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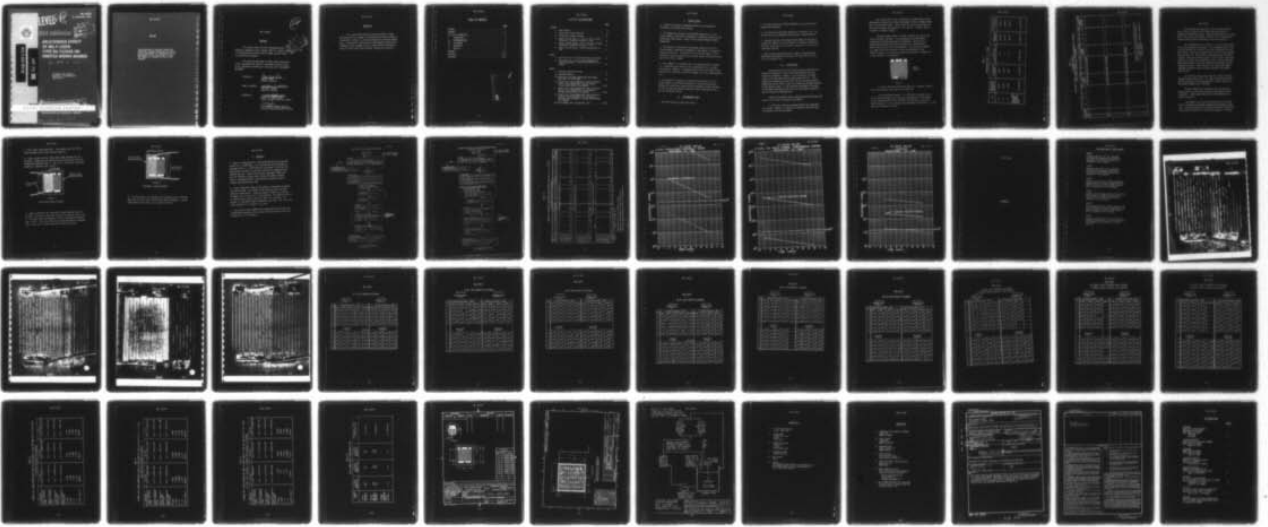
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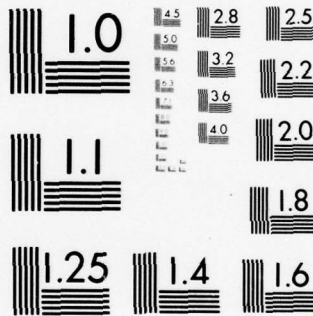
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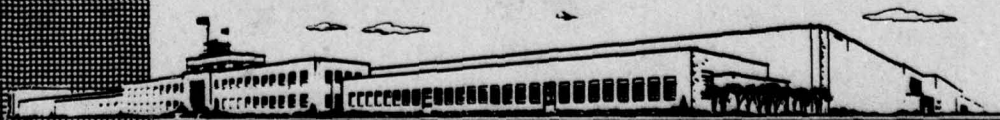
**DELETERIOUS EFFECT
OF MIL-F-14256,
TYPE RA FLUXES ON
PRINTED WIRING BOARDS**

See 1473 in back.

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PREFACE

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This report covers the work performed by NAC's Materials Laboratory from 1 January 1978 to 1 January 1979 on the deleterious effect of MIL-F-14256, Type RA Fluxes on printed wiring boards.

This work was performed for RADC, under sponsorship of Mr. John McCormick, Rome Air Development Center's Reliability Laboratory, Griffiss Air Force Base, NY; FQ761970032 BCN 90474.

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ABSTRACT

This study identified the corrosive effects of Type RA fluxes and flux residues on printed wiring boards subjected to electrical stress in a humid environment at elevated temperature. The effect of varying delay times between soldering and cleaning of flux residues was also studied and the protective value of solder resist and conformal coating was evaluated.

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I. CONCLUSIONS

1. Type RA fluxes have a degrading effect on the insulation resistance of printed wiring boards.
2. The analysis of variance of resistance values for A, B, & C fluxes showed a significant difference in resistance values for the three delay times chosen. Delay in flux residue removal affects degradation.
3. The analysis of variance of resistance values for A, B, & C fluxes showed a significant difference in the amount of degradation caused by each flux. The activity of the Type RA fluxes in this experiment cannot be based solely on water extract resistivity tests specified in MIL-F-14256D.
4. MIL-P-28809 is an excellent tool for the application intended: i.e., determining the level of ionic contamination on a printed wiring board. However, it appeared that one flux left some residue which was not measurable with MIL-P-28809, yet still caused degradation.
5. The analysis of variance of resistance values for A, B, & C fluxes showed a significant difference in the resistance values between the solder mask coated and the conformally coated specimens. The solder mask gave greater protection against degradation than did the conformal coating.

II. RECOMMENDATIONS

1. RA fluxes should be used with caution.

2. RA fluxes should be cleaned immediately from printed wiring boards after soldering.
3. Care should be taken when changing to a different flux. The new flux may not be compatible with the base laminate material.
4. Thorough cleaning of RA fluxes from printed wiring boards is a necessity. However, at present there is no method of detecting non-ionic contaminants. Work should be performed in this area of cleanliness testing.
5. Work should be performed on MIL-F-14256 to determine what additional requirements are necessary for specifying a RA flux; e.g., pH, organics, etc.

III. DISCUSSION

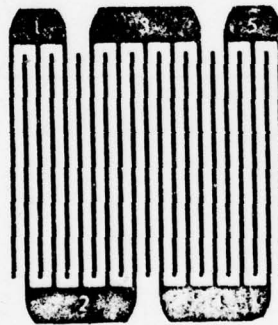
Activated rosin base (RA) fluxes have been generally considered too corrosive for use in the manufacture of military electronic assemblies. However, it is now possible for these fluxes to be used under military specification control. Flux vendors have proposed that once their RA flux has seen soldering temperature and has done its job its residues are rendered inactive. So the question arose: is the insulation resistance of printed wiring boards degraded by such fluxes as they might be generally used in electronics manufacturing?

Rome Air Development Center requested that NAC evaluate the effects of RA fluxes on printed wiring boards.

A literature survey was conducted before this experiment was started. However, it yielded no information about the type of experiment that was performed.

The fluxes used in this experiment were advertised by their manufactures to meet the minimum requirements of MIL-F-14256D, Amendment 1 for RA type fluxes. Three fluxes for testing were chosen on this basis and were designated "A", "B", and "C". Further characterization is shown in Table I.

The comb pattern shown in Figure 1 (below) was used as the basic resistance specimen. It was produced using conventional printed wiring board manufacturing techniques. Historically, a comb pattern specimen has been associated with printed wiring board insulation resistance measurements. This particular pattern is a duplicate of the one used in the IPC Round Robin on the "Additive Process for Producing Printed Wiring Boards". (Dimensions on Dwg. AV22107 in the Appendix.)



COMB
PATTERN

Figure 1.

A total of 200 comb pattern specimens was produced. Approximately 48 specimens were used for each test run.

Using resistance squares, 1.5×10^8 ohms insulation resistance on the comb pattern was found to be equivalent to 500 megohms on the trumpet pattern in MIL-P-55110C (equilibration calculation shown on page A-17 in the Appendix). Any resistance value below 1.5×10^8 ohms was considered a failure.

TABLE I.
CHARACTERIZATION OF FLUXES

FLUX	WATER EXTRACT RESISTIVITY OHM-CM X 10 ³	SOLIDS CONTENT BY WEIGHT	pH 0.1 ml OF FLUX DILUTED WITH 50 ml OF H ₂ O	CHLORIDE ION INDICATION	WATER SOLUBILITY 0.1 ml OF FLUX IN 50 ml OF H ₂ O
"A"	69.333	38.2%	4.4	Negative	Soluble
"B"	43.500	34.8%	5.1	Positive	Insoluble
"C"	37.400	35.2%	5.9	Negative	Insoluble
MIL-F-14256D Amendment 1 RA (Rosin Activated) Flux	50.0 Minimum	15% Minimum	No Requirement	No Requirement	No Requirement

TABLE II.
 EXPERIMENT MATRIX
 RESISTANCE READINGS DURING HUMIDITY & ELEVATED TEMPERATURE STRESSING
 MIL-STD-810C, METHOD 507.1, PROCEDURE I.

SPECIMENS PER SET	A ¹ 0 ² C ³	A100C A0S	A100S	R < 1.5x10 ⁸ Ω DURING TESTING	B0C B100C B0C B100S	R < 1.5x10 ⁸ Ω DURING TESTING	C0C C100C C0S C100S	R < 1.5x10 ⁸ Ω DURING TESTING
DAYS	4	4	4	4	4	4	4	4
72 HOUR DELAY BEFORE FLUX REMOVAL								
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								
DAYS	168 HOUR DELAY BEFORE FLUX REMOVAL							
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								
DAYS	IN PLANT, 1 MINUTE DELAY BEFORE FLUX REMOVAL							
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								

1 First letter (A,B,or C) indicates flux used.
 2 Number will either be 0(no DC voltage) or 100(DC volts).
 3 Last letter indicates conformal coated(C) or solder mask(S).

The experiment was designed so that some test specimens within a test set were very clean when they were ready for temperature and humidity stress. These specimens were used to determine if the copper clad laminate from which all the comb pattern specimens were produced contained any electrical anomalies.

The "Experiment Matrix", Table II, is a visual description of how the experiment was designed. Those specimens within a test set were divided into lots which were then contaminated with the three fluxes. Some test specimens within a flux lot were stressed with 100 volts D.C., while other test specimens were not voltage stressed. Some test specimens within a flux lot were solder mask coated, while others were conformally coated. The test specimens which were tested for electrical anomalies were neither voltage stressed nor coated. Within each flux lot, there were enough specimens provided to permit the data obtained to be analyzed statistically.

For the three fluxes used, there was a total of 48 test specimens for each delay time. This gave a possibility of five control specimens since the maximum which could be loaded into the humidity chamber was 53 specimens.

The MIL-P-28809 Ionic Contaminants Test was used on a sampling basis to monitor boards from the same process lot for cleanliness. (These sampled boards were not temperature and humidity stressed.)

Time between flux fusing and cleaning was the variable chosen to differentiate between temperature and humidity stress runs. It had been proposed that type RA fluxes would attack the insulating base laminate of a printed wiring board. The three

delay times between flux fusing and cleaning were chosen to simulate actual fabrication cycles with 1) in-line cleaning- or 2) 72 hours standing over a weekend, or 3) 168 hours for boards touched up or otherwise held in process for one week.

The temperature and humidity stress conditions of MIL-STD-810C environmental test methods, Method 507.1, Procedure I, were used. This was done because solder flux is used to fabricate printed wiring board assemblies used in electronic equipment. Ultimately the printed wiring board assemblies survive or fail in the environment the equipment sees.

The resistances of the specimens were measured in the humidity chamber during the high temperature and high humidity portion of the temperature and humidity stress cycle. The resistances were measured on 24 hour cycles on working days. The resistance measurements were made using a megohm bridge.

The experiment proceeded with the different delay times in this order:

1. 72 hours delay
2. 168 hours delay
3. In plant, wave soldered and cleaned, 1 minute delay before flux removal

An additional study was made to explore exposure to RA fluxes beyond the ten day requirement of the MIL Standard method. Specimens were prepared by the procedure employed in the main study, except that 1) flux or flux residues were not removed by the previously described cleaning steps, and 2) the MIL-STD-810, Environmental Test Methods, Method 507.1, Procedure I, was run for twenty days rather than ten days.

Some of the findings were:

1. It's possible to meet the humidity and insulation

resistance requirements of MIL-STD-810, Environmental Test Methods, Method 507.1, Procedure I, and at the same time attack the epoxy butter coat of the laminate.

2. Fluxes which appear to be more prone to humidity and insulation failure ($R < 1.5 \times 10^8$ ohms) than some other RA fluxes were very gentle to the epoxy butter coat of glass epoxy laminates.

3. The photographs in the Appendix are typical of what was observed.

NOTE: These are preliminary findings. It is thought they are worthy of mention, but more investigation is indicated. None of the conclusions or recommendations are affected by these findings.

IV. PROCEDURE

1. Make 200 comb pattern printed wiring boards of FL-GF, .062 C 1/1 glass epoxy laminate to conform to Dwg. AV 22109 on page A-24 in the Appendix.
2. Mask the laminate, using dry film resist so that the conductor pattern and the back of the printed wiring board can be plated.
3. Tin/lead plate.
4. Strip resist.
5. Etch unplated copper.
6. Rinse thoroughly in tap water and blow dry.

7. Omit solder fusing operation. (This makes sure that fusing fluid residues do not affect the test results.)

8. Figure 2 shows how the solder mask coated specimen was constructed. Solder mask was applied to the comb specimen which was governed by conductor pads 1, 2 and $\frac{1}{2}$ of 3. Electrical leads were soldered to conductor pads 1 and 2.

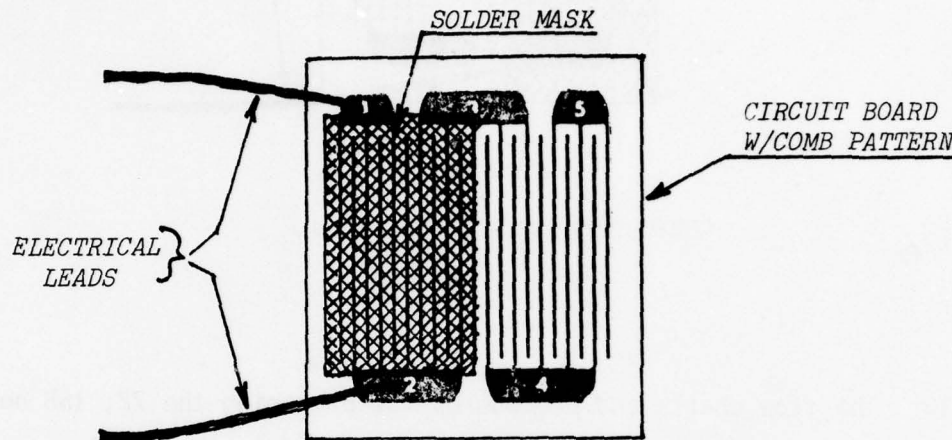


Figure 2.

