



Test Report

Date 05/22/2014

RDP GT-14-40

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Rev. 1

TurboFlex™ Wire

Glenair Drawing Numbers: 961-001, 961-002, 961-003, 961-004

Evaluation Test Report

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1. Scope

This evaluation test report covers Glenair TurboFlex™ wire of various conductor and insulation sizes in order to determine the abrasion resistance, insulation resistance, voltage and current carrying capabilities of different constructions offered under part numbers 961-004, 961-003, 961-002, and 961-001.

2. Applicable Standards / Specifications

- ASTM D 3032-98
- AS4373D
- AS50881B

3. Test Specimens

Table 1: Test Specimens by Part Number

TurboFlex™ Part Number	Wire Size, AWG	Conductor Type	Insulation Thickness, Inches
961-001-T-H-0	2/0	Tin Copper	0.125
961-002-T-E-0	4	Tin Copper	0.093
961-003-N-A-0	12	Nickel Copper	0.062
961-003-T-B-0	10	Tin Copper	0.062
961-004-N-A-0	12	Nickel Copper	0.032
961-004-N-B-0	10	Nickel Copper	0.032
961-004-N-C-0	8	Nickel Copper	0.032
961-004-N-D-0	6	Nickel Copper	0.032
961-004-T-C-0	8	Tin Copper	0.032

4. Description of Tests

Time/Current to Smoke - AS4373D, Method 507

The time/current to smoke test examines the ability of the wire to withstand overcurrent conditions. The test current is increased until smoke is visually detected from the wire insulation. This test is dependent upon conductor size and material, irrespective of insulation thickness.

Wire Fusing Time - AS4373D, Method 511

The wire fusing time test objective is to determine the performance of a sample wire in an overload condition. The sample is placed under a constant overload current until the wire opens or 5 minutes have passed. This test is dependent upon conductor size irrespective of insulation thickness.



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Voltage Withstand Test - ASTM D 3032-98, Section 8

The voltage withstand test determines the ability of the wire insulation to endure a constant high voltage beyond its intended service voltage and can be used to de-rate to an acceptable service voltage. This test is dependent on insulation thickness and material, irrespective of conductor size and type.

Insulation Resistance - ASTM D 3032-98, Section 6

The insulation resistance test is used to determine the bulk properties of the insulation on the wire and the ability of this material to prevent any leakage of current away from the conductor. The results obtained from insulation resistance testing are not intended to be useful in finding localized defects in the insulation as in a voltage withstand test, but rather to give information on the quality of the bulk material used for wire insulation. This test is dependent on insulation thickness and material, irrespective of conductor size and type.

Needle Scrape Abrasion Test - AS 4373D, Method 301

The needle abrasion test assesses the physical resistance of the wire insulation to withstand abrasion. As stated in AS4373, "The results of this test are not related to the specific survivability time frame of a wire in an air vehicle environment" since air frame abrasion of wires varies by application. The results of this test provide a good comparative assessment between different wire constructions.

5. Evaluation

5.1 Time/Current to Smoke - AS4373D, Method 507

5.1.1 Test Procedure Summary

A one foot length of wire is suspended in a draft free chamber. Using a 12 VDC power source, the test begins with the current set to 10 Amps. If no smoke is detected, the current is increased by 5 Amps every 30 seconds until smoke is detected.

5.1.2 Requirement

Read and report the current at which smoke is generated for each test sample.

5.1.3 Results

Table 2: Current to Smoke Results by Wire Size

TurboFlex™ Part Number	Wire Gauge	Smoke Current, Amps
961-004-N-A-0	12	80
961-004-N-B-0	10	120
961-004-N-C-0	8	180
961-004-N-D-0	6	240

5.2 Wire Fusing Time - AS4373D, Method 511

5.2.1 Test Procedure Summary

A one foot length of wire is placed in a draft free chamber and connected to a 12 VDC power source. The test current used is determined by the Rated Current from Figure 3 in AS50881. The Rated Current is based on the wire temperature rating, which is 260°C in the case of TurboFlex™ nickel-plated copper wire, and the temperature of the environment. The test current used is 2.5 times the Rated Current value. The sample is placed under a constant overload current until the wire opens or 5 minutes have passed.

5.2.2 Requirement

Read and report the time for the circuit to open or 5 minutes, whichever comes first.

5.2.3 Results

The wires generated smoke but none of the conductors opened after 5 minutes.



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Table 3: Wire Fusing Current/Time by Wire Size

TurboFlex™ Part Number	Wire Gauge	Rated Current, Amps (AS50881 Figure 3)	Test Current Applied, Amps	Duration to Open
961-004-N-A-0	12	75	187.5	None, 5 Minutes
961-004-N-B-0	10	110	275	None, 5 Minutes
961-004-N-C-0	8	165	412.5	None, 5 Minutes
961-004-N-D-0	6	220	550	None, 5 Minutes

5.3 Voltage Withstand Test - ASTM D 3032-98, Section 8

5.3.1 Test Procedure Summary

An 8 foot sample of wire is immersed in an aqueous electrolyte solution and energized with 500 VAC. The voltage is increased at a rate of approximately 100 V/s. The test for each sample ends when there is an increase in the leakage current greater than 20 mA or a visible arc indicating a direct path for current to flow. Additionally the corona initiation voltage is recorded as determined by audible indication. Five test samples of each wire size are tested and the average reported.

