Final Report

for

Acceleration Factor Determination for Metal Film Resistors

(29 June, 1963 - 1 March, 1967)

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Prepared by

Electra Manufacturing Company

Independence, Kansas

for

George C. Marshall Space Flight Center

Huntsville, Alabama

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Abstract

The purpose of the studies conducted under this contract was to establish acceleration factors for determining the reliability of high stability metal film resistors, to determine modes of failure, and to establish process improvements and stress screening techniques for detecting the presence of the failure modes.

Resistor parameters investigated included initial current noise and nonlinear distortion and deviations in resistance and current noise and nonlinear distortion due to applied stress. A later contract modification included investigation of resistor surface temperature obtained by the measurement of infrared radiation. Stresses applied to the resistors included variations in power and temperature for various intervals of time.

Metal film resistors from three separate manufacturers representing conformal coated, sealed ceramic sleeves and molded construction were tested.

A preliminary sixteen cell matrix of power and temperature was designed to determine the most meaningful stress conditions to be used in extended life testing. Also, in order to determine methods of predicting potential failures, one-half of the resistors in each matrix cell were submitted to various screening techniques. Four test conditions were selected from the sixteen cell matrix to provide one cell with no failures, two cells with intermediate numbers of failures and one cell with a large number of failures. Additional resistors were then subjected to extended life testing utilizing these four stress conditions. Resistance deviation as a function of time from the extended life test was then used in the acceleration factor study. The resistors which were considered failures were then dismantled and examined to determine the failure mode.

During the contract modification mentioned earlier, a number of resistors from each manufacturer were subjected to various conditions of power stress while the surface temperature was measured by means of the infrared radiation. Current noise and nonlinear distortion was also recorded for these resistors. Following the preliminary measurements, the resistors were subjected to an accelerated life test. Resistance deviation due to life test was then compared with current noise, nonlinear distortion and peak surface temperature.

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INTRODUCTION

The purpose of the studies conducted under this contract was to establish acceleration factors for determining the reliability of high stability metal film resistors, to determine modes of failure, and to establish process improvements and stress screening techniques for detecting the presence of the failure modes.

Resistor parameters investigated included initial current noise and nonlinear distortion and deviations in resistance, and current noise and nonlinear distortion due to applied stress. A later contract modification included investigation of resistor surface temperature obtained by the measurement of infrared radiation. Stresses applied to the resistors included variations in power and temperature for various intervals of time.

Metal film resistors from three separate manufacturers representing conformal coated, sealed ceramic sleeves and molded construction were tested.

A preliminary sixteen cell matrix of power and temperature was designed to determine the most meaningful stress conditions to be used in extended life testing. Also, in order to determine methods of predicting potential failures, one-half of the resistors in each matrix cell were submitted to various screening techniques. Deviations in resistor parameters occurring during the matrix tests were compared for screened and unscreened resistors to determine the effects of screening. Four test conditions were selected from the sixteen cell matrix to provide one cell with no failures, two cells with intermediate numbers of failures and one cell with a large number of failures. Additional resistors were then subjected to extended life testing utilizing these four stress conditions. Resistance deviation as a function of time from the extended life test was then used in the acceleration factor study. The resistors which were considered failures were then dismantled and examined to determine the failure mode.

During the contract modification mentioned earlier, a number of resistors from each manufacturer were subjected to various conditions of power stress while the surface temperature was measured by means of the infrared radiation. Current noise and nonlinear distortion was also recorded for these resistors. Following the preliminary measurements, the resistors were subjected to an accelerated life test. Resistance deviation due to life test was then compared with current noise, nonlinear distortion and peak surface temperature. The infrared temperature profiles were also examined for anomalies.

The following sections of this report describe in detail the studies conducted, the procedures followed, and the results obtained.

DISCUSSION AND RESULTS

Resistor Construction

The resistors on which these studies were conducted are precision metal film resistors of the RN55C type. They are 1/10 watt units designed to operate at full rated power at 125°C derated linearly to zero power at 175°C. The maximum temperature coefficient of resistance is ± 50 parts per million per degree centigrade. The composition of the films was not determined. However, the resistance elements were produced by the condensation of a film of evaporated metal onto the ceramic substrate under high vacuum conditions.

Process A is a ceramic core resistor with the metal film resistive element deposited on the outside of the core. The terminations are fired gold. It has press-fitted end cap and lead assemblies. The cap is of round construction with a No. 22 AWG tinned copper lead wire attached by staking. The ceramic core is tubular in shape and is .050 inches in diameter by .200 inches in length with a .018 inch diameter hole longitudinally through the center. The completed assembly is conformally coated with a varnish or enamel protective coating. The coated resistor body is .250 inches long by .187 inches in diameter.

Process B is a ceramic core resistor with the metal film resistive element deposited on the outside of the core. The terminations are fired gold. It has press-fitted end cap and lead assemblies. The cap is of round construction with a No. 22 AWG tinned copper lead wire attached by butt welding. The ceramic core is tubular in shape and is .159 inches long by .055 inches in diameter with a .018 inch diameter hole longitudinally through the center. The completed assembly is sealed in a ceramic sleeve with epoxy end seals. The sealed assembly is then coated with a varnish or enamel protective coating. The finished resistor body is .093 inches in diameter by .260 inches long.

Process C is also a ceramic core resistor with the metal film resistive element deposited on the outside of the core. The terminations are fired gold. It has press-fitted end cap and lead assemblies. The cap is of octagonal design with a No. 22 AWG tinned copper lead wire attached by mechanical staking. The ceramic core is tubular in shape and is .062 inches in diameter by .176 inches in length with a .021 inch diameter hole longitudinally through the center. The completed assembly is conformally coated with a varnish or enamel protective coating and molded in a glass filled, thermosetting plastic. The molded resistor body is .118 inches in diameter by .257 inches in length.

An X ray of the three types of construction is shown in Fig. 1.

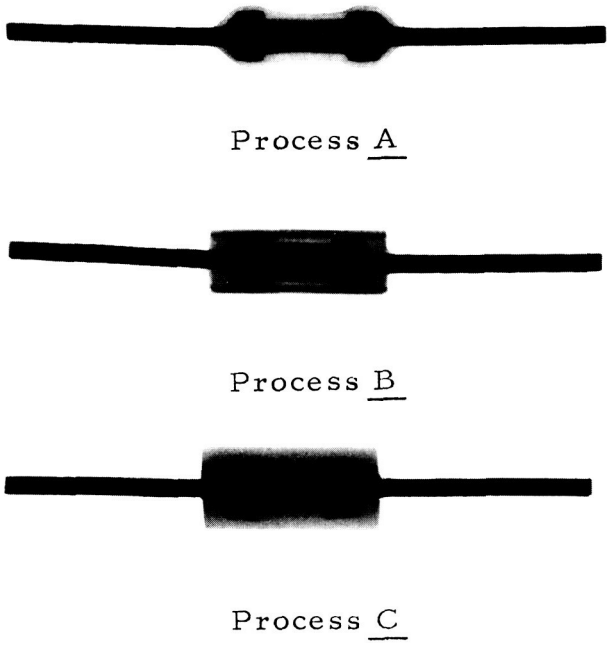


Figure 1. X-ray photograph of the three construction types. (Mag approximately 3.5X)

Figures 2, 3 and 4 are photographs of the three types of resistors in cross section. The magnification is approximately 20X and serves to show the similarities of substrates and the differences in cap and lead construction as well as the differences in encapsulating systems.

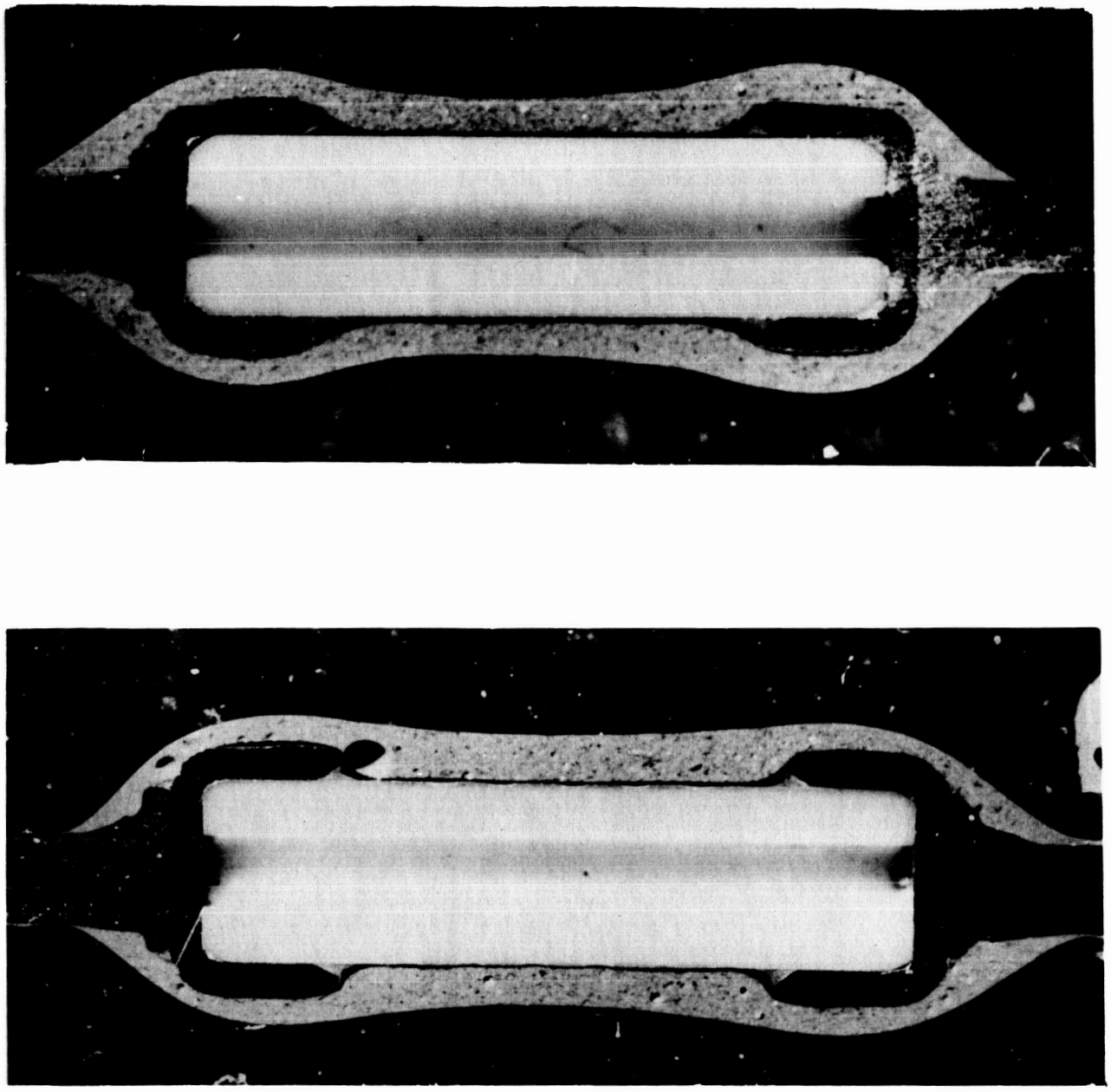
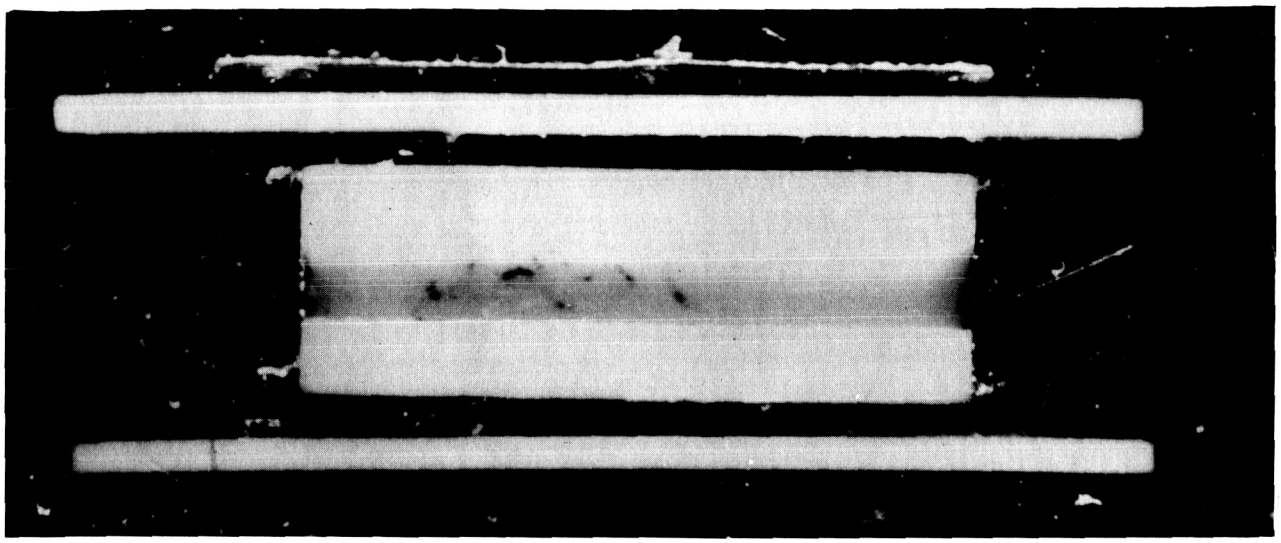


Figure 2. Cross section of Process A 100Ω and 39.2KΩ resistors. (Mag. approximately 20X)



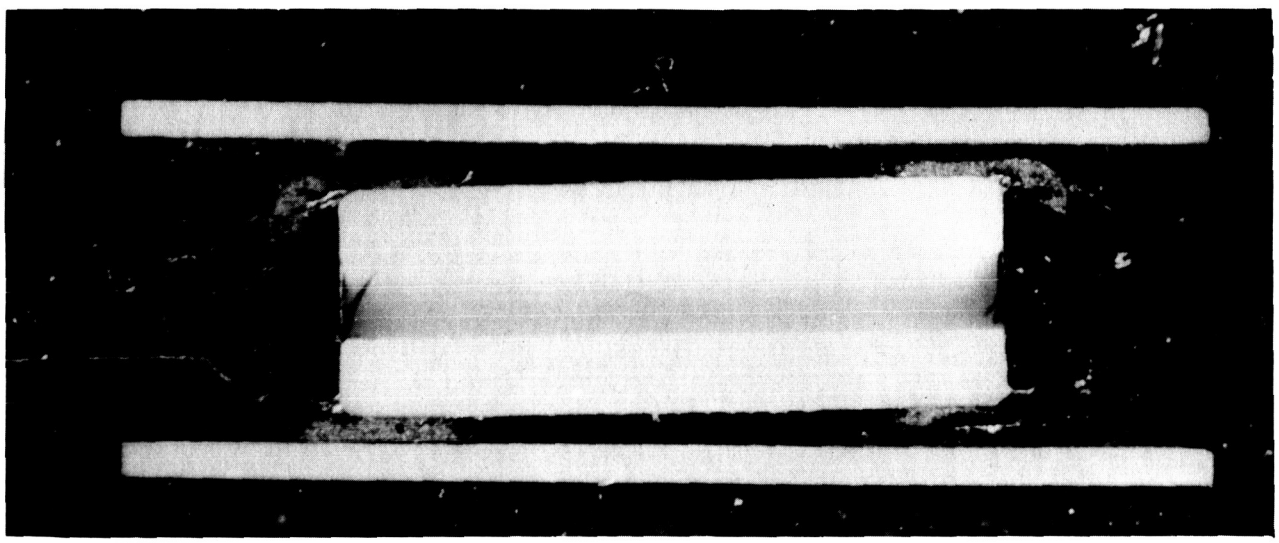


Figure 3. Cross section of Process B 100Ω and 39.2KΩ resistors. (Mag. approximately 20X)

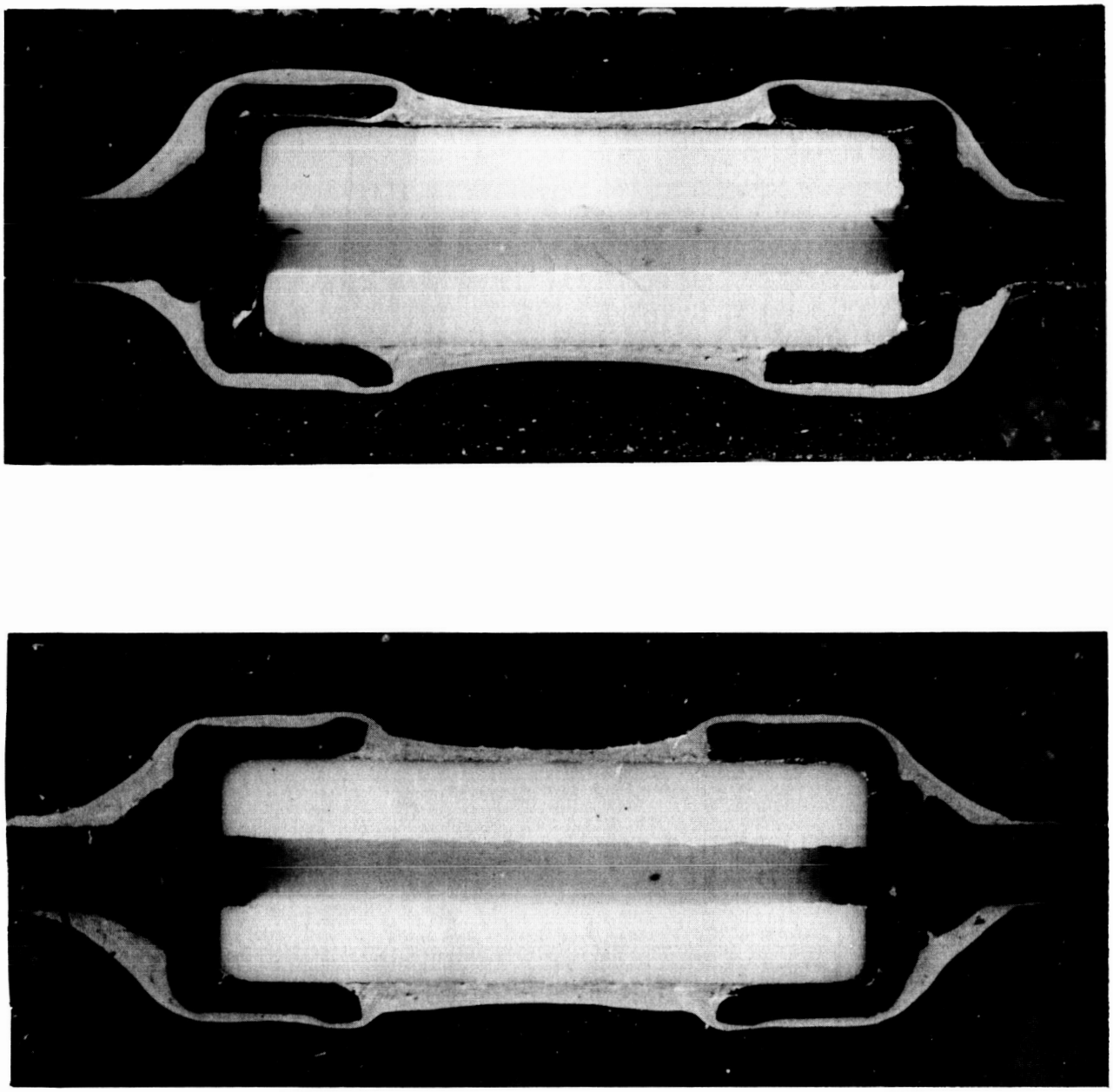


Figure 4. Cross section of Process C 100Ω and 39.2KΩ resistors. (Mag. approximately 20X)

Serialization

In order to maintain positive identification of all resistors throughout the contract performance period, each resistor was serialized to identify manufacturing process, resistance range and serial identification. Table I shows the serialization grouping.

Resistance	Manufacturing Process	Serial Numbers
	"A"	
100 ohm		030001 - 030550
39.2K ohms		033001 - 033550
	"B"	
100 ohm		034001 - 034550
39.2K ohms		035001 - 035550
	"C"	
100 ohm		036001 - 036575
39.2K ohms		037001 - 037750

Table I - Serialization

The first three digits indicate resistor style and resistance range, and the last three digits provide serial identification.

These resistors were used in the preliminary 1000 hour life tests, the 4000 hour life tests, all associated screen tests and the acceleration factor study.

Preliminary Life and Screen Tests

In order to determine significant stress conditions for extended life tests, a sixteen cell matrix was designed. The sixteen cells consisted of a combination of one, two and one-half, five and ten times rated power applied to the test resistors at ambient temperatures of 25°C, 70°C, 125°C and 150°C.

The number of resistors in each cell consisted of one-half 100 ohm units and one-half 39.2K ohm units. The quantities shown in Figure II are for each manufacturing process type. One-half of the units of each resistance value were subjected to various screen tests as described below, while the remaining one-half of the units were tested as received. Table II shows the breakdown of test units in the preliminary test matrix as well as the number of units which were used in the 4000 hour extended life tests. The preliminary life tests were conducted for 1000 hours.

Temperature - Power Stresses (1000 hours)					Extended Tests (4000 hours)	
Temp.	Power 1X	Power 2-1/2X	Power 5X	Power 10X	Matrix	Qty.
25°C	40	40	60	40	I	80
70°C	60	60	40	20	II	80
125°C	60	40	20	20	III	80
150°C	60	20	20	20	IV	80
Total	220	160	140	100		
			Total	620	Total	320

Table II - Test Matrix Determination

The screen tests which were performed on those units which were screened were temperature cycling, overstress load, and high temperature stabilization. Each test was preceded and followed by a noise measurement and a resistance measurement. Noise measurements in this phase were performed with an Ericcson Distortion Analyzer, Model ZTP1271. Resistance measurements were performed on an Electro Instrument Model 6200 Deviation Ohmmeter and associated automatic readout equipment.

The temperature cycling was performed in accordance with Method 102 of MIL-STD-202B test condition Letter C except that the extreme high temperature used was 150°C.

Overstress load (S.T.O.L.) consisted of applying a DC test potential, 2.5 times rated continuous working voltage for five seconds. The resistors were mounted in free space with no circulation other than that caused by the heat of the resistors being tested.

High Temperature Stabilization (Burn-In) consisted of operating the resistors at full rated load in still air at 125°C for 100 hours.

In order to determine methods of predicting potential failures, one-half of all test units were screen tested as shown on Table III.

A. Noise Measurement
B. Resistance Measurement
C. Temperature Cycling
D. Noise Measurement
E. Resistance Measurement
F. Overstress Load
G. Noise Measurement
H. Resistance Measurement
I. High Temperature Stabilization
J. Noise Measurement
K. Resistance Measurement

Table III - Screen Tests

Figures 5 through 18 show the distributions of resistance change and noise for each value and type of resistor tested.

In general, the distributions are similar for Types A, B and C. However, Type B is markedly different in Figures 6, 9 and 10, while Type C is different in Figure 12.

Although the differences in distribution are not apparent in all cases, the differences that are apparent serve to indicate different reactions for different construction types when subject to the same test.

Statistical comparisons of the three resistor types tested will be presented later in the report to show that the different types cannot be compared as like units during screen testing.

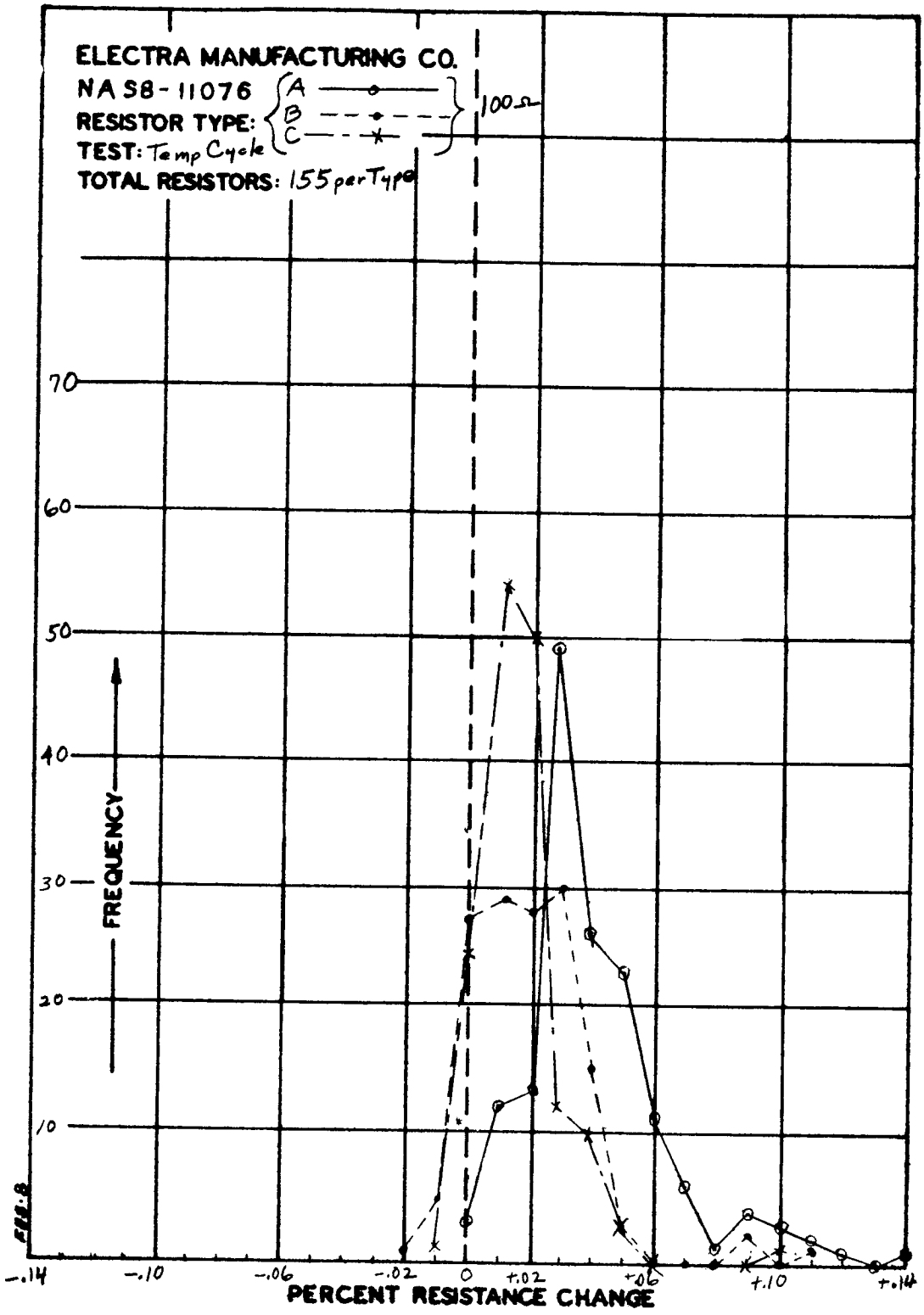


Figure 5. Distribution of resistance change due to Temperature Cycle - 100 ohm

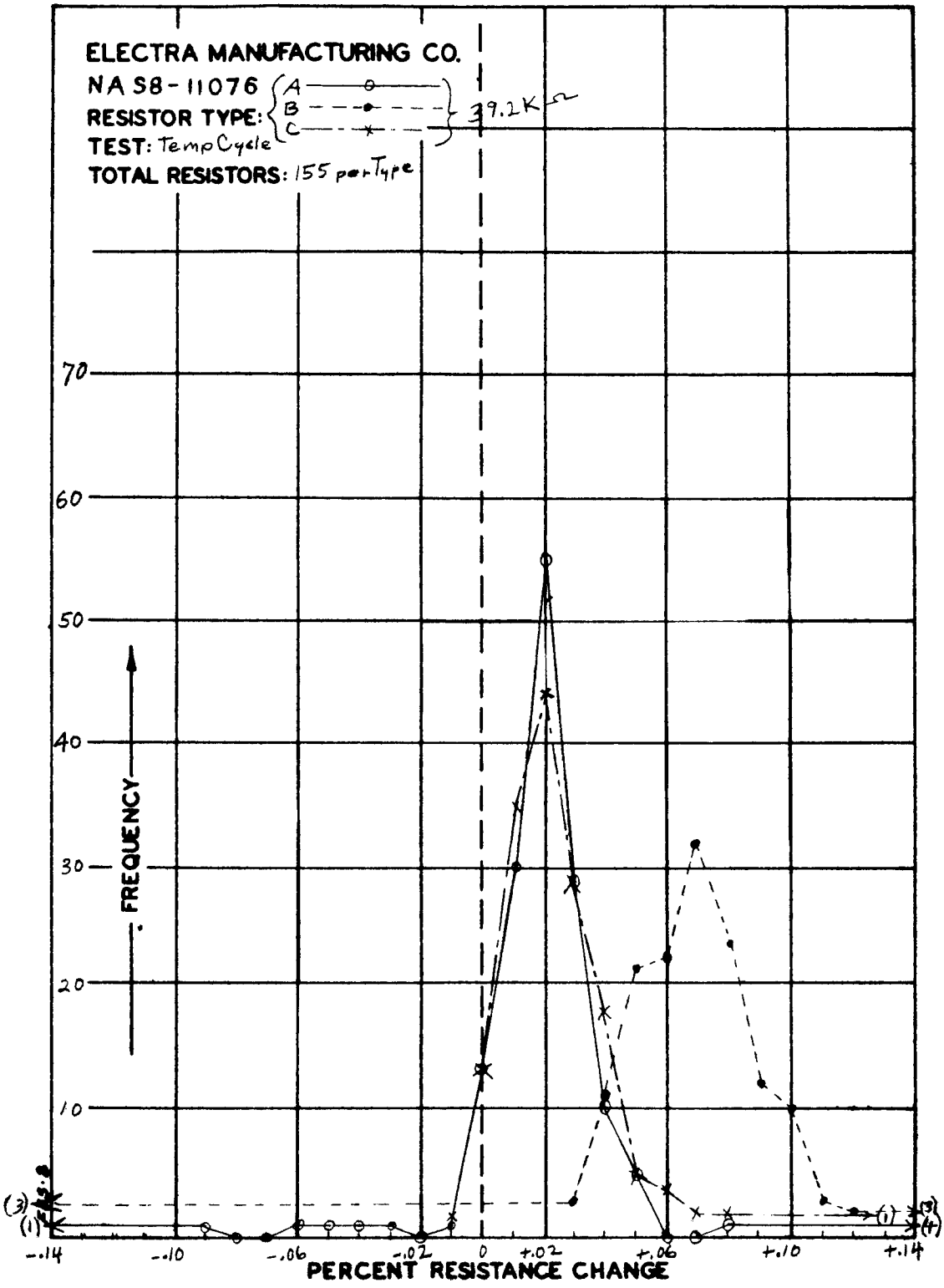


Figure 6. Distribution of resistance change due to Temperature Cycle - 39.2K ohm

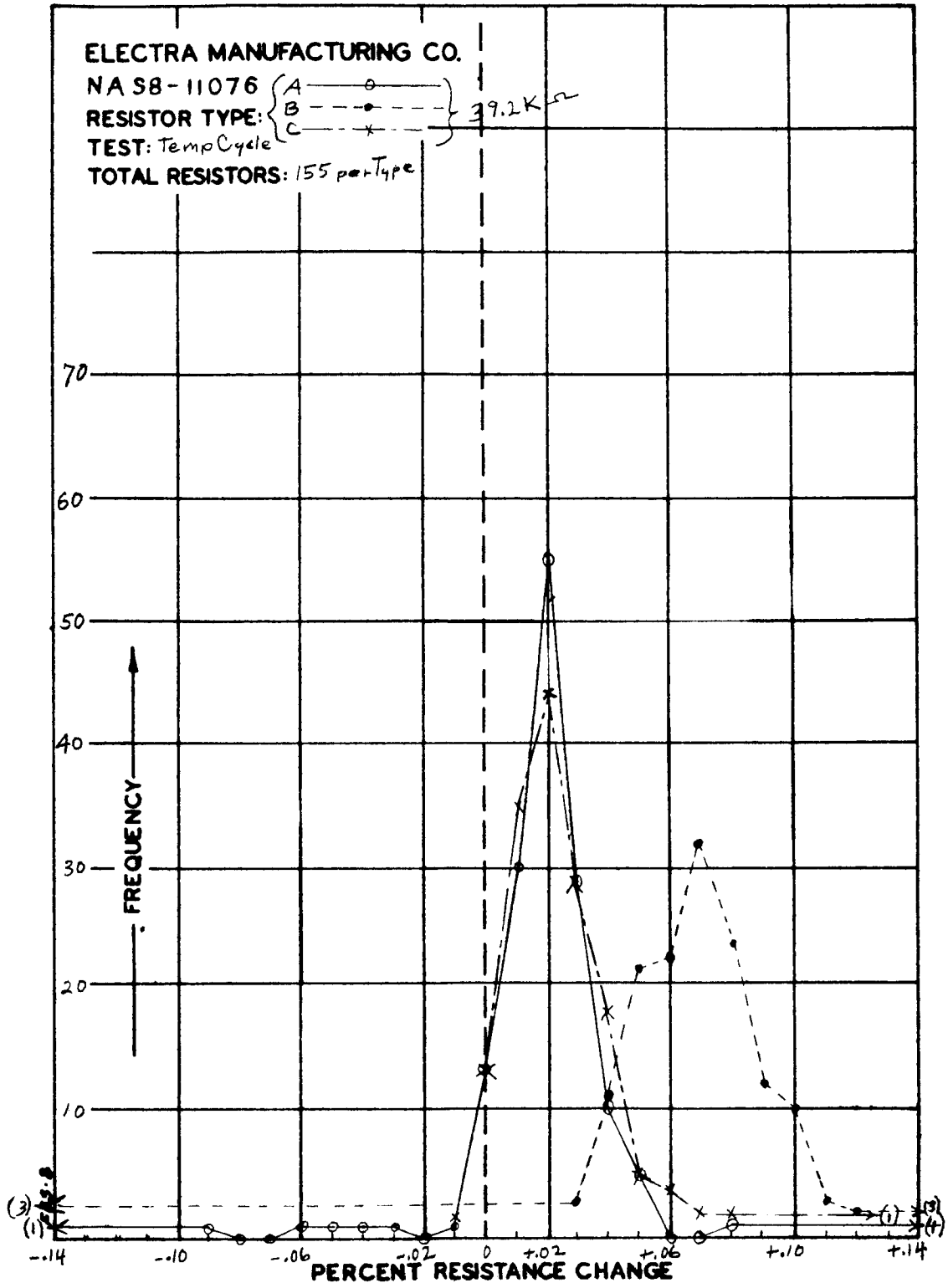


Figure 6. Distribution of resistance change due to Temperature Cycle - 39.2K ohm

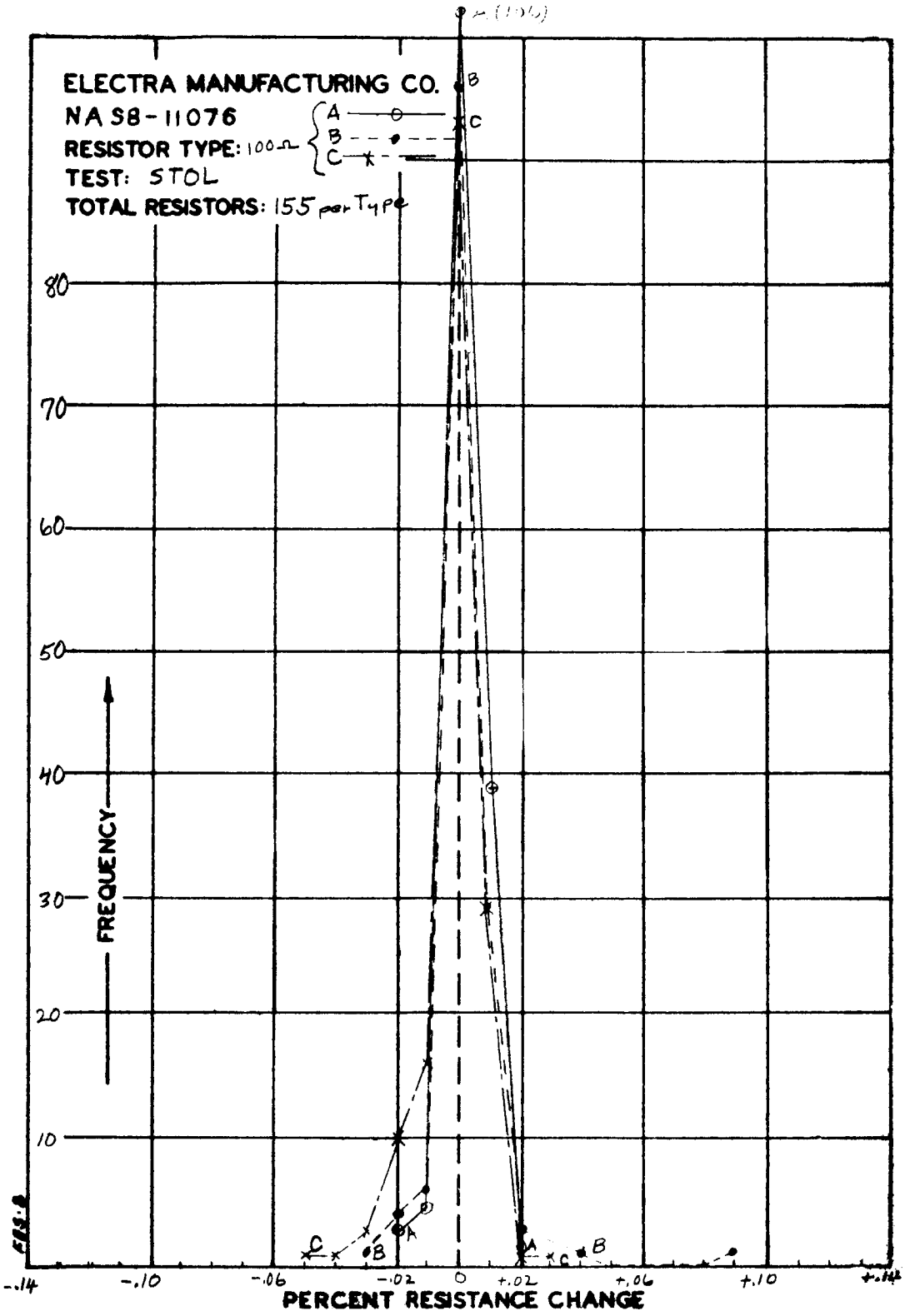


Figure 7. Distribution of resistance change due to Short Time Overload - 100 ohm

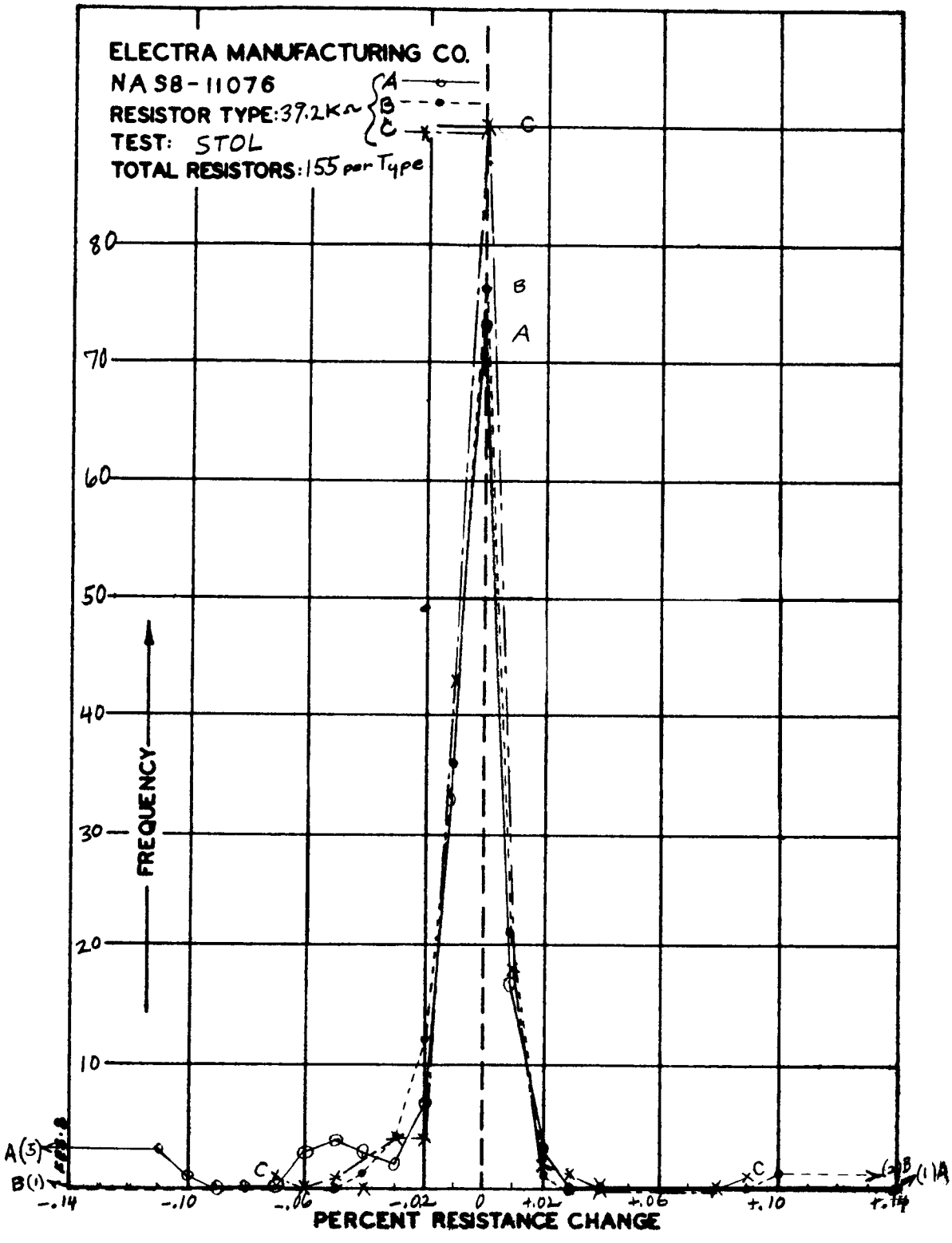


Figure 8. Distribution of resistance change due to Short Time Overload - 39.2K ohm

