

08DEN AIR LOGISTICS CENTER HILL AFB UT PROPELLANT LAB--ETC F/G 21/8.2
PROPELLANT SURVEILLANCE REPORT LGM-30 F & G STAGE I, PHASE G. S--ETC(U)
APR 80 J A THOMPSON
MANCP-438(80) NL

NL

10 OF 10

LEVEL *II*

HEADQUARTERS

OGDEN AIR LOGISTICS CENTER

UNITED STATES AIR FORCE

HILL AIR FORCE BASE, UTAH 84056

2
R

ADA 085630

PROPELLANT
SURVEILLANCE REPORT
LGM-30 F&G STAGE 1
PHASE G, SERIES I
TP-H1011

SDTIC
ELECTE
JUN 1 8 1980
D
C

PROPELLANT ANALYSIS LABORATORY

MAKPH REPORT

438(80)

April 1980

Handwritten signature and date 14/1/80

APPROVED FOR PUBLIC RELEASE, DISTRIBUTION UNLIMITED

DDC FILE COPY

80 6 16 171

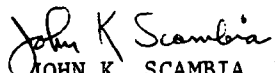
MAKPH REPORT NO 438(80)
MMWRM PROJECT M04046C-WNL0529

PROPELLANT SURVEILLANCE REPORT
LGM-30 F & G STAGE 1 (TP-H1011)

AUTHOR


JOHN A. THOMPSON, Chemist
Component & Combustion Test Unit

Engineering & Statistical Review By


JOHN K. SCAMBIA, Project Engineer
Service Engineering

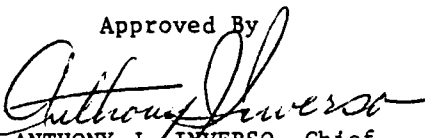

EDWARD J. ERICKSON, Math/Stat
Data Analysis Unit

Recommended Approval By


LEONIDAS A. BROWN, Chief
Component & Combustion Test Unit


RONALD F. LARSEN, Chief
Physical & Mechanical Test Unit

Approved By


ANTHONY J. INVERSO, Chief
Propellant Analysis Laboratory

April 1980

Directorate of Maintenance
Ogden Air Logistics Center
United States Air Force
Hill Air Force Base, Utah 84056

ABSTRACT

✓
This report contains propellant test results from cartons of TP-H1011 bulk propellant representing LGM-30 F and G First Stage Minuteman Motors. This report uses a statistical approach to analyze the bulk carton propellant data. Testing was accomplished in accordance with MMWRM Project MO4046C-WNL01529.

The data from this test period are combined with data from previous testing and entered into the G085 Computer for storage, analysis and regression analysis. From the statistical analysis of all data tested to date (fourteen years for F and G), significant degradation of the propellant does not appear likely for at least two years past the oldest data point.

Each point on the regression plot represents the mean of all samples at that particular age. The number of samples at each point is indicated on the sample size summary sheet on the page accompanying each regression plot or group of regression plots. The data range at any age can be found by suitable inquiry of the G085 system.

Accession For

NTIS	✓
DDC TAB	
Unannounced	
Justification	

By _____

Distribution/_____

Availability Codes

Dist	Avail and/or special
A	

TABLE OF CONTENTS

	<u>Page</u>
Abstract	ii
List of Figures	iv
List of References	viii
Glossary of Terms and Abbreviations	xiii
Introduction	1
Table 1 - Test Program	3
Statistical Approach	4
Test Results	6
Conclusions	10
Distribution List	117
DD 1473	118

LIST OF FIGURES

<u>Figure Nr</u>		<u>Page</u>
	Regression Plot, Very Low Rate Tensile	
1	Strain at Maximum Stress	12
2	Maximum Stress	13
3	Strain at Rupture	14
4	Stress at Rupture	16
5	Modulus	18
	Regression Plot, Low Rate Biaxial Tensile	
6	Strain at Maximum Stress	20
7	Maximum Stress	21
8	Strain at Rupture	22
9	Stress at Rupture	23
10	Modulus	24
	Regression Plot, Low Rate Tensile	
11	Strain at Maximum Stress	26
12	Maximum Stress	27
13	Strain at Rupture	28
14	Stress at Rupture	29
15	Modulus	30
	Regression Plot, High Rate Triaxial Tensile	
16	Strain at Maximum Stress	32
17	Maximum Stress	33
18	Strain at Rupture	34
19	Stress at Rupture	35
20	Modulus	36

LIST OF FIGURES (cont)

<u>Figure Nr</u>		<u>Page</u>
	Regression Plot, High Rate Hydrostatic Tensile	
21	Strain at Maximum Stress	38
22	Maximum Stress	39
23	Strain at Rupture	40
24	Stress at Rupture	41
25	Modulus	42
26	Regression Plot, Tear Energy	44
	Regression Plot, Stress Relaxation, .5% Strain, -65°F	
27	Modulus at 10 sec	46
28	Modulus at 50 sec	47
29	Modulus at 100 sec	49
30	Modulus at 1000 sec	50
	Regression Plot, Stress Relaxation, .5% Strain, -40°F	
31	Modulus at 10 sec	52
32	Modulus at 50 sec	53
33	Modulus at 100 sec	54
34	Modulus at 1000 sec	55
	Regression Plot, Stress Relaxation, 3% Strain, 20°F	
35	Modulus at 10 sec	57
36	Modulus at 50 sec	58
37	Modulus at 100 sec	59
38	Modulus at 1000 sec	60
	Regression Plot, Stress Relaxation, 3% Strain, 77°F	
39	Modulus at 10 sec	62

LIST OF FIGURES (cont)

<u>Figure Nr</u>		<u>Page</u>
	Regression Plot, Stress Relaxation, 3% Strain 77°F	
40	Modulus at 50 sec	63
41	Modulus at 100 sec	64
42	Modulus at 1000 sec	65
	Regression Plot, Stress Relaxation, 3% Strain, 100°F	
43	Modulus at 10 sec	67
44	Modulus at 50 sec	68
45	Modulus at 100 sec	69
46	Modulus at 1000 sec	70
	Regression Plot, Stress Relaxation, 3% Strain 140°F	
47	Modulus at 10 sec	72
48	Modulus at 50 sec	73
49	Modulus at 100 sec	74
50	Modulus at 1000 sec	75
	Regression Plot, Stress Relaxation, 3% Strain, 180°F	
51	Modulus at 10 sec	77
52	Modulus at 50 sec	78
53	Modulus at 100 sec	79
54	Modulus at 100 sec	80
	Regression Plot, Sol Gel	
55	Density	82
56	Percent Extractables	83
57	Gel Swell Ratio	84
58	Crosslink Density	86

LIST OF FIGURES (cont)

<u>Figure</u>		<u>Page</u>
59	Regression Plot, Constant Strain	88
60	Regression Plot, Hardness	90
	Regression Plot, Pressure Time	
61	Maximum Pressure	92
62	Time to Maximum Pressure	93
	Regression Plot, TCLE	
63	TCLE Above T_g	95
64	TCLE Below T_g	96
	Regression Plot, TGA, 9°C rise/min	
65	Ignition Temperature	98
66	Percent Weight Loss at 250° Hold	100
67	Percent Weight Loss at Ignition	102
	Regression Plot, DTA, 12°C rise/min	
68	Endotherm	104
69	Exotherm 1	105
70	Exotherm 2	107
71	Exotherm 3	109
72	Ignition Temperature	111
73	Regression Plot, Burning Rate, 1000 psi	113
	Regression Plot, DSC	
74	Endotherm	115
75	Exotherm 1	116
76	Exotherm 2	117

LIST OF REFERENCES

<u>Report Nr</u>	<u>Title</u>	<u>Report Date</u>
	LGM-30 First Stage, Wing I Test Reports	
29A	Test Report (Missile in silo)	13 Jan 64
29B	Zero Time Test Results	29 Jan 64
29C	Zero Time Test Results (Supplement 1)	30 Mar 64
29D	Zero Time Test Results (Aft Closure)	9 Jun 64
29E	Zero Time (Aft Closure Supplement 1)	24 Jun 64
29F	ATP Phase I Test Results	30 Mar 65
29G	ATP Phase I Test Results	19 Aug 65
29H	ATP Phase I Test Results	10 Sep 65
32A	Zero Time, Wings II-V Test Results	17 Mar 65
32B	Zero Time, Wings II-V Test Results (Aft Closure)	18 Mar 65
32C	ATP Phase I, Wings II-V Test Results	3 Nov 65
49	ATP Phase I, wings II-V (First Group)	18 Mar 66
53	ATP Phase I, wings II-V (Second Group)	22 Apr 66
55	ATP Phase I, wings II-V (Third Group)	29 Apr 66
58	ATP Phase I, wings II-V (Fourth Group)	6 May 66
61	ATP Phase I, wings II-V (Fifth Group)	10 Jun 66
66	ATP Phase I, wings II-V (Sixth Group)	22 Jul 66
76	ATP Phase II, Wing I Test Results	24 Jan 67
78	Zero Time, wing VI Test Results	3 Feb 67
104	ATP Phase I, wing VI (First Group	12 Oct 67
118	ATP Phase II, Wings II-V (First Group)	5 Mar 68

LIST OF REFERENCES (CONT)

<u>Report Nr</u>	<u>Title</u>	<u>Report Date</u>
126	ATP Phase II, Wings II-V (Second Group)	11 Apr 68
130	ATP Phase II, Wings II-V (Third Group)	3 May 68
162	ATP Phase I, Wing VI (Second Group)	30 Sep 69
176	ATP Phase II, Wing VI (First Group)	15 Apr 70
181	ATP Phase III, Wing I	7 May 70
185	ATP Phase I, Wing VI (Third Group)	22 Jun 70
195	ATP Phase III, Wings II-V (Retest)	29 Oct 70
223	Surveillance Report LGM-30 Stage I (TP-H1011)	Sep 71
239	Surveillance Report LGM-30 Stage I (TP-H1011 and TP-H1043)	Apr 72
258	Surveillance Report LGM-30 A & B Stage I (TP-H1011)	Nov 72
268	Surveillance Report LGM-30 A & B Stage I (TP-H1011)	May 73
271	Surveillance Report LGM-30 F & G Stage I Phase A Series II, (TP-H1011)	Jul 73
277	Surveillance Report LGM-30 F & G Stage I Phase A Series III, (TP-H1011)	Oct 73
280	Surveillance Report LGM-30 A & B Stage I (TP-H1011)	Nov 73
288	Propellant Surveillance Report LGM-30 A & B, Stage I, TP-H1043	Mar 74
290	Propellant Surveillance Report LGM-30 F & G, Stage I, Phase B, Series I TP-H1011	Mar 74
300	Minuteman Stage I Motor Reliability Improvement Program Surveillance	May 74

LIST OF REFERENCES (CONT)

<u>Report Nr</u>	<u>Title</u>	<u>Report Date</u>
302	Propellant Surveillance Report LGM-30 A & B Stage 1, TP-H1011	Nov 74
313	Stage 1 Propellant Surveillance Report, Propellant Containing Glacial Acrylic Acid	Oct 74
315	Propellant Surveillance Report LGM-30 F & G Stage 1, TP-H1011	Jan 75
316	Propellant Surveillance Report LGM-30 A & B Stage 1, TP-H1011	Feb 75
319	Propellant Surveillance Report LGM-30 Dissected Motors, Phase VI, TP-H1011	Apr 75
321	Propellant Surveillance Report LGM-30 F & G Stage 1, Phase B, Series II, TP-H1011	Apr 75
325	Propellant Surveillance Report LGM-30 A & B Stage 1, TP-H1011	Jun 75
328	Propellant Surveillance Report LGM-30 A & B Stage 1, TP-H1011	Sep 75
330	Propellant Surveillance Report LGM-30 F & G Stage 1, TP-H1011	Oct 75
335	Stage 1 Motor Reliability Improvement Program	Dec 75
337	Propellant Surveillance Report LGM-30 A & B, Stage 1, TP-H1043	Feb 76
339	Stage 1, New MAPO & ERL-510 Qualification	Mar 76
341	Propellant Surveillance Report LGM-30 Dissected Motors, Phase VII, TP-H1011	Mar 76

LIST OF REFERENCES (CONT)

<u>Report Nr</u>	<u>Title</u>	<u>Report Date</u>
343	Propellant Surveillance Report LGM-30 A & B, Stage 1, TP-H1011	Jun 76
345	Propellant Surveillance Report LGM-30 F & G, Stage 1 Phase B, Series III, TP-H1011	Jun 76
350	Qualification of a New MAPO Source and ERL-510 Curing Agent for Minuteman, Stage 1, UF-2121 Liner	Sep 76
351	Propellant Surveillance Report LGM-30 A & B, Stage 1, TP-H1011	Sep 76
354	Minuteman Stage 1 Motor Reliability Improvement Program Surveillance	Sep 76
358	Propellant Surveillance Report LGM-30 Dissected Motors, Phase VIII, TP-H1011	Oct 76
360	Propellant Surveillance Report LGM-30 F & G, Stage 1 Phase E, Series III, TP-H1011	Nov 76
367	Propellant Surveillance Report LGM-30 A & B, Stage 1, TP-H1011	Apr 77
370	Propellant Surveillance Report LGM-30 F & G, Stage 1, Phase E, Series II, TP-H1011	Apr 77
377	Qualification of a New MAPO Source and ERL-510 Curing Agent for Minuteman Stage 1, UF-2121 Liner	Oct 77
379	Final RIP Report, Minuteman Stage 1 Motor Reliability Improvement Program Surveillance	Oct 77
385	Propellant Surveillance Report LGM-30 A, B, F, & G, Stage 1, TP-H1043	Dec 77
388	Propellant Surveillance Report LGM-30 A & B Stage 1, TP-H1011	Jan 78
390	Propellant Surveillance Report LGM-30 F & G Stage 1, Phase E, Series IV, TP-H1011	Feb 78
392	Propellant Surveillance Report LGM-30 Dissected Motors, Phase IX, TP-H1011	Mar 78
393	Propellant Surveillance Report LGM-30 A & B Stage I, TP-H1011	May 78

LIST OF REFERENCES (CONT)

<u>Report Nr</u>	<u>Title</u>	<u>Report Date</u>
396	Propellant Surveillance Report LGM-30 F & G Stage I, TP-H1011	Jun 78
405	Propellant Surveillance Report LGM-30 F & G Stage I, TP-H1011	Oct 78
406	Propellant Surveillance Report LGM-30 Dissected Motors, Phase X, TP-H1011	Nov 78
416	Propellant Surveillance Report LGM-30 F and G Stage I, TP-H1011	Apr 79
423	Propellant Surveillance Report LGM-30 F and G Stage I, TP-H1011	Oct 79
424	Propellant Surveillance Report LGM-30 Stage I, TP-H1043	Nov 79
425	Propellant Surveillance Report LGM-30 A and B Stage I, TP-H1011	Nov 79
427	Propellant Surveillance Report LGM-30 Dissected Motors, Phase XI, TP-H1011	Nov 79

GLOSSARY OF TERMS AND ABBREVIATIONS

Aging Trend	A change in properties or performance resulting from aging of material or component
CSA	Cross Sectional Area
DB	Dogbone
Degradation	Gradual deterioration of properties or performance
E	Modulus (psi), defined as stress divided by strain along the initial linear portion of the curve.
EB	End Bonded
EGL	Effective Gage Length
em	Strain at maximum stress
er	Strain at rupture
"F" ratio	The ratio of the variance accounted for by the regression function to the random unexplained variance. The regression function having the most significant "F" ratio is used for plotting data. The ratio is also used in detecting significant changes in random variation between succeeding time points
JANNAF	Joint Army, Navy, NASA, Air Force Committee
MANCP	Propellant Lab Section at Ogden Air Logistics Center
Ogden ALC	Ogden Air Logistics Center, Air Force Logistics Command
r or R	The Correlation Coefficient is a measure of the degree of closeness of the linear relationship between two variables
Linear Regression Equation	The general form of the linear regression equation is $Y = a + bx$
Regression Line	Line representing mean test values with respect to time
S_b	Standard error of estimate of the regression coefficient

GLOSSARY OF TERMS AND ABBREVIATIONS (cont)

S_e or $S_{y.X}$	Standard deviation of the data about the regression line
S_m	Maximum Stress
S_r	Stress at rupture
Standard Deviation (S_y)	Square root of variance
Strain Rate	Crosshead speed divided by the EGL
"t" test	A statistical test used to detect significant differences between a measured parameter and an expected value of the parameter (determines if regression slope differs from zero at the 95% confidence level)
Variance	The sum of squares of deviations of the test results from the mean of the series after division by one less than the total number of test results
3 Sigma Band	The area between the upper and lower 3 sigma limit. It can be expected that 99.73% of the inventory represented by the test samples would fall within this range assuming that the population is normally distributed.
90-90 Band	It can be stated with 90% confidence that 90% of the inventory represented by the test samples would fall within this range assuming that the population is normally distributed
Significant	As used in the statistical sense, means a difference unlikely to have been the result of random sampling from some specified population.