SOLDER MASK COATED SPECIMEN

9. Figure 3 shows how the conformally coated specimen was constructed. Electrical leads were soldered to conductor pads 1 and 2. The leads exited the specimen from the end opposite conductor pads 1 and 2. This allows the comb specimen governed by conductor pad 1, 2 and $\frac{1}{2}$ of 3 to be conformally coated by dipping.

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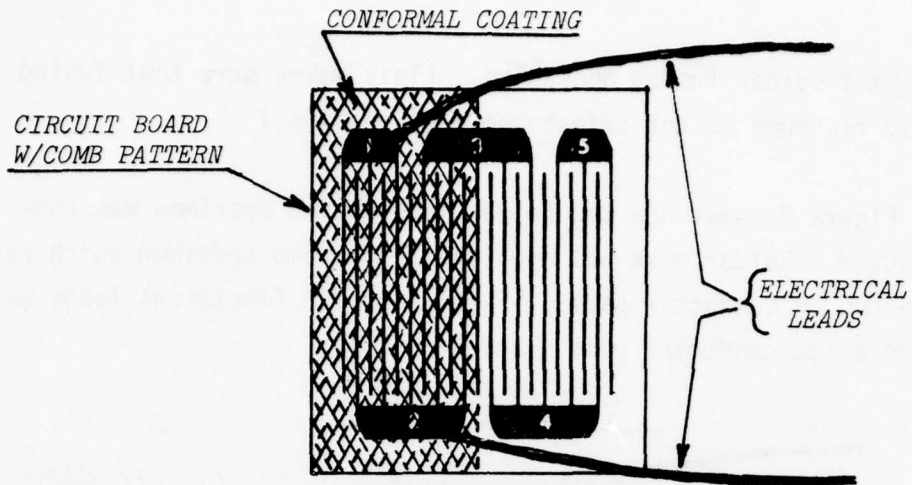


Figure 3.

CONFORMALLY COATED SPECIMEN

10. The flow charts and procedures for producing the 72, 168 hour delay and in-plant, wave soldered and cleaned specimens, 1 minute delay before flux removal, are on pages 12 and 13.

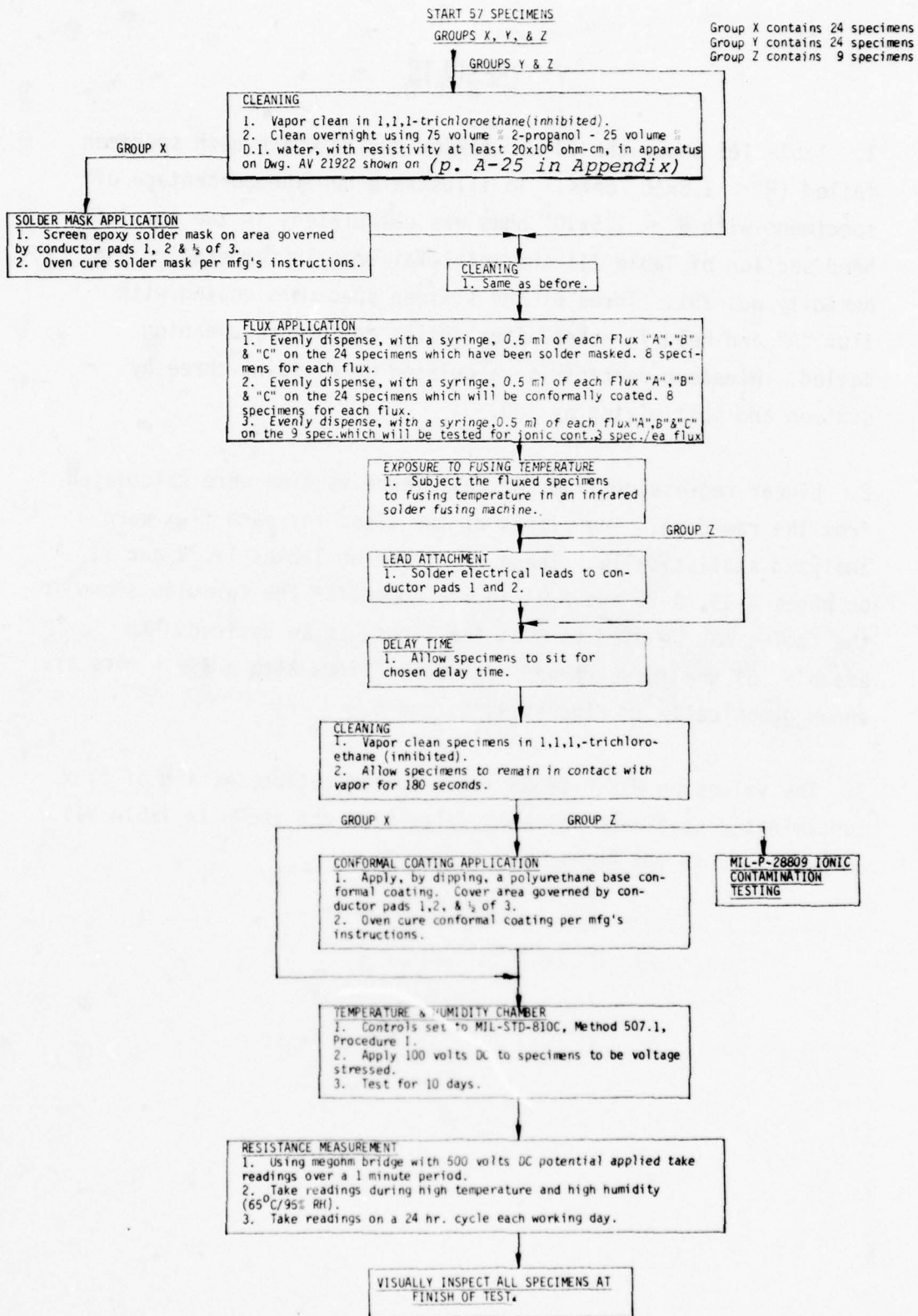
V. RESULTS

1. Table III shows the 24 hr. period during which each specimen failed ($R < 1.5 \times 10^8$ ohms). To illustrate how the percentage of specimens with $R < 1.5 \times 10^8$ ohms was calculated, in the top left hand section of Table III the total failures in temperature and humidity was 19%. Three of the sixteen specimens coated with flux "A" and held 72 hours after fusing and before cleaning failed. Nineteen percent is calculated by dividing three by sixteen and multiplying by 100.

2. Linear regression lines of resistance vs time were calculated from the raw data. The slopes of the lines for each flux were analyzed statistically. These are shown on Tables IV, V and VI on pages A-19, A-20 and A-21 in the Appendix. The formulas shown in the tables may be used to plot the lines, if so desired. An example of the above linear regression lines with $\pm 3\sigma$ limits are shown graphically in Figures 4, 5, and 6.

3. The values on MIL-P-28809 ionic contamination testing of flux contaminated specimens for each delay time are shown in Table VII on page A-22 in the Appendix.

FLOW CHART FOR 72 AND 168 HOUR DELAY SPECIMENS



FLOW CHART FOR IN PLANT, WAVE SOLDERED AND CLEANED SPECIMENS
(APPROXIMATELY 1 MINUTE DELAY)

Group X contains 24 specimens
Group Y contains 24 specimens
Group Z contains 9 specimens

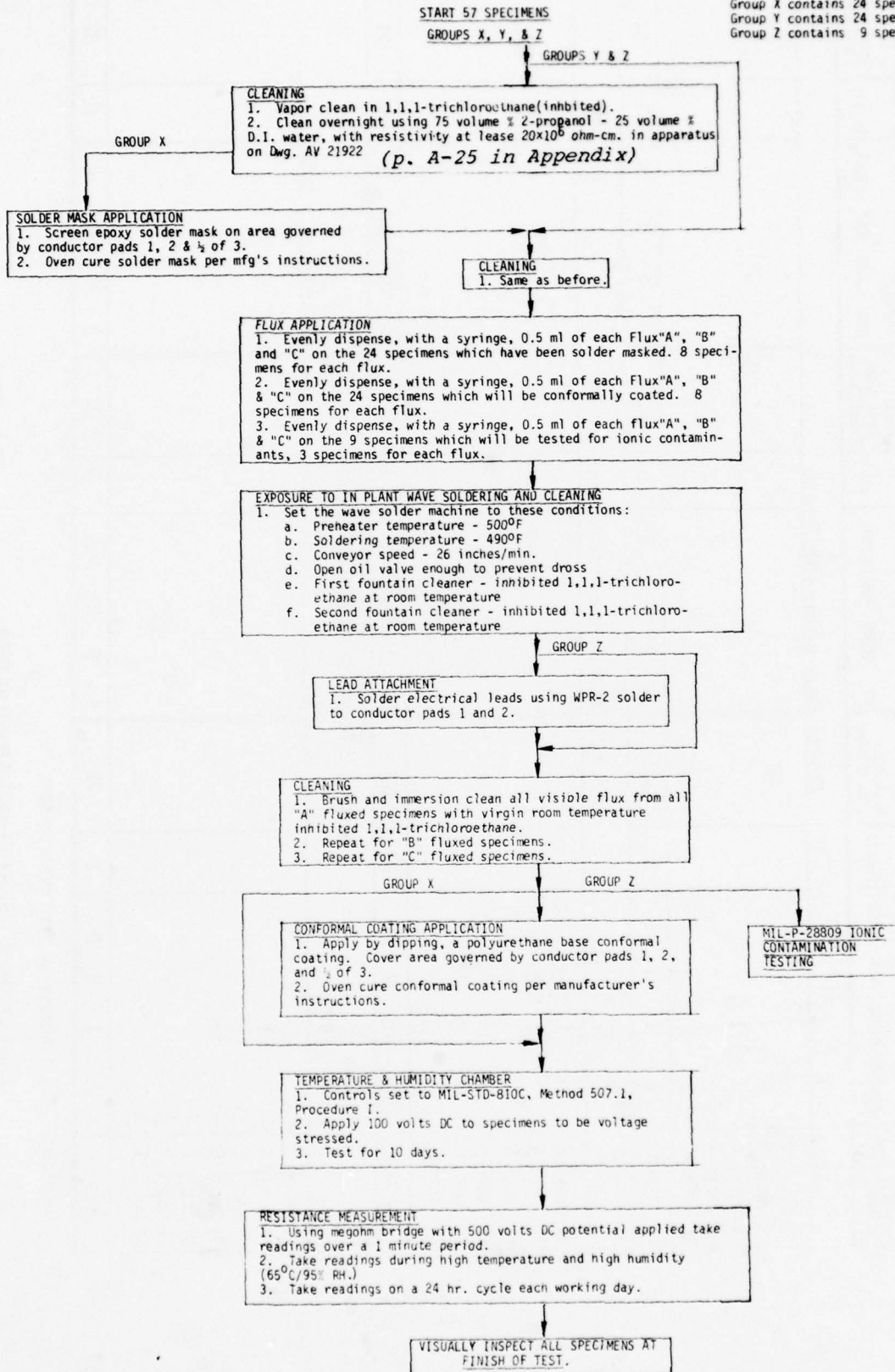


TABLE III.

HUMIDITY & ELEVATED TEMPERATURE RESISTANCES LESS THAN 1.5×10^8 OHMS

MIL-STD-810c, METHOD 507.1.1, PROCEDURE 1.

DATE (1978)	DAY	A ¹ A ² C ³	A100C A0S A100S	Totals	R is less than 1.5×10^8 ohms	B0C B100C B0S B100S	Totals	R is less than 1.5×10^8 ohms	C0C C100C C0S C100S	Totals	R is less than 1.5×10^8 ohms		
72 HOUR DELAY BEFORE FLUX REMOVAL													
3 JULY	3					1			1				
5 JULY	5	1											
6 JULY	6		1										
7 JULY	7												
10 JULY	10	1											
TOTALS		2	1	0	0	3	19%	1	0	0	0	1	6%
168 HOUR DELAY BEFORE FLUX REMOVAL													
17 JULY	3												
18 JULY	4					1							
19 JULY	5	1											
20 JULY	6												
21 JULY	7												
24 JULY	10												
TOTALS		1	1	0	0	2	12%	0	1	0	0	1	6%
IN PLANT 1 MINUTE DELAY BEFORE FLUX REMOVAL													
(3)*													
4 AUG	1												
7 AUG	4												
8 AUG	5	1											
9 AUG	6												
10 AUG	7												
11 AUG	8												
14 AUG	11												
TOTALS		0	1	0	0	1	7%	0	0	0	0	0	0%

Legend: * () NUMBER OF SPECIMENS IN SET.

¹ FIRST LETTER (A, B, OR C) INDICATES FLUX USED.

² NUMBER WILL EITHER BE 0 (NO DC VOLTAGE) OR 100 (DC VOLTS).

³ LAST LETTER INDICATES CONFORMAL COATED (C) OR SOLDER MASK (S).

FIGURE 4.