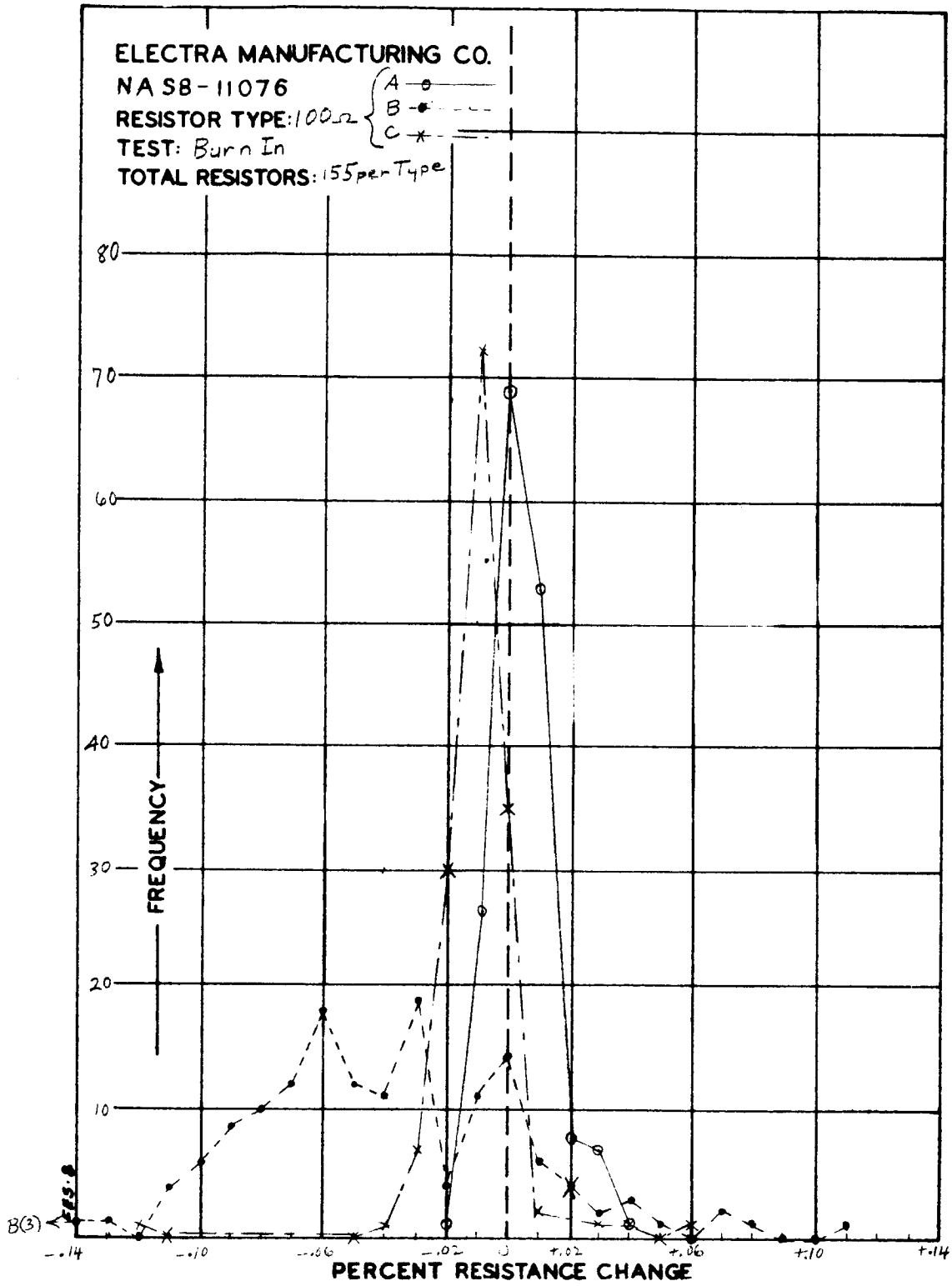


Figure 9. Distribution of resistance change due to Burn-In - 100 ohm

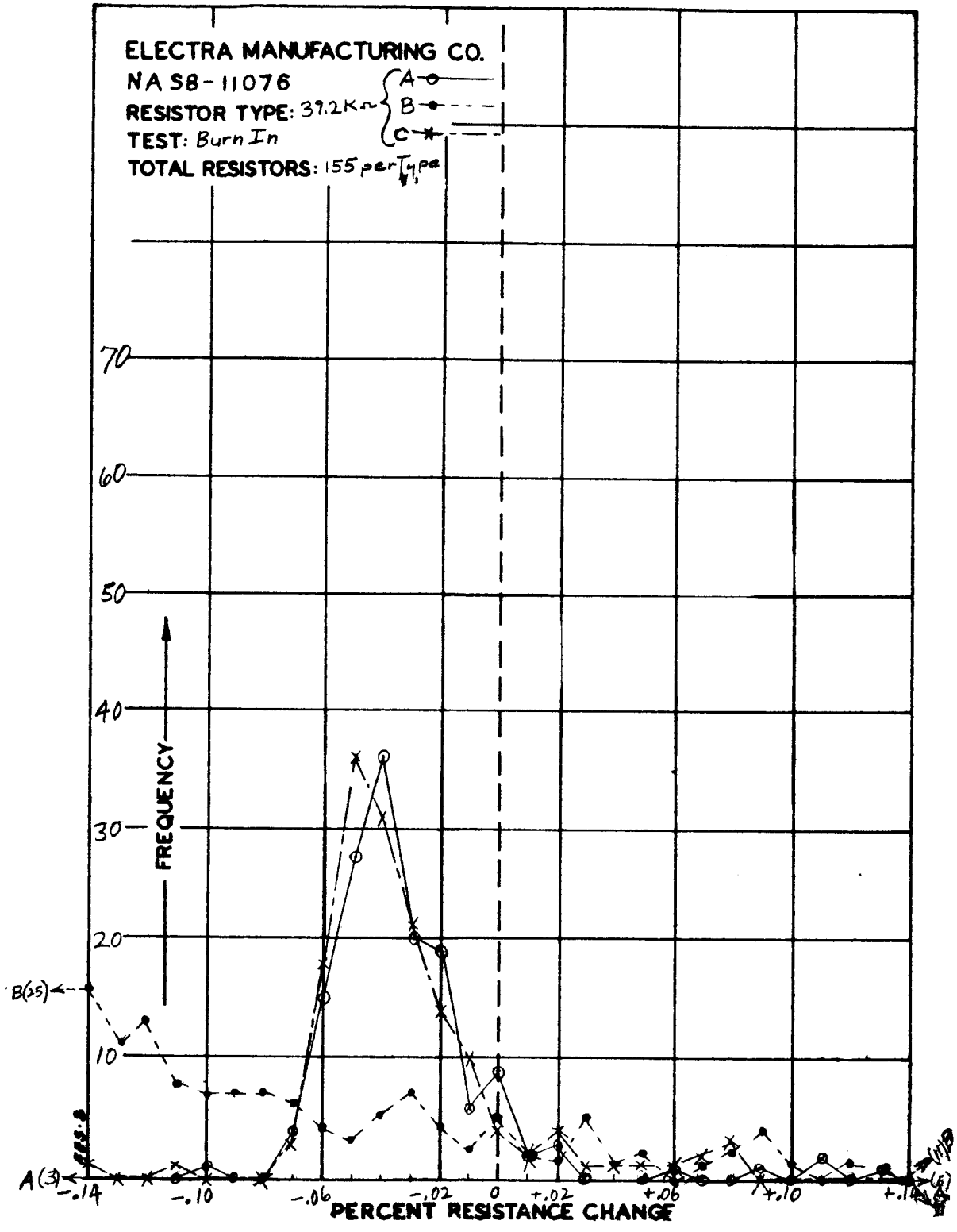


Figure 10. Distribution of resistance change due to Burn-In - 39.2K ohm

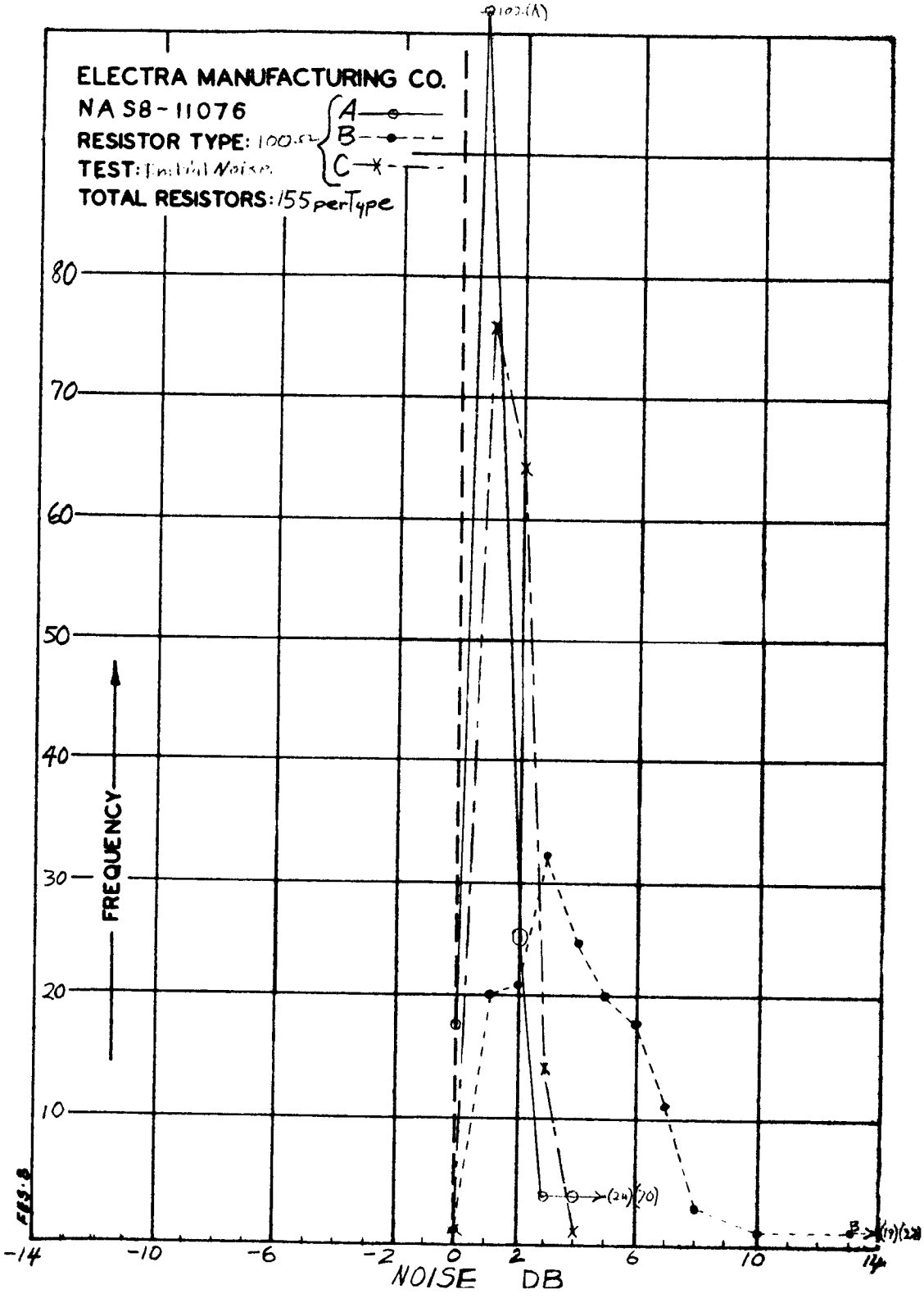


Figure 11. Distribution of Initial Noise - 100 ohm

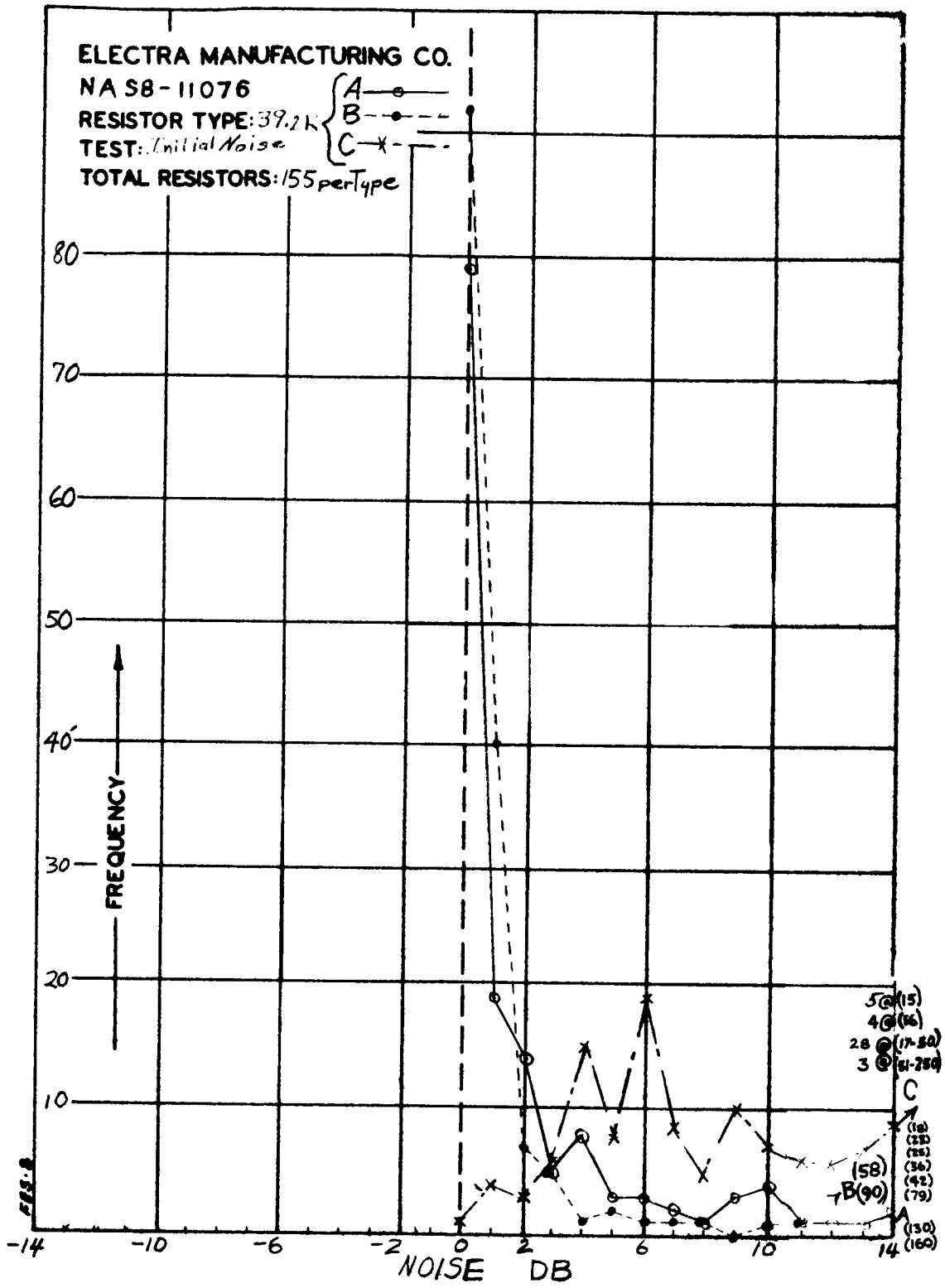


Figure 12. Distribution of Initial Noise - 39.2K ohm

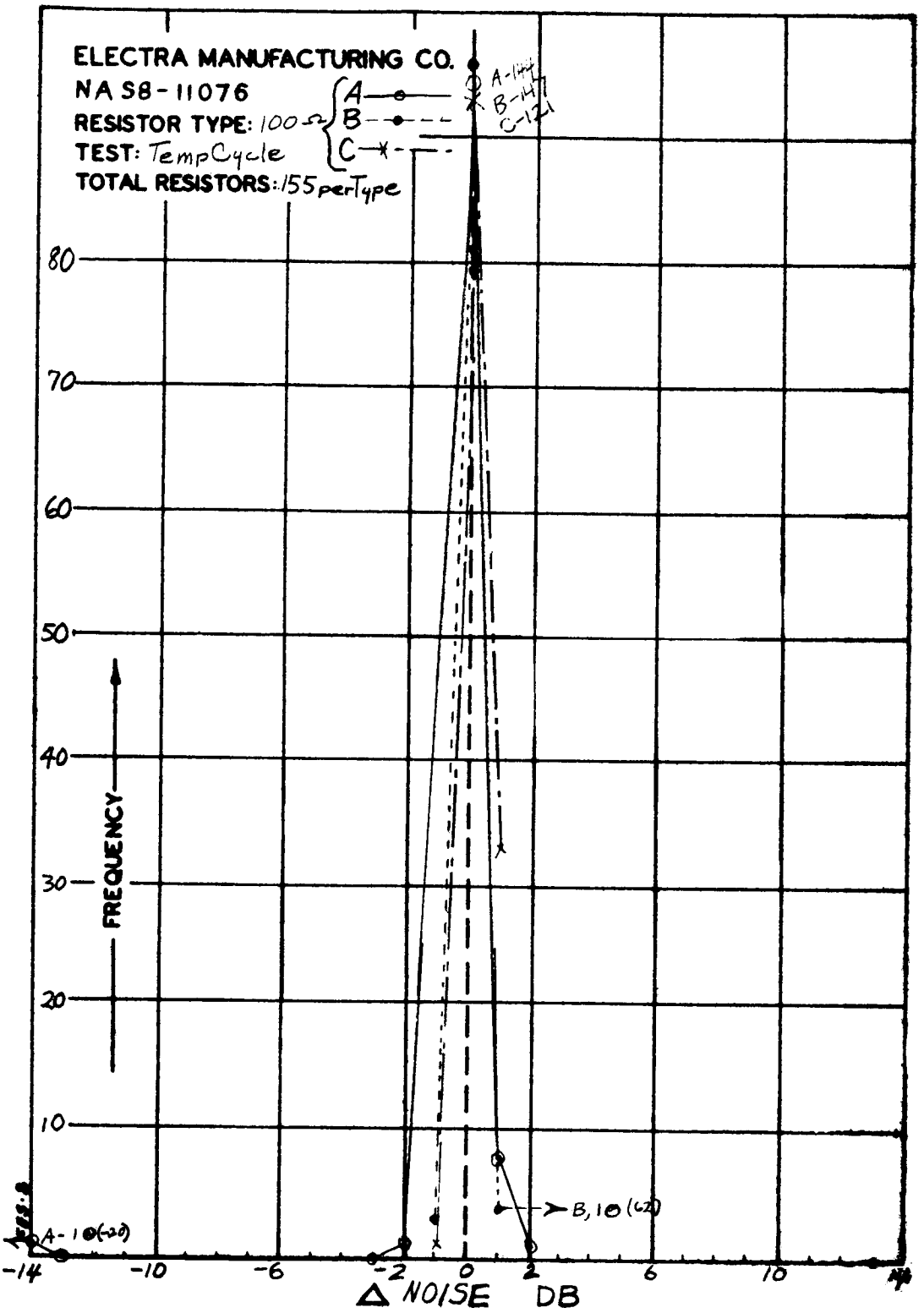


Figure 13. Distribution of noise change due to Temperature Cycle - 100 ohm

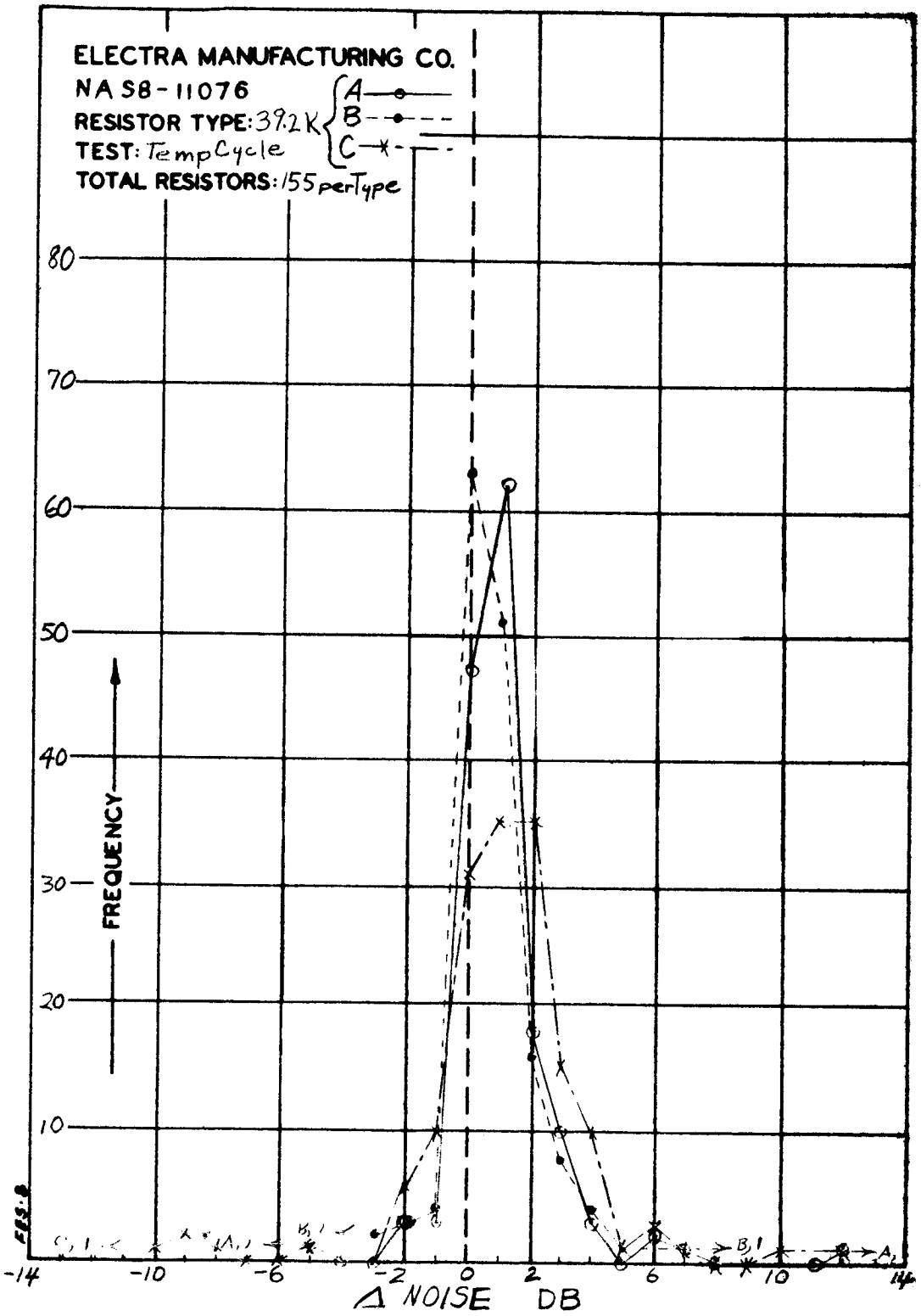


Figure 14. Distribution of noise change due to Temperature Cycle - 39.2K ohm

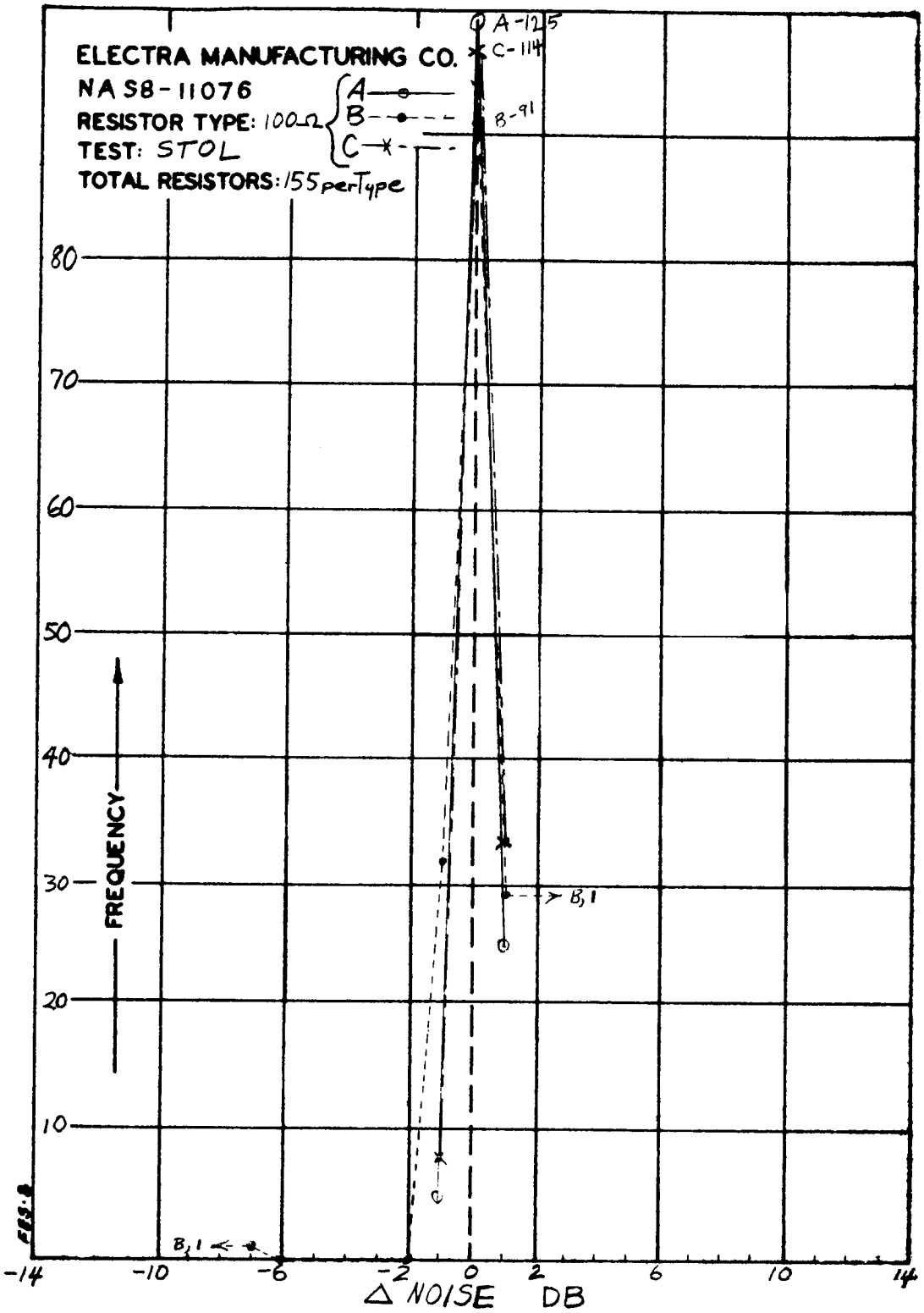


Figure 15. Distribution of noise change due to Short Time Overload - 100 ohm

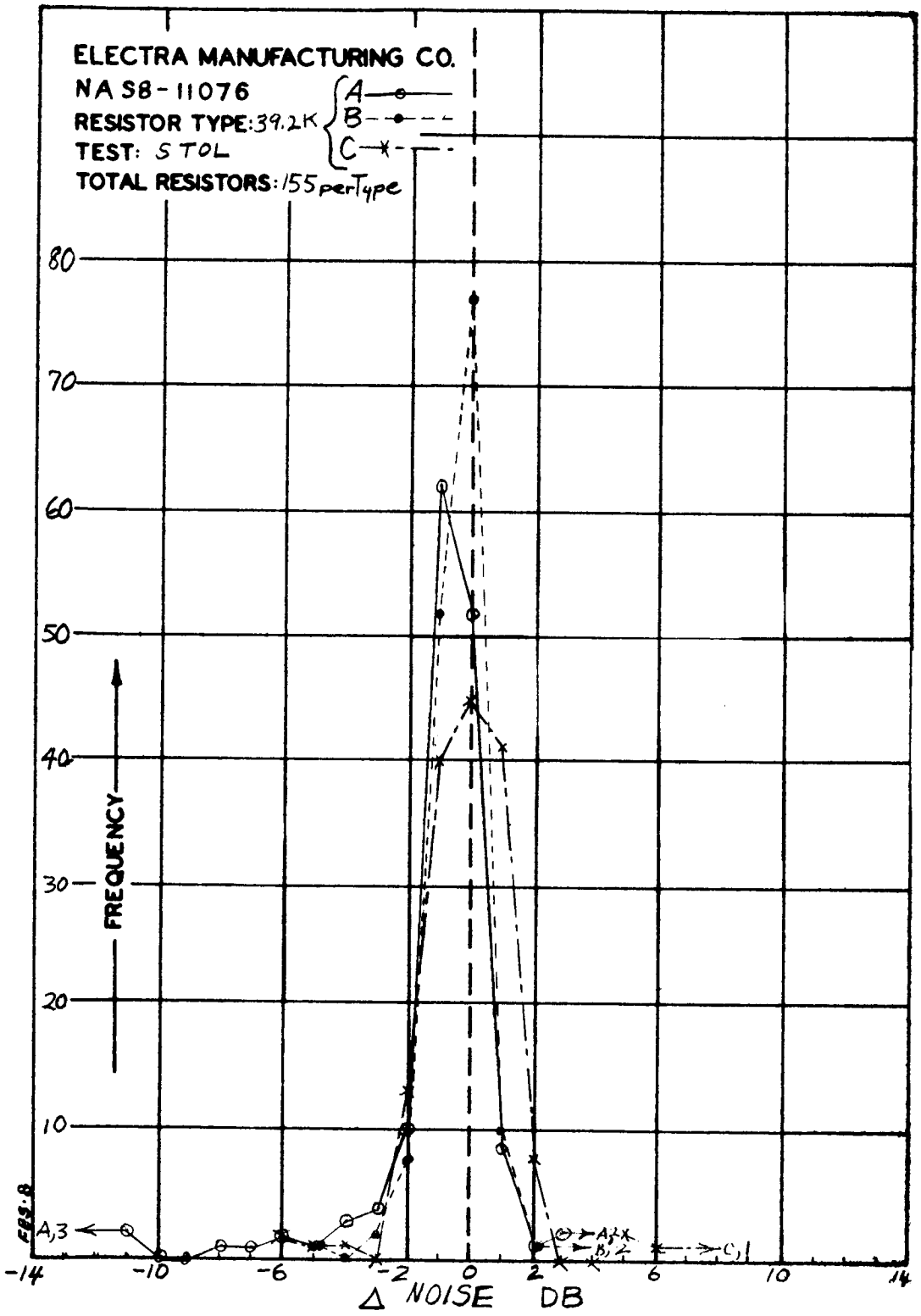


Figure 16. Distribution of noise change due to Short Time Overload - 39.2K ohm

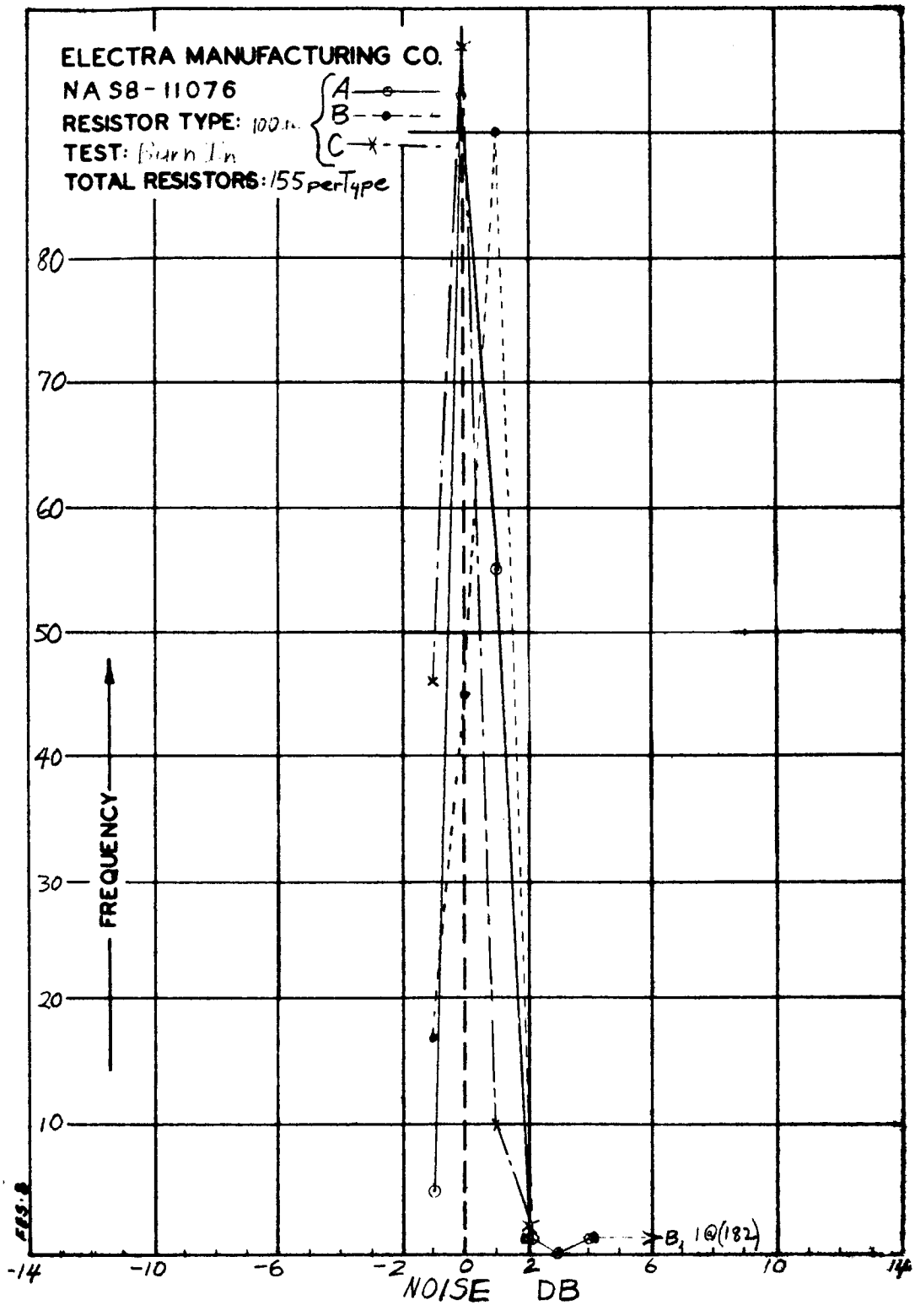


Figure 17. Distribution of noise change due to Burn-In - 100 ohm

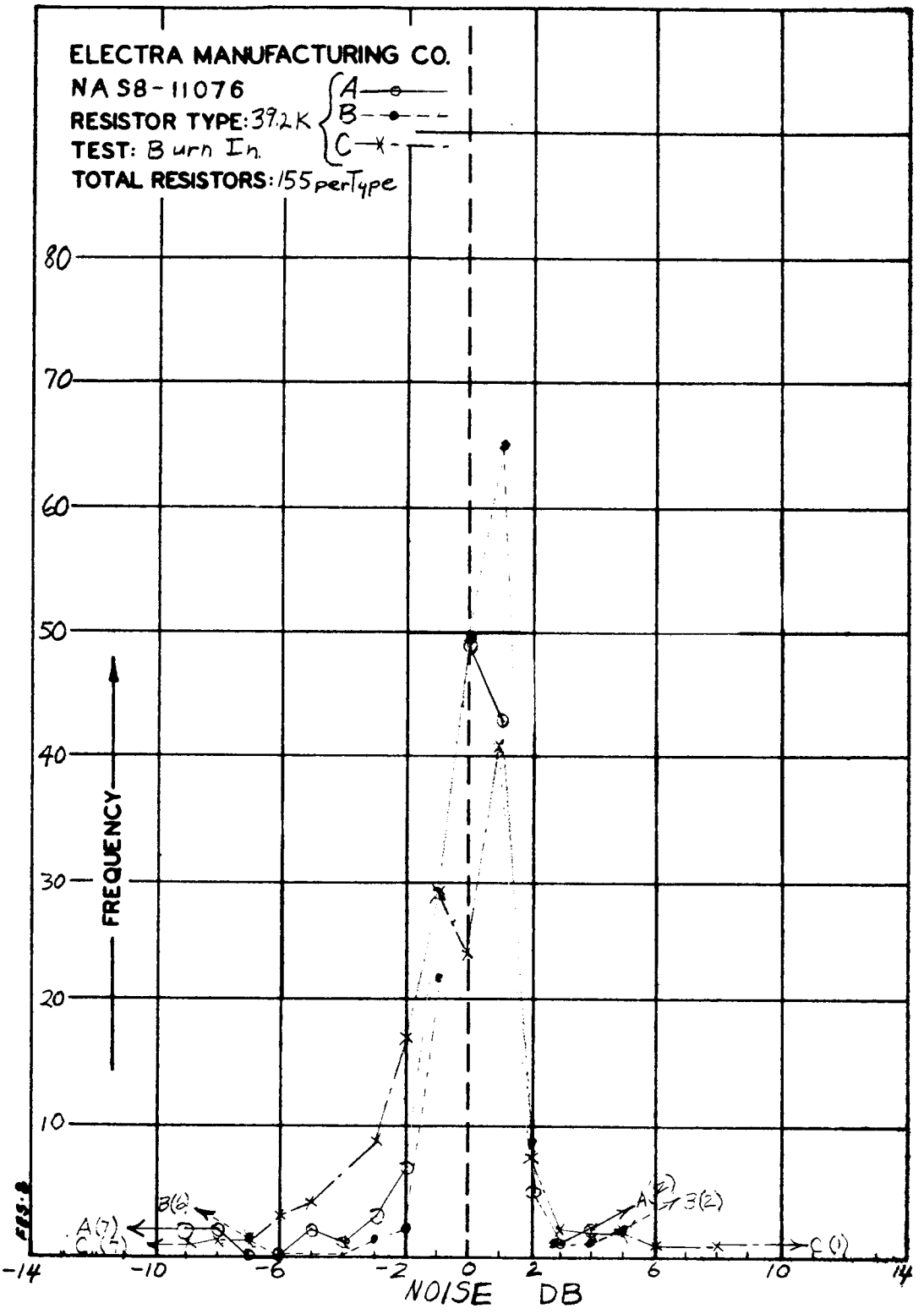


Figure 18. Distribution of noise change due to Burn-In - 39.2K ohm

The procedure followed in data analysis was to test for significant differences between resistor types for a given environmental test. If a significant difference exists between types, then each type must be handled separately during further analysis. However, if no significant difference exists, the three types may be handled as a group providing a larger sample to work with and therefore more meaningful results.

Each test group was tested for significant differences with each of the other test groups and the control or 1000 hour unscreened Life Test group. This analysis provided information as to the pertinence of the tests run and measurements taken in attempting to establish meaningful screen test procedures.

The following formulae and numerical example describe the Analysis of Variance Test used to test the various data for significant differences. The calculated value of "F" is then compared with the table value from reference (1) for the desired conditions. A calculated value of "F" smaller than the table value indicates test groups with like variances.

Variance of data was compared for each Manufacturing Type (i.e., A, B and C) for all tests performed in the preliminary phase. Overstress Load (S.T.O.L.) was eliminated in this comparison since the resistance change in most cases was not significantly large to compare variances. Data comparisons are shown in Tables IV, V, VI and VII. Significant differences are seen in all cases for each Manufacturing Type with the exception of two cases (i.e., the 100 ohm, 1 X rated power and 39.2K, 2-1/2 X rated power for Type A), again indicating different reactions to a given test for different Manufacturing Types. The various temperature stress data were combined for each power stress condition in this comparison.

Analysis of Variance

Single Variable of Classification (1)

	Category				
	A	B	C		
	X_{11}	X_{21}	X_{31}		
	X_{12}	X_{22}	X_{32}		
	X_{13}	X_{23}	X_{33}		
	X_{14}	X_{24}	X_{34}		
	.	.	.		
	.	.	.		
	.	.	.		
	X_{ij}	X_{ij}	X_{ij}		
Total	T_{1+}	T_{2+}	T_{3+}	T_{++}	= Grand Total
Mean	$\bar{X}_{11}$	$\bar{X}_{21}$	$\bar{X}_{31}$	$\bar{X}_{..}$	= Grand Mean

---

$$T_{1+} = X_{11} + X_{12} + X_{13} + X_{14} + \ldots \text{ etc.}$$

$$T_{++} = T_{1+} + T_{2+} + T_{3+} \ldots \text{ etc.}$$

$$\bar{X}_1 = \frac{T_{.+}}{n}$$

$$X_{..} = \frac{T_{++}}{N}$$

n = number pieces/variable
k = number variables
N = total pieces
df = degrees of freedom

Analysis of Variance Table for one Variable (1)

	Sum of Square	df	Mean Square	Estimate of Variance
Means	$\Sigma \frac{T_{it}^2}{n_i} - \frac{T_{++}^2}{N}$	k-1	S	$6^2 + n6_m^2$
Within	$\Sigma\Sigma X_{ij}^2 - \Sigma \frac{T_{it}^2}{n_i}$	N-k	S_p^2	6^2
Total	$\Sigma\Sigma X_{ij}^2 - \frac{T_{++}}{N}$	N-1		

$$S_p^2 = \frac{\Sigma\Sigma X_{ij}^2 - \left(\frac{T_{1+}^2}{n_1} + \frac{T_{2+}^2}{n_2} + \frac{T_{3+}^2}{n_3}\right)}{\sum_i n_i - 3}$$

$$S_p^2 = \frac{\Sigma\Sigma X_{ij}^2 - \Sigma\,(T_{i+}^2/N_i)}{\Sigma\, n_i - k}$$

$$S_m^2 = \frac{\frac{T_{1+}^2}{n_1} + \frac{T_{2+}^2}{n_2} + \frac{T_{3+}^2}{n_3} - \frac{T_{++}^2}{N}}{3-1}$$

$$S_m^2 = \frac{\sum_{i=1}^{k} \frac{T_{i+}^2}{n_i} - \frac{T_{++}^2}{N}}{k-1}$$

Sample calculation of Temp. Cycle, 100Ω at 5X rated power of process A, B, and C.

$$\text{Sum of Squares} = \Sigma \frac{T_{i+}^2}{n_i} - \frac{T_{++}^2}{N}$$

$$\frac{(1.38)^2}{35} + \frac{(.59)^2}{35} + \frac{(.72)^2}{35} - \frac{(2.69)^2}{105}$$

$$\frac{1.9044}{35} + \frac{.3481}{35} + \frac{.5184}{35} - \frac{7.2361}{105}$$

$$.0544 + .0099 + .0148 - .0687$$
$$.0791 - .0689 = .0102$$

$$\text{Within Sum of Squares} = \Sigma\Sigma X_{ij}^2 - \Sigma \frac{T_{i+}^2}{n_i} =$$

$$.1155 - .0791 = .0364$$

$$\text{Total} = \Sigma\Sigma X_{ij}^2 - \frac{T_{++}^2}{N} =$$

$$.1155 - .0689 = .0466$$

Analysis of Variance

	Sum of Square	df	Mean Square	F - Ratis
Category Mean	.0102	2	.00510	$F = \frac{.00510}{.00036}$
Within	.0364	102	.00036	F = 14.167
Total	.0466	104		

100 OHM, 1 X RATED

		A	B	C
Temp. Cycle	ΣX =	2.30	1.49	.85
	ΣX^2 =	.1307	.0641	.0223
Burn-In	ΣX =	.53	-1.38	-.56
	ΣX^2 =	.0109	.2276	.0250
Initial Noise	ΣX =	100.8	214.20	65.3
	ΣX^2 =	4939.66	1256.22	105.71
Load Life	ΣX =	-2.00	9.84	2.88
	ΣX^2 =	.1181	14.269	.1768
F - Ratio		2.048	98.38	143.81
Table Value:	$F_{.95}$ = 2.60			

39.2K, 1 X RATED

		A	B	C
Temp. Cycle	ΣX =	.96	3.85	1.16
	ΣX^2 =	.1898	.2818	.0318
Burn-In	ΣX =	-.86	-4.07	-1.66
	ΣX^2 =	.2149	.5921	.1133
Initial Noise	ΣX =	2216.2	15.0	4902.7
	ΣX^2 =	11810.76	23.56	11121.78
Load Life	ΣX =	.03	1.28	1.86
	ΣX^2 =	.0414	1.2886	1.5058
F - Ratio		551.2	12.043	55.40
Table Value:	$F_{.95}$ (3, 60) = 2.76			

TABLE IV - Variance of data by manufacturing type

100 OHM, $2\frac{1}{2}$ X RATED

		A	B	C
Temp. Cycle	ΣX =	1.48	.80	.55
	ΣX^2 =	.0808	.0395	.0112
Burn-In	ΣX =	.15	-.259	-.41
	ΣX^2 =	.0026	.2309	.0075
Initial Noise	ΣX =	58.90	153.0	47.0
	ΣX^2 =	634.36	1301.96	73.58
Load Life	ΣX =	3.07	19.23	4.15
	ΣX^2 =	.6055	156.54	.8763
F - Ratio		6.29	20.186	108.42
Table Value: $F_{.95}$ (2, 40) = 2.84				

39.2K, $2\frac{1}{2}$ X RATED

		A	B	C
Temp. Cycle	ΣX =	1.10	2.45	.85
	ΣX^2 =	.0501	1.2415	.0265
Burn-In	ΣX =	-1.02	-1.67	-1.54
	ΣX^2 =	.1098	1.4925	.0670
Initial Noise	ΣX =	236.8	236.8	463.6
	ΣX^2 =	4027.52	4027.52	6935.12
Load Life	ΣX =	-1.03	16.08	4.85
	ΣX^2 =	5790.35	3155.2	760.25
F - Ratio		.5759	9.059	89.73
Table Value: $F_{.95}$ (3, 40) = 2.84				

TABLE V - Variance of data by manufacturing type

100 OHM, 5 X RATED

		A	B	C
Temp. Cycle	ΣX =	1.38	.59	.72
	ΣX^2 =	.0622	.0285	.0248
Burn-In	ΣX =	.04	-1.52	-.30
	ΣX^2 =	.0024	.0845	.0116
Initial Noise	ΣX =	24.4	113.4	39.9
	ΣX^2 =	31.98	504.28	63.31
Load Life	ΣX =	-.13	176.46	1.70
	ΣX^2 =	.1619	4298.4766	1.2128
F - Ratio		36.99	8.449	78.79
Table Value: $F_{.95}$ (3, 40) = 2.84				

39.2K, 5 X RATED

		A	B	C
Temp. Cycle	ΣX =	3.53	2.34	1.00
	ΣX^2 =	6.4983	.1696	.0404
Burn-In	ΣX =	-.47	-1.77	-.13
	ΣX^2 =	.4239	.4937	.8118
Initial Noise	ΣX =	90.8	42.0	372.6
	ΣX^2 =	2322.56	104.36	5401.80
Load Life	ΣX =	7.29	83.74	20.99
	ΣX^2 =	17.4031	426.8008	48.5980
F - Ratio		3.532	22.123	88.317
Table Value: $F_{.95}$ (3, 40) = 2.84				

TABLE VI - Variance of data by manufacturing type

100 OHM, 10 X RATED

		A	B	C
Temp. Cycle	ΣX =	1.05	.62	.43
	ΣX^2 =	.0619	.0208	.0115
Burn-In	ΣX =	.02	1.0	.27
	ΣX^2 =	.0026	.0606	.0443
Initial Noise	ΣX =	22.3	83.8	26.2
	ΣX^2 =	55.61	359.68	37.08
Load Life	ΣX =	12.87	1288.95	61.54
	ΣX^2 =	23.2905	180753.48	324.7678
F - Ratio		8.199	13.387	16.985
Table Value: $F_{.95}$ (3, 25) = 2.99				

39.2K, 10 X RATED

		A	B	C
Temp. Cycle	ΣX =	.52	1.88	
	ΣX^2 =	.0169	.1624	
Burn-In	ΣX =	.50	-.34	
	ΣX^2 =	.0552	.6416	
Initial Noise	ΣX =	58.4	71.4	
	ΣX^2 =	442.68	3413.72	
Load Life	ΣX =	53.82	14 Resistors Unstable	16 Resistors Unstable
	ΣX^2 =	267.9231		
F - Ratio		16.681		
Table Value: $F_{.95}$ (3, 25) = 2.99				

TABLE VII - Variance of data by manufacturing type

The variance of data for each screen test performed was compared with the variance of load life data for each Manufacturing Type and each power stress condition. The various temperature stress conditions were combined to provide adequate sample sizes for comparison. The S.T.O.L. test data again was omitted for reasons given on Page 25. The data summary is presented in Tables VIII and IX.

Some degree of correlation is seen for the Temperature Cycle - Load Life Tests and the Burn-In Load Life Tests in several instances. No correlation is indicated for the Initial Noise - Load Life comparisons.

Next a comparison of data was made to test for significant differences between screened and unscreened units during the various stress conditions of the 1000 hour Life Test. Data for Manufacturing Types A, B and C were used collectively for this comparison. Results are shown in Table X for both 100 ohm and 39.2K ohm units. Table values for "F" were taken from Reference (1), upper 5% points ($F_{.95}$). Significant differences are seen between results of the screened and unscreened groups in thirteen of the thirty-two cases and in three cases the severity of the test conditions made the data uncomparable. The most promising results as far as indicating differences between screened and unscreened units appear in the 25°C, 70°C and 125°C temperature groups which were loaded from 1 X rated power to 5 X rated power. The 150°C and 10 X rated power groups showed little or no significant difference between the screened and unscreened groups. Probably the differences were masked by the increased severity of the higher stress conditions.

It was then necessary to determine if the effects of "screening" are beneficial or detrimental. Also to be determined was which screen test or tests yield data which will closely correlate to the Life Test results; thereby predicting in advance the operating life characteristics of a resistor or lot of resistors.

SUMMARY
100 OHM

	Temp. Cycle Load Life	Burn-In Load Life	Initial Noise Load Life
F - Ratio			
1 X Rated			
Group A	1.02	7.55	108977.8
Group B	506.38	59.69	34.995
Group C	2.83	1.35	1084.93
Table Value: $F_{.95}$ (1, 60) = 4.00			
$2\frac{1}{2}$ X Rated			
Group A	14.22	182.40	1480.5
Group B	6263.33	642.639	4.866
Group C	124.25	134.48	41.18
Table Value: $F_{.95}$ (1, 40) = 4.08			
5 X Rated			
Group A	20.73	68.80	92.75
Group B	182751.72	183759.54	24.834
Group C	1146.24	125.44	15.77
Table Value: $F_{.95}$ (1, 30) = 4.17			
10 X Rated			
Group A	935.82	6429.44	2.14
Group B	21166273.	5550596.2	1450.8489
Group C	42222.66	124484.05	18.01
Table Value: $F_{.95}$ (1, 25) = 4.24			

TABLE VIII - Variance of screen test data vs. Life Test

SUMMARY
39.2K

	Temp. Cycle Load Life	Burn-In Load Life	Initial Noise Load Life
F - Ratio			
1 X Rated			
Group A	4.0	4.62	1993750.
Group B	102.6	4.33	15.47
Group C	48.24	7.008	-961841.
Table Value: $F_{.95}$ (1, 60) = 4.00			
$2\frac{1}{2}$ X Rated			
Group A	291669.9	69373.8	1.5969
Group B	2872.587	2217.9	1.151
Group C	30917.4	4.863	78540.3
Table Value: $F_{.95}$ (1, 40) = 4.08			
5 X Rated			
Group A	2.747	39.96	123.67
Group B	1716.5	560.62	4.196
Group C	959.34	443.88	39.85
Table Value: $F_{.95}$ (1, 30) = 4.17			
10 X Rated			
Group A	9614.26	2805.9	2.014
Group B		Unable to Determine	
Group C		Unable to Determine	
Table Value: $F_{.95}$ (1, 25) = 4.24			

TABLE IX - Variance of screen test data vs. Life Test

EFFECTS OF SCREEN TESTS

100 OHM

	X1		X2½		X5		X10	
	Mean	Dev.	Mean	Dev.	Mean	Dev.	Mean	Dev.
25°C:								
Screened	-.072	.010	-.08	.029	-.017	.050	.14	.153
Unscreened	-.064	.022	-.065	.024	-.046	.028	.12	.086
70°C:								
Screened	-.088	.030	-.227	.026	-.042	.044	.34	.221
Unscreened	-.091	.036	-.094	.025	.041	.086	.44	.304
125°C:								
Screened	-.023	.015	.043	.137	.045	.028	2660	48.8
Unscreened	-.026	.035	.004	.064	.085	.027	4240	55.0
150°C:								
Screened	.268	.607	1.53	2.93	7.10	7.39	3520	51.7
Unscreened	.386	.723	1.42	2.77	4.75	1.82	2450	45.6

39.2K OHM

	X1		X2½		X5		X10	
	Mean	Dev.	Mean	Dev.	Mean	Dev.	Mean	Dev.
25°C:								
Screened	-.037	.020	-.496	.040	.297	.614	.157	.057
Unscreened	-.023	.015	-.270	.070	.125	.196	.157	.081
70°C:								
Screened	-.077	.043	-.044	.125	.655	.232	--	--
Unscreened	.093	.025	.095	.025	-.068	.111	--	--
125°C:								
Screened	-.005	.034	.331	.290	10.1	1.99	--	--
Unscreened	-.037	.073	.326	.320	1.60	1.67	--	--
150°C:								
Screened	.182	.160	2.33	1.06	26.2	3.44	--	--
Unscreened	.213	.206	5.00	1.65	28.1	3.90	--	--

Table X - Comparison of Screened and Unscreened Variance

Examination of Table XI indicates that approximately one-half of the test groups indicate a smaller mean resistance change and, or a smaller deviation for the screened groups. Approximately 25% of the groups tested indicate both a smaller mean resistance change and deviation for the screened groups.

Examination of Tables VIII and IX does not indicate strict correlation for any particular Screen Test and Life Test for all manufacturing types. However, other work in this area has indicated a direct correlation between Burn-In and Load Life.

Table XII is presented to summarize the individual comparisons of Screen Test Data for each manufacturing type vs. each of the other two types. Resistance change due to Temperature Cycle, Resistance Change due to Burn-In and Initial Noise primarily indicate different means and different variances. The resistance change due to Short Time Overload and all noise change data were significantly small enough to provide virtually meaningless data. Therefore, it is concluded that none of the proposed screen test methods at this point provide a consistent means of screening all types of metal film resistors.

The next phase of the analysis was an attempt to determine if one or more of the proposed screen tests would provide a significant means by which we can predict potential failures in load life. Correlation coefficients for the samples have been calculated and tabulated in Tables XIV, XV, XVI and XVII. Table XIII defines the symbols.

$\rho(1-\alpha)$ = Upper population correlation coefficient
$\rho(\alpha)$ = Lower population correlation coefficient
r = Sample correlation coefficient
n = Sample size
α = Confidence Level (.025)

Table XIII - Symbols used in correlation coefficient determination

100 OHM

Rated Power	X 1	X $2\frac{1}{2}$	X 5	X 10
25°C:				
Screened Variance	.0001	.00083	.0025	.0235
Unscreened Variance	.0005	.00058	.0008	.0073
F - Ratio	5.000	1.431	3.125	3.219
Table Value $F_{.95}$	(30, 30) = 1.84	(30, 30) = 1.84	(40, 40) = 1.69	(20, 20) = 2.12
70°C:				
Screened Variance	.0009	.0007	.0019	.0486
Unscreened Variance	.0013	.0006	.0074	.0926
F - Ratio	1.44	1.16	3.89	1.91
Table Value $F_{.95}$	(60, 60) = 1.56	(60, 60) = 1.56	(30, 24) = 1.94	(10, 10) = 2.98
125°C:				
Screened Variance	.000239	.0189	.0008	2371.62
Unscreened Variance	.001214	.0041	.00073	3128.476
F - Ratio	5.079	4.61	1.095	1.319
Table Value $F_{.95}$	(40, 40) = 1.69	(30, 30) = 1.80	(10, 10) = 2.98	(15, 15) = 2.62
150°C:				
Screened Variance	.3679	8.5544	175.6472	2668.48
Unscreened Variance	.5203	7.6833	53.2264	2084.84
F - Ratio	1.414	1.113	3.30	1.279
Table Value $F_{.95}$	(60, 60) = 1.56	2.40	2.40	2.40

39.2K OHM

Rated Power	X 1	X $2\frac{1}{2}$	X 5	X 10
25°C:				
Screened Variance	.000406	.001631	.37506	.00327
Unscreened Variance	.000231	.004924	.03848	.00658
F - Ratio	1.758	3.019	9.748	2.012
Table Value $F_{.95}$	(30, 30) = 1.84	(30, 30) = 1.84	(40, 40) = 1.69	(10, 10) = 2.98
70°C:				N = 15
Screened Variance	.001877	.0151	.0540	9 Unstable
Unscreened Variance	.000634	.0006	.0123	6 Greater than 20, 15
F - Ratio	2.961	25.16	4.39	
Table Value $F_{.95}$	(40, 40) = 1.69	(40, 40) = 1.69	(30, 30) = 1.80	
125°C:				N = 15
Screened Variance	.00117	.08374	3.9584	7 Unstable
Unscreened Variance	.00537	.10245	2.7995	9 Unstable
F - Ratio	4.59	1.223	1.4139	
Table Value $F_{.95}$	(40, 40) = 1.69	1.84	(15, 15) = 2.40	
150°C:				N = 15
Screened Variance	.02564	1.1268	11.80351	9 Unstable
Unscreened Variance	.04223	2.7271	15.170	10 Unstable
F - Ratio	1.647	2.42	1.285	
Table Value $F_{.95}$	(40, 40) = 1.69	(15, 15) = 2.40	(9, 11) = 2.90	

Table XI - Comparison of Mean Resistance Change and Deviation of Life Test Data for screened and unscreened resistors

ANALYSIS OF VARIANCE

	Variance					Mean			
	100 Ω					39.2 K			
	Method I		Method II			Method I		Method II	
	Same Var.	Diff. Var.	Same Mean.	Diff. Mean		Same Var.	Diff. Var.	Same Mean	Diff. Mean
				*** ΔR Temp. Cycle ***					
A-B		x		x			x	x	
A-C		x		x		x		x	
B-C		x	x				x		x
				*** ΔR STOL ***					
A-B	x		x			x		x	
A-C		x		x		x		x	
B-C		x		x		x		x	
				*** ΔR Burn In ***					
A-B		x		x			x	x	
A-C		x		x		x		x	
B-C	x			x			x	x	
				****Initial Noise ***					
A-B		x		x			x	x	
A-C	x		x				x		x
B-C		x		x			x		x
				Δ Noise-Temp Cycle *					
A-B	x		x			x		x	
A-C	x		x			x		x	
B-C	x		x			x		x	
				*** Δ Noise-STOL***					
A-B	x		x			x		x	
A-C	x		x			x		x	
B-C	x		x			x		x	
				Δ Noise-Burn In					
A-B	x		x			x		x	
A-C		x	x			x		x	
B-C	x		x				x		x

Table XII - Summary of Analysis of Variance

			Temp. Cycle vs Load Life			Burn In vs Load Life			Initial Noise vs Load Life		
			$\rho(\alpha)$	r	$\rho(1-\alpha)$	$\rho(\alpha)$	r	$\rho(1-\alpha)$	$\rho(\alpha)$	r	$\rho(1-\alpha)$
100Ω At 1X Rated Power											
25°C	Process A	10	.72	.21	-.46	.03	-.62	-.87	.68	.16	-.50
	B	10	.64	.064	-.57	.82	.44	-.25	.88	.48	-.20
	C	10	.71	.20	-.47	.68	.15	-.50	.85	.54	-.12
70°C	Process A	15	.65	.23	-.30	.80	.50	-.02	.79	.49	-.03
	B	15	.15	-.38	-.74	.75	.42	-.12	.55	.076	-.45
	C	15	.25	-.30	-.68	.52	.002	-.47	.78	.48	-.03
125°C	Process A	15	.64	.21	-.33	.77	.47	-.07	.57	.11	-.42
	B	15	.79	.49	-.03	.57	.11	-.42	.56	.09	-.43
	C	15	.50	-.02	-.50	.43	-.09	-.56	.86	.64	.18
150°C	Process A	15	.54	.06	-.45	.54	.06	-.45	.54	.063	-.45
	B	15	.52	.029	-.47	.69	.30	-.25	.63	.21	-.34
	C	15	.51	.008	-.50	.57	.097	-.42	.73	.38	-.15
100Ω At 2 1/2 X Rated Power											
25°C	Process A	10	.65	.09	-.55	.30	-.38	-.77	.92	.74	.20
	B	10	.51	-.14	-.68	.27	-.42	-.81	.53	-.11	-.66
	C	10	.70	.18	-.47	.82	.46	-.23	.35	-.34	-.78
70°C	Process A	15	.35	-.18	-.62	.75	.40	-.15	.77	.46	-.07
	B	15	.51	.09	-.43	.72	.35	-.20	.74	.39	-.15
	C	15	.44	-.08	-.50	.68	.30	-.25	.59	.14	-.38
125°C	Process A	10	.84	.50	-.18	.77	.34	-.35	.68	.15	-.50
	B	10	.78	.36	-.33	.68	.16	-.50	.82	.43	-.34
	C	10	.66	.10	-.55	.67	.12	-.52	.75	.30	-.39
150°C	Process A	5	.92	.48	-.60	.86	.20	-.75	.99	.90	.10
	B	5	.84	.08	-.78	.88	.32	-.70	.94	.58	-.52
	C	5	.97	.75	-.32	.82	0	-.82	.85	.15	-.77

Table XIV - Correlation Coefficients of Screen Tests vs. Life Tests 100Ω at 1 X Rated Power

			Temp. Cycle vs Load Life			Burn In vs Load Life			Initial Noise vs Load Life		
100Ω At 5X Rated Power											
		n	$\rho(\alpha)$	r	$\rho(1-\alpha)$	$\rho(\alpha)$	r	$\rho(1-\alpha)$	$\rho(\alpha)$	r	$\rho(1-\alpha)$
25°C	Process A	15	.88	.68	.27	.87	.66	.22	.60	.14	-.38
	B	15	.60	.14	-.38	.79	.49	-.03	.50	.005	-.50
	C	15	.78	.47	-.05	.66	.25	-.30	.51	.014	-.49
70°C	Process A	10	.61	.011	-.60	.74	.25	-.43	.95	.81	.33
	B	10	.62	.019	-.59	.62	.024	-.58	.72	.23	-.43
	C	10	.91	.71	.15	.92	.78	.20	.98	.93	.75
125°C	Process A	5	.83	.075	-.79	.88	.29	-.71	.95	.67	-.44
	B	55	.95	.62	-.48	.88	.28	-.72	.92	.51	-.57
	C	5	.98	.89	.05	.97	.79	-.25	.84	.098	-.73
150°C	Process A	5	.96	.71	-.38	.97	.80	-.23	.85	.12	-.77
	B	5	.98	.88	.05	.87	.24	-.73	.94	.60	-.50
	C	5	.86	.19	-.75	.83	.065	-.80	.95	.67	-.43
100Ω At 10 X Rated Power											
25°C	Process A	10	.86	.55	-.12	.67	.12	-.53	.80	.38	-.32
	B	10	.75	.28	-.40	.71	.20	-.47	.66	.10	-.64
	C	10	.92	.72	.16	.74	.26	-.42	.68	.14	-.50
70°C	Process A	5	.85	.16	-.76	.96	.72	-.35	.90	,37	-.67
	B	4	.89	.06	-.87	.89	.068	-.87	.95	.49	-.75
	C	5	.99	.97	.45	.86	.18	-.75	.85	.16	-.76
125°C	Process A	5	.94	.39	-.78	.82	0	-.82	.93	.56	-.54
	B	3	.97	.32	-.94	1.00	.98	-.40	1.00	.98	-.40
	C	5	.88	.052	-.87	.87	.21	-.74	.87	.22	-.74
150°C	Process A	4	.90	.14	-.85	.98	.82	-.47	.94	.42	-.77
	B	4	.97	.66	-.65	.96	.55	-.72	.99	.94	-.05
	C	4	.99	.94	-.05	.96	.55	-.72	.96	.58	-.70

Table XV - Correlation Coefficients of Screen Tests vs. Life Tests 100Ω at 5 X Rated Power

			Temp. Cycle vs Load Life			Burn In vs Load Life			Initial Noise vs Load Life		
		n	$\rho(1-\alpha)$	r	$\rho(\alpha)$	$\rho(1-\alpha)$	r	$\rho(\alpha)$	$\rho(1-\alpha)$	r	$\rho(\alpha)$
39.2KΩ Value at 1X rated power											
25°C	Process A	10	.75	.27	-.40	.81	.42	-.27	.61	.017	-.54
	B	10	.57	.014	-.50	.80	.39	-.30	.60	0	-.55
	C	10	.78	.34	-.35	.87	.60	-.05	.77	.33	-.35
70°C	Process A	15	.56	.073	-.43	.87	.68	.25	.60	.15	-.37
	B	15	.52	.02	-.47	.55	.068	-.45	.54	.056	-.45
	C	15	.62	.19	-.35	.69	.30	-.25	.67	.26	-.30
125°C	Process A	15	.82	.57	.08	.86	.67	.23	.88	.70	.27
	B	15	.71	.34	-.20	.83	.58	.10	.92	.78	.42
	C	15	.69	.30	-.25	.83	.58	.10	.91	.77	.40
150°C	Process A	15	.92	.79	.47	.51	*.019	-.49	.52	.02	-.47
	B	15	.58	.12	-.42	.53	.027	-.48	.65	.22	-.32
	C	15	.57	.11	-.42	.60	.14	-.38	.58	.12	-.40
39.2KΩ Value at 2 1/2X Rated Power											
25°C	Process A	10	.63	.040	-.57	.91	.70	.10	.75	.29	-.39
	B	10	.89	.65	.02	.84	.49	-.18	.70	.17	-.48
	C	10	.72	.21	-.47	.73	.24	-.43	.60	.00	-.55
70°C	Process A	15	.99	.96	.87	.62	*.18	-.35	.98	.95	.85
	B	13	.85	.62	.15	.70	.32	-.25	.68	*.22	-.40
	C	15	.78	.48	-.03	.77	.45	-.08	.58	.13	-.40
125°C	Process A	10	.75	.28	-.40	.65	.08	-.55	.73	.25	-.42
	B	10	.73	.23	-.43	.62	.003	-.60	.60	0	-.60
	C	10	.63	.05	-.57	.67	.11	-.52	.70	.17	-.48
150°C	Process A	5	.92	.49	-.58	.96	.72	-.36	.89	.34	-.68
	B	5	.91	.43	-.62	.85	.12	-.77	.91	.42	-.64
	C	5	.93	.56	-.55	.88	.31	-.70	.98	.86	-.20

Table XVI - Correlation Coefficients of Screen Tests vs. Life Tests 39.2KΩ at 1 X Rated Power

		Temp. Cycle vs Load Life				Burn In vs Load Life			Initial Noise vs Load Life		
		n	$\rho(\alpha)$	r	$\rho(1-\alpha)$	$\rho(\alpha)$	r	$\rho(1-\alpha)$	$\rho(\alpha)$	r	$\rho(1-\alpha)$
39.2KΩ Value at 5X Rated Power											
25°C	Process A	15	1.00	.99	.98	1.00	.99	.98	.99	.97	.93
	B	14	.80	.52	.00	.50	.001	-.50	.65	.09	-.42
	C	15	.52	.015	-.48	.65	.24	-.30	.73	.39	-.15
70°C	Process A	10	.93	.76	.23	.97	.93	.70	.65	.085	-.55
	B	10	.70	.18	-.47	.77	.32	-.37	.63	.054	-.57
	C	10	.80	.39	-.30	.60	.013	-.55	.62	.044	-.58
125°C	Process A	*4	.99	.98	.95	.98	.91*	-.25	.82	.18	-.74
	B	5	.82	.029	-.72	.85	.17	-.75	.96	.75	-.32
	C	5	.98	.78	-.25	.84	.13	-.76	.82	.18	-.74
150°C	Process A	5	.93	.53	-.55	.97	.77	-.30	.99	.90	.10
	B	5	.89	.32	-.70	.92	.44	-.62	.81	0	-.75
	C	4	.98	.85	-.10	.87	.25	-.73	.93	.49	-.58
39.2KΩ Value at 10X Rated Power											
25°C	Process A	10	.69	.16	-.50	.88	.63	0	.75	.30	-.38
	B	6	.77	.024	-.15	.87	.35	-.35	.78	.20	-.67
	C	9	.76	.24	-.47	.86	.086	-.58	.78	.32	-.42
70°C	Process A	5	.82	0	-.82	.97	.87	-.05	.82	0	-.82
	B	1	---	----	----	----	----	----	----	----	----
	C	0	---	----	----	----	----	----	----	----	----
125°C	Process A	5	.90	.39	-.65	.82	.016	-.80	.97	.80	-.23
	B	3	.96	.15	-.95	.97	.35	-.93	.95	0	-.96
	C	0	---	---	----	----	----	----	---	---	----
150°C	Process A	5	.95	.64	-.46	.88	.10	-.77	.88	.098	-.78
	B	1	----	----	----	----	---	----	---	----	----
	C	0	----	----	----	----	---	----	---	----	----

Table XVII - Correlation Coefficients of Screen Tests vs. Life Tests 39.2KΩ at 5 X Rated Power

The correlation coefficient for the sample,

$$r = \sum_{i=1}^{n} (x_i - \bar{x})(y_i - \bar{y}) \Big/ \sqrt{\sum_{i=1}^{n} (x_i - \bar{x})^2 \sum_{i=1}^{n} (y_i - \bar{y})^2}$$

provides the degree of relationship or association between screen test and the respective load life. Ninety-five percent (95%) confidence limits on each coefficient are also shown in the tables. The region between the two limits is where the correlation coefficient for the population is expected to occur. The correlation coefficient here, though it may be close to $\pm$ 1, cannot be used as a decision tool alone, but does show areas in which larger investigations would be practical.

The "Burn-In vs. Load Life" and the "Temperature Cycle vs. Load Life" data have been plotted for each process and each ohmic value (Figures 19 through 24). In most of these cases a line of the form L = a + bB has been fitted by least squares methods. These lines shwoing regression of L on B relate ΔR in load life (L) to ΔR in burn in (B) or Temperature Cycle. The 90% confidence lines are also shown to provide a measure of the effectiveness of these screening techniques. In Figure 19, for example, it may be determined whether or not screening at a Burn-In maximum ΔR of 0.25% will provide 95% confidence that the load life ΔR will be less than 0.5%. To do this, locate the abscissa at 0.25% for Burn-In ΔR and follow it up above the confidence lines. Since it is well below the 0.5% load life ΔR, there is greater than 95% confidence that the screening technique will remove any unit with over 0.5% ΔR in load life.

The effectiveness of Temperature Cycling as a screening technique shown by Figures 25 through 30 is similar to that found for Burn-In. On Figure 26, for example, a Temperature Cycling maximum ΔR of 0.25% will give us better than 90% confidence that the Load Life ΔR will be less than 0.5%, which was similarly described for Figure 19 of Burn-In versus Load Life. However, a comparison of the correlation coefficients of Burn-In versus

