



TEST REPORT

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Wet Arc Propagation and Wet Short
Circuit Testing of TurboFlex™ to AS4373
Method 509 and EN3475 Method 605

Revision	Description of Changes	Date	Author
1	Initial Release	8/18/2017	Sam Farhat



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Final Test Report
of Two (2) Wire Specification

Prepared for

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N710-R001 Rev A

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• Accredited to ISO/IEC 17025:2005 •

Revision History

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Original	08/17/2017	Alexander E Petrov	
A	08/17/2017	M. Traskos	- Inclusion of pass/fail criteria - Correction of 20AWG part number.

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1 Summary

Several tests were performed on two (2) cable specimens provided to Lectromec by Glenair, Inc. Table 1 provides the list of tests performed in this effort.

Table 1: Summary of tests performed in this effort.

Test #	Test Name	Test Spec	Method	Status
1	Wet Arc Resistance	AS4373	509	Complete
2	Wet Short Circuit	EN3475	605	Complete

The specimens provided to Lectromec by Glenair, Inc. are listed in Table 2.

Table 2: Wire specification tested in this effort.

Lectromec Sample Tracking ID	Wire Description	Glenair ID
N710-S01	20 AWG Red Wire	961-004-T-T-2
N710-S02	8 AWG Black Wire	961-004-T-C-0

The test results are summarized in Table 3.

Table 3: Test results summary.

Lectromec Test ID	Test	Sample	Pass/Fail
N710-S01	Wet Arc Resistance	961-004-T-T-2	Pass
N710-S02	Wet Arc Resistance	961-004-T-C-0	Pass
N710-S03	Wet Short Circuit	961-004-T-T-2	Pass
N710-S04	Wet Short Circuit	961-004-T-C-0	Pass

2 Wet Arc Track Propagation Resistance

2.1 Test Information

Testing was performed to the following specifications and parameters (if special parameters were identified).

Test Specification:	AS4373-Rev E
Method:	509
Additional Notes/Special Conditions:	None
Pass/Fail Criteria:	Minimum of 64 wires pass the post test dielectric test (using AS22759/82 as a basis)

2.2 Equipment and Description

The wet arc propagation resistance test assesses the ability of insulation to prevent damage during an electrical arcing event. Arc-propagation resistance is defined as the length of arc propagation damage along the wires and the extent of damage to the wire insulation of wires that were not pre-damaged. This test also evaluates the insulation's ability to prevent further arc-propagation when the wires are re-energized following an arcing event.

The testing follows the procedures outlined in AS4373 Method 509 (wet arc track resistance test). In this test, two of seven wires in the test bundle are initially damaged exposing a short section of the conductor. The test bundle is placed in a fixture under a saline drip and connected to three phase power. As the drops create a low resistance path between the damage sites, electrical activity can occur and, in some cases, an arcing event will occur. The test objective is to determine the damage caused to the five initially undamaged wires in the bundle.

The control system used is Lectromec's LEC1001 test unit. Photos of the equipment are shown in Figure 1. The control cabinet provides automatic handling of the test circuit. The power to the test sample follows the AS4373 requirements shown in Figure 2. A 20kVA power supply operating at 400Hz was used for the tests.