INTRODUCTION

A. PURPOSE:

Laboratory testing has been performed for fourteen years on First Stage LGM-30 F and G Minuteman Motor propellant blocks to evaluate the effects of aging on TP-H1011 propellant. This report contains those tests conducted on propellant as instructed in MMWRM Test Directive GTD-1C, Amendment 2, LGM-30 First Stage Operational Propellant Laboratory Testing.

Statistical analysis of the data from tests performed will provide early warning if serious degradation trends develop. Annual evaluation of the propellant provides data for input into engineering reliability analysis for service life predictions.

B. BACKGROUND:

LGM-30 F and G testing was started in 1966 with phase testing at 24 month intervals (Report Numbers 78 - zero time; 104, 162, 185-Phase I: 176, 239, 257-Phase II; 271-Phase III). Report Number 257 was the first time that LGM-30 F and G data were statistically analyzed separately from LGM-30A and B data. The present report is a continuation of testing and statistical analysis.

Zero time testing for LGM-30A, B, F and G was started as soon as possible after receipt of the propellant by MAKPH. Data from these tests were used to establish a base line for each test parameter.

The LGM-30F and G propellant test matrix (Table 1) is used to determine the number of specimens to be taken from each propellant loaf and the specific test or tests to which these specimens are to be subjected. Very low rate and low rate tensile specimens are taken on all LGM-30F and G blocks. Specimens for other physical and combustion tests are taken from every third (LGM-30F and G) block.

TABLE 1

SAMPLE PLAN

The Procedure for determining tests to be performed on propellant batch samples of LGM-30 F & G First Stage Motors are as follows:

1. Divide the USAF motor serial numbers into three groups by dividing the last three digits of each serial number by three to determine the remainder integer, e.g., $154 \div 3 = 51$ with a remainder integer of 1.
2. Use the remainder integer to enter the following matrix to determine the group of tests to be performed on the forward, middle, and aft batch samples associated with a particular motor serial number.

TP-H1011 PROPELLANT BATCH SAMPLE	GROUP MATRIX		
	GROUP I	GROUP II	GROUP III
Forward	1	2	0
Middle	0	1	2
Aft	2	0	1

Each group will receive the following tests:

TEST MATRIX		
GROUP I	GROUP II	GROUP III
High Rate Triaxial	Dynamic Response	High Rate Hydrostatic
Creep	Stress Relaxation	Sol Gel
Biaxial Low Rate	Burning Rate	DSC
TCLE	Heat of Explosion	TGA
Hardness	Pressure Time	DTA
Ignitability		Impact

NOTE: Low Rate and Very Low Rate Tensile tests are performed on all blocks.

STATISTICAL APPROACH

In order to determine aging trends for shelf/service life predictions, as directed by Service Engineering, First Stage LGM-30 F and G Minuteman TP-H1011 propellant blocks have been undergoing testing since 1966, statistically analyzed and reported on a regular test cycle by this laboratory.

The primary reason for performing statistical analysis on test data is for the detection of propellant changes due to aging that would affect motor reliability. Regression analysis was the method used to examine data and to aid in drawing conclusions about dependency relationships that may exist i.e., relationship between age versus test results.

In selecting the best fit model for the regression equation, the linear model $Y = a + bX$ was found to be the best fit model for the regression plots.

Individual data points from different time periods were used to establish a least squares trend line for the data. The variance about the regression line, obtained using individual values of the dependent variable, was used to compute a tolerance interval such that at the 90% confidence level 90% of the sample distribution falls within this interval. This tolerance interval was extrapolated to a maximum of 24 months into the future from age of the oldest motor tested. The 't' value and the significance of this statistic, which are reported for each regression model, give an indication of the "statistical significance" of the slope of the trend line as compared to a line of zero slope. When a regression slope is indicated to be significant, it should be noted that the slope of the regression line is significant from a statistical standpoint and it is an indication that a change over time is occurring, but does not necessarily mean that the indicated change in the

value obtained during testing is significant in regards to motor operational performance. In a few cases, this small change has become the apparent trend in data variance and regression line trends. However, the changes are gradual and no operational problems are expected at this time.

The data were plotted by computer. The 'y' axis is computed so that the values at one inch intervals are peculiar to the data spread of the parameter tested. Plotted data points represent means at the particular ages at which testing occurred. The number of specimens at each age point is indicated on the sample size summary sheet accompanying the regression plot. Variance at each test age can be determined by consulting the G085 data storage system.

TEST RESULTS

VERY LOW RATE TENSILE:

Very low rate regressions show a statistically significant decrease for strain at maximum stress and strain at rupture. The stresses and modulus show a statistically significant increase (Figures 1 thru 5). The trends are gradual for the respective regressions and no operational problems from the propellant are expected for at least two years beyond the last test data.

LOW RATE BIAXIAL TENSILE:

The strain at maximum stress regression shows a statistically significant gradual increase with the strain at rupture showing no statistically significant change. The stresses and modulus show a statistically significant increase (Figures 6 thru 10).

LOW RATE TENSILE:

Low rate tensile data regressions show a statistically significant gradual decrease for strains and a statistically significant increase for stresses and modulus (Figures 11 thru 15).

HIGH RATE TRIAXIAL TENSILE:

The strain at maximum stress, strain at rupture and modulus regressions show a statistically significant decrease. Maximum stress shows a statistically significant increase. Stress at rupture does not show a significant change (Figures 16 thru 20).

HIGH RATE HYDROSTATIC TENSILE:

The strains show a statistically significant decrease. The stresses and modulus show a statistically significant increase (Figures 21 thru 25).

TEAR ENERGY:

The cohesive energy shows a statistically significant decrease (Figure 26).

TENSILE SUMMARY:

The test data regressions show that the strain is gradually decreasing and the stress and modulus gradually increasing.

Based on the analysis of test data regressions, it does not appear that meaningful degradation is occurring at this time and no operational problems are expected in the propellant for at least two years beyond the last data point.

STRESS RELAXATION MODULUS:

For the 0.5% strain at -65°F, the regressions for data at 10, 50, 100, and 1000 seconds show a statistically significant gradual increase. (Figures 27 thru 30).

At -40°F, the 10, 50, and 100 second regressions show a statistically significant increase. The 1000 second regression shows no statistically significant change. (Figures 31 thru 34).

The 3% strain regressions at 20°F, 77°F, 100°F, and 180°F show a statistically significant gradual increase. (Figures 35 thru 54).

SOL GEL:

The percent extractables, density and gel swell ratio do not show a significant change. The crosslink density regression shows a statistically significant increase (Figures 55 thru 58).

CONSTANT STRAIN:

A statistically significant gradual decrease is shown for constant strain (Figure 59).

HARDNESS:

Shore A ten second hardness shows a statistically significant increase (Figure 60).

SUMMARY OF SOL GEL, TENSILE AND HARDNESS DATA:

The crosslink density, constant strain and hardness data regressions correlate with the tensile data. As the polymer continues to crosslink, the strains decrease and the stresses increases.

PRESSURE TIME:

Maximum pressure shows no significant change while time to maximum pressure shows a statistically significant gradual decrease (Figures 61 and 62).

TCLC (Thermal Coefficient of Linear Expansion):

The thermal coefficient of linear expansion for both above and below the glass transition point (T_g) shows a statistically significant gradual increase (Figures 63 and 64).

TGA (Thermal Gravimetric Analysis):

A statistically significant increase is shown for the ignition temperature (9°C rise/min), the percent weight loss at 250°C hold (12°C rise/min to hold) and the weight loss at ignition (Figures 65 thru 67).

DTA (Differential Thermal Analysis):

The endotherm and first and second exotherms show a statistically significant decrease. The third exotherm shows a statistically significant increase and the ignition temperature with no significant change (Figures 68 thru 72).

BURNING RATE:

The burning rate shows a statistically significant gradual increase (Figure 73).

DIFFERENTIAL SCANNING CALORIMETER:

The endotherm and first and second exotherms shows a statistically significant decrease. (Figures 74 thru 76).

THERMAL AND COMBUSTION SUMMARY:

The time to maximum pressure from the pressure time data and burning rate data show a correlation. In both cases, the regressions show a gradual increase in rate of reaction. The maximum pressure and DSC regressions also correlate well with each other. In both cases, a gradual decrease in energy is shown.

The ignition temperatures for TGA shows a gradual increase.

From the analyses of the regressions, no combustion problems are expected for at least two years beyond the oldest data point.

CONCLUSIONS

Fourteen years of aging at ambient temperature (77°F) has not greatly changed the properties of the propellant. Some test parameters indicate slight aging trends, but nothing that would adversely affect the operational characteristics of the rocket motor propellant.

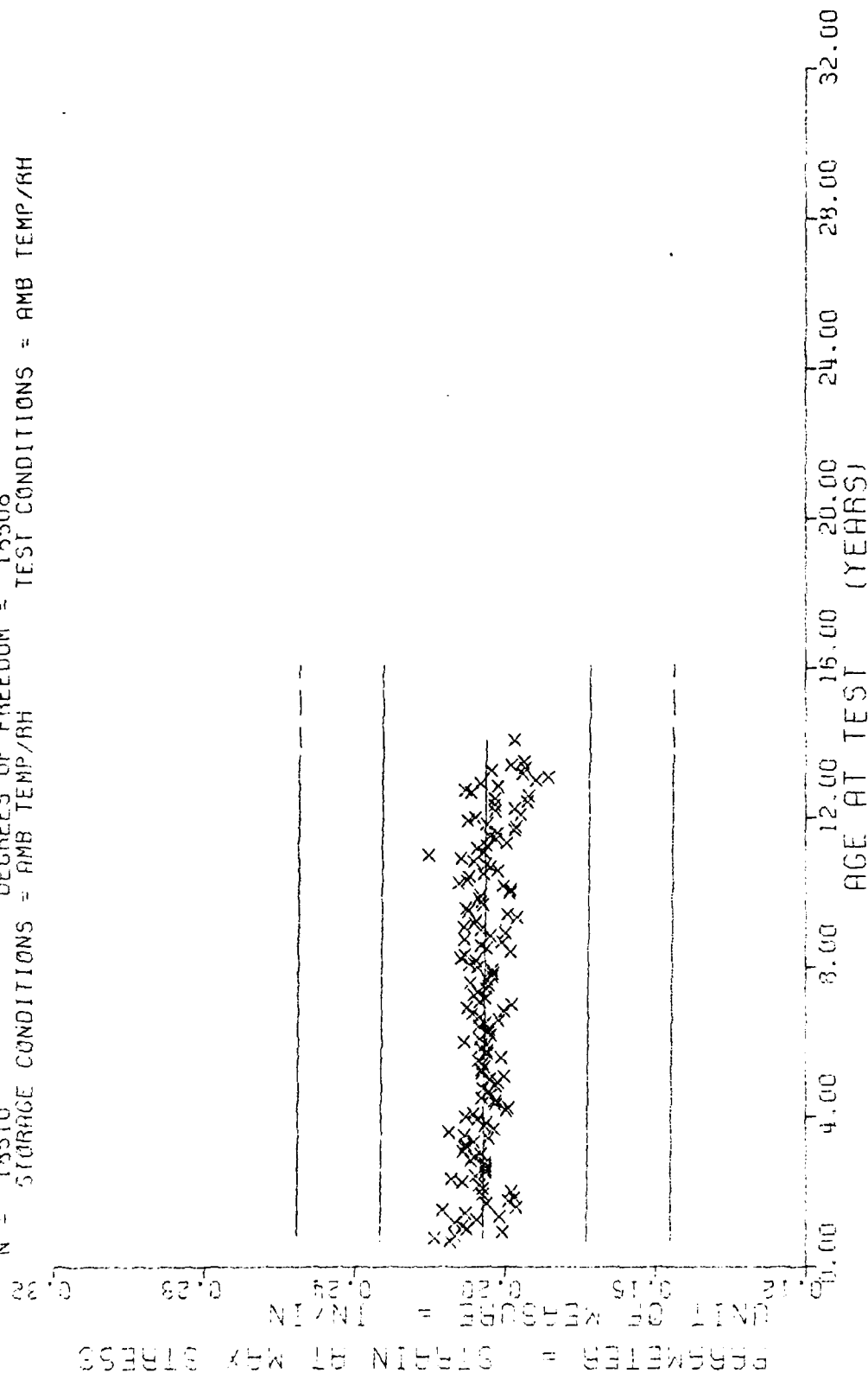
From the statistical analysis, it does not appear that a significant propellant degradation is occurring. Based on fourteen years of accumulated data, there is no reason to suspect that properties will show much change for at least two years past the last data point. Therefore, propellant reliability should not change appreciably over that time period. Since failure limits are not available for the parameters tested, this statement is based on the fact that the slope of the regression curves where statistically significant are, with few exceptions, relatively flat or close to the line of zero slope and have not changed appreciably from the last test period.

[illegible]

WING O.V.L.C., T.N.B.U.L., S.T.A.I.N. AT 11X STOPS 35, CHS=, 302 IN/NIN TO-HH C11

This sample size summary is applicable to figures 1 thru 3

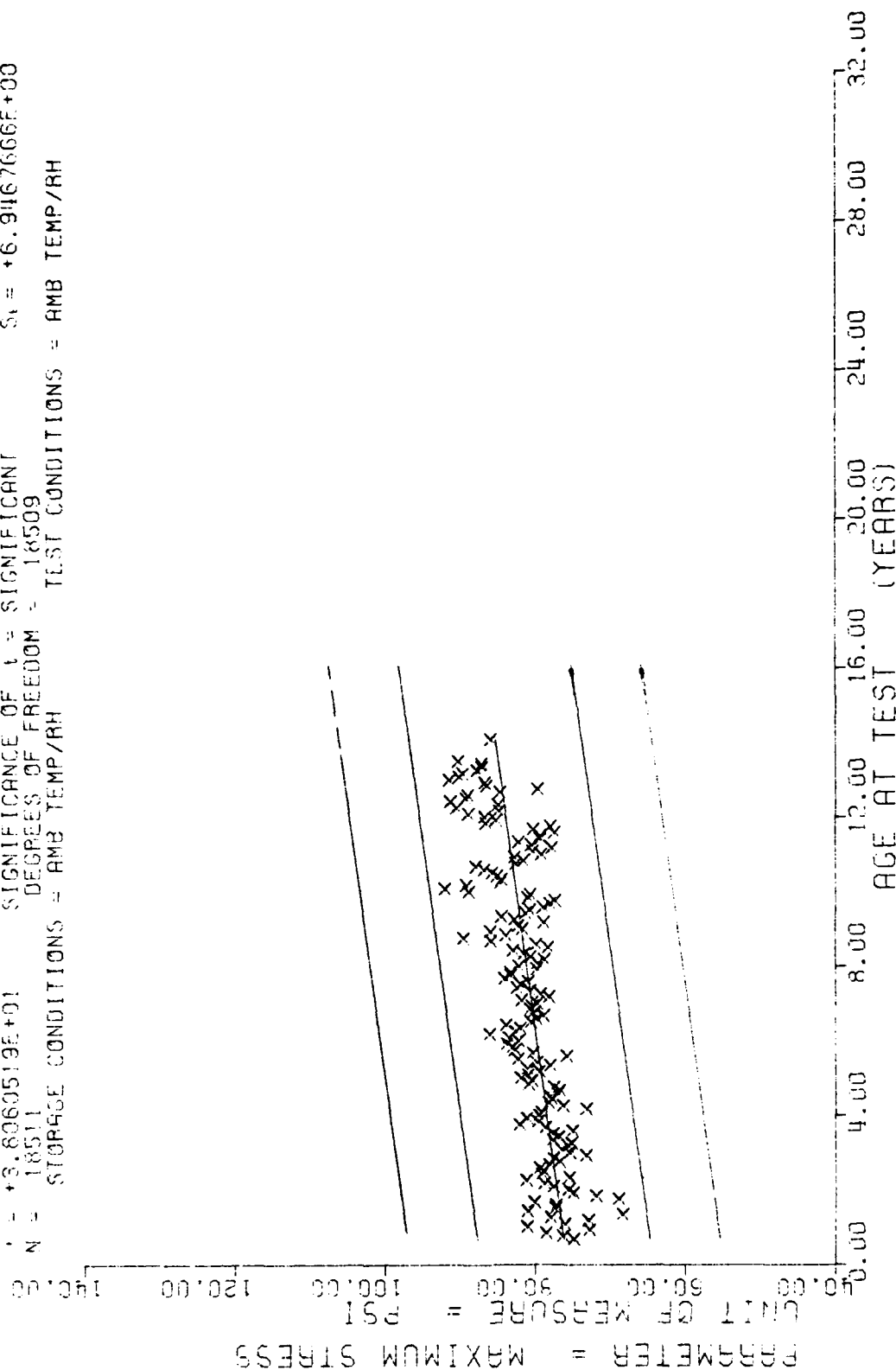
$Y = (1 + 2.050037E-01) + (-7.0511292E-06) \times X$
 $F = +4.0076015E+00$ SIGNIFICANCE OF F = SIGNIFICANT $\sigma_r = +1.6570709E-02$
 $R = 1.471343E-02$ SIGNIFICANCE OF R = SIGNIFICANT $S_d = +3.5222189E-06$
 $t = +2.001994E+00$ SIGNIFICANCE OF t = SIGNIFICANT $S_e = +1.6569362E-02$
 $N = 18510$ DEGREES OF FREEDOM = 18508
 STORAGE CONDITIONS = AMB TEMP/RH TEST CONDITIONS = AMB TEMP/RH