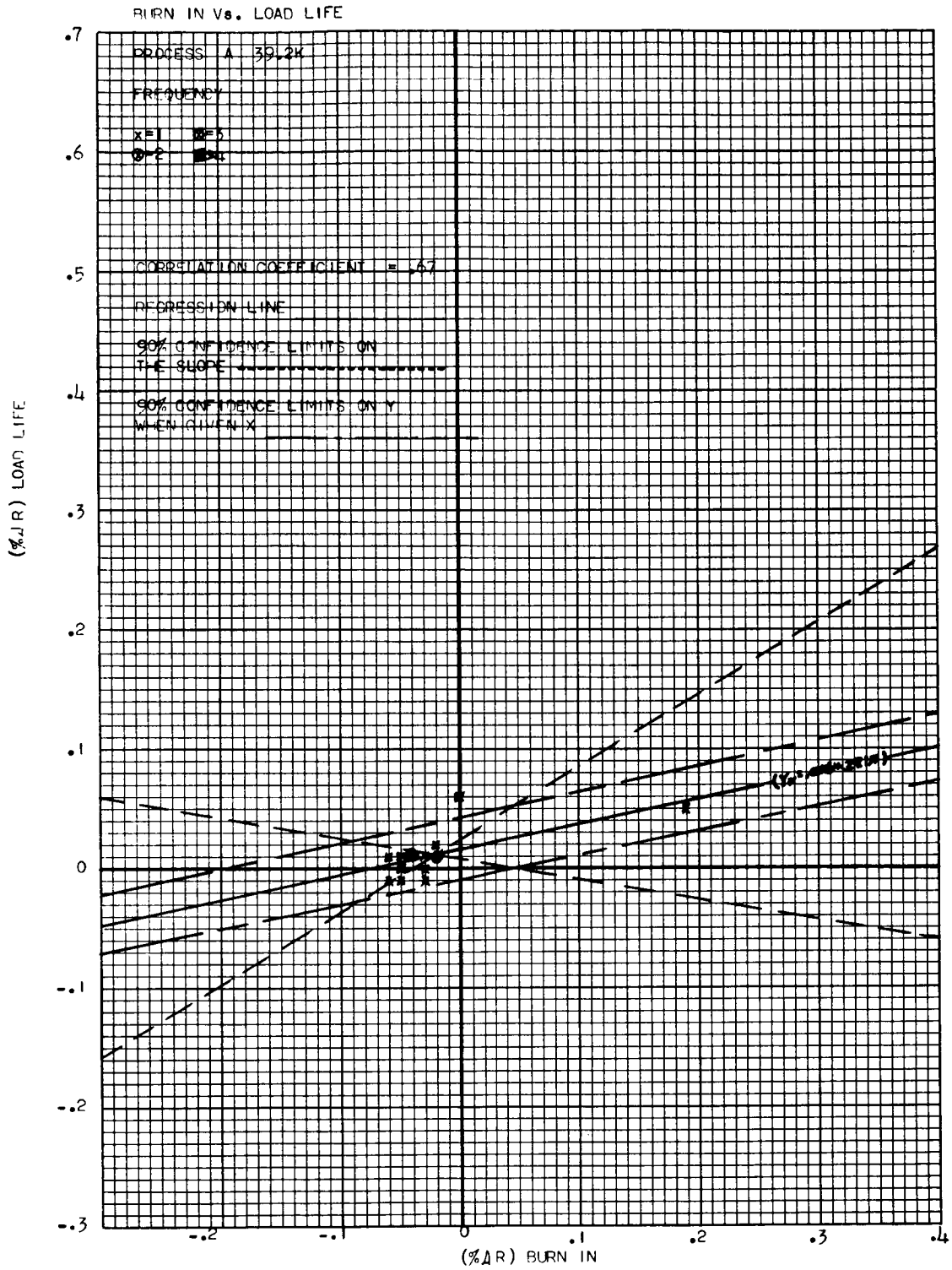


Figure 19 - Regression of Burn-In on Load Life
Type A - 39.2KΩ

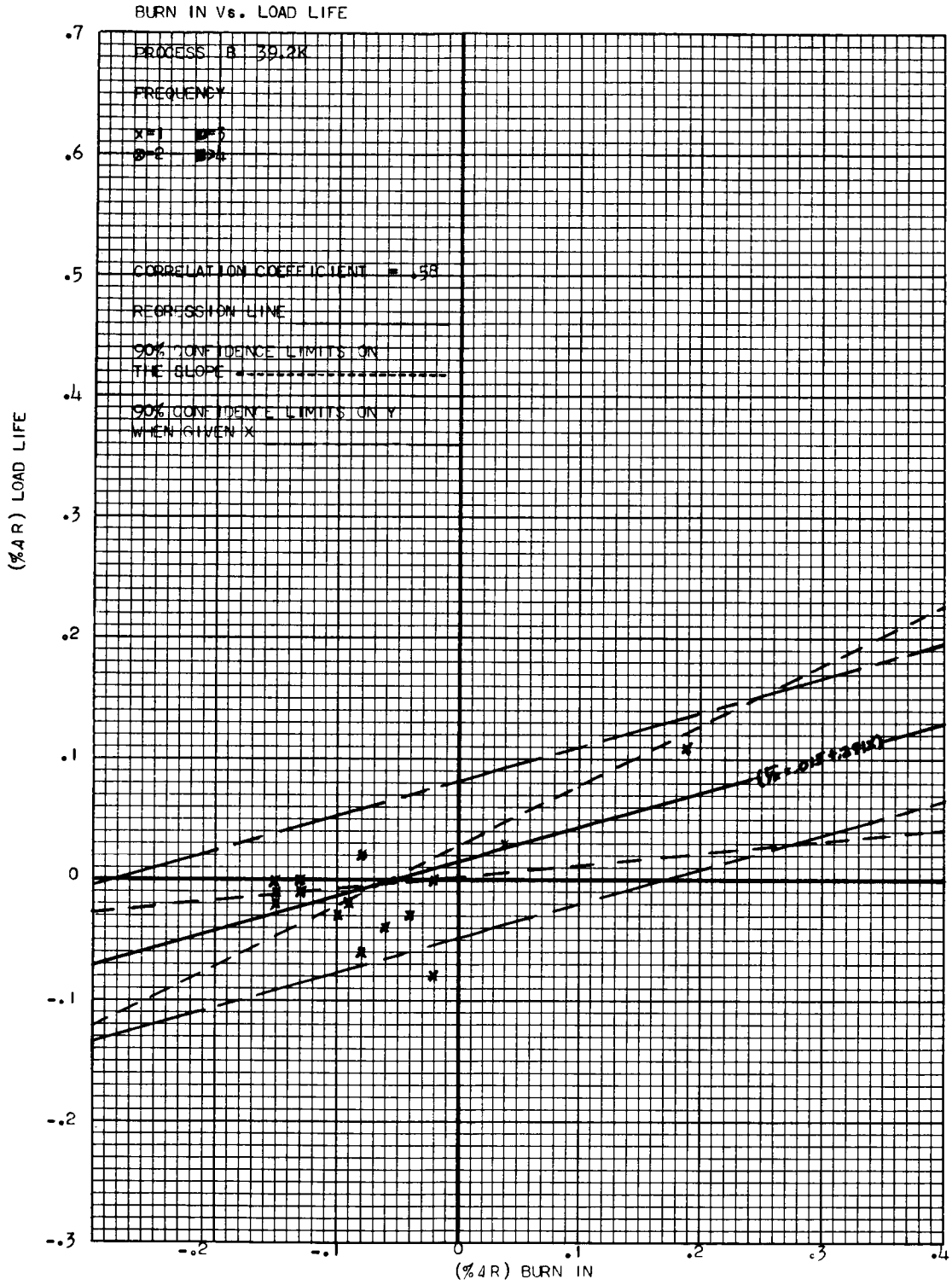


Figure 20 - Regression of Burn-In on Load Life
Type B - 39.2KΩ

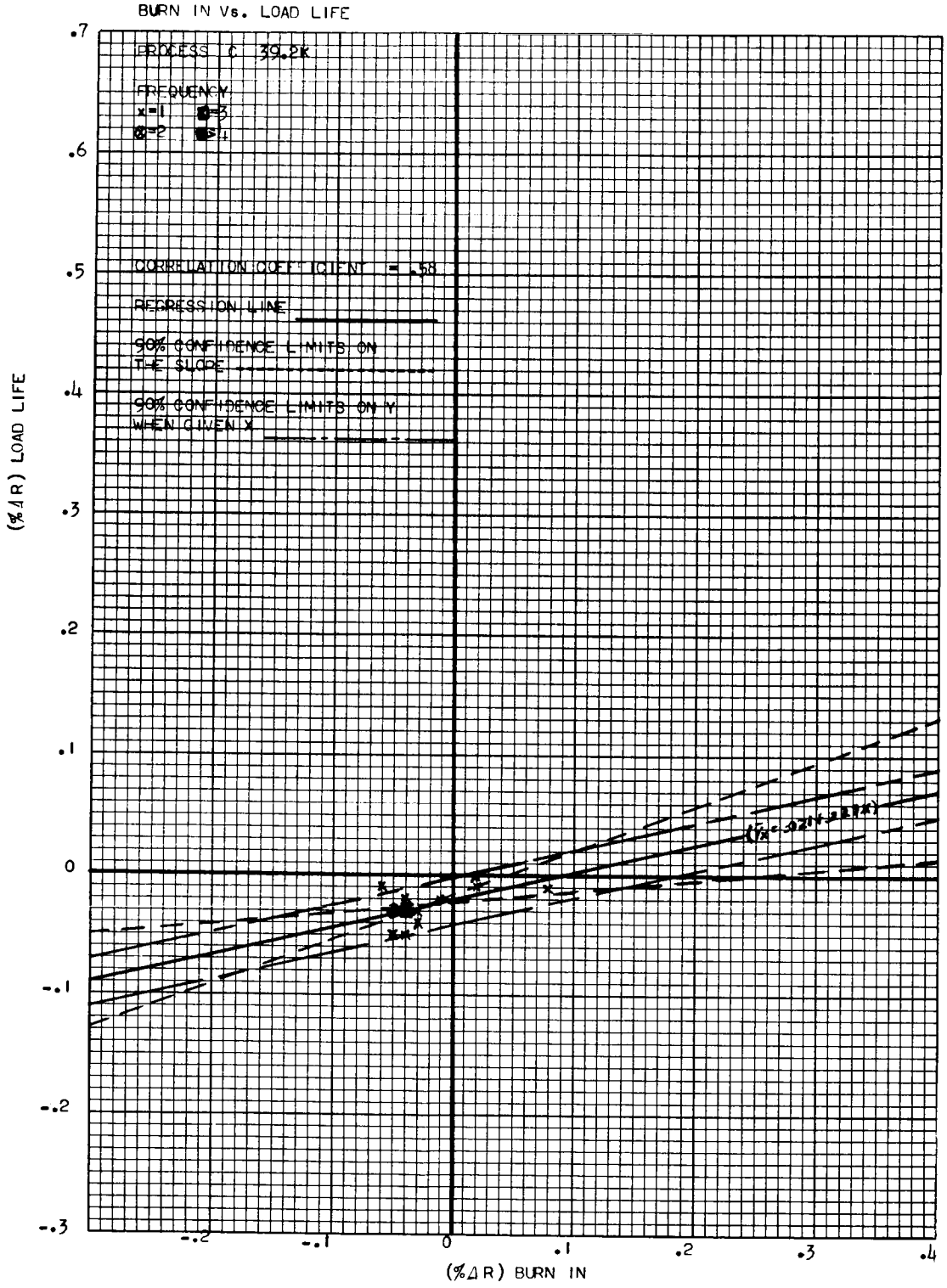


Figure 21 - Regression of Burn-In on Load Life
Type C - 39.2KΩ

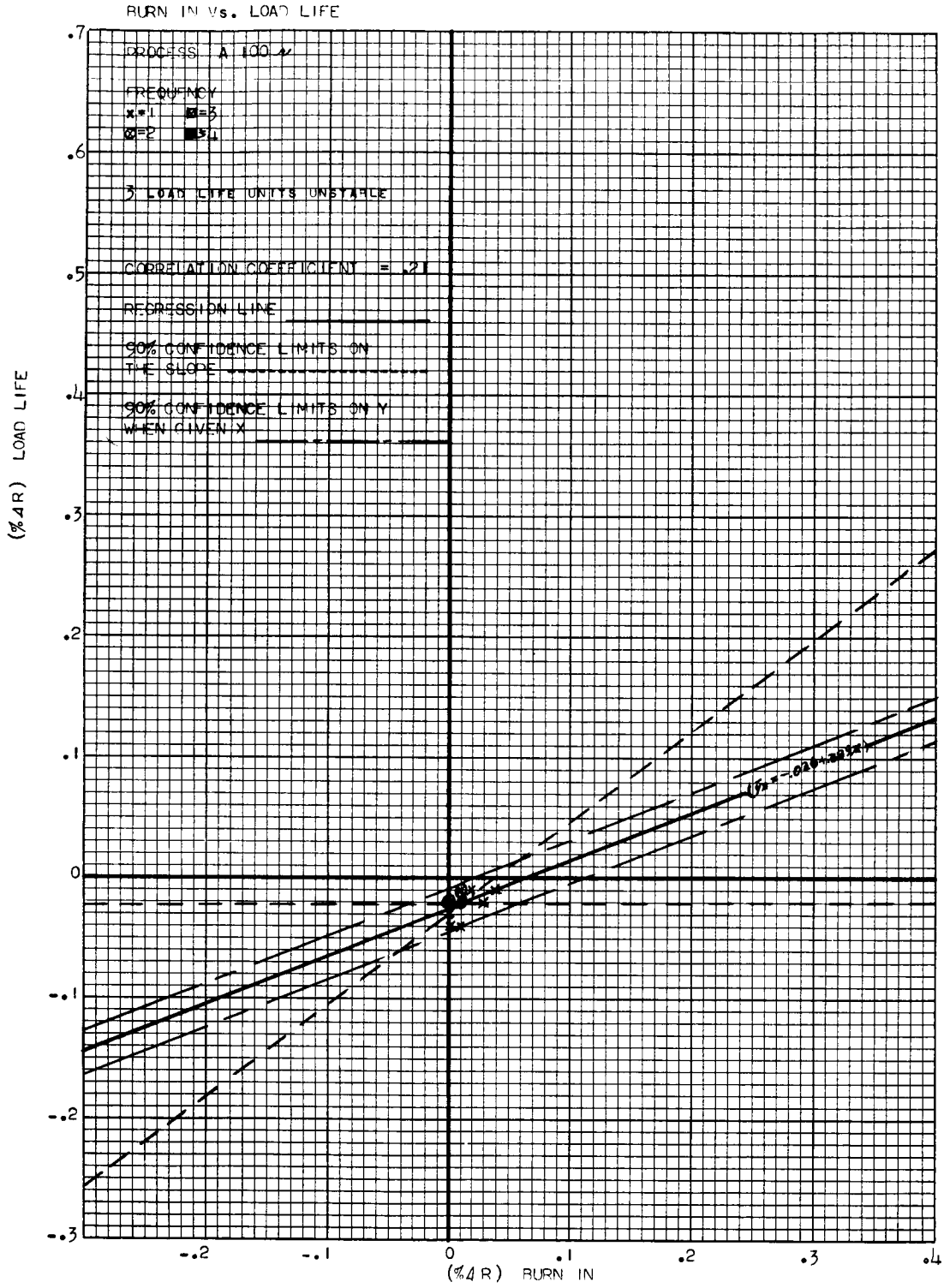


Figure 22 - Regression of Burn-In on Load Life
Type A - 100Ω

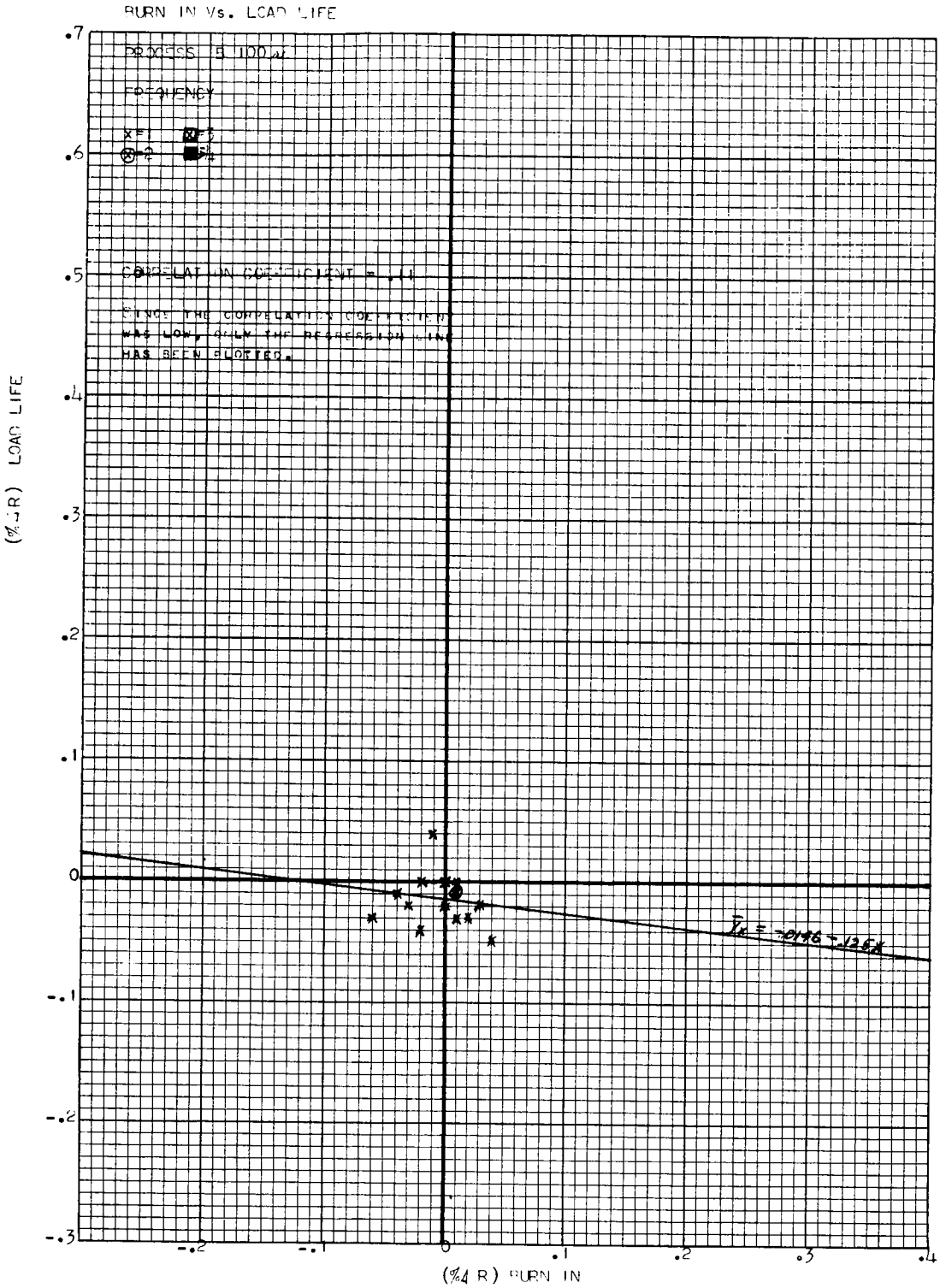


Figure 23 - Regression of Burn-In on Load Life
Type B - 100Ω

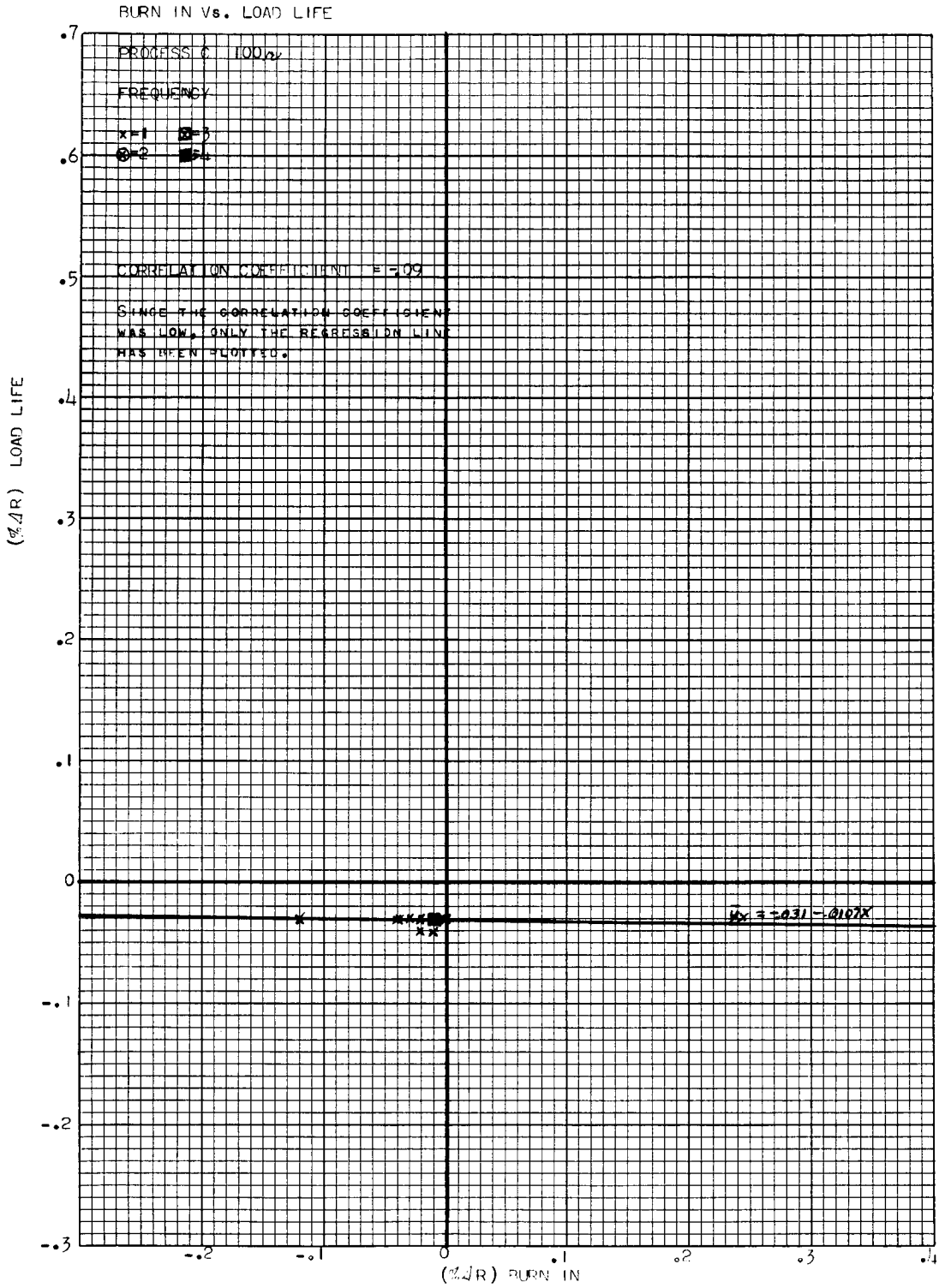


Figure 24 - Regression of Burn-In on Load Life
Type C - 100Ω

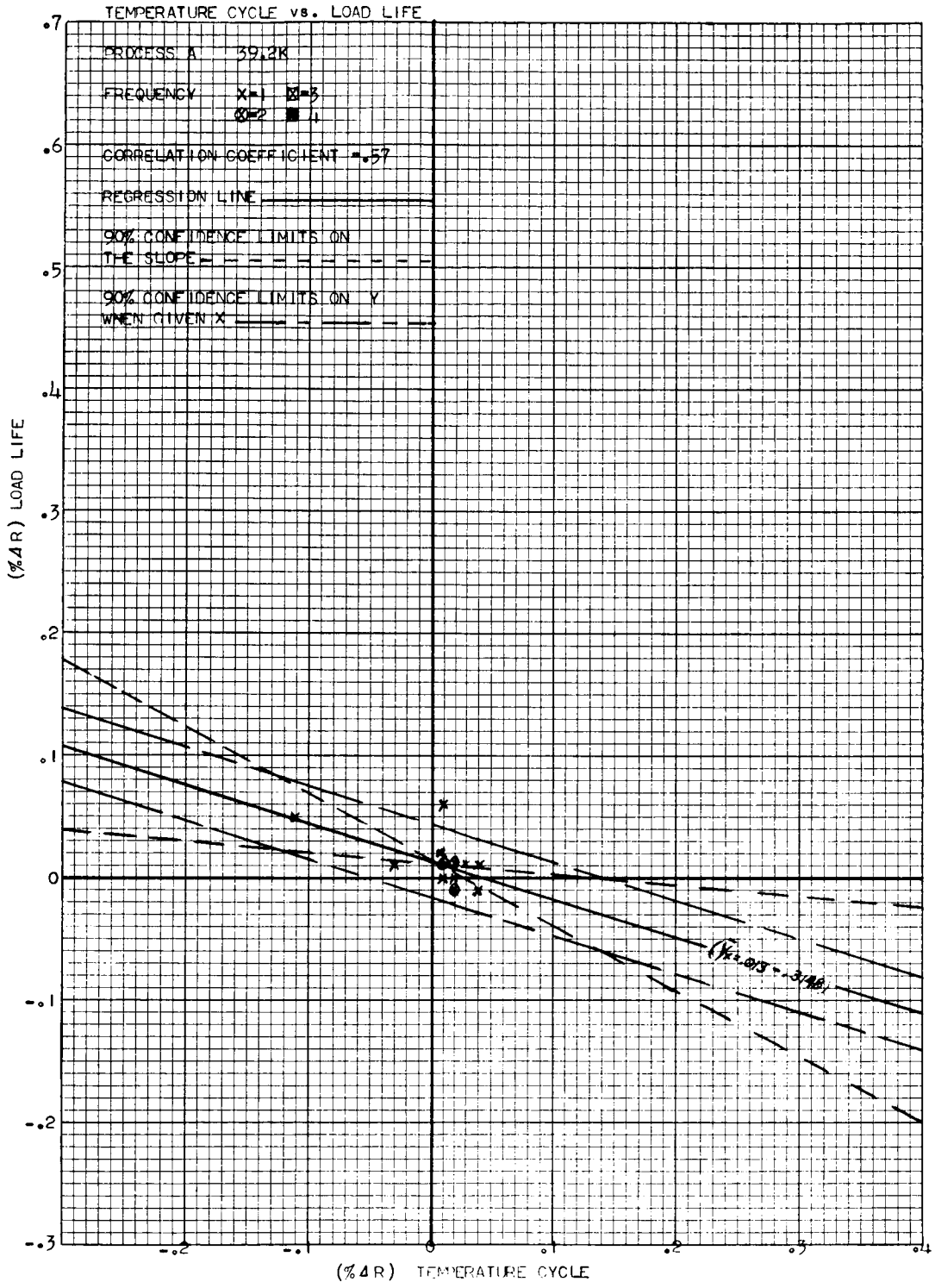


Figure 25 - Regression of Temperature Cycle on Load Life - Type A - 39.2KΩ

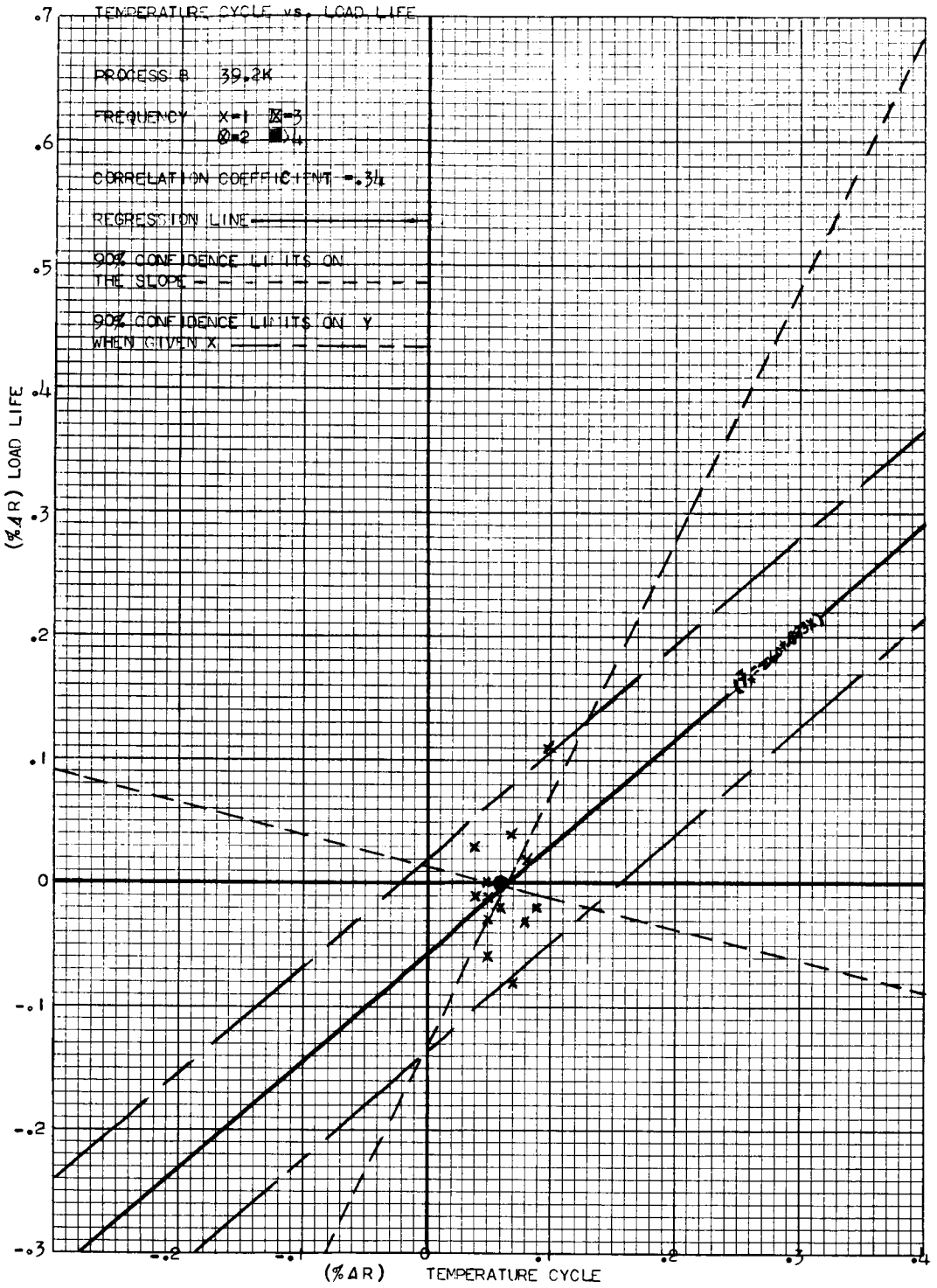


Figure 26 - Regression of Temperature Cycle on Load Life - Type B - 39.2KΩ

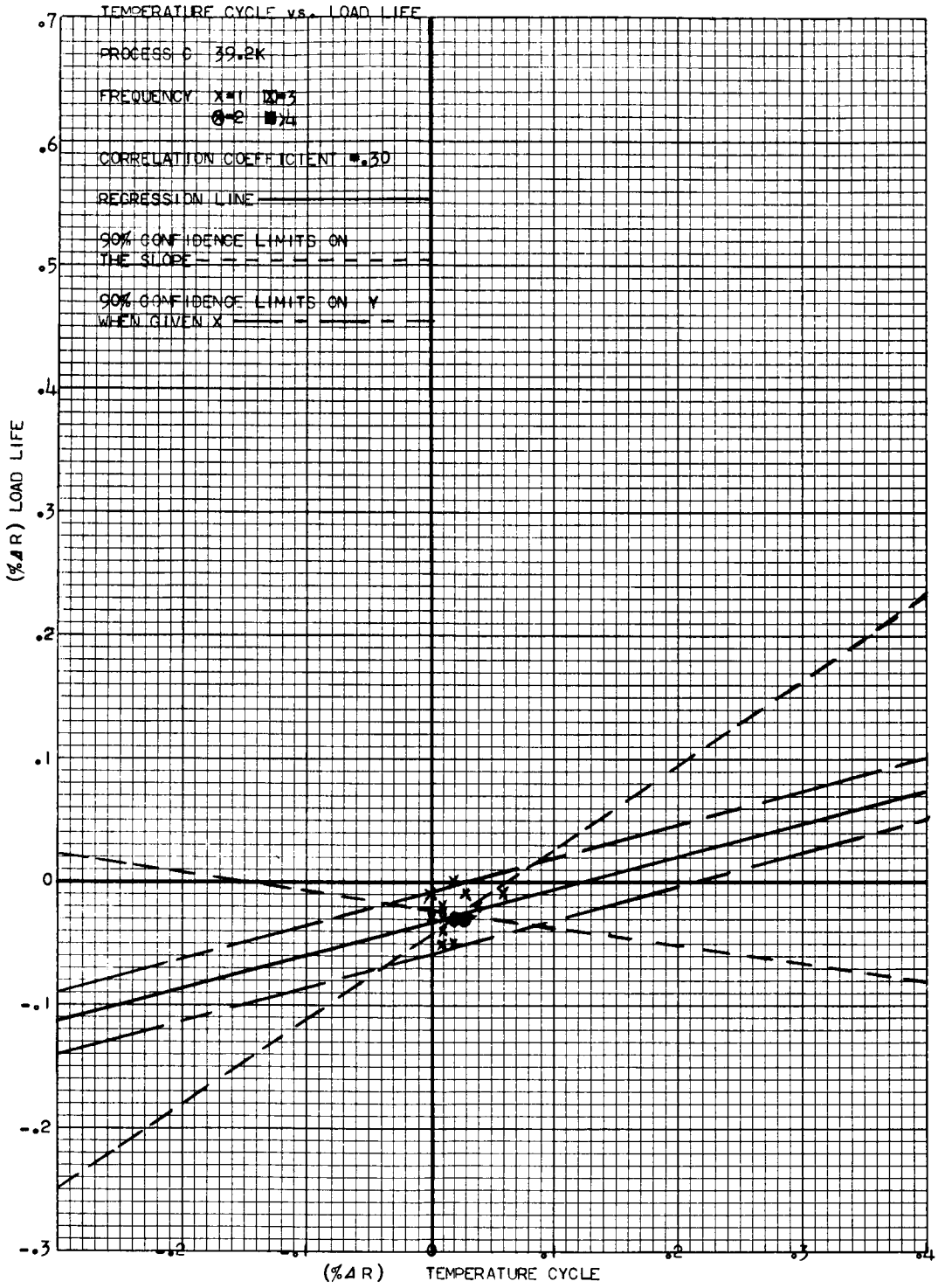


Figure 27 - Regression of Temperature Cycle on Load Life - Type C - 39.2KΩ

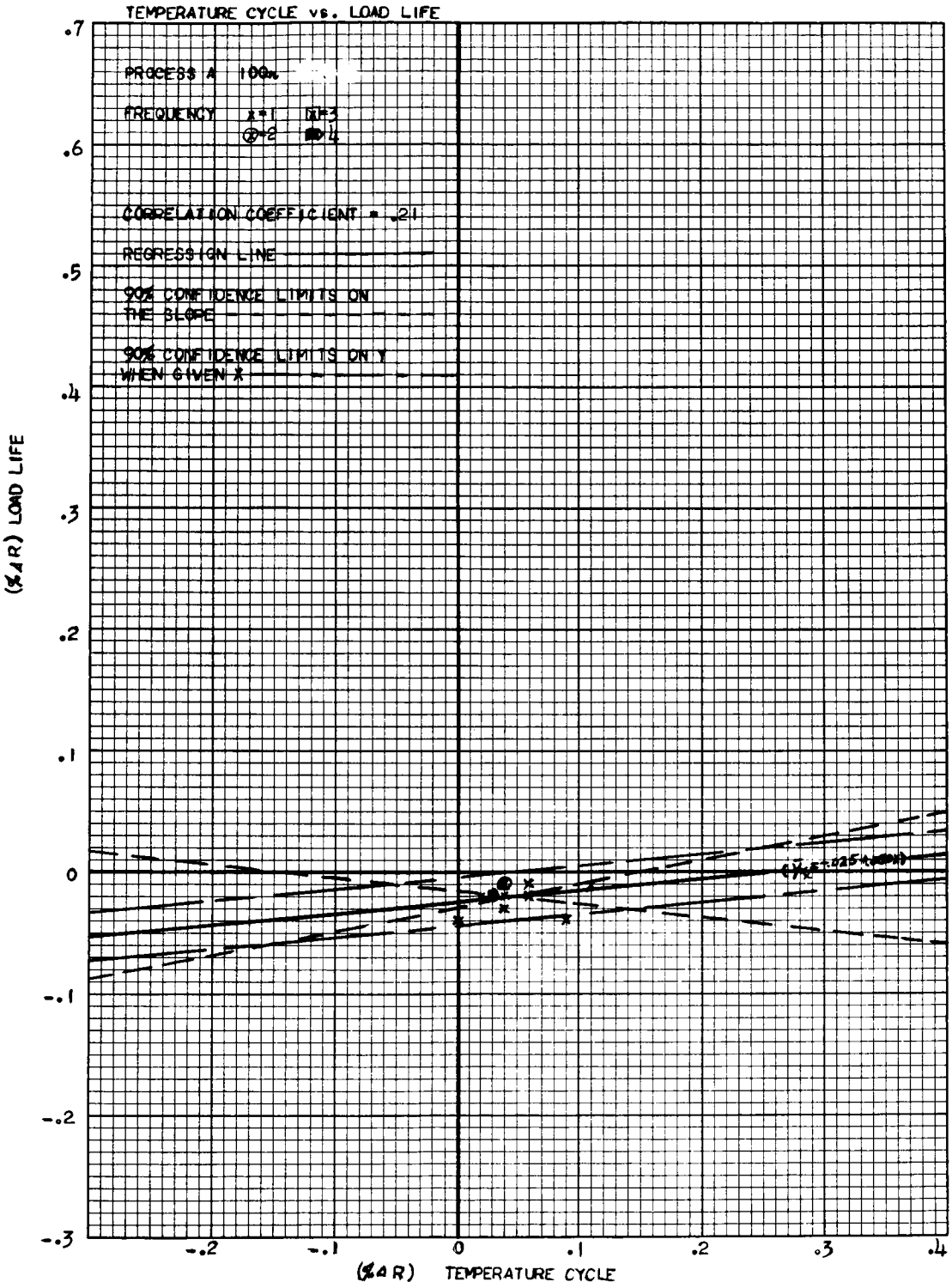


Figure 28 - Regression of Temperature Cycle on Load Life - Type A - 100Ω

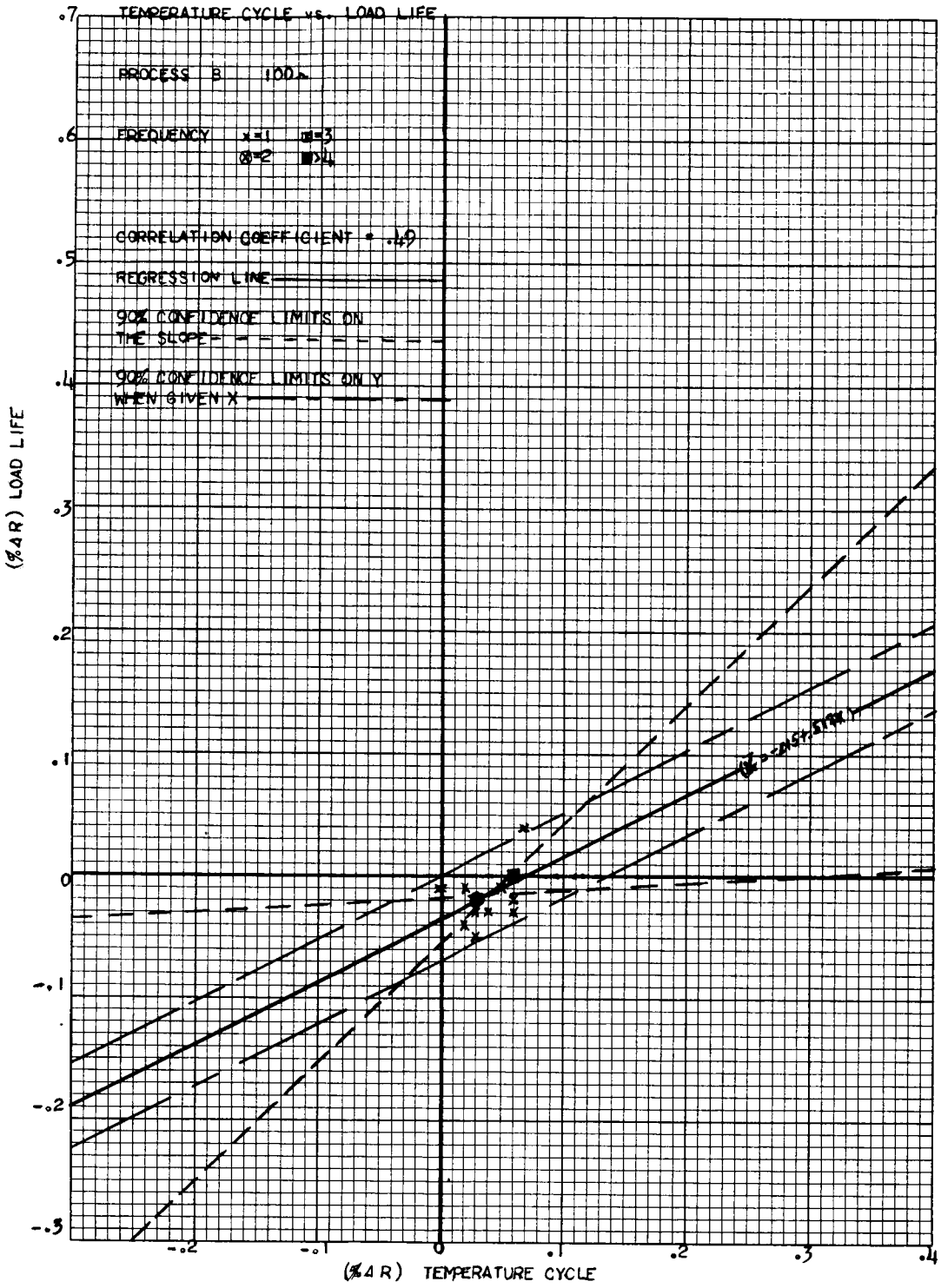


Figure 29 - Regression of Temperature Cycle on Load Life - Type B - 100Ω

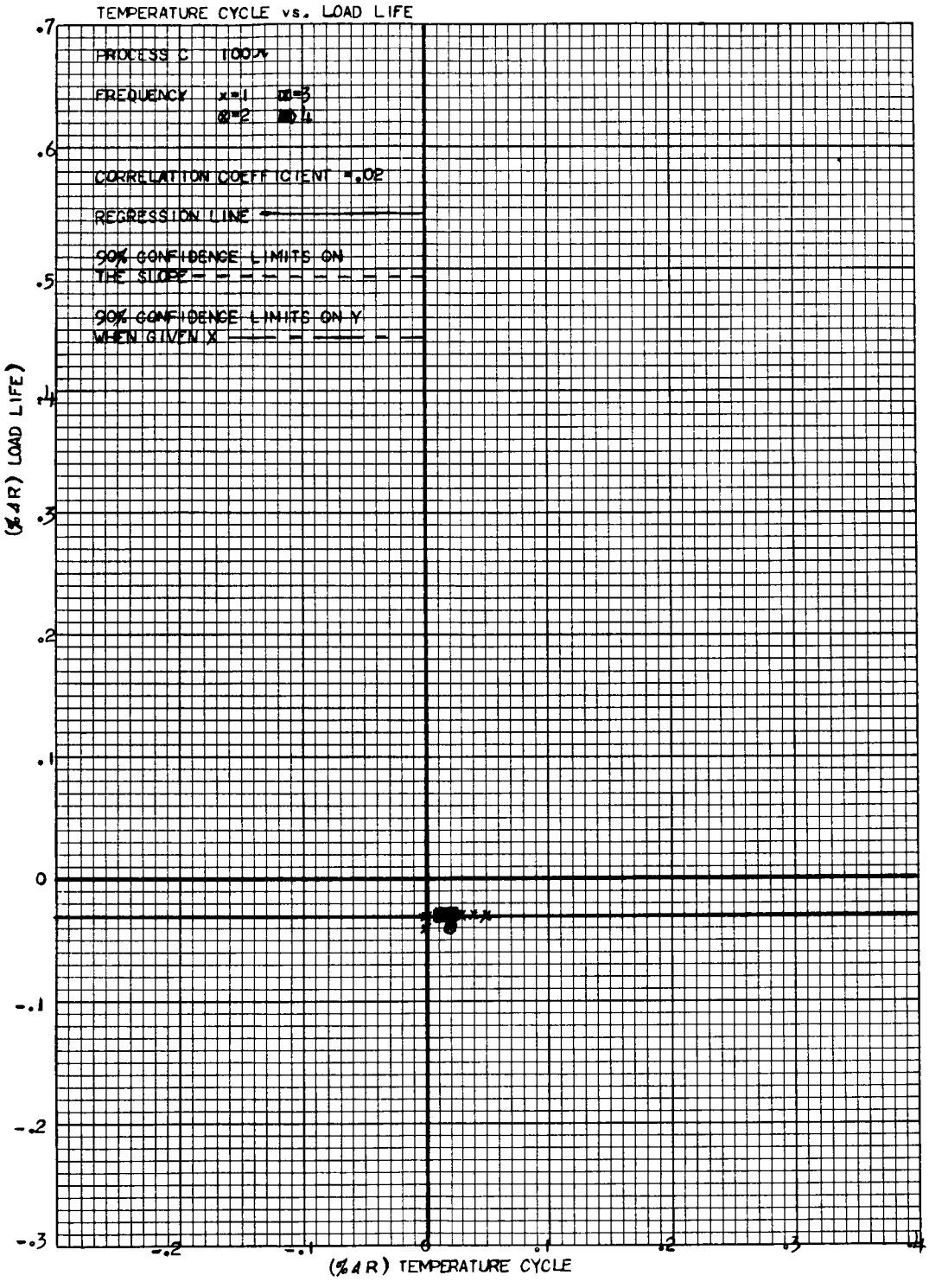


Figure 30 - Regression of Temperature Cycle on Load Life - Type C - 100Ω

Load Life shows that Burn-In has a consistently higher correlation to Load Life than Temperature Cycling. The estimated correlation coefficients and the 95% confidence limits on the correlation coefficients are shown in Table XVIII. From Table XVIII the correlation coefficient (r) = .67 for process A (39.2K value) has a confidence interval from (P.975 = .86) to (P.025 = .23). The limits are widely dispersed since the sample sizes were only 10 pieces.

CORRELATION COEFFICIENTS
(Rated Power and Temperature)

		BURN-IN		
	Resistance Value	P.975	(r)	P.025
Process A	39.2K	.86	.67	.23
B	39.2K	.83	.58	.10
C	39.2K	.83	.58	.10
Process A	100Ω	.77	.47	-.07
B	100Ω	.57	.11	-.42
C	100Ω	.43	-.09	-.56

		TEMPERATURE CYCLING		
	Resistance Value	P.975	(r)	P.025
Process A	39.2K	.82	.57	.08
B	39.2K	.71	.34	-.20
C	39.2K	.69	.30	-.25
Process A	100Ω	.64	.21	-.33
B	100Ω	.79	.49	-.03
C	100Ω	.50	-.02	-.50

Table XVIII - Calculated Correlation Coefficients

In view of the higher correlation of Burn-In to Load Life than Temperature Cycling to Load Life, further explorations of Burn-In as a screening technique appear to be more promising as an effective screening technique.

Acceleration Factors

The objective of this phase of the contract was to derive acceleration factors based on the Weibull Cumulative Distribution Function for the data from the 4000 hour Life Test Matrix. These load life units were subject to multiple stress, matrix testing and the calculated percent change of resistance, with time, relative to the initial reading was utilized in the derivation.

Following the screening tests and the 1000 hour Life Tests, samples for the 4000 hour Life Test, Multiple Stress Matrix were selected from both screened and unscreened portions of each lot, of each value, of each manufactures product. These units had not been previously tested. The resulting groups were subdivided between the four cells of the test matrix. Table XVIII provides tabulation of the group assignments. The samples were mounted on test fixtures placed in their respective ambients and initial readings were taken when their respective temperatures had stabilized. Assigned stress power ratings were applied to the test fixtures until the subsequent scheduled reading times. Readings were taken at 24, 48, 96, 250, 500, 1000, 1500, 2000, 2500, 3000, 3500 and 4000 hours.

Preliminary computations performed on the data included sums, sums of the squares, means, and variances of the percent change in resistance with respect to time. These data were charted against the stress conditions of power, temperature and time. Considerable effort was expended trying to relate the four cells of the multiple stress matrix. First and second order relationships were fitted through the common pair of adjacent cells but none were found that reasonably fitted the fourth cell of the matrix.

Initial Weibull charting encountered immediate difficulties as a result of the small sample size, and resultant large changes in percent failure values from one resistance reading time to the next. Differences ranging from ten to thirty-five percent were not uncommon. The number of failures was further found to decline with respect to time in several instances. This situation is attributable to the conditions

ALLOCATION OF UNITS

Ambient Temp. (°C)	Rating & Status (3)	Percentage of Rated Power (1)								
		100			250			1000		
		Processes Designated by Vendor								
		A	B	C	A	B	C	A	B	C
70	39.2K(S)	(2)			20	20	20	(2)		
	39.2K(R)				20	20	20			
	100 (S)				20	20	20			
	100 (R)				20	20	20			
125	39.2K(S)	20	20	20	20	20	20	(2)		
	39.2K(R)	20	20	20	20	20	20			
	100 (S)	20	20	20	20	20	20			
	100 (R)	20	20	20	20	20	20			
150	39.2K(S)	(2)			(2)			20	20	20
	39.2K(R)							20	20	20
	100 (S)							20	20	20
	100 (R)							20	20	20

(1) Rated Power = 100 MW
(2) These stress conditions were not studied.
(3) (R) Samples as received - (S) Samples subjected to screening tests.
(4) Notes: Twenty (20) piece samples were selected from the serialized units following initial measurement at room temperature (0). Half the samples were subjected to screening tests; each sample was randomly assigned to a stress condition; when each sample reached ambient temperature (1), resistance was recorded and power applied. Twelve more recordings were taken at (24, 48, 96, 250, 500, 1000, 1500, 2000, 2500, 3000, 3500, 4000) hours.

Table XVIII - Allocation of Units

indicated by the initial analysis of variance. The cumulative result was inability to visually fit a straight line through the resultant data with any degree of assurance. Transformations of the Weibull plots to Cartesian coordinates and calculations of slope, intercept and standard estimate of error were used to test the goodness of fit for selected values of Gamma. This method was found to be less cumbersome than the Log - Log computations; but such manipulations can not change the basic problems inherent in the data. These conditions so strongly affected the data that changing the estimate of Gamma by two to four orders of magnitude could not readily be detected in improved linearity of the function.

Distribution functions for the twenty piece samples were proposed to develop the estimates of percent failure. Preliminary analysis having shown many of the samples exceeded three standard deviations, a decision was made to attempt to fit the variables data with a Weibull function. An isometric drawing of this approach is shown in Figure 31. With the use of Weibull techniques, it was possible to build the cumulative distribution function at each reading time for each of the matrix cells. To accomplish this in a reasonable time frame, electronic data processing was obtained. The IBM Library of Contributor Programs for the 1620 computer was reviewed and the Weibull Analysis Program Package (6.0,078) was ordered. Pending receipt of this information, a variables data program previously developed to analyze component test parameters utilizing the Weibull function was adapted to the present task. Considerable difficulty was encountered fitting the complete problem into the available memory capacity of the computer. In consideration of run time, programming was designed to minimize sequential loading of output-input data, thus necessitating the linking of subdivisions of the overall computation together through the 1311 Disk Pack.

Need for an iterative technique to select the Gamma coefficient and test the fit of the resultant modifications of the Monitor System by Data Processing Center personnel, to accept consecutive linking of programs without intermediate printing of loaded information permitted our task to be accomplished with four sequential sub-routines.

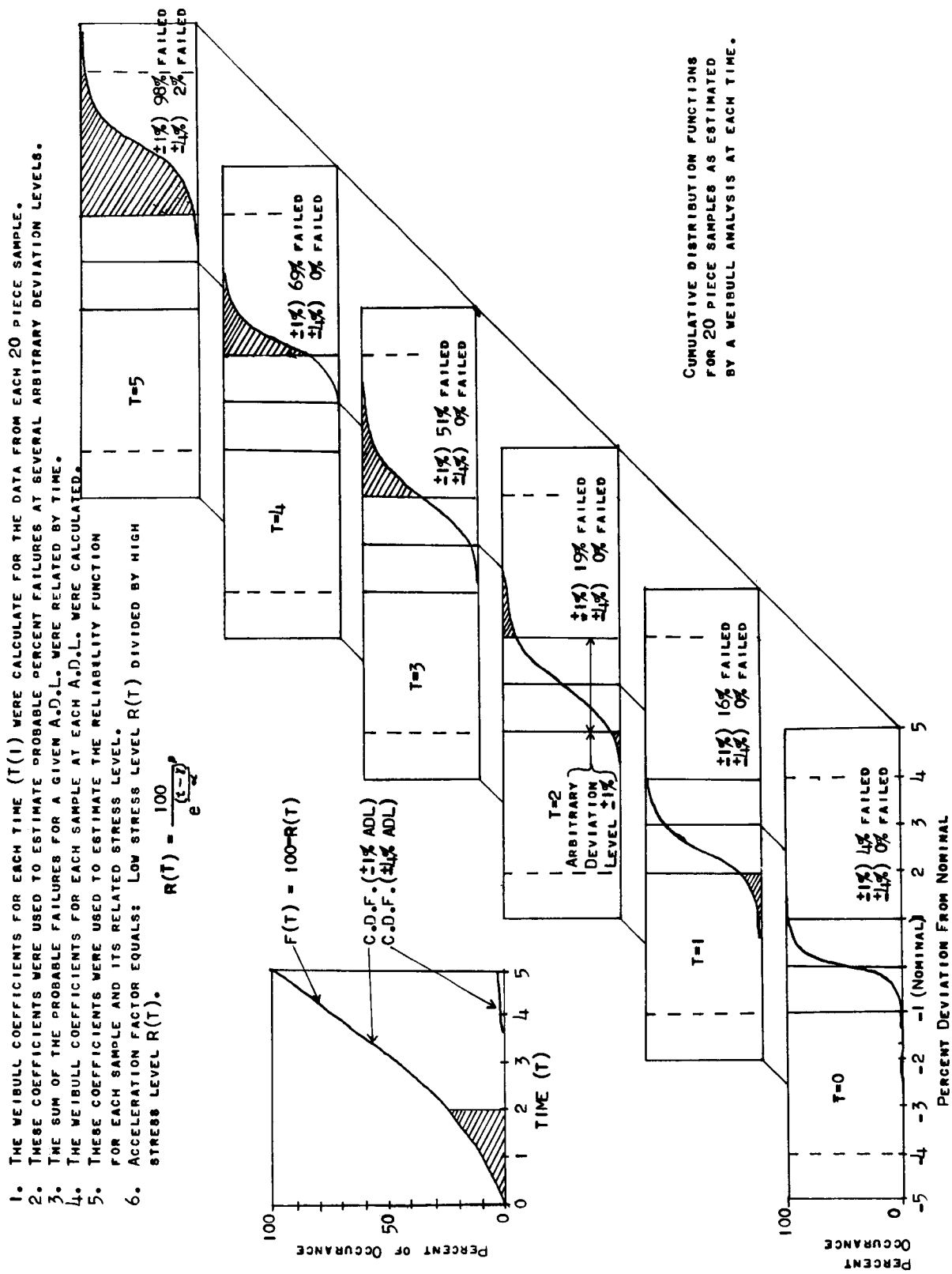


Figure 31 - Isometric drawing of Cumulative Distribution Functions

The titles of the four sub-routines and their particular job capabilities are described below. A tab run of each of the sub-routines is listed in Appendix I.

NASA1A:
This program converts the original readings taken, at room temperature under no load, as percent change from nominal, to resistance values. It also performs this same conversion for those readings taken on the one hundred (100) ohm samples, which were recorded in percent deviation from nominal.

Secondly, it tests for catastrophic failures (readings beyond +VHI or -VLO) and sets these readings to a test value of (-99.99999) for future exclusion from the distribution analysis.

The third function provides for sequentially computing:
1. Percent deviation from nominal.
2. Percent change with respect to time zero (0).
3. Percent change with respect to time one (1).

with the capability for looping from any one or all of these to the Weibull analysis routines of NASA2A and NASA2B.

NASA1B:
This program computes the sums (SX), sums of the squares (SXX), average (AVG) standard estimate of error (SEE), number (N) of readings included and prints the results of NASA1A and NASA1B computations.

NASA2A:
This program sorts the twenty (20) data bits into ascending order, casts out test values, selects a value for Gamma (G), calculates the Alpha (A) and Beta (B) coefficients of the Weibull cumulative distribution function and prints the applicable results. This analysis of the variables data is used in NASA2B to estimate the probability of occurrence within the Arbitrary Deviation Levels (ADL) selected.

NOTE: Proposed improvements are noted on the program tabulation for selection of Gamma and should be incorporated.

The coefficients of the Weibull Cumulative Distribution Function (Distribution Parameters) are found in Table XIX XX and XXI for each respective read out time.

NASA2B:
The density functions with respect to, resistance, change of resistance, etc., computed in NASA2A are expanded for each ADL at each time and the solutions are used to calculate

Table XIX - Distribution Parameters - 70°C

DISTRIBUTION PARAMETERS OF EACH SAMPLE
Per Cent Change from T (1)

Ambient Temp. (°C)			100	250			1000
				γ	β	α	
	39.2K (S)	24		-.007	4.96	.202-9	
		48		-.010	3.98	.178-7	
		96		-.007	3.91	.100-6	
		250		-.020	3.23	.893-6	
		500		-.020	.17	.5328	
		1000		-.038	.18	.5439	
		1500		-.028	1.10	.0087	
		2000		-.030	1.26	.0066	
		2500		-.040	1.61	.0023	
		3000		-.028	1.16	.0136	
		3500		-.022	.16	.6668	
		4000		-.025	.16	.6761	
70	39.2K (R)	24		-.239	12.36	.221-7	
		48		-.237	14.27	.969-9	
		96		-.316	21.80	.108-10	
		250		-.336	22.86	.539-11	
		500		-.260	10.69	.287-6	
		1000		-.352	11.98	.126-5	
		1500		-.339	12.00	.107-5	
		2000		-.339	11.75	.136-5	
		2500		-.344	10.18	.924-5	
		3000		-.336	9.28	.216-4	
		3500		-.323	8.80	.277-4	
		4000		-.326	8.60	.349-4	

(1) All units in sample beyond ±5% were discarded. Insufficient units remained to secure three plot points. Actual quantities are recorded on the tab runs.

Table XX - Distribution Parameters - 125°C

DISTRIBUTION PARAMETERS OF EACH SAMPLE
Per Cent Change from T (1)

Ambient Temp. (°C)			100			250			1000
			γ	β	α	γ	β	α	
	39.2K	24	.005	.16	.5012	.007	1.27	.0090	
	(S)	48	.000	.94	.0097	.010	1.26	.0066	
		96	.012	.19	.4989	.017	1.13	.0169	
		250	-.214	14.51	.146-8*	.015	1.16	.0179	
		500	.005	.15	.6842	.010	1.26	.0182	
		1000	.005	1.05	.0382	.015	1.02	.0526	
		1500	-.002	1.17	.0324	.017	.88	.0902	
		2000	.007	.16	.7443	.010	1.01	.0724	
		2500	.000	.87	.0806	.005	.81	.1325	
		3000	.007	.81	.1007	.028	.82	.1389	
		3500	.007	.84	.0863	.030	.81	.1493	
		4000	.000	.73	.1309	.017	1.08	.0847	
125	39.2K	24	-.630	48.97	.278-9	-.002	2.86	.140-4	
	(R)	48	-.617	41.28	.281-8	-.025	3.36	.263-4	
		96	-.247	13.96	.828-8	-.012	3.31	.286-4	
		250	-.035	2.55	.598-3	-.002	1.41	.0099	
		500	-.033	1.90	.0040	.000	1.58	.0089	
		1000	-.0[illegible]0	1.28	.0250	.012	1.24	.0324	
		1500	-.028	1.17	.0394	.015	1.28	.0353	
		2000	-.017	.97	.0657	.007	1.16	.0618	
		2500	-.033	1.00	.0724	.000	1.20	.0679	
		3000	-.017	.80	.1196	.022	1.21	.0704	
		3500	-.017	.85	.1077	.028	1.24	.0735	
		4000	-.028	.85	.1148	.015	1.27	.0770	

(1) All units in sample beyond ± 5% were discarded. Insufficient units remained to secure three plot points. Actual quantities are recorded on the tab runs.

* A bad reading is included in this calculation.

DISTRIBUTION PARAMETERS OF EACH SAMPLE
Per Cent Change from T (1)

Ambient Temp. (°C)			100	250	1000		
					γ	β	α
	39.2K (S)	24			.461	.94	.5882
		48			.635	1.38	.5258
		96			1.015	1.17	.6222
		250			1.607	.96	.8078
		500			2.084	1.24	1.3360
		1000			2.714	1.17	1.2750
		1500			-	-	-
		2000			-	-	-
		2500			-	-	- (1)
		3000			-	-	-
		3500			-	-	-
		4000			-	-	-
150	39.2K (R)	24			.451	1.36	.3981
		48			.563	1.45	.5155
		96			.818	1.25	.8386
		250			1.229	1.11	1.1910
		500			1.783	.71	1.0820
		1000			2.487	.48	.7146
		1500			-	-	-
		2000			-	-	-
		2500			-	-	- (1)
		3000			-	-	-
		3500			-	-	-
		4000			-	-	-

(1) All units in sample beyond ±5% were discarded. Insufficient units remained to secure three plot points. Actual quantities are recorded on the tab runs.

Table XXI - Distribution Parameters - 150°C

Weibull functions with respect to time for each ADL. The percent failure as calculated by the equations of NASA2A are printed for each ADL and time. The calculation parameters and the Weibull coefficients of the time based distribution are provided for reference. Finally, the reliability (Rt) for each reading time is provided in Appendix II for each ADL for which a fit was obtained. If less than three plot points were available, computations were inhibited. These values can be utilized to calculate Acceleration Ratios between cells of the stress matrix.

The acceleration ratio between two environmental conditions is defined as the ratio of their respective reliability factors:

$$A\ (t) = \frac{R_0(t)}{R_1(t)} \qquad \text{where} \quad t = \text{read out time}$$

The reliability factor expressed as a decimal is the mean fraction of the population which is expected to survive the ADL at the given stress conditions.

The acceleration ratio, for example, between the rated condition (100% rated power, 125°C ambient temperature) and the over-stress condition (250% rated power, 70°C ambient temperature) at 1000 hours and .5% ADL would be:

$$A\ (1000) = \frac{R_{(100\%)}(1000)}{R_{(250\%)}(1000)} = \frac{.9738}{.7743} = 1.257$$

$R_{(100\%)}(1000)$ and $R_{(250\%)}(1000)$ from Appendix II.

The reliability of the over-stressed population will be reduced by 20.5%. The reliability estimates for each environmental condition can be calculated by using the Weibull parameters shown in Tables XXII, XXIII, XXIV. The reliability of a given condition is defined as:

$$R\ (t) = \frac{1}{e^{\frac{(t-\gamma)}{\alpha}^{B}}}$$

In the above example, the rated condition reliability would be:

$$R(1000) = \frac{1}{e^{\frac{(1000-\gamma)}{\alpha}^{B}}} = \frac{1}{e^{\frac{(1000-24)}{.02}^{-1.095}}} = .9737$$

Reliabilities at time (t) are also given for each ADL in tab runs in Appendix II.

COMPUTER COMPUTATION OF WEIBULL PARAMETERS

Process A, 39.2K Ohms

Times Rated Power			1.0	2.5			10.0
Temp.	ADL			γ	β	α	
	39.2K	5.0		277	.226	42.18	
	(S)	4.5			.222	39.35	
		4.0		275	.217	36.45	
		3.5			.212	33.46	
		3.0		272	.207	30.36	
		2.5			.200	27.13	
		2.0		269	.192	23.53	
		1.5			.183	20.10	
		1.0		265	.170	16.09	
		.5			.150	11.38	
70							
	39.2K	5.0					
	(R)	4.5					
		4.0					
		3.5					
		3.0					
		2.5					
		2.0					
		1.5					
		1.0					
		.5					

(2) Data in these samples did not include any failures; thus no functions were calculated. Acceleration functions for each other cell to this cell is the reliability expression for the other cell.

Table XXII - Weibull Parameters - 70°C

Table XXIII - Weibull Parameters - 125°C

COMPUTER COMPUTATION OF WEIBULL PARAMETERS

Process A, 39.2K Ohms

Times Rated Power		1.0			2.5			10.0
Temp.	ADL	γ	β	α	γ	β	α	
	39.2K 5.0	24	.318	52.48				
	(S) 4.5	24	.310	48.24				
	4.0	24	.303	43.99				
	3.5	24	.294	39.70				
	3.0	24	.284	35.36		(2)		
	2.5	24	.273	30.96				
	2.0	24	.260	26.46				
	1.5	24	.244	21.79				
	1.0	24	.223	16.83				
	.5	24	-1.095	.02	2205	-.113	34.56	
125								
	39.2K 5.0							
	(R) 4.5							
	4.0							
	3.5							
	3.0							
	2.5							
	2.0							
	1.5							
	1.0							
	.5							

(2) Data in these samples did not include any failures; thus no functions were calculated. Acceleration functions for each other cell to this cell is the reliability expression for the other cell.

COMPUTER COMPUTATION OF WEIBULL PARAMETERS

Process A, 39.2K Ohms

Times Rated Power			1.0	2.5	10.0		
Temp.	ADL				γ	β	α
150	39.2K (S)	5.0			24	.578	85.86
		4.5			24	.617	97.36
		4.0			24	.672	115.70
		3.5			24	.253	148.30
		3.0			24	.871	208.70
		2.5			24	.860	154.30
		2.0			24	.820	85.59
		1.5					
	39.2K (R)	5.0			24	.929	601.4
		4.5			24	.926	566.4
		4.0			24	.920	517.4
		3.5			24	.906	438.1
		3.0			24	.882	331.5
		2.5			24	.858	218.3
		2.0			24	.932	183.8
		1.5			24	.891	66.53

(2) Data in these samples did not include any failures; thus no functions were calculated. Acceleration functions for each other cell to this cell is the reliability expression for the other cell.

Table XXIV - Weibull Parameters - 150°C

For the ADL's listed in Tables XXII, XXIII, XXIV, the unscreened data did not include any failures; thus no functions were calculated for these ADL's. An extension of these tables for the unscreened parts at smaller ADL's is shown in Table XXV. The Weibull parameters shown in Table XXV were obtained by graphic methods since the computer runs did not include these ADL's. The reliabilities for each ADL in Table XXV at time (t) equal to 500 hours has also been listed.

Since the original task was to develop a multivariate stress relationship, acceleration ratios have not been developed for all cells of the matrix. As stated previously, the task of developing a multivariate stress relationship proved to be impossible. The functions of the main effects (temperature, and power) could not be derived since only two points were available for describing either one of the functions; however, if one is willing to assume a linear relationship for the combination of main effects, the acceleration ratios will provide the correct acceleration factor between two predetermined cells.

GRAPHIC COMPUTATION OF WEIBULL PARAMETERS

Process A, 39.2K Ohms, Unscreened

		1 x RP				2.5 x RP				10 x RP			
	ADL	R(500)	γ	β	α	R(500)	γ	β	α	R(500)	γ	β	α
	5.												
	4.												
	3.												
	2.												
	1.												
70	.5												
	.1					92	12	.24	51				
	.05					82	12	.50	109				
	.01					.1	12	1.21	275				
	.005												
	5.												
	4.												
	3.												
	2.												
	1.												
125	.5												
	.1	.93	12	.35	115	83	12	1.00	3300				
	.05	.83	12	.60	220	65	12	.78	295				
	.01	.76	12	.38	7	1	1	.35	2				
	.005												
	5.									59	12	1.13	2100
	4.									53	12	1.03	920
	3.									35	12	.96	360
	2.									16	12	1.01	290
	1.									0	3	1.15	82
150	.5												
	.1												
	.05												
	.01												
	.005												

Table XXV - Graphic Weibull Parameters

Additional Tests

It was later considered desirable to investigate "current noise" as well as non-linear distortion since no relationship was found between non-linear distortion and load life in the original studies. Also included in this investigation is an attempt to correlate the two types of noise measurements.

The second major investigation in this phase of the work comprised a comparison of resistor temperature profiles obtained with infra-red techniques to load life.

The load life test for this phase was conducted at 2X rated power at 125°C ambient temperature. In order to further investigate Burn-In correlation to Load Life, it was decided to consider the first 100 hour data as Burn-In and correlate this data with the 1000 and 2000 hour Load Life readings.

Test Samples.- Nine-hundred test resistors consisting of one-hundred each of three resistance values produced by the same three manufacturers of the original samples were serialized as shown in Table XXVI.

Resistance		Serial Number
	Mfg. A	
100 ohm		85101 - 85200
39.2K ohm		85301 - 85400
100K ohm		85501 - 85600
	Mfg. B	
100 ohm		86101 - 86200
39.2K ohm		86301 - 86400
100K ohm		86501 - 86600
	Mfg. C	
100 ohm		87101 - 87200
39.2K ohm		87301 - 87400
100K ohm		87501 - 87600

Table XXVI - Serialization

Noise Tests.- The Quan-Tech Model 315 Resistor Noise Test Set measures the "current noise" developed by a resistor under a D.C. load. The noise measurements made by the Quan-Tech Test Set are performed in two steps. The first measurement is made with the test resistor in the circuit but no current passing through it. This is a measurement of the "system" noise which is the quadratic sum of the extraneous noise sources within the test system. The second measurement is made with current passing through the resistor and is an indication of "total" noise. The magnitude of current noise voltage is indicated by subtracting the effects of the presence of "system" noise from the "total" noise voltage measurements. Measurements are made at rated voltage.

The Ericsson Distortion Meter ZTP 1271 measures the non-linear distortion in the resistors under test. The distortion is a function of the current noise, thermal noise, and voltage coefficient of the resistor under test. The distortion is created by inherent film characteristics, irregularities in the resistive film, irregularities in the spiral path and poor mechanical connections.

A pure sine wave voltage of 10KC or 50KC is applied to the resistor under test. The third harmonic of 30KC or 150KC which is generated by the test resistor is then detected, amplified, and measured. The test system has an overall gain of 3,000 and the magnitude of the third harmonic is a direct function of the non-linear characteristics of the resistor under test.

The noise measurements taken on the Quan-Tech are either in $^{u}v/v$ or db's, and the readings taken on the Ericsson are in millivolts. The following formula can be used to convert the Ericsson readings from millivolts to microvolts per volt:

$$N\ (^{u}v/v) = \frac{E_1}{3E_2}$$

where E_1 = Noise reading in Mv

E_2 = Applied voltage in volts

Ericsson measurements were made at 10KC and rated voltage for comparison with Quan-Tech measurements.

Equipment limitations made it impossible to obtain the 50KC measurement at rated voltage on those units above 100 ohm. Therefore, an additional 10KC reading and a 50KC reading were made at 1/10 rated power on the 39.2K ohm and 100K ohm units. This was done to provide a comparison of measurements at the two different frequencies. Also provided is a comparison of distortion levels at rated and 1/10 rated power. Measurements on the 100 ohm units were made only at rated power.

Figures 32 through 34 show distributions of various noise measurements.

Figures 35 through 38 are scatter plots of Quan-Tech readings versus Ericsson readings. Readings from both systems have been converted into microvolts per volt ($^{\mu}v/v$).

Since there is no apparent relationship between the two measurement systems, no further analysis was conducted.

Noise measurements were then plotted against the 2000 hour Load Life data. These plots are shown in Figures 39 through 43. Again no apparent relationship was seen and further analysis was not undertaken.

