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ATOMICS INTERNATIONAL
A Division of North American Aviation, Inc.

MASTER

NAA-SR-MEMO -8824

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ATOMICS INTERNATIONAL A Division of North American Aviation, Inc.		SR- TDR NO 8824	APPROVALS <i>J. Johnson</i>
TECHNICAL DATA RECORD		PAGE 1 OF 29	
AUTHOR J.S. Holtwick, III/V.P. Nowell	DEPT. & GROUP NO. 722-25	DATE 7/31/63	
		GO NO. 7561	
TITLE Report of the Qualification Testing of SNAP 10A Fusistors		S/A NO 2560	TWR
		SECURITY CLASSIFICATION	
		(CHECK ONE BOX ONLY)	(CHECK ONE BOX ONLY)
		UNCL. <input checked="" type="checkbox"/> AEC <input type="checkbox"/> DOD CONF. <input type="checkbox"/> SECRET <input type="checkbox"/>	RESTRICTED DATA <input type="checkbox"/> DEFENSE INFO. <input type="checkbox"/>
PROGRAM DISTRIBUTION	SUBACCOUNT TITLE Instrumentation Qualification Testing	AUTHORIZED CLASSIFIER SIGNATURE <i>J. Johnson</i> DATE 9/4/63	
STATEMENT OF PROBLEM The qualification testing of Bradford Components, Inc. 4.7 ohm fusistors for use in SNAP 10A.			
ABSTRACT - Qualification testing of SNAP 10A fusistors was performed in accordance with A.I. control specification 10FS-24007. Test operations included: visual inspection, insulation resistance, dielectric strength and D.C. resistance testing prior to subjecting the fusistors to environmental testing; opening-time testing prior to, during, and following vacuum and temperature testing; and insulation resistance, dielectric strength and D.C. resistance testing following environmental applications of temperature, vacuum, and sinusoidal vibration.			
Testing prior to environmental applications disclosed that six of the initial 27 fusistors were outside the specified tolerance limits of 4.7 ohms \pm 5%.			
Opening-time testing, prior to environmental application, on three randomly selected fusistors resulted in failure of the fusistors to open within the specified time range, viz., 250 milliseconds minimum and one second maximum.			
Following temperature cycling from -30°F to +140°F ten times, two previously satisfactory fusistors tested were no longer within D.C. resistance tolerance limits. All ten fusistors showed an increase in D.C. resistance.			
During testing in an environment of 5×10^{-6} mm Hg and +140°F \pm 10°F, sustained for 22 hours, opening-time tests were conducted on two fusistors. In the case of each fusistor the opening time was in excess of the specified maximum. D.C. resistance tests conducted on the fusistors when they were removed from the above environment revealed that a fusistor (A-1217) that had gone out-of-tolerance following temperature cycling from -30°F to +140°F was once again in-tolerance and had a D.C. resistance even lower than when initially tested. Visual inspection of the fusistors following vacuum/temperature environmental testing showed that one fusistor's ceramic seal had cracked and fallen off. Seven fusistors were subjected to temperature environments of 0°F for			

ATOMICS INTERNATIONAL

A Division of North American Aviation, Inc.

NO. 8824
DATE 7/31/63
PAGE 1a OF 29

ABSTRACT (CONT'D)

30 minutes followed by 30 minutes at +140°F while carrying 1 amp D.C. At 0°F and again at +140°F one fusistor was tested for opening-time. Both fusistors opened at times within the specified tolerance range. The D.C. resistances of the remaining five fusistors, measured at room ambient temperature following the above environmental test, were out-of-tolerance. (Two fusistor's D.C. resistances had been out-of-tolerance before the above environmental test was started.)

Nine fusistors, not subjected to any of the above environmental tests, instead were subjected to qualification level sinusoidal vibration. In tests conducted after vibration, the D.C. resistance of one previously out-of-tolerance fusistor decreased to within the tolerance limits (A-1233) while another fusistor's D.C. resistance increased and went out-of-tolerance (A-1232).

All fusistors, at all times, satisfied the conditions of 10FS-24007 in terms of insulation resistance and dielectric strength.

Conclusions

D.C. resistance of fusistors apparently is affected easily by temperature environments. Many fusistors are delivered with, or can be altered to, D.C. resistances that are out-of-tolerance or are bordering on the upper tolerance limit.

Opening times of fusistors are variable not only in room ambient conditions, but also in temperature environments. For the most part the opening times are not within the specified time range.

ATOMICS INTERNATIONAL

A Division of North American Aviation, Inc.

NO. 8824
DATE 7/31/63
PAGE 2 OF 29

CONTENTS

	<u>Page</u>
Visual Inspection Test	<u>3</u>
Weight Tabulation	4
Insulation Resistance (Pre-Environment)	6
Dielectric Strength (Pre-Environment)	8
D.C. Resistance (Pre-Environment)	9
Opening-Time Test (Pre-Environment)	11
Atmospheric Test	14
Insulation Resistance Results	16
D.C. Resistance Results	17
Vacuum Chamber Test	18
Opening-Time Test Results	20
Insulation Resistance Results	20
D.C. Resistance Results	21
Opening-Time Test (Time vs. Current)	22
Temperature Test	23
Insulation Resistance Results	25
D.C. Resistance Results	26
Vibration Test	27
Insulation Resistance Results	28
D.C. Resistance Results	29

FIGURES

1. Dimensions of the Fusistor per 10FS-24007	5
2. Fusistor Opening-Time Test Circuit	13

ATOMICS INTERNATIONAL

A Division of North American Aviation, Inc.