WING 6, V.L.R. TENSILE, STRAIN AT MAX STRESS, CHS=0.002 IN/MIN TP-H1011

Figure 1

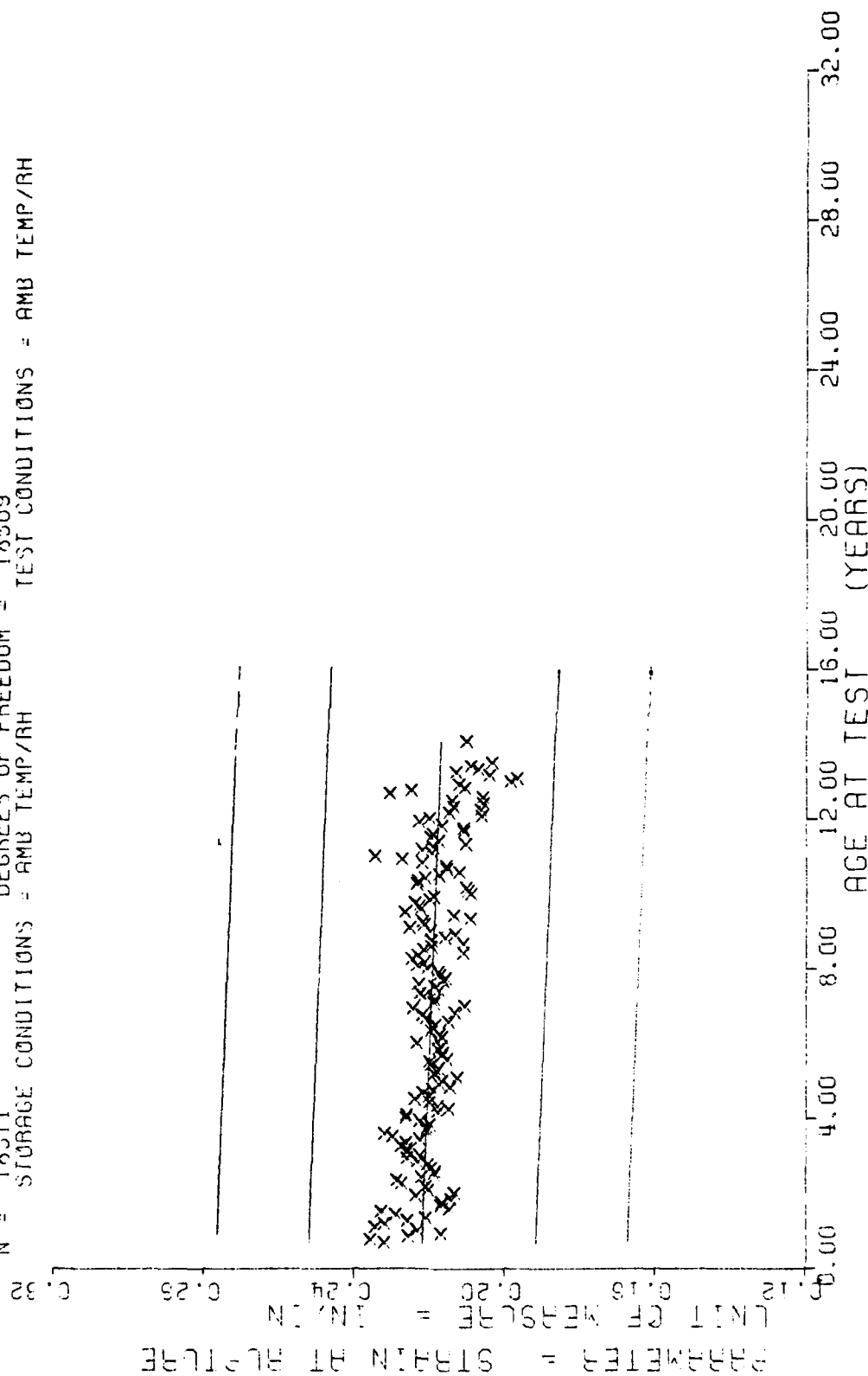
$Y = ((+7.5751760E+01) + (+5.6202468E-02) \times X)$
 $F = +1.4486031E+03$ SIGNIFICANCE OF F = SIGNIFICANT $G = +7.2132949E+00$
 $R = +2.6941422E-01$ SIGNIFICANCE OF R = SIGNIFICANT $S_e = +1.4766605E-02$
 $t = +3.8060519E+01$ SIGNIFICANCE OF t = SIGNIFICANT $S_t = +6.9467666E+00$
 $N = 18511$ DEGREES OF FREEDOM = 18509
 STORAGE CONDITIONS = AMB TEMP/RH TEST CONDITIONS = AMB TEMP/RH



WING 6, V.L.R. TENSILE, MAXIMUM STRESS, CHS-0.002 IN/MIN TP-H1011

Figure 2

$Y = ((+2.2222657E-01) + (-3.2085772E-05) * X)$
 $F = +6.8801816E+01$ SIGNIFICANCE OF F = SIGNIFICANT
 $R = -6.0855914E-02$ SIGNIFICANCE OF R = SIGNIFICANT
 $t = +8.2946860E+00$ SIGNIFICANCE OF t = SIGNIFICANT
 $N = 18511$ DEGREES OF FREEDOM = 18509
 STORAGE CONDITIONS = AMB TEMP/RH TEST CONDITIONS = AMB TEMP/RH



WING 6, V.L.R. TENSILE, STRAIN AT RUPTURE, CHS=0.002 IN/MIN TP-H1011

Figure 3

[illegible]

WALTING C.V., L.B. TENSILE, STRESS AT RUPTURE, CHS=0.002 IN/MIN TP-H1011

This sample size summary is applicable to figure 4

$Y = 10 (+7.0397839E+01) + (+7.3586983E-02) \times X$
 $F = +1.7405913E+03$ SIGNIFICANCE OF F = SIGNIFICANT $G_1 = +8.0210526E+00$
 $R = +2.9666185E-01$ SIGNIFICANCE OF R = SIGNIFICANT $S_1 = +1.7638131E-03$
 $t = +4.1720393E+01$ SIGNIFICANCE OF t = SIGNIFICANT $S_t = +8.2331833E+00$
 $N = 18039$ DEGREES OF FREEDOM = 18037
 STORAGE CONDITIONS = AMB TEMP/RH TEST CONDITIONS = AMB TEMP/RH

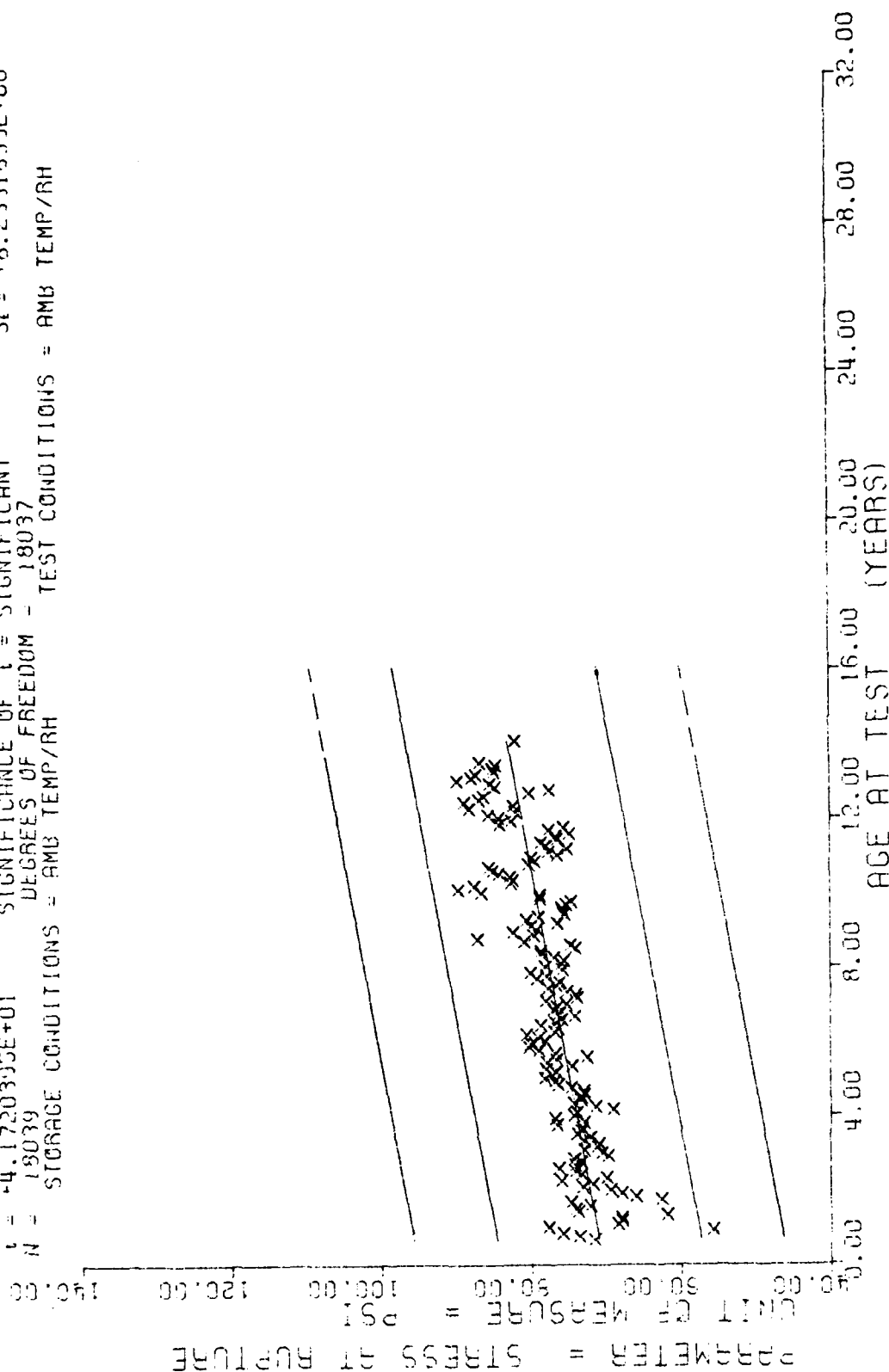


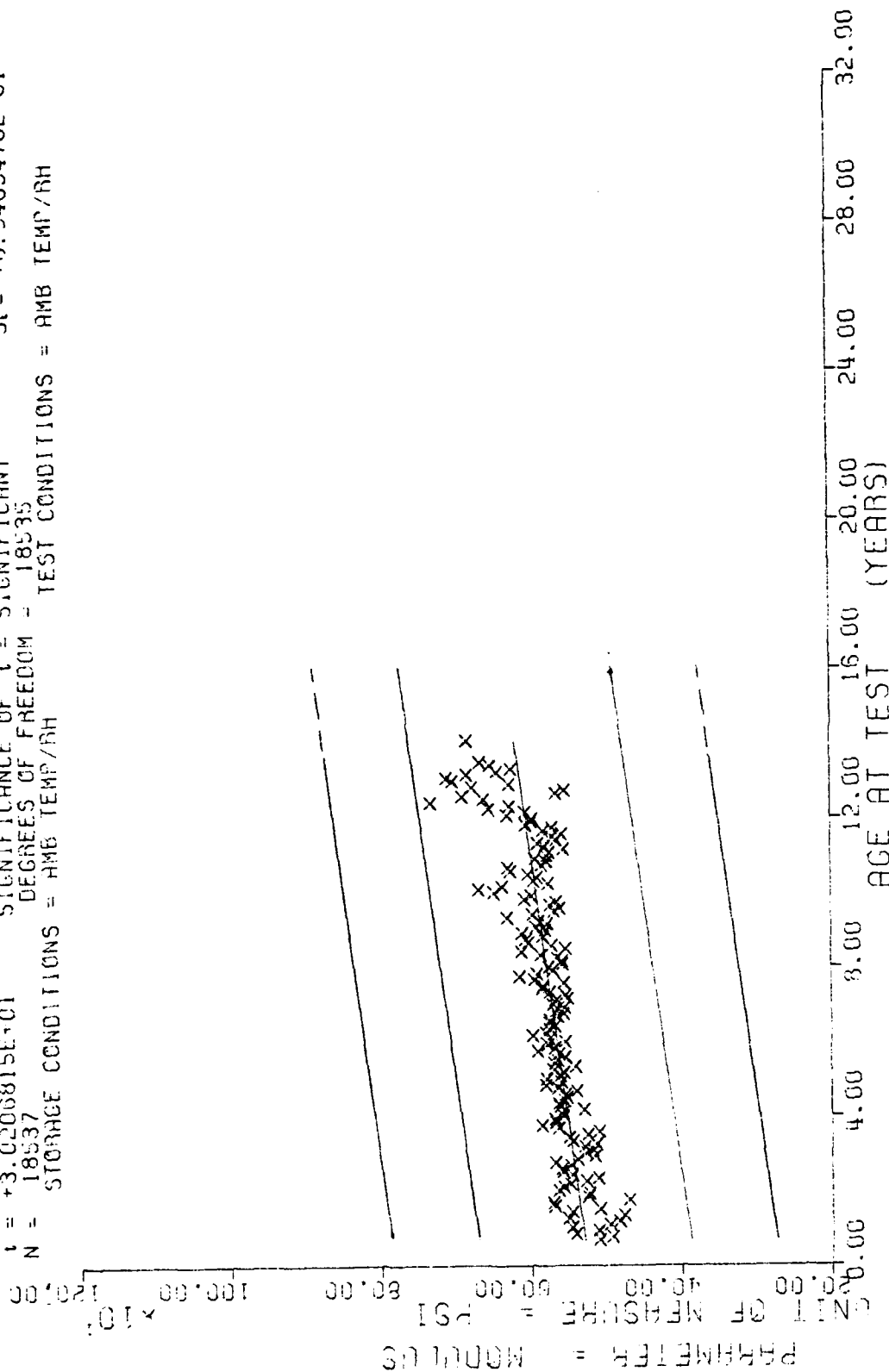
Figure 4

[illegible]

FIG. 6. VOLTAGE TENSILE MODULUS, CUS = 0.002 IN/MIN TP-H1011

This sample size summary is applicable to figure 5

Y = ((+5.2594013E+02) * (+5.4949313E-01) * X)
 F = +9.1245169E+02 SIGNIFICANCE OF F = SIGNIFICANT
 R = +2.1660755E-01 SIGNIFICANCE OF R = SIGNIFICANT
 t = +3.0206815E+01 SIGNIFICANCE OF t = SIGNIFICANT
 N = 18537 DEGREES OF FREEDOM = 18535
 STORAGE CONDITIONS = AMB TEMP/RH TEST CONDITIONS = AMB TEMP/RH