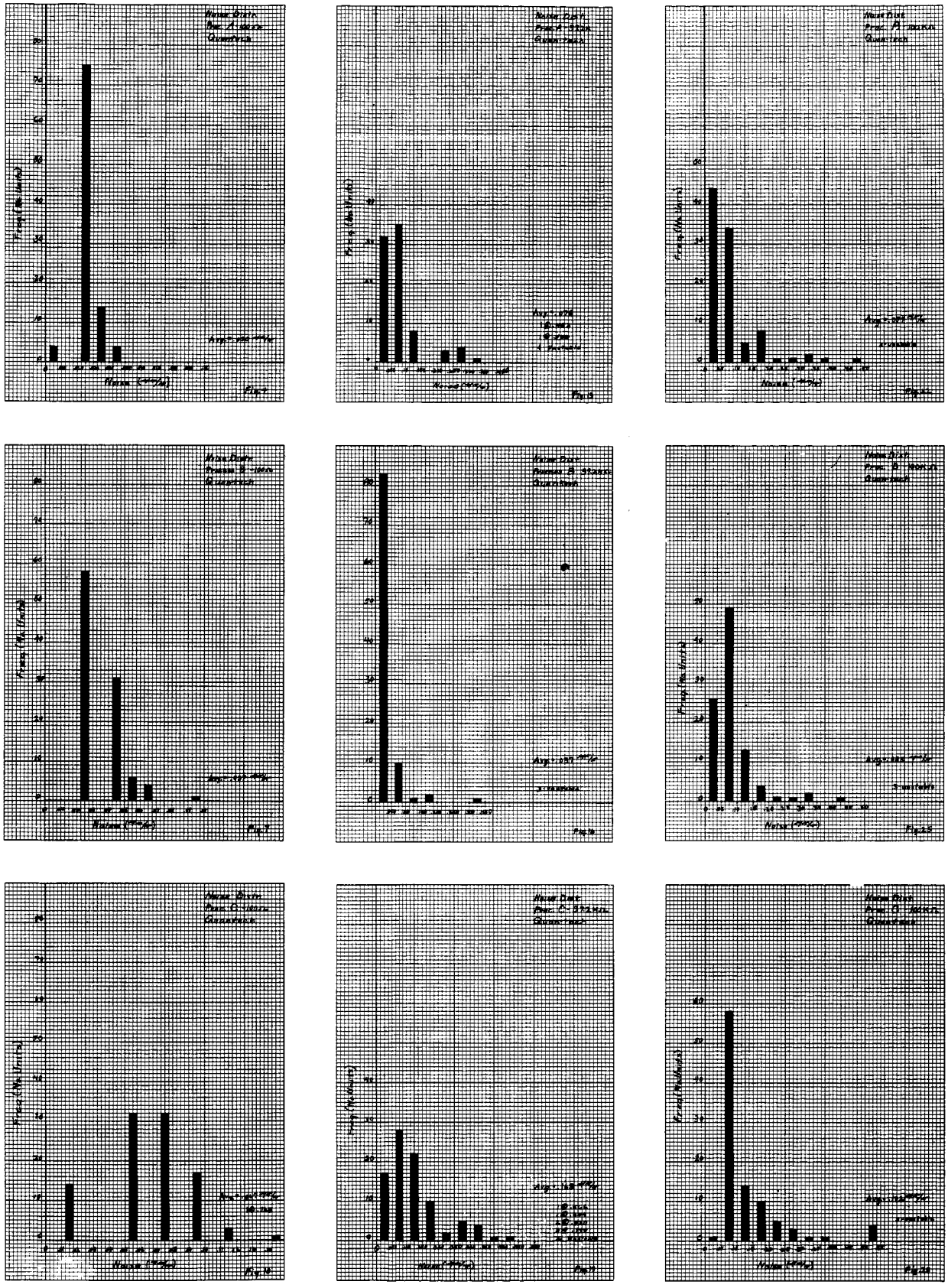


Figure 32 - Distribution of Quan-Tech Noise

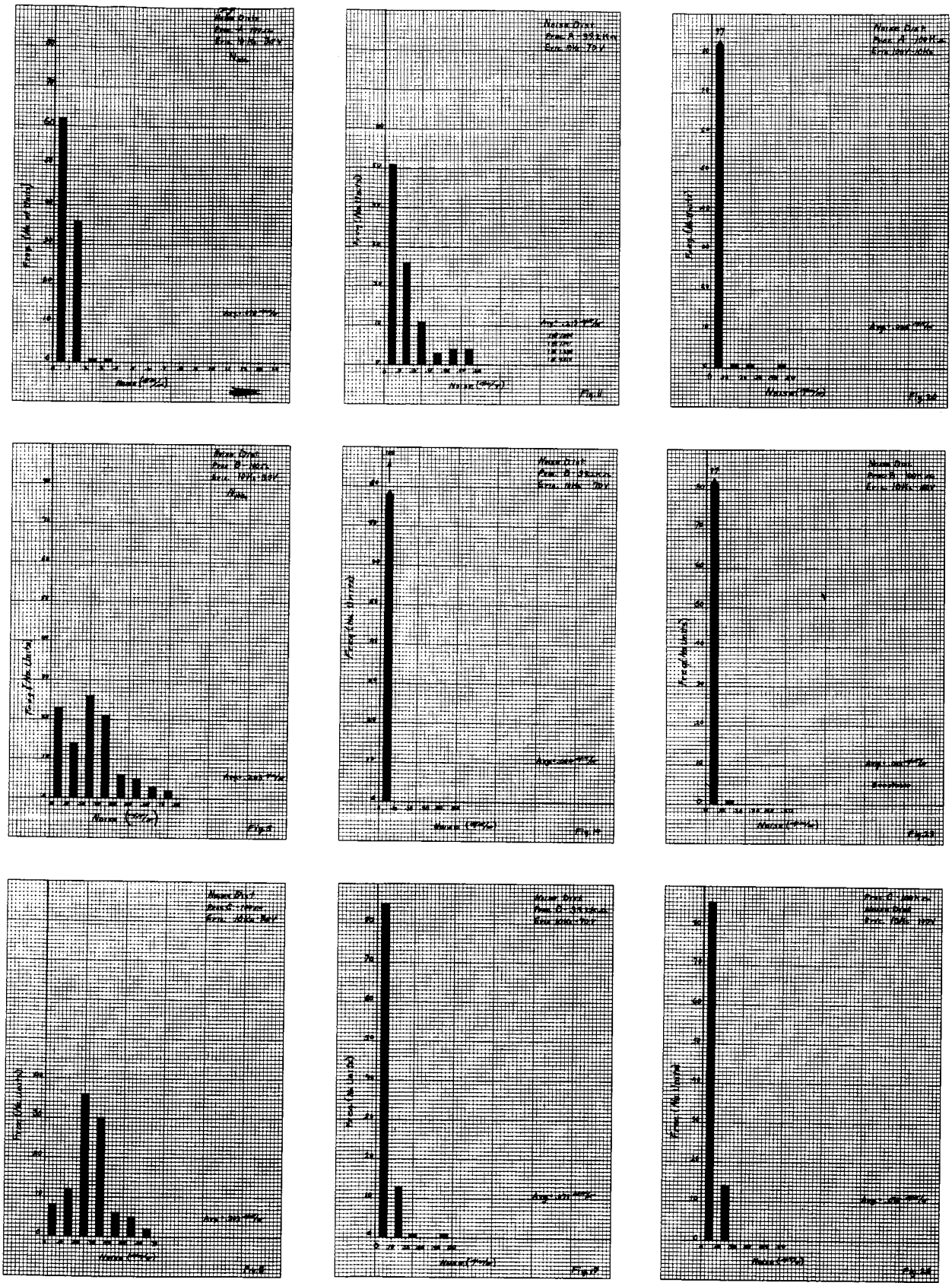


Figure 33 - Distribution of EricssonNoise at 10KC

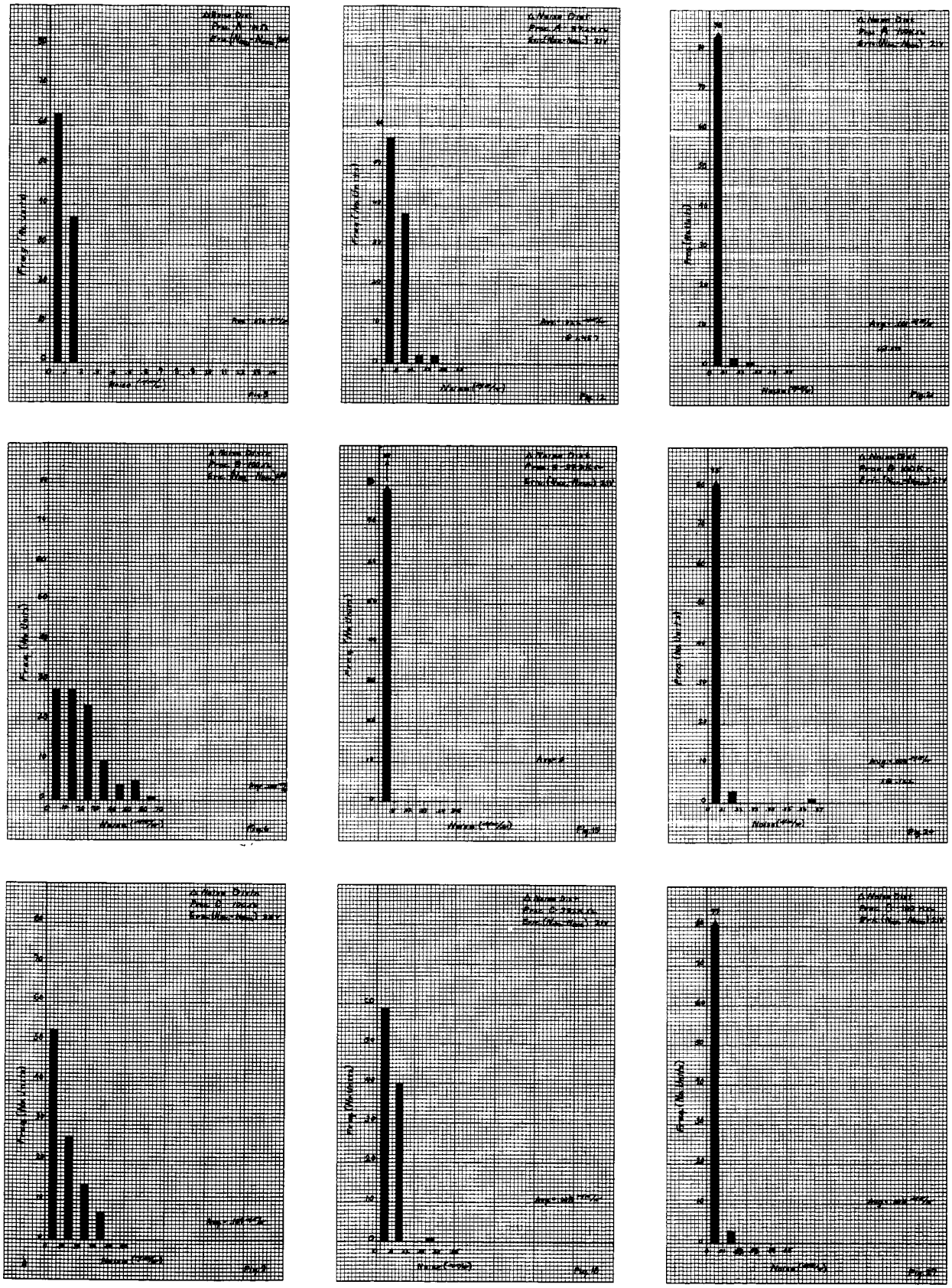


Figure 34 - Distribution of the difference in Ericsson noise from 10KC to 50KC

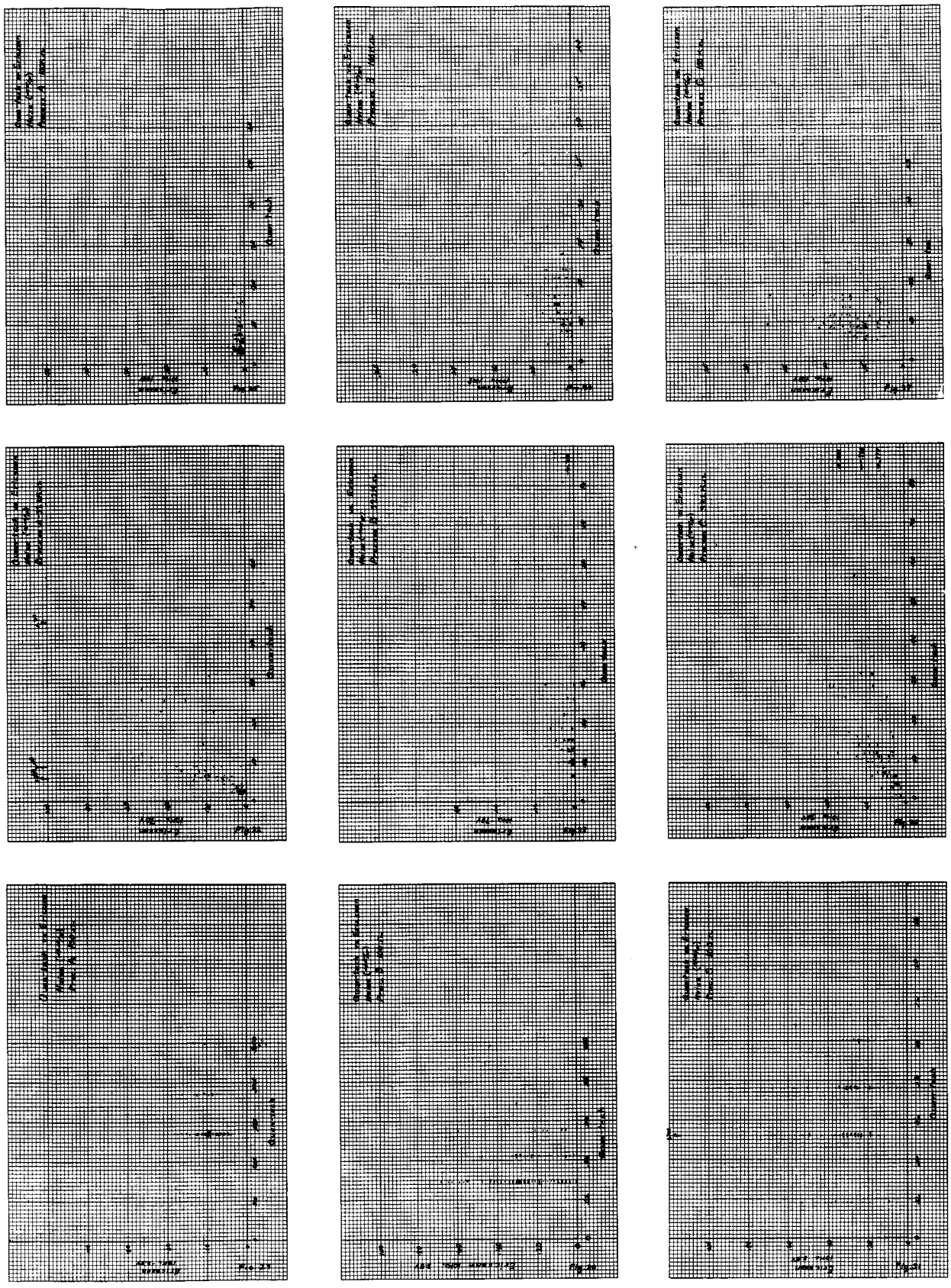


Figure 35 - Quan-Tech vs. Ericsson at 10KC

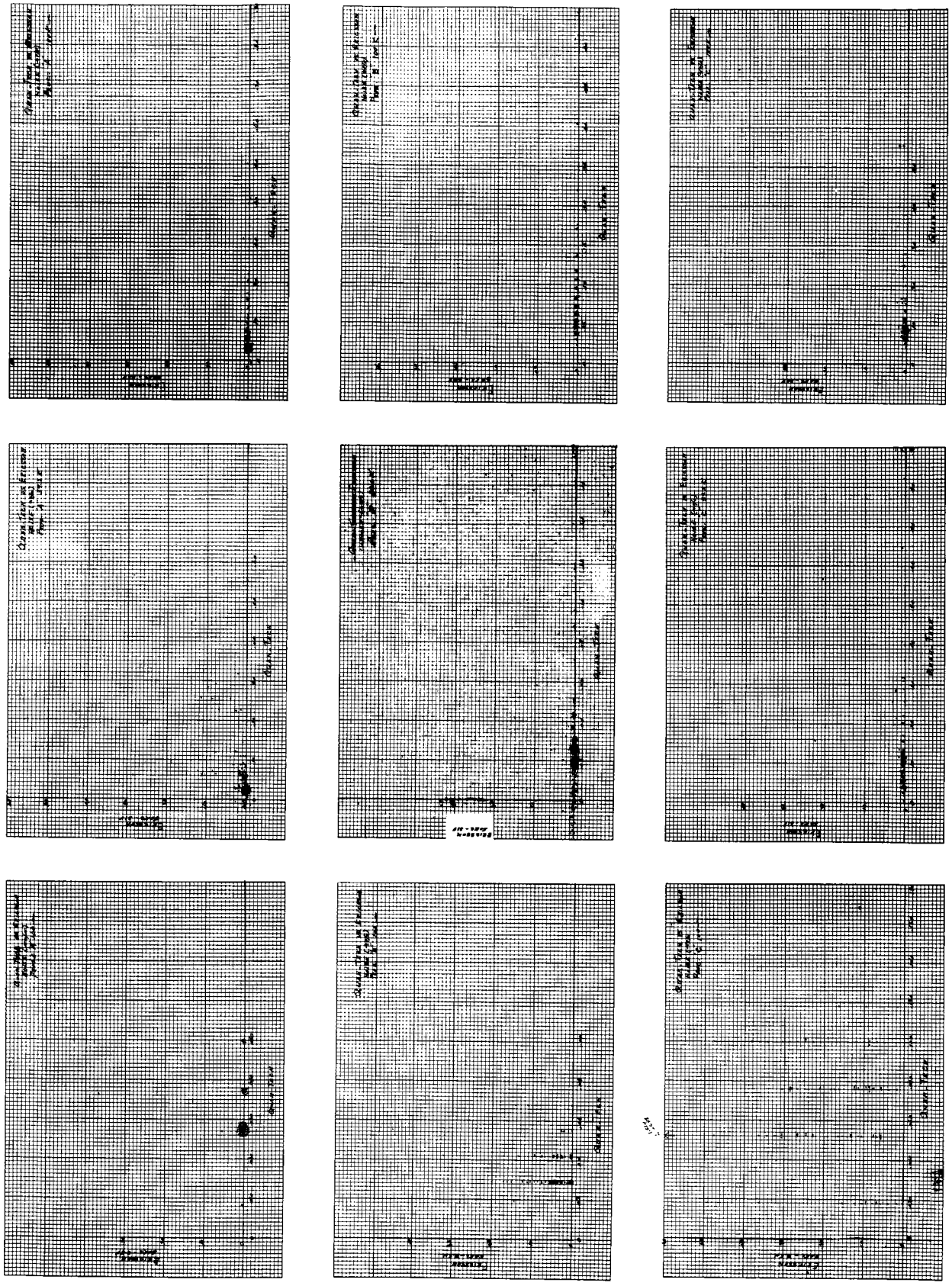


Figure 36 - Quan-Tech vs. Ericsson at 50KC

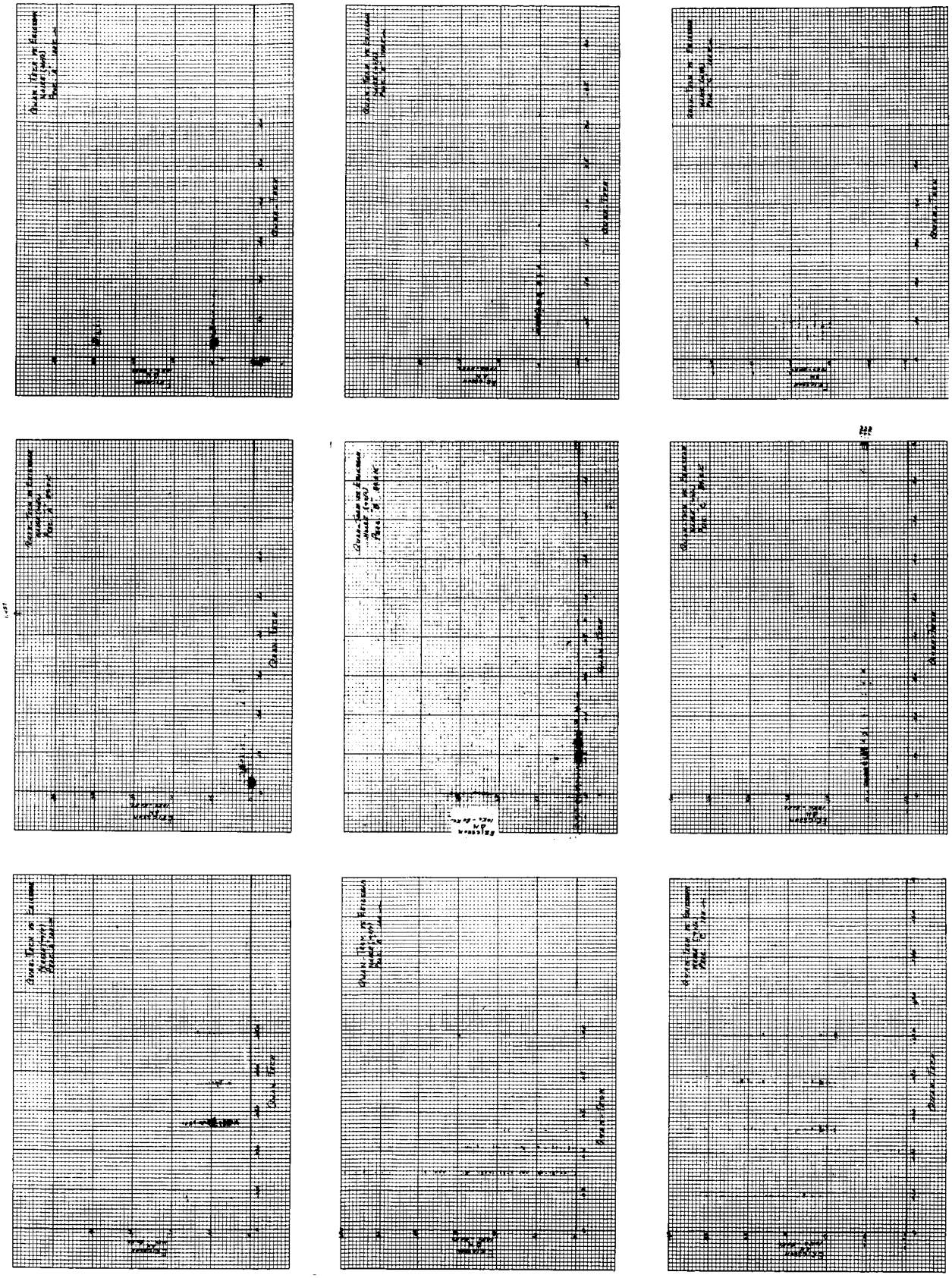


Figure 37 - Quan-Tech vs. Ericsson Noise Change from 10KC to 50KC

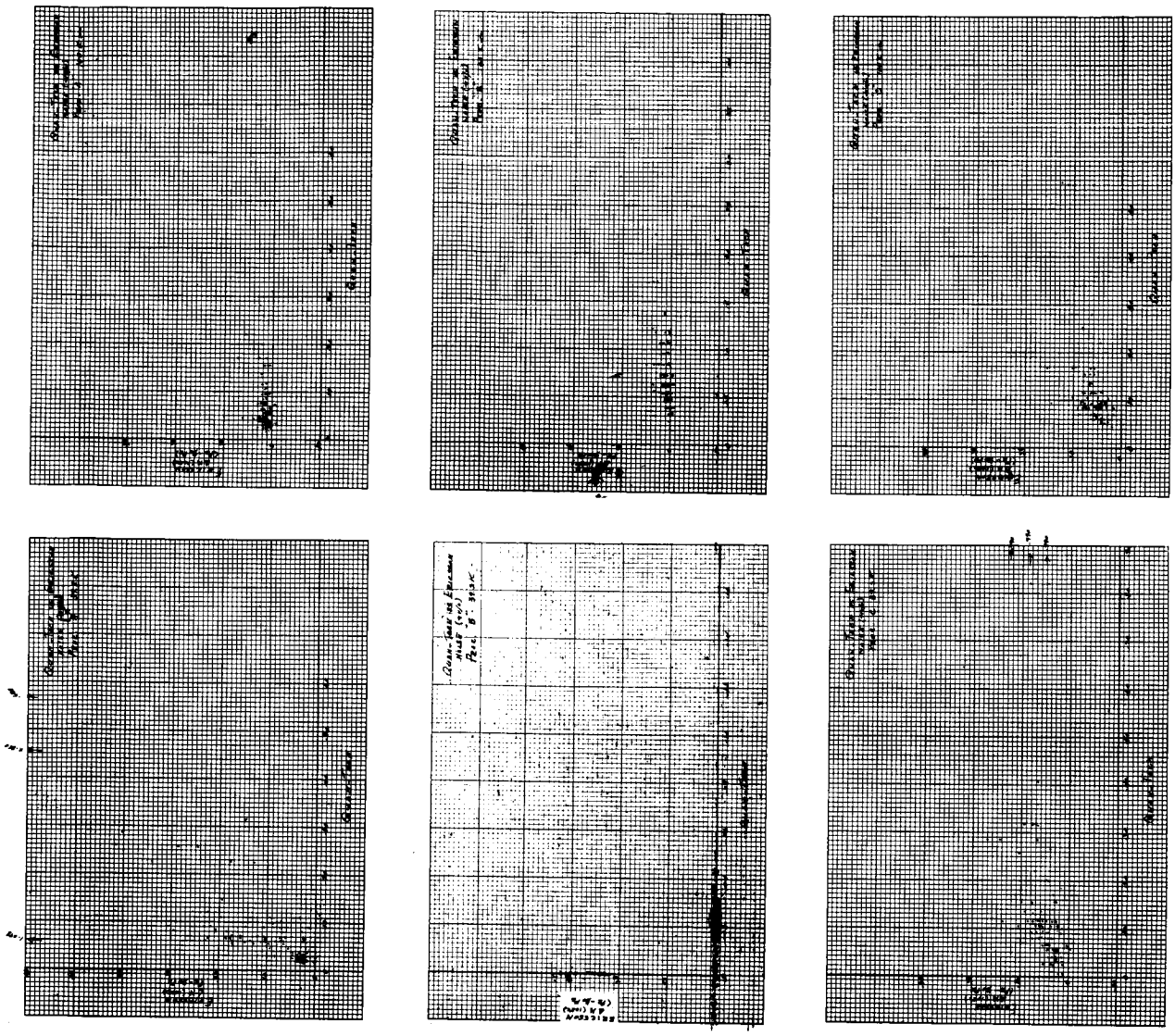


Figure 38 - Quan-Tech vs. Ericsson Noise Change from 0.1 X rated power to 1.0 X rated power at 10KC

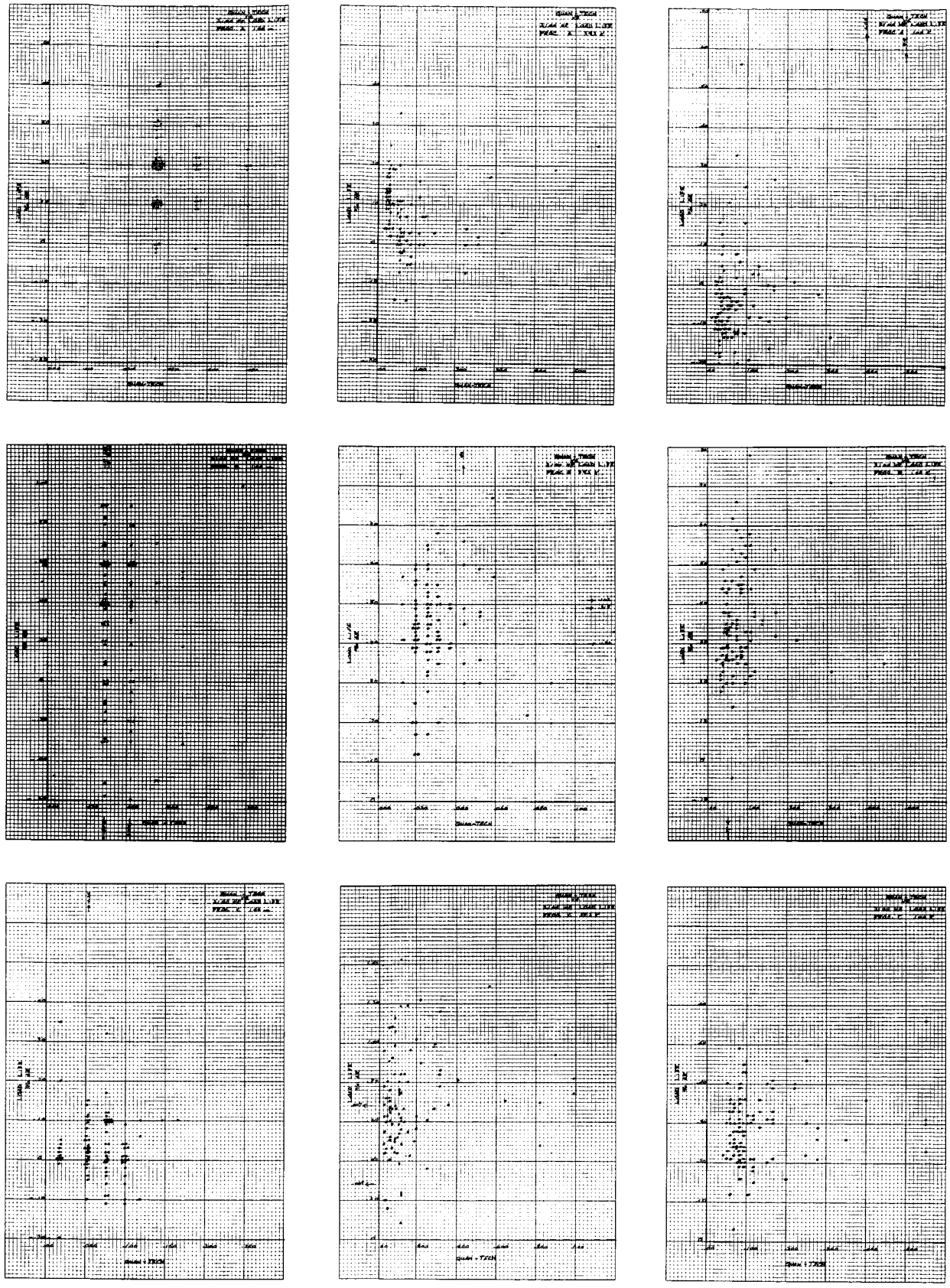


Figure 39 - Load Life vs. Quan-Tech Noise

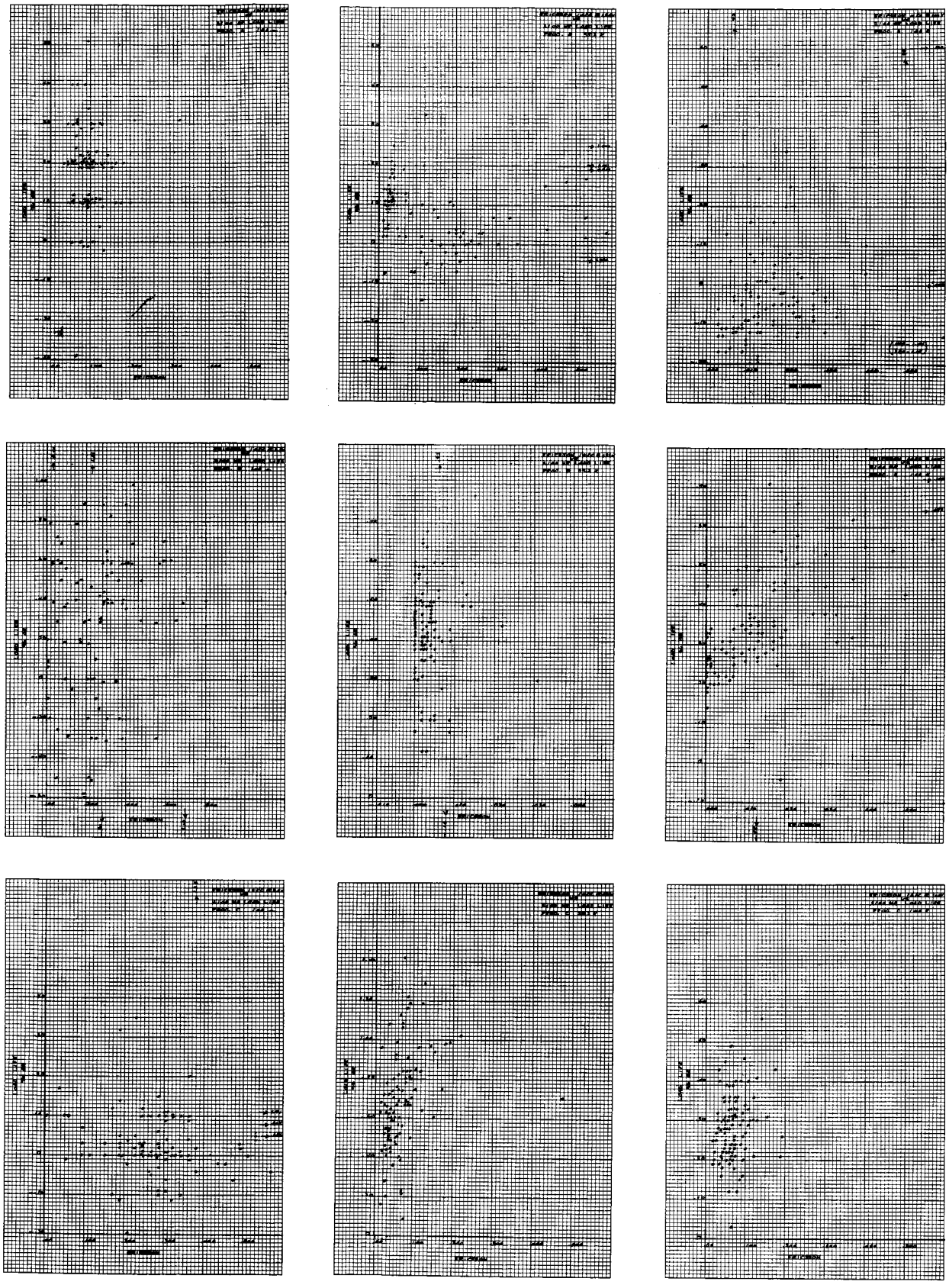


Figure 40 - Load Life vs. Ericsson Noise
at 10KC

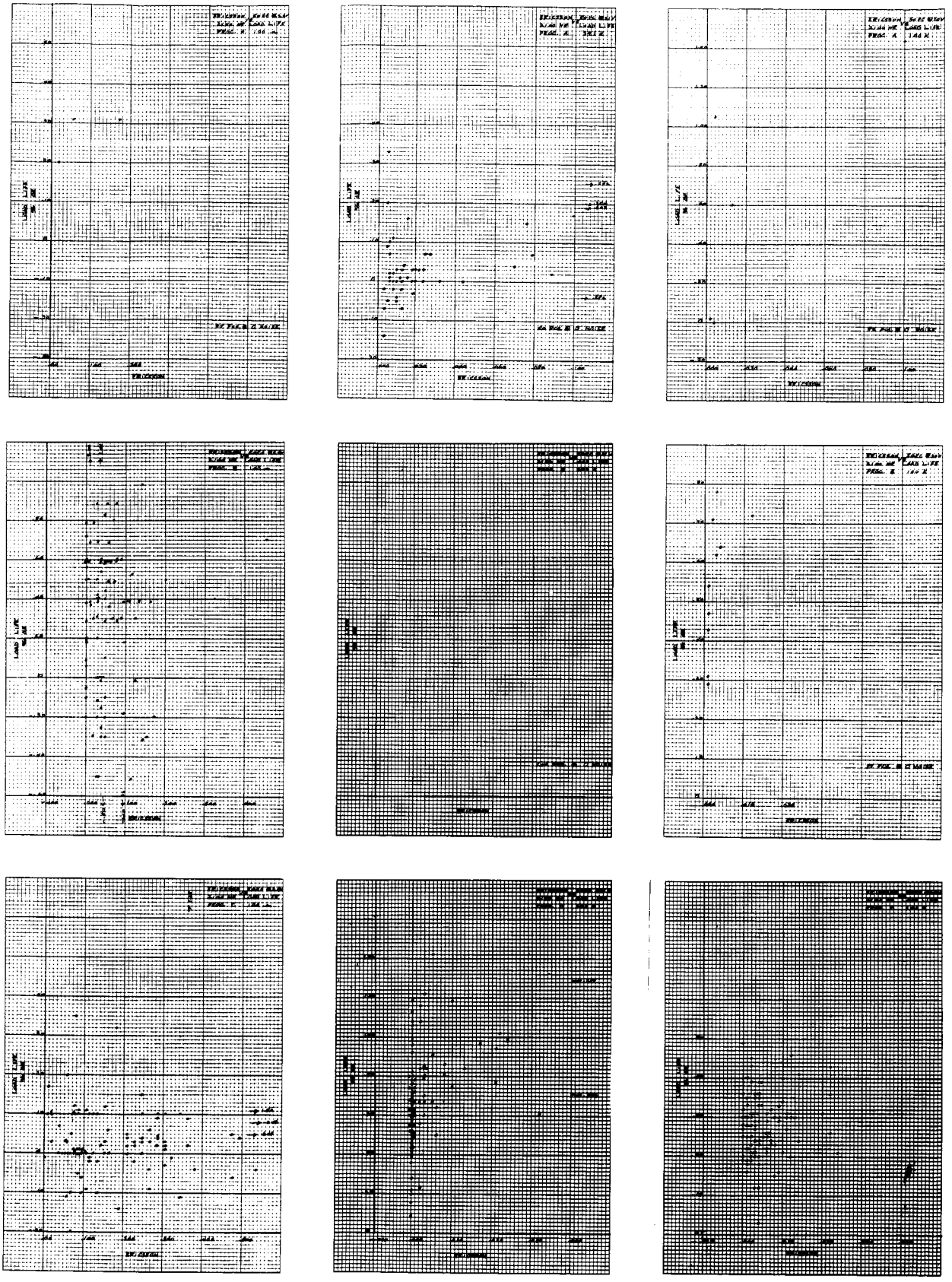


Figure 41 - Load Life vs. Ericsson Noise
at 50KC

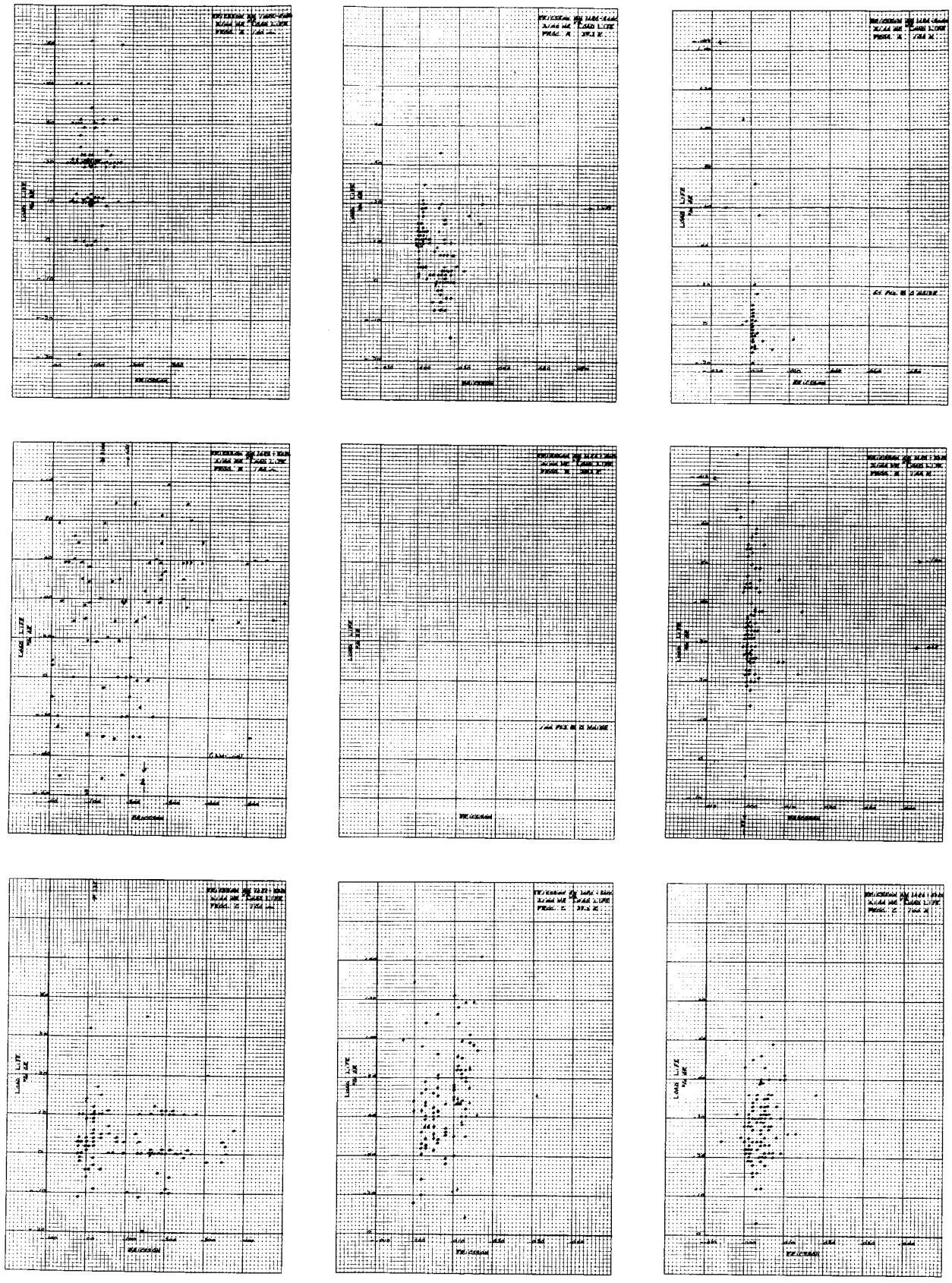


Figure 42 - Load Life vs. Difference in Ericsson Noise from 10KC to 50KC

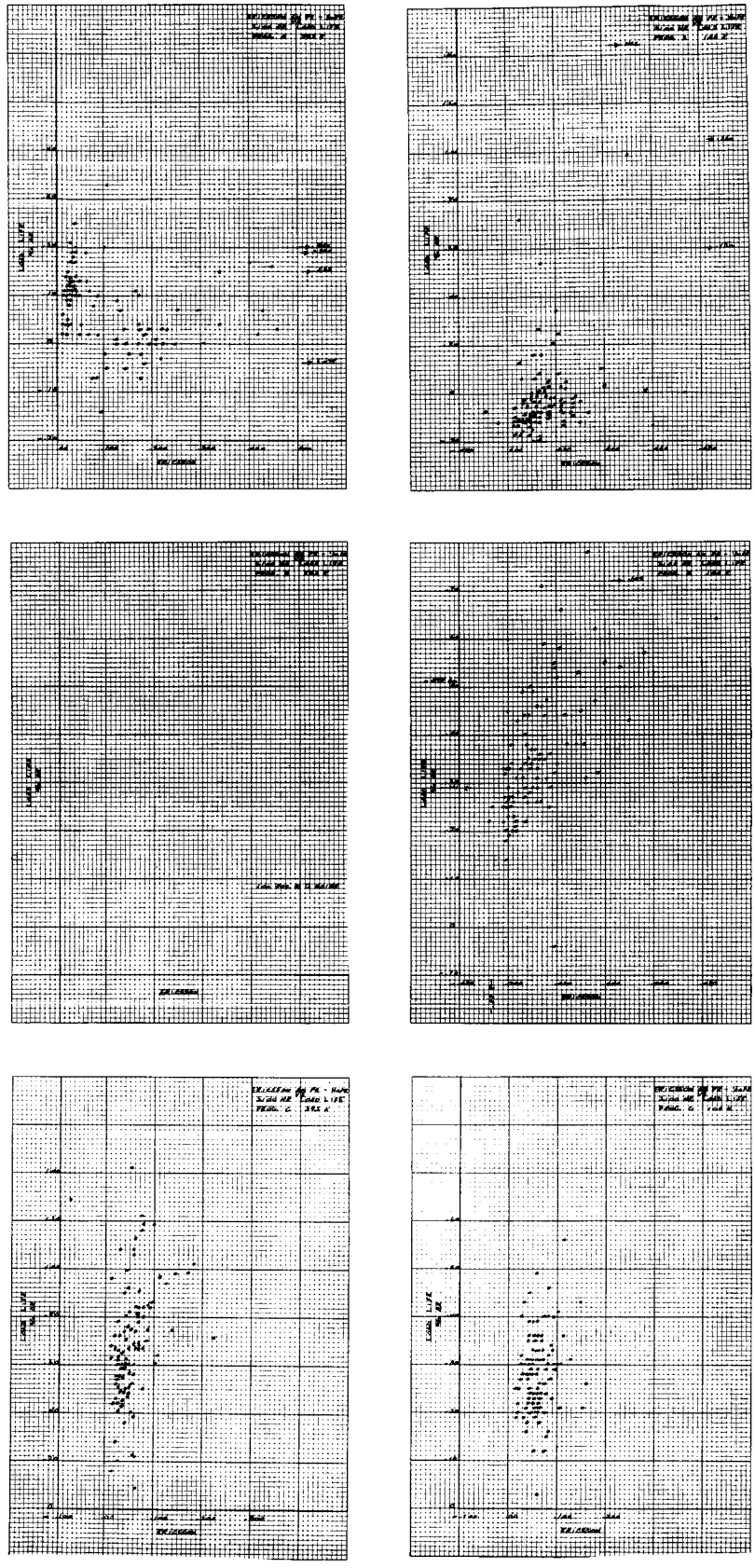


Figure 43 - Load Life vs. Difference in Ericsson Noise from 0.1 X rated power to 1.0 X rated power at 10KC

Infra-red Measurements.- Infra-red profiles were made on the 900 resistors which are being life tested. The measuring equipment used was a Barnes Engineering Model RM-1 Radiometric Microscope with a Model RM-112 Dual Axis Scanning Substage. All resistors in each of the nine groups were scanned at one-half and one times rated power. One half of each group was scanned also at two and one-half times rated power and one-fourth of each group was scanned at five times rated power. The scans were made longitudinally and four scans per resistor per condition were made at 90° intervals around the circumference of the resistors. The scanning rate used was 16 milli-inches per second and the scan was initiated as soon as the power was applied to the resistor. This was done to observe the effects of power stress while the resistor was heating rather than in an equilibrium condition.

Figures 44 through 46 are examples of the data recorded and are identified as follows:

Figure 44 -	1,2	Type A	100 Ω
	3,4	A	39.2K Ω
	5,6	A	100K Ω
Figure 45 -	1,2	Type B	100 Ω
	3,4	B	39.2K Ω
	5,6	B	100K Ω
Figure 46 -	1,2	Type C	100 Ω
	3,4	C	39.2K Ω
	5,6	C	100K Ω

Certain anomolies exist in the infra-red data such as skewed traces, unexplained dips, etc. These anomolies are discussed in the Failure Analysis section.

The peak surface temperature as measured from the infra-red profiles for 5 X rated power and 2.5 X rated power were plotted against resistance change from the 2000 hour life test. This data is presented in Figures 47 and 48. Again there was inadequate correlation to warrant further analysis.

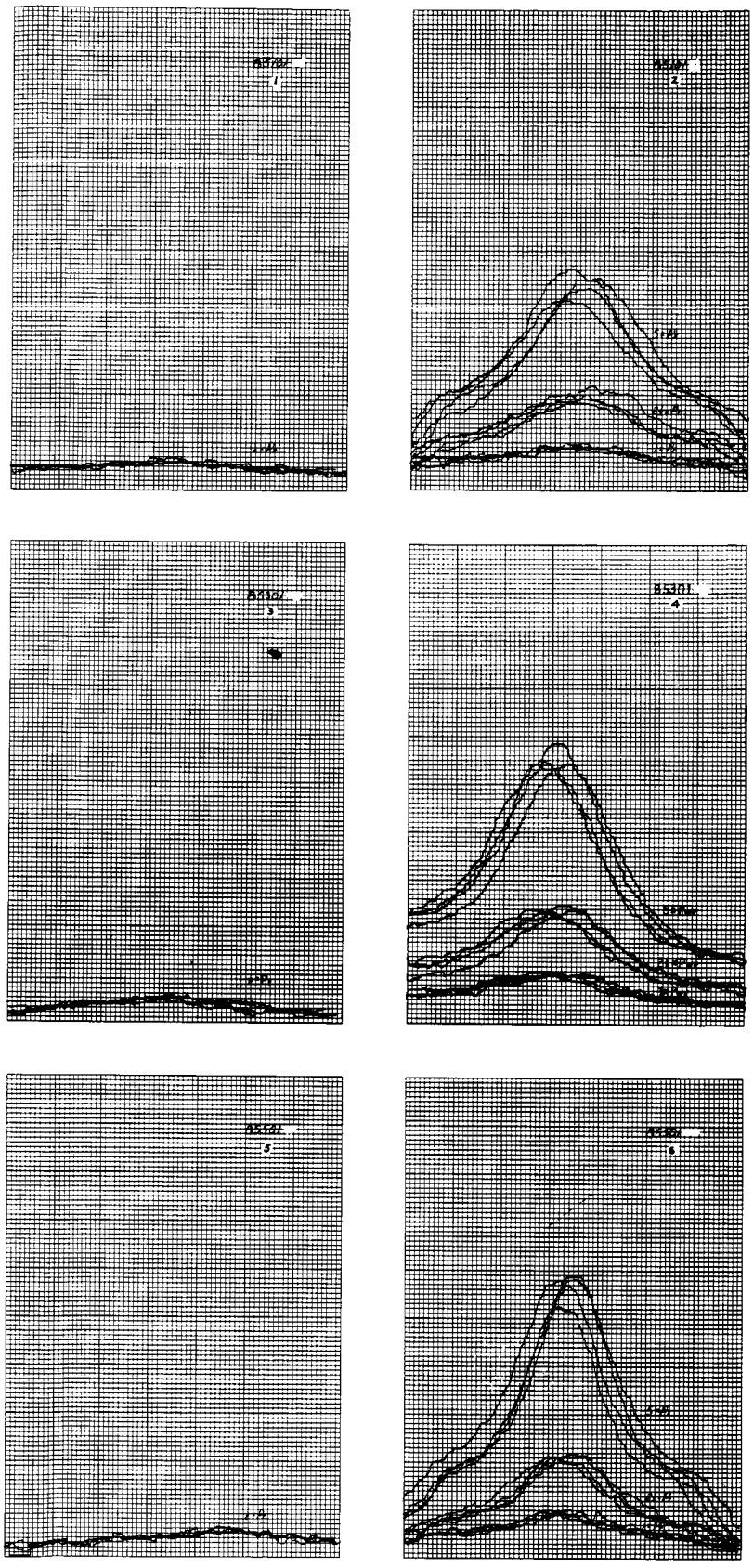


Figure 44 - Infra-red Profiles - Process A

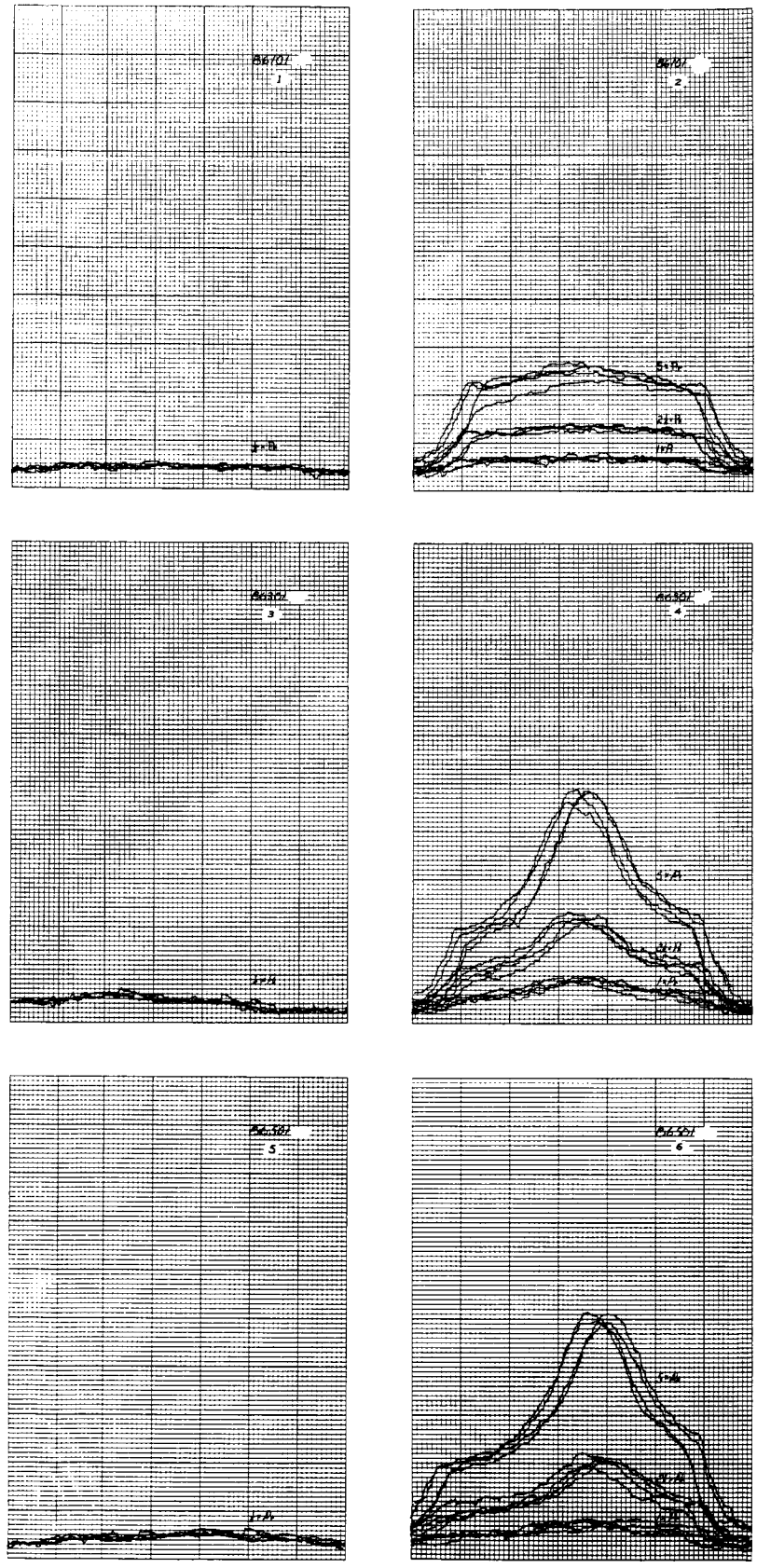


Figure 45 - Infra-red Profiles - Process B

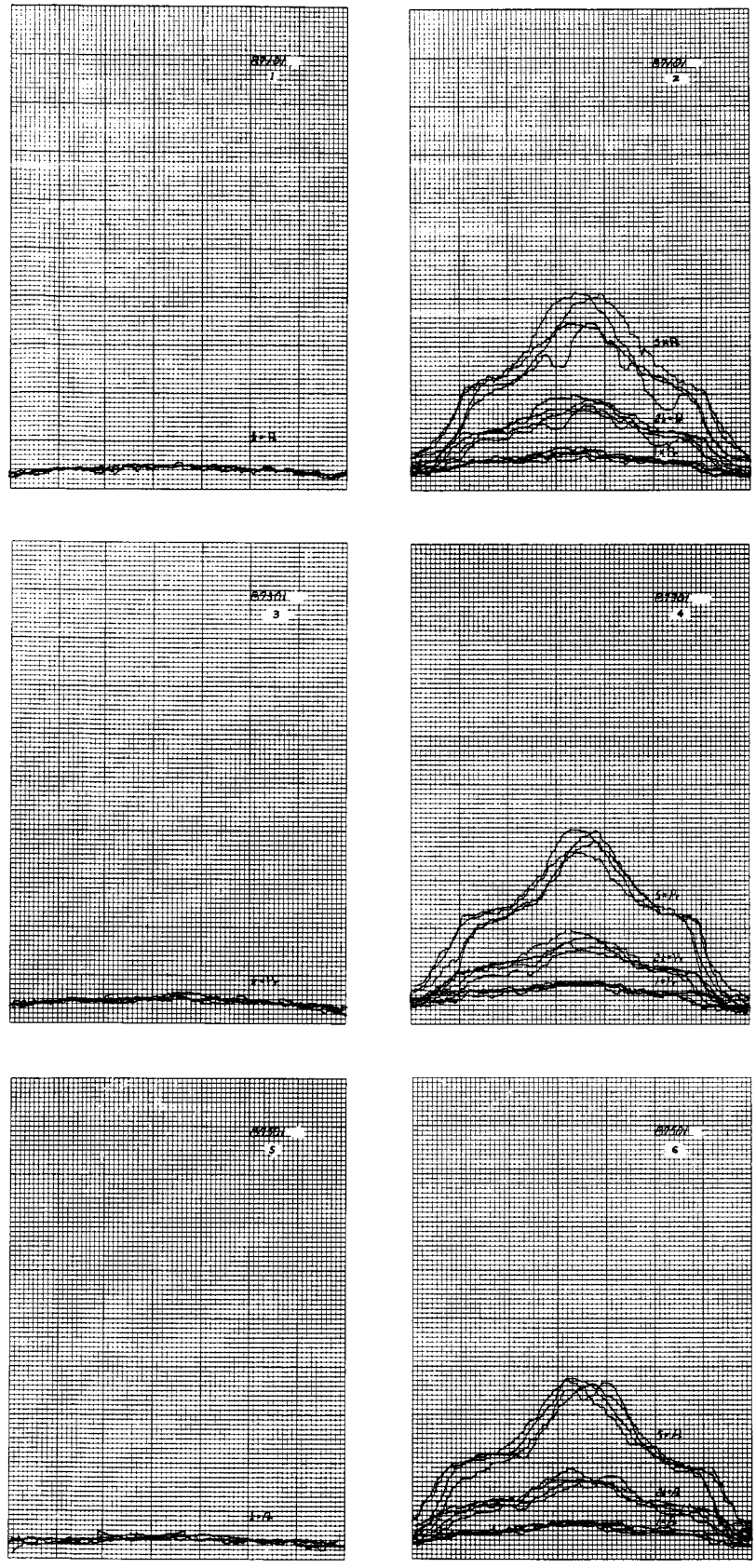


Figure 46 - Infra-red Profiles - Process C

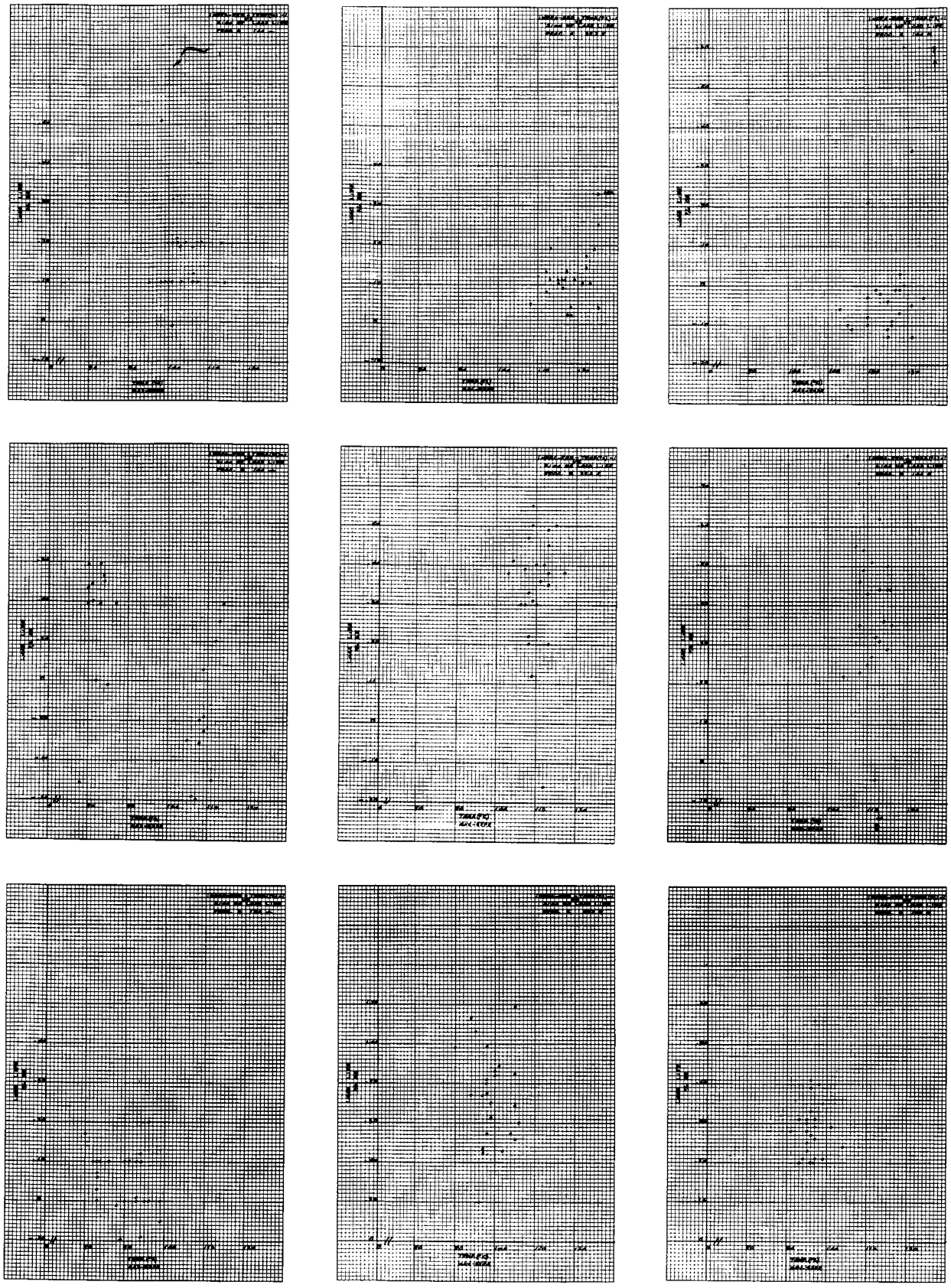


Figure 47 - Load Life vs. Infra-red Temperature
5 X rated power

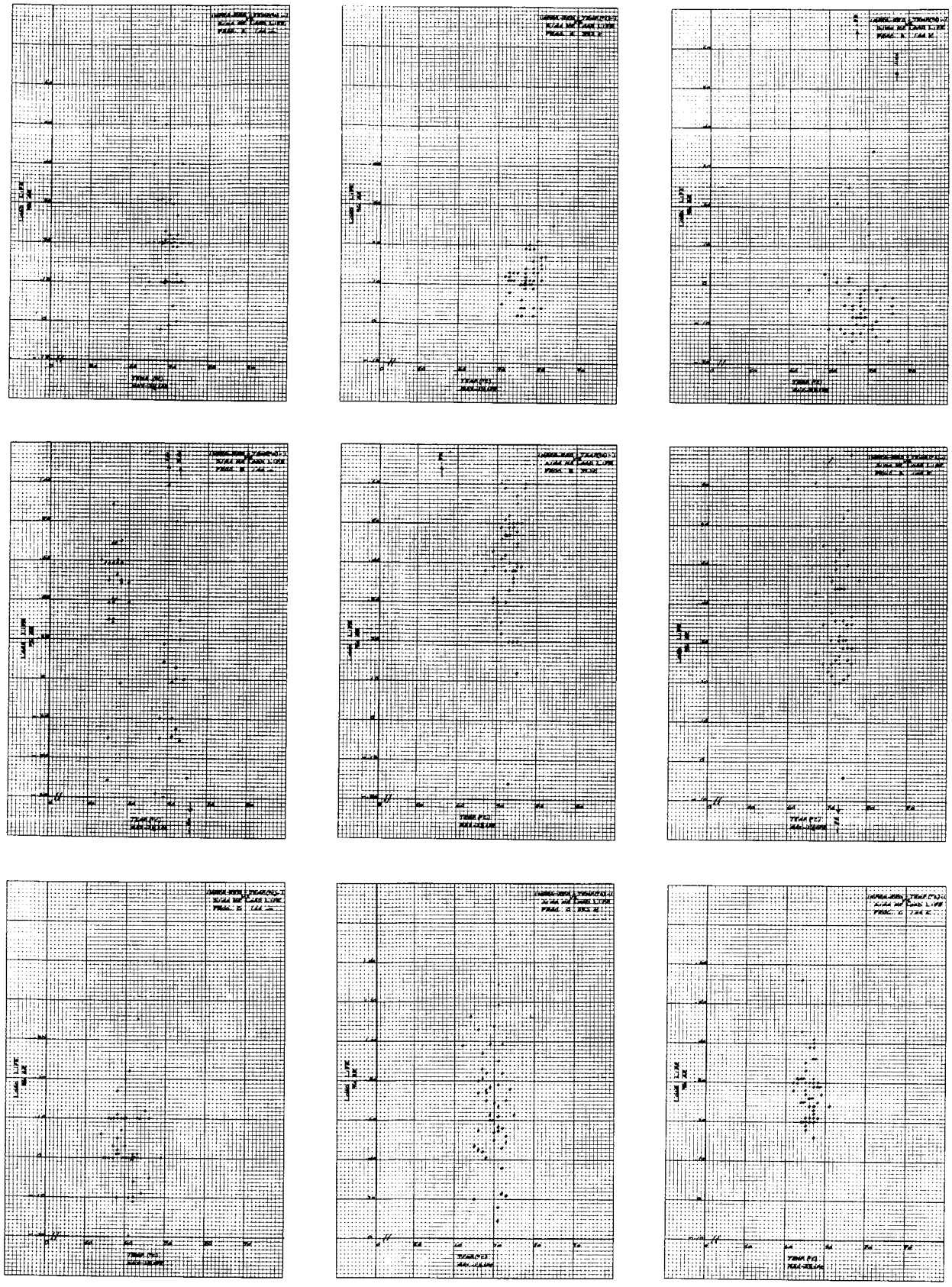


Figure 48 - Load Life vs. Infra-red Temperature
2.5 x rated power

Burn-In.- In order to further examine the correlation of Burn-In data with respect to Load Life, it was decided to consider the first 100 hours of the 2000 hour Load Life Test as Burn-In data and perform an analysis of the regression of Load Life resistance change on Burn-In. This data is shown in Figures 49 and 50.

Only one of the sample populations warranted extensive evaluation. This was the 100 ohm Type A group at both 1000 and 2000 hours. A negative correlation coefficient was obtained in both cases. Regression equations and correlation coefficients were:

1000 hours: $\%\Delta RLL = .16 - .92\%\Delta RBI \quad r = -.79$
2000 hours: $\%\Delta RLL = .20 - .80\%\Delta RBI \quad r = -.72$

The 2000 hour Load Life Summary is shown in Table XXVII.

2000 hour Load Life Summary

Proc. "A"	Mean %ΔR	Std. Dev.	Failures
100Ω	.184300	.110903	3
39.2K Ω	.077244	.082045	6
100K Ω	.016565	.256089	6
Proc. "B"			
100 Ω	.3122	.5325	4
39.2K Ω	.430900	.145776	3
100K Ω	.349797	.185944	4
Proc. "C"			
100 Ω	.045000	.145334	2
39.2K Ω	.694141	.252081	4
100K Ω	.284300	.085081	3

Table XXVII - 2000 hour Load Life Summary

It is not know whether these resistors received any type of power conditioning during manufacturing. Any additional work in these areas should be conducted with devices that are known to have received no power conditioning prior to testing.

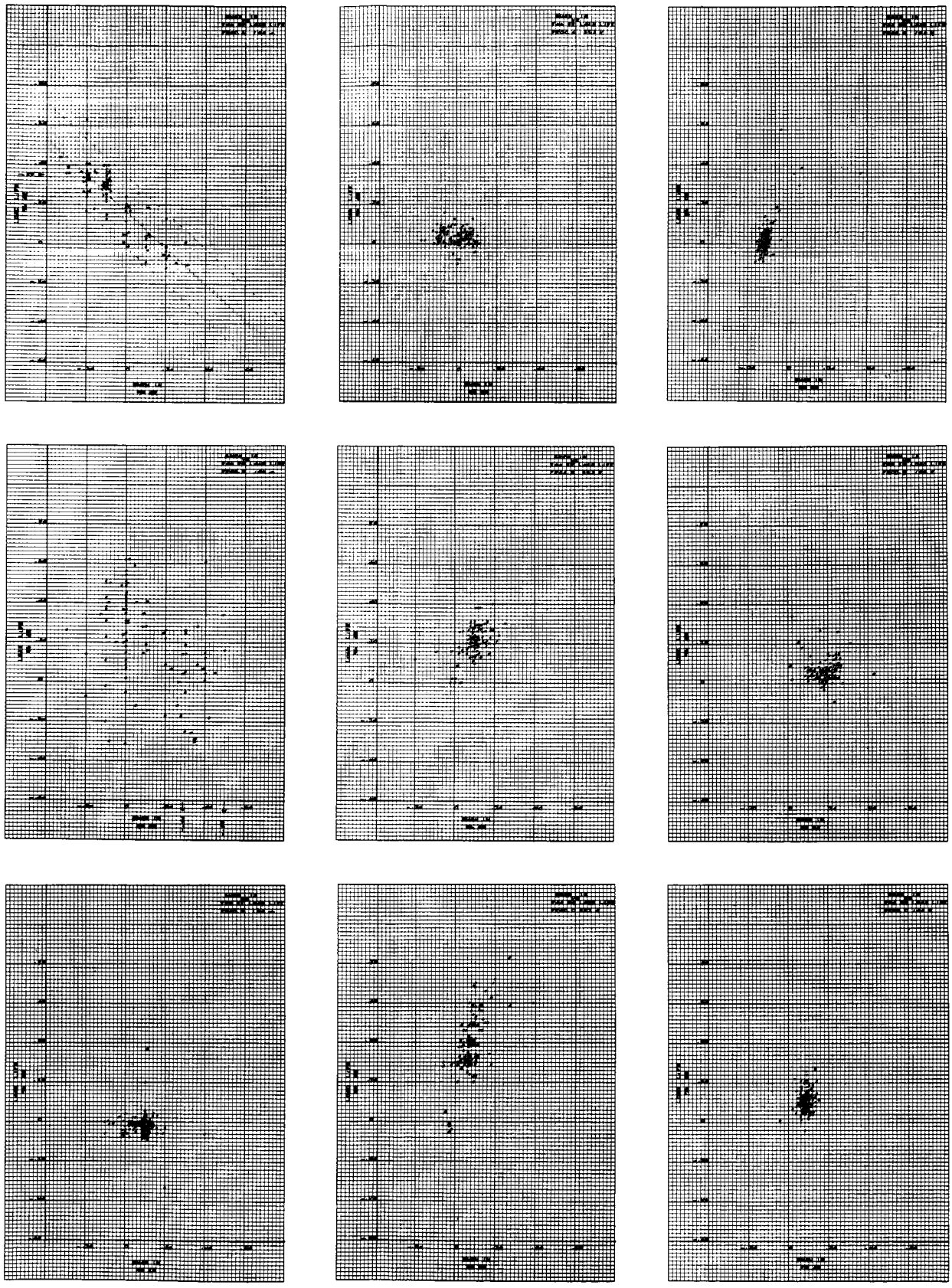


Figure 49 - Burn-In vs. Load Life
(1000 hours)

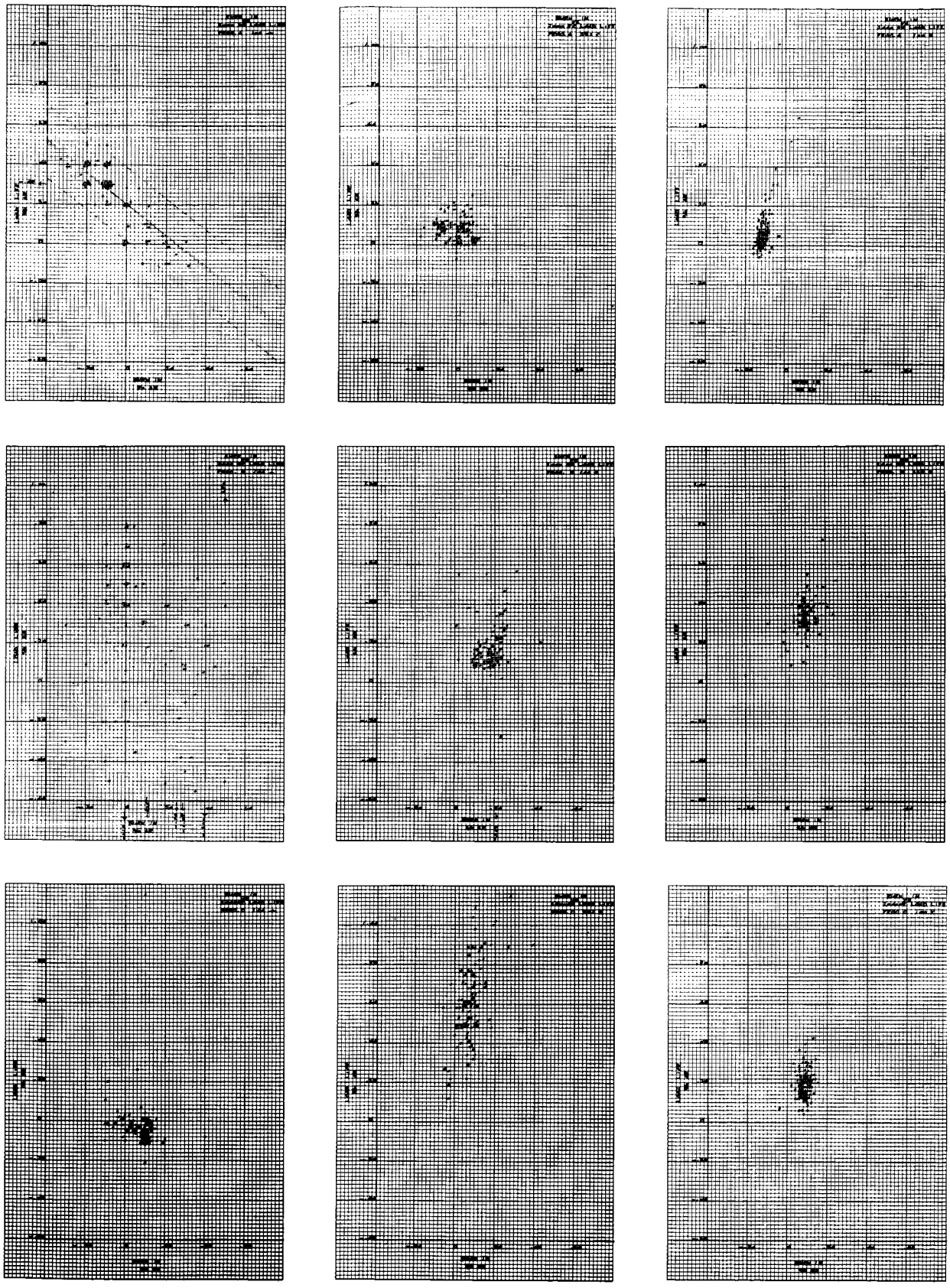


Figure 50 - Burn-In vs. Load Life
(2000 hours)

Failure Analysis.- All resistors tested in the preliminary phases which changed in resistance more than ± 5% were considered failures. The serial numbers of these units begin with 03. Resistors from the last phase which were tested at 2 X rated power and 125°C for 2000 hours were considered failures if the resistance change was more than two standard deviations from the mean for the group.

All failures were dismantled and examined microscopically for defects which would account for the abnormal resistance change.

Obvious defects are listed below:

033133	%ΔR = -7.5%	Ragged spiral
034233	Unstable	One turn spiral
034243	%ΔR = 21.2%	Ragged spiral
034244	%ΔR = 24.98%	Ragged spiral and chip under cap
035132	Unstable	Short spiral; no visible termination on one end; dirty spiral path
035195	Unstable	No visible termination on one end; dirty spiral path
035243	%ΔR = 5.49%	Dirty spiral path
035247	%ΔR = 5.32%	Dirty spiral path; thin spot in film
037244	%ΔR = 2.31%	Thin film under cap
037247	Unstable	Film and termination missing under one cap
85103 thru 85573		Talon lead construction
85393		Slip in spiral near center of rod
85525		Short spiral
85573		Short spiral
87101 thru 87524		Wide spiral groove

Where failure modes could be detected, the primary cause of failure appears to be due to ragged, dirty or wide spiral cuts into the substrate. This may be avoided by using spiral cutting wheels which do not leave residue in the cut, maintaining a sharp vibration free cutting wheel and controlling the pressure of the cutting wheel against the substrate.

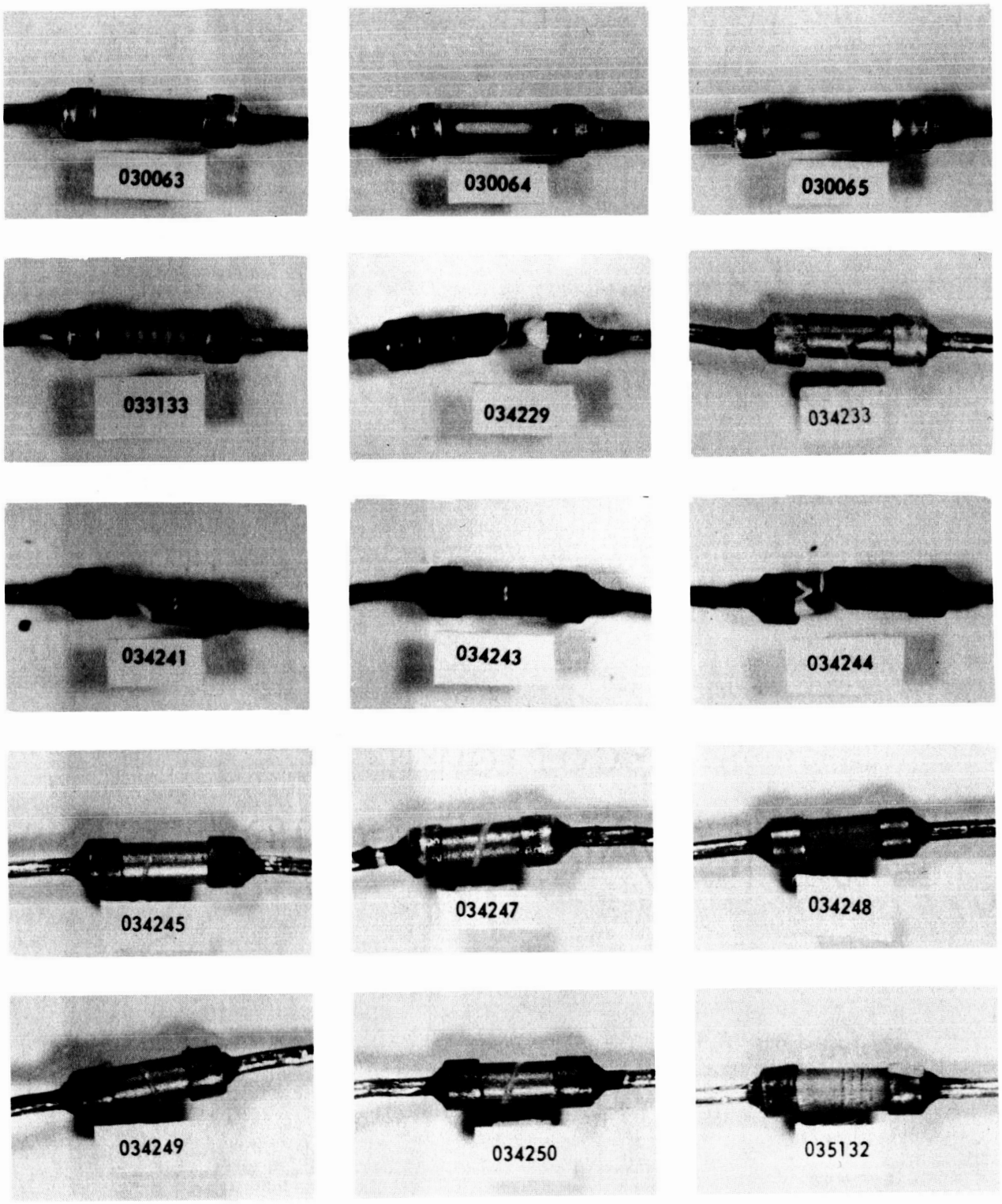


Figure 51 - Failure Analysis (Approx. 5X mag.)

