

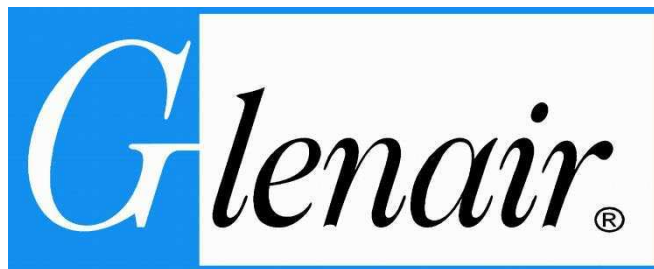
Glenair Test Report

Lightning, Indirect Effects;
ArmorLite Braid (103-051)

GT-11-28 (ARM-110)

Revision 1

2/17/22



Glenair, Inc.

1211 Air Way · Glendale, California 91201-2497
Telephone: 818-247-6000 · Facsimile: 818-500-9912
E-mail: sales@glenair.com

United States · United Kingdom · Germany · France · Nordic · Italy
www.glenair.com



TEST REPORT

Cage Code: 06324	Lightning, Indirect Effects; ArmorLite Braid (103-051)	Document #: GT-11-28 (ARM-110) Revision: 1 Page 2 of 29
---------------------	---	---

Revision Status	Description of Change	Date	Approval
1	Reformatting; cover page	02/17/22	JNN

ARM-110

REVISIONS		
LTR	DESCRIPTION	DATE
-	INITIAL RELEASE	12-02-2011






PREPARED BY: S. COOK 	DATE 12-2-11	DNB ENGINEERING, INC. FULLERTON, CA 92833 U.S.A. LIGHTNING DIRECT EFFECTS TEST REPORT FOR THE MICROFILAMENT NICKEL CLAD STAINLESS STEEL SHIELDING PREPARED FOR: GLENAIR, INC. PURCHASE ORDER NUMBER: H111064	
TEST ENGINEER: S. COOK 	12-2-11		
TEST DEPT. MGR: T. VU. 	12/02/11		
QUAL. ASSURANCE: M. NEIS  	12/2/11		
	SIZE A	CAGE CODE 63242	DRAWING NO. TR056785/20069
SCALE: NONE		REV LTR -	SHEET 1

TABLE OF CONTENTS

Paragraph		Page
	Test Completion Record	4
1.0	Introduction	5
2.0	Test Requirements	5
3.0	Test Equipment	5
4.0	Summary of Test Results	5
4.1	Lightning Indirect Effects, Glenair Test Plan	5
5.0	Test Description	7
6.0	Conclusions	8

SIZE A	CAGE CODE 63242	DRAWING NO. TR056785
SCALE: NONE	REV LTR -	SHEET 2

APPENDICES

Appendix	Title	Page
A	Test Log	A1 – A2
B	Test Equipment Log	B1 – B2
C	Test Program Listings and Transducer Factors	C1
D	Test Data	D1 – D137
E	Photographs	E1 – E14

SIZE A	CAGE CODE 63242	DRAWING NO. TR056785
SCALE: NONE	REV LTR -	SHEET 3

LIGHTNING INDIRECT EFFECTS TEST COMPLETION RECORD

For

MICROFILAMENT NICKEL CLAD STAINLESS STEEL SHIELDING

Part Numbers:

103-051-008 (0.250" Dia.)

103-051-024 (0.750" Dia.)




103-051-032 (1.0" Dia.)

Test Start Date: 11-15-11

Test Completion Date: 11-19-11

Test Completion Record: The following tests were performed in accordance with the requirements of Glenair Test Plan.

Lightning Indirect Effects: The Customer will determine the Pass/Fail status of each of the Test Samples for this test.

DNB TEST ENGINEER  DATE 12-2-11
DNB QUALITY ASSURANCE   DATE 12/2/11
CUSTOMER TEST ENGINEER _____ DATE _____

SIZE A	CAGE CODE 63242	DRAWING NO. TR056785
SCALE: NONE	REV LTR -	SHEET 4

1.0 INTRODUCTION

Lightning Indirect Effect tests were performed on three different sizes of the Microfilament Nickel Clad Stainless Steel Shielding, manufactured by Glenair. Two samples of each size were used for testing, one for the Transfer Impedance test and one for the Current Handling Capability test. Testing began on 11-15-11 and was completed on 11-19-11. The purpose of this test was to demonstrate compliance with the applicable sections of Glenair Test Plan. All test results have been summarized herein, and all data sheets have been incorporated in Appendix D.

2.0 TEST REQUIREMENTS

The test requirements for the tests performed as outlined in this document are defined by the applicable sections of Glenair Test Plan.

3.0 TEST EQUIPMENT

The test equipment log in Appendix B lists information on test equipment used, along with current calibration status. DNB's calibration service providers use procedures provided by the manufacturers and by other widely recognized bodies (for example, GIDEP). Standards used during calibration are traceable to NIST.

4.0 SUMMARY OF TEST RESULTS

4.1 Lightning Indirect Effects, MIL-DTL 38999L & EIA-364(E)-75

Introduction

Indirect Effect Lightning tests were performed on six samples of MNCSS Shielding in accordance with Glenair Test Plan. Each test sample was one meter in length.

Current Injection Tests

Direct current injection tests were performed on three different sizes of the MNCSS Shielding. Testing began with a 3000 amp waveform 5B applied ten times to the 0.250" diameter sample. If the test sample remained intact after the completion of the ten current pulses, then the current amplitude was increased by 2000 amps to 5000 amps and ten more pulses were applied. This process was repeated in 2000 amp increments until the 0.250" diameter test sample failed. The 0.750" diameter test sample was then setup and the current amplitude was set to one 2000 amp increment below the failure amplitude of the 0.250" diameter test sample.

SIZE A	CAGE CODE 63242	DRAWING NO. TR056785
SCALE: NONE		REV LTR -
		SHEET 5

4.1 **Lightning Indirect Effects** (Continued)

Current Injection Test (Continued)

Ten current pulses were applied at each 2000 amp increment until the 0.750" diameter test sample failed. The 1.0" diameter test sample was inserted into the setup and the current amplitude was set to 2000 amps below the failure amplitude of the 0.750" test sample. Ten current pulses were applied at this level and then at each 2000 amp increment until the 1.0" diameter test sample failed or the maximum output of the Waveform 5B generator is reached. Bond resistance measurements were performed per the Glenair Test Plan to verify that it was less than 5 milliohms.

Transfer Impedance Test

The Transfer Impedance test was performed on one sample of each size of the MNCSS Shielding. Four current waveforms were used for this test. Waveform 1 at 1500 amps, Waveform 5A at 2000 amps, Waveform 3 – 1 MHz at 300 amps, and Waveform 3 – 10 MHz at 55 amps. The current pulses were applied twice in each polarity for the open circuit voltage measurements, and again for the short circuit current measurements.

Pre and Post Functional Test Data

If applicable, The MNCSS Shielding test samples were tested for proper functionality prior to the indirect effects lightning tests. The MNCSS Shielding test samples were again tested for proper functionality after the indirect effects lightning tests.

Test Results

The MNCSS Shielding 0.250" diameter test sample failed on the third pulse at 7 KA. The 0.750" diameter test sample failed on the fifth pulse at 17 KA. The 1.0" diameter test sample was tested up to 26 KA and remained intact.

Test Log

Test Log is provided in Appendix A.

SIZE A	CAGE CODE 63242	DRAWING NO. TR056785	
SCALE: NONE		REV LTR -	SHEET 6

4.1 **Lightning Indirect Effects** *(Continued)*

Test Equipment

A list of the test equipment used to perform all testing complete with calibration dates is provided in Appendix B.

Test Data

Test Data are provided in Appendix D. All data plots have channel 3 measuring current. All current plots have a direct one to one correction from voltage to current so that 5000 volts per division equals 5000 amps per division.

Test Photographs

Test photographs are provided in Appendix E.

Disposition of Test Samples

Following testing, the MNCSS Shielding test samples were returned to Glenair, Inc. for further evaluation.

5.0 **TEST DESCRIPTION**

The test method and description, including details of the test set-up and test figures are described in Glenair Test Plan for the lightning tests. A list of the test equipment used in the performance of each of these tests, along with current calibration information is included in Appendix B. Photographs of each test set-up were taken and are included in Appendix E.