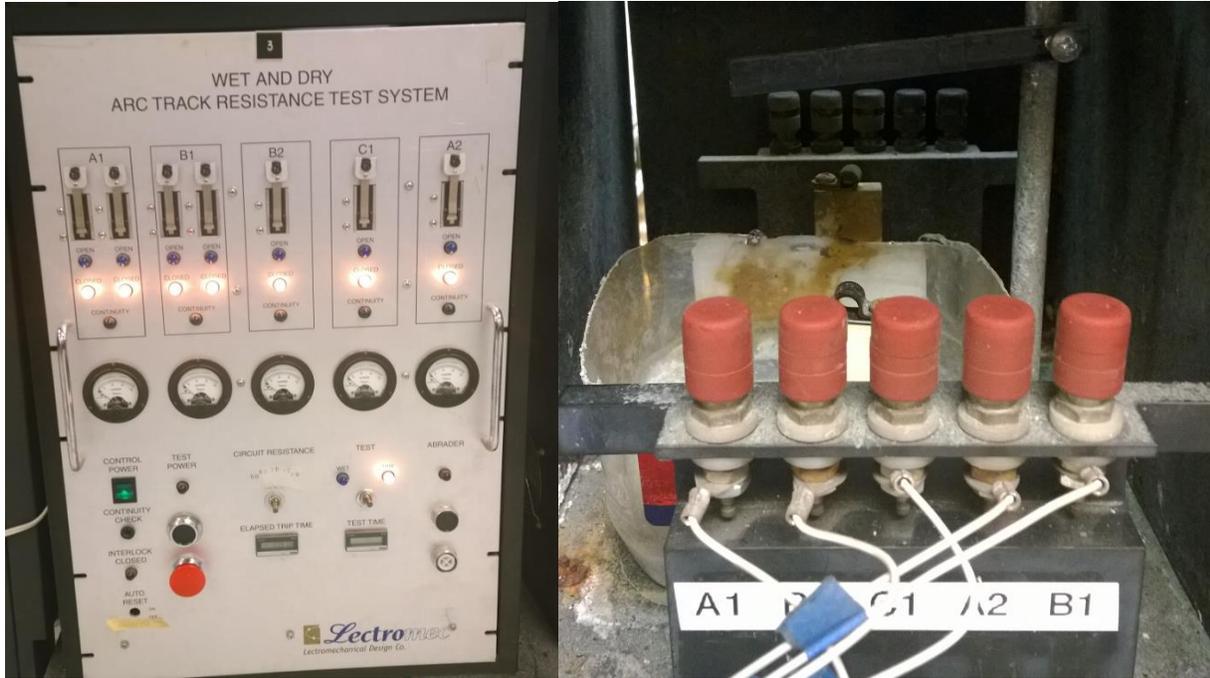


Figure 1: Lectromec wet arc track resistance test equipment control cabinet [left] and wet arc resistance test stand [right].