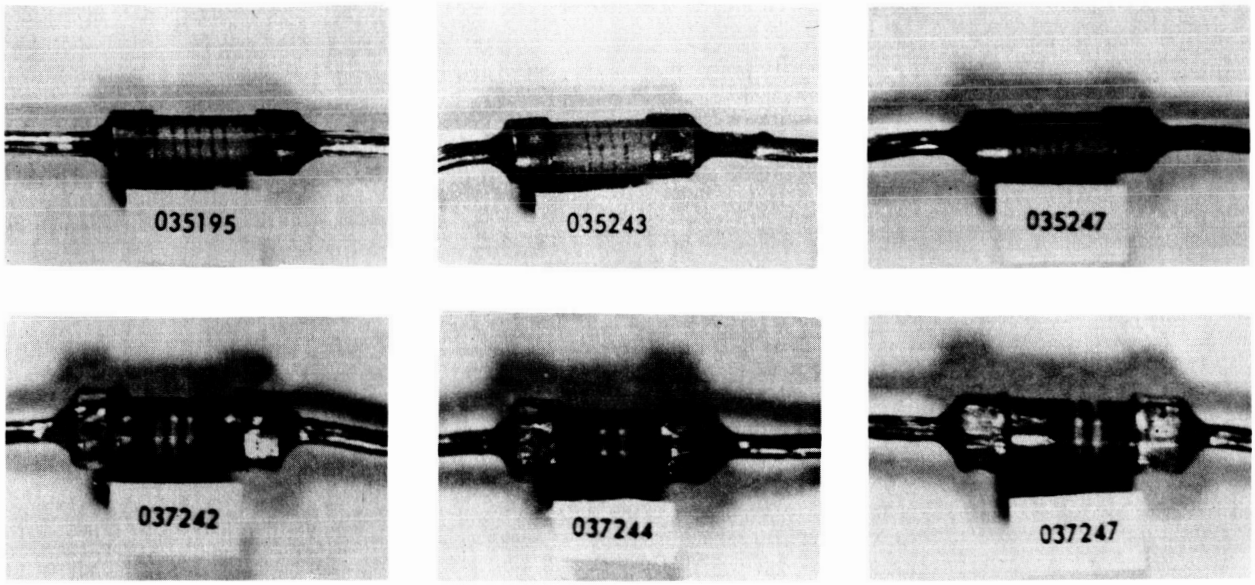


Figure 52 - Failure Analysis (Approx. 5X mag.)

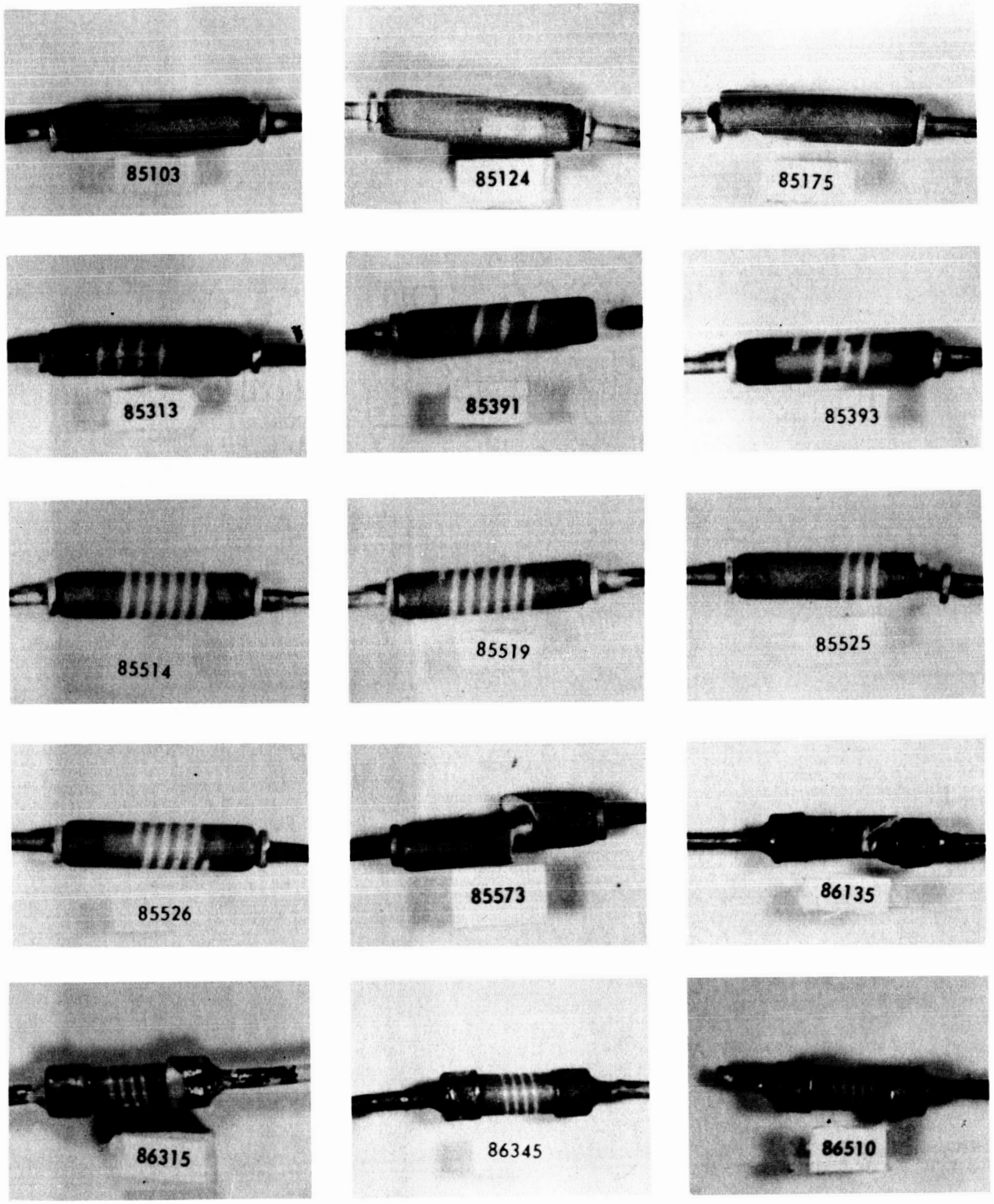


Figure 53 - Failure Analysis (Approx. 5X mag.)

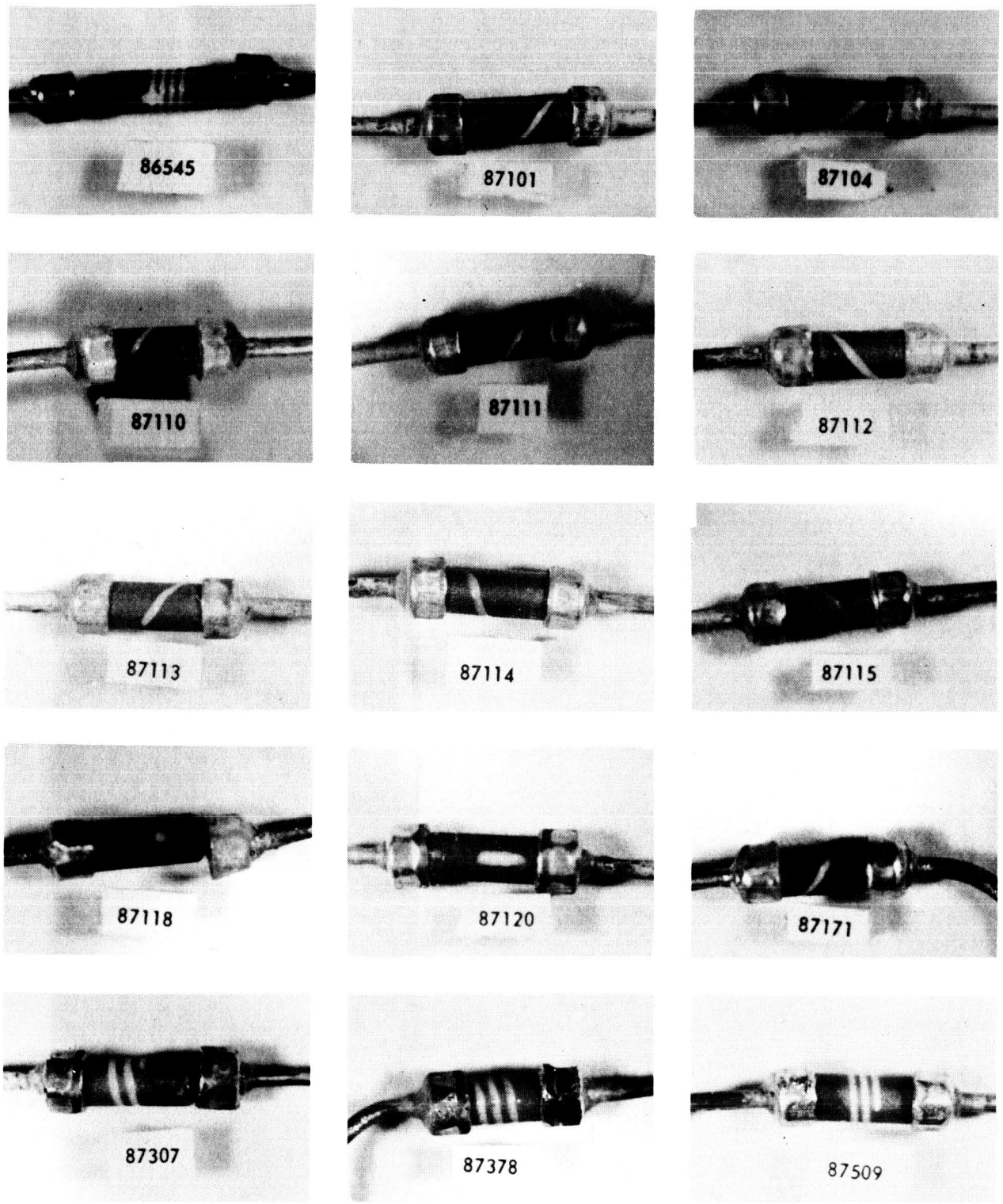


Figure 54 - Failure Analysis (Approx. 5X mag.)

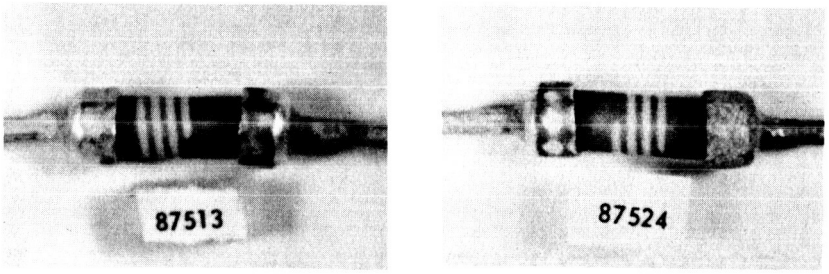


Figure 55 - Failure Analysis (Approx. 5X mag.)

Conclusions

In the initial phases of the testing, Short Time Overload indicated resistance changes which were too small to be useful in predicting operating life characteristics of metal film resistors. Temperature Cycling indicated some predictability but Burn-In appeared to be the most promising. This was not born out in later testing. However, the history of power and temperature stress imposed upon the test units during manufacturing is not known. Further investigations of Burn-In versus Load Life should be conducted on resistors whose entire history is known.

It was not possible to relate "current noise" to"non-linear distortion", nor was it possible to relate Load Life resistance changes to either of these measurements.

Infra-red measurements of resistor surface temperature indicates anomalies for several units. However infra-red temperature measurements could not be related to Load Life data.

It was not possible to develop a general stress level-related acceleration function. However, results indicate that Acceleration Ratios can be computed for the four stress level cells of the experiment.

No particular failure mode was identified with any of the resistor types tested although several failure modes were identified. Several of these included long known failure modes.

Any further investigations conducted should be performed on "new" resistors. That is, resistors which have not been subjected to additional power or temperature stress other than normal measuring and curing stresses.

While the majority of the investigations were negative, it is felt that additional Burn-In studies would be warranted as well as further investigation of the Acceleration Factor study using additional cells in the test matrix. It is also felt that each different construction type will require different screening techniques or at least different stress levels. Also, each type will exhibit a different acceleration ratio.

Bibliography

(1) "Introduction to Statistical Analysis"
W. J. Dixon and F. J. Massey, Jr.

(2) "Estimating Weibull-Distribution Parameters"
Joseph V. J. Ravenis II
Electro-Technology - March, 1964

(3) "Case Studies of the Decreasing Failure Rate Phenomena in Mixed Populations"
F. R. VanWagner

(4) "Failure Effect and Failure Mode Analysis Using a Digital Computer"
Harold V. McConnell
Evaluation Engineering - Jan./Febr., 1966

(5) "Infrared Electronics Reliability"
Dr. R. Vanzetti
EDN - July, 1965

(6) "Infrared Fault-finder Pinpoints Defects in Multilayer Boards"
L. M. White and R. W. Jones
Electronics - November, 1965

(7) "Infrared Heat-Transfer Engineering"
Glenn W. Carter
Electronic Packaging & Production - Sept., 1965

(8) "Infrared"
R. F. Leftwich
Machine Design - September, 1965

Appendix I

Computer Program

Fortran

IBM 1620 (20K Memory), 1311 Disc Pak and 1443 Printer

NAS8-11076

```
*LIST PRINTER
*LDISKNASA1A
*FANDK0806


C     NASA1A
      DIMENSIONTITLE(26),STAT(15,5),HOUR(15),LCC(3),CCL(5),ADL(10),C(13)
     1,DATA(15,20),HEAD3(40),HEAD2(5),HEAD1(5)
      COMMONTITLE,STAT,HOUR,LCC,CCL,ADL,I1B,N,C,HEAD3,K1B,DATA,HEAD2,S
      EQUIVALENCE(C(1),G),(C(2),B),(C(3),AO,A),(C(4),VF),(C(5),VB)
     1,(C(6),VAO,VA),(C(7),SX),(C(8),SY),(C(9),SXX),(C(10),SYY)
     2,(C(11),SXSX),(C(12),SXY),(C(13),P)
      EQUIVALENCE(LCC(1),IT),(LCC(2),JS),(LCC(3),LA),(CCL(1),CL),(CCL(2)
     1,OHM),(CCL(3),VALUE),(CCL(4),VHI),(CCL(5),VLO)
      EQUIVALENCE(DATA,RANDOM),(HEAD2(5),BLANK)
    1 FORMAT ( 10A3, A1, 7F3.0, 7F4.0 )
    2 FORMAT ( 20A3 )
    3 FORMAT ( 3I2, F4.0, 2F5.0, 2F5.4, 10F5.0 )
    4 FORMAT ( 2X, 26A3 )
    5 FORMAT ( 5X, F5.0, 14F5.3 )
   25 IF ( K1B - 1 )30, 90, 90
   30 READ 1, HEAD1, HEAD2, HOUR
      READ 2, HEAD3
      READ 3, LCC, CCL,(ADL(I),I=1,LA)
      READ 4, TITLE
      DO 35 J=1,JS
   35 READ 5,(DATA(I,J),I=1,IT)
      RVAL = VALUE / 100.0
      VHI = VALUE * VHI
      VLO = VALUE * VLO
      S = (-99.99999)
      K = 1
      DO 85 I=2,IT
      DO 65 J=1,JS
      GO TO ( 45, 45, 40, 45, 50), K
   40 IF(DATA(I,J)) 65, 45, 65
   45 DATA(I,J) = (DATA(I,J) + 100.0) * RVAL
      GO TO ( 65, 65, 65, 50, 50), K
   50 IF(DATA(I,J) - VHI) 55, 60, 60
   55 IF(DATA(I,J) - VLO) 60, 60, 65
   60 DATA(I,J) = S
   65 CONTINUE
      GO TO ( 70, 75, 75, 85, 85), K
   70 IF(OHM) 80, 75, 80
   75 K = K + 1
   80 K = K + 1
   85 CONTINUE
      K1B = 0
   90 K1B = K1B + 1
      I1B = K1B




      KM1 = K1B - 1
      DO160 J=1,JS
      GO TO (165,125,130,130), K1B
  125 RVAL = 100.0 / VALUE
  130 DO150 I=K1B,IT
      IF(DATA(I,J) - S)135,150,135
  135 GO TO (  30,140,145,145), K1B
  140 DATA(I,J) = (DATA(I,J) - VALUE) * RVAL
      GO TO150
  145 DATA(I,J) = DATA(I,J) - DATA(KM1,J)
  150 CONTINUE
      GO TO ( 30,160,155,155), K1B
  155 DATA(KM1,J) = BLANK
  160 CONTINUE
      GO TO175
  165 DO170 J=1,5
  170 STAT(1,J) = HEAD1(J)
      I1B = 2
  175 CALL LINK (NASA1B)
      END
```

```
00005 000001
00015 10000000-3
00025 99999990-2
00031 000002
00037 000000
00043 000005
 19749  TITLE 19999  18999   STAT 19739  18849   HOUR 18989  18827    LCC 18839  18827     IT         18833     JS
 18839     LA        18781    CCL 18821  18781     CL        18791    OHM         18801  VALUE         18811    VHI
 18821    VLO        18681    ADL 18771  18539      C 18659  18539      G         18549      B         18559     AO
 18559      A        18569     VE        18579     VB        18589    VAD         18589     VA         18599     SX
 18609     SY        18619    SXX        18629    SYY        18639   SXSX         18649    SXY         18659      P
 15133   DATA 18123  15133 RANDOM        18139  HEAD3 18529  15083  HEAD2 15123  15123  BLANK         00053  HEAD1 00093
 18671    I1B        18665      N        18129    K1B        15073      S         00099      I         00105      J
 00115   RVAL        00121      K        00127    KM1


0001 00134  0002 00224  0003 00262  0004 00376  0005 00422  0025 00474  0030 00542  0090 02240
0035 00914  0085 02180  0065 01964  0045 01422  0040 01326  0050 01656  0055 01764  0060 01872
0070 02056  0075 02108  0080 02144  0160 03190  0165 03234  0125 02400  0130 02436  0150 03010
0135 02556  0140 02608  0145 02776  0155 03098  0175 03424  0170 03246

03496 CORES USED
15063 NEXT COMMON
END OF COMPILATION
```

```
*LIST PRINTER
*LDISKNASA1B
*FANDK0806


C     NASA1B
      DIMENSIONTITLE(26),STAT(15,5),HOUR(15),LCC(3),CCL(5),ADL(10),C(13)
     1,DATA(15,20),HEAD3(40),HEAD2(5)
      COMMONTITLE,STAT,HOUR,LCC,CCL,ADL,I1B,N,C,HEAD3,K1B,DATA,HEAD2,S
      EQUIVALENCE(C(1),G),(C(2),B),(C(3),AO,A),(C(4),VE),(C(5),VB)
     1,(C(6),VAO,VA),(C(7),SX),(C(8),SY),(C(9),SXX),(C(10),SYY)
     2,(C(11),SXSX),(C(12),SXY),(C(13),P)
      EQUIVALENCE(LCC(1),IT),(LCC(2),JS),(LCC(3),LA),(CCL(1),CL),(CCL(2)
     1,OHM),(CCL(3),VALUE),(CCL(4),VHI),(CCL(5),VLO)
      EQUIVALENCE(DATA,RANDOM),(HEAD2(5),BLANK)
   10 FORMAT (1H )
   11 FORMAT ( 9H SER NO  , A3, I5, 13I8 )
   12 FORMAT(1H0,40A3/)
   14 FORMAT (1H1, 19X, 26A3 / )
   15 FORMAT ( 1H , I6, 2X, 14F8.3 )
  114 FORMAT (1H0,A3,5X,14I8)
  214 FORMAT (1H0,A3,5X,14F8.3)
  175 DO  230 I=I1B,IT
      DO180 J=1,5
  180 STAT(I,J) = 0.0
      N = 0
      DO 190 J=1,JS
      IF(DATA(I,J) - S) 185, 190, 185
  185 STAT(I,1) = STAT(I,1) + DATA(I,J)
      STAT(I,2) = STAT(I,2) + DATA(I,J) * DATA(I,J)
      N = N + 1
  190 CONTINUE
      STAT(I,5) = N
      IF ( N - 1 ) 230, 195, 225
  195 STAT(I,3) = STAT(I,1)
      STAT(I,4) = 0.0
      GO TO 230
  225 STAT(I,3) = STAT(I,1) / STAT(I,5)
      STAT(I,4)=((STAT(I,2)-STAT(I,1)*STAT(I,3))/(STAT(I,5)-1.0))**0.
  230 CONTINUE
      PRINT 14, TITLE
      HOUR(1) = HEAD2(K1B)
      PRINT 11, HOUR(1), (HOUR(I),I=I1B,IT)
      PRINT 10
      DO  235 J=1,JS
  235 PRINT 15, DATA(1,J), (DATA(I,J),I=I1B,IT)
      PRINT 10
      DO 260 J=1,5
      GO TO (240, 245, 245, 245),K1B
  240 GO TO (250, 250, 255, 255, 250), J



  245 GO TO (255, 255, 255, 255, 250), J
  250 PRINT 114, STAT(1,J), (STAT(I,J),I=I1B,IT)
      GO TO 260
  255 PRINT 214, STAT(1,J), (STAT(I,J),I=I1B,IT)
  260 CONTINUE
      PAUSE
      IF(SENSE SWITCH 4) 25, 265
   25 CALL LINK (NASA1A)
  265 PRINT 14, TITLE
      PRINT 12, HEAD3
      CALL LINK (NASA2A)
      END
```

SUGGESTED CHANGE
THE MINUS FOUR STD. DEV. POINTS FOR USE AS ESTIMATE OF GAMMA (G)

```
      DO 270 I = 1,IT
  270 STAT(I,1) = STAT(I,3) - STAT(I,5) * 4.0
```

```
00005 000001
00011 000005
00021 00000000RR
00027 000000
00037 10000000-1
00047 50000000-0
 19749  TITLE 19999  18999   STAT 19739  18849   HOUR 18969  18827    LCC 18839  18827      IT         18833     JS
 18839     LA        18781    CCL 18821  18781     CL        18791    OHM        18801  VALUE        18811    VHI
 18821    VLO        18681    AOL 18771  18539      C 18659  18539      G        18549      B        18559     AO
 18559      A        18569     VE        18579     VB        18589    VAO        18589     VA        18599     SX
 18609     SY        18619    SXX        18629    SYY        18639   SXSX        18649    SXY        18659      P
 15133   DATA 18123  15133 RANDOM        18139  HEAD3 18529  15083  HEAD2 15123  15123  BLANK        18671    I18
 18665      N        18129    K18        15073      S        00053      I        00059      J


0010 00056  0011 00094  0012 00174  0014 00226  0015 00286  0114 00352  0214 00416  0175 00476
0230 02306  0180 00500  0190 01342  0185 00790  0195 01542  0225 01754  0235 02618  0260 03384
0240 02916  0245 02972  0250 03028  0255 03210  0025 03452  0265 03504

03672 CORES USED
15063 NEXT COMMON
END OF COMPILATION
```

```
*LIST PRINTER
*LDISKNASA2A
*FANDK0806
```

```
    1,DATA(15,20),HEAD3(40),HEAD2(5),HEAD1(5),RANDOM(15,20),SORTED(20)
     COMMONTITLE,STAT,HOUR,LCC,CCL,ADL,I1B,N,C,HEAD3,K1B,DATA,HEAD2,S
     EQUIVALENCE(C(1),G),(C(2),B),(C(3),AO,A),(C(4),VE),(C(5),VR)
    1,(C(6),VAO,VA),(C(7),SX),(C(8),SY),(C(9),SXX),(C(10),SYY)
    2,(C(11),SXSX),(C(12),SXY),(C(13),P)
     EQUIVALENCE(LCC(1),IT),(LCC(2),JS),(LCC(3),LA),(CCL(1),CL),(CCL(2)
    1,OHM),(CCL(3),VALUE),(CCL(4),VHI),(CCL(5),VLO)
     EQUIVALENCE(DATA,RANDOM),(HEAD2(5),BLANK)
 10 FORMAT (1H )
 15 FORMAT(I1,I4,5E15.8)
416 FORMAT(1H0,2F8.3,10E10.4,I4)
325 DO 450 N=I1B,IT
     SORTED(1) = RANDOM(N,1)
     DO345 J=2,JS
     JM1 = J - 1
     DO330 I=1,JM1
     IF(SORTED(I) - RANDOM(N,J))330,330,335
330 CONTINUE
     SORTED(J) = RANDOM(N,J)
     GO TO 345
335 MOVE = J -I
     DO340 K=1,MOVE
     JMK = J - K
     JMKP1 = JMK + 1
340 SORTED(JMKP1) = SORTED(JMK)
     SORTED(I) = RANDOM(N,J)
345 CONTINUE
     NM = JS
     NOCC = 0
     DO365 M=1,JS
     IF(SORTED(M) - S)350,360,350
350 IF(SORTED(M+1) - SORTED(M))370,355,370
355 NOCC = NOCC + 1
     GO TO 365
360 NM = NM - 1
365 CONTINUE
370 IB = M + 1
     IE = JS - 1
     IF(IE - IB - 2) 440, 440, 375
375 OCC = NOCC + 2
     R = NM
     G = SORTED(M)
     SX = 0.0
```

SUGGESTED CHANGES STARTED NASA1B

G = STAT (I1B, 1)

350 IF (SORTED(M) - G) 352, 360, 352

352 (CHANGE STATEMENT NUMBER ONLY)

OMIT

```
      SY = 0.0
      SXX = 0.0
      SYY = 0.0
      SXY = 0.0
      DO380 I=IB,IF
      Y     = LOGF(LOGF(1.0 / (1.0 - ( OCC / R ))))
      X     = LOGF(SORTED(I) - G)
      SY = SY + Y
      SYY = SYY + Y     * Y
      SX = SX + X
      SXX = SXX + X     * X
      SXY = SXY + X     * Y
  380 OCC = OCC + 1.0
      SXSX = SX * SX
      P = IE - IB + 1
      B = (SXY * P - SX * SY) / (SXX * P - SXSX)
      AO = (SY - B*SX) / P
      VE = (SYY - AO * SY - B * SXY) / P
      VB = VE / (SXX - SXSX / P)
      VAO = VE * SXX / (P * SXX - SXSX)
      IF(AO) 395, 390, 385
  385 A = 1.0 / EXPF( AO)
      GO TO 425
  390 A = 1.0
      GO TO 425
  395 A = EXPF(-AO)
  425 VA = A * A * VAO
      DO430 J=1,4
  430 STAT(N,J) = C(J)
      STAT(N,4) = STAT(N,4) ** 0.5
  435 PRINT 416, (C(I),I=1,13)
      GO TO 445
  440 PRINT 10
      STAT(N,2) = 0.0
      STAT(N,3) = 1.0
  445 PUNCH 15, K1B, N, (STAT(N,J),J=1,5)
  450 CONTINUE
      IF(SENSE SWITCH 4) 25, 550
   25 K1B = 0
      CALL LINK (NASA1A)
  550 CALL LINK (NASA2B)


      END
```

```
00005 000002
00011 000001
00017 000000
00027 00000000RR
00037 10000000-1
00043 000004
00053 50000000-0
00059 000013
00065 000005
 19749  TITLE 19999  18999   STAT 19739  18849   HOUR 18989  18827    LCC 18839  18827     IT      18833     JS
 18839     LA        18781    CCL 18821  18781     CL        18791    DHB        18801  VALUE      18811    VHI
 18821    VLO        18681    ADL 18771  18539      C 18659  18539      G        18549      B      18559     AO
 18559      A        18569     VE        18579     VB        18589    VAO        18589     VA      18599     SX
 18609     SY        18619    SXX        18629    SYY        18639   SXSX        18649    SXY      18659      P
 15133   DATA 18123  15133 RANDOM 18123  18139  HEAD3 18529  15083  HEAD2 15123  15123  BLANK      00075  HEAD1 00115
 00125 SORTED 00315  18671    I1B        18665      N        18129    K1B        15073      S      00321      J
 00327    JM1        00333      I        00339   MOVE        00345      K        00351    JMK      00357  JMK1
 00363     NM        00369   NOCC        00375      M        00381     IB        00387     IE      00397    OCC
 00407      R        00417      Y        00427      X
```

```
0010 00434  0015 00462  0416 00518  0325 00592  0450 04410  0345 01486  0330 00910  0335 01082
0340 01202  0365 01922  0350 01682  0360 01886  0370 01958  0355 01842  0440 04066  0375 02110
0380 02770  0395 03534  0390 03502  0385 03458  0425 03582  0430 03642  0435 03938  0445 04258
0025 04466  0550 04542

04614 CORES USED
15063 NEXT COMMON
END OF COMPILATION
```

```
*LIST PRINTER
*LDISKNASA2B
*FANDK0806


C     NASA2B
      DIMENSIONTITLE(26),STAT(15,5),HOUR(15),LCC(3),CCL(5),ADL(10),C(13)
      DIMENSION HEAD3(40)
      COMMONTITLE,STAT,HOUR,LCC,CCL,ADL,I1B,N,C,HEAD3,K1B
      EQUIVALENCE(C(1),G),(C(2),B),(C(3),AO,A),(C(4),VE),(C(5),VB)
     1,(C(6),VAO,VA),(C(7),SX),(C(8),SY),(C(9),SXX),(C(10),SYY)
     2,(C(11),SXSX),(C(12),SXY),(C(13),P)
      EQUIVALENCE(LCC(1),IT),(LCC(2),JS),(LCC(3),LA),(CCL(1),CL),(CCL(2)
     1,OHM),(CCL(3),VALUE),(CCL(4),VHI),(CCL(5),VLO)
      EQUIVALENCE (TITLE(19),ADLM),(TITLE(20),ADLP),(TITLE(21),SJ)
     1,(TITLE(22),FP),(TITLE(23),FM),(TITLE(24),FC),(TITLE(25),Y)
     2,(TITLE(26),X)
    1 FORMAT(30X,A1,7F3.0,7F4.0)
    3 FORMAT(3I2,F4.0,2F5.0,2F5.4,10F5.0)
    4 FORMAT(2X,26A3)
    6 FORMAT(I1,I4,5E15.8)
   14 FORMAT(1H1,19X,26A3)
  111 FORMAT(1H F5.2,7HADL PCT,I4,13I8)
  211 FORMAT (1H , F8.3, 14F8.2)
  416 FORMAT(1H0,F8.2,F8.3,10E10.4,I4)
  525 IF(SENSE SWITCH 4)530, 550
  530 READ 1, HOUR
      READ 3, LCC, CCL, (ADL(I),I=1,LA)
  535 READ 4, TITLE
      PRINT 14, TITLE
  540 READ 6, K1B, N, (STAT(N,J),J=1,5),
      TITLE(N) = STAT(N,5)
      IF(N-IT)540, 550, 550
  545 I1B = K1B
      GO TO (555,560,560,560),I1B
  555 I1B = 2
  560 PRINT 111, CL, (HOUR(I),I=I1B,IT)
      DO 830 M=1,LA
      GO TO (565, 570, 570, 570 ),K1B
  565 ADLM = ( 1.0 - ADL(M)) * VALUE
      ADLP = ( 1.0 + ADL(M)) * VALUE
      GO TO 575
  570 ADLM = ( - ADL(M)) * 100.0
      ADLP = ( + ADL(M)) * 100.0
  575 SJ = JS
      STAT(1,5) = ADL(M)
      DO670 N=I1B,IT
      FC=CL*STAT(N,4)*2.0
      IF(TITLE(N)-5.0)655,580,580
  580 FP = ADLP - STAT(N,1)
```

CHANGES NEEDED TO OPERATE IN EITHER MODE

```
525 IF(SENSE SWITCH 4) 530, 545

540 READ 6, K1B, N, (STAT(N,J), J = 1,5)
    IF (N-IT) 540, 551 551

545 PRINT 14, TITLE
    DO 550 N = 1, IT
550 TITLE (N) = STAT (N,5)
551 I1B = K1B
```

```
      IF(FP) 585, 585, 590
  585 STAT(N,5) = 100.0
      GO TO 670
  590 FM = ADLM - STAT(N,1)
      IF(FM) 595, 595, 625
  595 FM = 0.0
      GO TO 635
  625 FM = FM ** STAT(N,2) / STAT(N,3)
      IF(FM - .001) 595, 595, 630
  630 FM = 100.0 - 100.0 / EXPF(FM)
  635 FP = FP ** STAT(N,2) / STAT(N,3)
      IF(FP - 7.0) 645, 640, 640
  640 FP = 0.0
      GO TO 650
  645 FP = 100.0 / EXPF(FP)
  650 STAT(N,5) = FP + FM + FC
      IF(TITLE(N)-SJ) 660, 665, 665
  655 STAT(N,5) = FC
  660 STAT(N,5)=100.0-TITLE(N)/SJ*(100.0-STAT(N,5))
  665 IF(STAT(N,5) - 100.0) 670, 670, 585
  670 CONTINUE
      IE = 0
      IB = 0
      DO725 N=I1B,IT
      IF(IB) 675, 675, 695
  675 IF(STAT(N,5) - 1.0) 725, 630, 650
  680 IF(N - I1B) 725, 690, 685
  685 IB = N
      G = (STAT(IB,5) * HOUR(IB-1) + HOUR(IB)) /(STAT(IB,5) + 1.0)
      GO TO 695
  690 IB = N + 1
      G = HOUR(N)
  695 IF(STAT(N,5) - 100.0) 725, 730, 730
  725 CONTINUE
      IE = IT
      IF(IB) 830, 830, 735
  730 IE = N - 1
  735 P = IE - IB + 1
      SX = 0.0
      SY = 0.0
      SXX = 0.0
      SYY = 0.0
      SXY = 0.0
      SXSX = 0.0
      DO 755 I=IB,IE
```