72 HOUR DELAY

14-20-60

A FLUX, 0 VOLTS STRESS, CONFORMALLY COATED
RESISTANCE VS TIME

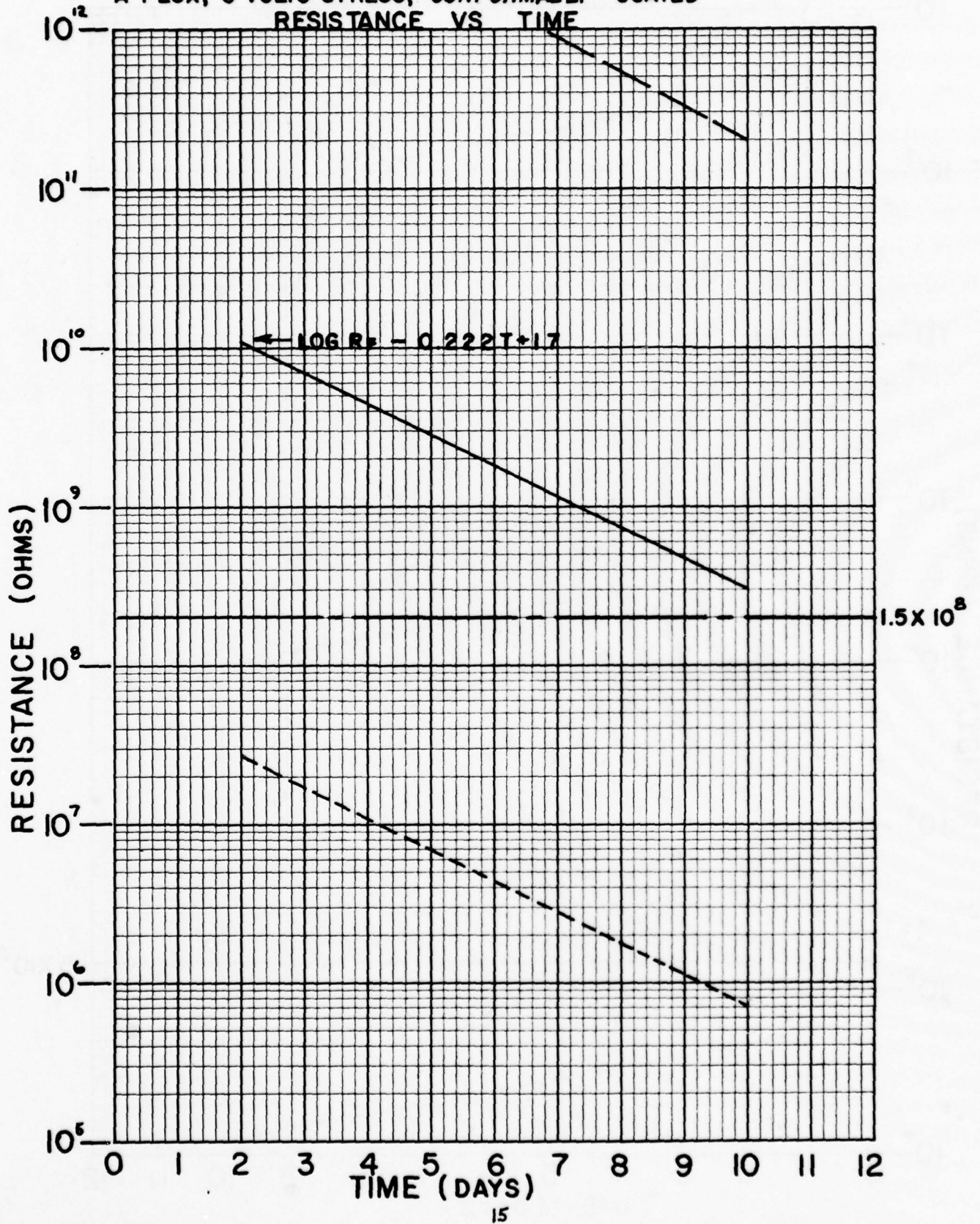
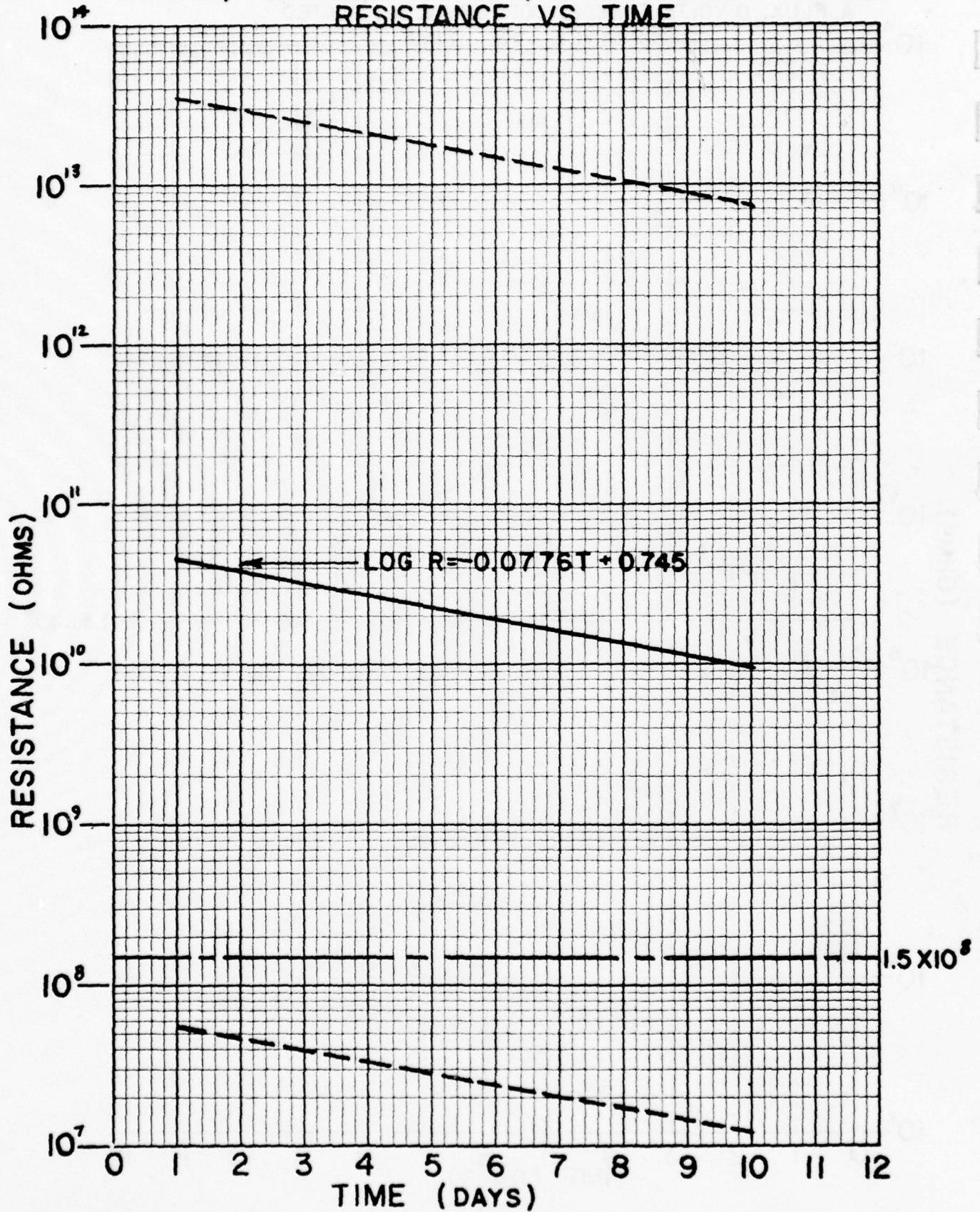


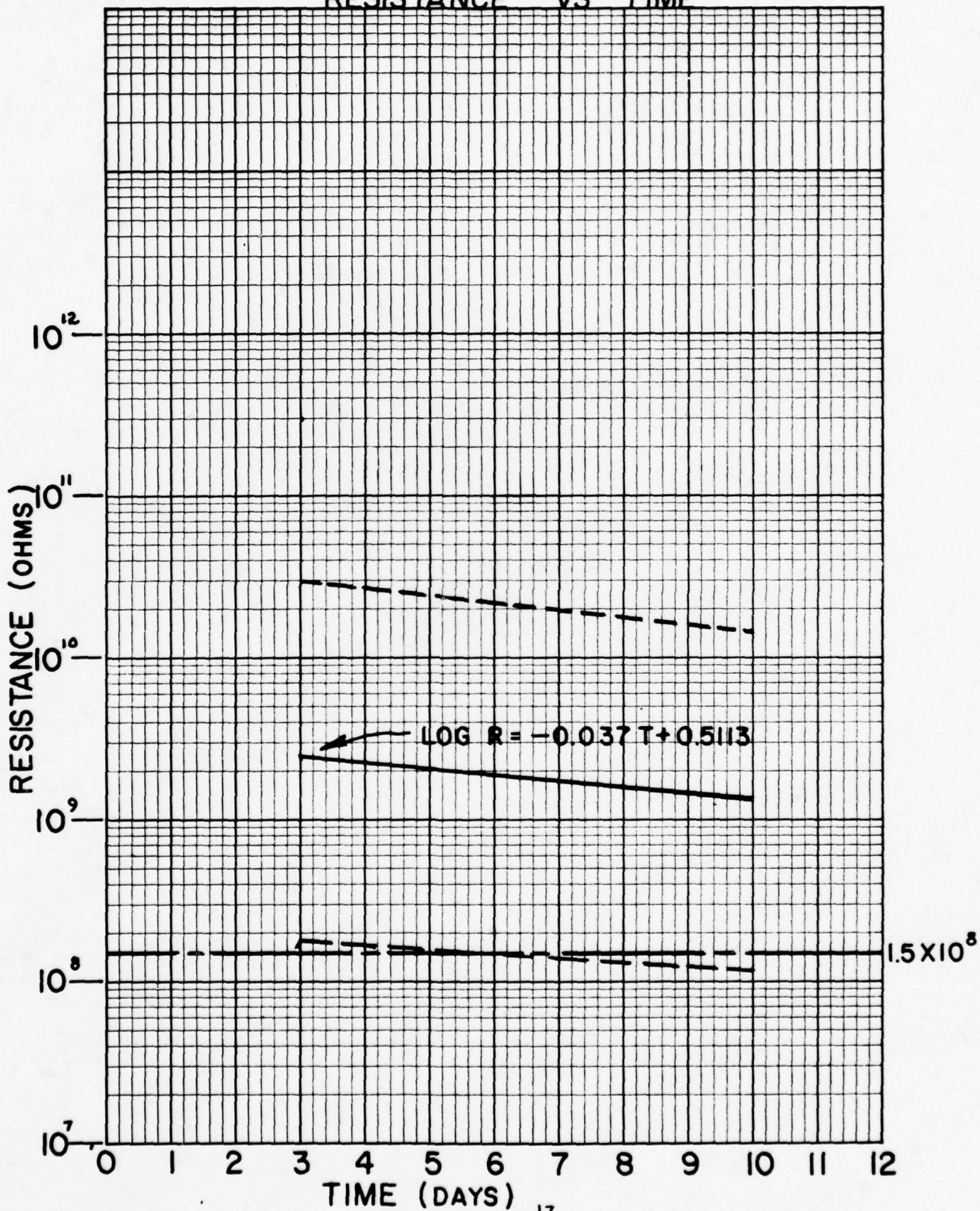
FIGURE 5.

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72 HOUR DELAY
A FLUX, 100 VOLTS STRESS, CONFORMALLY COATED
RESISTANCE VS TIME



72 HOUR DELAY
CONTROLS
RESISTANCE VS TIME



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APPENDIX

EXPLANATION OF PHOTOGRAPHS

3B100C

Laminate attack by "B" Flux subjected to 20 days of temperature and humidity testing per MIL-STD-810C, Method 507.1, Procedure 1 (flux removed).

1C100C

Laminate attack by "C" Flux subjected to 20 days at temperature and humidity testing per MIL-STD-810C, Method 507.1, Procedure 1 (flux removed).

4C100C

Burned out track due to surface resistance deterioration by 20 days of temperature and humidity testing per MIL-STD-810C, Method 507.1, Procedure 1 (no flux removed).

4A100C

Laminate which had been covered with "A" flux after 20 days of temperature and humidity testing per MIL-STD-810C, Method 507.1, Procedure 1 (flux removed).