WING 5, V.L.R. TENSILE, MODULUS, CHS-0.002 IN/MIN TP-H1011

Figure 5

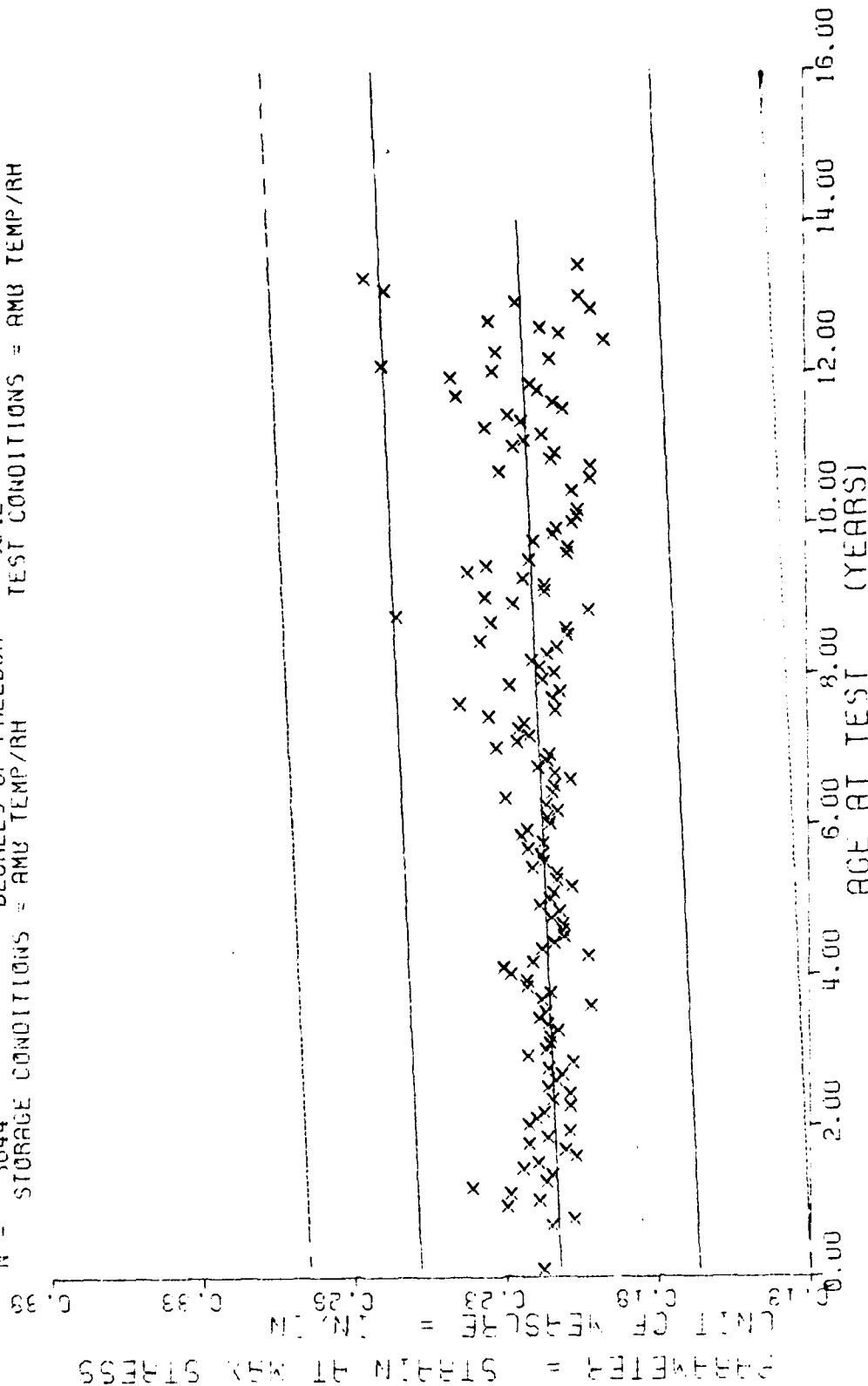
*** SAMPLE SIZE SUMMARY ***

AGE (MOS)	NR SAMP	AGE (MOS)	NR SAMP	AGE (MOS)	NR SAMP	AGE (MOS)	NR SAMP	AGE (MOS)	NR SAMP	AGE (MOS)	NR SAMP	AGE (MOS)	NR SAMP	AGE (MOS)	NR SAMP	AGE (MOS)	NR SAMP	AGE (MOS)	NR SAMP	AGE (MOS)	NR SAMP
1	1	13	22	58	40	83	16	108	14	135	18	135	14	108	14	135	18	135	14	108	14
2	2	34	26	59	31	84	10	109	22	136	2	136	22	109	22	136	2	136	22	109	22
3	3	35	26	60	45	85	6	110	25	137	17	137	25	110	25	137	17	137	25	110	25
4	4	36	34	61	35	86	7	111	10	138	67	138	10	111	10	138	67	138	10	111	10
5	5	37	14	62	57	87	8	112	10	139	36	139	10	112	10	139	36	139	10	112	10
6	6	38	11	63	54	88	10	113	15	140	8	140	15	113	15	140	8	140	15	113	15
7	7	39	26	64	42	89	8	114	66	141	8	141	66	114	66	141	8	141	66	114	66
8	8	40	16	65	18	90	6	115	19	142	6	142	19	115	19	142	6	142	19	115	19
9	9	41	14	66	27	91	15	116	48	143	24	143	48	116	48	143	24	143	48	116	48
10	10	42	8	67	32	92	10	117	68	144	41	144	68	117	68	144	41	144	68	117	68
11	11	43	2	68	32	93	10	118	32	145	4	145	32	118	32	145	4	145	32	118	32
12	12	44	5	69	34	94	29	119	32	146	8	146	32	119	32	146	8	146	32	119	32
13	13	45	4	70	43	95	27	120	44	147	2	147	44	120	44	147	2	147	44	120	44
14	14	46	10	71	17	96	30	121	32	148	4	148	32	121	32	148	4	148	32	121	32
15	15	47	16	72	16	97	37	122	8	149	6	149	8	122	8	149	6	149	8	122	8
16	16	48	24	73	24	98	53	123	4	150	6	150	4	123	4	150	6	150	4	123	4
17	17	49	24	74	20	99	40	125	10	151	4	151	10	125	10	151	4	151	10	125	10
18	18	50	24	75	35	100	18	127	10	152	5	152	10	127	10	152	5	152	10	127	10
19	19	51	34	76	14	101	14	128	5	153	2	153	5	128	5	153	2	153	5	128	5
20	20	52	49	77	19	102	8	129	6	154	2	154	6	129	6	154	2	154	6	129	6
21	21	53	41	78	22	103	3	130	24	155	2	155	24	130	24	155	2	155	24	130	24
22	22	54	26	79	20	104	14	131	78	156	2	156	78	131	78	156	2	156	78	131	78
23	23	55	32	80	17	105	4	132	24	157	4	157	24	132	24	157	4	157	24	132	24
24	24	56	36	81	29	106	6	133	12	159	4	159	12	133	12	159	4	159	12	133	12
25	25	57	40	82	24	107	2	134	19	160	4	160	19	134	19	160	4	160	19	134	19
26	26									161	2	161				161	2	161			
27	27									166	2	166				166	2	166			
28	28									168	2	168				168	2	168			

WING G.L.P. BIAXIAL TENSILE, STRAIN AT MAX STRESS, CHS=0.2 IN/MIN TPEH-1011

This sample size summary is applicable to figures 6 thru 10

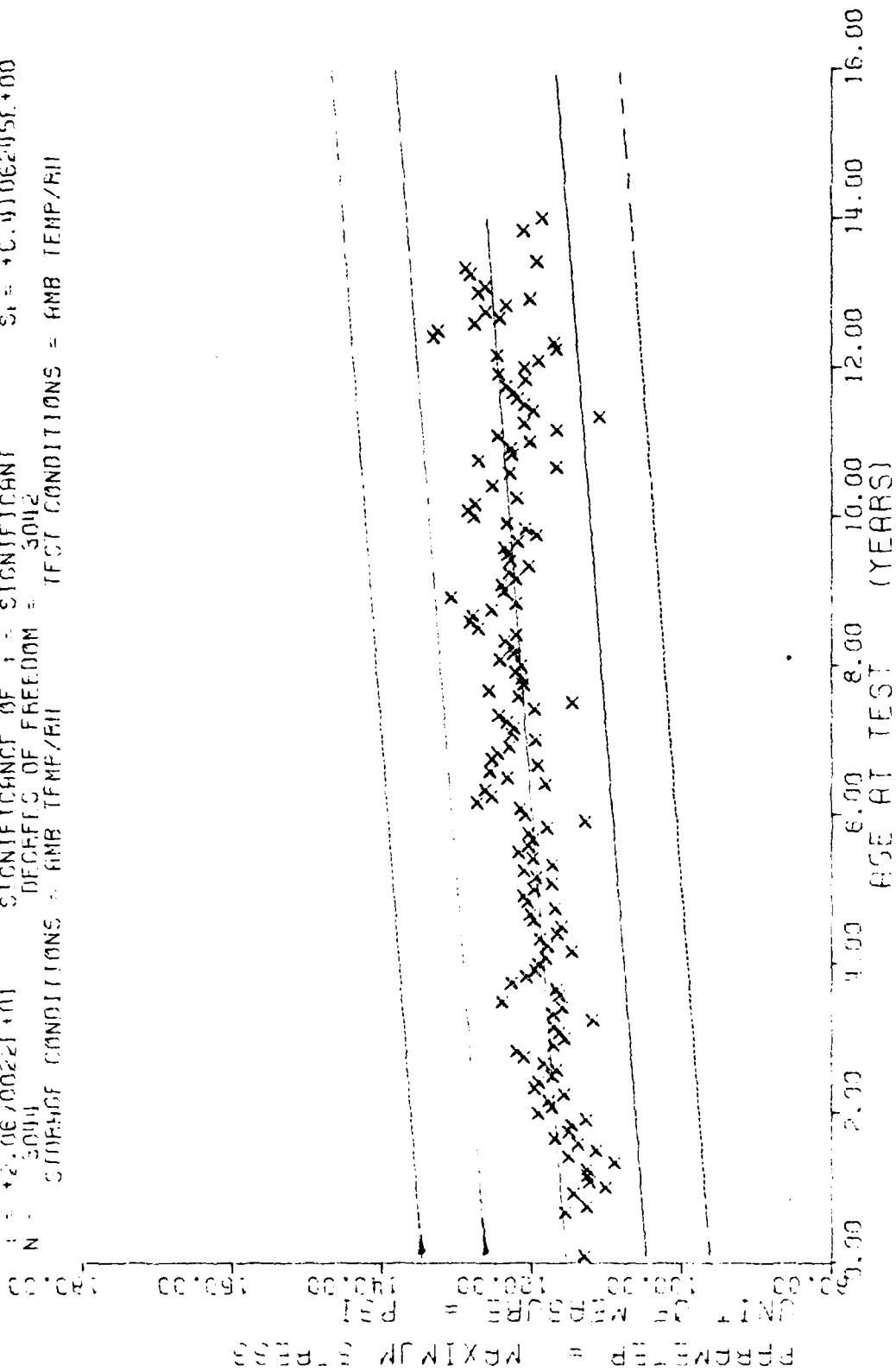
$Y = (1 + 2.1233708E-01) + (+7.2633296E-05) \times X$
 $F = +3.1272192E+01$ SIGNIFICANCE OF F = SIGNIFICANT
 $R = +1.0087396E-01$ SIGNIFICANCE OF R = SIGNIFICANT
 $t = +5.5921545E+00$ SIGNIFICANCE OF t = SIGNIFICANT
 $N = 3044$ DEGREES OF FREEDOM = 3042
 STORAGE CONDITIONS = AMB TEMP/RH TEST CONDITIONS = AMB TEMP/RH



WING G.L.R. BIAXIAL TENSILE, STRAIN AT MAX STRESS, CHS-0.2 IN/MIN TPH-1011

Figure 6

Y = (1 + 1.1540709F + 0.2 J + 1 + 0.2033921F - 0.2) * X
 F = +0.27200821 + 0.2
 F = +3.5093215F - 0.1
 F = +2.06700221 + 0.1
 N = 3044
 STORAGE CONDITIONS = AMB TEMP/RII
 TEST CONDITIONS = AMB TEMP/RII
 DEFECTS OF FREEDOM = 3042



KING G.L.P. BIAXIAL TENSILE, MAXIMUM STRESS, CHS=0.2 IN/MIN TPII-1011

Figure 7

$t = ((+2.4576091E-01) * (+1.7838577E-05) * X)$
 SIGNIFICANCE OF F = NOT SIGNIFICANT $\sigma_r = +3.0117368E-02$
 SIGNIFICANCE OF R = NOT SIGNIFICANT $S_a = +1.4236911E-05$
 SIGNIFICANCE OF χ^2 = NOT SIGNIFICANT $S_e = +3.0114547E-02$
 DEGREES OF FREEDOM = 3041
 N = 3043
 STORAGE CONDITIONS = AMB TEMP/RH
 TEST CONDITIONS = AMB TEMP/RH

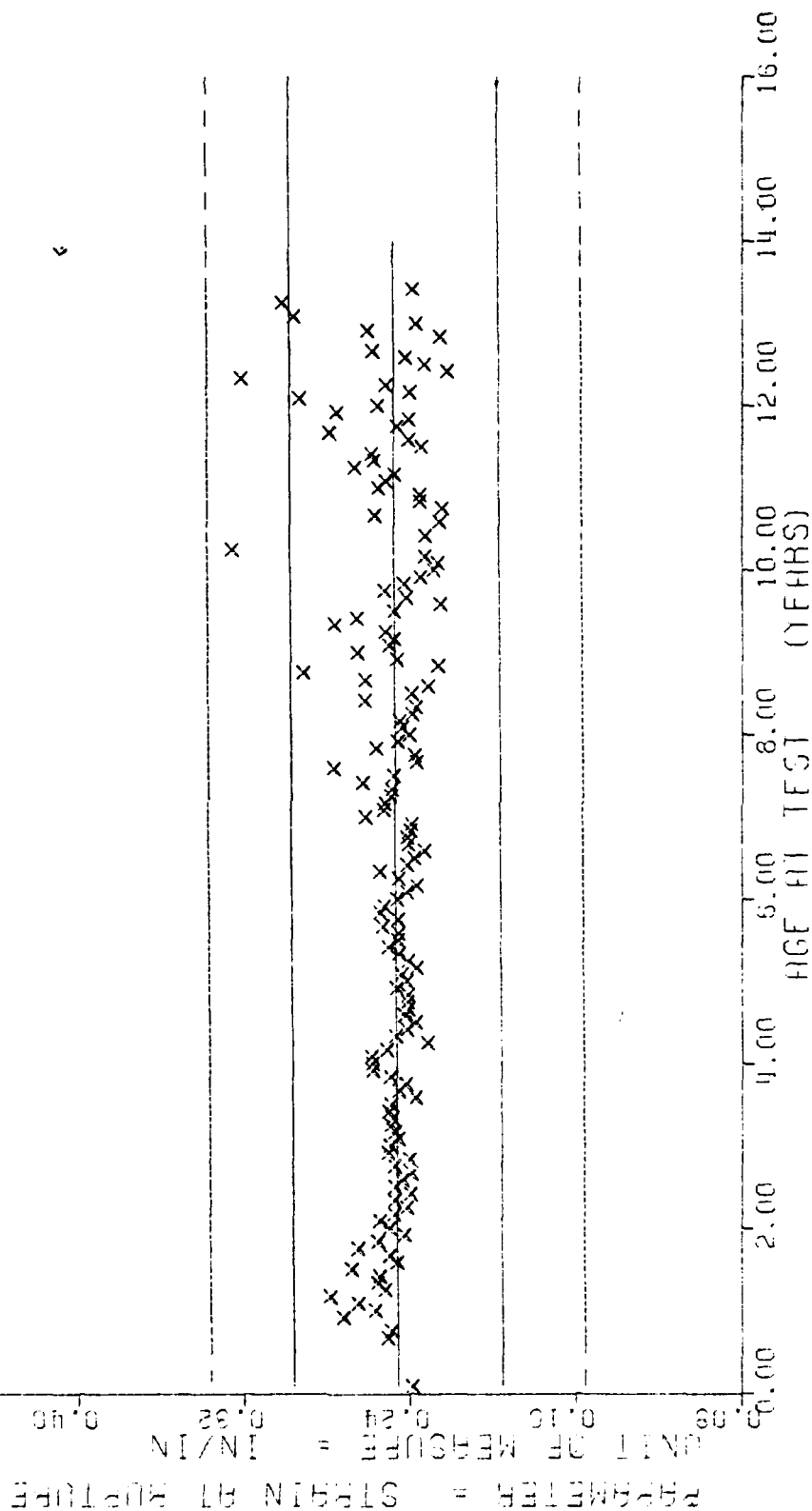


Figure 8

$Y = ((+1.0959310E+02) + (+7.2451902E-02) * X)$
 F = +4.5049335E+02 SIGNIFICANCE OF F = SIGNIFICANT $G_1 = +7.7355669E+00$
 R = +3.5920186E-01 SIGNIFICANCE OF R = SIGNIFICANT $S_0 = +3.4135447E-03$
 t = +2.1224828E+01 SIGNIFICANCE OF t = SIGNIFICANT $S_e = +7.2204812E+00$
 N = 3043 DEGREES OF FREEDOM = 3041
 STORAGE CONDITIONS - AMB TEMP/RH TEST CONDITIONS = AMB TEMP/RH