ELIMINATE DUAL ESTIMATE OF GAMMA (α)
725, 685, 685
OMIT

OMIT

```
      IF(STAT(I,5)) 745, 745, 740
  740 IF(STAT(I,5)-100.0) 750, 745, 745
  745 P = P - 1.0
      GO TO 755
  750 Y     = LOGF(LOGF(100.0 / (100.0 - STAT(I,5))))
      X     = LOGF((STAT(I,5)*HOUR(I   )+HOUR(I-1))/(STAT(I,5)+1.0) - G)
      SY = SY + Y
      SYY = SYY + Y     * Y
      SX = SX + X
      SXX = SXX + X     * X
      SXY = SXY + X     * Y
  755 CONTINUE
      IF(P - 3.0) 830, 760, 760
  760 SXSX = SX * SX
      B = (SXY * P - SX * SY) / (SXX * P - SXSX)
      AO = (SY - B*SX) / P
      VE = (SYY - AO * SY - B * SXY) / P
      VB = VE / (SXX - SXSX / P)
      VAO = VE * SXX / (P * SXX - SXSX)
      IF(AO) 775, 770, 765
  765 A = 1.0 / EXPF( AO)
      GO TO 780
  770 A = 1.0
      GO TO 780
  775 A = EXPF(-AO)
  780 VA = A * A * VAO
      PRINT 416, (C(I),I=1,13)
  785 PRINT 211, STAT(1,5), (STAT(N,5),N=I1B,IT)
      DO 825 I=I1B,IT
      HOUR(1) = HOUR(I) - C(1)
      IF(HOUR(1)) 790, 790, 795
  790 STAT(I,5) = 100.0
      GO TO  825
  795 STAT(I,5)=100.0/EXPF(HOUR(1)**C(2)/C(3))
  825 CONTINUE
      PRINT 211, STAT(1,5), (STAT(N,5),N=I1B,IT)
  830 CONTINUE
      IF(SENSESWITCH 4) 835, 535
  835 K1B = 0
      CALL LINK (NASAIA)
      END
```

```
00005 000001
00011 000005
00017 000002
00027 10000000-1
00037 10000000-3
00047 20000000-1
00057 50000000-1
00067 00000000RR
00077 10000000-K
00087 70000000-1
00093 000000
00103 30000000-1
00109 000013
 19749  TITLE 19999  19929   ADLM        19939   ADLP        19949    SJ         19959    FP         19969    FR
 19979     FC        19989      Y        19999      X        18999   STAT 19739  18849   HOUR 18989  18827   LCC 18839
 18827     IT        18833     JS        18839     LA        18781    CCL 18821  18781     CL        18791   OHM
 18801  VALUE        18811    VHI        18821    VLC        18681    ADL 18771  18539      C 18659  18539     G
 18549      S        18559     AD        18559      A        18569     VE        18579     VD        18589   VAO
 18589     VA        18599     SX        18609     SY        18619    SXX        18629    SYY        18639   SXSX
 18649    SXY        18659      P        18139  HEAD3 18529  18671    I1P        18665      M        18129   K1B
 00115      I        00121      J        00127      B        00133     IE        00139     IF
```

```
0001 00146  0003 00224  0004 00338  0006 00384  0014 00440  0111 00496  0211 00584  0416 00644
0525 00716  0530 00736  0550 01406  0535 00952  0540 01048  0555 01482  0560 01506  0830 07614
0565 01702  0570 01878  0575 02034  0670 03934  0655 03504  0580 02326  0585 02450  0590 02560
0595 02684  0625 02716  0635 02996  0630 02948  0645 03260  0640 03228  0650 03296  0660 03588
0665 03834  0725 04770  0675 04086  0695 04670  0680 04186  0690 04574  0685 04254  0730 04886
0735 04922  0755 06006  0745 05326  0740 05226  0750 05370  0760 06106  0775 06738  0770 06706
0765 06662  0780 06786  0785 06954  0825 07446  0790 07222  0795 07314  0835 07670

07766 CORES USED
18123 NEXT COMMON
END OF COMPILATION
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Appendix II

Acceleration Factor Computations

NAS8-11076

PROCESS A 39.200 K OHMS SCREENED 125 DEGREE CENTIGRADE 1.0 X RATED POWER

SER NO	RES 0	1	24	48	96	250	500	1000	1500	2000	2500	3000	3500	4000
33341	39.227	39.562	39.568	39.567	39.577	39.580	39.585	39.596	39.600	39.624	39.624	39.628	39.633	39.633
33342	39.227	38.994	39.002	39.002	39.006	39.029	39.084	39.119	39.140	39.139	39.102	39.107	39.003	39.112
33343	39.203	39.289	39.300	39.297	39.305	39.311	39.312	39.321	39.323	39.325	39.330	39.333	39.335	39.333
33344	39.197	39.250	39.253	39.250	39.256	39.254	39.252	39.255	39.253	39.255	39.252	39.255	39.255	39.251
33345	39.230	39.594	39.599	39.598	39.607	39.608	39.611	39.616	39.617	39.619	39.618	39.622	39.625	39.622
33346	39.215	39.435	39.438	39.436	39.441	39.443	39.455	39.460	39.458	39.460	39.461	39.465	39.466	39.463
33347	39.197	39.289	39.299	39.299	39.306	39.205	39.302	39.307	39.306	39.309	39.305	39.308	39.308	39.305
33348	39.211	39.425	39.430	39.428	39.435	39.436	39.437	39.462	39.465	39.471	39.469	39.475	39.478	39.478
33349	39.196	39.238	39.241	39.239	39.246	39.246	39.247	39.252	39.253	39.259	39.260	39.264	39.266	39.263
33350	39.232	39.615	39.619	39.616	39.623	39.623	39.624	39.630	39.628	39.631	39.630	39.633	39.634	39.631
33351	39.203	39.296	39.299	39.299	39.303	39.301	39.299	39.298	39.295	39.299	39.296	39.299	39.299	39.296
33352	39.196	39.221	39.223	39.221	39.226	39.225	39.223	39.225	39.224	39.246	39.224	39.228	39.229	39.225
33353	39.223	39.539	39.544	39.542	39.549	39.552	39.556	39.565	39.567	39.571	39.571	39.576	39.579	39.579
33354	39.224	39.566	39.572	39.570	39.581	39.588	39.592	39.599	39.599	39.602	39.601	39.607	39.607	39.604
33355	39.221	39.487	39.489	39.487	39.493	39.493	39.492	39.496	39.493	39.495	39.492	39.495	39.495	39.491
33356	39.196	39.231	39.234	39.234	39.243	39.243	39.243	39.247	39.248	39.250	39.249	39.253	39.254	39.250
33357	39.216	39.423	39.426	39.424	39.429	39.430	39.430	39.433	39.432	39.434	39.433	39.436	39.437	39.433
33358	39.223	39.540	39.544	39.542	39.548	39.549	39.549	39.556	39.555	39.558	39.557	39.560	39.561	39.557
33359	39.212	39.443	39.448	39.445	39.451	39.450	39.448	39.453	39.452	39.454	39.453	39.458	39.459	39.454
33360	39.194	39.238	39.240	39.238	39.243	39.243	39.241	39.243	39.241	39.241	39.240	39.242	39.242	39.238
N	20	20	20	20	20	20	20	20	20	20	20	20	20	20
SX	784	787	787	787	787	787	787	788	788	788	788	788	788	788
SXX	30752	31022	31029	31026	31037	31032	31046	31058	31059	31066	31060	31066	31060	31064
AVG	39.212	39.383	39.388	39.386	39.393	39.390	39.399	39.406	39.407	39.412	39.408	39.412	39.408	39.410
SEE	.010	.164	.163	.163	.164	.167	.158	.157	.155	.156	.161	.161	.173	.161

PROCESS A 39.200 K OHMS SCREENED 125 DEGREE CENTIGRADE 1.0 X RATED POWER

LOCATION	SHAPE	SCALE	VE	VB	VA	SX	SY	SXX	SYY	SXSX	SXY	P
39.194	.679	.6612E-01	.9910E-01	.3504E-02	.3431E-03	-.8214E+02	-.6943E+01	.4031E+03	.1752E+02	.6747E+04	.5090E+02	18
38.994	2.510	.1262E-00	.6783E-01	.3136E-01	.5383E-03	-.1760E+02	-.6943E+01	.1938E+02	.1752E+02	.3100E+03	.1222E+02	18
39.002	2.480	.1266E-00	.6372E-01	.2860E-01	.5054E-03	-.1779E+02	-.6943E+01	.1981E+02	.1752E+02	.3166E+03	.1238E+02	18
39.002	2.470	.1264E-00	.6366E-01	.2834E-01	.5035E-03	-.1788E+02	-.6943E+01	.2000E+02	.1752E+02	.3197E+03	.1244E+02	18
39.006	2.480	.1275E-00	.6254E-01	.2803E-01	.4995E-03	-.1774E+02	-.6943E+01	.1972E+02	.1752E+02	.3149E+03	.1237E+02	18
39.029	2.145	.1457E-00	.5926E-01	.1980E-01	.5578E-03	-.1939E+02	-.6943E+01	.2388E+02	.1752E+02	.3760E+03	.1390E+02	18
39.084	1.890	.1410E-00	.5761E-01	.1490E-01	.5197E-03	-.2232E+02	-.6943E+01	.3156E+02	.1752E+02	.4984E+03	.1591E+02	18
39.119	1.641	.1563E-00	.5549E-01	.1080E-01	.5672E-03	-.2457E+02	-.6943E+01	.3869E+02	.1752E+02	.6039E+03	.1791E+02	18
39.140	1.477	.1678E-00	.5300E-01	.8325E-02	.5891E-03	-.2644E+02	-.6943E+01	.4522E+02	.1752E+02	.6994E+03	.1960E+02	18
39.139	1.530	.1632E-00	.6268E-01	.1069E-01	.6808E-03	-.2586E+02	-.6943E+01	.4301E+02	.1752E+02	.6688E+03	.1894E+02	18
39.102	1.756	.1538E-00	.4949E-01	.1094E-01	.4927E-03	-.2312E+02	-.6943E+01	.3424E+02	.1752E+02	.5349E+03	.1686E+02	18
39.107	1.741	.1554E-00	.4975E-01	.1080E-01	.5017E-03	-.2323E+02	-.6943E+01	.3458E+02	.1752E+02	.5397E+03	.1697E+02	18
39.003	2.447	.1468E-00	.5350E-01	.2308E-01	.5053E-03	-.1694E+02	-.6943E+01	.1826E+02	.1752E+02	.2870E+03	.1220E+02	18
39.112	1.678	.1601E-00	.4744E-01	.9547E-02	.4950E-03	-.2378E+02	-.6943E+01	.3639E+02	.1752E+02	.5657E+03	.1751E+02	18

PROCESS A 39.200 K OHMS SCREENED 125 DEGREE CENTIGRADE 1.0 X RATED POWER

SER NO	D/N	0	1	24	48	96	250	500	1000	1500	2000	2500	3000	3500	4000
33341		.068	.923	.938	.936	.961	.969	.982	1.010	1.020	1.081	1.081	1.091	1.104	1.104
33342		.068	-.525	-.505	-.505	-.494	-.436	-.295	-.206	-.153	-.155	-.249	-.237	-.502	-.224
33343		.008	.227	.255	.247	.267	.283	.285	.308	.313	.318	.331	.339	.344	.339
33344		-.006	.127	.135	.127	.142	.137	.132	.140	.135	.140	.132	.140	.140	.130
33345		.078	1.005	1.017	1.015	1.038	1.040	1.048	1.061	1.063	1.068	1.066	1.076	1.084	1.076
33346		.038	.599	.607	.602	.614	.619	.650	.663	.658	.663	.665	.676	.678	.670
33347		-.006	.227	.252	.252	.270	.012	.260	.272	.270	.278	.267	.275	.275	.267
33348		.028	.573	.586	.581	.599	.602	.604	.668	.676	.691	.686	.701	.709	.709
33349		-.009	.096	.104	.099	.117	.117	.119	.132	.135	.150	.153	.163	.168	.160
33350		.081	1.058	1.068	1.061	1.079	1.079	1.081	1.096	1.091	1.099	1.096	1.104	1.107	1.099
33351		.009	.244	.252	.252	.262	.257	.252	.249	.242	.252	.244	.252	.252	.244
33352		-.009	.053	.058	.053	.066	.063	.058	.063	.061	.117	.061	.071	.073	.063
33353		.058	.864	.877	.872	.890	.897	.908	.931	.936	.946	.946	.959	.966	.966
33354		.061	.933	.948	.943	.971	.989	.999	1.017	1.017	1.025	1.022	1.038	1.038	1.030
33355		.054	.732	.737	.732	.747	.747	.744	.755	.747	.752	.744	.752	.752	.742
33356		-.009	.079	.086	.086	.109	.109	.109	.119	.122	.127	.124	.135	.137	.127
33357		.040	.568	.576	.571	.584	.586	.586	.594	.591	.596	.594	.602	.604	.594
33358		.059	.867	.877	.872	.887	.890	.890	.908	.905	.913	.910	.918	.920	.910
33359		.032	.619	.632	.624	.640	.637	.632	.645	.642	.647	.645	.658	.660	.647
33360		-.012	.096	.102	.096	.109	.109	.104	.109	.104	.104	.102	.107	.107	.096
N		20	20	20	20	20	20	20	20	20	20	20	20	20	20
SX		.638	9.374	9.612	9.525	9.867	9.716	10.158	10.543	10.584	10.821	10.630	10.826	10.624	10.760
SXX		.042	7.771	7.987	7.890	8.261	8.220	8.298	8.647	8.630	8.913	8.895	9.115	9.408	9.061
AVG		.031	.468	.480	.476	.493	.485	.507	.527	.529	.541	.531	.541	.531	.538
SEE		.033	.421	.421	.420	.422	.429	.406	.403	.399	.401	.413	.413	.445	.414

PROCESS A 39.200 K OHMS SCREENED 125 DEGREE CENTIGRADE 1.0 X RATED POWER

LOCATION	SHAPE	SCALE	VE	VB	VA	SX	SY	SXX	SYY	SXSX	SXY	P
-.012	.679	.1249E-00	.9910E-01	.3504E-02	.8060E-03	-.6528E+02	-.6943E+01	.2650E+03	.1752E+02	.4262E+04	.4440E+02	18
-.525	2.510	.1324E+01	.6783E-01	.3136E-01	.6708E-02	-.7500E-00	-.6943E+01	.2194E+01	.1752E+02	.5626E-00	.5718E+01	18
-.505	2.480	.1292E+01	.6372E-01	.2860E-01	.6043E-02	-.9373E-00	-.6943E+01	.2276E+01	.1752E+02	.8785E-00	.5886E+01	18
-.505	2.470	.1277E+01	.6366E-01	.2834E-01	.5924E-02	-.1024E+01	-.6943E+01	.2304E+01	.1752E+02	.1049E+01	.5942E+01	18
-.494	2.480	.1301E+01	.6254E-01	.2803E-01	.5997E-02	-.8896E-00	-.6943E+01	.2274E+01	.1752E+02	.7915E-00	.5876E+01	18
-.436	2.145	.1087E+01	.5926E-01	.1980E-01	.4355E-02	-.2534E+01	-.6943E+01	.3349E+01	.1752E+02	.6424E+01	.7400E+01	18
-.295	1.890	.8280E-00	.5761E-01	.1490E-01	.3138E-02	-.5470E+01	-.6943E+01	.5528E+01	.1752E+02	.2992E+02	.9417E+01	18
-.206	1.641	.7273E-00	.5549E-01	.1080E-01	.2681E-02	-.7719E+01	-.6943E+01	.8448E+01	.1752E+02	.5958E+02	.1141E+02	18
-.153	1.477	.6694E-00	.5300E-01	.8325E-02	.2378E-02	-.9590E+01	-.6943E+01	.1147E+02	.1752E+02	.9196E+02	.1310E+02	18
-.155	1.530	.6840E-00	.6268E-01	.1069E-01	.2881E-02	-.9004E+01	-.6943E+01	.1036E+02	.1752E+02	.8108E+02	.1244E+02	18
-.249	1.756	.7973E-00	.4949E-01	.1094E-01	.2593E-02	-.6272E+01	-.6943E+01	.6707E+01	.1752E+02	.3934E+02	.1036E+02	18
-.237	1.741	.7937E-00	.4975E-01	.1080E-01	.2595E-02	-.6375E+01	-.6943E+01	.6861E+01	.1752E+02	.4065E+02	.1047E+02	18
-.502	2.447	.1453E+01	.5350E-01	.2308E-01	.6282E-02	-.8511E-01	-.6943E+01	.2318E+01	.1752E+02	.7244E-02	.5706E+01	18
-.224	1.678	.7709E-00	.4744E-01	.9547E-02	.2406E-02	-.6927E+01	-.6943E+01	.7635E+01	.1752E+02	.4799E+02	.1101E+02	18

PROCESS A 39.200 K OHMS SCREENED 125 DEGREE CENTIGRADE 1.0 X RATED POWER

SER NO	C/O 0	1	24	48	96	250	500	1000	1500	2000	2500	3000	3500	4000
33341	0.000	.854	.869	.867	.892	.900	.913	.941	.951	1.012	1.012	1.022	1.035	1.035
33342	0.000	-.594	-.574	-.574	-.563	-.505	-.364	-.275	-.222	-.224	-.318	-.306	-.571	-.293
33343	0.000	.218	.246	.238	.258	.274	.276	.299	.304	.309	.322	.330	.335	.330
33344	0.000	.134	.142	.134	.149	.144	.139	.147	.142	.147	.139	.147	.147	.137
33345	0.000	.926	.938	.936	.959	.961	.969	.982	.984	.989	.987	.997	1.005	.997
33346	0.000	.560	.568	.563	.575	.580	.611	.624	.619	.624	.626	.637	.639	.631
33347	0.000	.234	.259	.259	.277	.019	.267	.279	.277	.285	.274	.282	.282	.274
33348	0.000	.544	.557	.552	.570	.573	.575	.639	.647	.662	.657	.672	.680	.680
33349	0.000	.106	.114	.109	.127	.127	.129	.142	.145	.160	.163	.173	.178	.170
33350	0.000	.976	.986	.979	.997	.997	.999	1.014	1.009	1.017	1.014	1.022	1.025	1.017
33351	0.000	.234	.242	.242	.252	.247	.242	.240	.232	.242	.234	.242	.242	.234
33352	0.000	.063	.068	.063	.076	.073	.068	.073	.071	.127	.071	.081	.083	.073
33353	0.000	.805	.818	.813	.831	.833	.849	.872	.877	.887	.887	.900	.907	.907
33354	0.000	.871	.886	.881	.909	.927	.938	.955	.955	.963	.960	.976	.976	.968
33355	0.000	.677	.682	.677	.692	.692	.689	.700	.692	.697	.689	.697	.697	.687
33356	0.000	.089	.096	.096	.119	.119	.119	.129	.132	.137	.134	.145	.147	.137
33357	0.000	.527	.535	.530	.543	.545	.545	.553	.550	.555	.553	.561	.563	.553
33358	0.000	.807	.817	.812	.827	.830	.830	.848	.845	.853	.850	.858	.860	.850
33359	0.000	.586	.599	.592	.607	.604	.599	.612	.609	.614	.612	.625	.627	.614
33360	0.000	.109	.115	.109	.122	.122	.117	.122	.117	.117	.115	.120	.120	.109
N	0	20	20	20	20	20	20	20	20	20	20	20	20	20
SX	.679	8.735	8.973	8.886	9.228	9.077	9.519	9.904	9.945	10.182	9.991	10.187	9.985	10.121
SXX	.124	6.859	7.059	6.968	7.315	7.257	7.311	7.625	7.600	7.869	7.866	8.072	8.396	8.018
AVG	.314	.436	.448	.444	.461	.453	.475	.495	.497	.509	.499	.509	.499	.506
SEE	20.000	.400	.399	.398	.401	.406	.382	.378	.373	.375	.389	.389	.423	.390

3 PROCESS A 39.200 K OHMS SCREENED 125 DEGREE CENTIGRADE 1.0 X RATED POWER

LOCATION	SHAPE	SCALE	VE	VB	VA	SX	SY	SXX	SYY	SXSX	SXY	P
-.594	2.916	.1529E+01	.6767E-01	.4224E-01	.8812E-02	.2418E-00	-.6943E+01	.1605E+01	.1752E+02	.5848E-01	.4579E+01	18
-.574	2.886	.1486E+01	.6259E-01	.3799E-01	.7690E-02	.6877E-01	-.6943E+01	.1647E+01	.1752E+02	.4730E-02	.4728E+01	18
-.574	2.875	.1467E+01	.6243E-01	.3761E-01	.7471E-02	-.1268E-01	-.6943E+01	.1659E+01	.1752E+02	.1609E-03	.4778E+01	18
-.563	2.883	.1497E+01	.6135E-01	.3712E-01	.7649E-02	.1138E-00	-.6943E+01	.1653E+01	.1752E+02	.1296E-01	.4722E+01	18
-.505	2.502	.1212E+01	.5795E-01	.2629E-01	.4965E-02	-.1387E+01	-.6943E+01	.2311E+01	.1752E+02	.1924E+01	.6051E+01	18
-.364	2.238	.8866E-00	.5816E-01	.2112E-01	.3388E-02	-.4068E+01	-.6943E+01	.3672E+01	.1752E+02	.1654E+02	.7734E+01	18
-.275	1.970	.7586E-00	.5626E-01	.1579E-01	.2824E-02	-.6046E+01	-.6943E+01	.5593E+01	.1752E+02	.3655E+02	.9353E+01	18
-.222	1.798	.6846E-00	.5387E-01	.1255E-01	.2466E-02	-.7651E+01	-.6943E+01	.7542E+01	.1752E+02	.5854E+02	.1066E+02	18
-.224	1.849	.7044E-00	.6386E-01	.1594E-01	.3013E-02	-.7163E+01	-.6943E+01	.6856E+01	.1752E+02	.5131E+02	.1017E+02	18
-.318	2.087	.8465E-00	.4954E-01	.1546E-01	.2748E-02	-.4763E+01	-.6943E+01	.4464E+01	.1752E+02	.2269E+02	.8524E+01	18
-.306	2.068	.8418E-00	.4994E-01	.1532E-01	.2756E-02	-.4853E+01	-.6943E+01	.4567E+01	.1752E+02	.2355E+02	.8614E+01	18
-.571	2.823	.1686E+01	.5369E-01	.3083E-01	.8696E-02	.8746E-00	-.6943E+01	.1783E+01	.1752E+02	.7650E-00	.4579E+01	18
-.293	2.002	.8114E-00	.4832E-01	.1386E-01	.2572E-02	-.5344E+01	-.6943E+01	.5071E+01	.1752E+02	.2856E+02	.9041E+01	18

PROCESS A 39.200 K OHMS SCREENED 125 DEGREE CENTIGRADE 1.0 X RATED POWER

SER NO	C/1 0	1	24	48	96	250	500	1000	1500	2000	2500	3000	3500	4000
33341	0.000	0.000	.015	.012	.038	.045	.058	.086	.096	.158	.158	.168	.181	.181
33342	0.000	0.000	.020	.020	.030	.089	.229	.318	.372	.369	.275	.288	.022	.301
33343	0.000	0.000	.026	.020	.040	.056	.058	.081	.086	.091	.104	.112	.117	.112
33344	0.000	0.000	.007	0.000	.015	.010	.005	.012	.007	.012	.005	.012	.012	.002
33345	0.000	0.000	.012	.010	.033	.035	.043	.056	.058	.063	.061	.071	.079	.071
33346	0.000	0.000	.007	.002	.015	.020	.051	.063	.058	.063	.066	.076	.079	.071
33347	0.000	0.000	.025	.025	.043	-.214	.033	.045	.043	.051	.040	.048	.048	.040
33348	0.000	0.000	.012	.007	.025	.028	.030	.094	.102	.117	.112	.127	.135	.135
33349	0.000	0.000	.007	.002	.020	.020	.022	.035	.038	.053	.056	.066	.071	.063
33350	0.000	0.000	.010	.002	.020	.020	.022	.038	.033	.040	.038	.045	.048	.040
33351	0.000	0.000	.007	.007	.017	.012	.007	.005	-.002	.007	0.000	.007	.007	0.000
33352	0.000	0.000	.005	0.000	.012	.010	.005	.010	.007	.063	.007	.017	.020	.010
33353	0.000	0.000	.012	.007	.025	.033	.043	.066	.071	.081	.081	.094	.102	.102
33354	0.000	0.000	.015	.010	.038	.056	.066	.084	.084	.091	.089	.104	.104	.096
33355	0.000	0.000	.005	0.000	.015	.015	.012	.022	.015	.020	.012	.020	.020	.010
33356	0.000	0.000	.007	.007	.030	.030	.030	.040	.043	.048	.045	.056	.058	.048
33357	0.000	0.000	.007	.002	.015	.017	.017	.025	.022	.028	.025	.033	.035	.025
33358	0.000	0.000	.010	.005	.020	.022	.022	.040	.038	.045	.043	.051	.053	.043
33359	0.000	0.000	.012	.005	.020	.017	.012	.025	.022	.028	.025	.038	.040	.028
33360	0.000	0.000	.005	0.000	.012	.012	.007	.012	.007	.007	.005	.010	.010	0.000
N	0	0	20	20	20	20	20	20	20	20	20	20	20	20
SX	.679	2.916	.237	.150	.492	.341	.783	1.168	1.209	1.446	1.255	1.451	1.249	1.385
SXX	.124	1.529	.003	.002	.013	.069	.075	.153	.194	.225	.159	.189	.119	.197
AVG	.314	.260	.011	.007	.024	.017	.039	.058	.060	.072	.062	.072	.062	.069
SEE	20.000	20.000	.006	.007	.009	.057	.048	.067	.079	.079	.065	.066	.046	.073

PROCESS A 39.200 K OHMS SCREENED 125 DEGREE CENTIGRADE 1.0 X RATED POWER

LOCATION	SHAPE	SCALE	VE	VB	VA	SX	SY	SXX	SYY	SXSX	SXY	P
.005	.161	.5012E-00	.3658E-00	.1156E-02	.1799E-01	-.1198E+03	-.6943E+01	.1114E+04	.1752E+02	.1436E+05	.9735E+02	18
0.000	.941	.9740E-02	.2708E-01	.3762E-02	.9155E-05	-.7524E+02	-.1375E+01	.3846E+03	.6912E+01	.5662E+04	.1367E+02	15
.012	.197	.4989E-00	.4243E-00	.2297E-02	.2299E-01	-.9846E+02	-.6943E+01	.7233E+03	.1752E+02	.9696E+04	.7447E+02	18
-.214	14.518	.1460E-08	.1340E-00	.2272E+01	.9896E-17	-.2570E+02	-.6943E+01	.3675E+02	.1752E+02	.6605E+03	.1077E+02	18
.005	.156	.6842E-00	.4427E-00	.1575E-02	.2915E-01	-.8801E+02	-.6943E+01	.7112E+03	.1752E+02	.7746E+04	.7791E+02	18
.005	1.055	.3828E-01	.3231E-01	.2523E-02	.4681E-04	-.6222E+02	-.6943E+01	.2278E+03	.1752E+02	.3871E+04	.3751E+02	18
-.002	1.171	.3242E-01	.3109E-01	.2985E-02	.3511E-04	-.5862E+02	-.6943E+01	.2013E+03	.1752E+02	.3436E+04	.3461E+02	18
.007	.169	.7443E-00	.4555E-00	.1973E-02	.3162E-01	-.7222E+02	-.6943E+01	.5207E+03	.1752E+02	.5217E+04	.6703E+02	18
0.000	.879	.8069E-01	.3335E-01	.1811E-02	.1405E-03	-.5940E+02	-.6943E+01	.2144E+03	.1752E+02	.3529E+04	.3911E+02	18
.007	.814	.1007E-00	.3894E-01	.1826E-02	.2229E-03	-.5922E+02	-.6943E+01	.2162E+03	.1752E+02	.3507E+04	.4021E+02	18
.007	.841	.8663E-01	.3924E-01	.1964E-02	.1833E-03	-.6057E+02	-.6943E+01	.2238E+03	.1752E+02	.3669E+04	.4017E+02	18
0.000	.733	.1309E-00	.5602E-01	.2953E-02	.5578E-03	-.5348E+02	-.4692E+01	.1872E+03	.1246E+02	.2861E+04	.2868E+02	17

4 PROCESS A 39.200 K DUMS SCREENED 125 DEGREE CENTIGRADE 1.0 X RATED POWER

0.00ABL PCT	24	48	96	250	500	1000	1500	2000	2500	3000	3500	4000	
24.00	.310	.5248E+02	.2254E-01	.3887E-02	.4015E+03	.1788E+02	-.6190E+01	.1124E+03	.1342E+02	.3200E+03	-.3507E+02		3
.050	7.52	0.00	6.37	0.00	16.26	0.00	0.00	17.11	0.00	0.00	0.00	0.00	
.050	100.00	94.89	92.84	89.86	87.33	84.34	82.35	80.81	79.54	78.45	77.49	76.63	
24.00	.310	.4824E+02	.2102E-01	.3635E-02	.3174E+03	.1789E+02	-.6063E+01	.1125E+03	.1287E+02	.3202E+03	-.3437E+02		3
.045	7.85	0.00	6.74	0.00	15.73	0.00	0.00	17.66	0.00	0.00	0.00	0.00	
.045	100.00	94.58	92.46	89.41	86.64	83.83	81.83	80.29	79.02	77.93	76.97	76.12	
24.00	.303	.4399E+02	.1943E-01	.3369E-02	.2447E+03	.1790E+02	-.5924E+01	.1125E+03	.1228E+02	.3204E+03	-.3360E+02		3
.040	8.24	0.00	7.18	0.00	16.28	0.00	0.00	18.28	0.00	0.00	0.00	0.00	
.040	100.00	94.21	92.02	88.90	86.29	83.25	81.24	79.69	78.42	77.34	76.39	75.54	
24.00	.294	.3970E+02	.1774E-01	.3086E-02	.1826E+03	.1790E+02	-.5769E+01	.1126E+03	.1164E+02	.3207E+03	-.3274E+02		3
.035	8.69	0.00	7.69	0.00	16.90	0.00	0.00	18.99	0.00	0.00	0.00	0.00	
.035	100.00	93.77	91.50	88.30	85.65	82.58	80.56	79.01	77.75	76.67	75.72	74.87	
24.00	.284	.3536E+02	.1595E-01	.2782E-02	.1307E+03	.1791E+02	-.5594E+01	.1127E+03	.1094E+02	.3209E+03	-.3177E+02		3
.030	9.23	0.00	8.30	0.00	17.63	0.00	0.00	19.32	0.00	0.00	0.00	0.00	
.030	100.00	93.24	90.88	87.59	84.89	81.80	79.77	78.22	76.96	75.88	74.94	74.10	
24.00	.273	.3096E+02	.1402E-01	.2453E-02	.8846E+02	.1792E+02	-.5391E+01	.1127E+03	.1016E+02	.3212E+03	-.3064E+02		3
.025	9.89	0.00	9.07	0.00	18.52	0.00	0.00	20.83	0.00	0.00	0.00	0.00	
.025	100.00	92.58	90.11	86.72	83.97	80.84	78.81	77.27	76.01	74.94	74.00	73.17	
24.00	.260	.2646E+02	.1192E-01	.2093E-02	.5515E+02	.1793E+02	-.5151E+01	.1128E+03	.9269E+01	.3215E+03	-.2930E+02		3
.020	10.74	0.00	10.07	0.00	19.62	0.00	0.00	22.08	0.00	0.00	0.00	0.00	
.020	100.00	91.70	89.11	85.61	82.81	79.65	77.62	76.08	74.83	73.77	72.85	72.03	
24.00	.244	.2179E+02	.9589E-02	.1690E-02	.3023E+02	.1794E+02	-.4853E+01	.1129E+03	.8219E+01	.3218E+03	-.2763E+02		3
.015	11.89	0.00	11.44	0.00	21.08	0.00	0.00	23.74	0.00	0.00	0.00	0.00	
.015	100.00	90.49	87.74	84.11	81.25	78.08	76.04	74.52	73.28	72.24	71.34	70.54	
24.00	.223	.1683E+02	.6924E-02	.1225E-02	.1309E+02	.1795E+02	-.4452E+01	.1130E+03	.6911E+01	.3222E+03	-.2537E+02		3
.010	13.62	0.00	13.54	0.00	23.21	0.00	0.00	26.13	0.00	0.00	0.00	0.00	
.010	100.00	88.60	85.66	81.88	78.97	75.78	73.77	72.27	71.07	70.05	69.18	68.40	
24.00	-1.095	.1997E-01	.3358E+01	.2733E-00	.5689E-02	.4969E+02	-.2706E+02	.3651E+03	.1428E+03	.2469E+04	-.2056E+03		7
.005	16.85	0.00	17.57	0.00	27.00	0.00	0.00	30.38	.11	.38	.17	1.01	
.005	100.00	21.46	63.02	87.64	94.33	97.38	98.32	98.78	99.04	99.22	99.34	99.43	

PROCESS A 39.200 K OHMS SCREENED 70 DEGREE CENTIGRADE 2.5 X RATED POWER

SER NO	RES	0	1	24	48	96	250	500	1000	1500	2000	2500	3000	3500	4000
33381		39.185	39.081	39.082	39.080	39.083	39.078	39.074	39.068	39.072	39.072	39.069	39.073	39.074	39.073
33382		39.221	39.439	39.440	39.439	39.441	39.436	39.432	39.428	39.431	39.432	39.430	39.435	39.437	39.437
33383		39.211	39.350	39.352	39.350	39.355	39.349	39.348	39.343	39.348	39.349	39.346	39.353	39.356	39.357
33384		39.205	39.288	39.289	39.288	39.291	39.285	39.281	39.275	39.280	39.280	39.278	39.282	39.284	39.284
33385		39.219	39.441	39.442	39.439	39.443	39.437	39.437	39.433	39.437	39.438	39.436	39.440	39.443	39.443
33386		39.207	39.312	39.313	39.311	39.315	39.308	39.305	39.298	39.302	39.302	39.300	39.304	39.305	39.304
33387		39.211	39.344	39.345	39.344	39.347	39.341	39.338	39.331	39.336	39.335	39.333	39.337	39.339	39.338
33388		39.223	39.452	39.457	39.455	39.458	39.453	39.451	39.446	39.451	39.451	39.449	39.454	39.457	39.457
33389		39.196	39.189	39.190	39.189	39.192	39.185	39.181	39.174	39.179	39.178	39.175	39.179	39.180	39.179
33390		39.228	39.525	39.527	39.525	39.530	39.525	39.522	39.516	39.522	39.522	39.520	39.525	39.528	39.528
33391		39.211	39.316	39.316	39.316	39.318	39.312	39.310	39.302	39.306	39.307	39.304	39.310	39.312	39.311
33392		39.198	39.186	39.187	39.185	39.187	39.182	39.188	39.183	39.186	39.185	39.182	39.187	39.188	39.187
33393		39.207	39.294	39.296	39.294	39.296	39.291	39.290	39.285	39.289	39.296	39.293	39.299	39.301	39.300
33394		39.205	39.281	39.283	39.282	39.287	39.286	39.294	39.299	39.300	39.302	39.306	39.325	39.329	39.325
33395		39.227	39.521	39.522	39.521	39.524	39.518	39.515	39.508	39.513	39.514	39.511	39.516	39.518	39.518
33396		39.211	39.344	39.344	39.344	39.348	39.341	39.339	39.332	39.337	39.338	39.336	39.340	39.342	39.342
33397		39.208	39.312	39.313	39.312	39.314	39.309	39.306	39.301	39.304	39.305	39.301	39.307	39.309	39.309
33398		39.182	39.044	39.044	39.043	39.045	39.040	39.036	39.029	39.033	39.032	39.028	39.033	39.035	39.034
33399		39.215	39.355	39.357	39.355	39.359	39.352	39.350	39.344	39.348	39.349	39.347	39.352	39.354	39.353
33400		39.212	39.119	39.116	39.115	39.116	39.111	39.125	39.127	39.121	39.122	39.120	39.141	39.149	39.144
N		20	20	20	20	20	20	20	20	20	20	20	20	20	20
SX		784	786	786	786	786	786	786	786	786	786	786	786	786	786
SXX		30747	30905	30907	30904	30909	30901	30899	30891	30897	30898	30895	30905	30909	30907
AVG		39.209	39.309	39.310	39.309	39.312	39.306	39.306	39.301	39.304	39.305	39.303	39.309	39.312	39.311
SEE		.007	.132	.133	.133	.133	.133	.132	.132	.133	.133	.133	.132	.132	.133

PROCESS A 39.200 K OHMS SCREENED 70 DEGREE CENTIGRADE 2.5 X RATED POWER

LOCATION	SHAPE	SCALE	VE	VB	VA	SX	SY	SXX	SYY	SXSX	SXY	P
39.182	1.335	.1047E-01	.2278E-00	.3779E-01	.5825E-04	-.6666E+02	-.6943E+01	.2528E+03	.1752E+02	.4443E+04	.3376E+02	18
39.044	1.345	.2076E-00	.1325E-00	.1924E-01	.2075E-02	-.2619E+02	-.6943E+01	.4499E+02	.1752E+02	.6860E+03	.1936E+02	18
39.044	1.344	.2089E-00	.1317E-00	.1908E-01	.2075E-02	-.2612E+02	-.6943E+01	.4483E+02	.1752E+02	.6826E+03	.1936E+02	18
39.043	1.333	.2116E-00	.1339E-00	.1913E-01	.2145E-02	-.2617E+02	-.6943E+01	.4506E+02	.1752E+02	.6852E+03	.1942E+02	18
39.045	1.338	.2112E-00	.1327E-00	.1908E-01	.2120E-02	-.2609E+02	-.6943E+01	.4479E+02	.1752E+02	.6810E+03	.1937E+02	18
39.040	1.337	.2109E-00	.1340E-00	.1928E-01	.2140E-02	-.2613E+02	-.6943E+01	.4489E+02	.1752E+02	.6829E+03	.1937E+02	18
39.036	1.386	.2028E-00	.1379E-00	.2142E-01	.2116E-02	-.2572E+02	-.6943E+01	.4319E+02	.1752E+02	.6616E+03	.1884E+02	18
39.029	1.412	.1989E-00	.1399E-00	.2263E-01	.2104E-02	-.2549E+02	-.6943E+01	.4229E+02	.1752E+02	.6501E+03	.1856E+02	18
39.033	1.391	.2033E-00	.1378E-00	.2157E-01	.2121E-02	-.2560E+02	-.6943E+01	.4281E+02	.1752E+02	.6555E+03	.1876E+02	18
39.032	1.401	.2026E-00	.1380E-00	.2192E-01	.2115E-02	-.2545E+02	-.6943E+01	.4229E+02	.1752E+02	.6479E+03	.1864E+02	18
39.028	1.414	.2013E-00	.1372E-00	.2217E-01	.2086E-02	-.2530E+02	-.6943E+01	.4176E+02	.1752E+02	.6403E+03	.1851E+02	18
39.033	1.428	.2001E-00	.1434E-00	.2387E-01	.2181E-02	-.2512E+02	-.6943E+01	.4108E+02	.1752E+02	.6313E+03	.1827E+02	18
39.035	1.421	.2027E-00	.1477E-00	.2447E-01	.2292E-02	-.2509E+02	-.6943E+01	.4103E+02	.1752E+02	.6299E+03	.1825E+02	18
39.034	1.415	.2040E-00	.1455E-00	.2383E-01	.2268E-02	-.2511E+02	-.6943E+01	.4115E+02	.1752E+02	.6309E+03	.1832E+02	18

PROCESS A 39.200 K OHMS SCREENED 70 DEGREE CENTIGRADE 2.5 X RATED POWER

SER NO	D/N 0	1	24	48	96	250	500	1000	1500	2000	2500	3000	3500	4000
33381	-.036	-.303	-.301	-.306	-.298	-.311	-.321	-.336	-.326	-.326	-.334	-.323	-.321	-.323
33382	.053	.609	.612	.609	.614	.602	.591	.581	.589	.591	.586	.599	.604	.604
33383	.028	.382	.387	.382	.395	.380	.377	.364	.377	.380	.372	.390	.397	.400
33384	.012	.224	.227	.224	.232	.216	.206	.191	.204	.204	.198	.209	.214	.214
33385	.049	.614	.617	.609	.619	.604	.604	.594	.604	.607	.602	.612	.619	.619
33386	.019	.285	.288	.283	.293	.275	.267	.249	.260	.260	.255	.265	.267	.265
33387	.028	.367	.369	.367	.374	.359	.352	.334	.346	.344	.339	.349	.354	.352
33388	.058	.642	.655	.650	.658	.645	.640	.627	.640	.640	.635	.647	.655	.655
33389	-.009	-.028	-.025	-.028	-.020	-.038	-.048	-.066	-.053	-.056	-.063	-.053	-.051	-.053
33390	.071	.829	.834	.829	.841	.829	.821	.806	.821	.821	.816	.829	.836	.836
33391	.028	.295	.295	.295	.301	.285	.280	.260	.270	.272	.265	.280	.285	.283
33392	-.004	-.035	-.033	-.038	-.033	-.045	-.030	-.043	-.035	-.038	-.045	-.033	-.030	-.033
33393	.018	.239	.244	.239	.244	.232	.229	.216	.227	.244	.237	.252	.257	.255
33394	.014	.206	.211	.209	.221	.219	.239	.252	.255	.260	.270	.318	.329	.318
33395	.068	.818	.821	.818	.826	.811	.803	.785	.798	.801	.793	.806	.811	.811
33396	.028	.367	.367	.367	.377	.359	.354	.336	.349	.352	.346	.357	.362	.362
33397	.021	.285	.288	.285	.290	.278	.270	.257	.265	.267	.257	.272	.278	.278
33398	-.044	-.397	-.397	-.400	-.395	-.408	-.418	-.436	-.426	-.428	-.438	-.426	-.420	-.423
33399	.039	.395	.400	.395	.405	.387	.382	.367	.377	.380	.374	.387	.392	.390
33400	.030	-.206	-.214	-.216	-.214	-.227	-.191	-.186	-.201	-.198	-.204	-.150	-.130	-.142
N	20	20	20	20	20	20	20	20	20	20	20	20	20	20
SX	.482	5.594	5.650	5.579	5.737	5.456	5.413	5.158	5.344	5.380	5.265	5.591	5.714	5.670
SXX	.029	3.790	3.845	3.801	3.908	3.746	3.679	3.534	3.665	3.694	3.643	3.789	3.859	3.854
AVG	.024	.279	.282	.278	.286	.272	.270	.257	.267	.269	.263	.279	.285	.283
SEE	.031	.342	.344	.343	.345	.344	.341	.340	.343	.343	.344	.342	.342	.343

PROCESS A 39.200 K OHMS SCREENED 70 DEGREE CENTIGRADE 2.5 X RATED POWER

LOCATION	SHAPE	SCALE	VE	VB	VA	SX	SY	SXX	SYY	SXSX	SXY	P
-.044	1.335	.3657E-01	.2278E-00	.3779E-01	.4039E-03	-.4980E+02	-.6943E+01	.1438E+03	.1752E+02	.2480E+04	.2726E+02	18
-.397	1.345	.7320E-00	.1325E-00	.1924E-01	.6720E-02	-.9334E+01	-.6943E+01	.1172E+02	.1752E+02	.8713E+02	.1286E+02	18
-.397	1.344	.7358E-00	.1317E-00	.1908E-01	.6706E-02	-.9271E+01	-.6943E+01	.1168E+02	.1752E+02	.8596E+02	.1285E+02	18
-.400	1.333	.7374E-00	.1339E-00	.1913E-01	.6836E-02	-.9319E+01	-.6943E+01	.1182E+02	.1752E+02	.8685E+02	.1292E+02	18
-.395	1.338	.7398E-00	.1327E-00	.1908E-01	.6791E-02	-.9240E+01	-.6943E+01	.1170E+02	.1752E+02	.8539E+02	.1287E+02	18
-.408	1.337	.7381E-00	.1340E-00	.1928E-01	.6849E-02	-.9277E+01	-.6943E+01	.1173E+02	.1752E+02	.8606E+02	.1287E+02	18
-.418	1.386	.7430E-00	.1379E-00	.2142E-01	.7101E-02	-.8866E+01	-.6943E+01	.1080E+02	.1752E+02	.7860E+02	.1234E+02	18
-.436	1.412	.7466E-00	.1399E-00	.2263E-01	.7240E-02	-.8640E+01	-.6943E+01	.1032E+02	.1752E+02	.7465E+02	.1206E+02	18
-.426	1.391	.7481E-00	.1378E-00	.2157E-01	.7137E-02	-.8746E+01	-.6943E+01	.1064E+02	.1752E+02	.7650E+02	.1226E+02	18
-.428	1.401	.7528E-00	.1380E-00	.2192E-01	.7182E-02	-.8598E+01	-.6943E+01	.1040E+02	.1752E+02	.7393E+02	.1213E+02	18
-.438	1.414	.7572E-00	.1372E-00	.2217E-01	.7173E-02	-.8447E+01	-.6943E+01	.1015E+02	.1752E+02	.7135E+02	.1201E+02	18
-.426	1.428	.7628E-00	.1434E-00	.2387E-01	.7568E-02	-.8268E+01	-.6943E+01	.9806E+01	.1752E+02	.6837E+02	.1177E+02	18
-.420	1.421	.7671E-00	.1477E-00	.2447E-01	.7849E-02	-.8242E+01	-.6943E+01	.9810E+01	.1752E+02	.6793E+02	.1175E+02	18
-.423	1.415	.7680E-00	.1455E-00	.2383E-01	.7729E-02	-.8261E+01	-.6943E+01	.9896E+01	.1752E+02	.6825E+02	.1182E+02	18

PROCESS A 39.200 K OHMS SCREENED 70 DEGREE CENTIGRADE 2.5 X RATED POWER

SER NO	C/0	0	1	24	48	96	250	500	1000	1500	2000	2500	3000	3500	4000
33381		0.000	-.266	-.264	-.269	-.261	-.274	-.284	-.299	-.289	-.289	-.297	-.286	-.284	-.286
33382		0.000	.555	.558	.555	.560	.548	.537	.527	.535	.537	.532	.545	.550	.550
33383		0.000	.353	.358	.353	.366	.351	.348	.335	.348	.351	.343	.361	.368	.371
33384		0.000	.211	.214	.211	.219	.203	.193	.178	.191	.191	.185	.196	.201	.201
33385		0.000	.564	.567	.559	.569	.554	.554	.544	.554	.557	.552	.562	.569	.569
33386		0.000	.265	.268	.263	.273	.255	.247	.230	.240	.240	.235	.245	.247	.245
33387		0.000	.338	.340	.338	.346	.330	.323	.305	.317	.315	.310	.320	.325	.323
33388		0.000	.583	.596	.591	.599	.586	.581	.568	.581	.581	.576	.588	.596	.596
33389		0.000	-.018	-.015	-.018	-.010	-.028	-.038	-.056	-.043	-.046	-.053	-.043	-.041	-.043
33390		0.000	.757	.762	.757	.769	.757	.749	.734	.749	.749	.744	.757	.764	.764
33391		0.000	.266	.266	.266	.272	.256	.251	.231	.241	.243	.236	.251	.256	.254
33392		0.000	-.030	-.028	-.033	-.028	-.040	-.025	-.038	-.030	-.033	-.040	-.028	-.025	-.028
33393		0.000	.220	.225	.220	.225	.213	.210	.197	.208	.225	.218	.233	.238	.236
33394		0.000	.191	.196	.194	.206	.204	.224	.237	.240	.245	.255	.303	.314	.303
33395		0.000	.749	.752	.749	.757	.742	.734	.716	.729	.732	.724	.737	.742	.742
33396		0.000	.338	.338	.338	.348	.330	.325	.307	.320	.323	.317	.328	.333	.333
33397		0.000	.263	.266	.263	.268	.256	.248	.235	.243	.245	.235	.250	.256	.256
33398		0.000	-.352	-.352	-.355	-.350	-.363	-.373	-.391	-.381	-.383	-.393	-.381	-.375	-.378
33399		0.000	.355	.360	.355	.365	.347	.342	.327	.337	.340	.335	.347	.352	.350
33400		0.000	-.237	-.245	-.247	-.245	-.258	-.222	-.217	-.232	-.229	-.235	-.181	-.161	-.173
N		0	20	20	20	20	20	20	20	20	20	20	20	20	20
SX		1.335	5.111	5.167	5.096	5.254	4.973	4.930	4.675	4.861	4.897	4.782	5.108	5.231	5.187
SXX		.036	3.179	3.231	3.190	3.288	3.140	3.075	2.942	3.063	3.090	3.044	3.173	3.236	3.233
AVG		.477	.255	.258	.254	.262	.248	.246	.233	.243	.244	.239	.255	.261	.259
SEE		20.000	.313	.315	.315	.316	.316	.312	.311	.314	.315	.316	.313	.313	.315

PROCESS A 39.200 K OHMS SCREENED 70 DEGREE CENTIGRADE 2.5 X RATED POWER

LOCATION	SHAPE	SCALE	VE	VB	VA	SX	SY	SXX	SYY	SXSX	SXY	P
-.352	1.241	.6611E-00	.1470E-00	.1857E-01	.6938E-02	-.1159E+02	-.6943E+01	.1538E+02	.1752E+02	.1343E+03	.1430E+02	18
-.352	1.227	.6693E-00	.1511E-00	.1877E-01	.7223E-02	-.1154E+02	-.6943E+01	.1545E+02	.1752E+02	.1332E+03	.1433E+02	18
-.355	1.218	.6706E-00	.1523E-00	.1868E-01	.7295E-02	-.1159E+02	-.6943E+01	.1562E+02	.1752E+02	.1345E+03	.1440E+02	18
-.350	1.217	.6747E-00	.1535E-00	.1883E-01	.7396E-02	-.1151E+02	-.6943E+01	.1552E+02	.1752E+02	.1327E+03	.1436E+02	18
-.363	1.216	.6731E-00	.1548E-00	.1901E-01	.7453E-02	-.1156E+02	-.6943E+01	.1556E+02	.1752E+02	.1336E+03	.1437E+02	18
-.373	1.317	.6576E-00	.1416E-00	.2000E-01	.6629E-02	-.1099E+02	-.6943E+01	.1379E+02	.1752E+02	.1208E+03	.1357E+02	18
-.391	1.361	.6540F-00	.1381E-00	.2073E-01	.6423E-02	-.1070E+02	-.6943E+01	.1303E+02	.1752E+02	.1146E+03	.1320E+02	18
-.381	1.318	.6634E-00	.1431E-00	.2028E-01	.6754E-02	-.1086E+02	-.6943E+01	.1361E+02	.1752E+02	.1180E+03	.1349E+02	18
-.383	1.332	.6664E-00	.1424E-00	.2058E-01	.6740E-02	-.1069E+02	-.6943E+01	.1327E+02	.1752E+02	.1143E+03	.1334E+02	18
-.393	1.348	.6688E-00	.1406E-00	.2075E-01	.6665E-02	-.1051E+02	-.6943E+01	.1292E+02	.1752E+02	.1106E+03	.1319E+02	18
-.381	1.393	.6641E-00	.1377E-00	.2163E-01	.6481E-02	-.1026E+02	-.6943E+01	.1222E+02	.1752E+02	.1054E+03	.1283E+02	18
-.375	1.394	.6660E-00	.1396E-00	.2200E-01	.6590E-02	-.1022E+02	-.6943E+01	.1215E+02	.1752E+02	.1045E+03	.1279E+02	18
-.378	1.383	.6686E-00	.1386E-00	.2147E-01	.6559E-02	-.1025E+02	-.6943E+01	.1229E+02	.1752E+02	.1051E+03	.1288E+02	18

PROCESS A 39.200 K OHMS SCREENED 70 DEGREE CENTIGRADE 2.5 X RATED POWER

SER NO	C/1 0	1	24	48	96	250	500	1000	1500	2000	2500	3000	3500	4000
33381	0.000	0.000	.002	-.002	.005	-.007	-.017	-.033	-.022	-.022	-.030	-.020	-.017	-.020
33382	0.000	0.000	.002	0.000	.005	-.007	-.017	-.028	-.020	-.017	-.022	-.010	-.005	-.005
33383	0.000	0.000	.005	0.000	.012	-.002	-.005	-.017	-.005	-.002	-.010	.007	.015	.017
33384	0.000	0.000	.002	0.000	.007	-.007	-.017	-.033	-.020	-.020	-.025	-.015	-.010	-.010
33385	0.000	0.000	.002	-.005	.005	-.010	-.010	-.020	-.010	-.007	-.012	-.002	.005	.005
33386	0.000	0.000	.002	-.002	.007	-.010	-.017	-.035	-.025	-.025	-.030	-.020	-.017	-.020
33387	0.000	0.000	.002	0.000	.007	-.007	-.015	-.033	-.020	-.022	-.028	-.017	-.012	-.015
33388	0.000	0.000	.012	.007	.015	.002	-.002	-.015	-.002	-.002	-.007	.005	.012	.012
33389	0.000	0.000	.002	0.000	.007	-.010	-.020	-.038	-.025	-.028	-.035	-.025	-.022	-.025
33390	0.000	0.000	.005	0.000	.012	0.000	-.007	-.022	-.007	-.007	-.012	0.000	.007	.007
33391	0.000	0.000	0.000	0.000	.005	-.010	-.015	-.035	-.025	-.022	-.030	-.015	-.010	-.012
33392	0.000	0.000	.002	-.002	.002	-.010	.005	-.007	0.000	-.002	-.010	.002	.005	.002
33393	0.000	0.000	.005	0.000	.005	-.007	-.010	-.022	-.012	.005	-.002	.012	.017	.015
33394	0.000	0.000	.005	.002	.015	.012	.033	.045	.048	.053	.063	.112	.122	.112
33395	0.000	0.000	.002	0.000	.007	-.007	-.015	-.033	-.020	-.017	-.025	-.012	-.007	-.007
33396	0.000	0.000	0.000	0.000	.010	-.007	-.012	-.030	-.017	-.015	-.020	-.010	-.005	-.005
33397	0.000	0.000	.002	0.000	.005	-.007	-.015	-.028	-.020	-.017	-.028	-.012	-.007	-.007
33398	0.000	0.000	0.000	-.002	.002	-.010	-.020	-.038	-.028	-.030	-.040	-.028	-.022	-.025
33399	0.000	0.000	.005	0.000	.010	-.007	-.012	-.028	-.017	-.015	-.020	-.007	-.002	-.005
33400	0.000	0.000	-.007	-.010	-.007	-.020	.015	.020	.005	.007	.002	.056	.076	.063
N	0	0	20	20	20	20	20	20	20	20	20	20	20	20
SX	1.335	1.241	.056	-.015	.142	-.137	-.181	-.436	-.249	-.214	-.329	-.002	.119	.076
SXX	.036	.661	0.000	0.000	.001	.001	.005	.017	.008	.008	.014	.019	.023	.020
AVG	.477	.383	.002	0.000	.007	-.006	-.009	-.021	-.012	-.010	-.016	0.000	.005	.003
SEE	20.000	20.000	.003	.003	.005	.006	.013	.020	.017	.018	.022	.032	.034	.032

4 PROCESS A 39.200 K OHMS SCREENED 70 DEGREE CENTIGRADE 2.5 X RATED POWER

LOCATION	SHAPE	SCALE	VE	VB	VA	SX	SY	SXX	SYY	SXSX	SXY	P
-.007	4.967	.2028E-09	.1483E-00	.3005E-00	.2587E-18	-.8227E+02	-.6943E+01	.3765E+03	.1752E+02	.6769E+04	.3418E+02	18
-.010	3.898	.1788E-07	.2209E-00	.3089E-00	.2162E-14	-.8415E+02	-.6943E+01	.3941E+03	.1752E+02	.7081E+04	.3524E+02	18
-.007	3.914	.1009E-06	.7192E-01	.8130E-01	.1475E-13	-.7584E+02	-.6943E+01	.3204E+03	.1752E+02	.5752E+04	.3271E+02	18
-.020	3.283	.8936E-06	.2389E-00	.2443E-00	.3717E-11	-.7845E+02	-.6943E+01	.3429E+03	.1752E+02	.6155E+04	.3347E+02	18
-.020	.177	.5328E-00	.4490E-00	.2084E-02	.2650E-01	-.1031E+03	-.6943E+01	.8059E+03	.1752E+02	.1063E+05	.7794E+02	18
-.038	.184	.5439E-00	.4348E-00	.2109E-02	.2527E-01	-.9698E+02	-.6943E+01	.7286E+03	.1752E+02	.9406E+04	.7545E+02	18
-.028	1.108	.8717E-02	.3947E-01	.3432E-02	.5746E-05	-.8324E+02	-.6943E+01	.3964E+03	.1752E+02	.6929E+04	.4486E+02	18
-.030	1.265	.6675E-02	.2638E-01	.2937E-02	.2446E-05	-.7676E+02	-.6943E+01	.3363E+03	.1752E+02	.5892E+04	.4097E+02	18
-.040	1.610	.2373E-02	.2673E-01	.4827E-02	.4418E-06	-.7185E+02	-.6943E+01	.2923E+03	.1752E+02	.5162E+04	.3663E+02	18
-.028	1.162	.1364E-01	.4415E-01	.4245E-02	.1327E-04	-.7246E+02	-.6943E+01	.3021E+03	.1752E+02	.5251E+04	.4004E+02	18
-.022	.165	.6668E-00	.4721E-00	.2026E-02	.3234E-01	-.8623E+02	-.6943E+01	.6461E+03	.1752E+02	.7437E+04	.7173E+02	18
-.025	.164	.6761E-00	.4740E-00	.2021E-02	.3275E-01	-.8522E+02	-.6943E+01	.6380E+03	.1752E+02	.7263E+04	.7136E+02	18

4 PROCESS A 39.200 K OHMS SCREENED 70 DEGREE CENTIGRADE 2.5 X RATED POWER

0.00ADL PCT	24	48	96	250	500	1000	1500	2000	2500	3000	3500	4000	
277.10	.226	.4218E+02	.9477E-02	.1627E-02	.1467E+03	.2806E+02	-.8621E+01	.2027E+03	.1892E+02	.7876E+03	-.5917E+02		4
.050	0.00	0.00	0.00	0.00	8.22	8.39	0.00	0.00	0.00	0.00	14.12	14.54	
.050	100.00	100.00	100.00	100.00	92.26	90.02	88.84	87.99	87.33	86.78	86.30	85.88	
276.01	.222	.3935E+02	.8912E-02	.1541E-02	.1211E+03	.2808E+02	-.8452E+01	.2029E+03	.1818E+02	.7886E+03	-.5805E+02		4
.045	0.00	0.00	0.00	0.00	8.61	8.80	0.00	0.00	0.00	0.00	14.60	15.03	
.045	100.00	100.00	100.00	100.00	91.89	89.60	88.40	87.54	86.86	86.30	85.82	85.39	
274.85	.217	.3645E+02	.8323E-02	.1449E-02	.9785E+02	.2810E+02	-.8265E+01	.2031E+03	.1738E+02	.7896E+03	-.5681E+02		4
.040	0.00	0.00	0.00	0.00	9.05	9.26	0.00	0.00	0.00	0.00	15.15	15.58	
.040	100.00	100.00	100.00	100.00	91.46	89.12	87.89	87.02	86.33	85.76	85.27	84.84	
273.63	.212	.3346E+02	.7704E-02	.1352E-02	.7699E+02	.2811E+02	-.8058E+01	.2033E+03	.1652E+02	.7906E+03	-.5543E+02		4
.035	0.00	0.00	0.00	0.00	9.57	9.81	0.00	0.00	0.00	0.00	15.78	16.22	
.035	100.00	100.00	100.00	100.00	90.96	88.56	87.30	86.42	85.72	85.14	84.64	84.20	
272.32	.207	.3036E+02	.7049E-02	.1247E-02	.5855E+02	.2813E+02	-.7824E+01	.2036E+03	.1557E+02	.7918E+03	-.5387E+02		4
.030	0.00	0.00	0.00	0.00	10.19	10.46	0.00	0.00	0.00	0.00	16.52	16.97	
.030	100.00	100.00	100.00	100.00	90.36	87.90	86.61	85.70	84.99	84.40	83.89	83.45	
270.90	.200	.2713E+02	.6350E-02	.1134E-02	.4255E+02	.2816E+02	-.7555E+01	.2038E+03	.1452E+02	.7930E+03	-.5206E+02		4
.025	0.00	0.00	0.00	0.00	10.96	11.26	0.00	0.00	0.00	0.00	17.42	17.87	
.025	100.00	100.00	100.00	100.00	89.61	87.08	85.76	84.84	84.11	83.51	83.00	82.54	
269.33	.192	.2373E+02	.5594E-02	.1008E-02	.2900E+02	.2818E+02	-.7235E+01	.2041E+03	.1331E+02	.7943E+03	-.4991E+02		4
.020	0.00	0.00	0.00	0.00	11.93	12.28	0.00	0.00	0.00	0.00	18.55	19.00	
.020	100.00	100.00	100.00	100.00	88.67	86.05	84.70	83.75	83.01	82.39	81.87	81.41	
267.54	.183	.2010E+02	.4762E-02	.8680E-03	.1792E+02	.2821E+02	-.6839E+01	.2044E+03	.1189E+02	.7958E+03	-.4723E+02		4
.015	0.00	0.00	0.00	0.00	13.24	13.66	0.00	0.00	0.00	0.00	20.04	20.49	
.015	100.00	100.00	100.00	100.00	87.38	84.67	83.27	82.30	81.54	80.91	80.38	79.91	
265.42	.170	.1609E+02	.3821E-02	.7055E-03	.9360E+01	.2824E+02	-.6310E+01	.2048E+03	.1012E+02	.7976E+03	-.4363E+02		4
.010	0.00	0.00	0.00	0.00	15.20	15.70	0.00	0.00	0.00	0.00	22.19	22.64	
.010	100.00	100.00	100.00	100.00	85.45	82.62	81.18	80.17	79.40	78.76	78.22	77.74	
262.62	.150	.1138E+02	.2712E-02	.5090E-03	.3387E+01	.2828E+02	-.5484E+01	.2053E+03	.7652E+01	.7998E+03	-.3798E+02		4
.005	0.00	0.00	0.00	0.00	18.79	19.40	0.00	0.00	0.00	0.00	25.99	26.42	
.005	100.00	100.00	100.00	100.00	81.90	78.93	77.43	76.40	75.61	74.97	74.42	73.94	

PROCESS A 39.200 K OHMS SCREENED 125 DEGREE CENTIGRADE 2.5 X RATED POWER

SER NO	RES	0	1	24	48	96	250	500	1000	1500	2000	2500	3000	3500	4000
33421	39.223	39.536	39.545	39.543	39.548	39.546	39.547	39.552	39.557	39.555	39.555	39.566	39.568	39.564
33422	39.223	39.525	39.536	39.535	39.541	39.544	39.547	39.559	39.567	39.569	39.570	39.581	39.586	39.585
33423	39.223	39.530	39.540	39.539	39.544	39.544	39.545	39.550	39.554	39.553	39.552	39.563	39.566	39.564
33424	39.196	39.254	39.270	39.270	39.276	39.275	39.277	39.285	39.291	39.290	39.295	39.308	39.311	39.308
33425	39.212	39.407	39.418	39.417	39.422	39.422	39.423	39.429	39.433	39.432	39.431	39.443	39.445	39.442
33426	39.194	39.199	39.218	39.217	39.237	39.236	39.248	39.257	39.267	39.269	39.287	39.299	39.303	39.302