SIZE A	CAGE CODE 63242	DRAWING NO. TR056785
SCALE: NONE	REV LTR -	SHEET 7

6.0**CONCLUSIONS**

The MNCSS Shielding concluded the Lightning Indirect Effect testing in accordance with the requirements of Glenair Test Plan. Upon the completion of testing, the test samples and all applicable Glenair, In. support equipment were returned to representatives of Glenair, Inc.

The results listed in this report relate only to the items tested as listed on the Test Completion Record on sheet 4 herein.

SIZE A	CAGE CODE 63242	DRAWING NO. TR056785
SCALE: NONE	REV LTR -	SHEET 8

APPENDIX A

Test Log

SIZE A	CAGE CODE 63242	DRAWING NO. TR056785
SCALE: NONE	REV LTR -	SHEET A1

LIGHTNING TEST LOG

CUSTOMER: GLENAIR	TEST SAMPLE: SHIELDED CABLE ASSEMBLIES
TEST ENGINEER: STEVE COOK	CUSTOMER REPRESENTATIVE::

DATE	TIME	TEST DESCRIPTION	
11-15-11	8:00	Setting up for transfer impedance measurements.	
		W.F. 1 at 1500 Amps; W.F. 5A at 2000 Amps	
			Bonding measurement – All setups less than 5 milliohms
	10:00	Begin transfer impedance test.	
		W.F. 1 – Open circuit voltage measurement	
		W.F. 5A – Open Circuit voltage measurement	
		Changed over to large injection core for small braid.	
		W.F. 5A – Short circuit current measurement	
		W.F. 1 – Short circuit current measurement	
	5:00	End testing for 11-15-11	
11-16-11	8:00	Setting up for Waveform 5B current handling test.	
		Sample 0.25" – Starting at 3 KA	
		Sample 0.25" failed at 7 KA	
		Sample 0.75" – Starting at 5 KA	
		Sample 0.75" failed at 17 KA.	
	Sample 1.0" – Starting at 15 KA		
	7:30	Completed 19 KA test level. End testing for 11-16-11	
11-17-11	8:00	Continue current handling test – 19 KA test level.	
	4:30	Sample 1.0" is still intact after reaching maximum level	
		Of generator – 26 KA.	
	5:00	Running second 0.25" sample. Setup was not correct for first sample.	
	6:30	Sample 0.25" failed at 7 KA. End testing for 11-17-11	
11-18-11	8:00	Continue transfer impedance test – Waveform 3.	
	2:00	Testing completed.	

APPENDIX B

Test Equipment Log

SIZE A	CAGE CODE 63242	DRAWING NO. TR056785
SCALE: NONE	REV LTR -	SHEET B1

TEST EQUIPMENT LOG

LIGHTNING

MANUFACTURER	DESCRIPTION	MODEL NO.	SERIAL NO.	CAL DUE
DNB	WAVEFORM 5B GENERATOR	WF5B-25KA	001	NCR
PEARSON	CURRENT PROBE	5664	80500	4-27-12
YOKOGAWA	OSCILLOSCOPE	DL7100	12W131589	10-6-12
HIPOTRONICS	H.V. POWER SUPPLY	850-20	11177-00	NCR
DNB	WAVEFORM 1 - 4- 5A GENERATOR	WF145A-6KV	001	NCR
DNB	WAVEFORM 3 - 1 MHz GENERATOR	WF3-1-L5	001	NCR
DNB	WAVEFORM 3 - 10 MHz GENERATOR	WF3-10-L5	001	NCR
SOLAR	CURRENT PROBE	6741-1	065742	5-13-12
SOLAR	CURRENT PROBE	6741-1	862003	8-19-12
PEARSON	CURRENT PROBE	3525	80338	8-17-12
BIRD	6 dB ATTENUATOR	150-SA-FFN-06	13079	4-31-12
BIRD	6 dB ATTENUATOR	150-SA-FFN-06	13080	8-31-12
BIRD	10 dB ATTENUATOR	150-SA-FFN-10	162455	8-31-12
BIRD	30 dB ATTENUATOR	150-SA-FFN-30	13086	8-31-12
DNB	INJECTION PROBE	10023	1022	NCR
DNB	INJECTION PROBE	IMAX2000	001	NCR