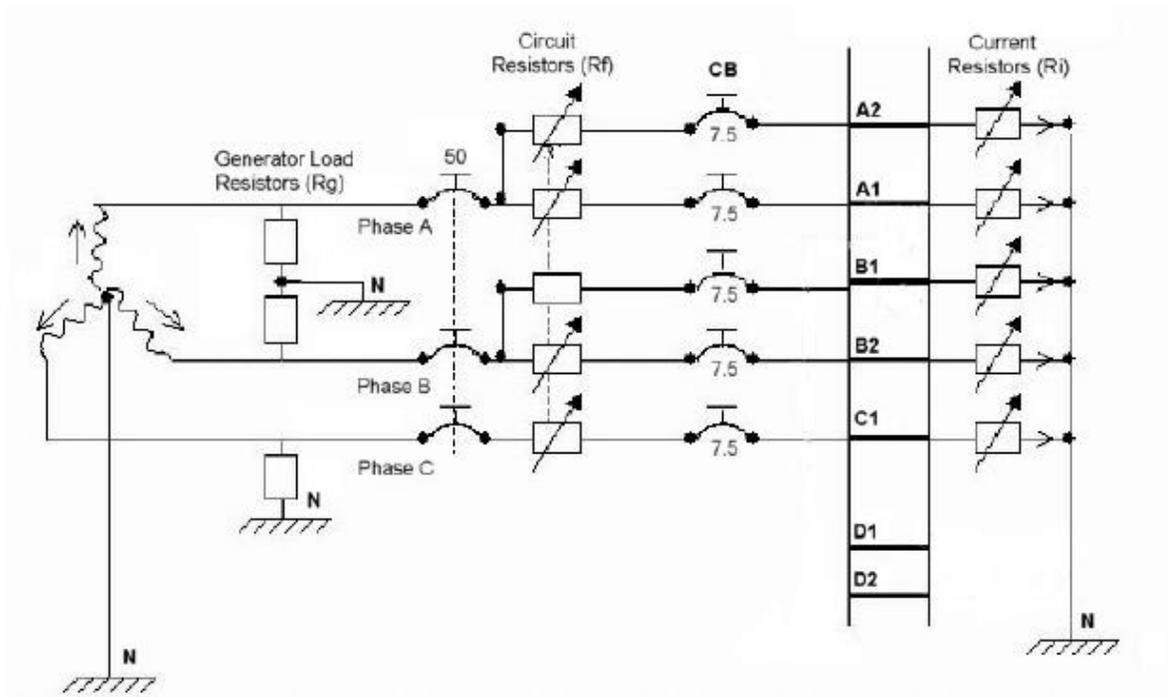


Figure 2: Power circuit for wet arc track resistance test system (source AS4373).

2.3 Test Results

Table 4 and Table 5 contain the wet arc track resistance test results.

Table 4: Wet arc track test resistance results for sample S-01 (961-004-T-T-2).

Test ID	In-Line Resistance (ohms)	CBs Tripped	Length of Damage (mm)							Post-test Dielectric Voltage Withstand (Pass/Fail)					
			A1	B1	C1	A2	B2	D1	D2	C1	A2	B2	D1	D2	Four or more wires fail
N710-01-01	0	none	4	10	0	0	0	0	0	P	P	P	P	P	N
N710-01-02	0	none	5	15	0	4	0	0	0	P	F	P	P	P	N
N710-01-03	0	none	3	5	0	0	0	0	0	P	P	P	P	P	N
N710-01-04	0.5	none	3	3	0	0	0	0	0	P	P	P	P	P	N
N710-01-05	0.5	none	7	7	0	0	0	0	0	P	P	P	P	P	N
N710-01-06	0.5	none	3	8	0	0	0	0	0	P	P	P	P	P	N
N710-01-07	1	none	3	10	0	0	0	0	0	P	P	P	P	P	N
N710-01-08	1	none	3	3	0	0	0	0	0	P	P	P	P	P	N
N710-01-09	1	none	3	5	0	0	0	0	0	P	P	P	P	P	N
N710-01-10	1.5	none	3	2	0	0	0	0	0	P	P	P	P	P	N
N710-01-11	1.5	none	3	7	0	0	0	0	0	P	P	P	P	P	N
N710-01-12	1.5	none	10	5	0	0	0	0	0	P	P	P	P	P	N
N710-01-13	2	none	2	2	0	0	0	0	0	P	P	P	P	P	N
N710-01-14	2	none	4	4	0	0	0	0	0	P	P	P	P	P	N
N710-01-15	2	none	5	10	0	0	0	0	0	P	P	P	P	P	N

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Table 5: Wet arc track test resistance results for Sample S-02 (961-004-T-C-0).

Test ID	In-Line Resistance (ohms)	CBs Tripped	Length of Damage (mm)							Post-test Dielectric Voltage Withstand (Pass/Fail)					Four or more wires fail
			A1	B1	C1	A2	B2	D1	D2	C1	A2	B2	D1	D2	
N710-02-01	0	none	11	25	0	0	0	0	0	F	P	P	P	P	N
N710-02-02	0	none	25	30	15	0	0	0	0	F	P	P	P	P	N
N710-02-03	0	none	20	25	20	0	0	0	0	F	P	P	P	P	N
N710-02-04	0.31	none	20	20	10	0	0	0	0	F	P	P	P	P	N
N710-02-05	0.31	none	25	20	0	0	0	0	0	P	P	P	P	P	N
N710-02-06	0.31	none	25	25	25	0	0	0	0	F	P	P	P	P	N
N710-02-07	0.062	none	25	25	20	0	0	0	0	F	P	P	P	P	N
N710-02-08	0.062	none	26	25	0	0	0	0	0	P	P	P	P	P	N
N710-02-09	0.062	none	15	20	15	0	0	0	0	F	P	P	P	P	N
N710-02-10	0.093	none	20	20	0	0	0	0	0	P	P	P	P	P	N
N710-02-11	0.093	none	15	20	0	0	0	0	0	P	P	P	P	P	N
N710-02-12	0.093	none	20	20	10	0	7	0	0	F	P	F	P	P	N
N710-02-13	0.124	none	25	20	0	0	0	0	0	P	P	P	P	P	N
N710-02-14	0.124	none	25	30	0	0	0	0	0	P	P	P	P	P	N
N710-02-15	0.124	none	20	11	0	0	0	0	0	P	P	P	P	P	N