NO. 8824
DATE 7/31/63
PAGE 3 OF 29

SNAP 10A

FUSISTOR-VISUAL INSPECTION TEST

TEST PERFORMED:

A total of 27 fusistors were tested. Each fusistor was visually inspected to determine if it was uniform, clean, and free of burrs, cracks, surface roughness or any other evidence of poor quality and workmanship.

The physical dimensions of each fusistor were measured with vernier calipers to determine whether they were within the specification tolerances shown in figure 1.

Each fusistor was weighed with a trip balance. Weights are recorded on next page.

TEST RESULTS:

The visual inspection revealed that the fusistors were not uniform in construction. The physical dimensions of fusistors A-1222 and A-1225 were in excess of the A.I. Specification for body length.

TEST EQUIPMENT

<u>Item</u>	<u>Mfr.</u>	<u>Model</u>
Vernier Calipers	Mowser	NAA #127
Trip Balance	Ohaus	

PREPARED BY: <i>WEMHOFF</i>	ATOMICS INTERNATIONAL A DIVISION OF NORTH AMERICAN AVIATION, INC.	PAGE NO. <i>4</i> OF <i>29</i>
CHECKED BY:		REPORT NO. <i>8824</i>
DATE: <i>1-17-63</i>	<i>SNAP 10A FUSISTOR</i> <i>WEIGHT RESULTS</i>	MODEL NO.

FUSISTOR SERIAL NO.

WEIGHT IN GRAMS

<i>A - 1207</i>	<i>6.1</i>
<i>A - 1208</i>	<i>6.1</i>
<i>A - 1209</i>	<i>6.0</i>
<i>A - 1210</i>	<i>6.1</i>
<i>A - 1211</i>	<i>6.1</i>
<i>A - 1212</i>	<i>6.0</i>
<i>A - 1213</i>	<i>6.1</i>
<i>A - 1214</i>	<i>6.1</i>
<i>A - 1215</i>	<i>6.0</i>
<i>A - 1216</i>	<i>6.1</i>
<i>A - 1217</i>	<i>6.0</i>
<i>A - 1218</i>	<i>6.1</i>
<i>A - 1219</i>	<i>6.0</i>
<i>A - 1220</i>	<i>6.0</i>
<i>A - 1221</i>	<i>6.0</i>
<i>A - 1222</i>	<i>6.1</i>
<i>A - 1223</i>	<i>6.0</i>
<i>A - 1224</i>	<i>6.1</i>
<i>A - 1225</i>	<i>6.1</i>
<i>A - 1226</i>	<i>6.0</i>
<i>A - 1227</i>	<i>6.1</i>
<i>A - 1228</i>	<i>6.1</i>
<i>A - 1229</i>	<i>6.0</i>
<i>A - 1230</i>	<i>6.1</i>
<i>A - 1231</i>	<i>6.0</i>
<i>A - 1232</i>	<i>6.0</i>
<i>A - 1233</i>	<i>5.9</i>

TEST EQUIPMENT:

TRIP BALANCE

MFR
OHFUS

DIMENSIONS OF THE FUSISTOR
PER IOFS-24007

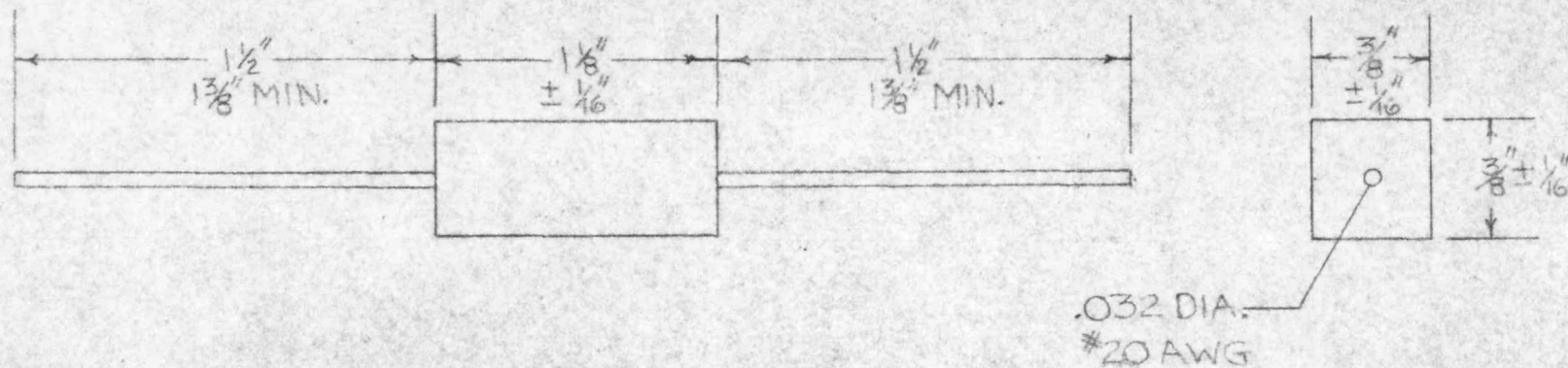


FIGURE 1

ATOMICS INTERNATIONAL

A Division of North American Aviation, Inc.