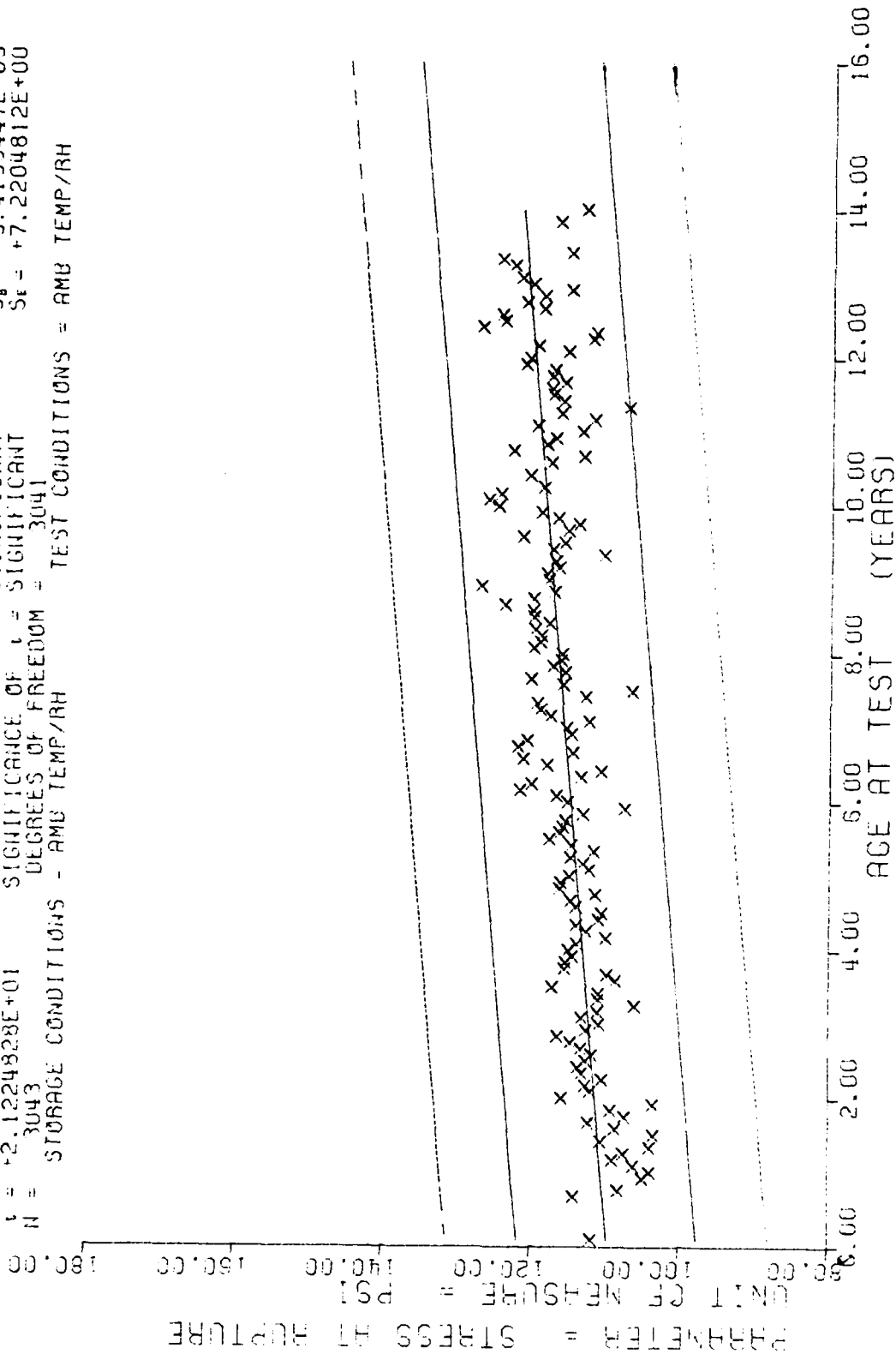
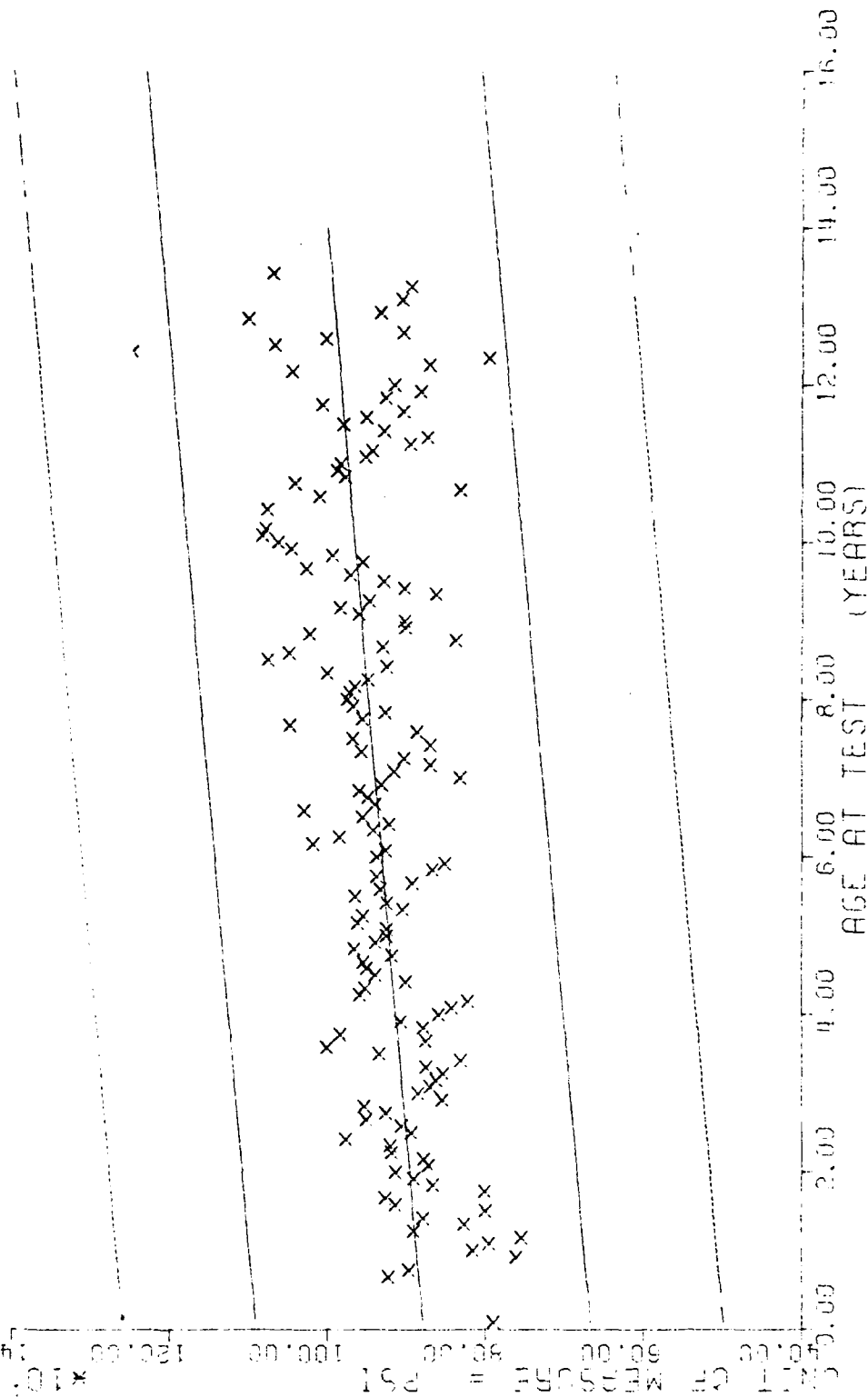


Figure 9

$t = 0.16, 202897E+02$ + (+7.2471371E-01) * X1
 SIGNIFICANCE OF F = SIGNIFICANT
 $G = +1.2971328E+02$
 $R = +2.1416231E-01$ SIGNIFICANCE OF R = SIGNIFICANT
 $S = +1.2988632E+01$ SIGNIFICANCE OF S = SIGNIFICANT
 $N = 3012$ DEGREES OF FREEDOM = 3010
 STORAGE CONDITIONS = AMB TEMP/RH TEST CONDITIONS = AMB TEMP/RH

PARAMETER = MODULUS
 UNIT OF MEASURE = PSI
 *10⁷



WING 6, L.R. BIAXIAL TENSILE, MODULUS, CHS-0.2 IN/MIN TPH-1011

Figure 10

$Y = (-5.8534151E-05) + (-2.6076270E-01) + (-1.9296162E-02) \times X$
 $t = +2.6481562E+02$ SIGNIFICANCE OF F = SIGNIFICANT
 $R = -1.2582072E-01$ SIGNIFICANCE OF R = SIGNIFICANT
 $U = +1.6273156E+01$ SIGNIFICANCE OF U = SIGNIFICANT
 $N = 16463$ DEGREES OF FREEDOM = 16463
 STORAGE CONDITIONS = AMB TEMP/RH TEST CONDITIONS = AMB TEMP/RH

PARAMETER = STRAIN AT MAX STRESS

UNIT OF MEASURE = IN/IN

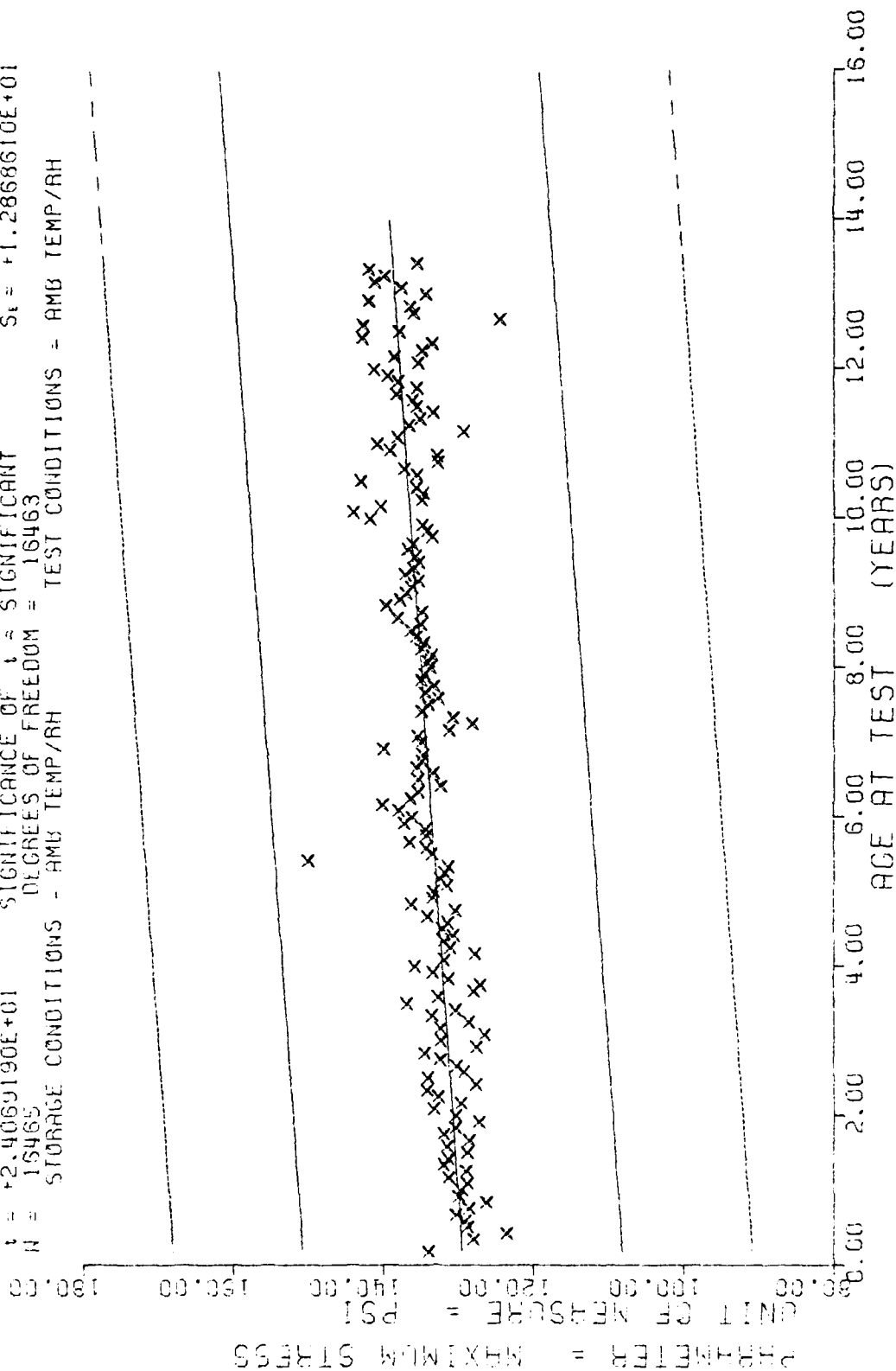
- 92 -

0.00 2.00 4.00 6.00 8.00 10.00 12.00 14.00 16.00
AGE AT TEST (YEARS)

WING C.L.R. TENSILE, STRAIN AT MAX STRESS, CHS-2.0 IN/MIN TP-H1011

Figure 11

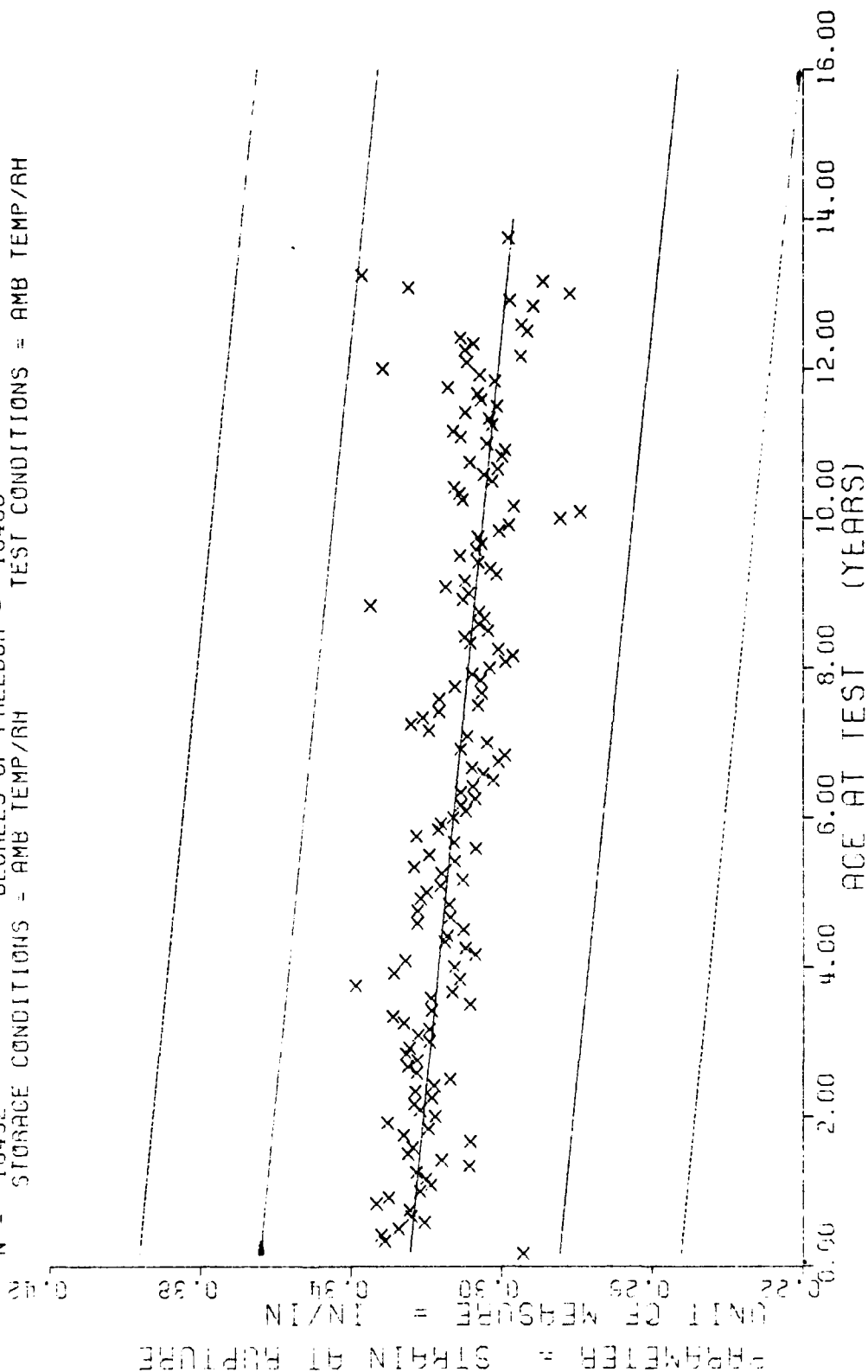
$Y = ((+1.2932833E+02) + (+5.8198485E-02) * X)$
 $F = +5.7932595E+02$ SIGNIFICANCE OF F = SIGNIFICANT
 $R = +1.8437289E-01$ SIGNIFICANCE OF R = SIGNIFICANT
 $t = +2.4069190E+01$ SIGNIFICANCE OF t = SIGNIFICANT
 $N = 16465$ DEGREES OF FREEDOM = 16463
 STORAGE CONDITIONS - AMB TEMP/RH TEST CONDITIONS - AMB TEMP/RH