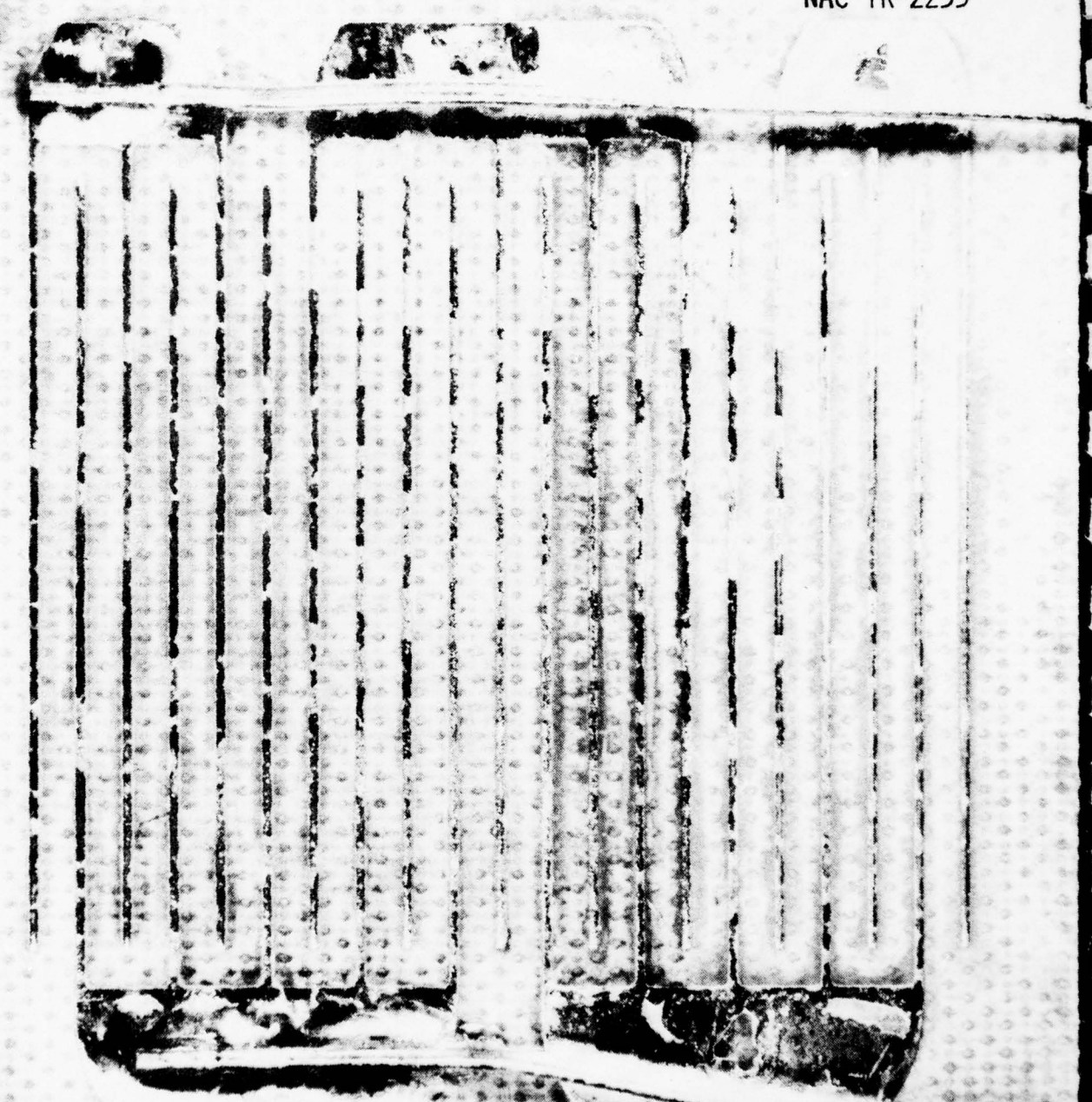
2B100S

Solder masked area, no laminate attack by "B" Flux subjected to 20 days of temperature and humidity testing per MIL-STD-810C, Method 507.1, Procedure 1 (flux removed).

3A100C

Conformal coating over "A" after 20 days of temperature and humidity testing per MIL-STD-810C, Method 507.1, Procedure 1 (no flux removed).

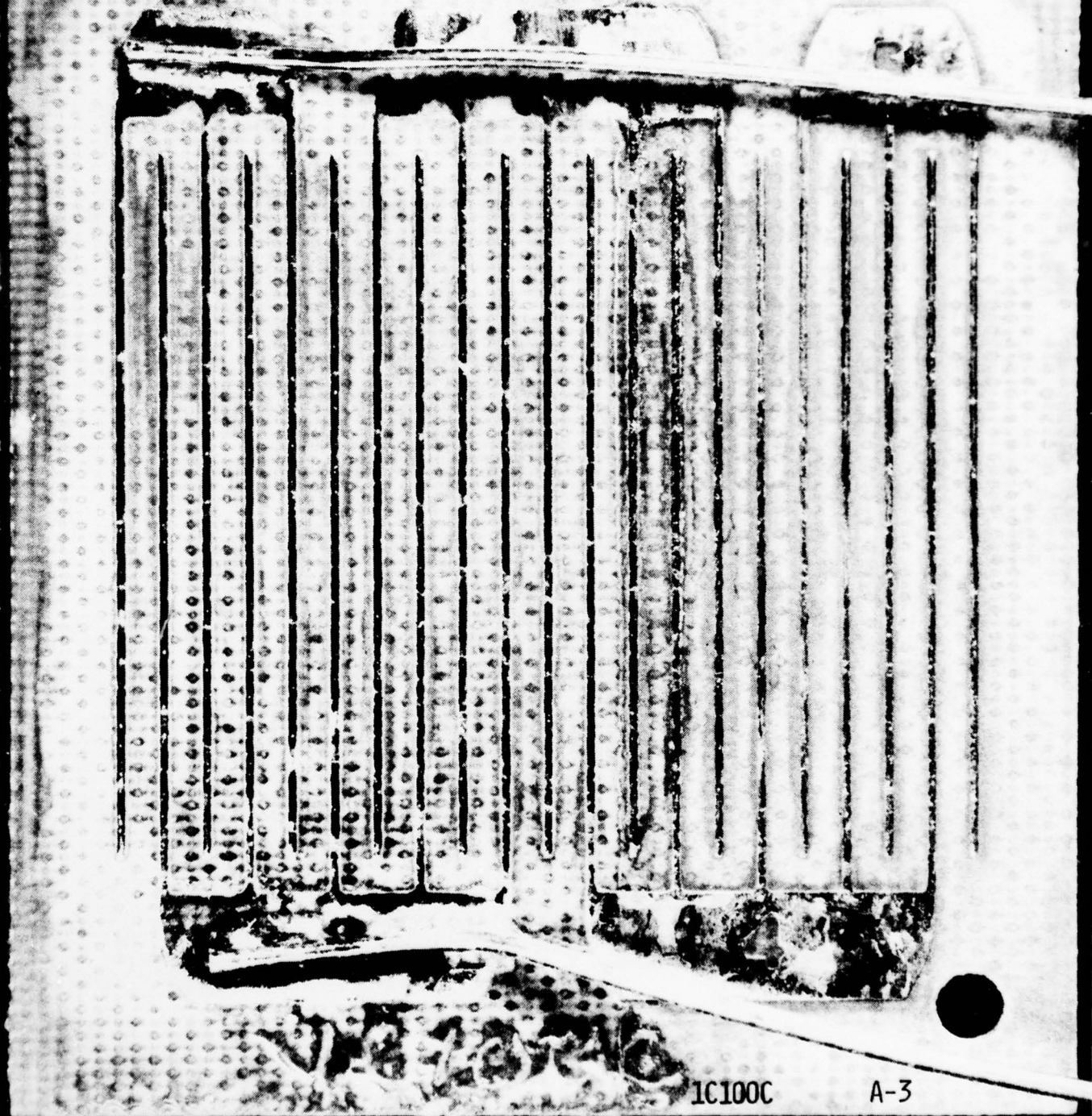
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3B100C

A-2

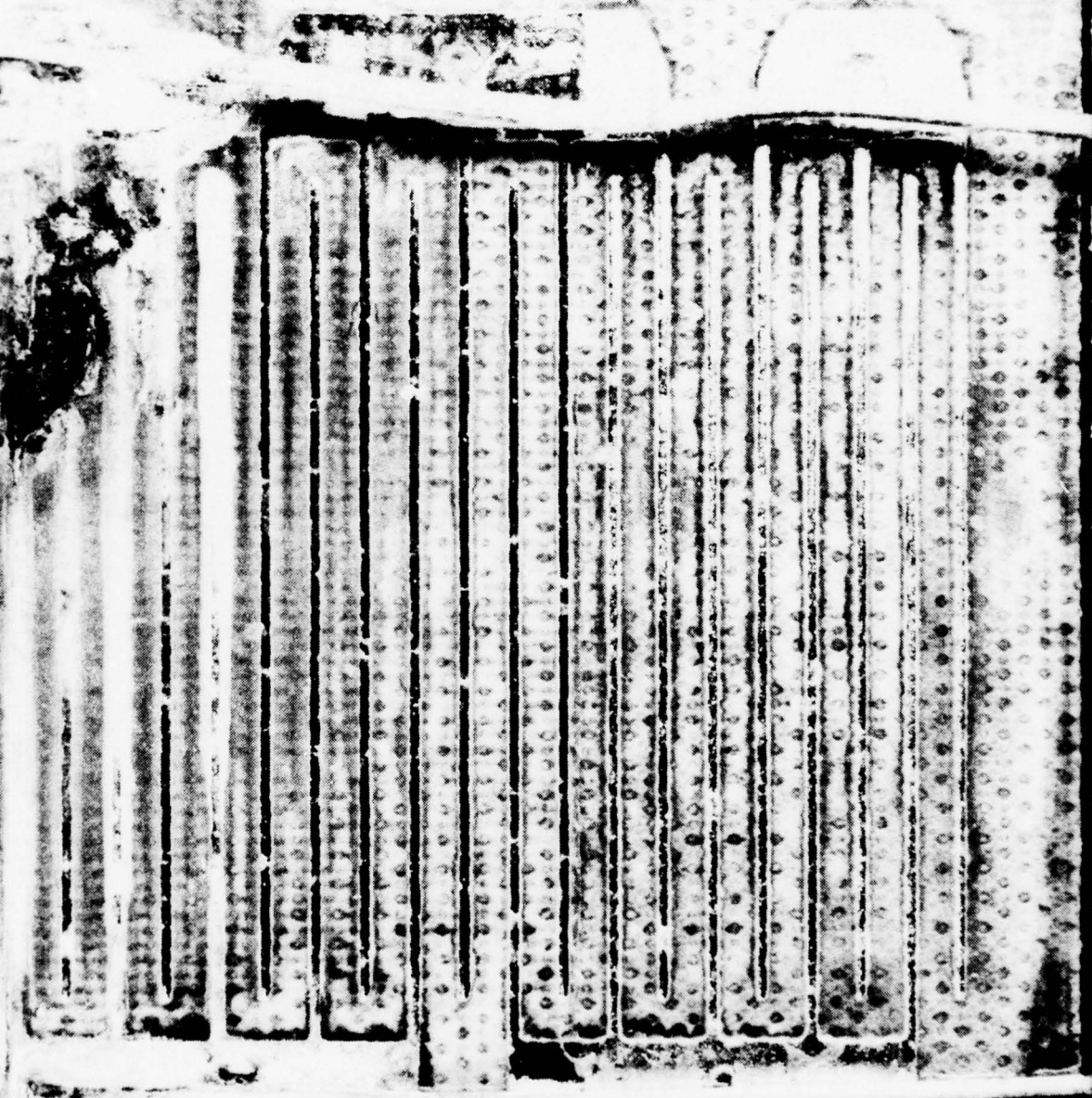
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1C100C

A-3

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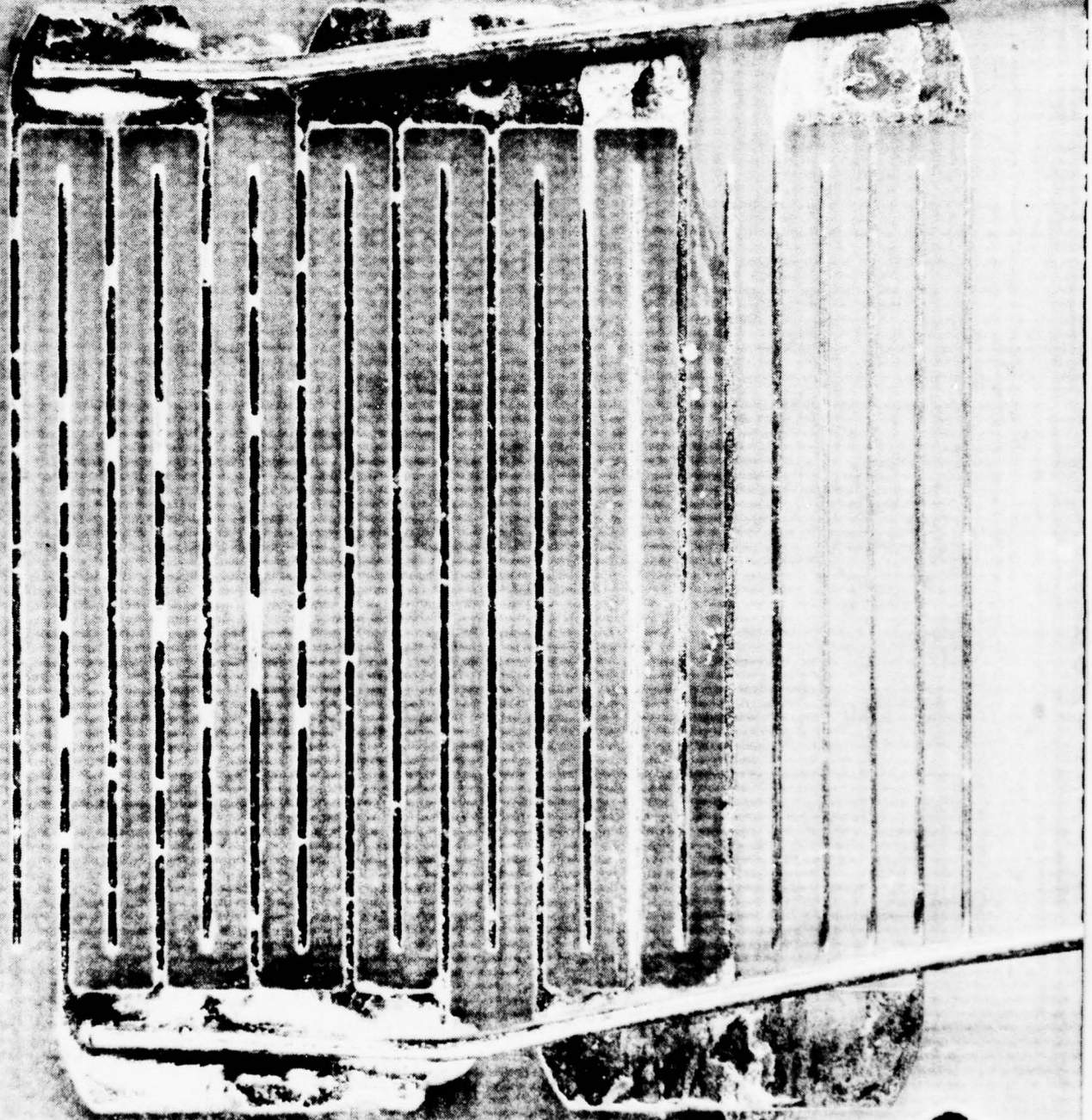