APPENDIX C

Test Program Listings and Transducer Factors

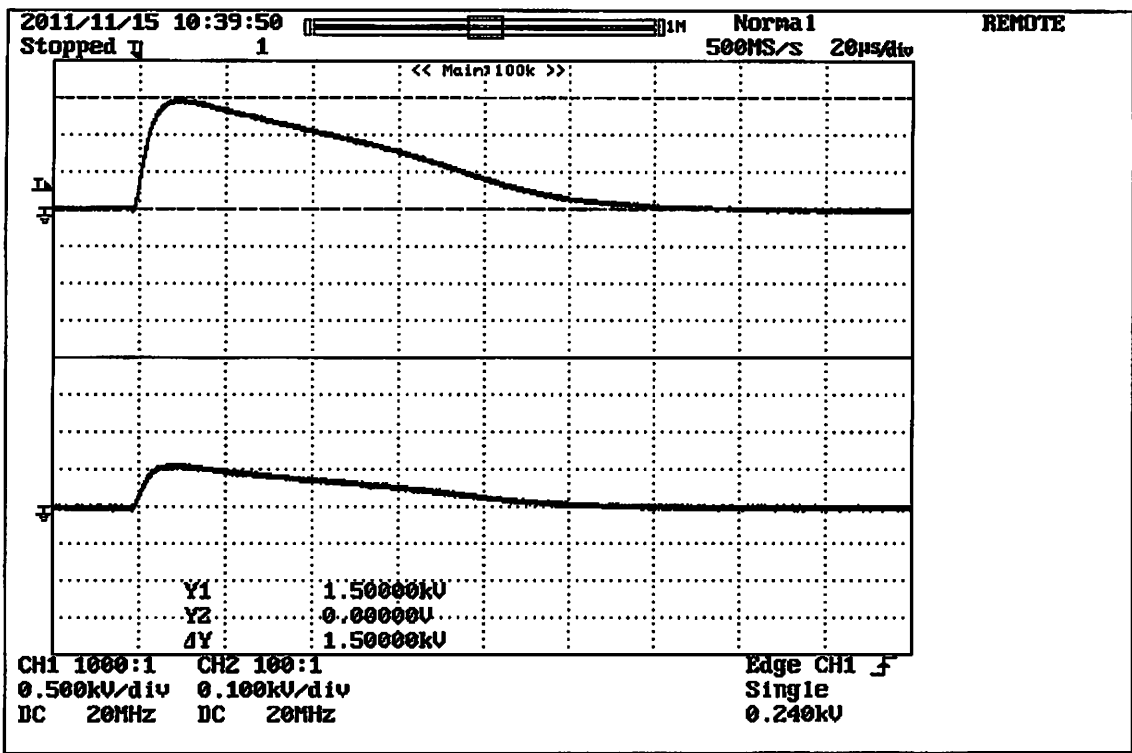
N/A

SIZE A	CAGE CODE 63242	DRAWING NO. TR056785
SCALE: NONE	REV LTR -	SHEET C1

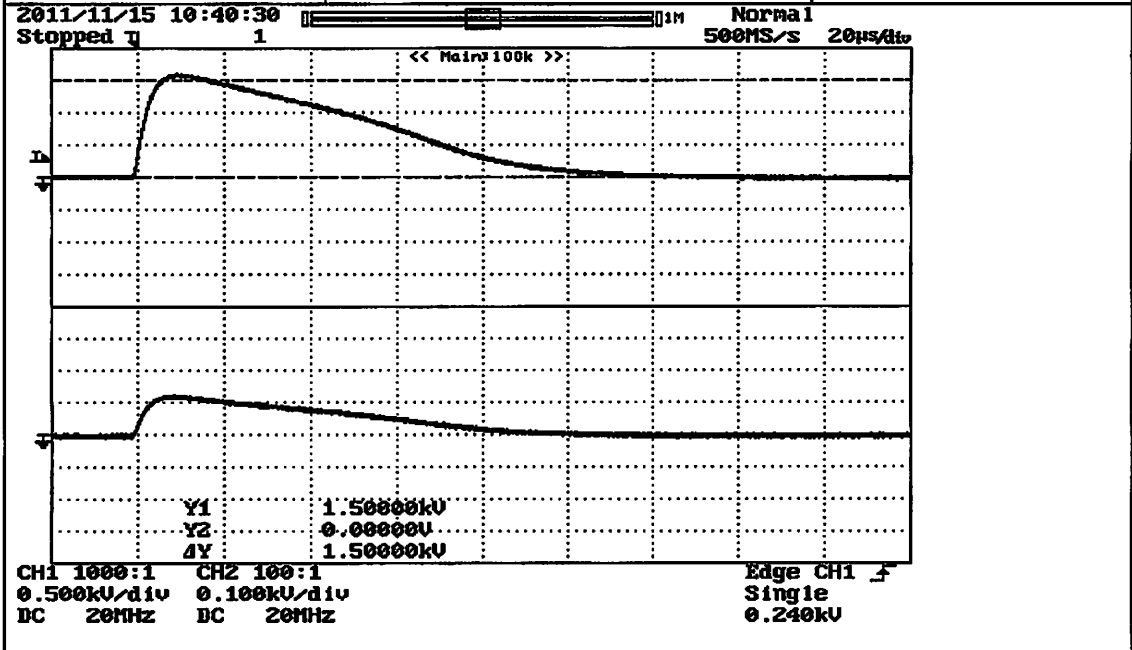
APPENDIX D

Test Data

SIZE A	CAGE CODE 63242	DRAWING NO. TR056785
SCALE: NONE	REV LTR -	SHEET D1

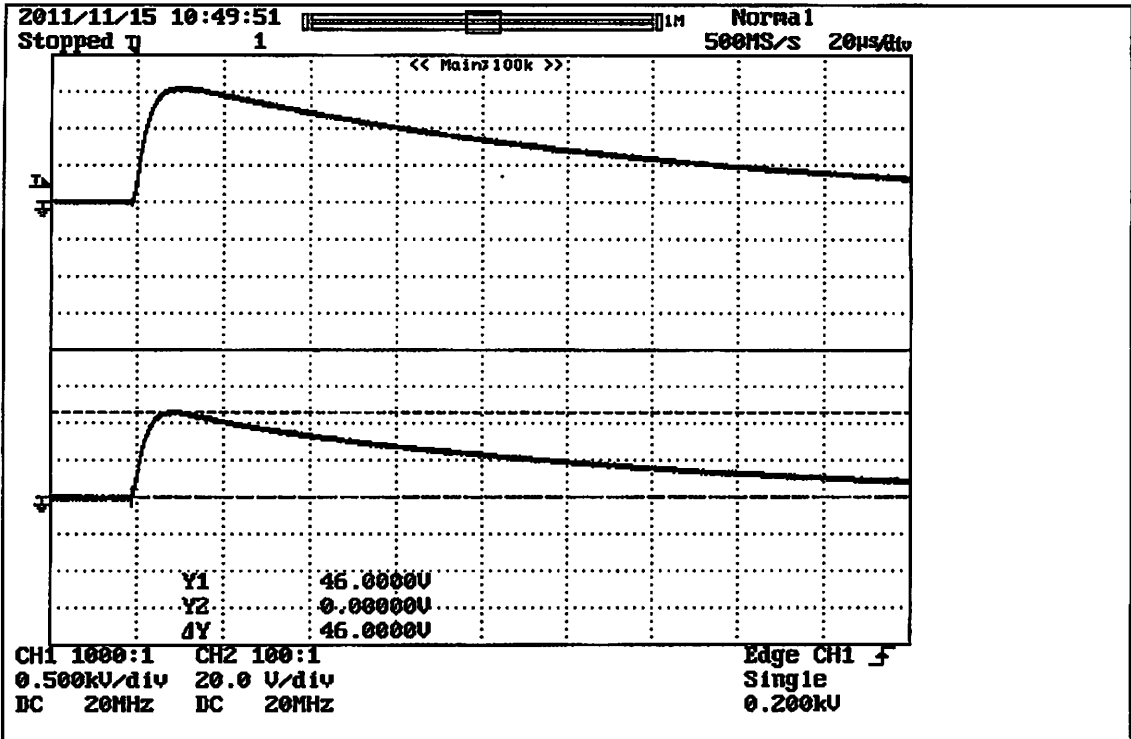


Pulse 1 – Size 0.250 **Open Circuit Voltage: 110 V** **CH1: 500 A/Div.**
CH2: 100 V/Div

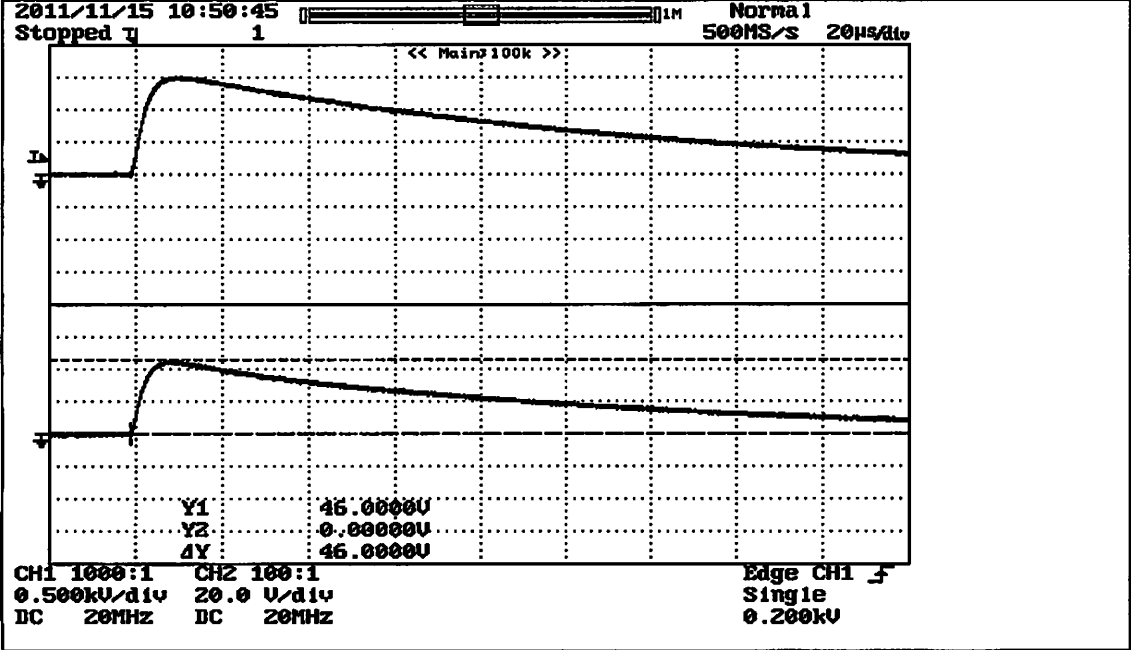


Pulse 2 – Size 0.250 **Open Circuit Voltage: 110 V** **CH1: 500 A/Div.**
CH2: 100 V/Div.