5.3.2 Requirement

Read and report the corona initiation voltage and rupture voltage of each test specimen.

5.3.3 Results

Table 4: Voltage Withstand by Insulation Thickness

TurboFlex™ Part Number	Insulation Thickness, Inches	Corona Initiation, Volts	Rupture, Volts
961-004-N-A-0	0.032	4,700	8,300
961-003-N-A-0	0.062	5,100	10,200

5.4 Insulation Resistance - ASTM D 3032-98, Section 6

5.4.1 Test Procedure Summary

A 25 foot (8 meter) length of wire is immersed in a water bath. After 4 hours of soaking, the wire is energized with 500 ± 50 volts DC. After 1 minute of electrification, the resistance between the water bath and the wire conductor is measured and reported as the insulation resistance. The insulation resistance per 1000 meters is calculated as $(R \times L)/1000$ where R is the measured resistance and L is the immersed length of wire (8 meters).

5.4.2 Requirement

Read and report resistance for each test specimen.

5.4.3 Results

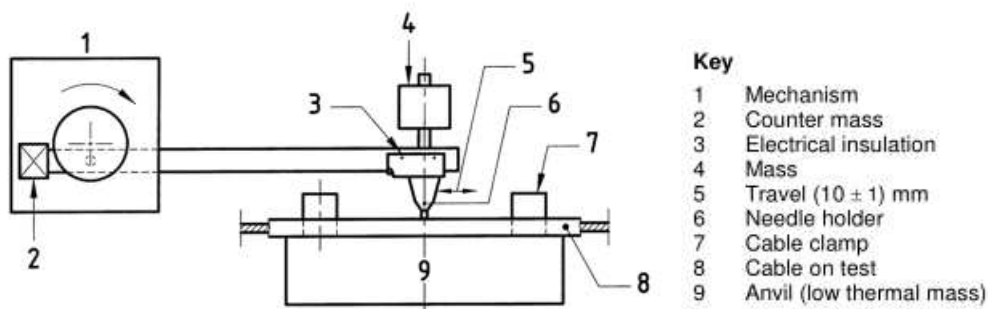
Table 5: Insulation Resistance by Thickness

TurboFlex™ Part Number	Wire Size, AWG	Insulation Thickness, Inches	Gigaohm/km
961-004-T-C-0	8	0.032	1×10^6
961-003-T-B-0	10	0.062	6×10^5
961-002-T-E-0	4	0.093	9×10^5
961-001-T-H-0	2/0	0.125	2×10^6

5.5 Needle Abrasion Test - AS 4373D, Method 301

5.5.1 Test Procedure Summary

At ambient temperature and with a load of 500 grams, a 0.5 mm diameter abrading needle/rod made from nickel coated steel is placed horizontal and perpendicular to the wire. The apparatus moves the abrading rod 10 ± 1 mm across the wire insulation at a frequency of 55 ± 10 cycles per minute. The test is stopped when the needle reaches the conductor underneath the insulation or the specified maximum number of cycles is reached. Each wire is tested in 10 different places at intervals of 4 inches. The average of the 10 tests is reported.

Figure 1: Needle Abrasion Test Setup (source: AS4373D Method 301)


5.5.2 Requirement

Report the number of cycles to failure or 10,000 cycles maximum.

5.5.3 Results

Table 6: Scrape Abrasion by Insulation Thickness

TurboFlex™ Part Number	Wire Size, AWG	Insulation Thickness, Inches	Average Cycles to Fail
961-004-T-C-0	8	0.032	453
961-003-T-B-0	10	0.062	7,194
961-002-T-E-0	4	0.093	> 10,000
961-001-T-H-0	2/0	0.125	> 10,000

Figure 2: Images of 2/0 Wire After 10,000 Cycles and 0.026 Inches of Penetration

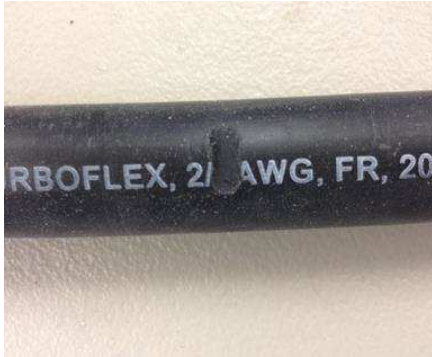


Figure 3: Images of 4 AWG Wire after 30,000 Cycles and 0.043 Inches of Penetration



6. Conclusions

The evaluation testing of TurboFlex™ provides an understanding of the performance across a broad range of wire sizes (10 to 2/0 AWG) and insulation thicknesses (0.032 to 0.125 inches).