The grouped test results are shown in Table 6.

Table 6: Summary of wet arc track resistance post-test DVW results.

Wire Type	# of Wires Passed (DWV)	# of Wire Failed (DVW)	% of Failing Wires (DVW)	Pass/Fail
N710-S01 (961-004-T-T-2)	74	1	1%	Pass
N710-S02 (961-004-T-C-0)	66	9	12%	Pass

3 Wet Short Circuit (EN3475-605)

3.1 Test Information

Testing was performed to the following specifications and parameters (if special parameters were identified).

Test Specification:	EN3475
Method:	605
Additional Notes/Special Conditions:	None
Pass/Fail Criteria:	Maximum burn back length less than 75mm (using AS22759/82 as a maximum burn back length).

3.2 Equipment and Description

The wet short circuit resistance test assesses the ability of insulation to prevent damage during an electrical arcing event. Arc-propagation resistance is defined as the length of arc propagation damage along the wires and the extent of damage to the wire insulation of wires that were not pre-damaged.

The testing follows the procedures outlined in EN3475 Method 605. In this test, a 0.5 meters seven wire harness is prepared. One end of the harness is connected to incoming power and the other end is cut so that all wires are exposed on the same place. The harness is then attached to the test stand with a 10° incline under a saline drip. The test is designed such that the saline is dropped 1cm from the end such that saline promotes arcing at the end of the wire harness. The test objective is to determine the damage length caused by the electrical arcing.

The control system used is Lectromec's LEC1001 test unit. Photos of the equipment are shown in Figure 2. The control cabinet provides automatic handling of the test circuit. A 20kVA power supply operating at 400Hz was used for the tests.

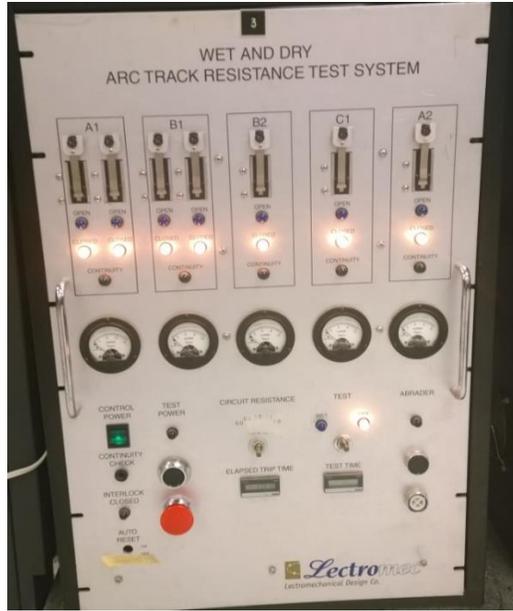


Figure 1: Lectromec wet short circuit test equipment control cabinet. Circuit C2 runs in a circuit in parallel with the control cabinet.

3.3 Test Results

Table 7 shows the results for the eighteen (18) tests performed at six (6) resistance levels for sample S01.

Table 8 shows the results for S02.

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Table 7: Sample S01 (961-004-T-T-2) wet short circuit test results.