Waveform 1 – 1500 Amps

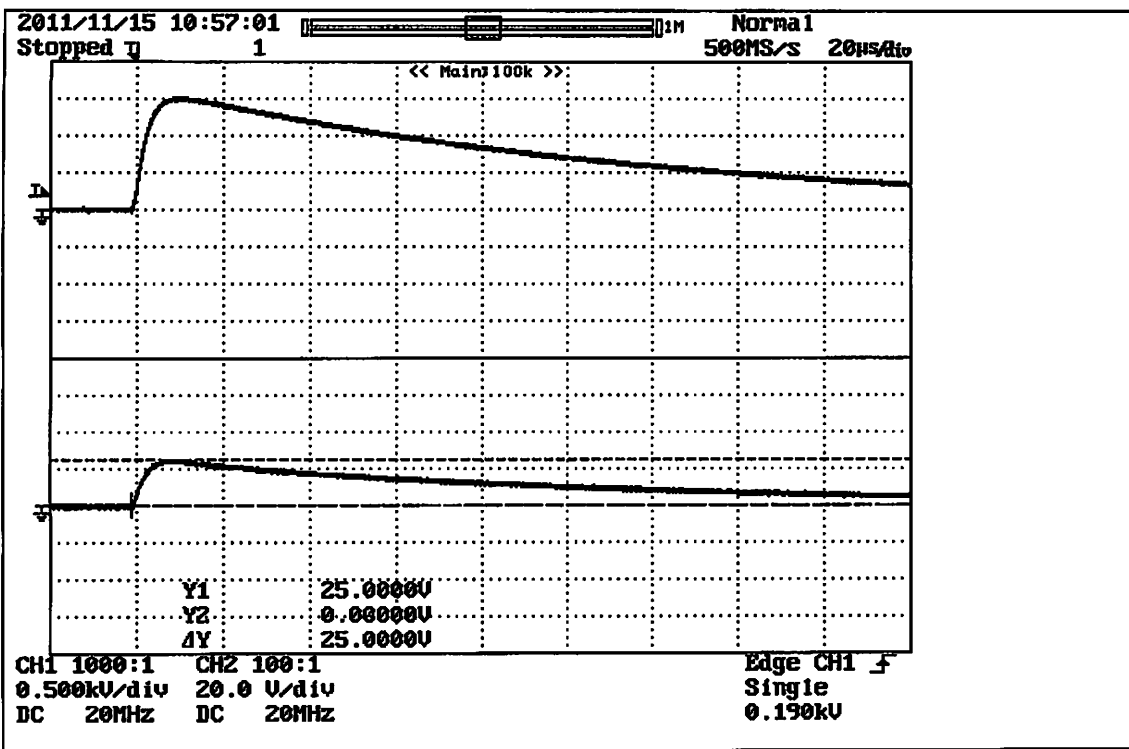


Pulse 1 – Size 0.750	Open Circuit Voltage: 46 V	CH1: 500 A/Div. CH2: 20 V/Div
-----------------------------	-----------------------------------	--

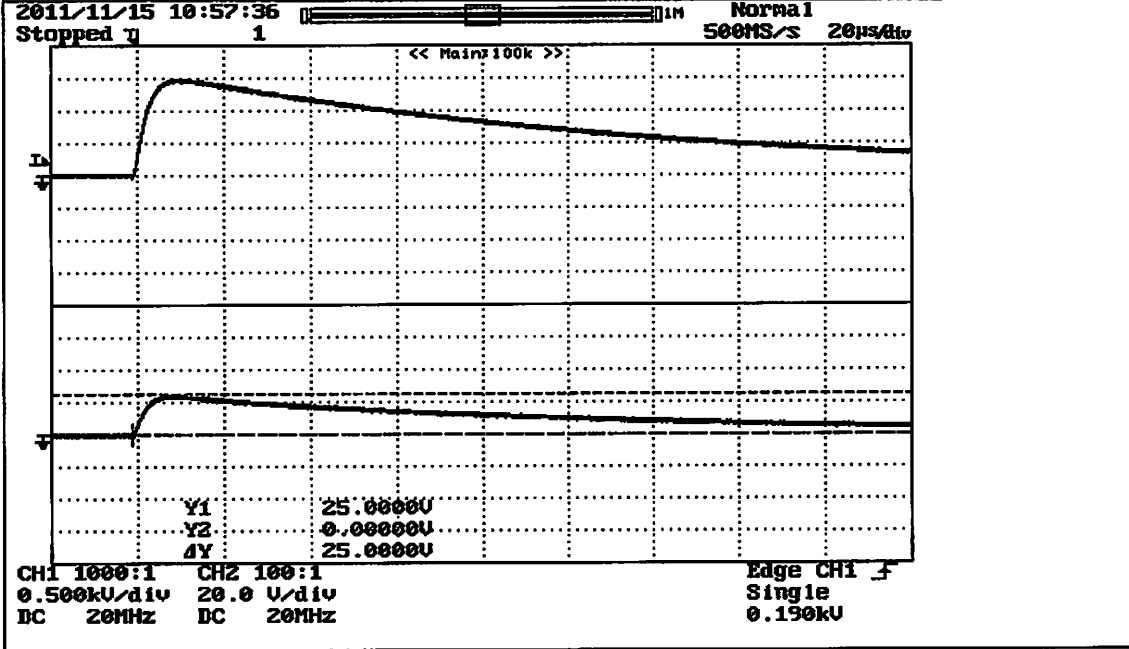


Pulse 2 – Size 0.750	Open Circuit Voltage: 46 V	CH1: 500 A/Div. CH2: 20 V/Div.
-----------------------------	-----------------------------------	---

Waveform 1 – 1500 Amps

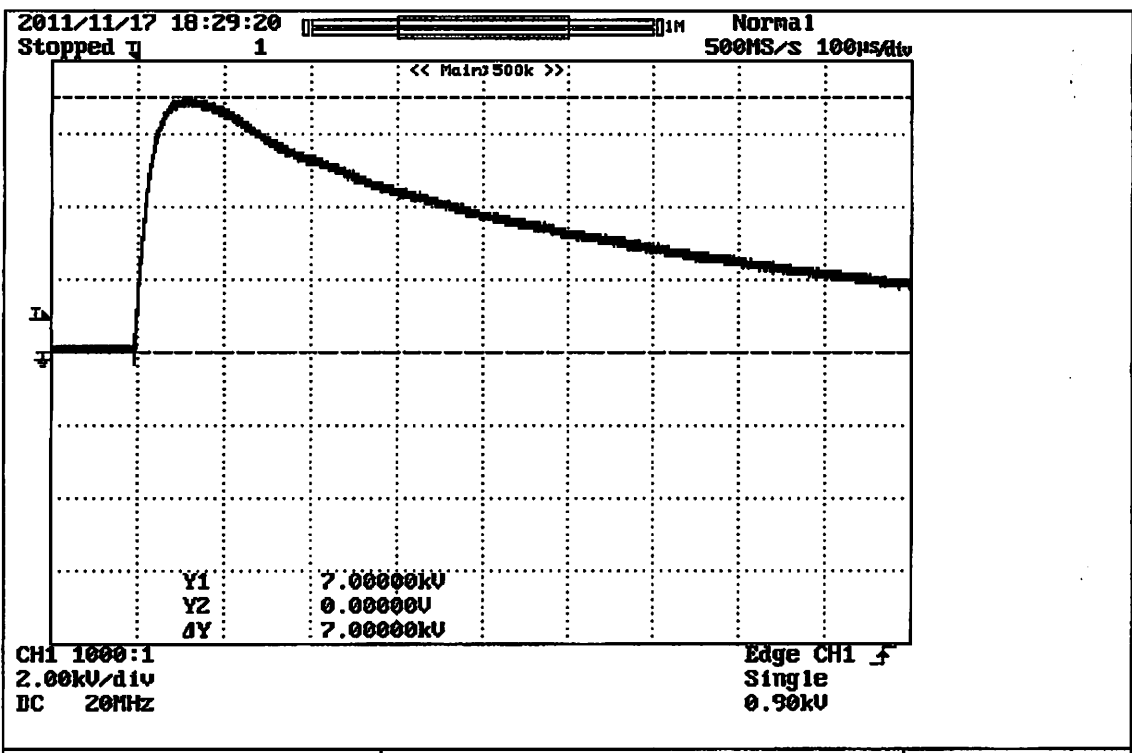


Pulse 1 – Size 1.0 **Open Circuit Voltage: 25 V** **CH1: 500 A/Div.**
CH2: 20 V/Div



Pulse 2 – Size 1.0 **Open Circuit Voltage: 25 V** **CH1: 500 A/Div.**
CH2: 20 V/Div.