WING 6, L.R. TENSILE, MAXIMUM STRESS, CHS=2.0 IN/MIN TP-H1011

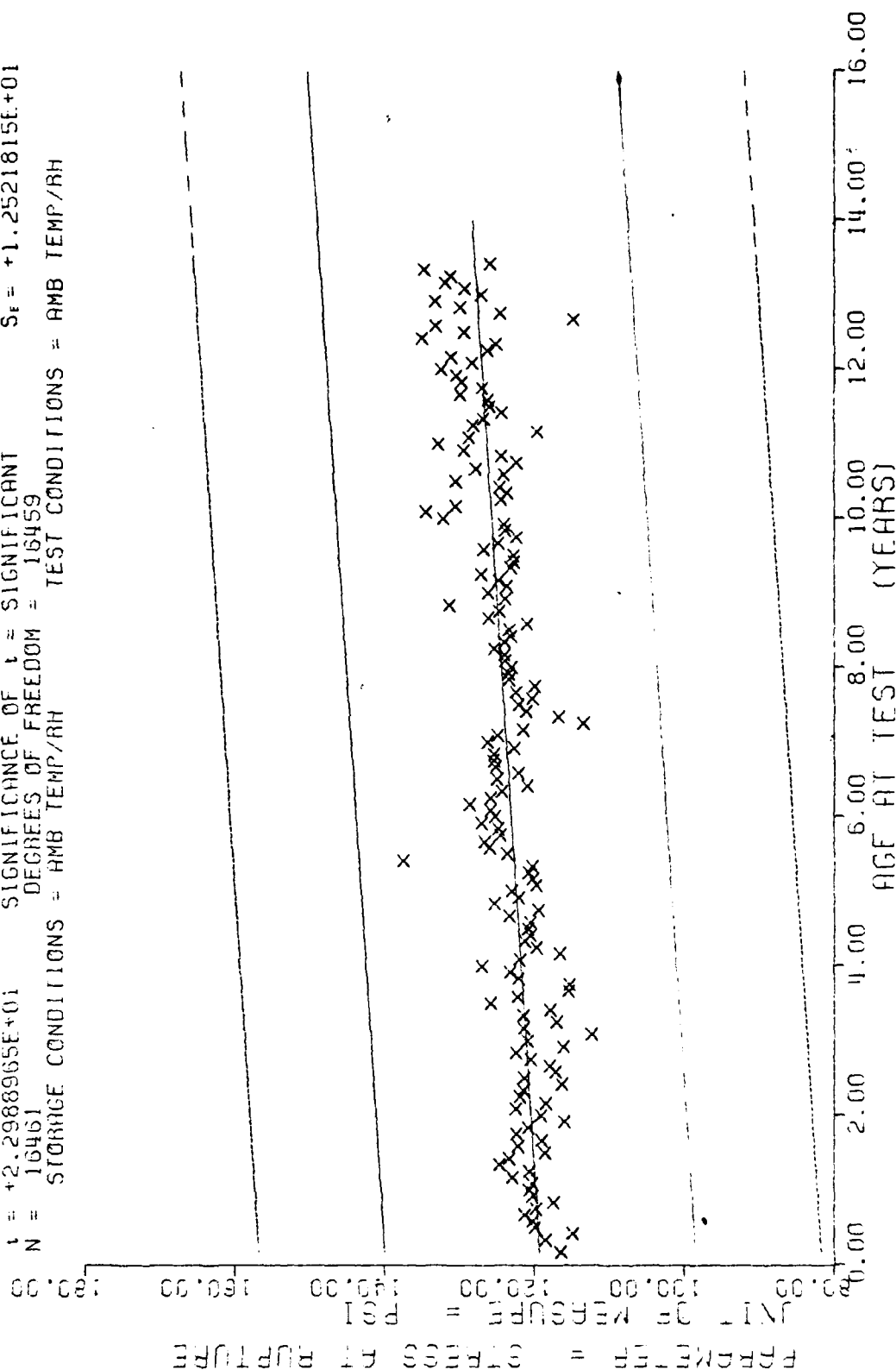
Figure 12

$Y = ((+3.2462003E-01) + (-1.6602281E-04) * X)$
 $F = +1.3574417E+03$ SIGNIFICANCE OF F = SIGNIFICANT $G_1 = +2.4946745E-02$
 $R = -2.7601932E-01$ SIGNIFICANCE OF R = SIGNIFICANT $S_0 = +4.5061659E-06$
 $t = +3.6843475E+01$ SIGNIFICANCE OF t = SIGNIFICANT $S_1 = +2.3978351E-02$
 $N = 16452$ DEGREES OF FREEDOM = 16460
 STORAGE CONDITIONS = AMB TEMP/RH TEST CONDITIONS = AMB TEMP/RH



WING 5, L.B. TENSILE, STRAIN AT RUPTURE, CHS-2.0 IN/MIN TP-H1011

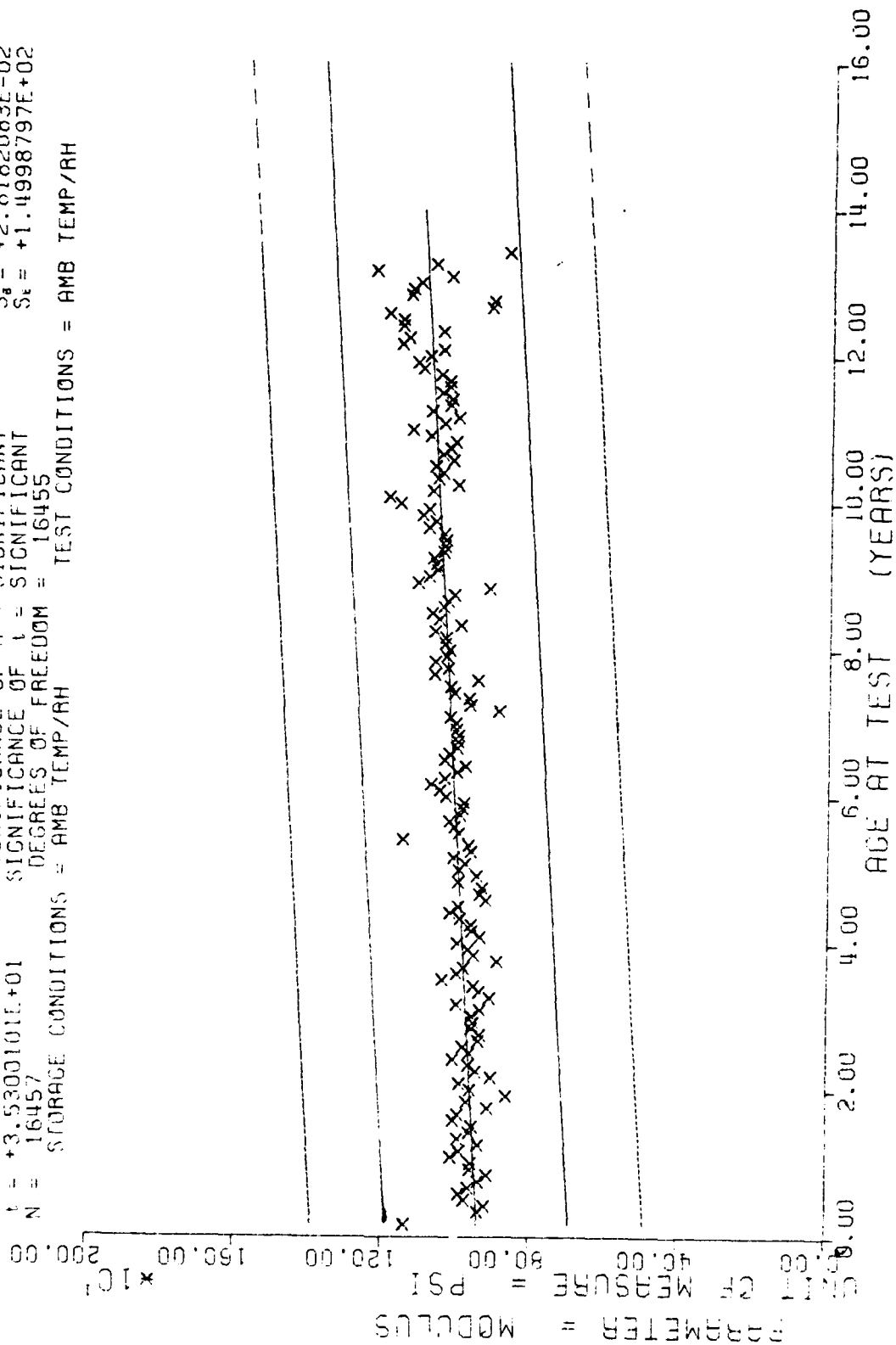
$Y = ((+1.1912500E+02) + (+5.4097209E-02) * X)$
 $F = +5.2849252E+02$ SIGNIFICANCE OF F = SIGNIFICANT $G_1 = +1.2720876E+01$
 $R = +1.7638221E-01$ SIGNIFICANCE OF R = SIGNIFICANT $S_0 = +2.3531815E-03$
 $t = +2.2988965E+01$ SIGNIFICANCE OF t = SIGNIFICANT $S_1 = +1.2521815E+01$
 $N = 16461$ DEGREES OF FREEDOM = 16459
 STORAGE CONDITIONS = HMB TEMP/RH TEST CONDITIONS = AMB TEMP/RH



WING G.L.R. TENSILE, STRESS AT RUPTURE, CHS-2.0 IN/MIN TP-H1011

Figure 1h

$Y = ((+9.3837264E+02) + (+9.9483042E-01) \times X)$
 $F = +1.2460971E+03$ SIGNIFICANCE OF F = SIGNIFICANT $G_r = +1.5555873E+02$
 $R = +2.6532358E-01$ SIGNIFICANCE OF R = SIGNIFICANT $S_d = +2.8182083E-02$
 $t = +3.5300101E+01$ SIGNIFICANCE OF t = SIGNIFICANT $S_t = +1.4998797E+02$
 $N = 16457$ DEGREES OF FREEDOM = 16455
 STORAGE CONDITIONS = AMB TEMP/RAH TEST CONDITIONS = AMB TEMP/RAH



WING 6, L.R. TENSILE, MODULUS, CHS-2.0 IN/MIN TP-H1011

Figure 15

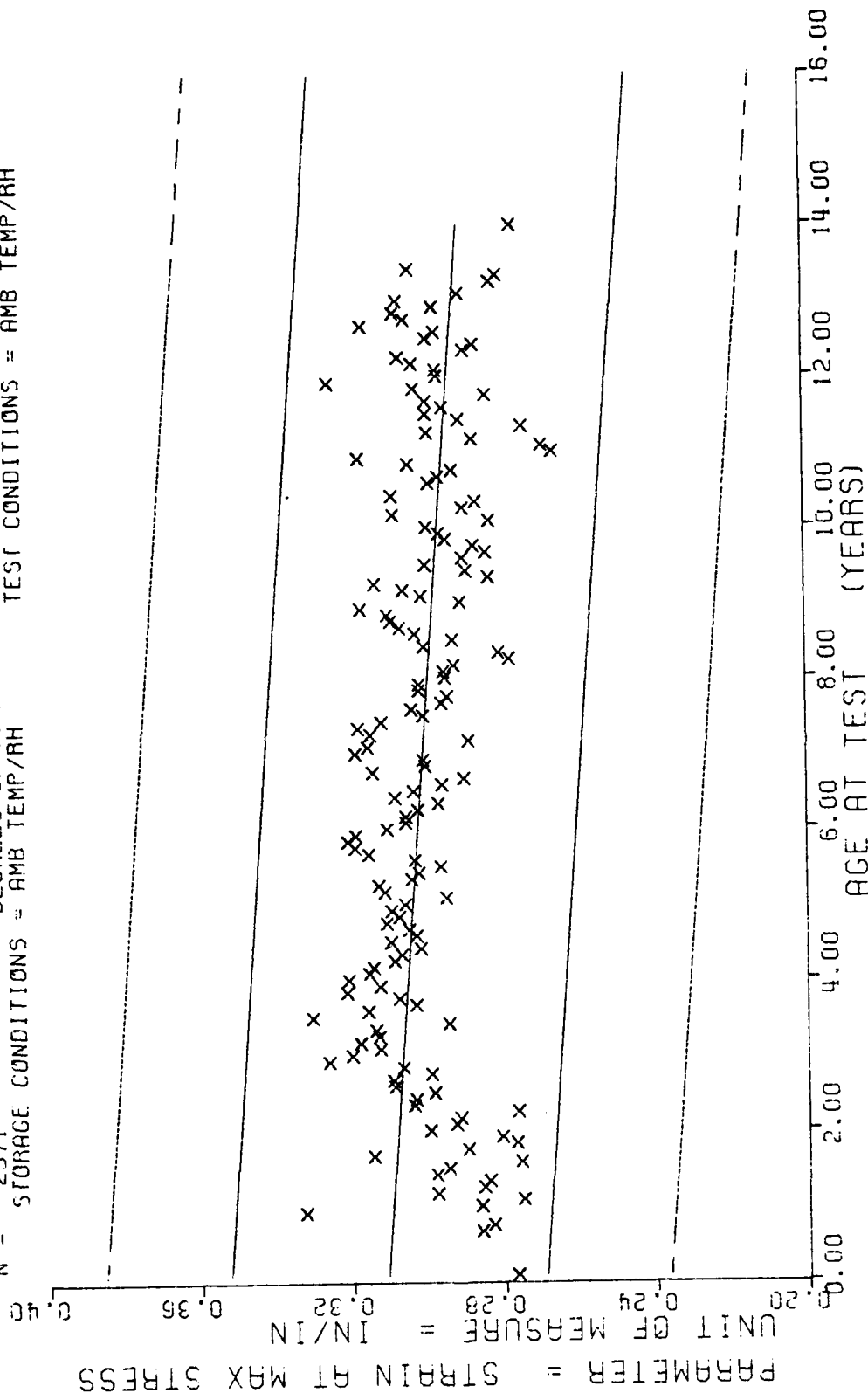
*** SAMPLE SIZE SUMMARY ***

[illegible]

FIGURE 6. H.P. TRIAXIAL TENSILE, STRAIN AT MAX STRESS, CHS=1750 IN/MIN, 800 PSI

This sample size summary is applicable to figures 16 thru 20

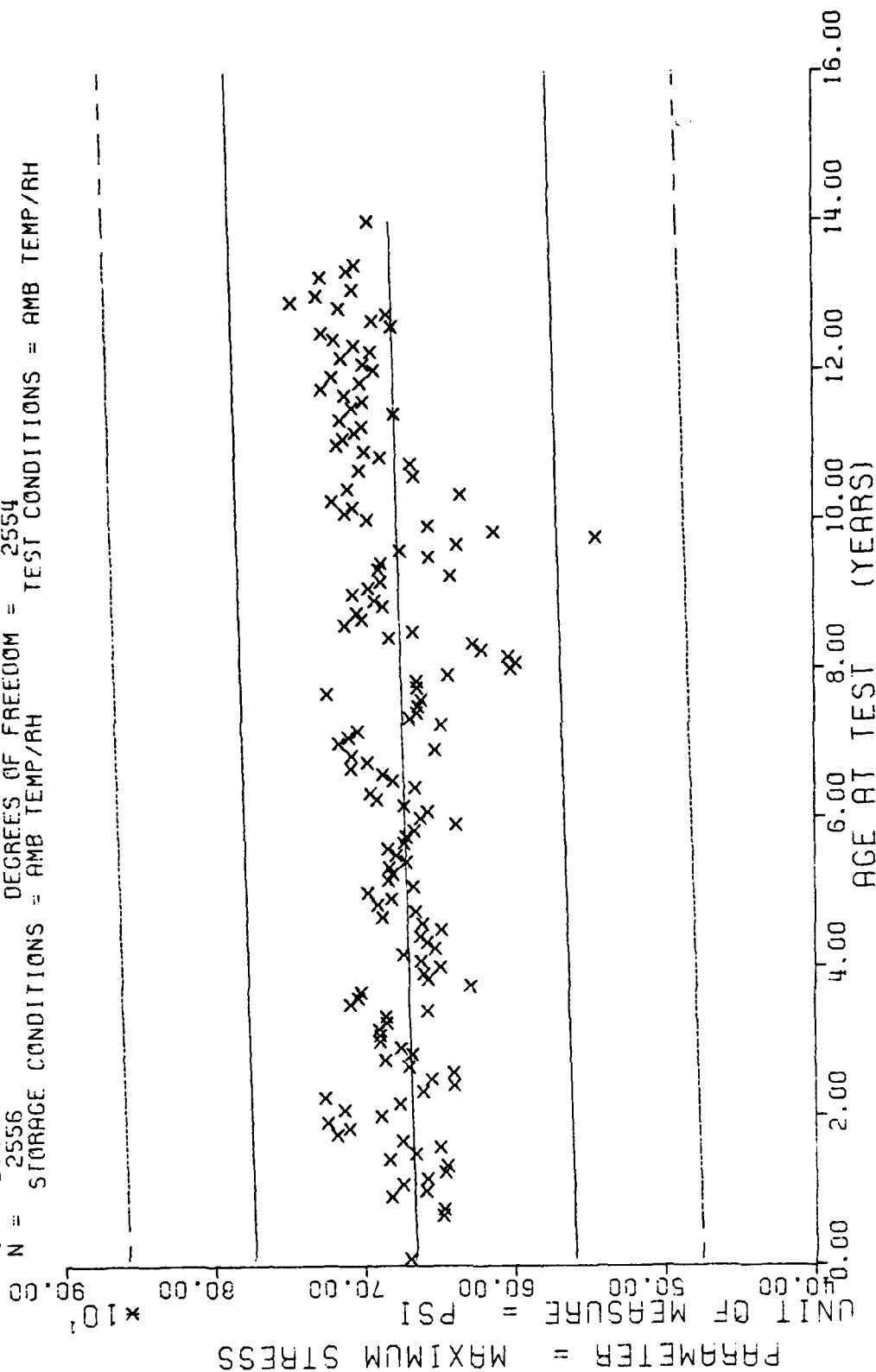
$Y = ((+3.1118430E-01) + (-1.2441944E-04) * X)$
 $F = +8.9494827E+01$ SIGNIFICANCE OF F = SIGNIFICANT
 $R = -1.8347675E-01$ SIGNIFICANCE OF R = SIGNIFICANT
 $t = +9.4601705E+00$ SIGNIFICANCE OF t = SIGNIFICANT
 $N = 2571$ DEGREES OF FREEDOM = 2569
 STORAGE CONDITIONS = AMB TEMP/RH TEST CONDITIONS = AMB TEMP/RH