NO. 8824
DATE 7/31/63
PAGE 6 OF 29

SNAP 10A

FUSISTOR-INSULATION RESISTANCE TEST

TEST PERFORMED:

The body of each fusistor was wrapped in aluminum foil. A megohmmeter was connected with the ground lead to the aluminum foil and the positive lead to the two fusistor axial leads which were clipped together. 100 vdc was applied between these points with the megohmmeter. The test was performed at room ambient temperature.

The requirements are: the insulation resistance shall be in excess of 100 megohms as specified by A.I. Control Specification, 10FS-24007.

TEST RESULTS:

The fusistors tested had insulation resistances higher than the specified 100 megohms. The lowest value was 550K megohms. The results are recorded on the next page.

<u>Item</u>	<u>Mfr.</u>	<u>Model</u>
Megohmmeter	Industrial Instruments	L-7
Cal. Date	Cal. Due	
11-7-62	2-7-63	

PREPARED BY: <i>W E M HOFF</i>	ATOMICS INTERNATIONAL A DIVISION OF NORTH AMERICAN AVIATION, INC.	PAGE NO. <i>37</i> OF <i>29</i>
CHECKED BY:	<i>SNAP 10A FUSISTOR</i>	REPORT NO. <i>8824</i>
DATE: <i>1-17-63</i>	INSULATION RESISTANCE RESULTS	MODEL NO.

FUSISTOR SERIAL NO.

RESISTANCE IN MEG OHMS

A-1207	5000 K
A-1208	4000 K
A-1209	1100 K
A-1210	3000 K
A-1211	10,000 K
A-1212	2000 K
A-1213	4000 K
A-1214	2500 K
A-1215	10,000 K
A-1216	4500 K
A-1217	550 K
A-1218	4000 K
A-1219	10,000 K
A-1220	1500 K
A-1221	1100 K
A-1222	600 K
A-1223	10,000 K
A-1224	700 K
A-1225	700 K
A-1226	5000 K
A-1227	4000 K
A-1228	1700 K
A-1229	10,000 K
A-1230	1100 K
A-1231	550 K
A-1232	1600 K
A-1233	5000 K

TEST EQUIPMENT:

MEGOHMETER	MODEL	MFR.
	L-7	INDUSTRIAL
		INSTRUMENTS

ATOMICS INTERNATIONAL

A Division of North American Aviation, Inc.

NO. 8824
DATE 7/31/63
PAGE 8 OF 29

SNAP 10A

FUSISTOR-DIELECTRIC STRENGTH TEST

The body of each fusistor was wrapped in aluminum foil. The ground lead of an A.C. high potential tester was connected to the foil; the high potential lead was connected to the fusistor's two axial leads which were clipped together. A 60 cps potential of 800 volts rms was applied between the leads, using the high potential tester, at a rate which did not exceed 500 volts rms per second. The 800 volts test voltage was maintained for ten seconds.

TEST CONDITIONS:

The test was performed at room ambient temperature.

TEST RESULTS:

The 27 fusistors exhibited no evidence of leakage or breakdown.

TEST EQUIPMENT:

<u>Item</u>	<u>Mfr.</u>	<u>Model</u>
A.C. High Potential Tester (HYPOT)	Associated Research	404
Cal. Date 11-9-62	Cal. Due 2-9-63	

ATOMICS INTERNATIONAL

A Division of North American Aviation, Inc.

NO. 8824
DATE 7/31/63
PAGE 9 OF 29

SNAP 10A

FUSISTOR-D.C. RESISTANCE TEST

TEST PERFORMED:

The D.C. resistances of the test fusistors were measured with a Wheatstone bridge with a calibrated accuracy of $\pm .1\%$. The bridge applied 750 millivolts across the fusistors while under test.

Requirements: The fusistor shall have a D.C. resistance of 4.7 ohms $\pm 5\%$ (4.465 to 4.935 ohms) as specified by A.I. Control Specification 10FS-24007.

TEST CONDITIONS:

The D.C. resistance test was performed on the fusistors at room ambient temperature.

TEST RESULTS:

The D.C. resistances of fusistors A-1208, A-1209, A-1210, A-1211, A-1218, and A-1233 were greater than 4.935 ohm and therefore not within the $\pm 5\%$ tolerance. The test results are on the next page.

<u>Item</u>	<u>Mfr.</u>	<u>Model</u>
Impedance Bridge	Electro-Scientific Industries, Inc.	250 DA
Cal. Date 11-28-62	Cal. Due 5-28-63	

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CHECKED BY:		REPORT NO. <i>78824252-14-G</i>
DATE: <i>1-18-63</i>	<i>SNAP 10A FUSISTORS</i> D.C. RESISTANCE RESULTS	MODEL NO.

FUSISTOR SERIAL NO.	D.C. RESISTANCE IN OHMS
A-1207	4.770
A-1208	4.944
A-1209	4.952
A-1210	4.953
A-1211	4.846
A-1212	4.791
A-1213	4.821
A-1214	4.821
A-1215	4.837
A-1216	4.922
A-1217	4.913
A-1218	4.938
A-1219	4.891
A-1220	4.891
A-1221	4.870
A-1222	4.850
A-1223	4.778
A-1224	4.879
A-1225	4.847
A-1226	4.882
A-1227	4.797
A-1228	4.759
A-1229	4.749
A-1230	4.869
A-1231	4.800
A-1232	4.908
A-1233	4.936

TEST EQUIPMENT:

IMPEDANCE BRIDGE	MFR. E. S. I.	MODEL 250 DA
------------------	------------------	-----------------

ATOMICS INTERNATIONAL

A Division of North American Aviation, Inc.