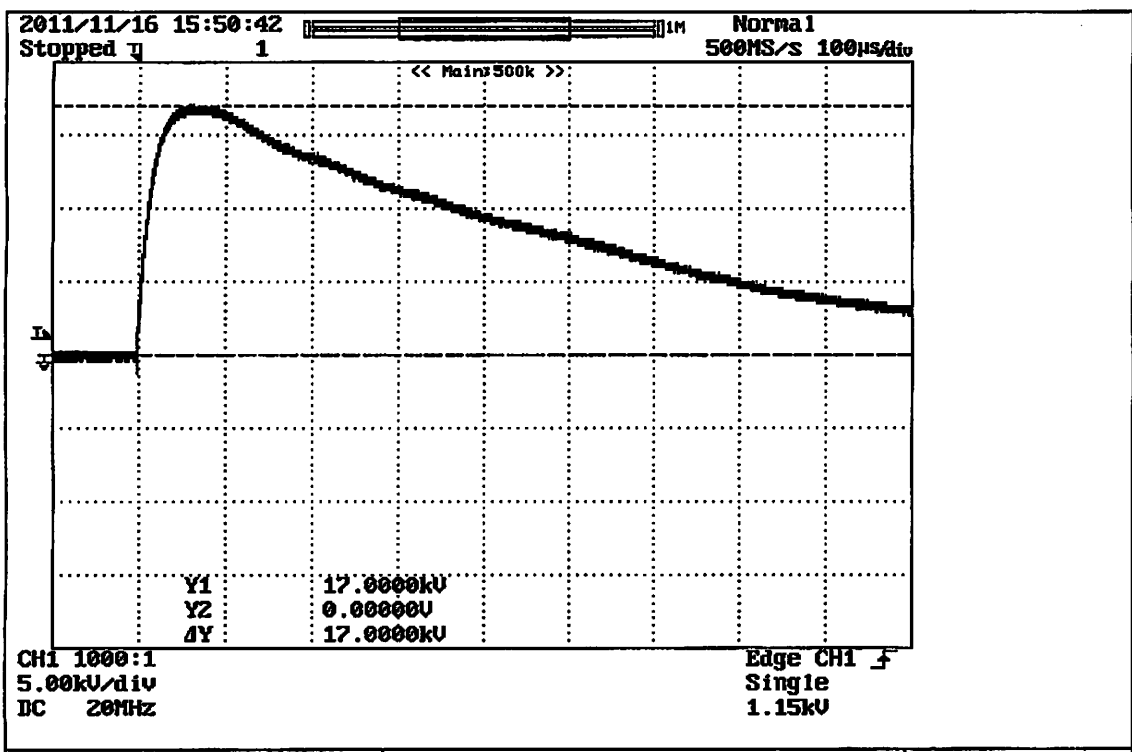
Waveform 1 – 1500 Amps



Pulse 3 – Size 0.025	Waveform 5B – 7 KA	2 KA/Div.
----------------------	--------------------	-----------

Braid Failed On Pulse 3

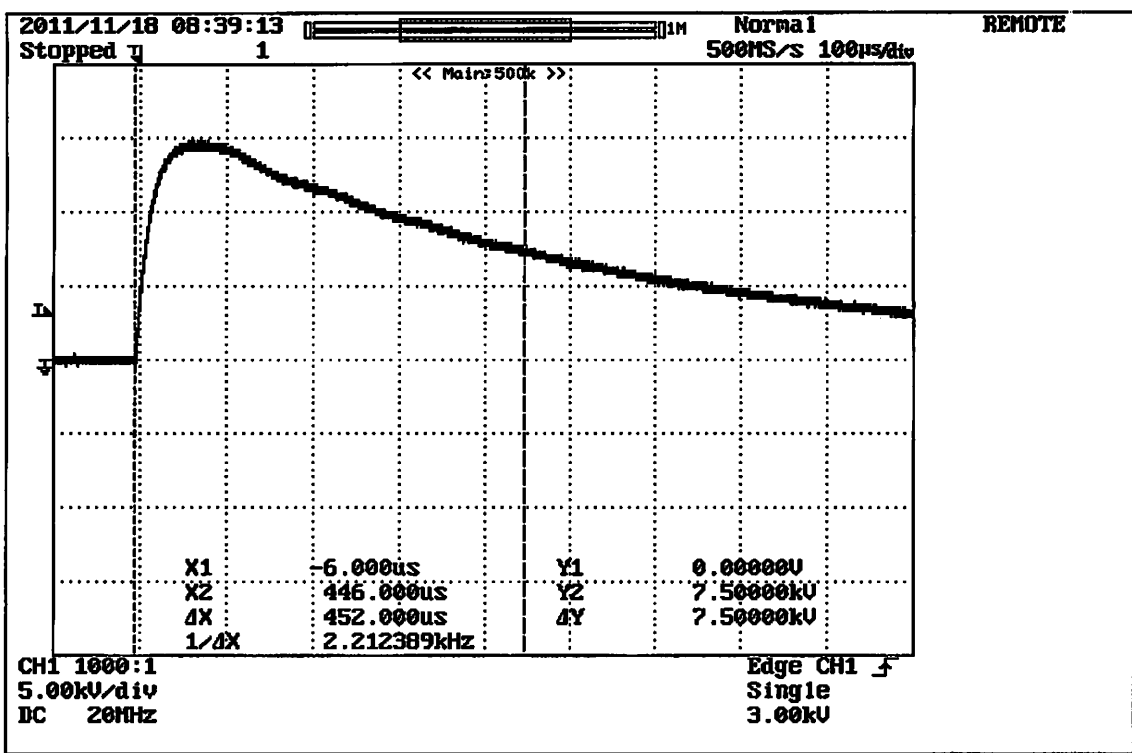
Pulse 4 – Size 0.025	Waveform 5B – 7 KA	2 KA/Div.
----------------------	--------------------	-----------



Pulse 5 - Size 0.075	Waveform 5B - 17 KA	5 KA/Div.
----------------------	---------------------	-----------

Braid Failed On Pulse 5

Pulse 6 - Size 0.075	Waveform 5B - 17 KA	5 KA/Div.
----------------------	---------------------	-----------



Calibration – Pulse Width	Waveform 5B	$T_w = 452 \mu s$
---------------------------	-------------	-------------------