4C100C

4C100C

A-4

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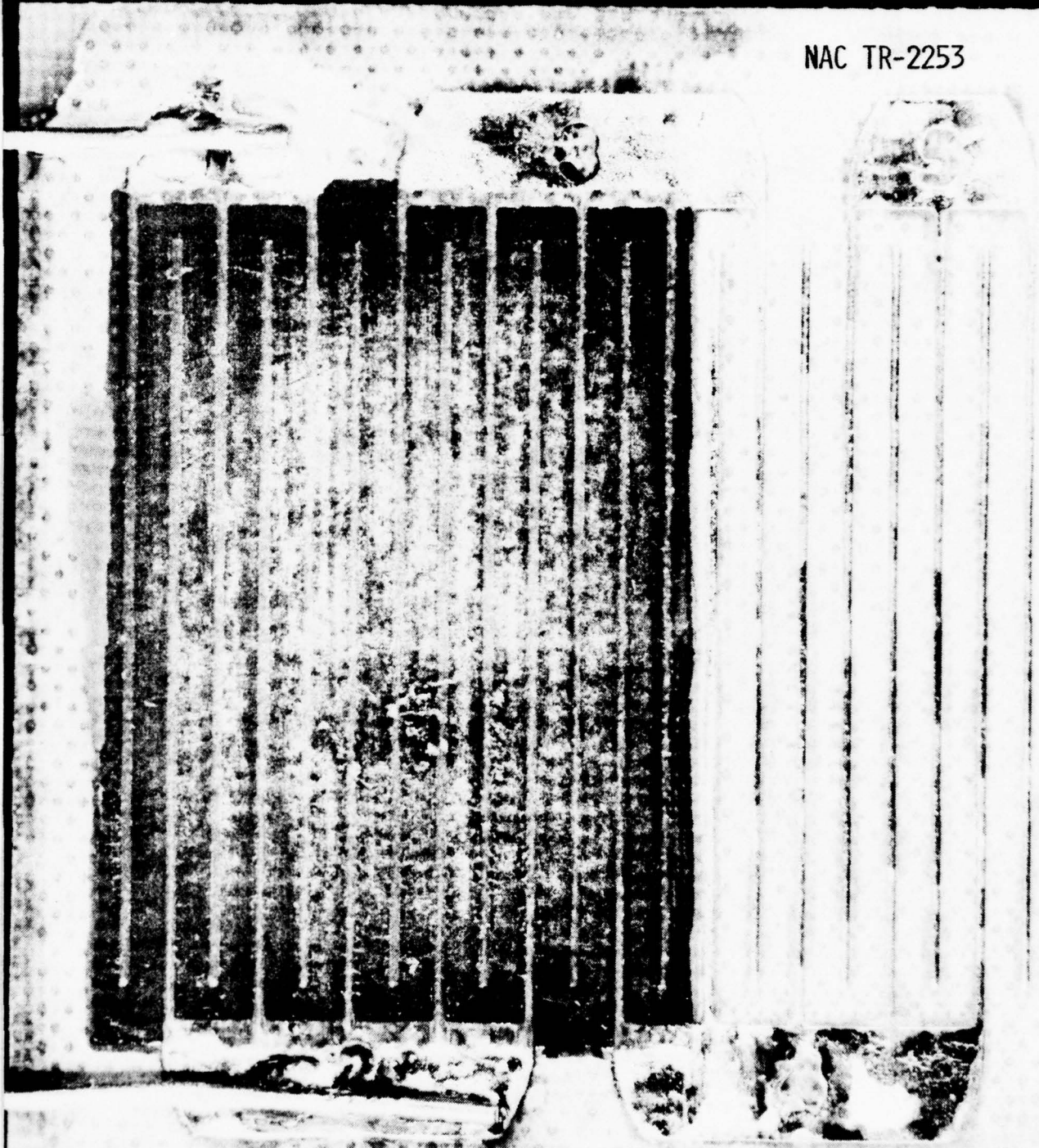


4A100C

4A100C

A-5

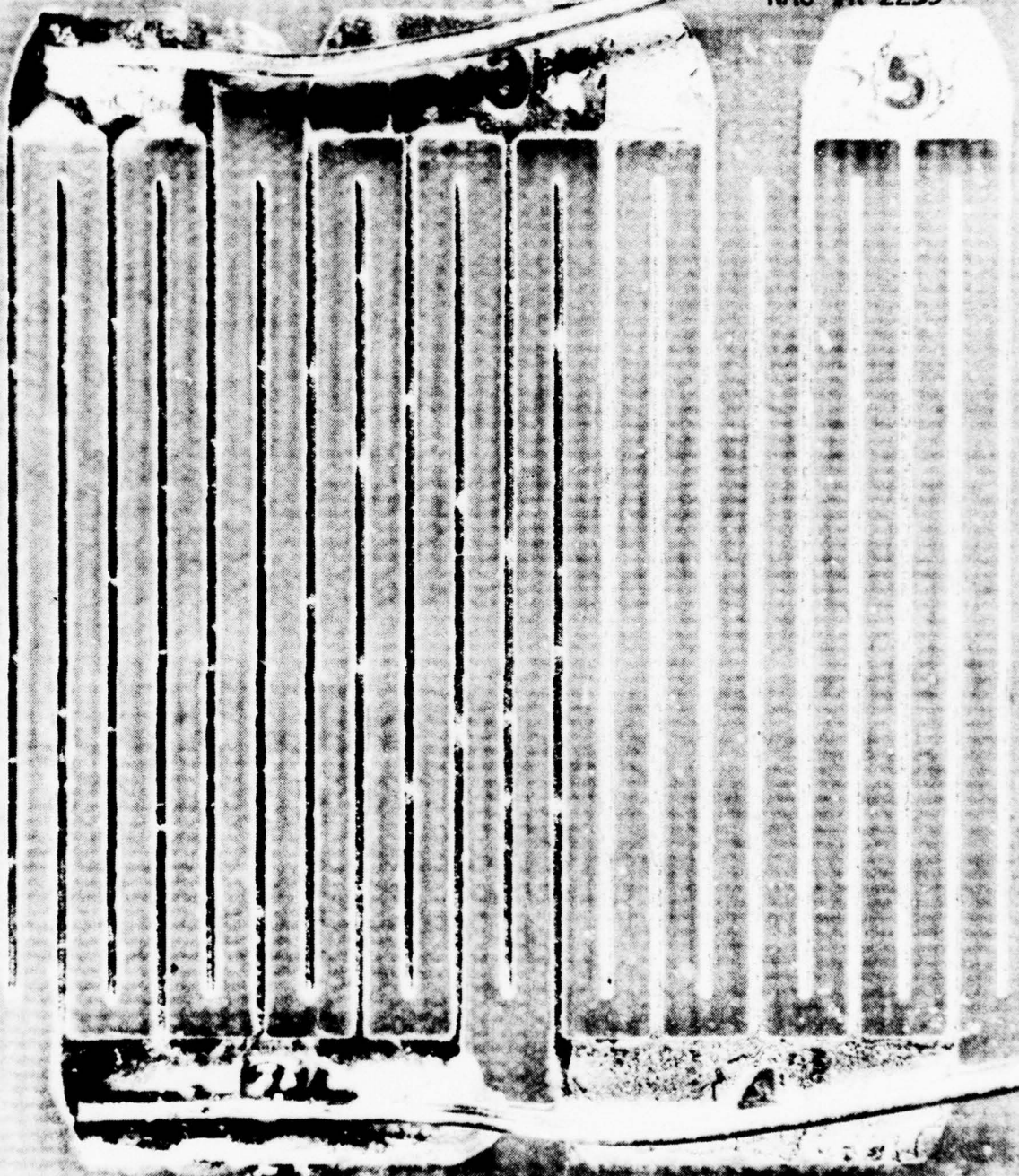
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2B100S

A-6

NAC IR-2253



3A1006

A-7

RAW DATA

72 HR. DELAY BEFORE FLUX REMOVAL

FLUX TYPE (A)
CONFORMAL COATED
0 VOLTS

FLUX TYPE (A)
CONFORMAL COATED
100 VOLTS

DAYS	Insulation Resistance - OHMS					Insulation Resistance - OHMS			
	Spec 1	Spec 2	Spec 3	Spec 4	Control#1	Spec 1	Spec 2	Spec 3	Spec 4
3	3.15×10^{11}	4.7×10^{10}	2.05×10^9	8×10^9	1.7×10^{10}	5.3×10^{10}	1.18×10^{11}	6.5×10^{10}	1.88×10^{10}
5	5.5×10^7	2×10^9	1.84×10^9	3.9×10^{10}	9.4×10^8	3.3×10^8	10.2×10^{10}	1.84×10^{11}	1.86×10^{10}
6	1.2×10^8	3.5×10^9	1.81×10^9	1.21×10^{10}	7.7×10^8	5.3×10^7	8.3×10^{10}	10.6×10^{10}	1.8×10^{10}
7	6.5×10^7	$.97 \times 10^{10}$	1.9×10^9	7.35×10^9	1.08×10^9	6×10^8	8.5×10^{10}	1.23×10^{11}	1.87×10^{10}
10	6.5×10^7	5.5×10^7	2.1×10^9	3.5×10^9	1.3×10^9	5.0×10^8	4.8×10^{10}	5.5×10^{10}	1.68×10^{10}
	SOLDER MASK 0 VOLTS				Control#2	SOLDER MASK 100 VOLTS			
3	4.5×10^{10}	7.6×10^{10}	5.4×10^9	5×10^8	1.66×10^9	4.75×10^{10}	1.58×10^{10}	1.74×10^{10}	2.9×10^{10}
5	9×10^{10}	1.56×10^9	9.6×10^8	3.95×10^8	1.52×10^9	4.45×10^{10}	1.52×10^{10}	1.62×10^{10}	2.3×10^{10}
6	5.6×10^{10}	5.7×10^{10}	4.65×10^9	5.9×10^9	1.64×10^9	3.9×10^{10}	1.32×10^{10}	1.54×10^{10}	1.9×10^{10}
7	2.95×10^9	4×10^{10}	10.2×10^9	8.4×10^9	2.55×10^9	3.35×10^{10}	1.47×10^{10}	1.7×10^{10}	1.72×10^{10}
10	6.2×10^9	1.7×10^9	1.14×10^{10}	1.2×10^{10}	3.5×10^9	11.0×10^9	1.34×10^{10}	1.5×10^{10}	1.58×10^{10}

RAW DATA

72 HR. DELAY BEFORE FLUX REMOVAL

FLUX TYPE (B)

FLUX TYPE (B)

CONFORMAL COATED
0 VOLTS

CONFORMAL COATED
100 VOLTS

DAYS	Insulation Resistance - OHMS				Insulation Resistance - OHMS			
	Spec 1	Spec 2	Spec 3	Spec 4	Spec 1	Spec 2	Spec 3	Spec 4
3	7.9×10^9	3.75×10^7	1.3×10^9	8.2×10^8	5.9×10^{11}	1.84×10^{12}	7.3×10^{10}	4.35×10^{11}
5	3.3×10^9	3×10^7	1.18×10^{10}	1.26×10^{10}	1.34×10^9	1.2×10^{10}	4.6×10^{10}	2.3×10^{10}
6	4.9×10^9	2.45×10^7	1.1×10^{10}	1.6×10^{10}	1×10^9	1×10^{10}	3.95×10^{10}	2.2×10^{10}
7	4.6×10^9	2.6×10^7	1.27×10^{10}	1.08×10^{10}	27×10^7	1.8×10^{10}	3.95×10^{10}	23×10^{10}
10	2.45×10^9	1.85×10^7	4.0×10^9	7.1×10^9	15×10^{12}	27×10^{12}	11×10^{12}	18×10^{12}
	SOLDER MASK 0 VOLTS				SOLDER MASK 100 VOLTS			
3	1.66×10^{10}	9×10^{10}	3.3×10^{10}	3.35×10^{10}	2.85×10^{11}	2.05×10^{11}	2.45×10^{12}	1.14×10^{11}
5	2.65×10^9	2.7×10^{10}	6.4×10^9	5.1×10^9	2.75×10^{10}	2.05×10^{10}	1.04×10^{11}	1.68×10^{10}
6	2.1×10^9	2.85×10^{10}	5.3×10^9	3.8×10^9	2.5×10^{10}	2×10^{10}	1.22×10^{11}	1.66×10^{10}
7	2.1×10^9	1.74×10^9	4.85×10^9	3.1×10^9	1.62×10^{10}	1.93×10^{10}	6.4×10^{10}	1.74×10^{10}
10	30×10^{12}	1.54×10^{10}	5.8×10^9	4.1×10^9	24×10^{12}	21×10^{12}	24×10^{12}	30×10^{12}

RAW DATA

72 HR. DELAY BEFORE FLUX REMOVAL

FLUX TYPE (C)

FLUX TYPE (C)