NO. 8824
DATE 7/31/63
PAGE 11 OF 29

SNAP 10A

FUSISTOR-OPENING-TIME TEST

TEST PERFORMED:

The opening-time test was performed on the following seven fusistors, serial numbers: A-1208, A-1210, A-1220, A-1227, A-1228, A-1229, and A-1231.

The test was performed by passing 6 amps D.C. through the fusistor and recording the resultant signal on an oscillograph as shown in figure 2. The opening time was determined from the instant 6 amps were applied to the instant the fusistor had permanently opened.

Requirements: The opening time shall be no less than 250 milliseconds and no greater than 1 second, as per A.I. Control Specification 1OFS-24007.

TEST CONDITIONS:

The test was performed at room ambient temperature.

TEST RESULTS:

Fusistors No. A-1208, A-1229, A-1227, and A-1220 were used to set up the test, therefore the data recorded on these four fusistors was not accurate. Fusistors A-1228, A-1231 and A-1210 were opened and accurate data was recorded. (Data is on next page.) These last three fusistors were found to be out of tolerance according to A.I. Document 1OFS-24007.

PREPARED BY: <i>WEMHOFF</i>	ATOMICS INTERNATIONAL A DIVISION OF NORTH AMERICAN AVIATION, INC.	PAGE NO. <i>12</i> OF <i>29</i>
CHECKED BY:		REPORT NO. <i>78824-52-14-9</i>
DATE: <i>1-23-63</i>	<i>SNAP 10A FUSISTOR</i> <i>OPENING TIME TEST DATA</i>	MODEL NO.

FUSISTOR SERIAL NO.

OPENING TIME
IN SECONDS

A-1228

1.245

A-1231

1.270

A-1210

1.355

TEST EQUIPMENT:

VISCORDER

MFR.
HONEYWELL

MODEL
906B

IMPEDANCE BRIDGE

CAL. DATE - *11-28-62*

CAL. DUE - *5-28-63*

ELECTRO
SCIENTIFIC
INDUSTRIES

250 DA
(*ACCURACY*)
±.1%

50 MV, 10AMP SHUNT

WESTON

—

REGULATED DC
POWER SUPPLY

HARRISON
LABORATORIES

814-A
(*±.03%*)
(*ACCURACY*)