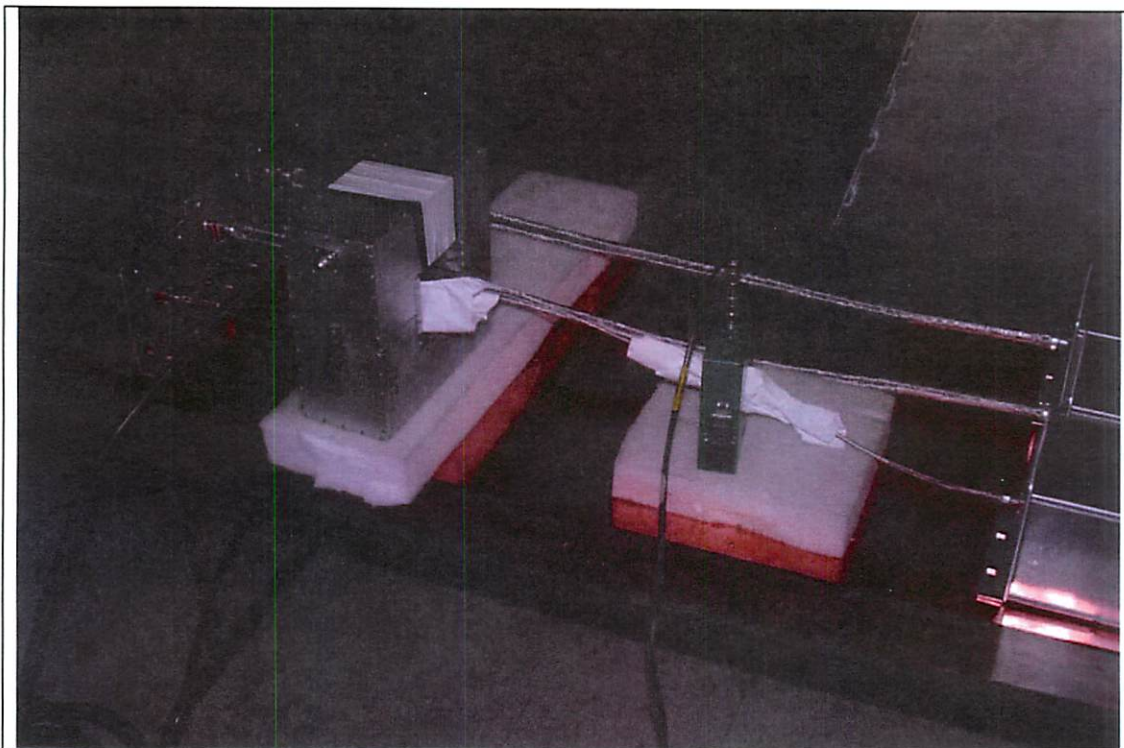


--	--	--

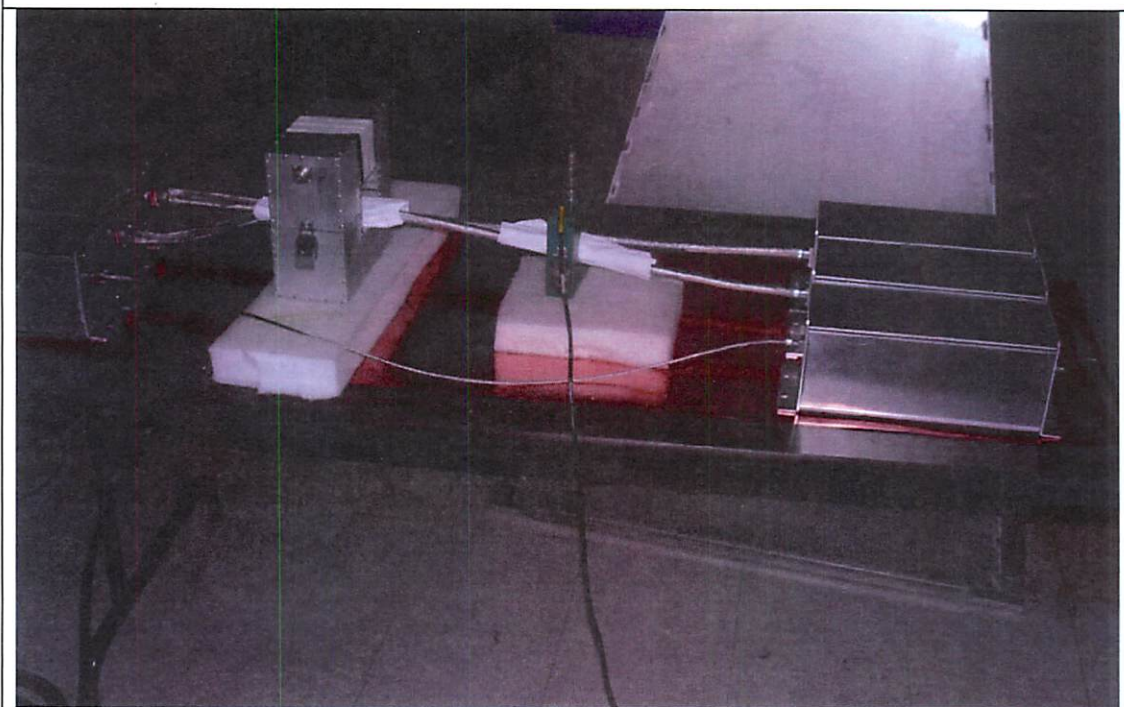
APPENDIX E

Photographs

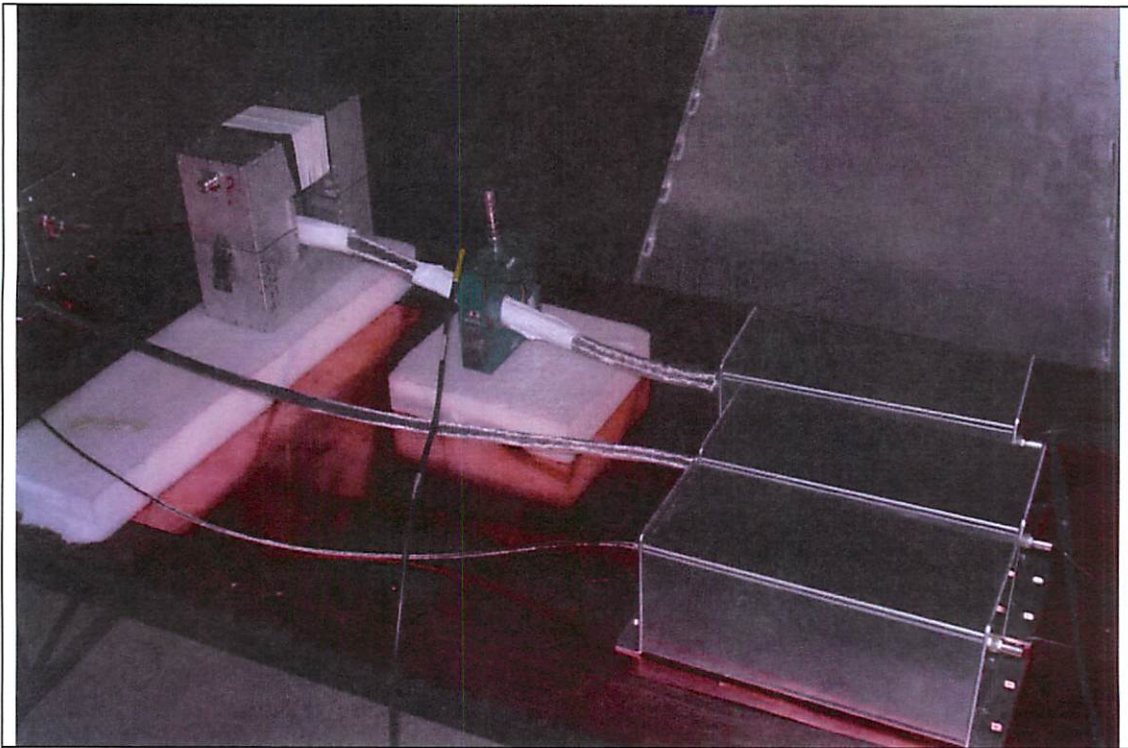
SIZE A	CAGE CODE 63242	DRAWING NO. TR056785
SCALE: NONE	REV LTR -	SHEET E1



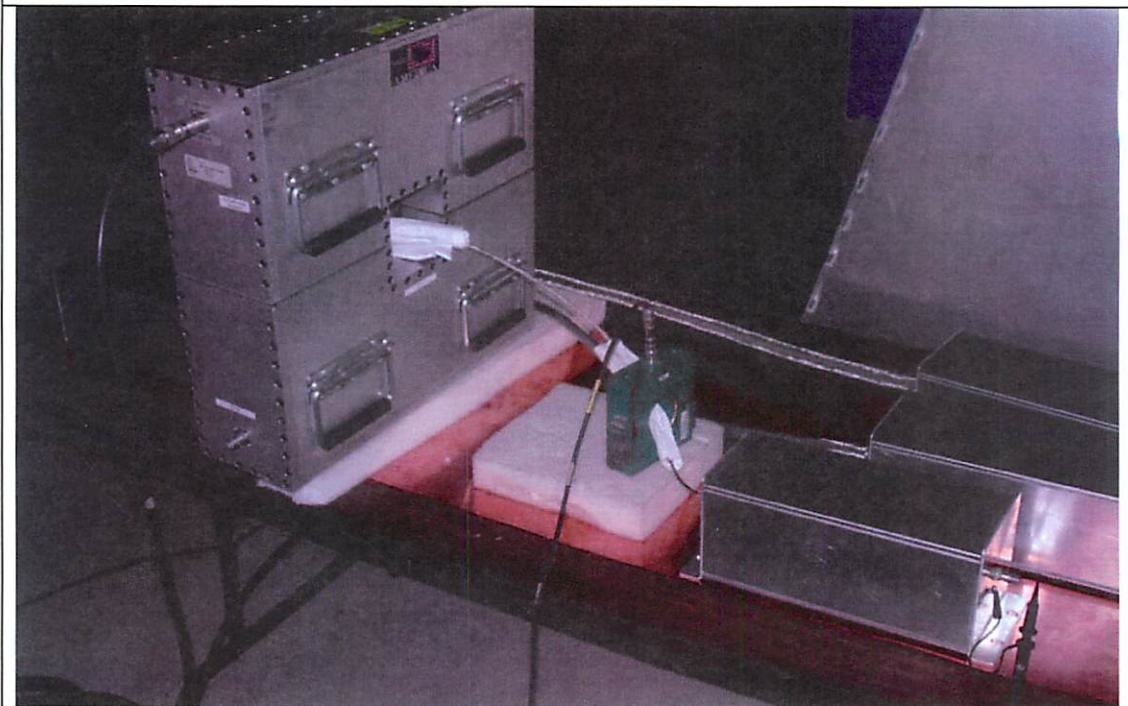
Transfer Impedance – Waveform 1 – Open Circuit Voltage – Size 0.250