33427	39.200	39.233	39.237	39.237	39.240	39.242	39.247	39.253	39.259	39.260	39.266	39.277	39.279	39.277
33428	39.180	39.071	39.079	39.077	39.079	39.077	39.075	39.077	39.078	39.075	39.073	39.082	39.083	39.078
33429	39.219	39.349	39.352	39.355	39.373	39.382	39.379	39.508	39.517	39.520	39.522	39.537	39.540	39.537
33430	39.216	39.495	39.525	39.527	39.535	39.543	39.553	39.573	39.586	39.594	39.598	39.610	39.617	39.617
33431	39.223	39.544	39.563	39.563	39.563	39.570	39.577	39.586	39.588	39.588	39.587	39.597	39.600	39.602
33432	39.219	39.482	39.505	39.506	39.514	39.517	39.522	39.536	39.542	39.544	39.545	39.557	39.560	39.557
33433	39.204	39.348	39.357	39.357	39.362	39.361	39.360	39.364	39.365	39.363	39.361	39.371	39.373	39.368
33434	39.212	39.443	39.452	39.452	39.455	39.455	39.454	39.453	39.452	39.451	39.446	39.455	39.456	39.450
33435	39.207	39.381	39.397	39.396	39.400	39.399	39.401	39.407	39.410	39.410	39.412	39.423	39.430	39.430
33436	39.223	39.512	39.521	39.521	39.525	39.525	39.526	39.530	39.532	39.533	39.532	39.542	39.543	39.540
33437	39.211	39.391	39.399	39.397	39.401	39.400	39.400	39.405	39.407	39.407	39.407	39.417	39.420	39.417
33438	39.223	39.547	39.557	39.556	39.562	39.563	39.564	39.571	39.575	39.574	39.572	39.582	39.584	39.580
33439	39.196	39.244	39.252	39.251	39.255	39.253	39.251	39.253	39.254	39.252	39.251	39.261	39.262	39.257
33440	39.207	39.363	39.373	39.372	39.376	39.373	39.372	39.373	39.373	39.372	39.371	39.382	39.386	39.383
N	20	20	20	20	20	20	20	20	20	20	20	20	20	20
SX	784	787	788	788	788	788	788	788	788	788	788	788	788	788
SXX	30750	31036	31055	31054	31063	31065	31068	31088	31095	31095	31097	31114	31119	31115
AVG	39.211	39.392	39.404	39.404	39.410	39.411	39.413	39.426	39.430	39.430	39.431	39.442	39.445	39.442
SEE	0.000	.134	.136	.136	.136	.137	.138	.141	.142	.143	.142	.142	.142	.143

PROCESS A 39.200 K OHMS SCREENED 125 DEGREE CENTIGRADE 2.5 X RATED POWER

LOCATION	SHAPE	SCALE	VE	VB	VA	SX	SY	SXX	SYY	SXSX	SXY	P
39.180	2.407	.3124E-03	.4686E-01	.1938E-01	.2362E-07	-.6323E+02	-.6943E+01	.2245E+03	.1752E+02	.3998E+04	.3020E+02	18
39.071	2.220	.1080E-00	.4854E-01	.1712E-01	.3080E-03	-.2116E+02	-.6943E+01	.2771E+02	.1752E+02	.4478E+03	.1445E+02	18
39.079	2.248	.1077E-00	.4775E-01	.1726E-01	.3015E-03	-.2092E+02	-.6943E+01	.2708E+02	.1752E+02	.4376E+03	.1429E+02	18
39.077	2.259	.1078E-00	.4942E-01	.1806E-01	.3130E-03	-.2081E+02	-.6943E+01	.2681E+02	.1752E+02	.4333E+03	.1420E+02	18
39.079	2.334	.1030E-00	.5555E-01	.2186E-01	.3336E-03	-.2049E+02	-.6943E+01	.2588E+02	.1752E+02	.4202E+03	.1383E+02	18
39.077	2.335	.1048E-00	.5719E-01	.2258E-01	.3523E-03	-.2035E+02	-.6943E+01	.2554E+02	.1752E+02	.4141E+03	.1376E+02	18
39.075	2.395	.1014E-00	.5934E-01	.2471E-01	.3506E-03	-.2009E+02	-.6943E+01	.2483E+02	.1752E+02	.4037E+03	.1350E+02	18
39.077	2.376	.1118E-00	.6328E-01	.2607E-01	.4273E-03	-.1951E+02	-.6943E+01	.2357E+02	.1752E+02	.3807E+03	.1329E+02	18
39.078	2.420	.1095E-00	.5361E-01	.2263E-01	.3482E-03	-.1931E+02	-.6943E+01	.2308E+02	.1752E+02	.3729E+03	.1318E+02	18
39.075	2.442	.1093E-00	.5181E-01	.2221E-01	.3352E-03	-.1914E+02	-.6943E+01	.2269E+02	.1752E+02	.3666E+03	.1308E+02	18
39.073	2.554	.1003E-00	.4379E-01	.2032E-01	.2504E-03	-.1892E+02	-.6943E+01	.2204E+02	.1752E+02	.3580E+03	.1280E+02	18
39.082	2.573	.9998E-01	.4363E-01	.2054E-01	.2484E-03	-.1880E+02	-.6943E+01	.2177E+02	.1752E+02	.3537E+03	.1272E+02	18
39.083	2.582	.1003E-00	.4280E-01	.2028E-01	.2445E-03	-.1871E+02	-.6943E+01	.2156E+02	.1752E+02	.3501E+03	.1266E+02	18
39.078	2.596	.1005E-00	.4054E-01	.1935E-01	.2318E-03	-.1859E+02	-.6943E+01	.2130E+02	.1752E+02	.3458E+03	.1261E+02	18

PROCESS A 39.200 K OHMS SCREENED 125 DEGREE CENTIGRADE 2.5 X RATED POWER

SER NO	D/N	0	1	24	48	96	250	500	1000	1500	2000	2500	3000	3500	4000
33421		.059	.857	.880	.874	.887	.882	.885	.897	.910	.905	.905	.933	.938	.928
33422		.058	.829	.857	.854	.869	.877	.885	.915	.936	.941	.943	.971	.984	.982
33423		.059	.841	.867	.864	.877	.877	.880	.892	.903	.900	.897	.926	.933	.928
33424		-.007	.137	.178	.178	.193	.191	.196	.216	.232	.229	.242	.275	.283	.275
33425		.031	.528	.556	.553	.566	.566	.568	.584	.594	.591	.589	.619	.624	.617
33426		-.014	-.002	.045	.043	.094	.091	.122	.145	.170	.176	.221	.252	.262	.260
33427		.001	.084	.094	.094	.102	.107	.119	.135	.150	.153	.168	.196	.201	.196
33428		-.049	-.329	-.308	-.313	-.308	-.313	-.318	-.313	-.311	-.318	-.323	-.301	-.298	-.311
33429		.048	.380	.387	.395	.441	.464	.456	.785	.808	.816	.821	.859	.867	.859
33430		.042	.752	.829	.834	.854	.874	.900	.951	.984	1.005	1.015	1.045	1.063	1.063
33431		.059	.877	.926	.926	.926	.943	.961	.984	.989	.989	.987	1.012	1.020	1.025
33432		.050	.719	.778	.780	.801	.808	.821	.857	.872	.877	.880	.910	.918	.910
33433		.010	.377	.400	.400	.413	.410	.408	.418	.420	.415	.410	.436	.441	.428
33434		.031	.619	.642	.642	.650	.650	.647	.645	.642	.640	.627	.650	.653	.637
33435		.019	.461	.502	.499	.510	.507	.512	.528	.535	.535	.540	.568	.586	.586
33436		.058	.795	.818	.818	.829	.829	.831	.841	.846	.849	.846	.872	.874	.867
33437		.028	.487	.507	.502	.512	.510	.510	.522	.528	.528	.528	.553	.561	.553
33438		.059	.885	.910	.908	.923	.926	.928	.946	.956	.954	.948	.974	.979	.969
33439		-.008	.112	.132	.130	.140	.135	.130	.135	.137	.132	.130	.155	.158	.145
33440		.018	.415	.441	.438	.448	.441	.438	.441	.441	.438	.436	.464	.474	.466
N		20	20	20	20	20	20	20	20	20	20	20	20	20	20
SX		.563	9.831	10.448	10.428	10.734	10.783	10.887	11.533	11.752	11.762	11.818	12.380	12.530	12.392
SXX		.034	7.122	7.805	7.791	8.090	8.188	8.327	9.156	9.444	9.493	9.519	10.209	10.416	10.273
AVG		.028	.491	.522	.521	.536	.539	.544	.576	.587	.588	.590	.619	.626	.619
SEE		.031	.347	.351	.351	.350	.353	.355	.363	.365	.368	.365	.366	.367	.369

2 PROCESS A 39.200 K OHMS SCREENED 125 DEGREE CENTIGRADE 2.5 X RATED POWER

LOCATION	SHAPE	SCALE	VE	VB	VA	SX	SY	SXX	SYY	SXSX	SXY	P
-.049	2.407	.2977E-02	.4687E-01	.1939E-01	.1164E-05	-.4637E+02	-.6943E+01	.1219E+03	.1752E+02	.2150E+04	.2370E+02	18
-.329	2.220	.8646E-00	.4854E-01	.1712E-01	.2748E-02	-.4305E+01	-.6943E+01	.3864E+01	.1752E+02	.1853E+02	.7954E+01	18
-.308	2.248	.8852E-00	.4775E-01	.1726E-01	.2768E-02	-.4063E+01	-.6943E+01	.3683E+01	.1752E+02	.1651E+02	.7788E+01	18
-.313	2.259	.8946E-00	.4942E-01	.1806E-01	.2897E-02	-.3960E+01	-.6943E+01	.3606E+01	.1752E+02	.1568E+02	.7707E+01	18
-.308	2.334	.9169E-00	.5555E-01	.2186E-01	.3347E-02	-.3642E+01	-.6943E+01	.3278E+01	.1752E+02	.1326E+02	.7337E+01	18
-.313	2.335	.9346E-00	.5719E-01	.2258E-01	.3518E-02	-.3493E+01	-.6943E+01	.3211E+01	.1752E+02	.1220E+02	.7264E+01	18
-.318	2.395	.9559E-00	.5934E-01	.2471E-01	.3742E-02	-.3236E+01	-.6943E+01	.2983E+01	.1752E+02	.1047E+02	.7001E+01	18
-.313	2.376	.1035E+01	.6328E-01	.2607E-01	.4380E-02	-.2655E+01	-.6943E+01	.2819E+01	.1752E+02	.7052E+01	.6793E+01	18
-.311	2.420	.1057E+01	.5361E-01	.2263E-01	.3798E-02	-.2455E+01	-.6943E+01	.2704E+01	.1752E+02	.6030E+01	.6682E+01	18
-.318	2.442	.1077E+01	.5181E-01	.2221E-01	.3761E-02	-.2290E+01	-.6943E+01	.2623E+01	.1752E+02	.5244E+01	.6580E+01	18
-.323	2.554	.1097E+01	.4379E-01	.2032E-01	.3250E-02	-.2064E+01	-.6943E+01	.2391E+01	.1752E+02	.4260E+01	.6300E+01	18
-.301	2.573	.1112E+01	.4363E-01	.2054E-01	.3300E-02	-.1951E+01	-.6943E+01	.2335E+01	.1752E+02	.3806E+01	.6218E+01	18
-.298	2.582	.1126E+01	.4280E-01	.2028E-01	.3293E-02	-.1855E+01	-.6943E+01	.2301E+01	.1752E+02	.3441E+01	.6166E+01	18
-.311	2.596	.1144E+01	.4054E-01	.1935E-01	.3186E-02	-.1739E+01	-.6943E+01	.2262E+01	.1752E+02	.3024E+01	.6108E+01	18

PROCESS A 39.200 K OHMS SCREENED 125 DEGREE CENTIGRADE 2.5 X RATED POWER

SER NO	C/0 0	1	24	48	96	250	500	1000	1500	2000	2500	3000	3500	4000
33421	0.000	.797	.820	.815	.827	.822	.825	.837	.850	.845	.845	.873	.878	.868
33422	0.000	.770	.798	.795	.810	.818	.826	.856	.877	.882	.884	.912	.925	.923
33423	0.000	.781	.807	.804	.817	.817	.820	.832	.843	.840	.837	.866	.873	.868
33424	0.000	.145	.186	.186	.201	.199	.204	.224	.240	.237	.250	.283	.291	.283
33425	0.000	.496	.524	.521	.534	.534	.536	.552	.562	.559	.557	.587	.593	.585
33426	0.000	.012	.060	.058	.109	.106	.137	.160	.185	.191	.236	.267	.277	.275
33427	0.000	.082	.092	.092	.100	.105	.117	.133	.148	.151	.166	.194	.199	.194
33428	0.000	-.279	-.258	-.263	-.258	-.263	-.268	-.263	-.261	-.268	-.273	-.251	-.248	-.261
33429	0.000	.331	.338	.346	.392	.415	.407	.736	.759	.767	.772	.810	.818	.810
33430	0.000	.709	.786	.791	.811	.832	.857	.908	.941	.962	.972	1.002	1.020	1.020
33431	0.000	.817	.866	.866	.866	.883	.901	.924	.929	.929	.927	.952	.960	.965
33432	0.000	.668	.727	.729	.750	.757	.770	.806	.821	.826	.829	.859	.867	.859
33433	0.000	.366	.389	.389	.402	.399	.397	.407	.409	.404	.399	.425	.430	.417
33434	0.000	.587	.610	.610	.618	.618	.615	.613	.610	.608	.595	.618	.621	.605
33435	0.000	.441	.482	.480	.490	.487	.492	.508	.515	.515	.520	.548	.566	.566
33436	0.000	.736	.759	.759	.770	.770	.772	.782	.787	.790	.787	.813	.816	.808
33437	0.000	.458	.478	.473	.483	.481	.481	.493	.499	.499	.499	.524	.532	.524
33438	0.000	.825	.850	.848	.863	.866	.868	.886	.896	.894	.888	.914	.919	.909
33439	0.000	.121	.141	.139	.149	.144	.139	.144	.146	.141	.139	.164	.167	.154
33440	0.000	.396	.422	.419	.429	.422	.419	.422	.422	.419	.417	.445	.455	.447
N	0	20	20	20	20	20	20	20	20	20	20	20	20	20
SX	2.407	9.267	9.884	9.864	10.170	10.219	10.323	10.969	11.188	11.198	11.254	11.816	11.966	11.828
SXX	.002	6.201	6.847	6.833	7.115	7.206	7.337	8.113	8.386	8.433	8.460	9.118	9.316	9.178
AVG	.216	.463	.494	.493	.508	.510	.516	.548	.559	.559	.562	.590	.598	.591
SEE	20.000	.316	.321	.321	.319	.323	.325	.332	.334	.337	.334	.335	.336	.338

PROCESS A 39.200 K OHMS SCREENED 125 DEGREE CENTIGRADE 2.5 X RATED POWER

LOCATION	SHAPE	SCALE	VE	VB	VA	SX	SY	SXX	SYY	SXSX	SXY	P
-.279	2.192	.6952E-00	.4488E-01	.1536E-01	.2072E-02	-.6151E+01	-.6943E+01	.5024E+01	.1752E+02	.3784E+02	.8777E+01	18
-.258	2.218	.7119E-00	.4509E-01	.1580E-01	.2126E-02	-.5887E+01	-.6943E+01	.4778E+01	.1752E+02	.3465E+02	.8599E+01	18
-.263	2.230	.7191E-00	.4642E-01	.1648E-01	.2210E-02	-.5772E+01	-.6943E+01	.4666E+01	.1752E+02	.3331E+02	.8508E+01	18
-.258	2.314	.7326E-00	.5211E-01	.2006E-01	.2530E-02	-.5419E+01	-.6943E+01	.4228E+01	.1752E+02	.2936E+02	.8101E+01	18
-.263	2.315	.7482E-00	.5587E-01	.2164E-01	.2769E-02	-.5252E+01	-.6943E+01	.4114E+01	.1752E+02	.2759E+02	.8004E+01	18
-.268	2.387	.7607E-00	.5338E-01	.2190E-01	.2683E-02	-.4970E+01	-.6943E+01	.3809E+01	.1752E+02	.2470E+02	.7735E+01	18
-.263	2.375	.8310E-00	.5621E-01	.2292E-01	.3070E-02	-.4324E+01	-.6943E+01	.3491E+01	.1752E+02	.1870E+02	.7493E+01	18
-.261	2.419	.8457E-00	.5057E-01	.2124E-01	.2804E-02	-.4116E+01	-.6943E+01	.3322E+01	.1752E+02	.1694E+02	.7348E+01	18
-.268	2.444	.8613E-00	.4921E-01	.2106E-01	.2776E-02	-.3938E+01	-.6943E+01	.3198E+01	.1752E+02	.1551E+02	.7231E+01	18
-.273	2.562	.8692E-00	.4151E-01	.1933E-01	.2357E-02	-.3693E+01	-.6943E+01	.2904E+01	.1752E+02	.1363E+02	.6927E+01	18
-.251	2.582	.8812E-00	.4156E-01	.1965E-01	.2393E-02	-.3569E+01	-.6943E+01	.2822E+01	.1752E+02	.1274E+02	.6837E+01	18
-.248	2.592	.8928E-00	.4082E-01	.1943E-01	.2382E-02	-.3465E+01	-.6943E+01	.2767E+01	.1752E+02	.1200E+02	.6781E+01	18
-.261	2.606	.9069E-00	.3857E-01	.1850E-01	.2286E-02	-.3338E+01	-.6943E+01	.2703E+01	.1752E+02	.1114E+02	.6718E+01	18

PROCESS A 39.200 K OHMS SCREENED 125 DEGREE CENTIGRADE 2.5 X RATED POWER

SER NO	C/1 0	1	24	48	96	250	500	1000	1500	2000	2500	3000	3500	4000
33421	0.000	0.000	.022	.017	.030	.025	.028	.040	.053	.048	.048	.076	.081	.071
33422	0.000	0.000	.028	.025	.040	.048	.056	.086	.107	.112	.114	.142	.155	.153
33423	0.000	0.000	.025	.022	.035	.035	.038	.051	.061	.058	.056	.084	.091	.086
33424	0.000	0.000	.040	.040	.056	.053	.058	.079	.094	.091	.104	.137	.145	.137
33425	0.000	0.000	.028	.025	.038	.038	.040	.056	.066	.063	.061	.091	.096	.089
33426	0.000	0.000	.048	.045	.096	.094	.124	.147	.173	.178	.224	.255	.265	.262
33427	0.000	0.000	.010	.010	.017	.022	.035	.051	.066	.068	.084	.112	.117	.112
33428	0.000	0.000	.020	.015	.020	.015	.010	.015	.017	.010	.005	.028	.030	.017
33429	0.000	0.000	.007	.015	.061	.084	.076	.405	.428	.436	.441	.479	.487	.479
33430	0.000	0.000	.076	.081	.102	.122	.147	.198	.232	.252	.262	.293	.311	.311
33431	0.000	0.000	.048	.048	.048	.066	.084	.107	.112	.112	.109	.135	.142	.147
33432	0.000	0.000	.058	.061	.081	.089	.102	.137	.153	.158	.160	.191	.198	.191
33433	0.000	0.000	.022	.022	.035	.033	.030	.040	.043	.038	.033	.058	.063	.051
33434	0.000	0.000	.022	.022	.030	.030	.028	.025	.022	.020	.007	.030	.033	.017
33435	0.000	0.000	.040	.038	.048	.045	.051	.066	.073	.073	.079	.107	.125	.125
33436	0.000	0.000	.022	.022	.033	.033	.035	.045	.051	.053	.051	.076	.079	.071
33437	0.000	0.000	.020	.015	.025	.022	.022	.035	.040	.040	.040	.066	.073	.066
33438	0.000	0.000	.025	.022	.038	.040	.043	.061	.071	.068	.063	.089	.094	.084
33439	0.000	0.000	.020	.017	.028	.022	.017	.022	.025	.020	.017	.043	.045	.033
33440	0.000	0.000	.025	.022	.033	.025	.022	.025	.025	.022	.020	.048	.058	.051
N	0	0	20	20	20	20	20	20	20	20	20	20	20	20
SX	2.407	2.192	.617	.596	.903	.951	1.056	1.701	1.920	1.931	1.987	2.548	2.698	2.561
SXX	.002	.695	.024	.023	.051	.061	.081	.295	.358	.376	.409	.548	.596	.569
AVG	.216	.211	.030	.029	.045	.047	.052	.085	.096	.096	.099	.127	.134	.128
SEE	20.000	20.000	.016	.017	.023	.029	.036	.089	.095	.100	.105	.108	.110	.112

PROCESS A 39.200 K OHMS SCREENED 125 DEGREE CENTIGRADE 2.5 X RATED POWER

LOCATION	SHAPE	SCALE	VE	VB	VA	SX	SY	SXX	SYY	SXSX	SXY	P
.007	1.275	.9051E-02	.1494E-00	.2001E-01	.2678E-04	-.7181E+02	-.6943E+01	.2940E+03	.1752E+02	.5158E+04	.3723E+02	18
.010	1.264	.6698E-02	.6888E-01	.8095E-02	.6774E-05	-.7674E+02	-.6943E+01	.3356E+03	.1752E+02	.5889E+04	.4036E+02	18
.017	1.134	.1697E-01	.5131E-01	.4743E-02	.2196E-04	-.7078E+02	-.6943E+01	.2891E+03	.1752E+02	.5010E+04	.3957E+02	18
.015	1.161	.1790E-01	.4014E-01	.3835E-02	.1842E-04	-.6830E+02	-.6943E+01	.2696E+03	.1752E+02	.4664E+04	.3850E+02	18
.010	1.264	.1820E-01	.1973E-01	.2176E-02	.9070E-05	-.6251E+02	-.6943E+01	.2262E+03	.1752E+02	.3908E+04	.3557E+02	18
.015	1.028	.5269E-01	.1714E-01	.1246E-02	.3893E-04	-.5827E+02	-.6943E+01	.2023E+03	.1752E+02	.3395E+04	.3661E+02	18
.017	.882	.9020E-01	.2745E-01	.1488E-02	.1336E-03	-.5695E+02	-.6943E+01	.1986E+03	.1752E+02	.3243E+04	.3823E+02	18
.010	1.011	.7249E-01	.2352E-01	.1669E-02	.8449E-04	-.5355E+02	-.6943E+01	.1734E+03	.1752E+02	.2867E+04	.3491E+02	18
.005	.817	.1325E-00	.5452E-01	.2627E-02	.4534E-03	-.5297E+02	-.6943E+01	.1766E+03	.1752E+02	.2806E+04	.3739E+02	18
.028	.824	.1389E-00	.6944E-01	.3470E-02	.6232E-03	-.5151E+02	-.6943E+01	.1674E+03	.1752E+02	.2653E+04	.3636E+02	18
.030	.818	.1493E-00	.8165E-01	.4093E-02	.8133E-03	-.5026E+02	-.6943E+01	.1603E+03	.1752E+02	.2526E+04	.3572E+02	18
.017	1.083	.8473E-01	.1725E-01	.1864E-02	.9309E-04	-.4304E+02	-.4692E+01	.1182E+03	.1246E+02	.1852E+04	.2191E+02	17

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                    4 PROCESS A 39.200 K OHMS   SCREENED  125 DEGREE CENTIGRADE  2.5 X RATED POWER
0.00ADL PCT  24      48      96     250     500    1000    1500    2000    2500    3000    3500    4000

2205.31   -.113 .3456E+02 .4328E-00 .8969E-01 .4409E+04 .2528E+02-.1704E+02 .1646E+03 .7439E+02 .6391E+03-.1082E+03   4
   .005    0.00    0.00    0.00    0.00    0.00    0.00     .29     .12    1.43    2.07    2.72     .47
   .005  100.00  100.00  100.00  100.00  100.00  100.00  100.00  100.00   98.49   98.65   98.72   98.77
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PROCESS A 39.200 K OHMS SCREENED 150 DEGREE CENTIGRADE 10.0 X RATED POWER

SER NO	RES	0	1	24	48	96	250	500	1000	1500	2000	2500	3000	3500	4000
33461	39.223	39.582	39.839	39.904	40.035	40.260	40.496	41.013	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999
33462	39.235	39.655	40.172	40.362	40.640	40.853	41.096	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999
33463	39.227	39.598	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999
33464	39.194	39.223	39.757	39.843	39.729	40.083	40.353	40.891	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999
33465	39.223	39.597	40.083	40.204	40.391	40.711	41.025	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999
33466	39.215	39.503	40.079	40.161	40.265	40.528	40.839	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999
33467	39.208	39.262	39.576	39.617	39.760	39.938	40.204	41.013	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999
33468	39.207	39.334	39.525	39.642	39.831	40.131	40.446	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999
33469	39.217	39.520	39.811	39.908	40.089	40.412	41.040	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999
33470	39.213	39.494	39.899	40.016	40.227	40.573	41.014	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999
33471	39.207	39.389	39.705	39.797	39.982	40.332	41.094	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999
33472	39.219	41.138	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999
33473	39.211	39.447	39.735	39.826	39.986	40.225	40.487	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999
33474	39.208	39.431	40.135	40.332	40.698	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999
33475	39.203	39.348	39.618	39.674	39.791	39.978	40.165	40.413	40.636	40.871	-99.999	-99.999	-99.999	-99.999	-99.999
33476	39.230	39.643	40.018	40.165	40.400	40.760	41.093	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999
33477	39.205	39.356	39.713	39.837	40.089	40.496	40.974	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999
33478	39.194	39.166	39.347	39.415	39.564	39.828	40.185	40.978	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999
33479	39.214	39.446	39.880	39.993	40.254	40.612	40.957	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999
33480	39.219	39.554	39.913	39.999	40.138	40.353	40.562	40.835	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999
N		20	20	18	18	18	17	17	6	1	1	0	0	0	0
SX		784	790	716	718	721	686	692	245	40	40	0	0	0	0
SXX		30754	31262	28545	28696	28951	27689	28172	10016	1651	1670	0	0	0	0
AVG		39.214	39.534	39.822	39.927	40.103	40.357	40.707	40.857	40.636	40.871	0.000	0.000	0.000	0.000
SEE		.012	.401	.224	.254	.309	.300	.356	.228	0.000	0.000	0.000	0.000	0.000	0.000

PROCESS A 39.200 K OHMS SCREENED 150 DEGREE CENTIGRADE 10.0 X RATED POWER

LOCATION	SHAPE	SCALE	VE	VB	VA	SX	SY	SXX	SYY	SXSX	SXY	P
39.194	.740	.6799E-01	.3105E-00	.1837E-01	.1544E-02	-.7475E+02	-.6943E+01	.3273E+03	.1752E+02	.5588E+04	.4134E+02	18
39.166	1.557	.1854E-00	.6748E-01	.1200E-01	.8589E-03	-.2392E+02	-.6943E+01	.3743E+02	.1752E+02	.5725E+03	.1798E+02	18
39.347	2.102	.2660E-00	.1494E-01	.5370E-02	.3131E-03	-.1290E+02	-.5938E+01	.1318E+02	.1474E+02	.1664E+03	.1063E+02	16
39.415	2.024	.3207E-00	.2044E-01	.6864E-02	.5234E-03	-.1191E+02	-.5938E+01	.1185E+02	.1474E+02	.1420E+03	.1045E+02	16
39.564	1.634	.4254E-00	.2209E-01	.4842E-02	.7431E-03	-.1199E+02	-.5938E+01	.1356E+02	.1474E+02	.1439E+03	.1190E+02	16
39.828	1.377	.4870E-00	.4151E-01	.7297E-02	.1725E-02	-.1178E+02	-.5442E+01	.1495E+02	.1338E+02	.1389E+03	.1211E+02	15
40.165	.693	.7284E-00	.1341E-00	.6868E-02	.8243E-02	-.1469E+02	-.5442E+01	.3392E+02	.1338E+02	.2159E+03	.1888E+02	15
40.413	3.908	.8431E-01	.8808E-02	.1144E-00	.3816E-03	-.2682E+01	-.5919E-00	.1876E+01	.1298E+01	.7196E+01	.6977E-00	4

PROCESS A 39.200 K OHMS SCREENED 150 DEGREE CENTIGRADE 10.0 X RATED POWER

SER NO	D/N	0	1	24	48	96	250	500	1000	1500	2000	2500	3000	3500	4000
33461		.060	.974	1.630	1.795	2.130	2.704	3.306	4.624	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999
33462		.089	1.160	2.479	2.964	3.673	4.216	4.836	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999
33463		.068	1.015	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999
33464		-.014	.058	1.420	1.640	1.349	2.252	2.941	4.313	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999
33465		.058	1.012	2.252	2.561	3.038	3.854	4.655	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999
33466		.038	.772	2.242	2.451	2.716	3.387	4.181	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999
33467		.021	.158	.959	1.063	1.428	1.882	2.561	4.624	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999
33468		.018	.341	.829	1.127	1.609	2.374	3.178	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999
33469		.043	.816	1.558	1.806	2.267	3.091	4.693	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999
33470		.033	.749	1.783	2.081	2.619	3.502	4.627	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999
33471		.018	.482	1.288	1.522	1.994	2.887	4.831	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999
33472		.048	4.943	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999
33473		.028	.630	1.364	1.596	2.005	2.614	3.283	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999
33474		.020	.589	2.385	2.887	3.821	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999
33475		.008	.377	1.066	1.209	1.507	1.984	2.461	3.094	3.663	4.262	-99.999	-99.999	-99.999	-99.999
33476		.078	1.130	2.086	2.461	3.061	3.979	4.829	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999
33477		.014	.397	1.308	1.624	2.267	3.306	4.525	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999
33478		-.013	-.086	.374	.548	.928	1.602	2.512	4.535	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999
33479		.035	.627	1.734	2.022	2.688	3.602	4.482	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999
33480		.049	.903	1.818	2.038	2.392	2.941	3.474	4.170	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999
N		20	20	18	18	18	17	17	6	1	1	0	0	0	0
SX		.714	17.056	28.584	33.405	41.502	50.186	65.382	25.364	3.663	4.262	0.000	0.000	0.000	0.000
SXX		.040	34.538	51.016	69.190	106.312	157.590	264.702	108.934	13.419	18.171	0.000	0.000	0.000	0.000
AVG		.035	.852	1.588	1.855	2.305	2.952	3.846	4.227	3.663	4.262	0.000	0.000	0.000	0.000
SEE		.027	1.025	.575	.650	.790	.767	.909	.584	0.000	0.000	0.000	0.000	0.000	0.000

2 PROCESS A 39.200 K OHMS SCREENED 150 DEGREE CENTIGRADE 10.0 X RATED POWER

LOCATION	SHAPE	SCALE	VE	VB	VA	SX	SY	SXX	SYY	SXSX	SXY	P
-.014	.740	.1359E-00	.3105E-00	.1837E-01	.3835E-02	-.5789E+02	-.6943E+01	.2031E+03	.1752E+02	.3352E+04	.3484E+02	18
-.086	1.557	.7975E-00	.6748E-01	.1200E-01	.3563E-02	-.7071E+01	-.6943E+01	.8398E+01	.1752E+02	.5001E+02	.1148E+02	18
.374	2.102	.1905E+01	.1494E-01	.5370E-02	.3721E-02	.2082E+01	-.5938E+01	.3053E+01	.1474E+02	.4335E+01	.5077E+01	16
.548	2.024	.2136E+01	.2044E-01	.6864E-02	.6983E-02	.3065E+01	-.5938E+01	.3566E+01	.1474E+02	.9397E+01	.4893E+01	16
.928	1.634	.1965E+01	.2209E-01	.4843E-02	.5988E-02	.2984E+01	-.5938E+01	.5118E+01	.1474E+02	.8905E+01	.6348E+01	16
1.602	1.377	.1768E+01	.4151E-01	.7297E-02	.9176E-02	.2259E+01	-.5442E+01	.6028E+01	.1338E+02	.5104E+01	.7014E+01	15
2.461	.693	.1394E+01	.1341E-00	.6868E-02	.1742E-01	-.6482E-00	-.5442E+01	.1955E+02	.1338E+02	.4202E-00	.1378E+02	15
3.094	3.908	.3277E+01	.8808E-02	.1144E-00	.1105E-00	.1063E+01	-.5919E-00	.3596E-00	.1298E+01	.1130E+01	.1433E-00	4

PROCESS A 39.200 K OHMS SCREENED 150 DEGREE CENTIGRADE 10.0 X RATED POWER

SER NO	C/0 0	1	24	48	96	250	500	1000	1500	2000	2500	3000	3500	4000
33461	0.000	.913	1.569	1.734	2.069	2.643	3.245	4.564	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999
33462	0.000	1.070	2.389	2.874	3.583	4.126	4.746	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999
33463	0.000	.946	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999
33464	0.000	.073	1.435	1.655	1.364	2.267	2.956	4.328	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999
33465	0.000	.953	2.193	2.502	2.979	3.795	4.596	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999
33466	0.000	.733	2.203	2.412	2.677	3.348	4.142	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999
33467	0.000	.136	.937	1.041	1.406	1.860	2.539	4.603	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999
33468	0.000	.322	.810	1.108	1.590	2.356	3.159	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999
33469	0.000	.772	1.514	1.762	2.223	3.047	4.649	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999
33470	0.000	.716	1.749	2.047	2.585	3.468	4.593	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999
33471	0.000	.463	1.269	1.503	1.975	2.868	4.812	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999
33472	0.000	4.894	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999
33473	0.000	.601	1.335	1.567	1.976	2.585	3.254	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999
33474	0.000	.568	2.364	2.866	3.800	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999
33475	0.000	.368	1.057	1.200	1.498	1.975	2.452	3.085	3.654	4.253	-99.999	-99.999	-99.999	-99.999
33476	0.000	1.051	2.007	2.382	2.982	3.900	4.750	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999
33477	0.000	.382	1.293	1.610	2.252	3.291	4.510	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999
33478	0.000	-.072	.388	.562	.942	1.616	2.526	4.549	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999
33479	0.000	.591	1.698	1.986	2.652	3.566	4.446	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999
33480	0.000	.853	1.768	1.988	2.342	2.891	3.424	4.120	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999
N	20	20	18	18	18	17	17	6	1	1	0	0	0	0
SX	.714	16.341	27.987	32.808	40.905	49.610	64.806	25.251	3.654	4.253	0.000	0.000	0.000	0.000
SXX	.040	32.890	48.762	66.571	103.054	153.665	259.795	107.957	13.353	18.094	0.000	0.000	0.000	0.000
AVG	.035	.817	1.554	1.822	2.272	2.918	3.812	4.208	3.654	4.253	0.000	0.000	0.000	0.000
SEE	.027	1.014	.555	.631	.770	.745	.892	.579	0.000	0.000	0.000	0.000	0.000	0.000

3 PROCESS A 39.200 K OHMS SCREENED 150 DEGREE CENTIGRADE 10.0 X RATED POWER

LOCATION	SHAPE	SCALE	VE	VB	VA	SX	SY	SXX	SYY	SXSX	SXY	P
-.072	1.567	.7134E-00	.6903E-01	.1246E-01	.3303E-02	-.8306E+01	-.6943E+01	.9370E+01	.1752E+02	.6900E+02	.1188E+02	18
.388	2.062	.1741E+01	.1619E-01	.5610E-02	.3207E-02	.1426E+01	-.5938E+01	.3014E+01	.1474E+02	.2033E+01	.5425E+01	16
.562	1.988	.1964E+01	.2050E-01	.6639E-02	.5544E-02	.2446E+01	-.5938E+01	.3461E+01	.1474E+02	.5987E+01	.5232E+01	16
.942	1.629	.1844E+01	.2414E-01	.5276E-02	.5529E-02	.2368E+01	-.5938E+01	.4926E+01	.1474E+02	.5607E+01	.6578E+01	16
1.616	1.329	.1659E+01	.4759E-01	.7864E-02	.8986E-02	.1618E+01	-.5442E+01	.6227E+01	.1338E+02	.2618E+01	.7459E+01	15
2.452	.725	.1392E+01	.1337E-00	.7483E-02	.1731E-01	-.6579E-00	-.5442E+01	.1789E+02	.1338E+02	.4329E-00	.1320E+02	15
3.085	3.609	.2924E+01	.2801E-01	.3322E-00	.2466E-00	.1025E+01	-.5919E-00	.3470E-00	.1298E+01	.1051E+01	.1526E-00	4

PROCESS A 39.200 K OHMS SCREENED 150 DEGREE CENTIGRADE 10.0 X RATED POWER

SER NO	C/1	0	1	24	48	96	250	500	1000	1500	2000	2500	3000	3500	4000
33461		0.000	0.000	.655	.821	1.155	1.729	2.331	3.650	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999
33462		0.000	0.000	1.318	1.803	2.512	3.056	3.676	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999
33463		0.000	0.000	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999
33464		0.000	0.000	1.362	1.581	1.290	2.193	2.882	4.255	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999
33465		0.000	0.000	1.239	1.548	2.025	2.841	3.642	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999
33466		0.000	0.000	1.469	1.678	1.943	2.614	3.408	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999
33467		0.000	0.000	.801	.905	1.270	1.724	2.403	4.466	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999
33468		0.000	0.000	.487	.785	1.267	2.033	2.836	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999
33469		0.000	0.000	.742	.989	1.451	2.275	3.877	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999
33470		0.000	0.000	1.033	1.331	1.869	2.752	3.877	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999
33471		0.000	0.000	.806	1.040	1.512	2.405	4.349	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999
33472		0.000	0.000	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999
33473		0.000	0.000	.734	.966	1.375	1.984	2.653	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999
33474		0.000	0.000	1.795	2.298	3.232	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999
33475		0.000	0.000	.688	.831	1.130	1.607	2.084	2.716	3.285	3.885	-99.999	-99.999	-99.999	-99.999
33476		0.000	0.000	.956	1.331	1.931	2.849	3.698	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999
33477		0.000	0.000	.910	1.227	1.869	2.908	4.127	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999
33478		0.000	0.000	.461	.635	1.015	1.688	2.599	4.622	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999
33479		0.000	0.000	1.107	1.395	2.061	2.974	3.854	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999
33480		0.000	0.000	.915	1.135	1.489	2.038	2.571	3.267	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999
N		20	0	18	18	18	17	17	6	1	1	0	0	0	0
SX		.714	1.567	17.487	22.308	30.405	39.678	54.874	22.979	3.285	3.885	0.000	0.000	0.000	0.000
SXX		.040	.713	19.130	30.745	56.649	96.659	185.285	90.811	10.795	15.094	0.000	0.000	0.000	0.000
AVG		.035	.262	.971	1.239	1.689	2.334	3.227	3.829	3.285	3.885	0.000	0.000	0.000	0.000
SEE		.027	20.000	.354	.426	.557	.503	.713	.748	0.000	0.000	0.000	0.000	0.000	0.000

4 PROCESS A 39.200 K OHMS SCREENED 150 DEGREE CENTIGRADE 10.0 X RATED POWER

LOCATION	SHAPE	SCALE	VE	VB	VA	SX	SY	SXX	SYY	SXSX	SXY	P
.461	.942	.5882E-00	.1345E-00	.1151E-01	.6553E-02	-.1530E+02	-.5938E+01	.2631E+02	.1474E+02	.2341E+03	.1669E+02	16
.635	1.384	.5258E-00	.1342E-01	.2088E-02	.5418E-03	-.1171E+02	-.5938E+01	.1500E+02	.1474E+02	.1372E+03	.1324E+02	16
1.015	1.179	.6222E-00	.2392E-01	.2737E-02	.1124E-02	-.1147E+02	-.5938E+01	.1696E+02	.1474E+02	.1316E+03	.1456E+02	16
1.607	.916	.8078E-00	.6042E-01	.4830E-02	.3875E-02	-.9430E+01	-.5442E+01	.1843E+02	.1338E+02	.8894E+02	.1488E+02	15
2.084	1.249	.1336E+01	.4795E-01	.6997E-02	.5754E-02	-.8723E-00	-.5442E+01	.6903E+01	.1338E+02	.7609E-00	.8876E+01	15
2.716	1.175	.1275E+01	.1511E-01	.1817E-01	.6349E-02	.3256E-00	-.5919E-00	.8585E-00	.1298E+01	.1060E-00	.9300E-00	4

4 PROCESS A 39.200 K OHMS SCREENED 150 DEGREE CENTIGRADE 10.0 X RATED POWER

0.00ADL	PCT	24	48	96	250	500	1000	1500	2000	2500	3000	3500	4000	
24.00	.578	.8586E+02	.2604E-00	.2842E-01	.5919E+04	.2569E+02	-.7398E+01	.1412E+03	.1531E+02	.6602E+03	-.3271E+02			5
.050	10.00	10.00	10.00	16.91	19.92	73.79	100.00	100.00	100.00	100.00	100.00	100.00		
.050	100.00	92.93	87.08	76.49	66.20	53.54	45.22	39.08	34.28	30.40	27.18	24.46		
24.00	.617	.9736E+02	.2256E-00	.2459E-01	.6589E+04	.2570E+02	-.7033E+01	.1412E+03	.1451E+02	.6606E+03	-.3049E+02			5
.045	10.15	10.00	10.00	18.20	23.94	76.38	100.00	100.00	100.00	100.00	100.00	100.00		
.045	100.00	92.96	86.61	74.74	63.06	48.77	39.58	32.97	27.93	23.96	20.76	18.12		
24.00	.672	.1157E+03	.1856E-00	.2021E-01	.7658E+04	.2571E+02	-.6459E+01	.1414E+03	.1342E+02	.6611E+03	-.2704E+02			5
.040	10.33	10.00	10.26	20.41	30.75	80.49	100.00	100.00	100.00	100.00	100.00	100.00		
.040	100.00	92.93	85.77	71.80	57.88	41.22	31.02	24.06	19.05	15.32	12.46	10.23		
24.00	.753	.1483E+03	.1506E-00	.1638E-01	.1020E+05	.2572E+02	-.5614E+01	.1415E+03	.1227E+02	.6617E+03	-.2196E+02			5
.035	10.70	10.00	10.81	24.21	41.77	86.66	100.00	100.00	100.00	100.00	100.00	100.00		
.035	100.00	92.87	84.43	67.00	49.56	29.95	19.27	12.85	8.79	6.12	4.33	3.10		
24.00	.871	.2087E+03	.1327E-00	.1445E-01	.1785E+05	.2574E+02	-.4270E+01	.1417E+03	.1128E+02	.6627E+03	-.1398E+02			5
.030	11.50	10.17	12.44	30.88	58.48	95.11	100.00	100.00	100.00	100.00	100.00	100.00		
.030	100.00	92.64	81.94	58.30	35.61	14.50	6.27	2.81	1.29	.60	.29	.14		
24.00	.860	.1543E+03	.5966E-01	.1099E-01	.6199E+04	.1889E+02	-.3900E+01	.9466E+02	.8058E+01	.3569E+03	-.1375E+02			4
.025	13.23	10.99	16.94	42.85	81.19	100.00	100.00	100.00	100.00	100.00	100.00	100.00		
.025	100.00	90.50	77.35	50.30	27.14	8.90	3.16	1.18	.45	.18	.07	.03		
24.00	.820	.8559E+02	.8527E-02	.3231E-02	.4502E+03	.1277E+02	-.2863E+01	.5705E+02	.4535E+01	.1632E+03	-.1002E+02			3
.020	17.01	14.83	28.57	65.24	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00		
.020	100.00	85.33	67.65	36.82	15.86	3.62	.94	.26	.08	.02	0.00	0.00		

PROCESS A 39.200 K OHMS UNSCREENED 125 DEGREE CENTIGRADE 1.0 X RATED POWER

SER NO	RES	0	1	24	48	96	250	500	1000	1500	2000	2500	3000	3500	4000
33361		39.194	39.249	39.249	39.249	39.252	39.250	39.250	39.252	39.250	39.252	39.249	39.253	39.253	39.249
33362		39.209	39.392	39.395	39.393	39.399	39.403	39.405	39.415	39.416	39.420	39.420	39.426	39.429	39.427
33363		39.227	39.564	39.568	39.567	39.575	39.583	39.589	39.603	39.610	39.619	39.624	39.632	39.635	39.636
33364		39.223	39.516	39.517	39.516	39.521	39.523	39.526	39.532	39.533	39.535	39.536	39.540	39.542	39.539
33365		39.192	39.222	39.224	39.221	39.226	39.226	39.226	39.230	39.228	39.229	39.227	39.233	39.234	39.231
33366		39.198	39.260	39.274	39.272	39.277	39.277	39.280	39.286	39.286	39.290	39.289	39.296	39.298	39.298
33367		39.200	39.257	39.256	39.253	39.257	39.253	39.251	39.254	39.256	39.257	39.254	39.258	39.258	39.254
33368		39.227	39.551	39.554	39.552	39.557	39.558	39.559	39.564	39.563	39.565	39.562	39.567	39.568	39.564
33369		39.217	39.449	39.438	39.433	39.435	39.435	39.436	39.441	39.438	39.442	39.436	39.444	39.446	39.444
33370		39.219	39.469	39.470	39.468	39.472	39.472	39.473	39.478	39.476	39.479	39.478	39.483	39.483	39.480
33371		39.227	39.554	39.562	39.560	39.566	39.568	39.570	39.576	39.577	39.584	39.583	39.588	39.590	39.590
33372		39.223	39.511	39.511	39.510	39.514	39.515	39.515	39.519	39.520	39.522	39.520	39.526	39.527	39.524
33373		39.219	39.473	39.473	39.470	39.474	39.472	39.472	39.477	39.476	39.477	39.474	39.479	39.479	39.475
33374		39.194	39.186	39.189	39.189	39.193	39.197	39.201	39.208	39.211	39.216	39.219	39.223	39.226	39.226
33375		39.228	39.564	39.564	39.561	39.565	39.562	39.562	39.565	39.562	39.565	39.561	39.565	39.565	39.561
33376		39.197	39.267	39.267	39.264	39.268	39.265	39.263	39.264	39.260	39.262	39.258	39.261	39.261	39.257
33377		39.227	39.549	39.550	39.549	39.553	39.552	39.556	39.562	39.562	39.565	39.565	39.570	39.570	39.567
33378		39.216	39.466	39.465	39.463	39.468	39.464	39.462	39.462	39.458	39.459	39.455	39.459	39.459	39.455
33379		39.215	39.407	39.416	39.413	39.418	39.418	39.419	39.426	39.424	39.427	39.426	39.432	39.432	39.432
33380		39.184	39.146	38.899	38.904	39.049	39.216	39.320	39.314	39.254	39.277	39.267	39.265	39.211	39.244
SX		784	788	787	787	788	788	788	786	788	788	788	788	788	788
SXX		30751	31051	31035	31032	31050	31064	31074	31081	31075	31082	31079	31086	31084	31083
AVG		39.212	39.402	39.392	39.390	39.401	39.410	39.416	39.421	39.418	39.422	39.420	39.425	39.423	39.422
SEE		.016	.141	.172	.171	.152	.136	.131	.132	.135	.135	.136	.137	.141	.139
N		20	20	20	20	20	20	20	20	20	20	20	20	20	20

PROCESS A 39.200 K OHMS UNSCREENED 125 DEGREE CENTIGRADE 1.0 X RATED POWER

SER NO	D/N	0	1	24	48	96	250	500	1000	1500	2000	2500	3000	3500	4000
33361		-.009	.124	.124	.122	.132	.127	.127	.132	.127	.132	.124	.135	.135	.124
33362		.021	.489	.497	.492	.507	.517	.525	.551	.551	.561	.561	.576	.584	.579
33363		.068	.928	.938	.936	.956	.977	.992	1.028	1.045	1.068	1.081	1.102	1.112	1.112
33364		.059	.806	.808	.806	.818	.823	.831	.846	.849	.854	.852	.867	.872	.864
33365		-.019	.056	.061	.053	.066	.066	.066	.076	.071	.073	.068	.084	.086	.079
33366		-.004	.153	.188	.183	.196	.196	.204	.219	.219	.229	.227	.244	.249	.249
33367		0.000	.145	.142	.135	.145	.135	.130	.137	.142	.145	.137	.147	.147	.137
33368		.068	.895	.903	.897	.910	.913	.915	.928	.926	.931	.923	.936	.938	.928
33369		.044	.635	.607	.594	.599	.599	.602	.614	.607	.617	.602	.622	.627	.622
33370		.048	.686	.688	.683	.693	.693	.696	.709	.704	.711	.709	.721	.721	.714
33371		.068	.903	.923	.918	.933	.938	.943	.959	.961	.979	.977	.989	.994	.994
33372		.058	.793	.793	.790	.801	.803	.803	.813	.816	.821	.816	.831	.834	.826
33373		.048	.696	.696	.688	.698	.693	.693	.706	.704	.706	.698	.711	.711	.701
33374		-.014	-.035	-.028	-.028	-.017	-.007	.002	.020	.028	.040	.048	.058	.066	.066
33375		.072	.928	.928	.920	.931	.923	.923	.931	.923	.931	.920	.931	.931	.920
33376		-.005	.170	.170	.163	.173	.165	.160	.163	.153	.158	.147	.155	.155	.145
33377		.068	.890	.892	.890	.900	.897	.908	.923	.923	.931	.931	.943	.943	.936
33378		.040	.678	.676	.670	.683	.673	.668	.668	.658	.660	.650	.660	.660	.650
33379		.038	.528	.551	.543	.556	.556	.558	.576	.571	.579	.576	.591	.591	.591
33380		-.039	-.137	-.767	-.755	-.385	.040	.306	.290	.137	.196	.170	.165	.020	.112
SX		.616	10.336	9.798	9.709	10.303	10.737	11.061	11.298	11.122	11.331	11.227	11.479	11.395	11.359
SXX		.044	7.068	8.523	8.392	8.230	8.113	8.291	8.603	8.526	8.744	8.653	8.969	9.012	8.884
AVG		.030	.516	.489	.485	.515	.536	.553	.564	.556	.566	.561	.573	.569	.567
SEE		.036	.364	.442	.440	.392	.351	.338	.341	.351	.349	.351	.353	.364	.357
N		20	20	20	20	20	20	20	20	20	20	20	20	20	20

PROCESS A 39.200 K OHMS UNSCREENED 125 DEGREE CENTIGRADE 1.0 X RATED POWER

SER NO	C/0	1	24	48	96	250	500	1000	1500	2000	2500	3000	3500	4000
33361		.134	.134	.132	.142	.137	.137	.142	.137	.142	.134	.145	.145	.134
33362		.467	.475	.470	.485	.495	.503	.529	.529	.539	.539	.554	.562	.557
33363		.859	.869	.867	.887	.908	.923	.959	.976	.999	1.012	1.033	1.043	1.043
33364		.746	.748	.746	.758	.763	.771	.786	.789	.794	.792	.807	.812	.804
33365		.076	.081	.073	.086	.086	.086	.096	.091	.093	.088	.104	.106	.099
33366		.158	.193	.188	.201	.201	.209	.224	.224	.234	.232	.249	.254	.254
33367		.145	.142	.135	.145	.135	.130	.137	.142	.145	.137	.147	.147	.137
33368		.826	.834	.828	.841	.844	.846	.859	.857	.862	.854	.867	.869	.859
33369		.590	.562	.549	.554	.554	.557	.569	.562	.572	.557	.577	.582	.577
33370		.637	.639	.634	.644	.644	.647	.660	.655	.662	.660	.672	.672	.665
33371		.834	.854	.849	.864	.869	.874	.890	.892	.910	.908	.920	.925	.925
33372		.734	.734	.731	.742	.744	.744	.754	.757	.762	.757	.772	.775	.767
33373		.647	.647	.639	.649	.644	.644	.657	.655	.657	.649	.662	.662	.652
33374		-.020	-.013	-.013	-.002	.007	.017	.035	.043	.055	.063	.073	.081	.081
33375		.855	.855	.847	.858	.850	.850	.858	.850	.858	.847	.858	.858	.847
33376		.176	.176	.169	.179	.171	.166	.169	.159	.164	.153	.161	.161	.151
33377		.821	.823	.821	.831	.828	.839	.854	.854	.862	.862	.874	.874	.867
33378		.637	.635	.629	.642	.632	.627	.627	.617	.619	.609	.619	.619	.609
33379		.489	.512	.504	.517	.517	.519	.537	.532	.540	.537	.552	.552	.552
33380		-.097	-.727	-.715	-.345	.080	.346	.330	.177	.236	.210	.205	.068	.152
SX		9.719	9.181	9.092	9.686	10.120	10.444	10.681	10.505	10.714	10.610	10.862	10.778	10.742
SXX		6.769	7.372	7.249	7.101	7.016	7.209	7.500	7.411	7.621	7.534	7.830	7.858	7.746
AVG		.485	.459	.454	.484	.506	.522	.534	.525	.535	.530	.543	.538	.537
SEE		.328	.407	.404	.356	.315	.303	.307	.315	.314	.316	.318	.328	.322
N		20	20	20	20	20	20	20	20	20	20	20	20	20

PROCESS A 39.200 K OHMS UNSCREENED 125 DEGREE CENTIGRADE 1.0 X RATED POWER

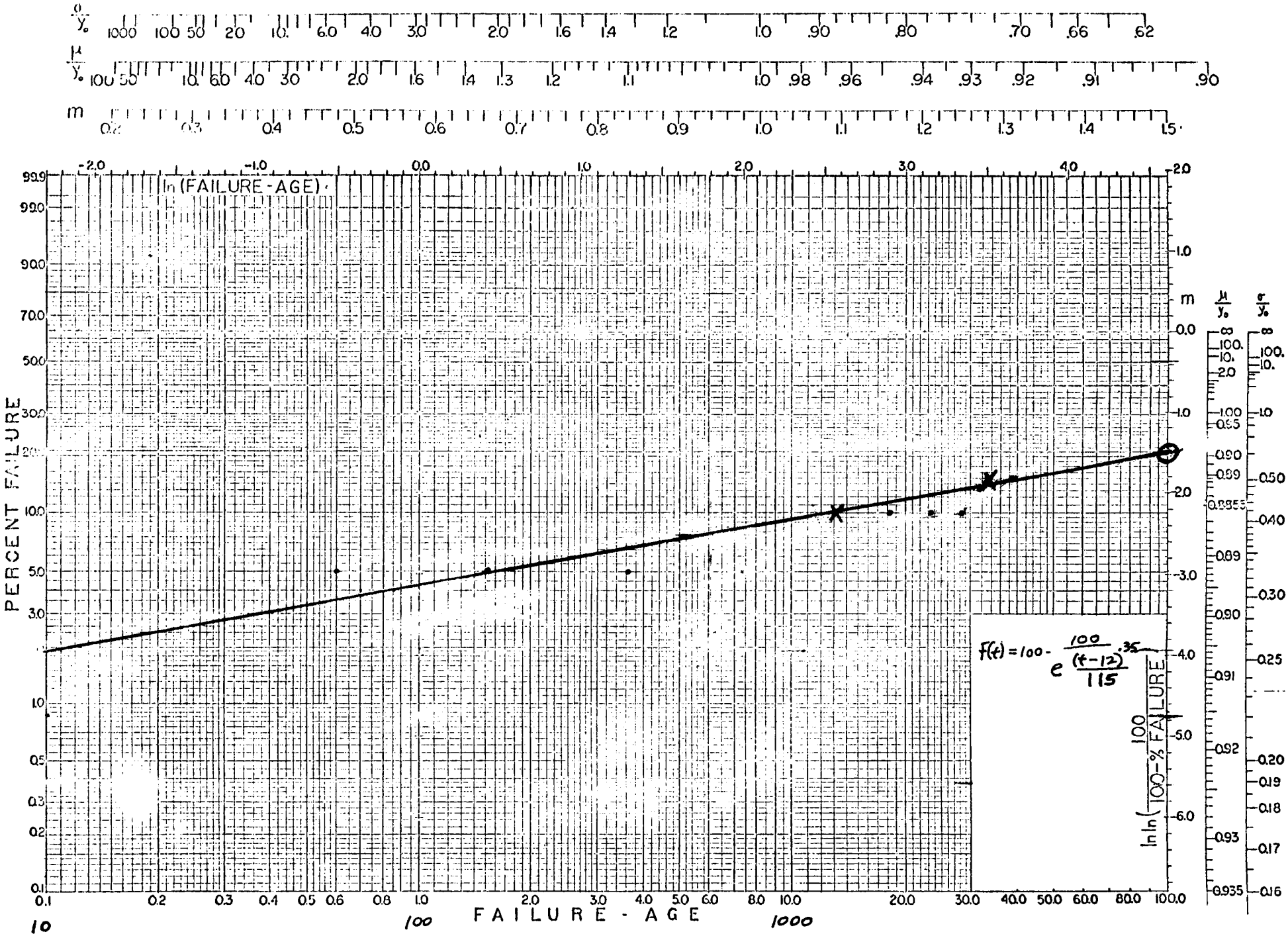
SER NO	C/1	24	48	96	250	500	1000	1500	2000	2500	3000	3500	4000
33361		0.000	-.002	.007	.002	.002	.007	.002	.007	0.000	.010	.010	0.000
33362		.007	.002	.017	.028	.035	.061	.061	.071	.071	.086	.094	.089
33363		.010	.007	.028	.048	.063	.099	.117	.140	.153	.173	.183	.183
33364		.002	0.000	.012	.017	.025	.040	.043	.048	.045	.061	.066	.058
33365		.005	-.002	.010	.010	.010	.020	.015	.017	.012	.028	.030	.022
33366		.035	.030	.043	.043	.051	.066	.066	.076	.073	.091	.096	.096
33367		-.002	-.010	0.000	-.010	-.015	-.007	-.002	0.000	-.007	.002	.002	-.007
33368		.007	.002	.015	.017	.020	.033	.030	.035	.028	.040	.043	.033
33369		-.028	-.040	-.035	-.035	-.033	-.020	-.028	-.017	-.033	-.012	-.007	-.012
33370		.002	-.002	.007	.007	.010	.022	.017	.025	.022	.035	.035	.028
33371		.020	.015	.030	.035	.040	.056	.058	.076	.073	.086	.091	.091
33372		0.000	-.002	.007	.010	.010	.020	.022	.028	.022	.038	.040	.033
33373		0.000	-.007	.002	-.002	-.002	.010	.007	.010	.002	.015	.015	.005
33374		.007	.007	.017	.028	.038	.056	.063	.076	.084	.094	.102	.102
33375		0.000	-.007	.002	-.005	-.005	.002	-.005	.002	-.007	.002	.002	-.007
33376		0.000	-.007	.002	-.005	-.010	-.007	-.017	-.012	-.022	-.015	-.015	-.025
33377		.002	0.000	.010	.007	.017	.033	.033	.040	.040	.053	.053	.045
33378		-.002	-.007	.005	-.005	-.010	-.010	-.020	-.017	-.028	-.017	-.017	-.028
33379		.022	.015	.028	.028	.030	.048	.043	.051	.048	.063	.063	.063
33380		-.630	-.617	-.247	.178	.443	.428	.275	.334	.308	.303	.165	.249
SX		-.538	-.627	-.033	.400	.724	.961	.785	.994	.890	1.142	1.058	1.022
SXX		.400	.384	.068	.042	.212	.216	.113	.164	.152	.171	.116	.147
AVG		-.026	-.031	-.001	.020	.036	.048	.039	.049	.044	.057	.052	.051
SEE		.142	.138	.059	.042	.098	.094	.066	.077	.077	.074	.056	.070
N		20	20	20	20	20	20	20	20	20	20	20	20

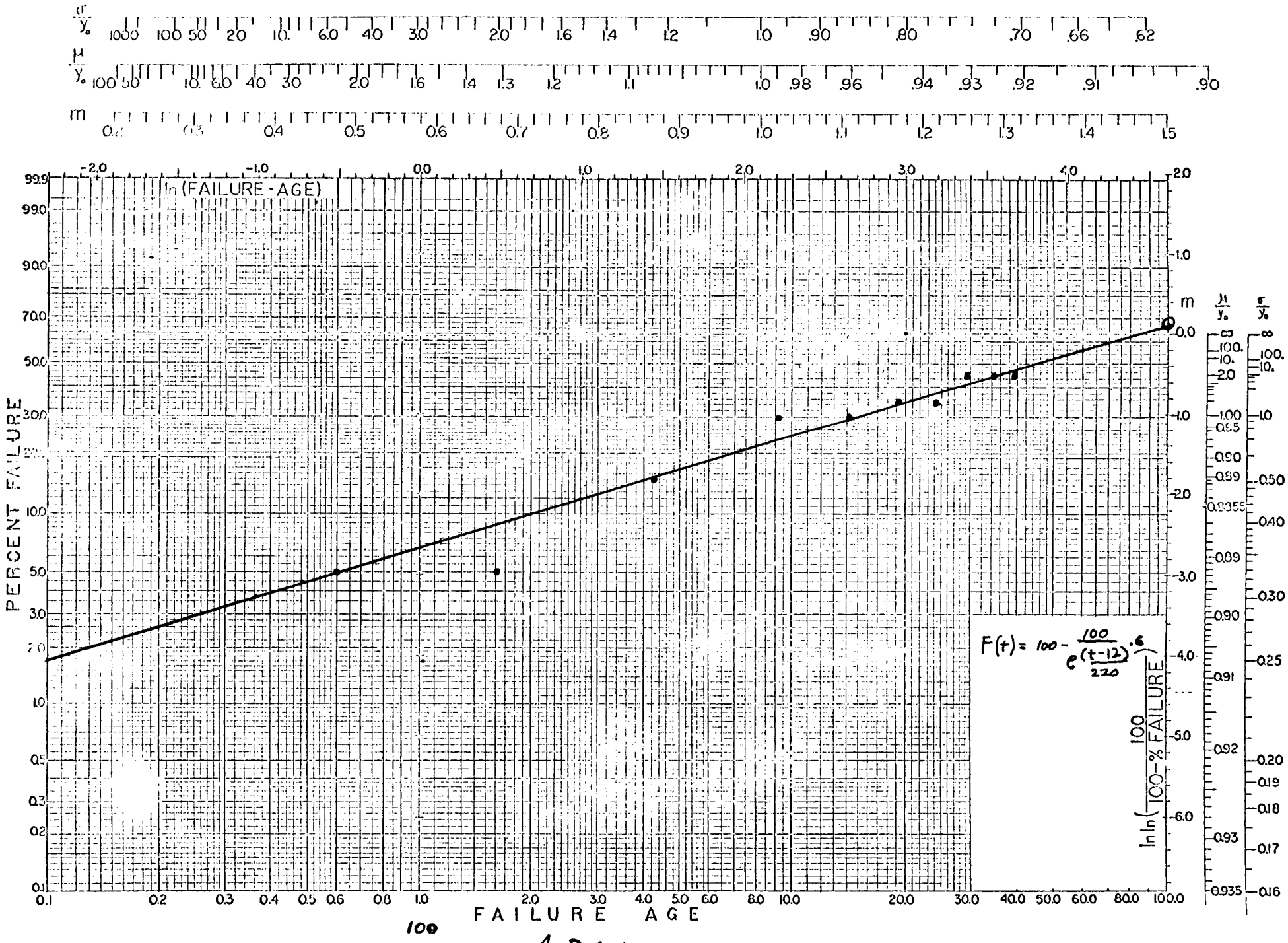
4 PROCESS A 39.200 K OHMS UNSCREENED 125 DEGREE CENTIGRADE 1.0 X RATED POWER

LOCATION	SHAPE	SCALE	VE	VB	VA	SX	SY	SXX	SYY	SXSX	SXY	P
-.630	48.978	.2786E-09	.1854E-00	.3863E+02	.6277E-18	-.8227E+01	-.6943E+01	.3765E+01	.1752E+02	.6768E+02	.3408E+01	18
-.617	41.285	.2819E-08	.1701E-00	.2460E+02	.4630E-16	-.8751E+01	-.6943E+01	.4261E+01	.1752E+02	.7658E+02	.3661E+01	18