DC AMPLIFIER

DYNAMICS

6109

50 MV DC AMMETER

CAL. DATE - *9-1-62*

CAL. DUE - *12-1-62*

WESTON

901
(*ACCURACY*)
±.25%

FUSISTOR OPENING TIME TEST CIRCUIT

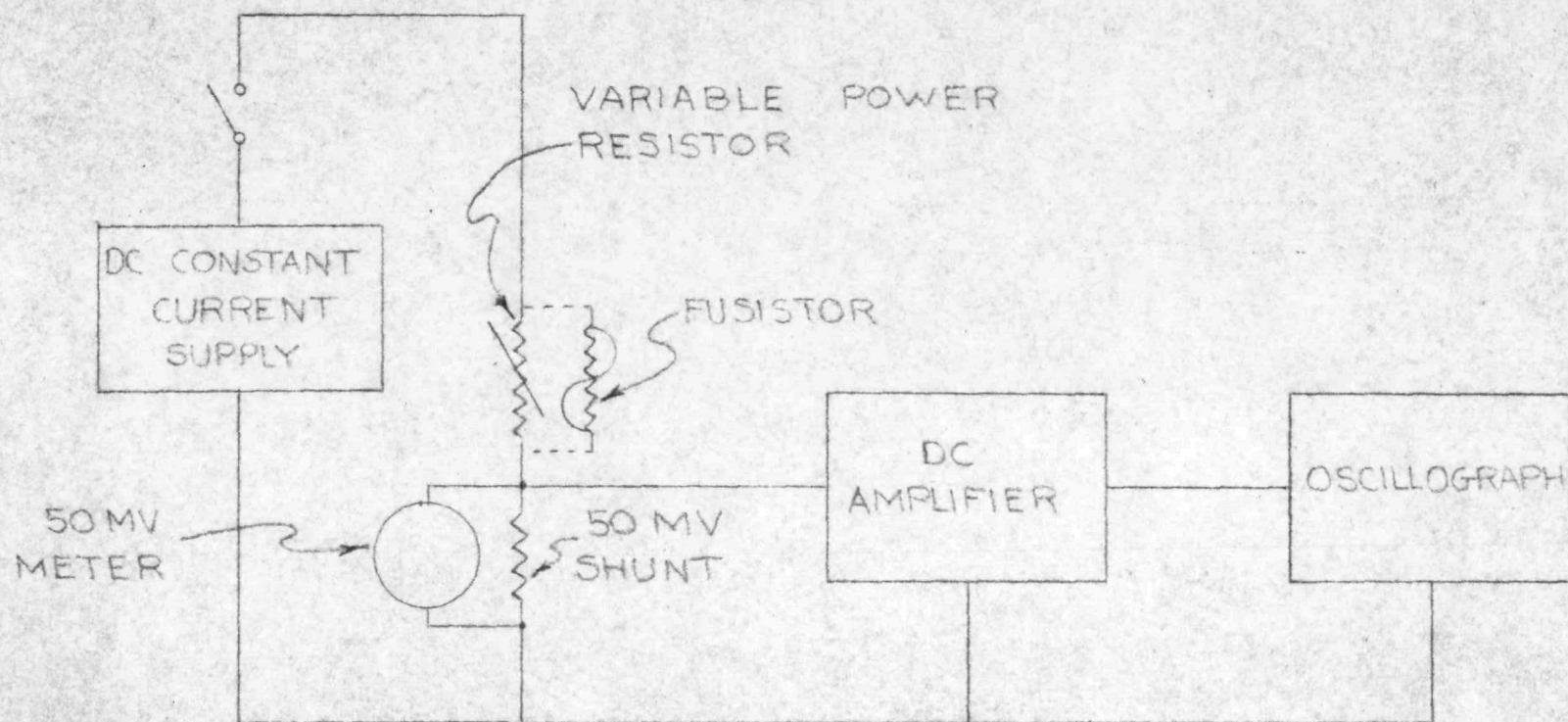


FIGURE 2

ATOMICS INTERNATIONAL
A Division of North American Aviation, Inc.

NO. 8824
DATE 7/31/63
PAGE 13 OF 29

ATOMICS INTERNATIONAL

A Division of North American Aviation, Inc.

NO. 8824
DATE 7/31/63
PAGE 14 OF 29

SNAP 10A

FUSISTOR-ATMOSPHERIC TEST

TEST PERFORMED:

Ten fusistors were mounted on a chassis, suspended by their axial leads, with standoff insulators that provided space around each fusistor to allow the free circulation of air. The chassis, with fusistors and mounts, was placed in a temperature environmental chamber. A calibrated, iron vs. constantan thermocouple was mounted next to the fusistors on a standoff insulator. The thermocouple was read-out on a millivolt potentiometer and the readings taken were used to calculate the correct chamber temperature.

The temperature chamber was cycled ten times from $-30^{\circ}\text{F} \pm 5^{\circ}\text{F}$ to $+140^{\circ}\text{F} \pm 5^{\circ}\text{F}$ at a rate not exceeding 5°F per minute. After the 10th cycle was completed the fusistors were returned to room ambient temperature and the following tests were performed:

1. Insulation resistance (as detailed on page 6)
2. Dielectric strength (as detailed on page 8)
3. D.C. Resistance (as detailed on page 9)

TEST CONDITIONS:

Atmospheric Test - $-30^{\circ}\text{F} \pm 5^{\circ}\text{F}$ to $+140^{\circ}\text{F} \pm 5^{\circ}\text{F}$.

Insulation resistance, dielectric strength and D.C. resistance tests - room ambient temperature.

TEST RESULTS:

The insulation resistances showed little variation from the first test and were still within the specified tolerance limits.

During the dielectric strength test there was no evidence of leakage or breakdown in any fusistors.

An increase in resistance for each fusistor was evident in the D.C. resistance test. The average increase in resistance of the ten fusistors was 0.066 ohms. Fusistors A-1216, and A-1217 were out of tolerance limits in resistance after undergoing the temperature cycling. Fusistors A-1209 and A-1218 had been out-of-tolerance from the start of testing.

ATOMICS INTERNATIONAL

A Division of North American Aviation, Inc.

NO. 8824
DATE 7/31/63
PAGE 15 OF 29

SNAP 10A Fusistor-Atmospheric Test (Continued)

TEST EQUIPMENT:

<u>Item</u>	<u>Mfr.</u>	<u>Model</u>
Temperature Environmental Chamber	Bemco	LNF-250/350-4.5
Millivolt Potentiometer	Leeds & Northrup	8686
Thermocouple, iron vs. constantan	- - -	3576
A.C. High Potential Tester	Associated Research	404

Cal. Date 11-9-62

Cal. Due 2-9-63

(Other test equipment - see next two pages)

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CHECKED BY:	<i>SNAP 10A FUSISTORS</i>	REPORT NO. <i>8824</i>
DATE: <i>1-29-63</i>	<i>INSULATION RESISTANCE RESULTS</i>	MODEL NO.

AFTER ATMOSPHERIC TEST

FUSISTOR SERIAL NO. RESISTANCE IN MEG OHMS

<i>A-1207</i>	<i>10,000K</i>
<i>A-1209</i>	<i>2,000K</i>
<i>A-1211</i>	<i>2,300K</i>
<i>A-1212</i>	<i>1,700K</i>
<i>A-1213</i>	<i>1,950K</i>
<i>A-1214</i>	<i>2,100K</i>
<i>A-1215</i>	<i>5,000K</i>
<i>A-1216</i>	<i>4,000K</i>
<i>A-1217</i>	<i>60K</i>
<i>A-1218</i>	<i>40K</i>

TEST EQUIPMENT

	<i>MFR</i>	<i>MODEL</i>
<i>MEG OHMETER</i>	<i>INDUSTRIAL</i>	<i>L-7</i>
	<i>INSTRUMENTS</i>	

CAL. DATE 11-7-62 CAL. DUE 2-7-63

PREPARED BY: <i>WEMHOFF</i>	ATOMICS INTERNATIONAL A DIVISION OF NORTH AMERICAN AVIATION, INC	PAGE NO. <i>17</i> OF <i>29</i>
CHECKED BY:	<i>SNAP 10A FUSISTORS</i>	REPORT NO. <i>8824</i>
DATE:	<i>DC RESISTANCE RESULTS</i>	MODEL NO.