WING 6, H.R. TRIAXIAL TENSILE STRAIN AT MAX STRESS, CHS=1750 IN/MIN, 800 PSI

Figure 16

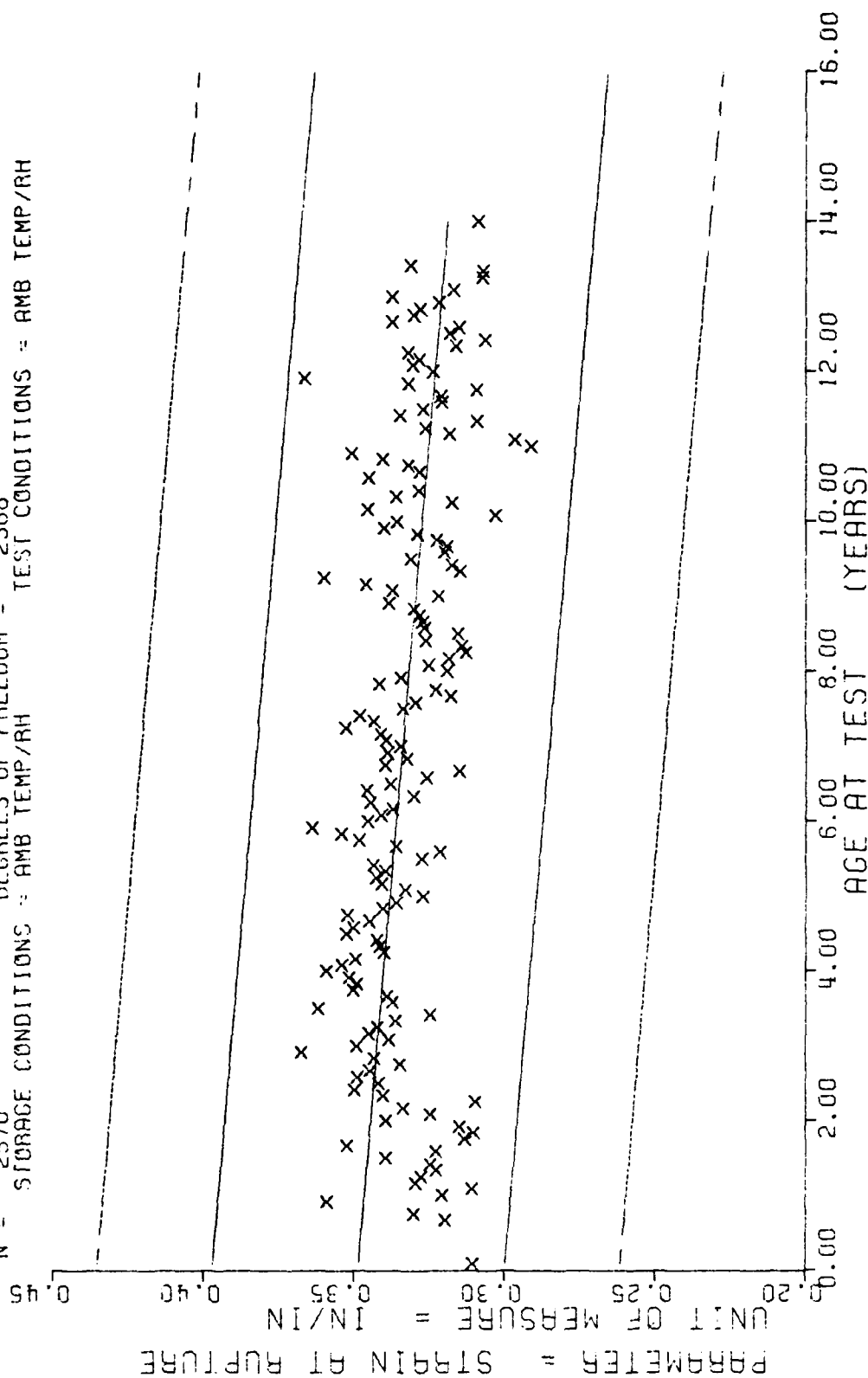
$Y = ((+6.6636864E+02) + (+8.9971123E-02) * X)$
 $F = +7.0513944E+00$ SIGNIFICANCE OF F = SIGNIFICANT
 $R = +5.2472089E-02$ SIGNIFICANCE OF R = SIGNIFICANT
 $t = +2.6554461E+00$ SIGNIFICANCE OF t = SIGNIFICANT
 $N = 2556$ DEGREES OF FREEDOM = 2554
 STORAGE CONDITIONS = AMB TEMP/RH TEST CONDITIONS = AMB TEMP/RH



WING 6.H.R. TRIAXIAL TENSILE, MAXIMUM STRESS, CHS=1750 IN/MIN, 800 PSI

Figure 17

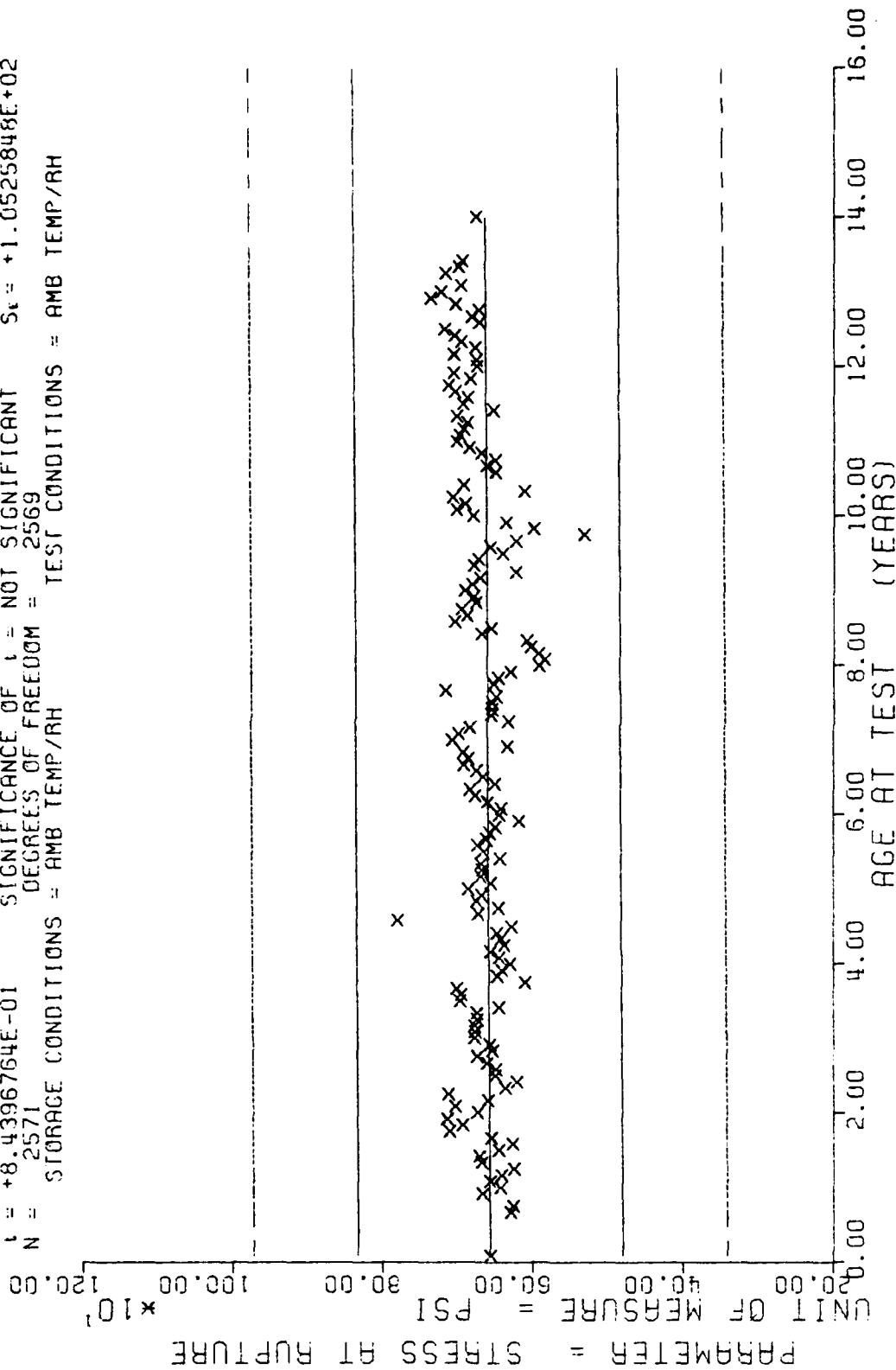
$Y = ((+3.4855676E-01) + (-1.7879952E-04) \times X)$
 $F = +1.3534188E+02$ SIGNIFICANCE OF F = SIGNIFICANT $G_1 = +2.9692513E-02$
 $R = -2.2375133E-01$ SIGNIFICANCE OF R = SIGNIFICANT $S_0 = +1.5369163E-05$
 $t = +1.1633653E+01$ SIGNIFICANCE OF t = SIGNIFICANT $S_t = +2.8945331E-02$
 $N = 2570$ DEGREES OF FREEDOM = 2568
 STORAGE CONDITIONS = AMB TEMP/RH TEST CONDITIONS = AMB TEMP/RH



WING 6,H.R. TRIAXIAL TENSILE, STRAIN AT RUPTURE, CHS=1750 IN/MIN, 800 PSI

Figure 18

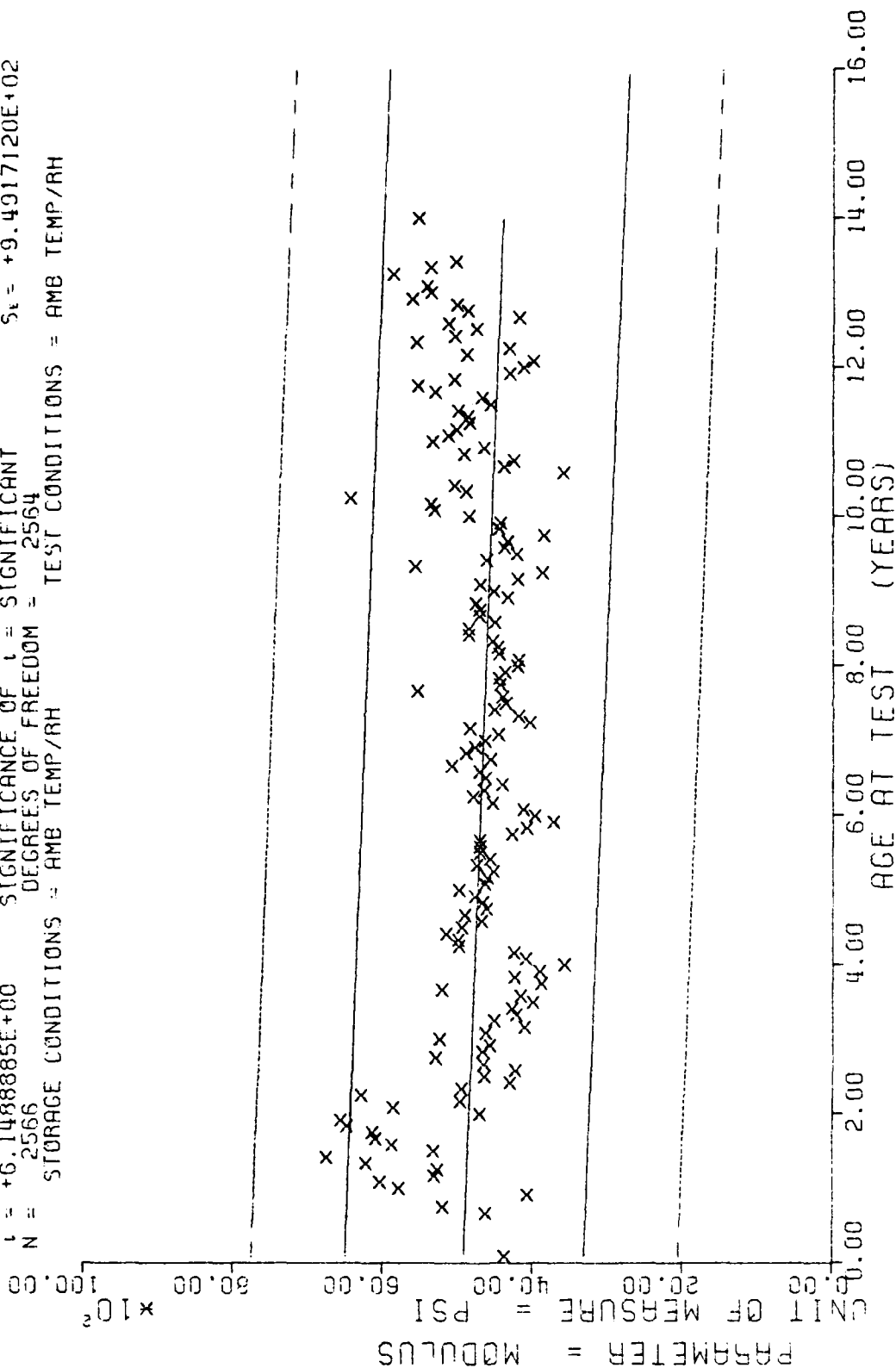
$Y = ((+6.5728351E+02) + (+4.7166954E-02) * X)$
 F = +7.1228139E-01 SIGNIFICANCE OF F = NOT SIGNIFICANT $G_1 = +1.0525259E+02$
 R = +1.6648823E-02 SIGNIFICANCE OF R = NOT SIGNIFICANT $S_0 = +5.5887159E-02$
 t = +8.4396764E-01 SIGNIFICANCE OF t = NOT SIGNIFICANT $S_1 = +1.0525848E+02$
 N = 2571 DEGREES OF FREEDOM = 2569
 STORAGE CONDITIONS = AMB TEMP/RH TEST CONDITIONS = AMB TEMP/RH



WING G,H,R, TRIAXIAL TENSILE, STRESS AT RUPTURE, CHS=1750 IN/MIN, 800 PSI

Figure 19

$Y = (1 + 4.9076799E+03) + (-3.1027591E+00) * X$
 $F = +3.7809830E+01$ SIGNIFICANCE OF F = SIGNIFICANT
 $R = -1.2054770E-01$ SIGNIFICANCE OF R = SIGNIFICANT
 $t = +6.1488885E+00$ SIGNIFICANCE OF t = SIGNIFICANT
 $N = 2566$ DEGREES OF FREEDOM = 2564
 STORAGE CONDITIONS = AMB TEMP/RH TEST CONDITIONS = AMB TEMP/RH