CONFORMAL COATED
0 VOLTS

CONFORMAL COATED
100 VOLTS

DAYS	Insulation Resistance - OHMS				Insulation Resistance - OHMS			
	Spec 1	Spec 2	Spec 3	Spec 4	Spec 1	Spec 2	Spec 3	Spec 4
3	3.65×10^{10}	3.4×10^{10}	2.5×10^{10}	8.4×10^{10}	1.5×10^{11}	2.45×10^{11}	1.72×10^{11}	1.76×10^{11}
5	1.7×10^{10}	9.4×10^8	5.6×10^8	4.9×10^8	1.2×10^8	1.84×10^{10}	1.4×10^{10}	1.86×10^{10}
6	1.28×10^{10}	2.15×10^9	4.85×10^9	2.7×10^9	9.2×10^7	1.8×10^{10}	8.8×10^9	1.84×10^{10}
7	2.2×10^{10}	3.2×10^9	8.4×10^9	2.75×10^9	9.0×10^7	1.92×10^{10}	7.3×10^9	21×10^9
10	3.5×10^{10}	8.5×10^9	8.2×10^8	4.95×10^9	4.2×10^8	1.32×10^{10}	2.2×10^9	2.1×10^{10}
	SOLDER MASK 0 VOLTS				SOLDER MASK 100 VOLTS			
3	9.7×10^9	2.8×10^9	2×10^9	8.7×10^9	1.4×10^{11}	1.48×10^{11}	1.6×10^{11}	1.64×10^{11}
5	2.9×10^9	2.6×10^9	2.45×10^9	9×10^9	6.8×10^9	1.98×10^{10}	3.5×10^9	1.48×10^{10}
6	3.3×10^9	2.9×10^9	2.5×10^9	8.2×10^9	9.4×10^9	6.5×10^9	3.5×10^9	8.4×10^9
7	3.75×10^9	3.2×10^9	2.85×10^9	7.6×10^9	6.5×10^9	1.72×10^{10}	4.5×10^9	3.7×10^9
10	5.9×10^9	5.6×10^9	3.5×10^9	8.5×10^8	8.4×10^9	1.48×10^{10}	2.0×10^9	8.5×10^9

RAW DATA

168 HR. DELAY BEFORE FLUX REMOVAL

FLUX TYPE (A)
CONFORMAL COATED
0 VOLTS

FLUX TYPE (A)
CONFORMAL COATED
100 VOLTS

DAYS	Insulation Resistance - OHMS					Insulation Resistance - OHMS				
	Spec 1	Spec 2	Spec 3	Spec 4	Control#1	Spec 1	Spec 2	Spec 3	Spec 4	
3	3.2×10^8	3.1×10^9	2.5×10^9	1.72×10^9	2.35×10^9	9.0×10^8	5.5×10^{10}	9.3×10^{10}	2.3×10^{10}	
4	2.15×10^8	6.1×10^9	2.52×10^9	7.7×10^9	2.4×10^9	6.7×10^7	5.0×10^{10}	5.1×10^{10}	2.0×10^{10}	
5	18×10^7	3.3×10^9	2.8×10^9	2.15×10^9	3.1×10^9	4.9×10^7	0.94×10^{11}	7.1×10^{10}	2.4×10^{10}	
6	1.3×10^8	1.24×10^{10}	2.95×10^9	4.35×10^{10}	2.55×10^9	4.2×10^7	2.55×10^{10}	3.5×10^{10}	1.84×10^{10}	
7	2.7×10^7	3.3×10^9	3.1×10^9	19×10^8	3.1×10^9	3.0×10^7	2.4×10^{10}	5.5×10^{10}	2.15×10^{10}	
10	7.3×10^7	3.54×10^9	5.2×10^9	9.7×10^8	2.2×10^9	2.8×10^7	4.0×10^{10}	7.0×10^{10}	2.2×10^{10}	
	SOLDER MASK 0 VOLTS						SOLDER MASK 100 VOLTS			
					Control#2					
3	6.9×10^{10}	1.47×10^{10}	2.25×10^{10}	2.3×10^{10}	3.3×10^9	7.3×10^{10}	1.4×10^{10}	2.5×10^{10}	2.25×10^{10}	
4	1.9×10^9	4.1×10^9	6.0×10^8	5.6×10^8	5.5×10^8	6.5×10^{10}	1.36×10^{10}	2.5×10^{10}	2.05×10^{10}	
5	1.74×10^9	4.7×10^8	5.8×10^8	5.6×10^8	1.9×10^8	5.6×10^{10}	1.48×10^{10}	2.55×10^{10}	1.95×10^{10}	
6	1.6×10^9	1.78×10^9	4.25×10^{10}	4.65×10^8	1.58×10^9	4.7×10^{10}	1.34×10^{10}	2.15×10^{10}	1.61×10^{10}	
7	1.7×10^9	3.2×10^9	6.5×10^8	4.2×10^8	1.54×10^9	1.16×10^{10}	1.3×10^{10}	2.0×10^{10}	1.7×10^{10}	
10	12.4×10^8	14.6×10^{10}	5.1×10^8	3.3×10^8	2.2×10^9	2.5×10^{10}	1.2×10^{10}	2.0×10^{10}	1.56×10^{10}	

RAW DATA

168 HR. DELAY BEFORE FLUX REMOVAL

FLUX TYPE (B)
CONFORMAL COATING
0 VOLTS

FLUX TYPE (B)
CONFORMAL COATED
100 VOLTS

DAYS	Insulation Resistance - OHMS					Insulation Resistance - OHMS			
	Spec 1	Spec 2	Spec 3	Spec 4	Control#3	Spec 1	Spec 2	Spec 3	Spec 4
3	1.3×10^9	1.3×10^9	1.6×10^9	4.3×10^9	2.2×10^9	2.5×10^9	3.25×10^{10}	3.7×10^{10}	2.1×10^7
4	1.44×10^9	1.44×10^9	7.1×10^8	3.95×10^9	2.15×10^{10}	2.05×10^{10}	4.15×10^9	3.1×10^{10}	2.05×10^7
5	2.1×10^9	1.18×10^{10}	7.7×10^8	5.3×10^9	18.5×10^9	3.5×10^9	4.35×10^{10}	3.86×10^{10}	2.04×10^7
6	2.8×10^9	1.27×10^9	10×10^8	4.9×10^9	2.0×10^{10}	6.8×10^8	4.0×10^{10}	4.1×10^{10}	2.0×10^7
7	7.1×10^8	2.7×10^9	7.8×10^8	4.2×10^9	2.1×10^{10}	12.2×10^8	4.5×10^{10}	3.8×10^{10}	2.0×10^7
10	2.5×10^9	7.0×10^8	5.1×10^8	3.7×10^9	3.1×10^{10}	13.8×10^{10}	2.8×10^{10}	2.5×10^{10}	5.3×10^6
	SOLDER MASK 0 VOLTS					SOLDER MASK 100 VOLTS			
3	1.54×10^9	12.0×10^8	4.6×10^8	2.6×10^9		2.3×10^{10}	1.94×10^{10}	5.7×10^{10}	2.25×10^{10}
4	7.4×10^9	1.32×10^9	1.36×10^9	3×10^9		2.15×10^{10}	4.95×10^{10}	2.25×10^{10}	2.25×10^{10}
5	1.97×10^9	1.18×10^9	3.15×10^9	3×10^9		2.0×10^{10}	1.73×10^{10}	4.0×10^{10}	2.15×10^{10}
6	1.94×10^9	1.8×10^9	5.9×10^8	2.8×10^9		1.92×10^{10}	1.62×10^{10}	3.6×10^{10}	2.1×10^{10}
7	1.82×10^9	1.8×10^9	3.8×10^9	2.7×10^9		1.84×10^{10}	1.56×10^{10}	3.2×10^{10}	1.98×10^{10}
10	1.4×10^9	5.1×10^8	2.5×10^8	2.1×10^9		1.6×10^{10}	1.42×10^{10}	2.5×10^{10}	1.6×10^{10}

RAW DATA

168 HR. DELAY BEFORE FLUX REMOVAL

FLUX TYPE (C)
CONFORMAL COATED
0 VOLTS

FLUX TYPE (C)
CONFORMAL COATED
100 VOLTS

DAYS	Insulation Resistance - OHMS				Insulation Resistance - OHMS			
	Spec 1	Spec 2	Spec 3	Spec 4	Spec 1	Spec 2	Spec 3	Spec 4
3	1.6×10^9	1.14×10^9	7.8×10^8	4.0×10^8	17.0×10^9	1.46×10^{10}	1.56×10^{10}	1.72×10^{10}
4	8.6×10^9	2.75×10^9	3.25×10^9	7.1×10^9	1.8×10^{10}	1.24×10^{10}	1.52×10^{10}	1.7×10^{10}
5	2.8×10^{10}	8.7×10^9	9.1×10^9	1.56×10^{10}	1.84×10^{10}	1.15×10^{10}	1.56×10^{10}	1.68×10^{10}
6	14.2×10^{10}	1.08×10^{10}	2.7×10^{10}	8.7×10^8	1.8×10^{10}	1.08×10^{10}	1.52×10^{10}	1.7×10^{10}
7	2.3×10^9	1.84×10^9	1.6×10^9	7.0×10^9	1.9×10^{10}	1.06×10^{10}	1.52×10^{10}	1.7×10^{10}
10	1.48×10^9	6.2×10^8	7.5×10^8	3.2×10^8	1.68×10^{10}	6.2×10^9	1.34×10^{10}	1.58×10^{10}
	SOLDER MASK 0 VOLTS				SOLDER MASK 100 VOLTS			
3	1.8×10^9	8.3×10^8	10.0×10^8	7.7×10^9	1.84×10^{10}	1.54×10^{10}	2.2×10^{10}	1.78×10^{10}
4	1.42×10^9	3.55×10^9	1.5×10^9	1.07×10^{10}	1.78×10^{10}	1.44×10^9	1.9×10^{10}	1.76×10^{10}
5	1.47×10^9	2.56×10^9	2.3×10^9	1.34×10^{10}	1.84×10^{10}	1.68×10^{10}	1.75×10^{10}	1.54×10^{10}
6	1.6×10^9	3.52×10^9	3.2×10^9	4.1×10^{10}	1.7×10^{10}	1.6×10^{10}	1.28×10^{10}	1.44×10^{10}
7	1.48×10^9	5.0×10^9	3.9×10^9	1.8×10^9	1.6×10^{10}	1.6×10^{10}	5.0×10^6	1.34×10^{10}
10	1.02×10^9	1.74×10^{10}	1.52×10^{10}	8×10^8	1.56×10^{10}	1.38×10^{10}	5×10^6	6×10^6

RAW DATA

IN PLANT, WAVE SOLDERED AND CLEANED
1 MINUTE DELAY BEFORE FLUX REMOVAL

FLUX TYPE (A)
CONFORMAL COATED
0 VOLTS

FLUX TYPE (A)
CONFORMAL COATED
100 VOLTS

DAYS	Insulation Resistance - OMHS				Insulation Resistance - OMHS			
	Spec 1	Spec 2	Spec 3	Spec 4	Spec 1	Spec 2	Spec 3	
1	1.09×10^{10}	7.0×10^9	9.2×10^9	1.3×10^9	1.74×10^{11}	3.3×10^{10}	2.5×10^{10}	
4	2.4×10^8	6.5×10^9	6.7×10^9	2.1×10^9	1.34×10^8	6.8×10^{10}	1.5×10^{11}	
5	7×10^9	4.3×10^{10}	3.9×10^9	3.5×10^{10}	2.5×10^9	3.1×10^{11}	1.76×10^{11}	
6	1.3×10^9	1.62×10^{11}	1.02×10^{10}	5.2×10^9	2.6×10^9	2.6×10^{11}	1.8×10^{11}	
7	1.2×10^9	4.5×10^9	2.3×10^{10}	3.2×10^9	1.9×10^9	2.5×10^{11}	2.0×10^{11}	
8	3.0×10^9	1.52×10^{10}	2.54×10^{10}	4.1×10^{10}	2.1×10^9	2.5×10^{11}	- -	
11	2.5×10^9	5.0×10^{10}	5.4×10^{10}	5.7×10^9	4.5×10^8	2.3×10^{11}	- -	
	SOLDER MASK 0 VOLTS				SOLDER MASK 100 VOLTS			
1	1.38×10^9	1.34×10^9	3.59×10^8	2.9×10^8	2.4×10^{11}	1.5×10^{10}	2.2×10^{10}	1.76×10^{10}
4	2.5×10^9	2.1×10^9	1.06×10^9	7.2×10^8	10.4×10^{10}	2.3×10^{10}	3.0×10^{10}	2.6×10^{10}
5	1.48×10^{11}	9.0×10^9	6.0×10^{10}	6.0×10^9	16.0×10^{11}	9.7×10^{10}	10.0×10^{10}	1.2×10^{11}
6	1.1×10^{11}	1.58×10^{10}	8.3×10^9	2.6×10^{10}	4.7×10^{11}	8.4×10^{10}	1×10^{11}	1.08×10^{11}
7	3.0×10^{10}	4.9×10^{10}	4.0×10^9	6.0×10^9	3.6×10^{11}	10.3×10^{10}	1.5×10^{11}	1.2×10^{11}
8	2.54×10^{10}	11.2×10^{11}	4.52×10^9	9.0×10^9	1.06×10^{11}	9.6×10^{10}	1.06×10^{11}	1.2×10^{11}
11	5.5×10^9	1.4×10^{10}	3.5×10^9	2.0×10^9	1.8×10^{12}	10.0×10^{10}	1.1×10^{11}	1.16×10^{11}