AFTER ATMOSPHERIC TEST

FUSISTOR SERIAL NO. DC RESISTANCE IN OHMS

<i>A-1207</i>	<i>4.855</i>
<i>A-1209</i>	<i>4.987</i>
<i>A-1211</i>	<i>4.854</i>
<i>A-1212</i>	<i>4.871</i>
<i>A-1213</i>	<i>4.863</i>
<i>A-1214</i>	<i>4.908</i>
<i>A-1215</i>	<i>4.918</i>
<i>A-1216</i>	<i>4.966</i>
<i>A-1217</i>	<i>4.973</i>
<i>A-1218</i>	<i>5.096</i>

TEST EQUIPMENT

MFR MODEL

<i>IMPEDANCE BRIDGE</i>	<i>ELECTRO</i>	<i>250 DA</i>
	<i>SCIENTIFIC</i>	
	<i>INDUSTRIES</i>	

CAL. DATE 11-28-62 CAL. DUE 5-28-63

ACCURACY $\pm 1\%$

ATOMICS INTERNATIONAL

A Division of North American Aviation, Inc.

NO. 8824
DATE 7/31/63
PAGE 18 OF 29

SNAP 10A

FUSISTORS-VACUUM CHAMBER TEST

TEST PERFORMED:

Ten fusistors were placed in a high-vacuum chamber with two fusistors mounted on ceramic standoffs and connected to an external power source as shown in figure 2. The high vacuum chamber was sealed and startup procedure was initiated. After two hours the chamber was at 5×10^{-6} MM(Hg). At this time the chamber temperature was raised to $140^{\circ}\text{F} \pm 10^{\circ}\text{F}$. This temperature was maintained throughout the 22 hour test. Eighteen hours after startup the chamber was still at 5×10^{-6} MM(Hg) and maintained this condition throughout the remainder of the test. Due to vapor pressure or possible leaks, the chamber was unable to exceed 5×10^{-6} MM (Hg). The chamber temperature was monitored with a calibrated, iron vs. constantan thermocouple connected externally to a millivolt potentiometer. After 22 hours an opening-time test was performed on the two fusistors which were mounted on the ceramic standoffs. The vacuum chamber was returned to atmospheric conditions and insulation resistance, dielectric strength and D.C. resistance tests were performed.

TEST CONDITIONS:

Vacuum Chamber Test - 5×10^{-6} MM (Hg) at $140^{\circ}\text{F} \pm 10^{\circ}\text{F}$ for 22 hours.

Opening Time Test - 5×10^{-6} MM(Hg) at 140°F

Insulation Resistance, dielectric strength and DC resistance tests -
at room conditions.

TEST RESULTS:

Opening Time - the opening time of fusistors A-1213 and A-1214, was outside tolerance specification limits of A.I. Control Specification 10FS-24007.

Insulation Resistance - The insulation resistance of the fusistors was still greater than the 100 megohms minimum specified in A.I. Control Specification 10FS-24007.

D.C. Resistance - Fusistors A-1209, A-1216 and A-1218 were still outside the specification limits of 4.935 ohms. Fusistor A-1217 decreased in resistance, coming inside tolerance limits.

Dielectric Strength - No evidence of leakage or breakdown.

Visual Inspection - The ceramic seal on fusistor A-1218 had cracked and fallen off.

ATOMICS INTERNATIONAL

A Division of North American Aviation, Inc.

NO. 8824
DATE 7/31/63
PAGE 19 OF 29

SNAP 10A FUSISTORS-VACUUM CHAMBER TEST (CONT'D)

<u>Test Equipment</u>	<u>Mfr.</u>	<u>Model</u>
Viscorder	Honeywell	906B
50MV 10 Amp Shunt	Weston	- -
Regulated DC Power Supply	Harrison Laboratories	814-A Accuracy $\pm .03\%$
DC Amplifier	Dynamics	6109
50MV DC Ammeter	Weston	901
50MV DC Ammeter	Weston	901
Cal. Date 9-1-62 Cal. Due 12-1-62	Accuracy $\pm .25\%$	
High Vacuum Chamber	NRC	- -
Millivolt Potentiometer	L & N	8686
Thermocouple	Iron vs. Constantan	3576
AC High Potential Tester	Associated Research, Incorporated	404
Cal. Date 11-9-62	Cal. Due 2-9-63	

ATOMICS INTERNATIONAL

A Division of North American Aviation, Inc.

NO. 8824
DATE 7/31/63
PAGE 20 OF 29

SNAP 10A FUSISTORS VACUUM CHAMBER TEST (CONT'D)

Opening Time Test Results

<u>Fusistor Serial No.</u>	<u>Opening Time in Seconds</u>
A-1213	1.1
A-1214	1.09

Insulation Resistance Test Data After Vacuum Chamber Test:

<u>Fusistor Serial No.</u>	<u>Resistance in Meg ohms</u>
A-1207	50,000 K
A-1209	50,000 K
A-1211	50,000 K
A-1212	50,000 K
A-1215	50,000 K
A-1216	50,000 K
A-1217	10,000 K
A-1218	50,000 K

<u>Test Equipment</u>	<u>Mfr.</u>	<u>Model</u>
Megohmmeter	Industrial Instruments	L-7
Cal. Date: 11-7-62	Cal. Due 2-7-63	

ATOMICS INTERNATIONAL

A Division of North American Aviation, Inc.