-.247	13.961	.8282E-08	.1726E-00	.2866E+01	.3647E-15	-.2448E+02	-.6943E+01	.3337E+02	.1752E+02	.5997E+03	.1028E+02	18
-.035	2.555	.5982E-03	.2621E-01	.1190E-01	.4029E-07	-.5499E+02	-.6943E+01	.1702E+03	.1752E+02	.3024E+04	.2684E+02	18
-.033	1.905	.4090E-02	.8730E-02	.2157E-02	.3524E-06	-.5559E+02	-.6943E+01	.1757E+03	.1752E+02	.3091E+04	.2915E+02	18
-.020	1.281	.2502E-01	.2517E-01	.2872E-02	.1904E-04	-.5721E+02	-.6943E+01	.1906E+03	.1752E+02	.3273E+04	.3330E+02	18
-.028	1.176	.3940E-01	.3635E-01	.3547E-02	.5524E-04	-.5535E+02	-.6943E+01	.1804E+03	.1752E+02	.3064E+04	.3341E+02	18
-.017	.970	.6579E-01	.5010E-01	.4578E-02	.2016E-03	-.5248E+02	-.4692E+01	.1729E+03	.1246E+02	.2754E+04	.2511E+02	17
-.033	1.007	.7242E-01	.4812E-01	.3496E-02	.1776E-03	-.5376E+02	-.6943E+01	.1743E+03	.1752E+02	.2891E+04	.3461E+02	18
-.017	.806	.1196E-00	.7582E-01	.3658E-02	.5670E-03	-.5598E+02	-.6943E+01	.1948E+03	.1752E+02	.3134E+04	.3831E+02	18
-.017	.856	.1077E-00	.6749E-01	.3635E-02	.4361E-03	-.5489E+02	-.6943E+01	.1860E+03	.1752E+02	.3013E+04	.3708E+02	18
-.028	.854	.1148E-00	.7046E-01	.3785E-02	.4967E-03	-.5372E+02	-.6943E+01	.1789E+03	.1752E+02	.2886E+04	.3662E+02	18

4 PROCESS A 39.200 K OHMS UNSCREENED 125 DEGREE CENTIGRADE 1.0 X RATED POWER

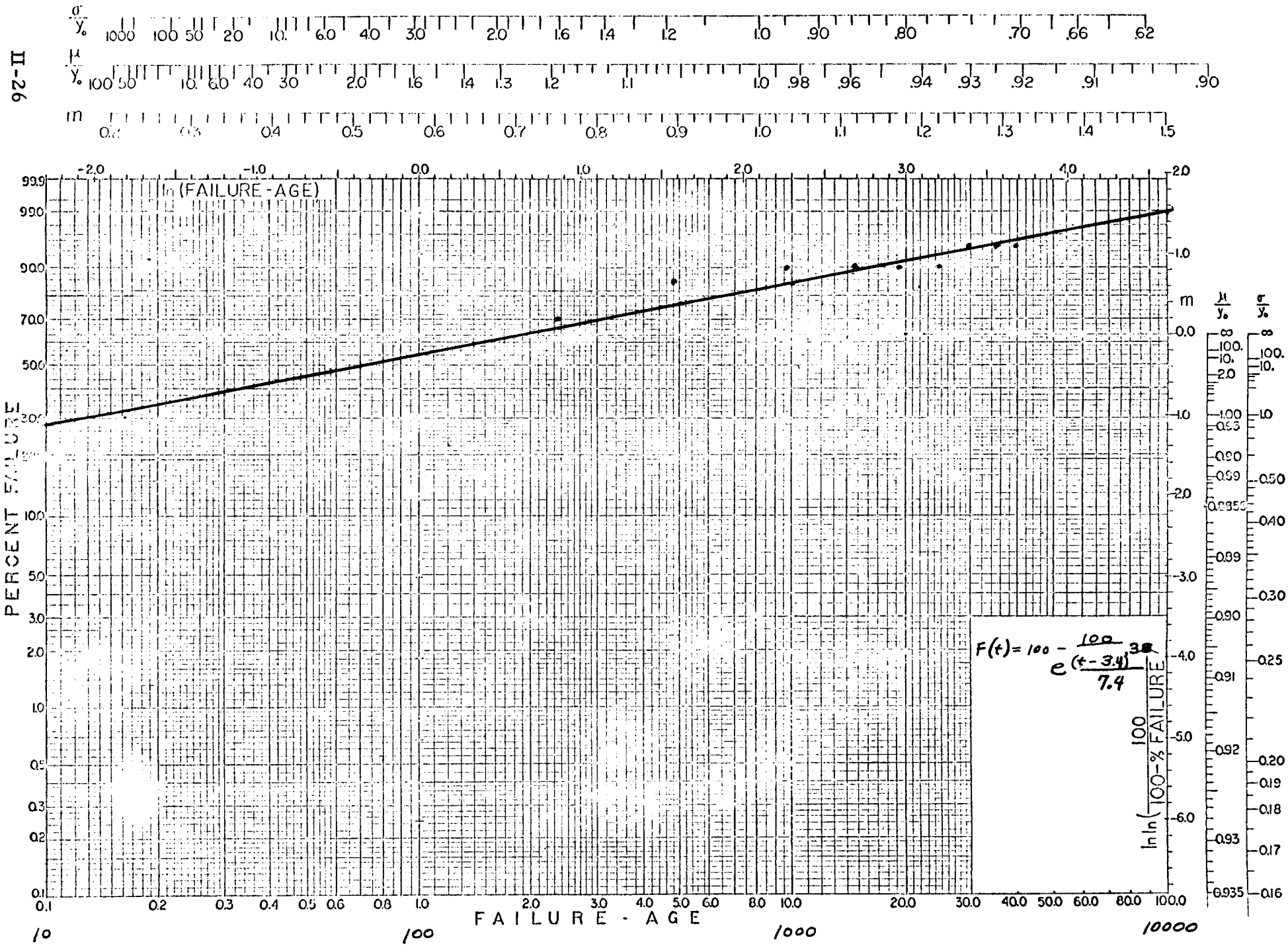
0.00ADL PCT 24 48 96 250 500 1000 1500 2000 2500 3000 3500 4000


σ/y₀
1000 100 50 20 10. 6.0 4.0 3.0 2.0 1.6 1.4 1.2 1.0 .90 .80 .70 .66 .62
μ/y₀
100 50 10. 6.0 4.0 3.0 2.0 1.6 1.4 1.3 1.2 1.1 1.0 .98 .96 .94 .93 .92 .91 .90
m
0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0 1.1 1.2 1.3 1.4 1.5
ln (FAILURE - AGE)
PERCENT FAILURE
FAILURE - AGE
ln ln (100 / 100 - % FAILURE)
F(t) = 100 - 100 / e^((t-12)/115)^.35
10
100
1000
ADL ±.100


σ/y₀
1000 100 50 20 10. 6.0 4.0 3.0 2.0 1.6 1.4 1.2 1.0 .90 .80 .70 .66 .62
μ/y₀
100 50 10. 6.0 4.0 3.0 2.0 1.6 1.4 1.3 1.2 1.1 1.0 .98 .96 .94 .93 .92 .91 .90
m
0.4 0.5 0.6 0.7 0.8 0.9 1.0 1.1 1.2 1.3 1.4 1.5
ln (FAILURE - AGE)
PERCENT FAILURE
FAILURE AGE
m
μ/y₀
σ/y₀
$F(t) = 100 - \frac{100}{e^{\left(\frac{t-12}{220}\right)^{.6}}}$
$\ln\ln\left(\frac{100}{100 - \%\ \text{FAILURE}}\right)$

100

ADL ± .050


σ/y₀
1000 100 50 20 10. 6.0 4.0 3.0 2.0 1.6 1.4 1.2 1.0 .90 .80 .70 .66 .62
μ/y₀
100 50 10. 6.0 4.0 3.0 2.0 1.6 1.4 1.3 1.2 1.1 1.0 .98 .96 .94 .93 .92 .91 .90
m
0.4 0.5 0.6 0.7 0.8 0.9 1.0 1.1 1.2 1.3 1.4 1.5
ln (FAILURE - AGE)
PERCENT FAILURE
FAILURE - AGE
m
μ/y₀
σ/y₀
F(t) = 100 - 100 / e^((t - 3.4)/7.4)
ln ln (100 / (100 - % FAILURE))

ADL ± .010

PROCESS A 39.200 K OHMS UNSCREENED 150 DEGREE CENTIGRADE 10.0 X RATED POWER

SER NO	RES	0	1	24	48	96	250	500	1000	1500	2000	2500	3000	3500	4000
33481	39.201	39.368	39.646	39.700	39.797	39.963	40.137	40.358	40.571	40.805	-99.999	-99.999	-99.999	-99.999
33482	39.206	39.200	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999
33483	39.220	39.532	39.838	39.932	40.131	40.440	40.825	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999
33484	39.219	39.457	39.900	39.971	40.245	40.600	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999
33485	39.211	39.428	39.698	39.754	39.858	40.057	40.264	40.537	40.791	40.959	-99.999	-99.999	-99.999	-99.999
33486	39.193	39.275	39.548	39.617	39.745	39.945	40.145	40.451	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999
33487	39.207	39.410	39.635	39.685	39.778	39.941	40.109	40.385	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999
33488	39.196	39.220	39.453	39.531	39.689	39.958	40.209	40.666	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999
33489	39.207	39.365	39.718	39.883	40.146	40.591	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999
33490	39.215	39.489	40.230	40.252	40.439	40.751	41.030	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999
33491	39.207	39.377	39.749	39.819	39.965	40.170	40.375	40.632	41.118	-99.999	-99.999	-99.999	-99.999	-99.999
33492	39.207	39.373	39.764	39.867	40.085	40.561	40.950	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999
33493	39.219	39.483	39.811	39.903	40.068	40.317	40.629	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999
33494	39.203	39.330	40.078	40.343	40.955	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999
33495	39.219	39.515	39.794	39.862	39.994	40.197	40.524	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999
33496	39.215	39.491	40.040	40.153	40.395	40.651	40.918	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999
33497	39.196	39.317	39.494	39.538	39.638	39.799	40.030	40.651	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999
33498	39.216	39.385	39.732	39.844	40.091	40.535	40.871	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999
33499	39.215	39.505	40.022	40.175	40.407	40.782	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999
33500	39.196	39.201	39.481	39.573	39.777	40.094	40.430	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999
SX	784	787	755	757	761	725	607	283	122	81	0	0	0	0
SXX	30746	31025	30052	30193	30498	29231	24601	11496	5000	3342	0	0	0	0
AVG	39.208	39.386	39.770	39.863	40.063	40.297	40.496	40.525	40.826	40.882	0.000	0.000	0.000	0.000
SEE	.007	.103	.212	.236	.326	.319	.348	.129	.275	.108	0.000	0.000	0.000	0.000
N	20	20	19	19	19	18	15	7	3	2	0	0	0	0

PROCESS A 39.200 K OHMS UNSCREENED 150 DEGREE CENTIGRADE 10.0 X RATED POWER

SER NO	D/N	0	1	24	48	96	250	500	1000	1500	2000	2500	3000	3500	4000
33481	.003	.428	1.137	1.275	1.522	1.946	2.390	2.954	3.497	4.094	-99.999	-99.999	-99.999	-99.999
33482	.015	0.000	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999
33483	.051	.846	1.627	1.867	2.374	3.163	4.145	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999
33484	.048	.655	1.785	1.966	2.665	3.571	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999
33485	.028	.581	1.270	1.413	1.678	2.186	2.714	3.410	4.058	4.487	-99.999	-99.999	-99.999	-99.999
33486	-.015	.191	.887	1.063	1.390	1.900	2.410	3.191	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999
33487	.019	.535	1.109	1.237	1.474	1.890	2.318	3.022	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999
33488	-.009	.051	.645	.844	1.247	1.933	2.573	3.739	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999
33489	.018	.420	1.321	1.742	2.413	3.548	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999
33490	.038	.737	2.627	2.683	3.160	3.956	4.668	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999
33491	.018	.451	1.400	1.579	1.951	2.474	2.997	3.653	4.892	-99.999	-99.999	-99.999	-99.999	-99.999
33492	.018	.441	1.438	1.701	2.257	3.471	4.464	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999
33493	.048	.721	1.558	1.793	2.214	2.849	3.645	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999
33494	.008	.331	2.239	2.915	4.477	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999
33495	.048	.803	1.515	1.688	2.025	2.543	3.377	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999
33496	.038	.742	2.142	2.431	3.048	3.701	4.382	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999
33497	-.009	.298	.749	.862	1.117	1.528	2.117	3.701	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999
33498	.040	.471	1.357	1.642	2.272	3.405	4.262	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999
33499	.038	.778	2.096	2.487	3.079	4.035	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999
33500	-.009	.002	.716	.951	1.471	2.280	3.137	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999
SX	.445	9.492	27.630	32.147	41.844	50.387	49.607	23.673	12.448	8.581	0.000	0.000	0.000	0.000
SXX	.019	5.859	45.513	60.996	104.671	152.388	175.191	80.714	52.645	36.899	0.000	0.000	0.000	0.000
AVG	.022	.474	1.454	1.691	2.202	2.799	3.307	3.381	4.149	4.290	0.000	0.000	0.000	0.000
SEE	.022	.267	.544	.605	.833	.816	.891	.329	.702	.277	0.000	0.000	0.000	0.000
N	20	20	19	19	19	18	15	7	3	2	0	0	0	0

PROCESS A 39.200 K OHMS UNSCREENED 150 DEGREE CENTIGRADE 10.0 X RATED POWER

SER NO	C/0	1	24	48	96	250	500	1000	1500	2000	2500	3000	3500	4000
33481		.424	1.133	1.271	1.518	1.942	2.386	2.950	3.493	4.090	-99.999	-99.999	-99.999	-99.999
33482		-.015	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999
33483		.794	1.575	1.815	2.323	3.111	4.093	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999
33484		.606	1.736	1.917	2.616	3.522	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999
33485		.552	1.241	1.384	1.649	2.157	2.685	3.381	4.029	4.458	-99.999	-99.999	-99.999	-99.999
33486		.207	.903	1.079	1.406	1.916	2.426	3.207	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999
33487		.515	1.089	1.217	1.454	1.870	2.298	3.002	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999
33488		.061	.655	.854	1.257	1.943	2.583	3.749	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999
33489		.401	1.302	1.723	2.394	3.529	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999
33490		.698	2.588	2.644	3.121	3.917	4.629	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999
33491		.432	1.381	1.560	1.932	2.455	2.978	3.634	4.873	-99.999	-99.999	-99.999	-99.999	-99.999
33492		.422	1.419	1.682	2.238	3.452	4.445	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999
33493		.672	1.509	1.744	2.165	2.800	3.596	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999
33494		.322	2.230	2.906	4.468	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999
33495		.754	1.466	1.639	1.976	2.494	3.328	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999
33496		.703	2.103	2.392	3.009	3.662	4.343	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999
33497		.308	.759	.872	1.127	1.538	2.127	3.711	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999
33498		.430	1.316	1.601	2.231	3.364	4.221	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999
33499		.739	2.057	2.448	3.040	3.996	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999
33500		.012	.726	.961	1.481	2.290	3.147	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999
SX		9.046	27.200	31.717	41.414	49.966	49.293	23.637	12.396	8.548	0.000	0.000	0.000	0.000
SXX		5.261	43.985	59.261	102.476	149.605	172.712	80.486	52.196	36.607	0.000	0.000	0.000	0.000
AVG		.452	1.431	1.669	2.179	2.775	3.286	3.376	4.132	4.274	0.000	0.000	0.000	0.000
SEE		.248	.529	.592	.823	.800	.875	.333	.695	.260	0.000	0.000	0.000	0.000
N		20	19	19	19	18	15	7	3	2	0	0	0	0

PROCESS A 39.200 K OHMS UNSCREENED 150 DEGREE CENTIGRADE 10.0 X RATED POWER

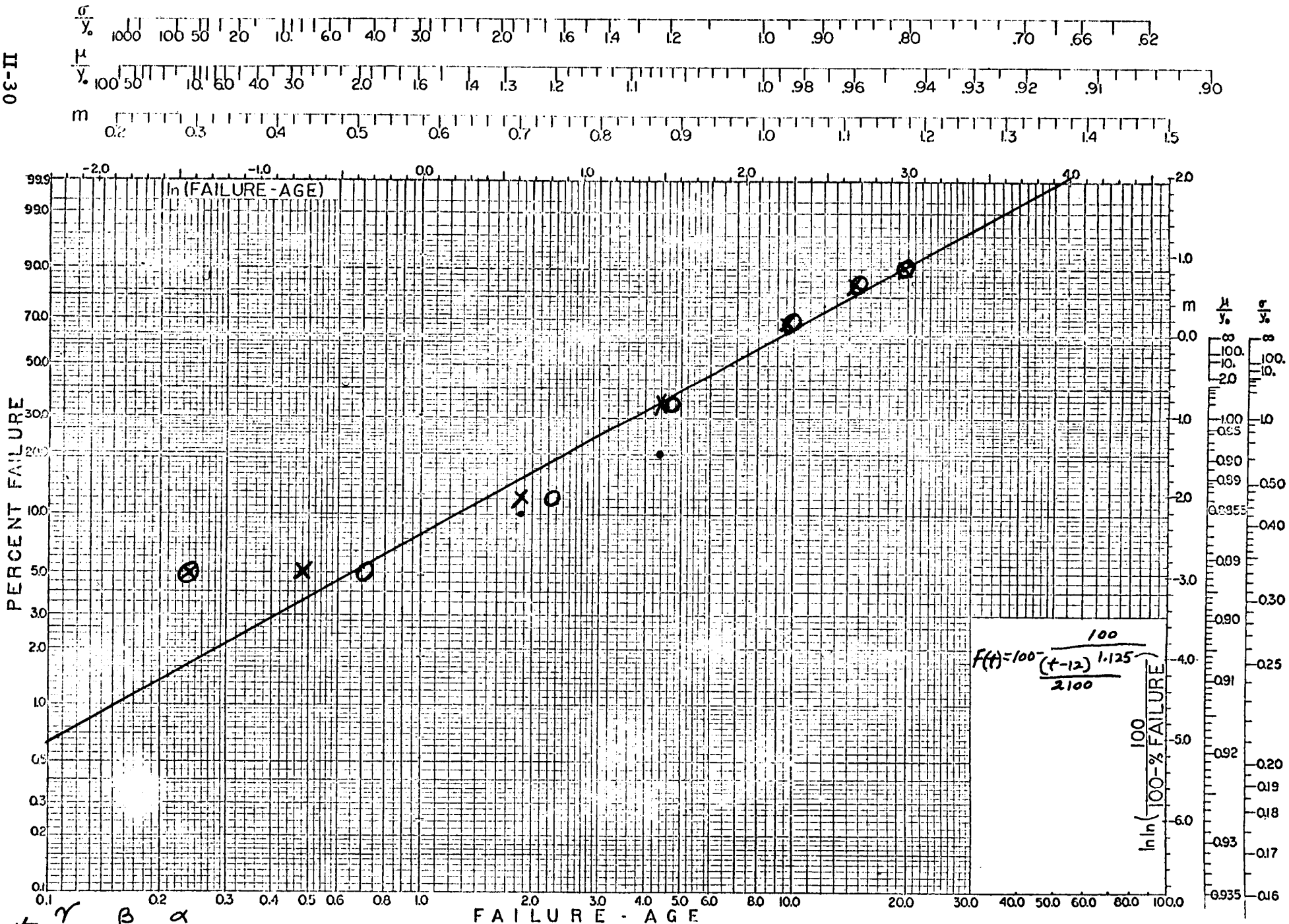
SER NO	C/1	24	48	96	250	500	1000	1500	2000	2500	3000	3500	4000
33481		.709	.846	1.094	1.517	1.961	2.528	3.068	3.665	-99.999	-99.999	-99.999	-99.999
33482		-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999
33483		.780	1.020	1.528	2.316	3.298	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999
33484		1.130	1.311	2.010	2.915	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999
33485		.688	.831	1.096	1.604	2.132	2.829	3.477	3.905	-99.999	-99.999	-99.999	-99.999
33486		.696	.872	1.198	1.709	2.219	2.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999
33487		.573	.701	.938	1.354	1.783	2.487	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999
33488		.594	.793	1.196	1.882	2.522	3.688	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999
33489		.900	1.321	1.992	3.127	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999
33490		1.890	1.946	2.423	3.219	3.931	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999
33491		.948	1.127	1.500	2.022	2.549	3.201	4.441	-99.999	-99.999	-99.999	-99.999	-99.999
33492		.997	1.260	1.816	3.030	4.022	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999
33493		.836	1.071	1.492	2.127	2.923	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999
33494		1.908	2.584	4.145	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999
33495		.711	.885	1.221	1.739	2.573	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999
33496		1.400	1.688	2.306	2.959	3.640	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999
33497		.451	.563	.818	1.229	1.818	3.403	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999
33498		.885	1.170	1.801	2.933	3.790	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999
33499		1.318	1.709	2.301	3.257	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999
33500		.714	.948	1.469	2.278	3.135	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999	-99.999
SX		18.137	22.655	32.352	41.227	42.301	21.135	10.987	7.571	0.000	0.000	0.000	0.000
SXX		20.357	31.418	65.509	102.699	127.798	65.005	41.233	28.692	0.000	0.000	0.000	0.000
AVG		.954	1.192	1.702	2.290	2.820	3.019	3.662	3.785	0.000	0.000	0.000	0.000
SEE		.411	.494	.760	.697	.779	.445	.704	.169	0.000	0.000	0.000	0.000
N		19	19	19	18	15	7	3	2	0	0	0	0

4 PROCESS A 39.200 K OHMS UNSCREENED 150 DEGREE CENTIGRADE 10.0 X RATED POWER

LOCATION	SHAPE	SCALE	VE	VB	VA	SX	SY	SXX	SYY	SXSX	SXY	P
.451	1.367	.3981E-00	.3725E-01	.5339E-02	.1111E-02	-.1615E+02	-.6438E+01	.2232E+02	.1612E+02	.2609E+03	.1566E+02	17
.563	1.452	.5155E-00	.1642E-01	.2586E-02	.6099E-03	-.1218E+02	-.6438E+01	.1508E+02	.1612E+02	.1484E+03	.1384E+02	17
.818	1.254	.8386E-00	.2847E-01	.3395E-02	.1645E-02	-.7515E+01	-.6438E+01	.1170E+02	.1612E+02	.5648E+02	.1336E+02	17
1.229	1.110	.1191E+01	.3885E-01	.4018E-02	.3625E-02	-.2826E+01	-.5938E+01	.1016E+02	.1474E+02	.7986E+01	.1178E+02	16
1.783	.714	.1082E+01	.7991E-01	.4983E-02	.8000E-02	-.4813E+01	-.4466E+01	.1781E+02	.1075E+02	.2317E+02	.1311E+02	13
2.487	.483	.7146E-00	.7089E-01	.1095E-01	.1383E-01	-.5429E+01	-.9443E-00	.1236E+02	.2044E+01	.2947E+02	.4153E+01	5

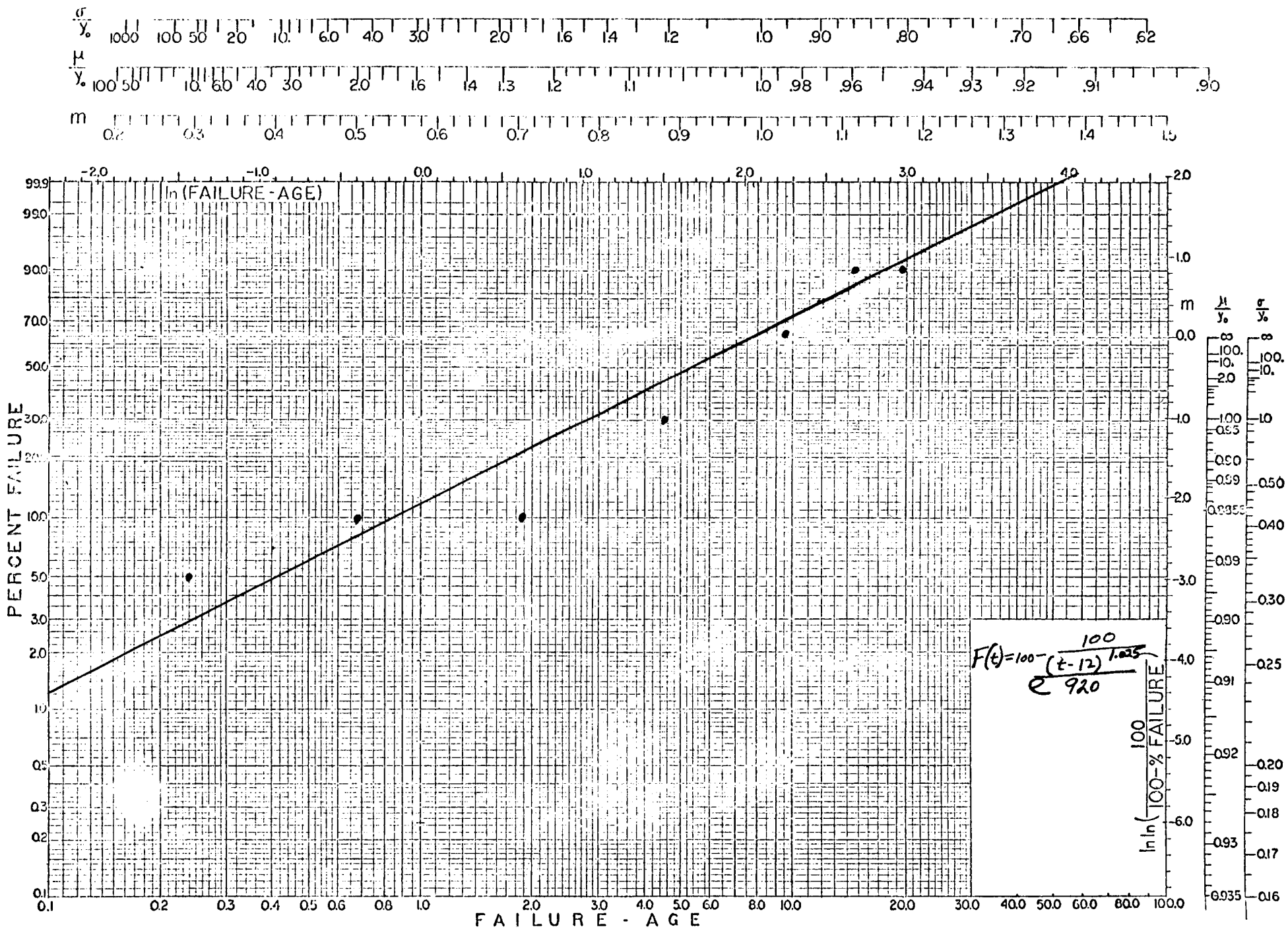
4 PROCESS A 39.200 K OHMS UNSCREENED 150 DEGREE CENTIGRADE 10.0 X RATED POWER

0.00ADL	PCT	24	48	96	250	500	1000	1500	2000	2500	3000	3500	4000	
24.00		.929	.6014E+03	.1654E-00	.9486E-02	.1230E+06		.4042E+02	-.7220E+01	.2509E+03	.2367E+02	.1634E+04	-.2549E+02	7
.050		5.00	5.00	5.00	12.30	33.92	68.94	85.00	90.00	100.00	100.00	100.00	100.00	
.050		100.00	96.86	91.52	77.39	59.91	36.85	23.07	14.61	9.33	5.99	3.87	2.51	
24.00		.926	.5669E+03	.1364E-00	.7831E-02	.9029E+05		.4043E+02	-.6930E+01	.2510E+03	.2276E+02	.1635E+04	-.2390E+02	7
.045		5.00	5.00	5.20	13.94	36.36	69.92	85.00	90.00	100.00	100.00	100.00	100.00	
.045		100.00	96.70	91.15	76.56	58.72	35.51	21.90	13.67	8.61	5.46	3.48	2.23	
24.00		.920	.5174E+03	.1008E-00	.5798E-02	.5571E+05		.4045E+02	-.6513E+01	.2511E+03	.2149E+02	.1636E+04	-.2163E+02	7
.040		5.00	5.00	5.58	16.67	39.66	71.33	85.00	90.00	100.00	100.00	100.00	100.00	
.040		100.00	96.46	90.58	75.31	56.97	33.64	20.31	12.43	7.68	4.78	3.00	1.89	
24.00		.906	.4381E+03	.5832E-01	.3362E-02	.2318E+05		.4047E+02	-.5873E+01	.2514E+03	.1959E+02	.1638E+04	-.1823E+02	7
.035		5.00	5.00	6.55	21.17	44.25	73.56	85.00	90.00	100.00	100.00	100.00	100.00	
.035		100.00	96.00	89.55	73.25	54.25	30.96	18.15	10.83	6.54	3.98	2.44	1.51	
24.00		.882	.3315E+03	.1959E-01	.1134E-02	.4486E+04		.4051E+02	-.4886E+01	.2517E+03	.1698E+02	.1641E+04	-.1304E+02	7
.030		5.00	5.00	8.98	28.49	50.90	77.70	85.00	90.00	100.00	100.00	100.00	100.00	
.030		100.00	95.14	87.70	69.76	49.93	27.01	15.18	8.73	5.10	3.02	1.80	1.09	
24.00		.858	.2183E+03	.6579E-01	.3851E-02	.6613E+04		.4056E+02	-.2878E+01	.2521E+03	.1423E+02	.1645E+04	-.2016E+01	7
.025		5.11	5.59	14.64	40.11	61.20	94.52	85.00	90.00	100.00	100.00	100.00	100.00	
.025		100.00	93.22	83.52	61.84	40.21	18.50	9.01	4.54	2.34	1.23	.66	.35	
24.00		.932	.1838E+03	.3649E-02	.6643E-03	.5316E+03		.1888E+02	-.3240E+01	.9468E+02	.7419E+01	.3567E+03	-.1017E+02	4
.020		5.98	8.56	26.85	58.01	80.00	100.00	85.00	90.00	100.00	100.00	100.00	100.00	
.020		100.00	89.99	74.55	42.60	18.09	3.54	.73	.15	.03	0.00	0.00	0.00	
24.00		.891	.6653E+02	.1023E-02	.3936E-03	.3327E+02		.1280E+02	-.1177E+01	.5728E+02	.2530E+01	.1640E+03	-.2711E+01	3
.015		11.51	21.30	50.48	83.94	100.00	100.00	85.00	90.00	100.00	100.00	100.00	100.00	
.015		100.00	77.46	50.67	15.19	2.57	.09	0.00	0.00	0.00	0.00	0.00	0.00	

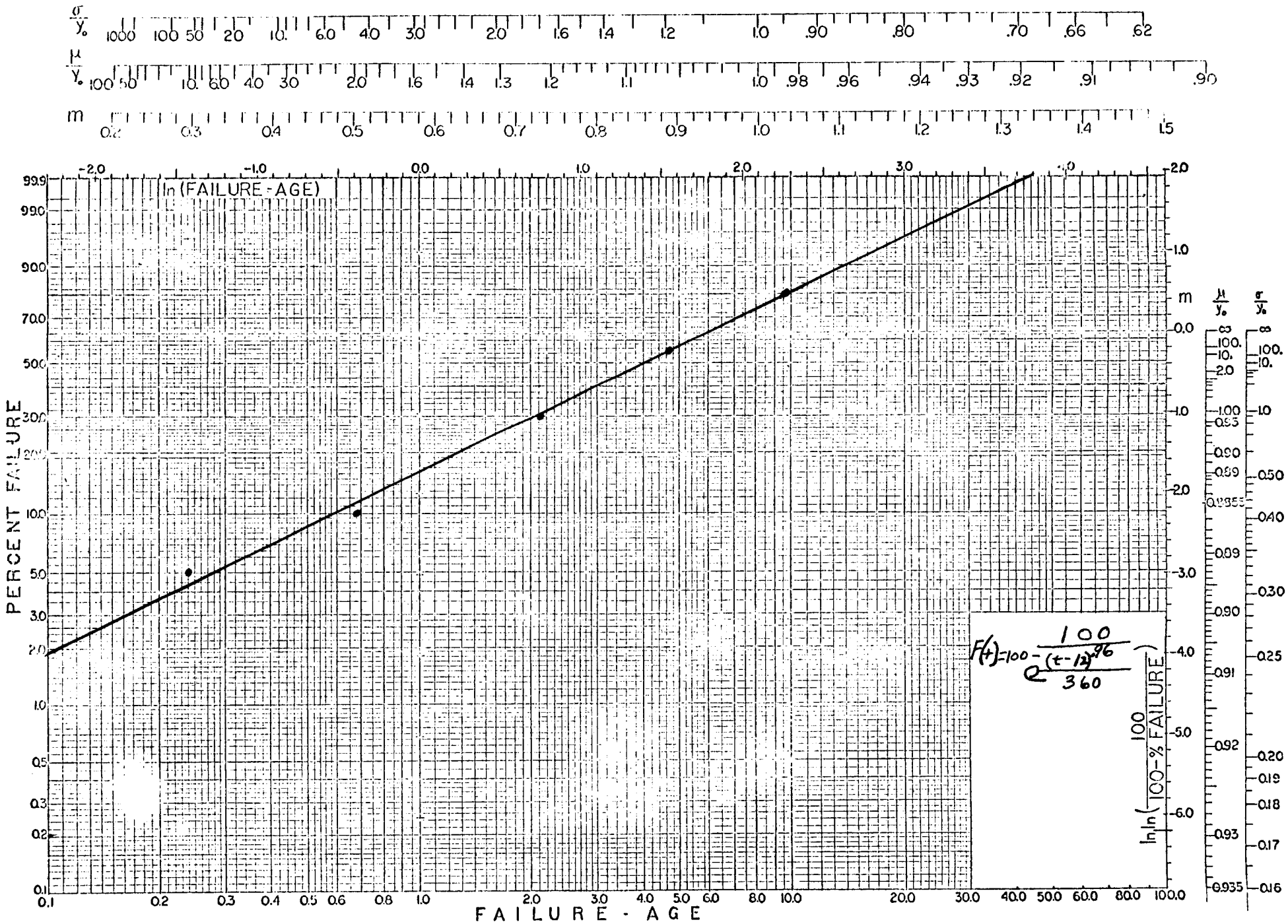


	γ	β	α
Computer	24	.929	6014
Graph	12	1.125	2100

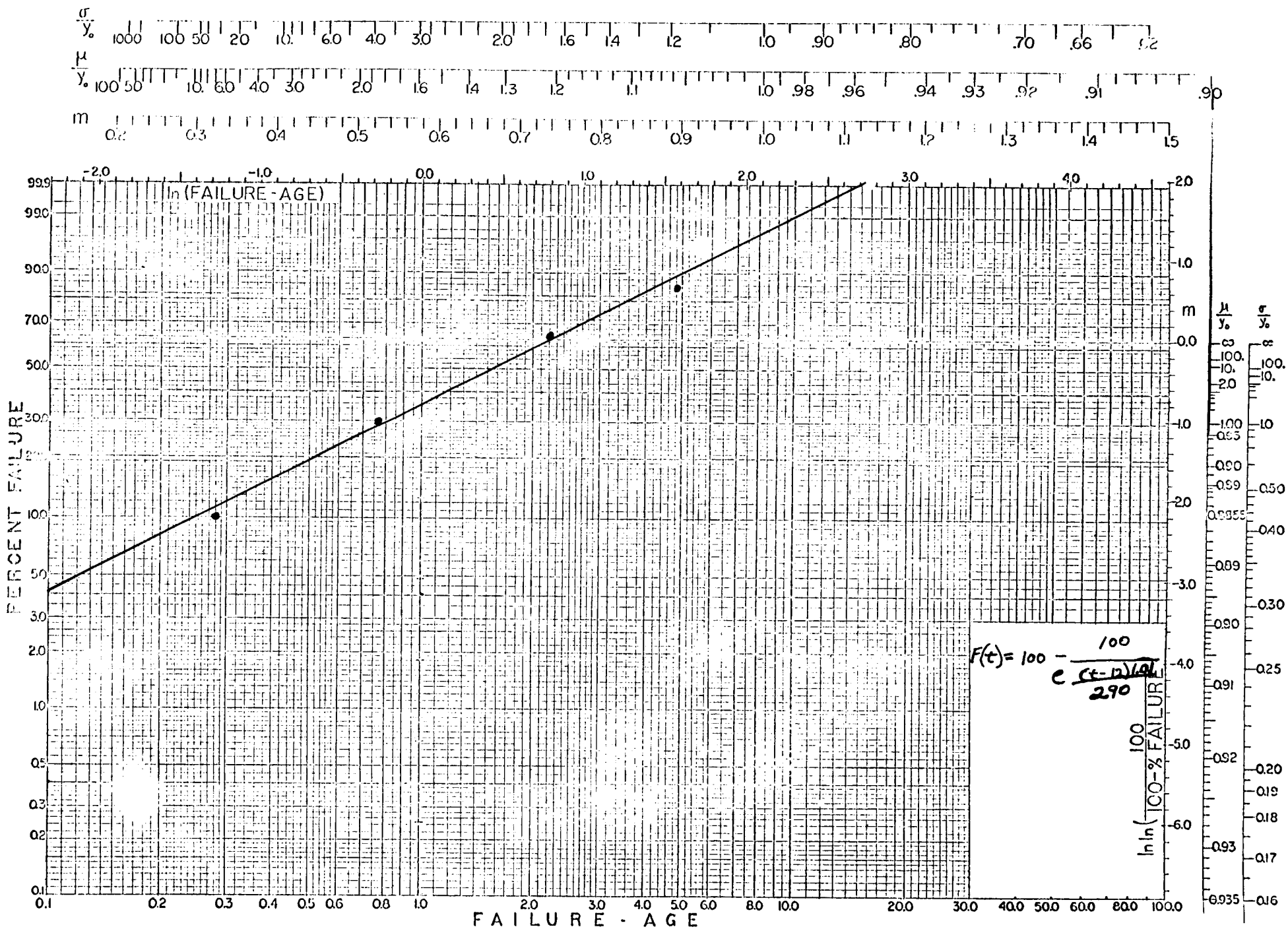
ADL ± 5%


σ/y₀
1000 100 50 20 10. 6.0 4.0 3.0 2.0 1.6 1.4 1.2 1.0 .90 .80 .70 .66 .62
μ/y₀
100 50 10. 6.0 4.0 3.0 2.0 1.6 1.4 1.3 1.2 1.1 1.0 .98 .96 .94 .93 .92 .91 .90
m
0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0 1.1 1.2 1.3 1.4 1.5
ln (FAILURE - AGE)
PERCENT FAILURE
FAILURE - AGE
m
μ/y₀
σ/y₀
ln ln (100/(100-% FAILURE))
F(t) = 100 - 100 / e^((t-12)^1.025 / 920)

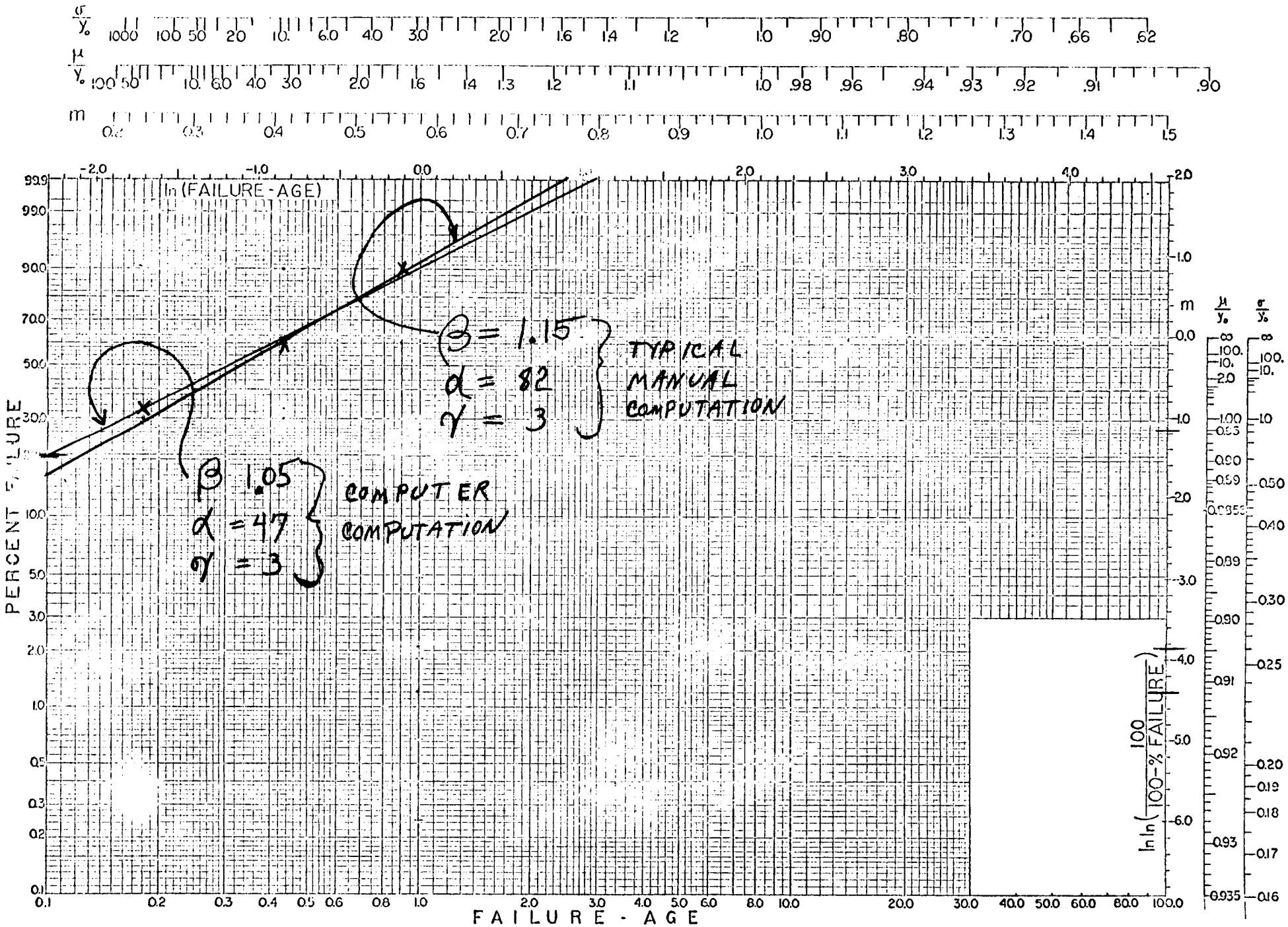
ADL ± 4%


σ/y₀
1000 100 50 20 10. 6.0 4.0 3.0 2.0 1.6 1.4 1.2 1.0 .90 .80 .70 .66 .62
μ/y₀
100 50 10. 6.0 4.0 3.0 2.0 1.6 1.4 1.3 1.2 1.1 1.0 .98 .96 .94 .93 .92 .91 .90
m
0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0 1.1 1.2 1.3 1.4 1.5
ln (FAILURE - AGE)
PERCENT FAILURE
FAILURE - AGE
m
μ/y₀
σ/y₀
$F(t) = 100 - \frac{100}{e^{\frac{(t-12)^{.96}}{360}}}$
ln ln (100 / 100 - % FAILURE)

ADL=3%


σ/y₀
μ/y₀
m
ln (FAILURE - AGE)
PERCENT FAILURE
FAILURE - AGE
ln ln (100/(100-% FAILURE))
F(t) = 100 - 100 / e^((t-12)/290)

ADL ±2%


σ/y₀
μ/y₀
m
ln (FAILURE - AGE)
PERCENT FAILURE
FAILURE - AGE
ln ln (100 / 100 - % FAILURE)
β = 1.15
α = 82
γ = 3
TYPICAL MANUAL COMPUTATION
β 1.05
α = 47
γ = 3
COMPUTER COMPUTATION

ADL ± 1%

PROCESS A 39.200 K OHMS UNSCREENED 70 DEGREE CENTIGRADE 2.5 X RATED POWER

SER NO	RES	0	1	24	48	96	250	500	1000	1500	2000	2500	3000	3500	4000
33401	39.223	39.455	39.437	39.438	39.440	39.437	39.435	39.432	39.435	39.434	39.432	39.432	39.433	39.432
33402	39.208	39.319	39.319	39.317	39.318	39.311	39.307	39.300	39.302	39.303	39.300	39.300	39.300	39.299
33403	39.214	39.322	39.322	39.321	39.320	39.307	39.366	39.359	39.362	39.362	39.360	39.359	39.360	39.358
33404	39.188	39.123	39.123	39.121	39.121	39.115	39.110	39.102	39.105	39.103	39.102	39.101	39.102	39.100
33405	39.215	39.382	39.382	39.381	39.381	39.376	39.374	39.367	39.369	39.369	39.367	39.367	39.367	39.366
33406	39.212	39.384	39.376	39.374	39.377	39.373	39.372	39.364	39.368	39.368	39.365	39.365	39.365	39.364
33407	39.216	39.406	39.405	39.403	39.404	39.400	39.396	39.390	39.393	39.393	39.391	39.390	39.391	39.389
33408	39.219	39.443	39.430	39.430	39.431	39.425	39.418	39.410	39.415	39.415	39.413	39.412	39.413	39.412
33409	39.203	39.238	39.235	39.234	39.236	39.235	39.234	39.233	39.234	39.234	39.233	39.234	39.233	39.232
33410	39.224	39.484	39.484	39.483	39.483	39.480	39.474	39.466	39.469	39.468	39.467	39.466	39.467	39.465
33411	39.196	39.198	39.201	39.201	39.207	39.207	39.210	39.208	39.212	39.212	39.211	39.211	39.211	39.211
33412	39.219	39.445	39.445	39.444	39.445	39.440	39.436	39.431	39.434	39.433	39.431	39.431	39.432	39.430
33413	39.207	39.289	39.290	39.289	39.289	39.287	39.285	39.281	39.283	39.283	39.282	39.282	39.282	39.281
33414	39.200	39.239	39.239	39.237	39.237	39.232	39.227	39.218	39.222	39.221	39.219	39.218	39.219	39.217
33415	39.203	39.266	39.265	39.263	39.264	39.257	39.260	39.250	39.254	39.253	39.251	39.250	39.251	39.250
33416	39.212	39.377	39.376	39.375	39.376	39.371	39.369	39.362	39.367	39.367	39.364	39.364	39.365	39.364
33417	39.216	39.409	39.315	39.316	39.285	39.277	39.307	39.271	39.276	39.276	39.274	39.277	39.282	39.281
33418	39.205	39.298	39.298	39.297	39.298	39.293	39.290	39.285	39.290	39.289	39.287	39.292	39.294	39.292
33419	39.189	39.130	39.129	39.127	39.127	39.121	39.116	39.108	39.112	39.110	39.107	39.111	39.111	39.110
33420	39.211	39.334	39.334	39.333	39.334	39.330	39.330	39.326	39.332	39.332	39.342	39.346	39.349	39.348
SX	784	786	786	786	786	786	786	786	786	786	786	786	786	786
SXX	30747	30932	30921	30920	30919	30911	30914	30902	30908	30907	30905	30906	30907	30905
AVG	39.209	39.327	39.320	39.319	39.318	39.313	39.315	39.308	39.311	39.311	39.309	39.310	39.311	39.310
SEE	.007	.103	.099	.099	.100	.099	.100	.100	.100	.100	.100	.100	.100	.100
N	20	20	20	20	20	20	20	20	20	20	20	20	20	20

PROCESS A 39.200 K OHMS UNSCREENED 70 DEGREE CENTIGRADE 2.5 X RATED POWER

SER NO	D/N	0	1	24	48	96	250	500	1000	1500	2000	2500	3000	3500	4000
33401	.058	.650	.604	.607	.612	.604	.599	.591	.599	.596	.591	.591	.594	.591
33402	.020	.303	.303	.298	.301	.283	.272	.255	.260	.262	.255	.255	.255	.252
33403	.035	.311	.311	.308	.306	.272	.423	.405	.413	.413	.408	.405	.408	.403
33404	-.028	-.196	-.196	-.201	-.201	-.216	-.229	-.249	-.242	-.247	-.249	-.252	-.249	-.255
33405	.038	.464	.464	.461	.461	.448	.443	.426	.431	.431	.426	.426	.426	.423
33406	.032	.469	.448	.443	.451	.441	.438	.418	.428	.428	.420	.420	.420	.418
33407	.040	.525	.522	.517	.520	.510	.499	.484	.492	.492	.487	.484	.487	.482
33408	.048	.619	.586	.586	.589	.573	.556	.535	.548	.548	.543	.540	.543	.540
33409	.008	.096	.089	.086	.091	.089	.086	.084	.086	.086	.084	.086	.084	.081
33410	.062	.724	.724	.721	.721	.714	.698	.678	.686	.683	.681	.678	.681	.676
33411	-.008	-.005	.002	.002	.017	.017	.025	.020	.030	.030	.028	.028	.028	.028
33412	.050	.624	.624	.622	.624	.612	.602	.589	.596	.594	.589	.589	.591	.586
33413	.018	.227	.229	.227	.227	.221	.216	.206	.211	.211	.209	.209	.209	.206
33414	0.000	.099	.099	.094	.094	.081	.068	.045	.056	.053	.048	.045	.048	.043
33415	.008	.168	.165	.160	.163	.145	.153	.127	.137	.135	.130	.127	.130	.127
33416	.031	.451	.448	.446	.448	.436	.431	.413	.426	.426	.418	.418	.420	.418
33417	.042	.533	.293	.295	.216	.196	.272	.181	.193	.193	.188	.196	.209	.206
33418	.012	.249	.249	.247	.249	.237	.229	.216	.229	.227	.221	.234	.239	.234
33419	-.027	-.178	-.181	-.186	-.186	-.201	-.214	-.234	-.224	-.229	-.237	-.227	-.227	-.229
33420	.028	.341	.341	.339	.341	.331	.331	.321	.336	.336	.362	.372	.380	.377
SX	.479	6.482	6.135	6.081	6.053	5.801	5.908	5.517	5.698	5.676	5.607	5.632	5.681	5.614
SXX	.024	3.461	3.141	3.116	3.105	2.959	3.018	2.806	2.907	2.902	2.865	2.866	2.898	2.858
AVG	.023	.324	.306	.304	.302	.290	.295	.275	.284	.283	.280	.281	.284	.280
SEE	.026	.267	.257	.258	.258	.259	.258	.259	.259	.260	.260	.259	.260	.259
N	20	20	20	20	20	20	20	20	20	20	20	20	20	20

PROCESS A 39.200 K OHMS UNSCREENED 70 DEGREE CENTIGRADE 2.5 X RATED POWER

SER NO	C/0 1	24	48	96	250	500	1000	1500	2000	2500	3000	3500	4000
33401	.591	.545	.548	.553	.545	.540	.532	.540	.537	.532	.532	.535	.532
33402	.282	.282	.277	.280	.262	.251	.234	.239	.241	.234	.234	.234	.231
33403	.275	.275	.272	.270	.236	.387	.369	.377	.377	.372	.369	.372	.367
33404	-.167	-.167	-.172	-.172	-.187	-.200	-.221	-.213	-.218	-.221	-.223	-.221	-.226
33405	.425	.425	.422	.422	.409	.404	.387	.392	.392	.387	.387	.387	.384
33406	.436	.415	.410	.418	.408	.405	.385	.395	.395	.387	.387	.387	.385
33407	.484	.481	.476	.479	.469	.459	.443	.451	.451	.446	.443	.446	.441
33408	.570	.537	.537	.540	.524	.507	.486	.499	.499	.494	.491	.494	.491
33409	.087	.080	.077	.082	.080	.077	.075	.077	.077	.075	.077	.075	.072
33410	.661	.661	.658	.658	.651	.635	.615	.623	.620	.618	.615	.618	.613
33411	.003	.011	.011	.026	.026	.034	.029	.039	.039	.037	.037	.037	.037
33412	.574	.574	.571	.574	.561	.551	.538	.545	.543	.538	.538	.540	.535
33413	.208	.210	.208	.208	.202	.197	.187	.192	.192	.190	.190	.190	.187
33414	.099	.099	.094	.094	.081	.068	.045	.056	.053	.048	.045	.048	.043
33415	.159	.156	.151	.154	.136	.144	.118	.128	.126	.121	.118	.121	.118
33416	.419	.416	.414	.416	.404	.399	.381	.394	.394	.386	.386	.388	.386
33417	.490	.250	.252	.173	.153	.229	.138	.150	.150	.145	.153	.166	.163
33418	.237	.237	.234	.237	.224	.216	.203	.216	.214	.208	.221	.226	.221
33419	-.150	-.153	-.158	-.158	-.173	-.186	-.206	-.196	-.201	-.209	-.199	-.199	-.201
33420	.312	.312	.310	.312	.302	.302	.292	.307	.307	.333	.343	.351	.348
SX	6.002	5.655	5.601	5.573	5.321	5.428	5.037	5.218	5.196	5.127	5.152	5.201	5.134
SXX	2.911	2.623	2.599	2.593	2.460	2.507	2.317	2.409	2.404	2.370	2.372	2.400	2.364
AVG	.300	.282	.280	.278	.266	.271	.251	.260	.259	.256	.257	.260	.256
SEE	.241	.232	.232	.233	.234	.233	.234	.234	.235	.235	.234	.234	.234
N	20	20	20	20	20	20	20	20	20	20	20	20	20

PROCESS A 39.200 K OHMS UNSCREENED 70 DEGREE CENTIGRADE 2.5 X RATED POWER

SER NO	C/1 24	48	96	250	500	1000	1500	2000	2500	3000	3500	4000
33401	-.045	-.043	-.038	-.045	-.051	-.058	-.051	-.053	-.058	-.058	-.056	-.058
33402	0.000	-.005	-.002	-.020	-.030	-.048	-.043	-.040	-.048	-.048	-.048	-.051
33403	0.000	-.002	-.005	-.038	.112	.094	.102	.102	.096	.094	.096	.091
33404	0.000	-.005	-.005	-.020	-.033	-.053	-.045	-.051	-.053	-.056	-.053	-.058
33405	0.000	-.002	-.002	-.015	-.020	-.038	-.033	-.033	-.038	-.038	-.038	-.040
33406	-.020	-.025	-.017	-.028	-.030	-.051	-.040	-.040	-.048	-.048	-.048	-.051
33407	-.002	-.007	-.005	-.015	-.025	-.040	-.033	-.033	-.038	-.040	-.038	-.043
33408	-.033	-.033	-.030	-.045	-.063	-.084	-.071	-.071	-.076	-.079	-.076	-.079
33409	-.007	-.010	-.005	-.007	-.010	-.012	-.010	-.010	-.012	-.010	-.012	-.015
33410	0.000	-.002	-.002	-.010	-.025	-.045	-.038	-.040	-.043	-.045	-.043	-.048
33411	.007	.007	.022	.022	.030	.025	.035	.035	.033	.033	.033	.033
33412	0.000	-.002	0.000	-.012	-.022	-.035	-.028	-.030	-.035	-.035	-.033	-.038
33413	.002	0.000	0.000	-.005	-.010	-.020	-.015	-.015	-.017	-.017	-.017	-.020
33414	0.000	-.005	-.005	-.017	-.030	-.053	-.043	-.045	-.051	-.053	-.051	-.056
33415	-.002	-.007	-.005	-.022	-.015	-.040	-.030	-.033	-.038	-.040	-.038	-.040
33416	-.002	-.005	-.002	-.015	-.020	-.038	-.025	-.025	-.033	-.033	-.030	-.033
33417	-.239	-.237	-.316	-.336	-.260	-.352	-.339	-.339	-.344	-.336	-.323	-.326
33418	0.000	-.002	0.000	-.012	-.020	-.033	-.020	-.022	-.028	-.015	-.010	-.015
33419	-.002	-.007	-.007	-.022	-.035	-.056	-.045	-.051	-.058	-.048	-.048	-.051
33420	0.000	-.002	0.000	-.010	-.010	-.020	-.005	-.005	.020	.030	.038	.035
SX	-.346	-.400	-.428	-.681	-.573	-.964	-.783	-.806	-.874	-.849	-.801	-.867
SXX	.061	.060	.103	.123	.096	.169	.150	.152	.162	.157	.147	.152
AVG	-.017	-.020	-.021	-.034	-.028	-.048	-.039	-.040	-.043	-.042	-.040	-.043
SEE	.053	.052	.070	.072	.064	.080	.079	.079	.080	.079	.077	.077
N	20	20	20	20	20	20	20	20	20	20	20	20

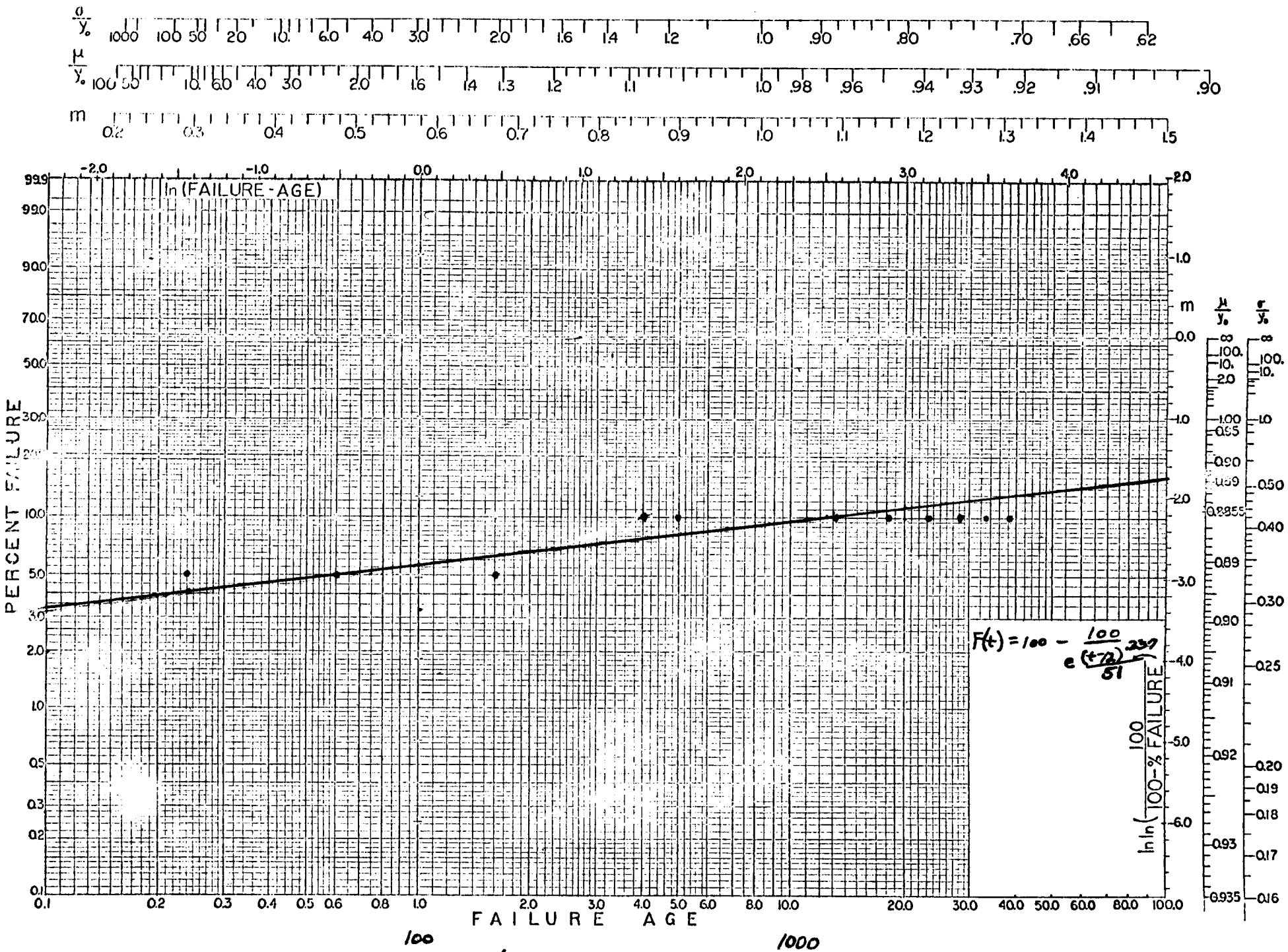
ADL r
.100 12 12 1 0 36 1 24 72 1 60 173 1 161 416 2 404 [illegible]
.050 12 12 1 [illegible] 36 1 24 72 1 60 173 1 161 450 4 [illegible]
.010 5 19 4 14 44 5 39 89 6 84 242 19 237 20
.005 3 20 6 11 46 12 93 93 14 90 [illegible]

4 PROCESS A 39.200 K OHMS UNSCREENED 70 DEGREE CENTIGRADE 2.5 X RATED POWER

LOCATION	SHAPE	SCALE	VE	VB	VA	SX	SY	SXX	SYY	SXSX	SXY	P
-.239	12.365	.2215E-07	.2971E-00	.4782E+01	.4986E-14	-.2621E+02	-.6943E+01	.3825E+02	.1752E+02	.6874E+03	.1088E+02	18
-.237	14.274	.9698E-09	.2363E-00	.4545E+01	.9389E-17	-.2665E+02	-.6943E+01	.3952E+02	.1752E+02	.7105E+03	.1102E+02	18
-.316	21.800	.1088E-10	.2468E-00	.1127E+02	.1848E-20	-.2116E+02	-.6943E+01	.2489E+02	.1752E+02	.4477E+03	.8639E+01	18
-.336	22.863	.5394E-11	.6893E-01	.2647E+01	.1023E-21	-.2073E+02	-.6943E+01	.2390E+02	.1752E+02	.4297E+03	.8591E+01	18
-.260	10.693	.2871E-06	.1242E-00	.1126E+01	.1944E-12	-.2600E+02	-.6943E+01	.3768E+02	.1752E+02	.6762E+03	.1121E+02	18
-.352	11.987	.1269E-05	.1241E-00	.1414E+01	.3103E-11	-.2096E+02	-.6943E+01	.2450E+02	.1752E+02	.4395E+03	.9138E+01	18
-.339	12.007	.1070E-05	.1247E-00	.1427E+01	.2273E-11	-.2118E+02	-.6943E+01	.2502E+02	.1752E+02	.4488E+03	.9221E+01	18
-.339	11.759	.1363E-05	.1142E-00	.1234E+01	.3212E-11	-.2126E+02	-.6943E+01	.2521E+02	.1752E+02	.4521E+03	.9289E+01	18
-.344	10.183	.9241E-05	.1332E-00	.1110E+01	.1318E-09	-.2117E+02	-.6943E+01	.2501E+02	.1752E+02	.4481E+03	.9386E+01	18
-.336	9.287	.2162E-04	.1399E-00	.9788E-00	.6609E-09	-.2156E+02	-.6943E+01	.2598E+02	.1752E+02	.4650E+03	.9646E+01	18
-.323	8.806	.2775E-04	.1498E-00	.9567E-00	.1130E-08	-.2223E+02	-.6943E+01	.2761E+02	.1752E+02	.4943E+03	.9955E+01	18
-.326	8.600	.3499E-04	.1579E-00	.9733E-00	.1837E-08	-.2227E+02	-.6943E+01	.2773E+02	.1752E+02	.4963E+03	.9989E+01	18

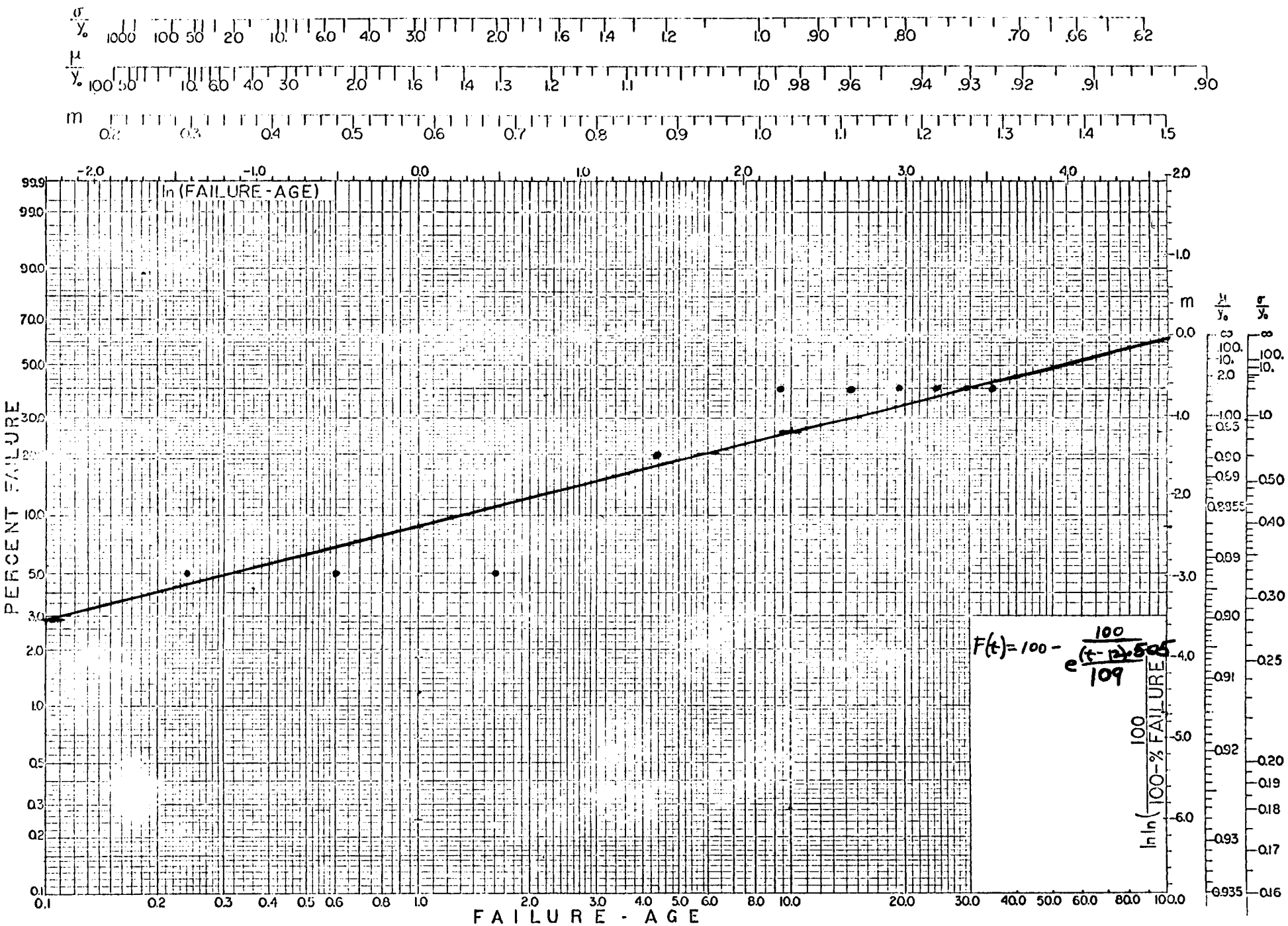
4 PROCESS A 39.200 K OHMS UNSCREENED 70 DEGREE CENTIGRADE 2.5 X RATED POWER

0.00ADL PCT 24 48 96 250 500 1000 1500 2000 2500 3000 3500 4000

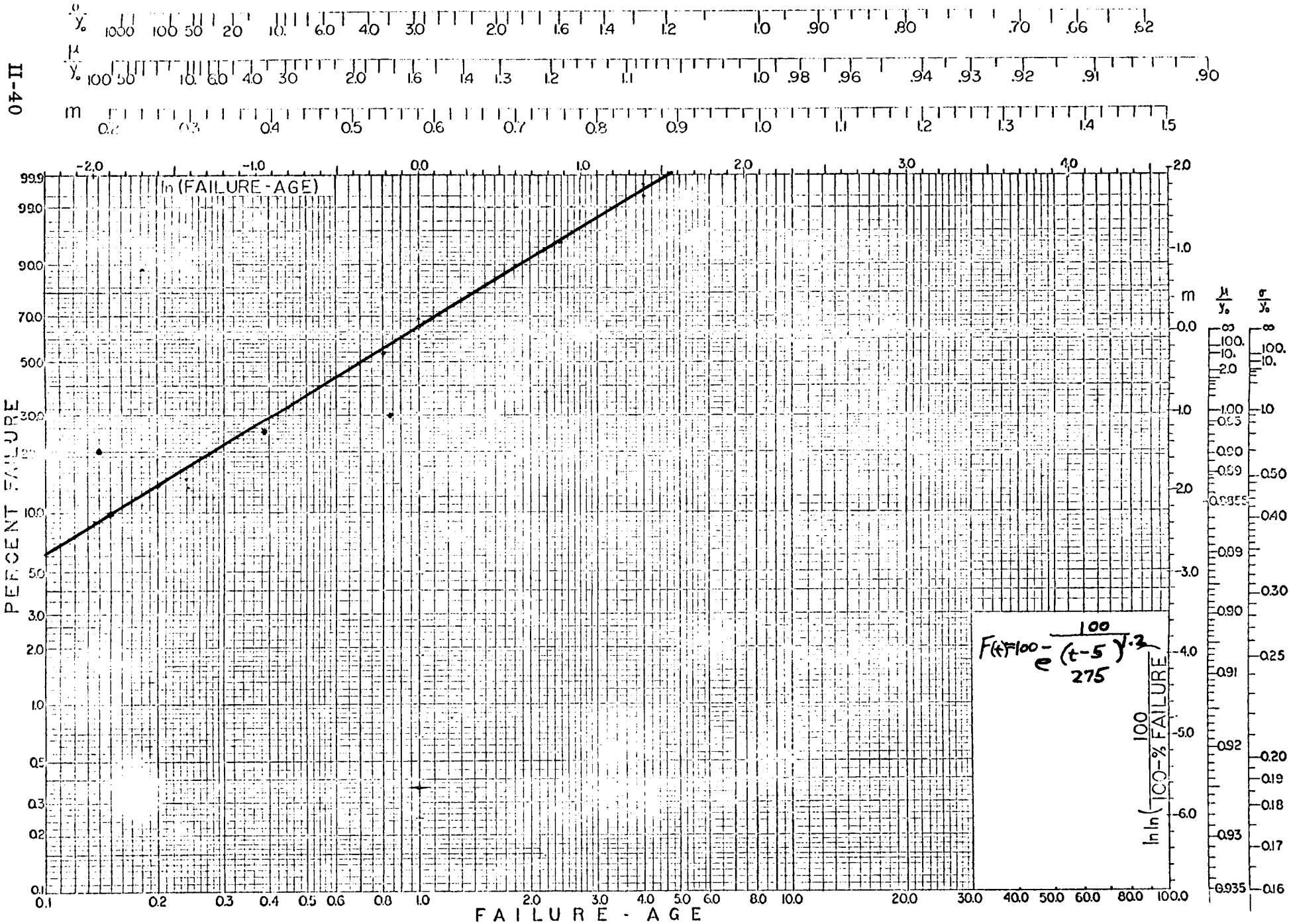


σ/y₀
μ/y₀
m
ln (FAILURE - AGE)
PERCENT FAILURE
FAILURE AGE
ln ln (100/100-% FAILURE)
F(t) = 100 - 100 / e^((t-72)/51)^.237
100
1000

ADL .100


σ/y₀
1000 100 50 20 10. 6.0 4.0 3.0 2.0 1.6 1.4 1.2 1.0 .90 .80 .70 .66 .62
μ/y₀
100 50 10. 6.0 4.0 3.0 2.0 1.6 1.4 1.3 1.2 1.1 1.0 .98 .96 .94 .93 .92 .91 .90
m
0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0 1.1 1.2 1.3 1.4 1.5
ln (FAILURE - AGE)
PERCENT FAILURE
FAILURE - AGE
m
μ/y₀
σ/y₀
ln ln (100/(100-% FAILURE))
F(t) = 100 - 100/e^((t-12)/109)

ADL ± .050


ln (FAILURE - AGE)
PERCENT FAILURE
FAILURE - AGE
m
$\frac{\mu}{y_0}$
$\frac{\sigma}{y_0}$
$F(t) = 100 - e^{-\left(\frac{t-5}{275}\right)^{.3}}$
$\ln \ln \left(\frac{100}{100 - \% \text{ FAILURE}}\right)$

ADL ± 010

PROCESS A 39.200 K OHMS UNSCREENED 125 DEGREE CENTIGRADE 2.5 X RATED POWER

SER NO	RES	0	1	24	48	96	250	500	1000	1500	2000	2500	3000	3500	4000
33441		39.184	39.127	39.132	39.132	39.138	39.141	39.146	39.169	39.174	39.175	39.178	39.185	39.188	39.185
33442		39.211	39.406	39.417	39.417	39.423	39.424	39.429	39.440	39.448	39.451	39.458	39.478	39.488	39.490
33443		39.205	39.347	39.356	39.356	39.360	39.361	39.361	39.366	39.370	39.372	39.372	39.383	39.392	39.393
33444		39.215	39.399	39.405	39.407	39.411	39.415	39.420	39.429	39.433	39.435	39.437	39.441	39.444	39.443
33445		39.212	39.404	39.410	39.409	39.414	39.414	39.419	39.428	39.434	39.436	39.438	39.452	39.459	39.459
33446		39.192	39.147	39.151	39.153	39.158	39.164	39.172	39.182	39.190	39.193	39.198	39.204	39.209	39.209
33447		39.207	39.351	39.357	39.358	39.361	39.365	39.367	39.371	39.375	39.374	39.377	39.390	39.393	39.392
33448		39.215	39.351	39.357	39.359	39.364	39.371	39.378	39.396	39.401	39.403	39.406	39.411	39.415	39.415
33449		39.200	39.302	39.309	39.308	39.312	39.316	39.323	39.335	39.345	39.349	39.356	39.370	39.376	39.377
33450		39.209	39.391	39.390	39.388	39.394	39.397	39.401	39.416	39.419	39.430	39.430	39.448	39.460	39.464
33451		39.219	39.483	39.489	39.487	39.492	39.493	39.496	39.502	39.505	39.506	39.506	39.518	39.522	39.520
33452		39.219	39.495	39.502	39.501	39.508	39.515	39.521	39.540	39.551	39.559	39.567	39.581	39.589	39.588
33453		39.219	39.510	39.516	39.514	39.518	39.516	39.515	39.519	39.520	39.517	39.515	39.524	39.527	39.523
33454		39.213	39.442	39.445	39.432	39.437	39.441	39.455	39.471	39.477	39.491	39.508	39.511	39.518	39.523
33455		39.207	39.389	39.397	39.396	39.402	39.401	39.405	39.417	39.423	39.425	39.427	39.439	39.443	39.440
33456		39.203	39.332	39.335	39.333	39.336	39.333	39.332	39.337	39.338	39.335	39.332	39.341	39.343	39.338
33457		39.211	39.402	39.407	39.406	39.410	39.411	39.413	39.420	39.424	39.424	39.424	39.435	39.439	39.437
33458		39.207	39.354	39.365	39.366	39.370	39.369	39.370	39.372	39.372	39.369	39.367	39.376	39.378	39.374
33459		39.210	39.393	39.536	39.528	39.531	39.538	39.542	39.545	39.548	39.546	39.549	39.557	39.560	39.557
33460		39.200	39.289	39.293	39.291	39.294	39.292	39.292	39.297	39.300	39.297	39.296	39.306	39.309	39.306
SX		784	787	787	787	787	787	787	787	788	788	788	788	788	788
SXX		30745	30993	31013	31011	31018	31021	31028	31043	31051	31054	31058	31074	31083	31081
AVG		39.208	39.365	39.378	39.377	39.381	39.383	39.387	39.397	39.402	39.404	39.407	39.417	39.422	39.421
SEE		.012	.096	.103	.101	.101	.101	.101	.100	.100	.101	.101	.102	.103	.104
N		20	20	20	20	20	20	20	20	20	20	20	20	20	20

PROCESS A 39.200 K OHMS UNSCREENED 125 DEGREE CENTIGRADE 2.5 X RATED POWER

SER NO	D/N	0	1	24	48	96	250	500	1000	1500	2000	2500	3000	3500	4000
33441		-.039	-.186	-.173	-.173	-.158	-.150	-.137	-.079	-.066	-.063	-.056	-.038	-.030	-.038
33442		.028	.525	.553	.553	.568	.571	.584	.612	.632	.640	.658	.709	.734	.739
33443		.012	.374	.397	.397	.408	.410	.410	.423	.433	.438	.438	.466	.489	.492
33444		.039	.507	.522	.528	.538	.548	.561	.584	.594	.599	.604	.614	.622	.619
33445		.032	.520	.535	.533	.545	.545	.558	.581	.596	.602	.607	.642	.660	.660
33446		-.018	-.135	-.124	-.119	-.107	-.091	-.071	-.045	-.025	-.017	-.005	.010	.022	.022
33447		.018	.385	.400	.403	.410	.420	.426	.436	.446	.443	.451	.484	.492	.489
33448		.038	.385	.400	.405	.418	.436	.454	.499	.512	.517	.525	.538	.548	.548
33449		0.000	.260	.278	.275	.285	.295	.313	.344	.369	.380	.397	.433	.448	.451
33450		.023	.487	.484	.479	.494	.502	.512	.551	.558	.586	.586	.632	.663	.673
33451		.048	.721	.737	.732	.744	.747	.755	.770	.778	.780	.780	.811	.821	.816
33452		.048	.752	.770	.767	.785	.803	.818	.867	.895	.915	.936	.971	.992	.989
33453		.048	.790	.806	.801	.811	.806	.803	.813	.816	.808	.803	.826	.834	.823
33454		.033	.617	.624	.591	.604	.614	.650	.691	.706	.742	.785	.793	.811	.823
33455		.018	.482	.502	.499	.515	.512	.522	.553	.568	.573	.579	.609	.619	.612
33456		.009	.336	.344	.339	.346	.339	.336	.349	.352	.344	.336	.359	.364	.352
33457		.029	.515	.528	.525	.535	.538	.543	.561	.571	.571	.571	.599	.609	.604
33458		.019	.392	.420	.423	.433	.431	.433	.438	.438	.431	.426	.448	.454	.443
33459		.025	.492	.857	.836	.844	.862	.872	.880	.887	.882	.890	.910	.918	.910
33460		0.000	.227	.237	.232	.239	.234	.234	.247	.255	.247	.244	.270	.278	.270
SX		.423	8.454	9.104	9.033	9.267	9.380	9.584	10.081	10.323	10.426	10.563	11.096	11.357	11.308
SXX		.018	4.753	5.499	5.397	5.612	5.717	5.906	6.362	6.606	6.736	6.904	7.506	7.819	7.778
AVG		.021	.422	.455	.451	.463	.469	.479	.504	.516	.521	.528	.554	.567	.565
SEE		.022	.249	.267	.263	.263	.263	.262	.259	.259	.261	.264	.266	.268	.269
N		20	20	20	20	20	20	20	20	20	20	20	20	20	20

PROCESS A 39.200 K OHMS UNSCREENED 125 DEGREE CENTIGRADE 2.5 X RATED POWER

SER NO	C/0	1	24	48	96	250	500	1000	1500	2000	2500	3000	3500	4000
33441		-.146	-.133	-.133	-.118	-.110	-.097	-.039	-.026	-.023	-.016	.001	.009	.001
33442		.496	.524	.524	.539	.542	.555	.583	.603	.611	.629	.680	.705	.710
33443		.362	.384	.384	.395	.397	.397	.410	.420	.425	.425	.453	.476	.479
33444		.467	.482	.488	.498	.508	.521	.544	.554	.559	.564	.574	.582	.579
33445		.487	.502	.500	.512	.512	.525	.548	.563	.569	.574	.609	.627	.627
33446		-.116	-.106	-.100	-.088	-.072	-.052	-.026	-.006	.001	.013	.029	.041	.041
33447		.366	.381	.384	.391	.401	.407	.417	.427	.424	.432	.465	.473	.470
33448		.346	.361	.366	.379	.397	.415	.461	.473	.478	.486	.499	.509	.509
33449		.260	.278	.275	.285	.295	.313	.344	.369	.380	.397	.433	.448	.451
33450		.463	.460	.455	.470	.478	.488	.527	.534	.562	.562	.608	.639	.649
33451		.672	.688	.683	.695	.698	.706	.721	.729	.731	.731	.762	.772	.767
33452		.703	.721	.718	.736	.754	.769	.818	.846	.866	.887	.922	.943	.940
33453		.741	.757	.752	.762	.757	.754	.764	.767	.759	.754	.777	.785	.774
33454		.583	.591	.557	.570	.580	.616	.657	.672	.708	.751	.759	.777	.789
33455		.463	.483	.481	.496	.493	.503	.534	.549	.554	.560	.590	.600	.593
33456		.326	.334	.329	.336	.329	.326	.339	.342	.334	.326	.349	.354	.342
33457		.485	.498	.495	.505	.508	.513	.531	.541	.541	.541	.569	.579	.574
33458		.372	.400	.403	.413	.411	.413	.418	.418	.411	.406	.428	.434	.423
33459		.466	.831	.810	.818	.836	.846	.854	.861	.856	.864	.884	.892	.884
33460		.227	.237	.232	.239	.234	.234	.247	.255	.247	.244	.270	.278	.270
SX		8.030	8.680	8.609	8.843	8.956	9.160	9.657	9.899	10.002	10.139	10.672	10.933	10.884
SXX		4.208	4.922	4.824	5.029	5.129	5.309	5.747	5.982	6.105	6.267	6.845	7.146	7.107
AVG		.401	.434	.430	.442	.447	.458	.482	.494	.500	.506	.533	.546	.544
SEE		.227	.246	.242	.242	.242	.242	.238	.238	.241	.243	.246	.248	.249
N		20	20	20	20	20	20	20	20	20	20	20	20	20

PROCESS A 39.200 K OHMS UNSCREENED 125 DEGREE CENTIGRADE 2.5 X RATED POWER

SER NO	C/1	24	48	96	250	500	1000	1500	2000	2500	3000	3500	4000
33441		.012	.012	.028	.035	.048	.107	.119	.122	.130	.147	.155	.147
33442		.028	.028	.043	.045	.058	.086	.107	.114	.132	.183	.209	.214
33443		.022	.022	.033	.035	.035	.048	.058	.063	.063	.091	.114	.117
33444		.015	.020	.030	.040	.053	.076	.086	.091	.096	.107	.114	.112
33445		.015	.012	.025	.025	.038	.061	.076	.081	.086	.122	.140	.140
33446		.010	.015	.028	.043	.063	.089	.109	.117	.130	.145	.158	.158
33447		.015	.017	.025	.035	.040	.051	.061	.058	.066	.099	.107	.104
33448		.015	.020	.033	.051	.068	.114	.127	.132	.140	.153	.163	.163
33449		.017	.015	.025	.035	.053	.084	.109	.119	.137	.173	.188	.191
33450		-.002	-.007	.007	.015	.025	.063	.071	.099	.099	.145	.176	.186
33451		.015	.010	.022	.025	.033	.048	.056	.058	.058	.089	.099	.094
33452		.017	.015	.033	.051	.066	.114	.142	.163	.183	.219	.239	.237
33453		.015	.010	.020	.015	.012	.022	.025	.017	.012	.035	.043	.033
33454		.007	-.025	-.012	-.002	.033	.073	.089	.125	.168	.176	.193	.206
33455		.020	.017	.033	.030	.040	.071	.086	.091	.096	.127	.137	.130
33456		.007	.002	.010	.002	0.000	.012	.015	.007	0.000	.022	.028	.015
33457		.012	.010	.020	.022	.028	.045	.056	.056	.056	.084	.094	.089
33458		.028	.030	.040	.038	.040	.045	.045	.038	.033	.056	.061	.051
33459		.364	.344	.352	.369	.380	.387	.395	.390	.397	.418	.426	.418
33460		.010	.005	.012	.007	.007	.020	.028	.020	.017	.043	.051	.043
SX		.650	.579	.813	.926	1.130	1.627	1.869	1.971	2.109	2.642	2.903	2.854
SXX		.138	.124	.138	.157	.180	.247	.294	.318	.363	.488	.567	.561
AVG		.032	.028	.040	.046	.056	.081	.093	.098	.105	.132	.145	.142
SEE		.078	.075	.074	.077	.078	.077	.079	.080	.086	.085	.087	.090
N		20	20	20	20	20	20	20	20	20	20	20	20

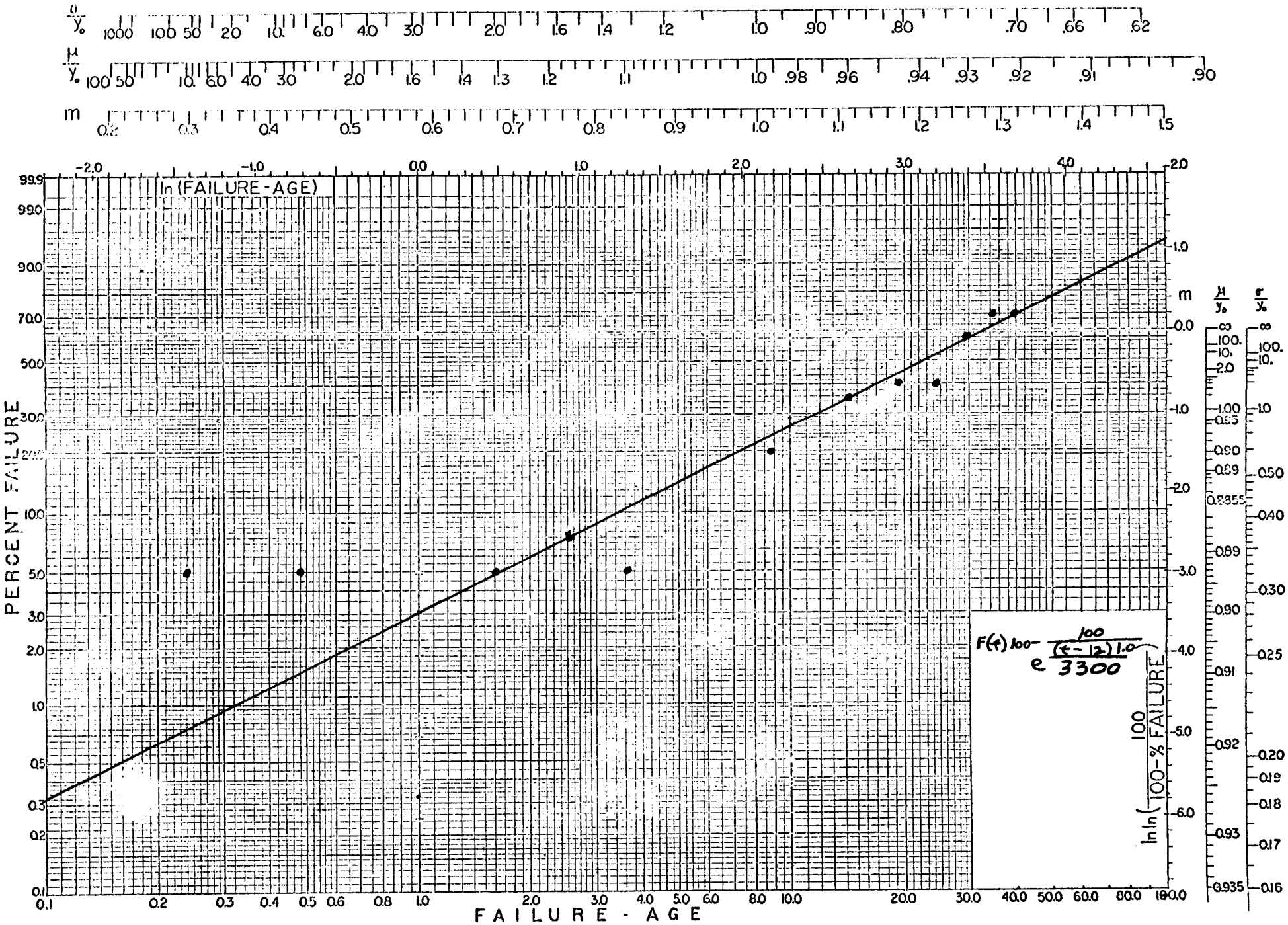
4 PROCESS A 39.200 K OHMS UNSCREENED 125 DEGREE CENTIGRADE 2.5 X RATED POWER

LOCATION	SHAPE	SCALE	VE	VB	VA	SX	SY	SXX	SYY	SXSX	SXY	P
-.002	2.865	.1404E-04	.4659E-01	.2730E-01	.8819E-10	-.7260E+02	-.6943E+01	.2945E+03	.1752E+02	.5271E+04	.3289E+02	18
-.025	3.363	.2638E-04	.9355E-01	.8041E-01	.5944E-09	-.5847E+02	-.6943E+01	.1911E+03	.1752E+02	.3419E+04	.2646E+02	18
-.012	3.312	.2869E-04	.4432E-01	.3460E-01	.3075E-09	-.5893E+02	-.6943E+01	.1942E+03	.1752E+02	.3473E+04	.2697E+02	18
-.002	1.415	.9988E-02	.1094E-00	.1703E-01	.2174E-04	-.6348E+02	-.6943E+01	.2303E+03	.1752E+02	.4030E+04	.3358E+02	18
0.000	1.548	.8927E-02	.9637E-01	.1761E-01	.1568E-04	-.5933E+02	-.6943E+01	.2010E+03	.1752E+02	.3520E+04	.3135E+02	18
.012	1.241	.3240E-01	.8996E-01	.1047E-01	.1091E-03	-.5531E+02	-.6943E+01	.1786E+03	.1752E+02	.3060E+04	.3199E+02	18
.015	1.285	.3533E-01	.6357E-01	.7663E-02	.8492E-04	-.5221E+02	-.6943E+01	.1597E+03	.1752E+02	.2726E+04	.3080E+02	18
.007	1.161	.6188E-01	.8888E-01	.9046E-02	.2768E-03	-.4911E+02	-.6943E+01	.1438E+03	.1752E+02	.2411E+04	.3035E+02	18
0.000	1.205	.6793E-01	.6577E-01	.6993E-02	.2268E-03	-.4591E+02	-.6943E+01	.1265E+03	.1752E+02	.2108E+04	.2904E+02	18
.022	1.215	.7048E-01	.7288E-01	.7951E-02	.2669E-03	-.4499E+02	-.6943E+01	.1216E+03	.1752E+02	.2024E+04	.2849E+02	18
.028	1.241	.7352E-01	.6653E-01	.7513E-02	.2564E-03	-.4343E+02	-.6943E+01	.1136E+03	.1752E+02	.1886E+04	.2774E+02	18
.015	1.279	.7704E-01	.6429E-01	.7682E-02	.2636E-03	-.4150E+02	-.6943E+01	.1040E+03	.1752E+02	.1722E+04	.2671E+02	18

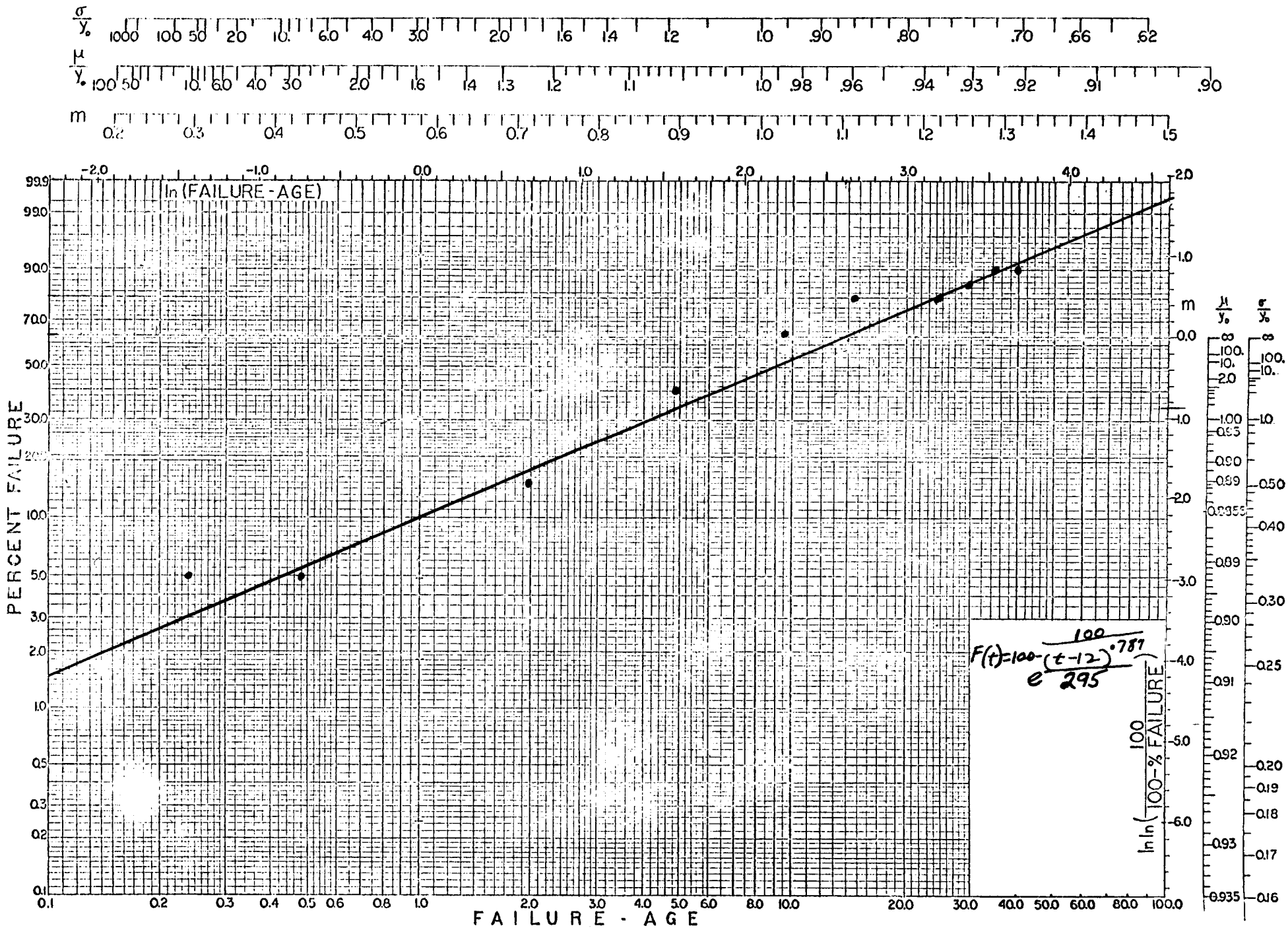
0.00ADL PCT	24	48	96	250	500	1000	1500	2000	2500	3000	3500	4000
24.00	.038	.3040E-00	.1761E-00	.6075E-02	.2623E-01	.7301E+02	.1589E+02	.5136E+03	.2495E+02	.5331E+04	.1066E+03	11
.050	99.97	96.31	96.36	99.97	97.17	96.89	97.21	97.02	97.22	99.99	96.36	97.77
.050	100.00	2.43	2.07	1.74	1.55	1.38	1.28	1.22	1.18	1.14	1.11	1.08
24.00	.038	.3040E-00	.1761E-00	.6075E-02	.2623E-01	.7301E+02	.1589E+02	.5136E+03	.2495E+02	.5331E+04	.1066E+03	11
.045	99.97	96.31	96.36	99.97	97.17	96.89	97.21	97.02	97.22	99.99	96.36	97.77
.045	100.00	2.43	2.07	1.74	1.55	1.38	1.28	1.22	1.18	1.14	1.11	1.08
24.00	.038	.3040E-00	.1761E-00	.6075E-02	.2623E-01	.7301E+02	.1589E+02	.5136E+03	.2495E+02	.5331E+04	.1066E+03	11
.040	99.97	96.31	96.36	99.97	97.17	96.89	97.21	97.02	97.22	99.99	96.36	97.77
.040	100.00	2.43	2.07	1.74	1.55	1.38	1.28	1.22	1.18	1.14	1.11	1.08
24.00	.038	.3040E-00	.1761E-00	.6075E-02	.2623E-01	.7301E+02	.1589E+02	.5136E+03	.2495E+02	.5331E+04	.1066E+03	11
.035	99.97	96.31	96.36	99.97	97.17	96.89	97.21	97.02	97.22	99.99	96.36	97.77
.035	100.00	2.43	2.07	1.74	1.55	1.38	1.28	1.22	1.18	1.14	1.11	1.08
24.00	.038	.3040E-00	.1761E-00	.6075E-02	.2623E-01	.7301E+02	.1589E+02	.5136E+03	.2495E+02	.5331E+04	.1066E+03	11

4 PROCESS A 39.200 K OHMS UNSCREENED 125 DEGREE CENTIGRADE 2.5 X RATED POWER

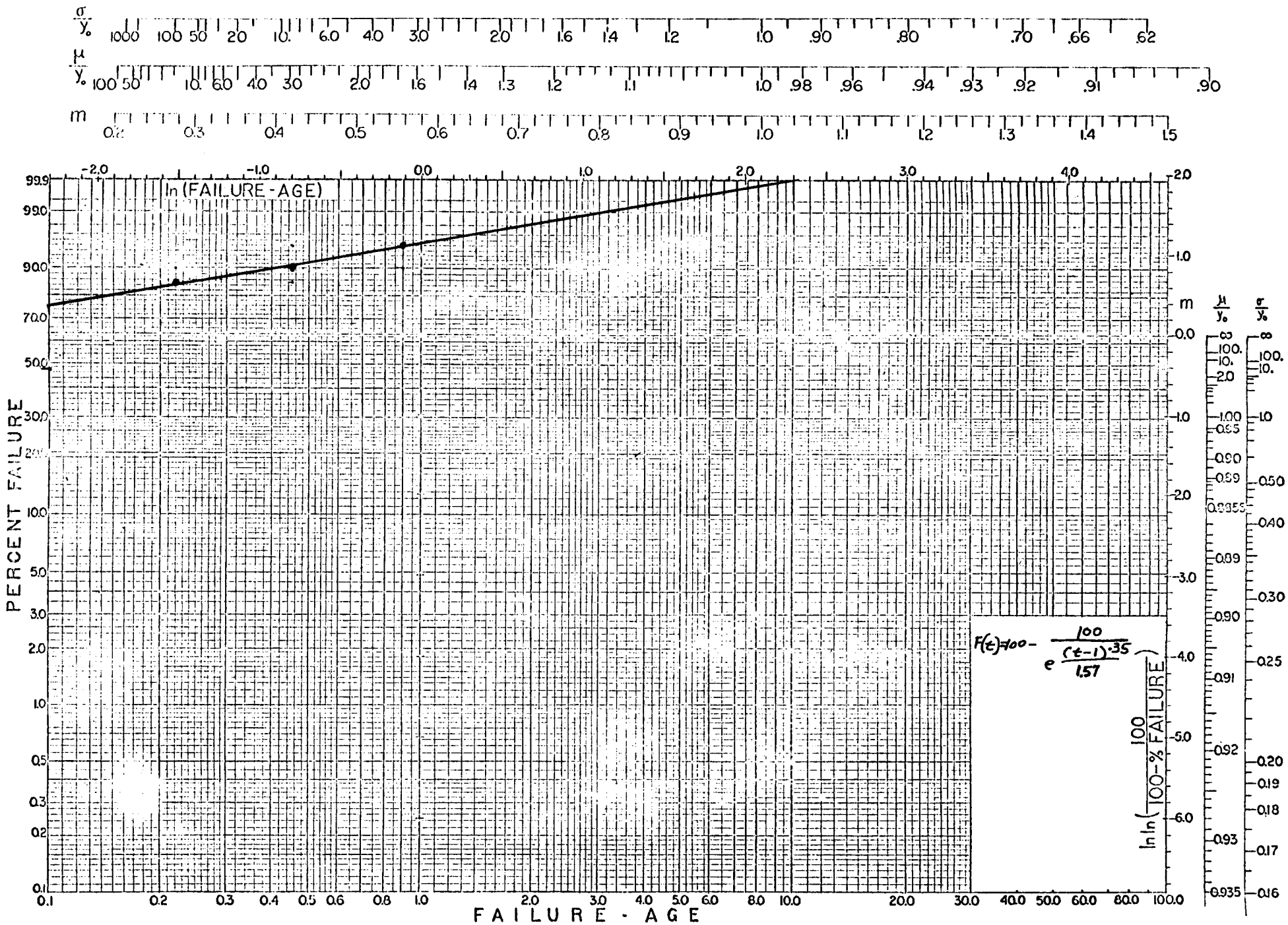
0.00ADL PCT	24	48	96	250	500	1000	1500	2000	2500	3000	3500	4000


σ/y₀
1000 100 50 20 10. 6.0 4.0 3.0 2.0 1.6 1.4 1.2 1.0 .90 .80 .70 .66 .62
μ/y₀
100 50 10. 6.0 4.0 3.0 2.0 1.6 1.4 1.3 1.2 1.1 1.0 .98 .96 .94 .93 .92 .91 .90
m
0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0 1.1 1.2 1.3 1.4 1.5
ln (FAILURE - AGE)
PERCENT FAILURE
FAILURE - AGE
m
μ/y₀
σ/y₀
F(t) 100 - 100 / e^((t-12)1.0/3300)
ln ln (100 / (100 - % FAILURE))

ADL ±100


σ/y₀
1000 100 50 20 10. 6.0 4.0 3.0 2.0 1.6 1.4 1.2 1.0 .90 .80 .70 .66 .62
μ/y₀
100 50 10. 6.0 4.0 3.0 2.0 1.6 1.4 1.3 1.2 1.1 1.0 .98 .96 .94 .93 .92 .91 .90
m
0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0 1.1 1.2 1.3 1.4 1.5
ln (FAILURE - AGE)
PERCENT FAILURE
FAILURE - AGE
m
μ/y₀
σ/y₀
ln ln (100/(100 - % FAILURE))
F(t) = 100 - 100 / e^((t-12)/295)^.787

ADL ±.050


σ/y₀
1000 100 50 20 10. 6.0 4.0 3.0 2.0 1.6 1.4 1.2 1.0 .90 .80 .70 .66 .62
μ/y₀
100 50 10. 6.0 4.0 3.0 2.0 1.6 1.4 1.3 1.2 1.1 1.0 .98 .96 .94 .93 .92 .91 .90
m
0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0 1.1 1.2 1.3 1.4 1.5
ln (FAILURE - AGE)
PERCENT FAILURE
FAILURE - AGE
F(t)=100 - 100 / e^((t-1)^.35 / 1.57)
ln ln (100 / (100 - % FAILURE))

ADL ±.010