NAC TR-2253

RAW DATA

IN PLANT, WAVE SOLDERED AND CLEANED
1 MINUTE DELAY BEFORE FLUX REMOVAL

FLUX TYPE (B)
CONFORMAL COATED
0 VOLTS

FLUX TYPE (B)
CONFORMAL COATED
100 VOLTS

DAYS	Insulation Resistance - OHMS				Insulation Resistance - OHMS			
	Spec 1	Spec 2	Spec 3	Spec 4	Spec 1	Spec 2	Spec 3	Spec 4
1	1.8×10^{10}	4.5×10^{10}	4.51×10^8		11.2×10^{10}	5.4×10^9	2.3×10^{10}	2.4×10^{10}
4	1.66×10^9	16.0×10^8	4.0×10^8		2.5×10^9	1.3×10^{10}	1.96×10^{11}	2.4×10^{11}
5	3.0×10^{10}	1.32×10^{10}	8.4×10^9		1.87×10^{11}	4.65×10^{11}	6.5×10^{11}	1.84×10^{11}
6	4.6×10^{10}	1.7×10^{11}	- -		3.6×10^{11}	2.8×10^{11}	1.22×10^{12}	2.4×10^{11}
7	1.2×10^{10}	6.5×10^{10}	3.4×10^{10}		6.5×10^{11}	4.3×10^{11}	4.0×10^{11}	2.7×10^{11}
8	1.56×10^{10}	2.56×10^{10}	4.0×10^{10}		2.5×10^{11}	4.2×10^{11}	2.58×10^{11}	2.1×10^{11}
11	6.5×10^9	11.4×10^9	6.4×10^9		8.0×10^{10}	2.2×10^{11}	7.0×10^{11}	1.96×10^{11}
	SOLDER MASK 0 VOLTS				SOLDER MASK 100 VOLTS			
1	2.4×10^9	7.4×10^8	3.9×10^9	9.5×10^9	4.0×10^{10}	2.3×10^{10}	1.15×10^{11}	2.3×10^{10}
4	2.3×10^{10}	2.2×10^{10}	5.9×10^{10}	12.0×10^9	2.5×10^{11}	16.0×10^{10}	6.0×10^{11}	1.72×10^{11}
5	2.5×10^{10}	2.95×10^{10}	4.8×10^{10}	1.4×10^{11}	2.4×10^{11}	12.5×10^{10}	7.3×10^{11}	1.1×10^{11}
6	3.45×10^{10}	6.3×10^{10}	1.2×10^{10}	- -	2.5×10^{11}	1.26×10^{11}	1.82×10^{12}	1.04×10^{11}
7	3.5×10^{10}	2.2×10^{10}	5.0×10^9	- -	2.4×10^{11}	1.3×10^{11}	9.0×10^{11}	1.08×10^{11}
8	4.0×10^{10}	15.5×10^9	5.7×10^{11}	7.3×10^9	2.58×10^{11}	13.2×10^{10}	7.7×10^{11}	1.12×10^{11}
11	8.5×10^{10}	4.5×10^9	8.4×10^9	10.0×10^9	3.5×10^{11}	1.24×10^{11}	3.5×10^{11}	1.16×10^{11}

RAW DATA

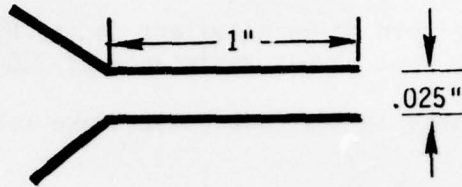
IN PLANT, WAVE SOLDERED AND CLEANED
 1 MINUTE DELAY BEFORE FLUX REMOVAL

FLUX TYPE (C)
 CONFORMAL COATED
 0 VOLTS

FLUX TYPE (C)
 CONFORMAL COATED
 100 VOLTS

DAYS	Insulation Resistance - OHMS				Insulation Resistance - OHMS		
	Spec 1	Spec 2	Spec 3	Spec 4	Spec 1	Spec 2	Spec 3
1	4.5×10^{11}	2.5×10^{10}	6.5×10^9		2.3×10^{10}	15.0×10^9	2.1×10^{10}
4	1.8×10^{10}	6.0×10^9	4.1×10^{10}		1.8×10^{11}	14.0×10^{10}	1.64×10^{11}
5	2.6×10^{10}	1.6×10^{11}	1.4×10^{11}		1.8×10^{11}	9.5×10^{10}	1.4×10^{11}
6	2.7×10^{10}	3.1×10^{10}	3.4×10^{10}		2.05×10^{11}	9.4×10^{10}	1.34×10^{11}
7	3.2×10^{10}	18.5×10^9	2.6×10^{11}		2.5×10^{11}	9.5×10^{10}	1.4×10^{11}
8	8.5×10^9	11.0×10^9	3.1×10^{11}		2.54×10^{11}	10.6×10^{10}	1.58×10^{11}
11	5.0×10^{11}	6.4×10^9	7.0×10^9		1.98×10^{11}	9.9×10^{10}	3.52×10^{10}
	SOLDER MASK 0 VOLTS				SOLDER MASK 100 VOLTS		
1	1.84×10^{10}	13.6×10^8	2.5×10^9	1.4×10^{10}	1.54×10^{10}	1.88×10^{10}	4.53×10^9
4	8.5×10^{10}	5.5×10^{10}	3.2×10^{10}	11.0×10^9	1.36×10^{11}	1.6×10^{11}	1.7×10^{11}
5	7.4×10^{10}	8.8×10^{10}	3.7×10^{10}	1.5×10^{10}	12.2×10^{10}	12.6×10^{10}	12.0×10^{10}
6	7.5×10^{10}	2.5×10^{11}	5.1×10^{10}	4×10^{10}	1.08×10^{11}	1.28×10^{11}	1.1×10^{11}
7	1.7×10^{10}	10.2×10^9	5.2×10^{10}	8.3×10^9	1.1×10^{11}	1.5×10^{11}	1.22×10^{11}
8	7.9×10^{10}	2.0×10^{10}	5.3×10^{10}	15.0×10^9	1.2×10^{11}	2.2×10^{11}	1.36×10^{11}
11	5.8×10^{10}	15.5×10^9	2.9×10^{10}	3.56×10^9	1.1×10^{11}	8.6×10^{10}	- -

EQUILIBRATION OF COMB
PATTERN TO MIL-P-55110
TRUMPET PATTERN



MIL-P-55110 TRUMPET PATTERN

1. Number of resistance squares

$$\frac{1.00''}{.025''} = 40 \text{ squares}$$

2. Assume the squares are resistors connected in parallel

$$\frac{1}{R_T} = \frac{1}{R_1} + \frac{1}{R_2} + \dots + \frac{1}{R_{40}}$$

$$\frac{1}{R_T} = \frac{40}{R_S}$$

Where $R_T = 500 \times 10^6$ ohms per MIL-P-55110

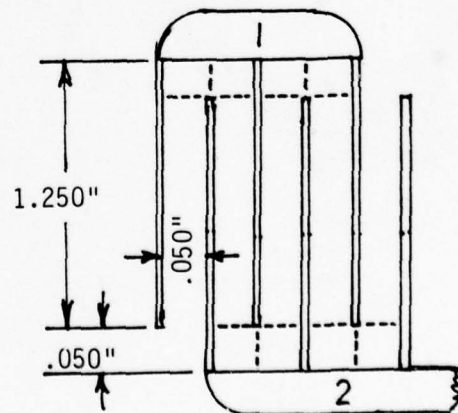
R_S = resistance of each square.

3. $R_T = \frac{R_S}{40}$

4. $500 \times 10^6 = \frac{R_S}{40}$

$$R_S = 200 \times 10^8 \text{ ohms}$$

Resistance measured portion
of comb pattern specimen



5. Number of resistance squares

$$\frac{1.250'' - .050''}{.050''} \times 5 + 8 \text{ corner squares at the ends of the conductors} = 128 \text{ squares.}$$

6. For this comb pattern to be equivalent to the MIL-P-55110 trumpet pattern, each square must have a resistance of 200×10^8 ohms.

7. Assumes the squares in the comb pattern are resistors in parallel

$$\frac{1}{R_T} = \frac{1}{R_1} + \frac{1}{R_2} + \dots + \frac{1}{R_{128}}$$

$$\frac{1}{R_T} = \frac{128}{R_S}$$

where

$$R_T = \text{total resistance}$$

$$R_S = 200 \times 10^8 \text{ ohms}$$

8.
$$R_T = \frac{R_S}{128}$$

9.
$$R_T = \frac{200 \times 10^8}{128}$$

$$R_T \approx 1.5 \times 10^8 \text{ ohms}$$

10. Therefore, the comb pattern specimen has a MIL-P-55110 equivalent value of 1.5×10^8 ohms. Any resistance value less than this during testing was a failure.

TABLE IV
 FORMULA FOR LINEAR REGRESSION LINES OF RESISTANCE VS TIME AND ANALYSIS OF LINE SLOPES
 72 HOUR DELAY BEFORE FLUX REMOVAL

CONDITIONS	"A" FLUX	"B" FLUX	"C" FLUX
0 Volts Electrical Stress, Conformally Coated	$\log R = -0.222T+1.7$	$\log R = -0.00839T+0.3202$	$\log R = -0.0703T+1.231$
100 Volts Electrical Stress, Conformally Coated	$\log R = -0.0776T+0.745$	$\log R = -0.505T+3.112$	$\log R = -0.203T+1.202$
0 Volts Electrical Stress, Solder Mask Coated	$\log R = -0.00505T+0.921$	$\log R = -0.109T+1.547$	$\log R = -0.0203T+0.7057$
100 Volts Electrical Stress, Solder Mask Coated	$\log R = -0.0377T+0.523$	$\log R = -0.229T+1.875$	$\log R = -0.168T+1.160$
\bar{X} Slopes	- 0.0856	- 0.213	- 0.115
σ Slopes	0.1828	0.1859	0.07334
$\bar{X} + 3\sigma$	0.1629	0.3448	0.1046
$\bar{X} - 3\sigma$	- 0.3341	- 0.7705	- 0.3354
Trend of Slopes Is	Negative	Negative	Negative

TABLE V
 FORMULA FOR LINEAR REGRESSION LINES OF RESISTANCE VS TIME AND ANALYSIS OF LINE SLOPES
 168 HOUR DELAY BEFORE FLUX REMOVAL

CONDITIONS	"A" FLUX	"B" FLUX	"C" FLUX
0 Volts Electrical Stress, Conformally Coated	$\log R = -0.0309T + 0.3834$	$\log R = -0.0229T - 0.0399$	$\log R = -0.0659T + 0.9007$
100 Volts Electrical Stress, Conformally Coated	$\log R = -0.0534T + 0.2055$	$\log R = -0.0833T + 0.7896$	$\log R = -0.0254T + 0.2768$
0 Volts Electrical Stress, Solder Mask Coated	$\log R = -0.0796T + 1.838$	$\log R = -0.0286T + 0.425$	$\log R = 0.0323T + 0.3096$
100 Volts Electrical Stress, Solder Mask Coated	$\log R = -0.0346T + 0.5373$	$\log R = -0.0286T + 0.5196$	$\log R = -0.264T + 1.273$
\bar{X} Slopes	- 0.0496	- 0.04085	- 0.0808
σ Slopes	0.01929	0.02462	0.1114
$\bar{X} + 3\sigma$	0.008259	0.03301	0.2535
$\bar{X} - 3\sigma$	- 0.1075	- 0.1147	- 0.4149
Trend Of Slopes Is	Negative	Negative	Negative

TABLE VI
 FORMULA FOR LINEAR REGRESSION LINES OF RESISTANCE VS TIME AND ANALYSIS OF LINE SLOPES
 IN PLANT, WAVE SOLDERED, 1 MINUTE DELAY BEFORE FLUX REMOVAL

CONDITIONS	"A" FLUX	"B" FLUX	"C" FLUX
0 Volts Electrical Stress, Conformally Coated	$\log R = -.0538T + 0.567$	$\log R = 0.0547T - 0.221$	$\log R = -0.00838T + 0.609$
100 Volts Electrical Stress, Conformally Coated	$\log R = -0.0498T + 0.755$	$\log R = 0.112T - 0.4649$	$\log R = 0.0488T - 2.694$
0 Volts Electrical Stress, Solder Mask Coated	$\log R = -0.0116T + 0.2076$	$\log R = 0.055T - 0.0574$	$\log R = 0.0342T + 0.1962$
100 Volts Electrical Stress, Solder Mask Coated	$\log R = 0.0805T + 0.5388$	$\log R = 0.0588T - 0.898$	$\log R = 0.0904T + 0.454$
\bar{X} Slopes	-.008675	0.07013	0.04126
σ Slopes	.0546	0.02423	0.0353
$\bar{X} + 3\sigma$.1535	0.1428	0.1472
$\bar{X} - 3\sigma$	-.1708	- 0.002566	- 0.06466
Trend of Slopes Is	Negative	Positive	Positive