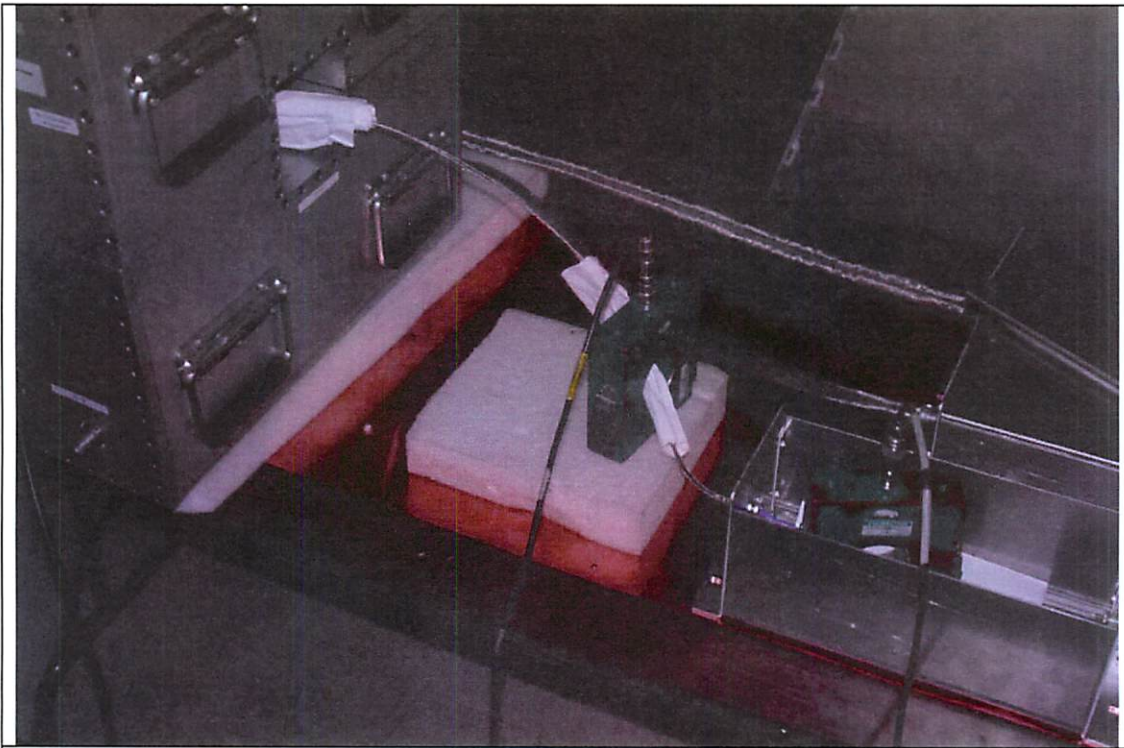
Transfer Impedance – Waveform 1 – Open Circuit Voltage – Size 0.750



Transfer Impedance – Waveform 1 – Open Circuit Voltage – Size 1.0



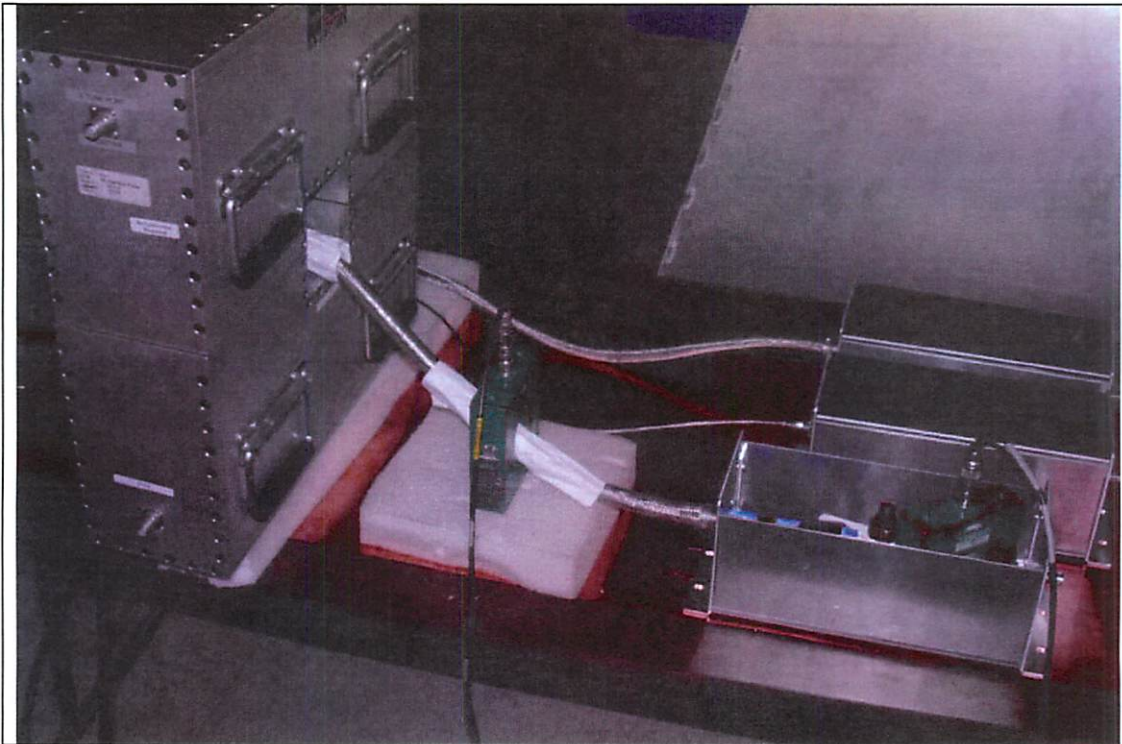
Transfer Impedance – Waveform 5A – Open Circuit Voltage – Size 0.250



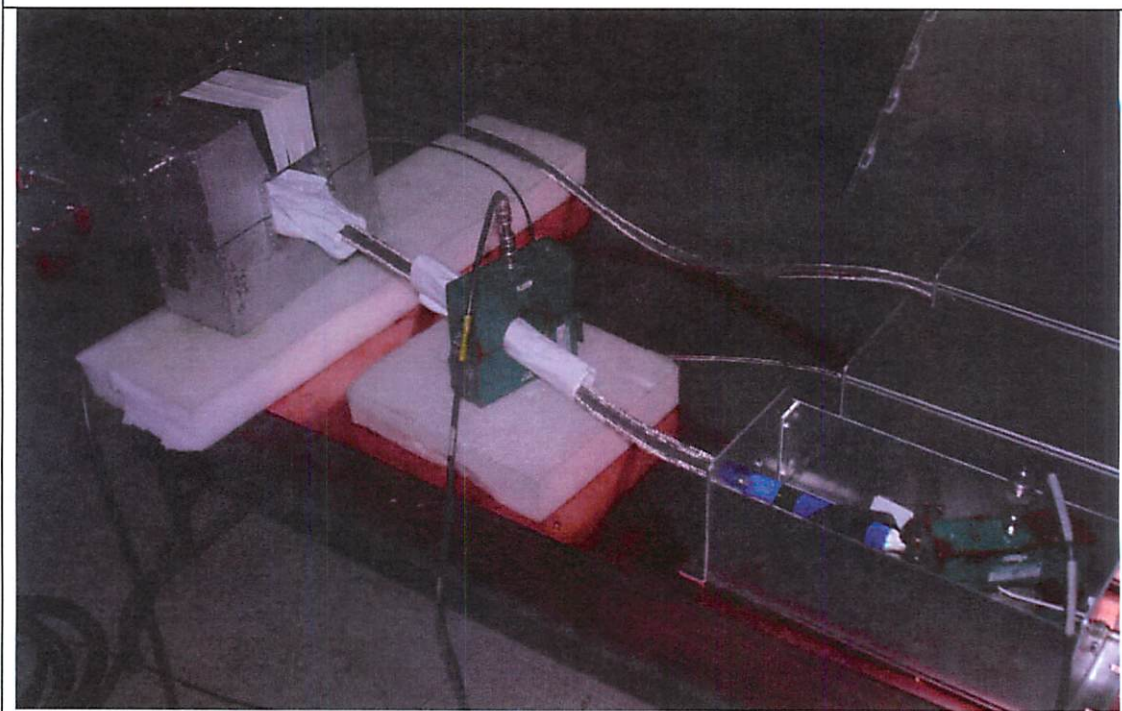
Transfer Impedance – Waveform 5A – Short Circuit Current – Size 0.250