Trial Number	Current (Ampere)	Circuit breakers tripped?							Time to Trip/Completion (hr:min)	Length of Damage (mm)						
		A1 Trip (Y/N)	B1 Trip (Y/N)	B2 Trip (Y/N)	C1 Trip (Y/N)	A2 Trip (Y/N)	C2 Trip (Y/N)	A1		B1	C1	A2	B2	C2	N	
1	40	N	N	N	N	N	N	2:00	0	0	0	0	0	0	0	
2	40	N	N	N	N	N	N	2:00	0	0	0	0	1	1	1	
3	40	N	N	Y	N	N	N	0:22	0	0	0	0	0	0	0	
4	60	N	N	Y	N	N	N	0:50	0	0	0	0	0	0	0	
5	60	N	N	N	N	N	N	2:00	0	0	0	0	0	0	0	
6	60	N	N	N	N	N	N	2:00	0	0	0	0	0	0	0	
7	80	N	N	N	N	N	N	2:00	3	2	1	0	0	0	0	
8	80	N	N	N	N	N	N	2:00	1	0	0	2	1	2	0	
9	80	N	N	N	N	N	N	2:00	0	3	3	0	0	0	1	
10	100	N	N	N	N	N	N	2:00	2	2	0	2	2	0	0	
11	100	N	N	N	N	N	N	2:00	0	0	0	1	0	0	0	
12	100	N	N	N	N	N	N	2:00	0	0	0	0	0	1	0	
13	125	N	N	N	N	N	N	2:00	0	0	0	3	5	5	0	
14	125	N	N	N	N	N	N	2:00	1	0	2	2	0	1	0	
15	125	N	N	N	N	N	N	2:00	0	0	0	3	5	3	0	
16	250	N	N	N	N	N	N	2:00	1	2	2	2	1	2	0	
17	250	N	N	N	N	N	N	2:00	1	1	1	1	0	0	0	
18	250	N	N	N	N	N	N	2:00	1	1	1	1	1	1	0	

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Table 8: Sample S02 (961-004-T-C-0) wet short circuit test results.

Trial Number	Current (Ampere)	Circuit breakers tripped?							Time to Trip/Completion (hr:min)	Length of Damage (mm)						
		A1 Trip (Y/N)	B1 Trip (Y/N)	B2 Trip (Y/N)	C1 Trip (Y/N)	A2 Trip (Y/N)	C2 Trip (Y/N)	A1		B1	C1	A2	B2	C2	N	
1	40	N	N	N	N	N	N	2:00	0	0	0	0	0	0	0	
2	40	N	N	N	N	N	N	2:00	2	1	0	0	0	0	0	
3	40	N	N	Y	N	N	N	0:22	2	1	1	0	0	0	0	
4	60	N	N	Y	N	N	N	0:50	3	3	0	0	0	0	0	
5	60	N	N	N	N	N	N	2:00	5	5	0	0	0	0	0	
6	60	N	N	N	N	N	N	2:00	5	4	0	0	0	0	0	
7	80	N	N	N	N	N	N	2:00	2	1	0	0	0	0	0	
8	80	N	N	N	N	N	N	2:00	1	0	0	0	3	3	0	
9	80	N	N	N	N	N	N	2:00	5	0	0	0	0	5	0	
10	100	N	N	N	N	N	N	2:00	5	5	0	0	0	0	0	
11	100	N	N	N	N	N	N	2:00	3	3	0	0	0	3	0	
12	100	N	N	N	N	N	N	2:00	2	1	0	0	0	0	0	
13	125	N	N	N	N	N	N	2:00	0	0	0	0	0	0	1	
14	125	N	N	N	N	N	N	2:00	2	1	3	0	0	0	0	
15	125	N	N	N	N	N	N	2:00	2	0	0	0	0	2	0	
16	250	N	N	N	N	N	N	2:00	3	5	5	0	0	0	0	
17	250	N	N	N	N	N	N	2:00	3	3	0	0	0	0	0	
18	250	N	N	N	N	N	N	2:00	3	3	0	0	0	0	0	