102.5	-0.8
200.0 Lbs. Tens.	199.3	197.5	202.5	-0.2
300.0 Lbs. Tens.	300.2	297.5	302.5	0.2
400.0 Lbs. Tens.	399.7	397.5	402.5	-0.3
500.0 Lbs. Tens.	499.5	497.5	502.5	-0.5

This is to certify that the equipment noted herein has been compared to the standards listed below in accordance with the reference procedure or specification and has been found to conform to the specified limits. Although the item calibrated meets the specification and performance at the time of calibration, due to any number of factors, the recommended due date of the item calibrated does not imply continuing conformance to specification during the recommended interval. Permanent data, if any, is listed on the attached sheets. The standards that have been utilized in this calibration are certified by, or are traceable to, the National Institute of Standards and Technology (NIST), and meet or exceed manufacturer's requirements for the above mentioned item.

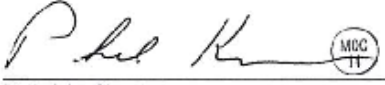
The certificate or report shall not be reproduced except in full without the written approval of the laboratory.

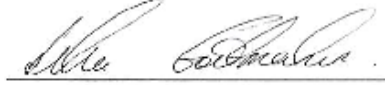
STANDARDS EMPLOYED

Cal Std	Model Number	Instrument Type	Due Date
3816	CT485 AL	CHART RECORDER, TRMP/RH, WB CT485 AL	02/28/2017
4028	10 X 25 LBS	TEST WEIGHTS	10/31/2016
4210	N/A	WEIGHT SET	10/31/2016
4105	2000-303-0	WEIGHT TRAY	05/31/2016
4044	N/A	TEST WEIGHT SET	02/28/2017

Numbers traceable to National Institute of Standards and Technology:

(3816) 260638	(3816) 266076-01	(4028) 275953-10	(4210) 822/278735-10	(4210) 684/284451-14
(4210) 681/280058-10	(4210) 12437	(4105) 275953-10	(4105) ALC0414	(4044) 684/284451-14
(4044) 8162-11163326				


 Technician Signature


 Approval Signature

9168 De Soto Avenue, Chatsworth, California 91311

Page: 1 of 1 Customer # SINC84 Tel: (818)701-4969 Fax: (818)818-6285 Cert Number 1000727085

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