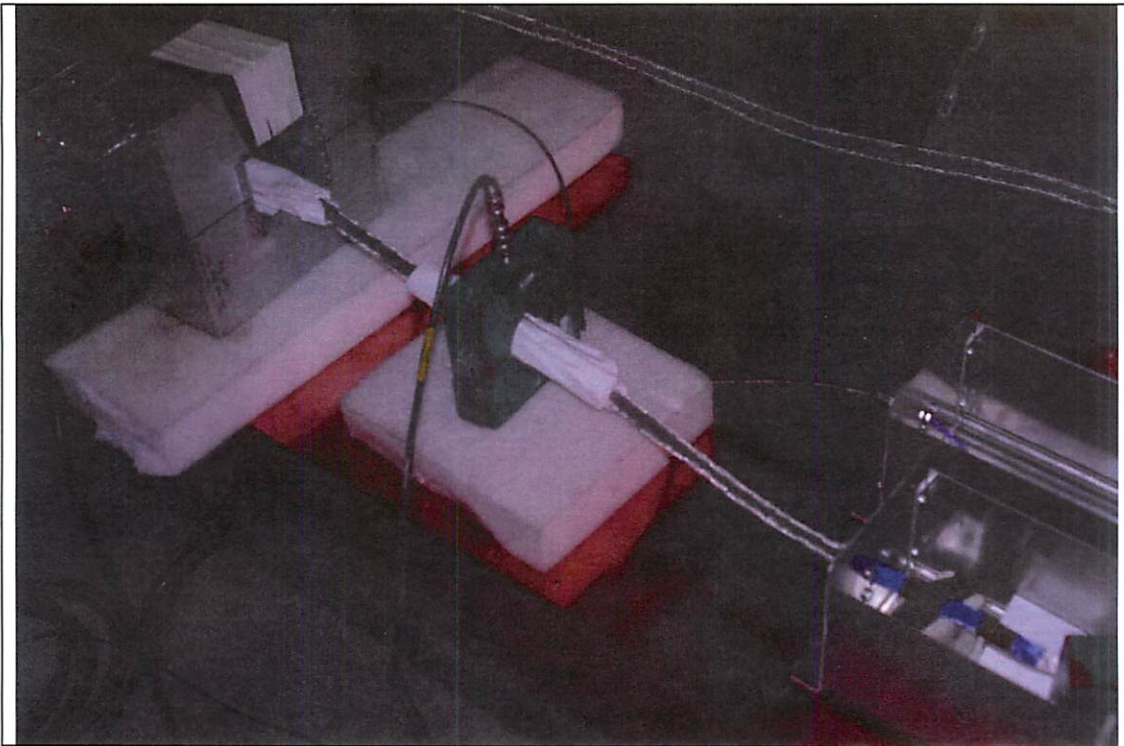
Transfer Impedance – Waveform 5A – Short Circuit Current – Size 0.750



Transfer Impedance – Waveform 5A – Short Circuit Current – Size 1.0



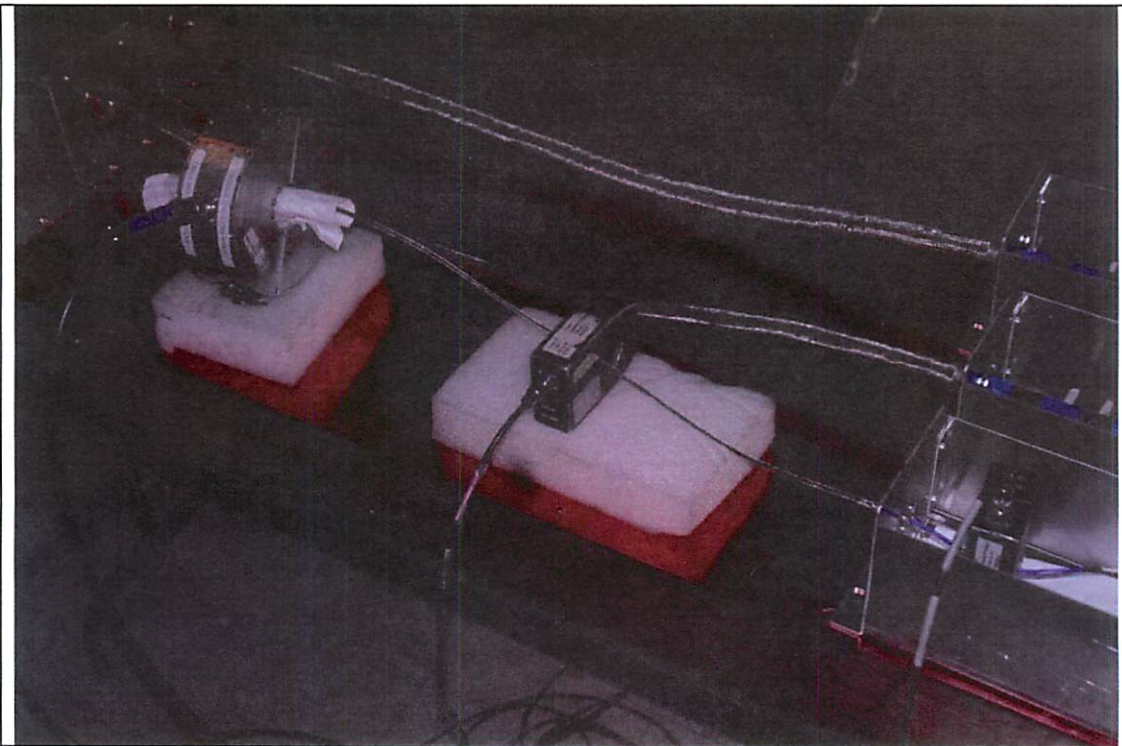
Transfer Impedance – Waveform 1 – Short Circuit Current – Size 1.0



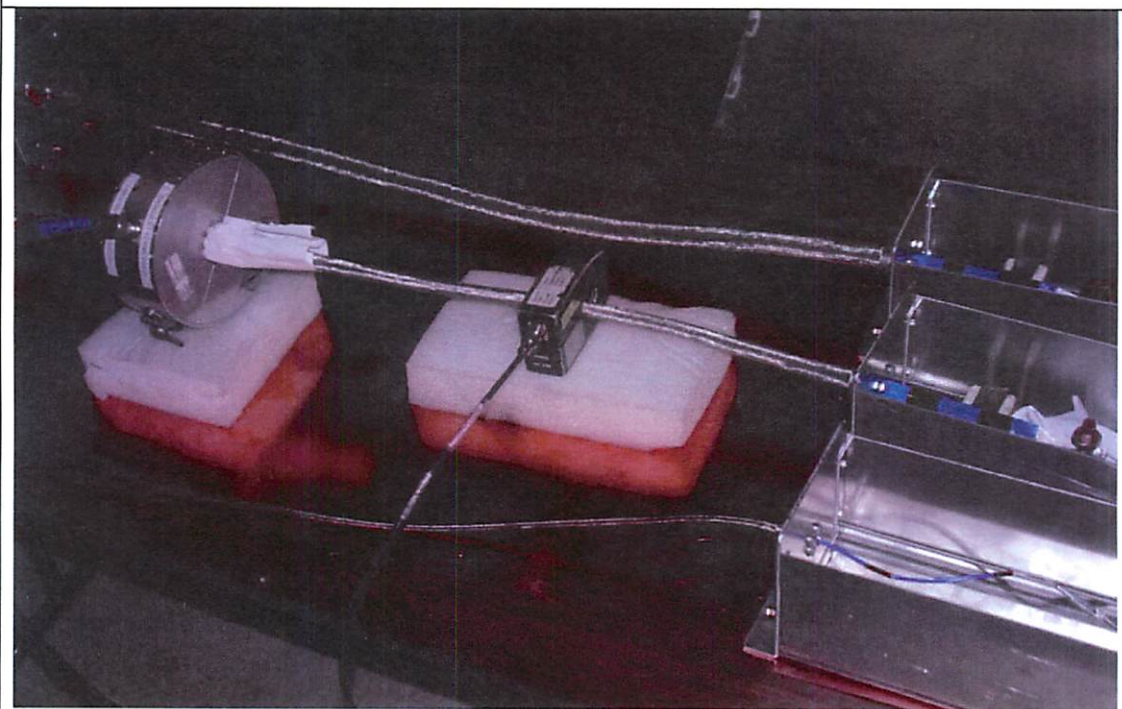
Transfer Impedance – Waveform 1 – Short Circuit Current – Size 0.0750



Transfer Impedance – Waveform 1 – Short Circuit Current – Size 0.0250



Transfer Impedance – Waveform 3 – Short Circuit Current – Size 0.250



Transfer Impedance – Waveform 3 – Short Circuit Current – Size 0.750