NO. 8422
DATE 7/31/63
PAGE 21 OF 29

SNAP 10A FUSISTORS VACUUM CHAMBER TEST (CONT'D)

D.C. Resistance Test Data after Vacuum Chamber Test:

<u>Fusistor Serial No.</u>	<u>D.C. Resistance in Ohms</u>
A-1207	4.845
A-1209	4.979
A-1211	4.857
A-1212	4.862
A-1215	4.915
A-1216	4.965
A-1217	4.896
A-1218	5.112

<u>Test Equipment</u>	<u>Mfr.</u>	<u>Model</u>
Impedance Bridge	Electro-Scientific Industries	250 DA

Cal. Date 11-28-62

Cal. Due 5-28-63

ATOMICS INTERNATIONAL

A Division of North American Aviation, Inc.

NO. 8422
DATE 7/31/63
PAGE 22 OF 29

SNAP 10A

FUSISTOR - OPENING-TIME TEST

(TIME VS. CURRENT)

TEST PERFORMED:

Fusistor A-1222 was placed in series with an ammeter across a regulated 10 amp D.C. power supply. A strip chart recorder was connected across the fusistor. A current of 1 amp was passed through the fusistor for 15 minutes. The current was raised to 2 amps for 15 minutes and then to 3 amps.

TEST CONDITIONS:

The test was performed at room ambient conditions.

TEST RESULTS:

18 seconds after the current through the fusistor was increased to 30 amps the fusistor opened.

TEST EQUIPMENT:

<u>Item</u>	<u>Mfr.</u>	<u>Model</u>
Regulated DC Power Supply	Harrison Laboratories	814-A
DC Ammeter	Weston	901
Cal. Date 9-1-62	Cal. Due 12-1-62	
Accuracy $\pm .25\%$		
"Autograf" Recorder	Moseley	680

ATOMICS INTERNATIONAL

A Division of North American Aviation, Inc.

NO. 8422
DATE 7/31/63
PAGE 23 OF 29

SNAP 10A

FUSISTORS - TEMPERATURE TEST

TEST PERFORMED:

Seven fusistors were placed in an environmental temperature chamber and connected to an external power supply as shown in figure 2. The power supply was turned on and one amp of current was passed through each fusistor. The temperature in the chamber was lowered to $0^{\circ}\text{F} \pm 5^{\circ}\text{F}$ at a rate not exceeding 5°F per minute. The chamber was stabilized at $0^{\circ}\text{F} \pm 5^{\circ}\text{F}$ for 30 minutes. After 30 minutes at $0^{\circ}\text{F} \pm 5^{\circ}\text{F}$ the amperage through fusistor A-1217 was increased to 6 amps and the opening time recorded. The chamber temperature was then increased to $+140^{\circ}\text{F} \pm 5^{\circ}\text{F}$, not exceeding 5°F per minute, rate of change, and stabilized for 30 minutes with 1 amp of current flowing through the fusistors. After 30 minutes the current through fusistor A-1212 was increased to 6 amps and the opening time recorded. The temperature in the chamber was returned to room conditions at a rate not exceeding 5°F per minute. The fusistors were removed from the chamber and insulation resistance, dielectric strength and D.C. resistance tests were performed as specified on pages 6, 8 and 9.

TEST CONDITIONS:

From room temperature to $0^{\circ}\text{F} \pm 5^{\circ}\text{F}$ for 30 minutes and from 0°F to $+140^{\circ}\text{F} \pm 5^{\circ}\text{F}$ for 30 minutes and back to room temperature never exceeding a rate of change of 5°F per minute for the complete cycle. Insulation resistance, dielectric strength and D.C. resistance tests were performed at room ambient temperature.

ATOMICS INTERNATIONAL

A Division of North American Aviation, Inc.

NO. 8824
DATE 7/31/63
PAGE 24 OF 29

SNAP 10A FUSISTOR-TEMPERATURE TEST (CONT'D)

TEST RESULTS:

Insulation Resistance - The insulation resistances of the fusistors was greater than the specified minimum of 100 megohms of A.I. Control Specification 10FS-24007.

D.C. Resistance - The average resistances of the fusistors increased 0.1 ohm. All the fusistors were outside the tolerance limit of 4.935 ohms in the Control Specification.

Dielectric Strength Test - There was no evidence of leakage or breakdown at 800 volts rms.

Opening-Time Test* -

<u>Fusistor Serial No.</u>	<u>Opening-Time in Seconds</u>
A-1212	.387
A-1217	.423

TEST EQUIPMENT:

<u>Item</u>	<u>Mfr.</u>	<u>Model</u>
Temperature Chamber	Bemco, Inc.	- -
Viscorder	Honeywell	906 B
50 MV 10 amp Shunt	Weston	- -
Regulated DC Power Supply	Harrison Laboratories	814 A
DC Amplifier	Dynamics	6109
50 MV DC Ammeter	Weston	901
Cal. Date 9-1-62 Cal. Due 12-1-62	Accuracy \pm .25%	
Millivolt Potentiometer	Leeds & Northrup	2686
Thermocouple	Iron vs. Constantan	3576

(Other test equipment - see next two pages)

*AI Control Specification 10FS-24007 tolerances: Min. 250 milliseconds,
Max. 1 second

PREPARED BY: <i>WEMHOFF</i>	ATOMICS INTERNATIONAL A DIVISION OF NORTH AMERICAN AVIATION, INC.	PAGE NO. <i>25</i> OF <i>29</i>
CHECKED BY:		REPORT NO. <i>8824</i>
DATE: <i>2-6-63</i>	<i>SNAP 10A FUSISTORS</i> <i>INSULATION RESISTANCE DATA</i>	MODEL NO.