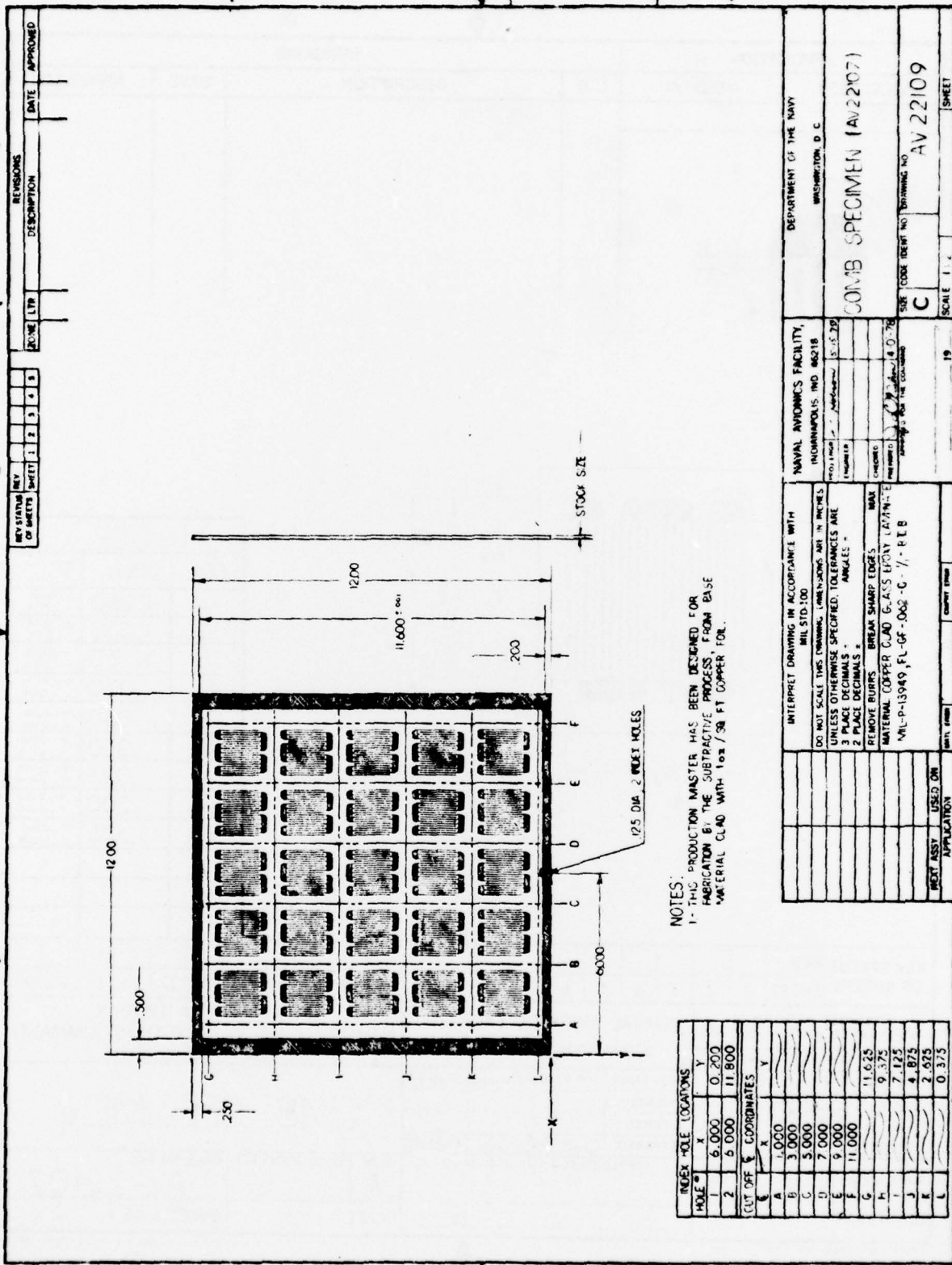
TABLE VII
MIL-P-28809 IONIC CONTAMINANTS TEST

CLEANING DELAY	"A" FLUX RESISTIVITY, OHM-CM X 10 ⁶	"B" FLUX RESISTIVITY, OHM-CM X 10 ⁶	"C" FLUX RESISTIVITY, OHM-CM X 10 ⁶	BEGINNING RESISTIVITY OF WASH SOLUTION
72 Hour Specimen 1 Specimen 2	10.4 15.7	4.3 3.7	4.4 4.6	29 X 10 ⁶ ohm-cm
168 Hour Specimen 1 Specimen 2 Specimen 3	8.8 9.7 10.0	2.0 1.0 1.02	2.0 2.05 2.0	37 X 10 ⁶ ohm-cm
1 Minute In Plant Wave Solder & Clean Specimen 1	7.0	6.2	5.2	23 X 10 ⁶ ohm-cm

APPLICATION		REVISIONS				
NEXT ASSY	USED ON	LTR	DESCRIPTION	DATE	APPROVED	

TABLE		
CODE	DIM.	TOL.
L ₁	1.250	+ .000 - .004
L ₂	1.550	+ .000 - .004
L ₃	1.750	+ .000 - .004
S ₁	.050	+ .004 - .000
S ₂	.050	+ .004 - .000
S ₃	.050	+ .004 - .000
W ₁	.025	+ .000 - .004
W ₂	.200	+ .000 - .004
W ₃	1.525	+ .000 - .004

REV STATUS OF SHEETS	REV SHEET	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
INTERPRET DRAWING IN ACCORDANCE WITH MIL-STD-100		NAVAL AVIONICS FACILITY INDIANAPOLIS, IND. 46218										DEPARTMENT OF THE NAVY NAVAL SYSTEMS COMMAND WASHINGTON, D. C. 20360										
DIMENSIONS ARE IN INCHES		UNLESS OTHERWISE SPECIFIED, TOLERANCES ARE: 3 PLACE DECIMALS ± 2 PLACE DECIMALS ± ANGLES ±		PROJ ENGR <i>W. T. Nelson</i> 5-12-78		COMB SPECIMEN																
				ENGINEER		APPROVED FOR THE COMMAND										SIZE A		CODE IDENT NO.		DRAWING NO. AV-22107		
				CHECKED												SCALE 1 : 1		SHEET 1 OF 1				
MATL ENGR				PREPARED <i>J. L. ...</i> 4-06-78																		
CMPNT ENGR																						



NOTES:

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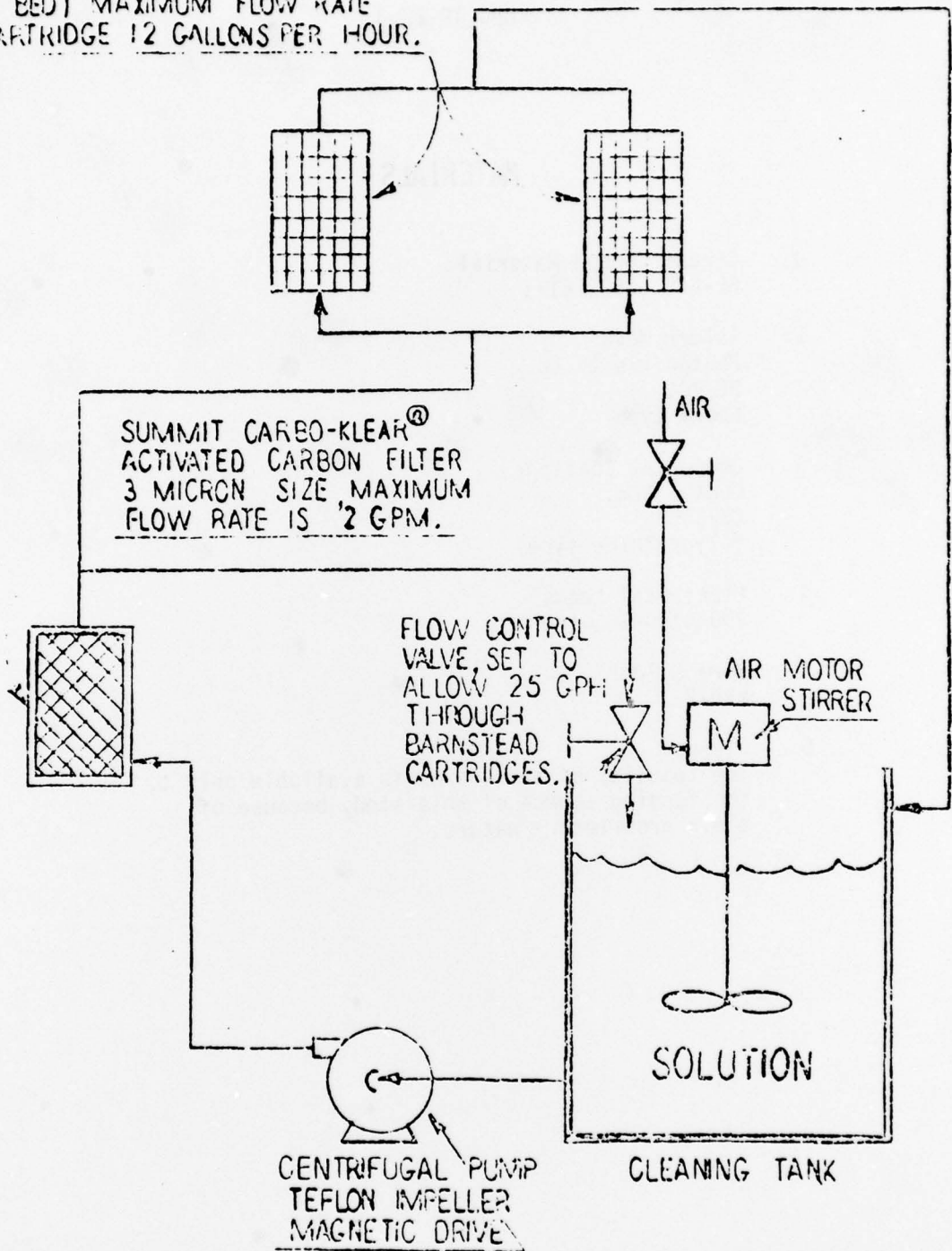
INDEX HOLE LOCATIONS	
HOLE #	COORDINATES
1	6.000 0.200
2	6.000 11.800
CUT OFF COORDINATES	
X	Y
A	1.000
B	3.000
C	5.000
D	7.000
E	9.000
F	11.000
G	11.625
H	9.375
I	7.125
J	4.875
K	2.625
L	0.375

DEPARTMENT OF THE NAVY WASHINGTON, D. C.	
NAVAL AVIONICS FACILITY, INDIANAPOLIS, IND 46218	
INTERPRET DRAWING IN ACCORDANCE WITH MIL-STD-100	DATE: 12-15-79 DRAWN BY: [signature] CHECKED BY: [signature]
DO NOT SCALE THIS DRAWING. DIMENSIONS ARE IN INCHES. UNLESS OTHERWISE SPECIFIED, TOLERANCES ARE: 3 PLACE DECIMALS ± .005 2 PLACE DECIMALS ± .010 ANGLES ± .1°	
REMOVE BURRS BREAK SHARP EDGES MAX MATERIAL COPPER 6.00 G. ASS. 1471N7-E MIL-P-15949, FL-GF-066-G-1/- PEB	
TITLE: CONVB SPECIMEN (AV22107)	SHEET NO: AV 22109
SIZE: CODE IDENT NO: [blank] REVISION NO: [blank]	SCALE: 1:1

REV	STATUS	REV OF SHEETS	REV DESCRIPTION	DATE	APPROVED
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2	REV	2			
3	REV	3			
4	REV	4			
5	REV	5			

BARNSTEAD HOSE NIPPLE
 CARTRIDGE D 8902 ULTRA-PURE
 (MIXED BED) MAXIMUM FLOW RATE
 PER CARTRIDGE 12 GALLONS PER HOUR.

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SYSTEM SOLUTION

75% 2-PROPANOL
 25% DEIONIZED WATER
 APPROXIMATELY 1.2 GALLONS

DRAWN BY <i>J. Carlson</i>				CLEANING SYSTEM SCHEMATIC	
PROJ. ENGR. <i>N.E. 12/27/77</i>	SIZE A	CODE IDENT NO. 02387	DRAWING NO. AV 21922		
DATE 8-2-77	SCALE	REV	SHEET 1 of 1		

MATERIALS

1. Circuit Board Material
FL-GF, .062, C1/1
2. Solder Mask
Photocircuits Co.
PC-401
Epoxy type
3. Conformal Coating
Conap, Inc.
CE-1155
Polyurethane type
4. Electrical Leads
200AS100-18 wire
5. Wire Solder
WRP-2
6. Fluxes
The identity of the fluxes is available only to
the funding source of this study because of
their proprietary nature.

EQUIPMENT

1. Temperature and Humidity Chamber
Blue M Co.
Model FR-256BP
2. Power Supply
Lambda Co.
Model LP-534-FM
3. Megohm Bridge
General Radio Co.
Model 1644-A
4. Vapor Cleaner
Acra Electric Corp.
Spee Degreaser Model D-3
5. Infra-Red Solder Fusing Machine
Research, Inc.
Model 4384
6. Wave Soldering System
Plant fabricated using equipment
from the following companies:
Hollis Engineering Inc.
Electrovert Co.
Branson Equipment Co.
7. MIL-P-28809 Apparatus as described
in Naval Avionics Center Materials
Research Report 3-78

UNCLASSIFIED

Security Classification

DOCUMENT CONTROL DATA - R&D

(Security classification of title, body of abstract and indexing annotation must be entered when the overall report is classified)

1. ORIGINATING ACTIVITY (Corporate author) Naval Avionic Center Indianapolis, Indiana 46218		2a. REPORT SECURITY CLASSIFICATION UNCLASSIFIED	
		2b. GROUP	
3. REPORT TITLE ⑥ Deleterious Effect of MIL-F-14256, Type RA Fluxes on Printed Wiring Boards			
4. DESCRIPTIVE NOTES (Type of report and inclusive dates) Technical Report - 31 January 1979			
5. AUTHOR(S) (Last name, first name, initial) Pond, David O. / Pond		⑨ Technical Rept. 1 Jan 78-4 Jan 79	
⑩	6. REPORT DATE 31 January 1979	7a. TOTAL NO. OF PAGES 54	7b. NO. OF PAGES
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10. AVAILABILITY/LIMITATION NOTICES APPROVED FOR PUBLIC RELEASE; DISTRIBUTION UNLIMITED			
11. SUPPLEMENTARY NOTES ⑫ 58 p.		12. SPONSORING MILITARY ACTIVITY RADC	
13. ABSTRACT This study identified the corrosive effects of Type RA fluxes and flux residues on printed wiring boards subjected to electrical stress in a humid environment at elevated temperature. The effect of varying delay times between soldering and cleaning of flux residues was also studied and the protective value of solder resist and conformal coating was evaluated.			

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14. KEY WORDS	LINK A		LINK B		LINK C	
	ROLE	WT	ROLE	WT	ROLE	WT
RA Fluxes Printed Circuit Boards Corrosion Testing						

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Naval Avionics Center (NAC Report
TR-2253)

Deleterious Effect of MIL-F-14256,
Type RA Fluxes on Printed Wiring
Boards, by David O. Pond, 31 Jan 1979
UNCLASSIFIED, 54 p.

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