AFTER TEMPERATURE TEST

<i>FUSISTOR SERIAL NO.</i>	<i>RESISTANCE IN MEG OHMS</i>
<i>A-1207</i>	<i>30,000 K</i>
<i>A-1209</i>	<i>8,000 K</i>
<i>A-1211</i>	<i>40,000 K</i>
<i>A-1215</i>	<i>50,000 K</i>
<i>A-1216</i>	<i>50,000 K</i>

<i>TEST EQUIPMENT:</i>	<i>MFR.</i>	<i>MODEL</i>
<i>MEGOHMETER</i>	<i>INDUSTRIAL INSTRUMENTS</i>	<i>L-7</i>
<i>CAL DATE</i>	<i>11-7-62</i>	<i>CAL DUE 2-7-63</i>

PREPARED BY: <i>WEMHOFF</i>	ATOMICS INTERNATIONAL A DIVISION OF NORTH AMERICAN AVIATION, INC.	PAGE NO. <i>26</i> OF <i>29</i>
CHECKED BY:		REPORT NO. <i>8824</i>
DATE: <i>2-6-63</i>	<i>SNAP 10A FUSISTORS</i> <i>DC RESISTANCE DATA</i>	MODEL NO.

AFTER TEMPERATURE TEST

FUSISTOR SERIAL NO. RESISTANCE IN OHMS

<i>A-1207</i>	<i>4.952</i>
<i>A-1209</i>	<i>5.070</i>
<i>A-1211</i>	<i>4.955</i>
<i>A-1215</i>	<i>4.936</i>
<i>A-1216</i>	<i>5.058</i>

TEST EQUIPMENT:

MFR.

MODEL

IMPEDANCE BRIDGE

ELECTRO

250 DA

SCIENTIFIC

INDUSTRIES

CAL DATE

11-28-62

CAL DUE

5-28-63

ACCURACY $\pm 1\%$

ATOMICS INTERNATIONAL

A Division of North American Aviation, Inc.

NO. 8824
DATE 7/31/63
PAGE 27 OF 29

SNAP 10A

FUSISTOR - VIBRATION TEST

TEST PERFORMED:

Nine fusistors, mounted to a rigid test fixture, were subjected to qualification level sinusoidal vibration in each of three mutually perpendicular axes as follows:

5 to 14 cps	1/2" double amplitude displacement
14 to 400 cps	5 g
400 to 3000 cps	7.5 g

Following the vibration test the fusistors were tested for insulation resistance, dielectric strength and D.C. resistance as detailed on pages 6, 8, and 9.

TEST CONDITIONS:

All tests were performed at room ambient conditions.

TEST RESULTS:

Insulation Resistance - All fusistors had insulation resistances greater than the 100 megohm minimum of A.I. Control Specification 10FS-24007.

Dielectric Strength - There was no evidence of leakage or breakdown in any fusistor.

D.C. Resistance Test - Fusistor A-1232 no longer in tolerance. Fusistor A-1233 previously out-of-tolerance (refer to Page 9) now within tolerance limits and lower in resistance than when initially measured.

TEST EQUIPMENT:

<u>Item</u>	<u>Mfr.</u>	<u>Model</u>
A. C. High Potential Tester	Associated Research	404
Cal. Date: 11-9-62	Cal. Due: 2/9/63	

(Other test equipment - see next two pages)

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CHECKED BY:		REPORT NO. <u>8824</u>
DATE: <u>2-14-63</u>	<u>SNAP 10A FUSISTORS</u> <u>INSULATION RESISTANCE DATA</u>	MODEL NO.

AFTER SINUSOIDAL VIBRATION TEST

FUSISTOR SERIAL NO.	RESISTANCE IN MEG OHMS
A-1219	300 K
A-1221	20 K
A-1223	15 K
A-1224	500 K
A-1225	100 K
A-1226	85 K
A-1230	14 K
A-1232	750 K
A-1233	170 K

TEST EQUIPMENT:

Item
Megohmmeter

Mfr.
Industrial Instruments

Model
L-7

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CHECKED BY:		REPORT NO. <u>7.8824</u>
DATE: <u>2-14-63</u>	<u>SNAP 10A FUSISTORS</u> <u>DC RESISTANCE DATA</u>	MODEL NO.

AFTER SINUSOIDAL VIBRATION TEST

<u>FUSISTOR SERIAL NO.</u>	<u>RESISTANCE IN OHMS</u>
A - 1221	4.910
A - 1223	4.775
A - 1224	4.912
A - 1225	4.856
A - 1226	4.886
A - 1230	4.850
A - 1232	4.950
A - 1233	4.911
A - 1219	4.930

TEST EQUIPMENT:

<u>Item</u>	<u>Mfg.</u>	<u>Model</u>
Impedance Bridge	Electro-Scientific Industries	250 DA
Cal. date - 11-28-62 Cal. Due - 5-28-63		
Accuracy: $\pm .1\%$		