WING 6, H.R. TRIAXIAL TENSILE, MODULUS, CHS=1750 IN/MIN AT 800 PSI

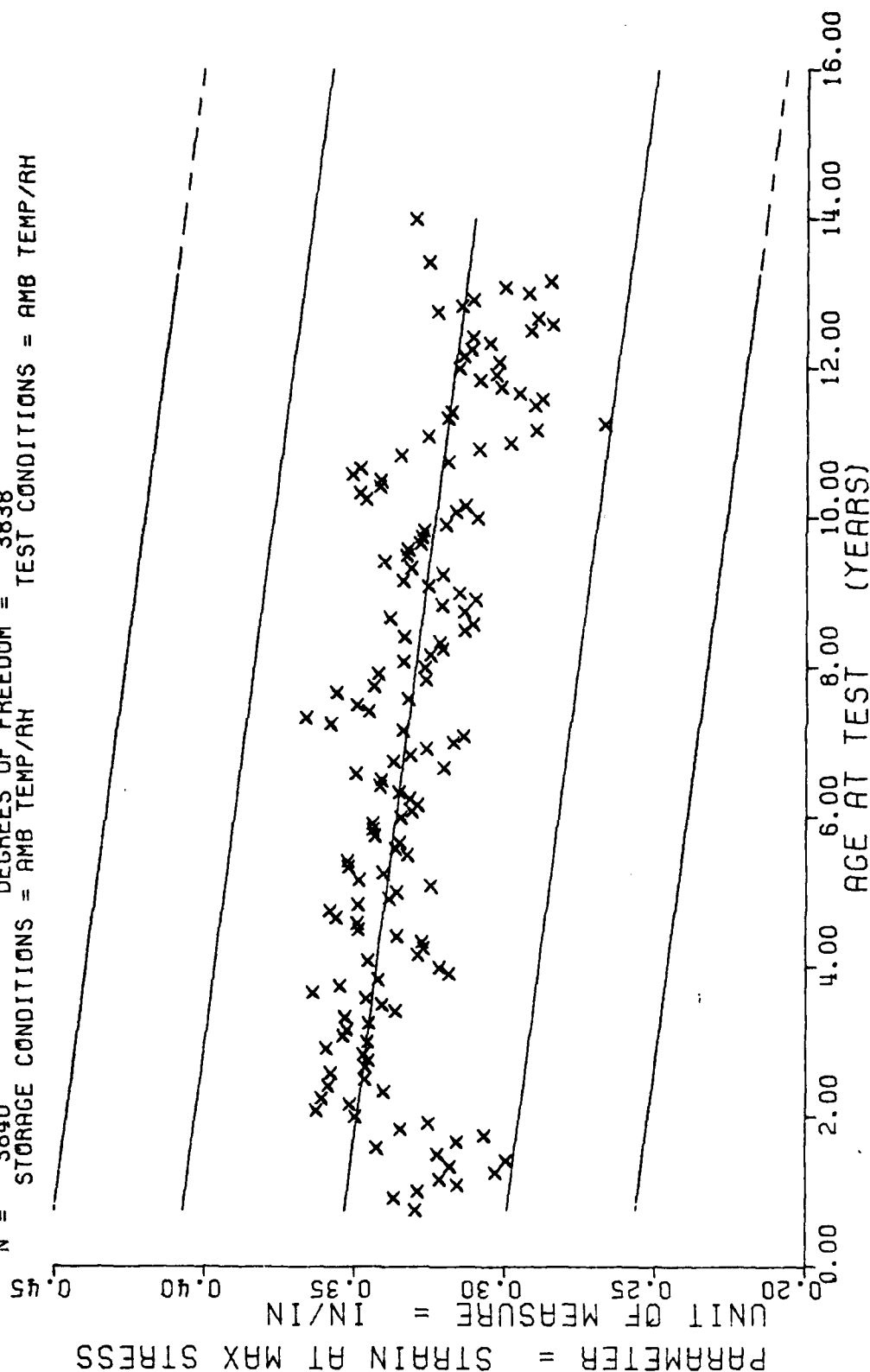
Figure 20

[illegible]

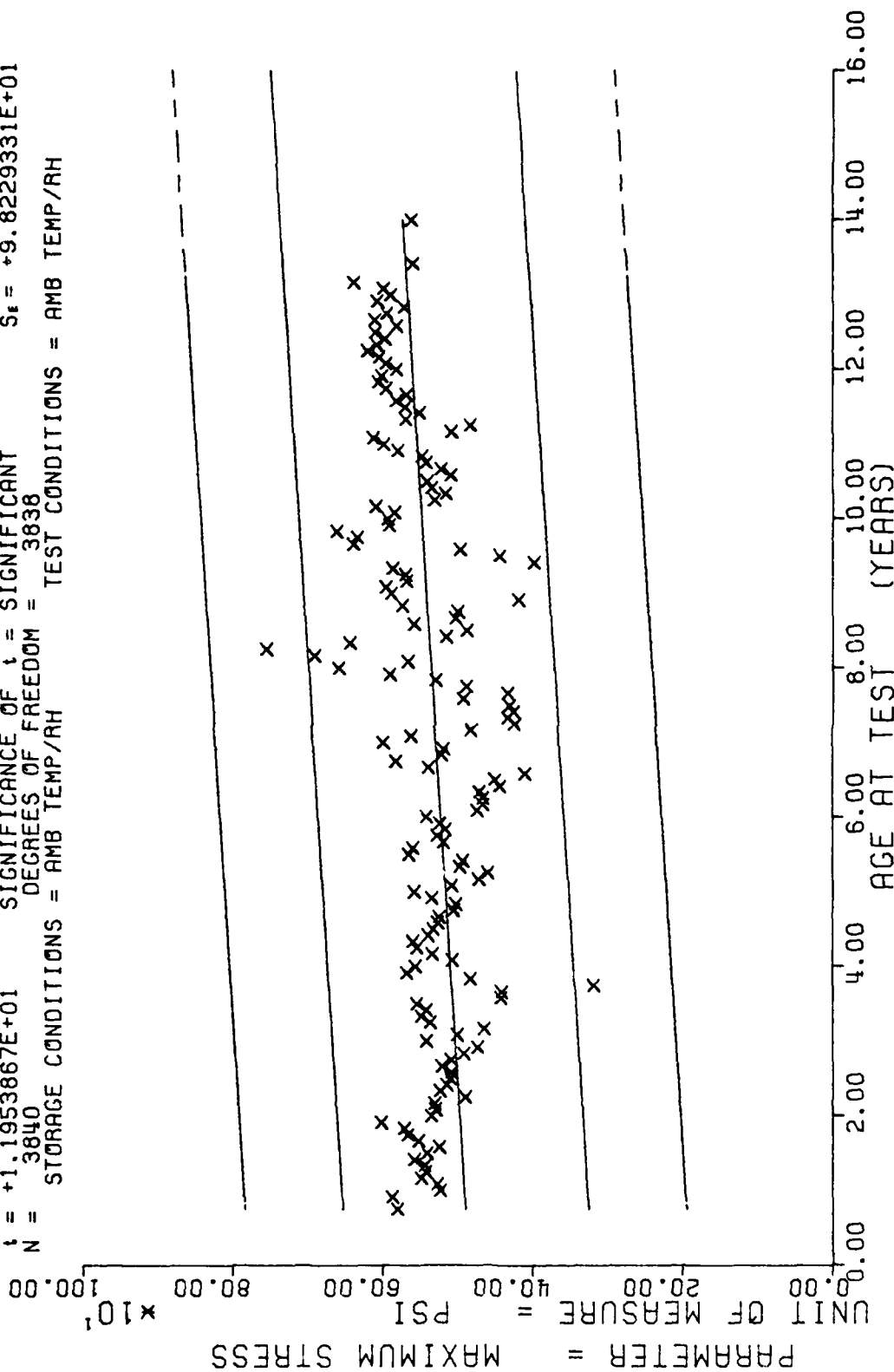
WING 6,H.2.HYDROSTATIC,STRAIN AT MAX STRESS,1750 IN/MIN,800 PSI

This sample size summary is applicable to figures 21 thru 25

$Y = ((+3.5563392E-01) + (-2.7020832E-04) * X)$
 $F = +3.4828417E+02$ SIGNIFICANCE OF F = SIGNIFICANT $S_f = +3.3710426E-02$
 $R = -2.8843802E-01$ SIGNIFICANCE OF R = SIGNIFICANT $S_R = +1.4478776E-05$
 $t = +1.8662373E+01$ SIGNIFICANCE OF t = SIGNIFICANT $S_t = +3.2281890E-02$
 $N = 3840$ DEGREES OF FREEDOM = 3838
 STORAGE CONDITIONS = AMB TEMP/RH TEST CONDITIONS = AMB TEMP/RH



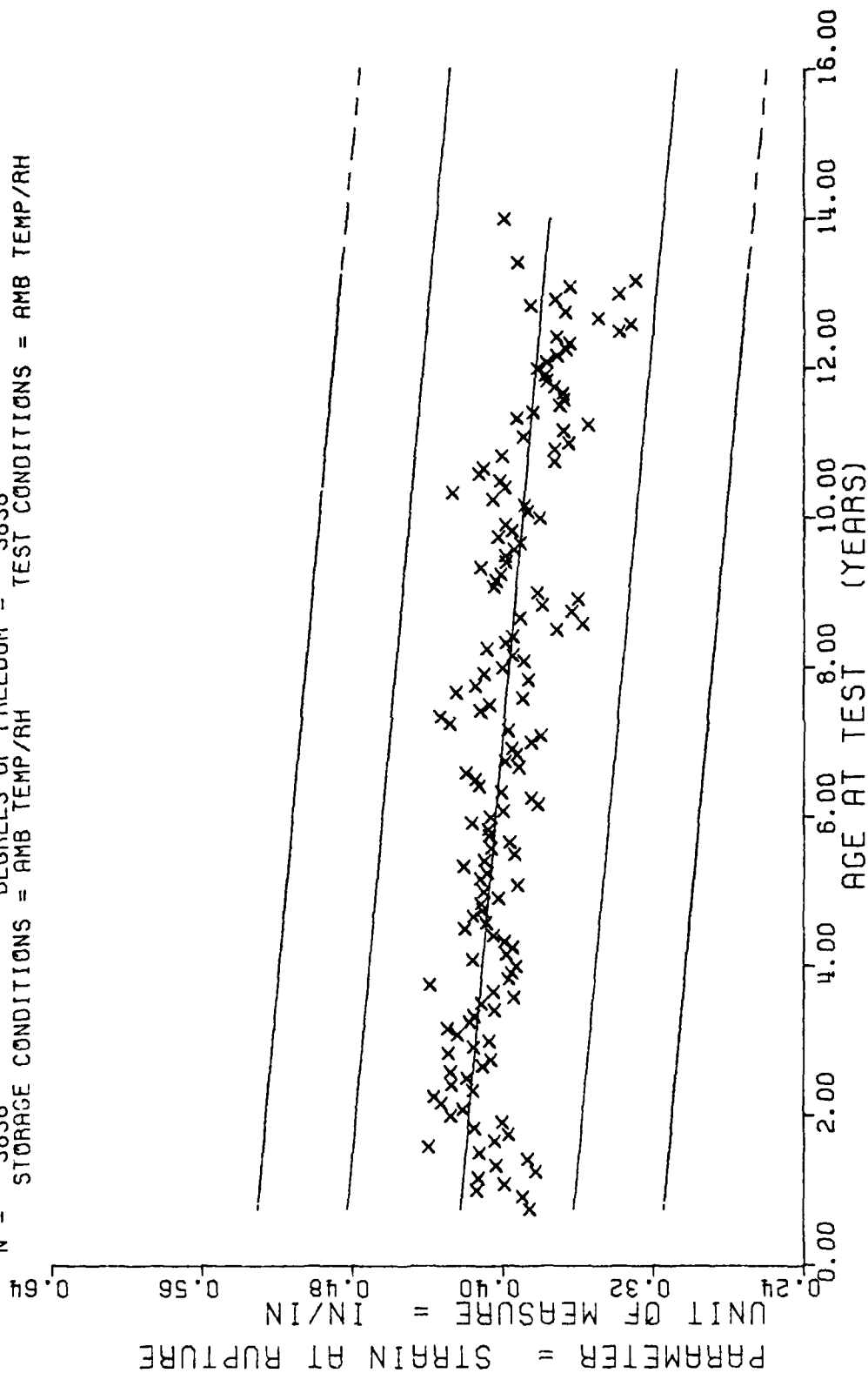
$Y = ((+4.8412235E+02) + (+5.2665051E-01) * X)$
 $F = +1.4289494E+02$ SIGNIFICANCE OF F = SIGNIFICANT $\sigma_t = +1.0002820E+02$
 $R = +1.8946023E-01$ SIGNIFICANCE OF R = SIGNIFICANT $S_e = +4.4056915E-02$
 $t = +1.1953867E+01$ SIGNIFICANCE OF t = SIGNIFICANT $S_t = +9.8229331E+01$
 $N = 3840$ DEGREES OF FREEDOM = 3838
 STORAGE CONDITIONS = AMB TEMP/RH TEST CONDITIONS = AMB TEMP/RH



WING 6,H.R.HYDROSTATIC,MAXIMUM STRESS,1750IN/MIN,800 PSI

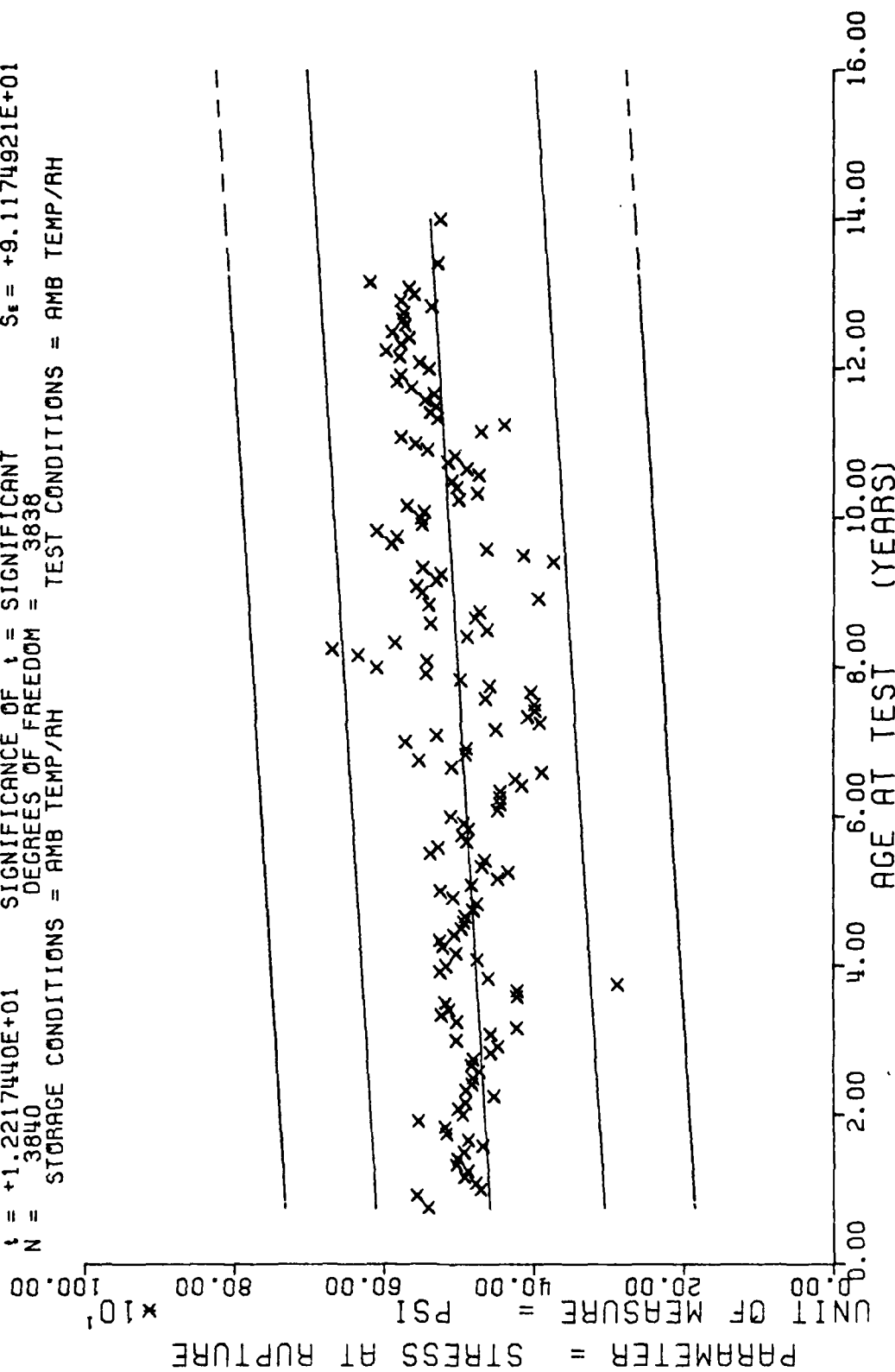
Figure 22

$Y = ((+4.2495602E-01) + (-2.9814843E-04) \times X)$
 $F = +3.4061363E+02$ SIGNIFICANCE OF F = SIGNIFICANT
 $R = -2.8557413E-01$ SIGNIFICANCE OF R = SIGNIFICANT
 $t = +1.8455720E+01$ SIGNIFICANCE OF t = SIGNIFICANT
 $N = 3838$ DEGREES OF FREEDOM = 3836
 STORAGE CONDITIONS = AMB TEMP/RH TEST CONDITIONS = AMB TEMP/RH



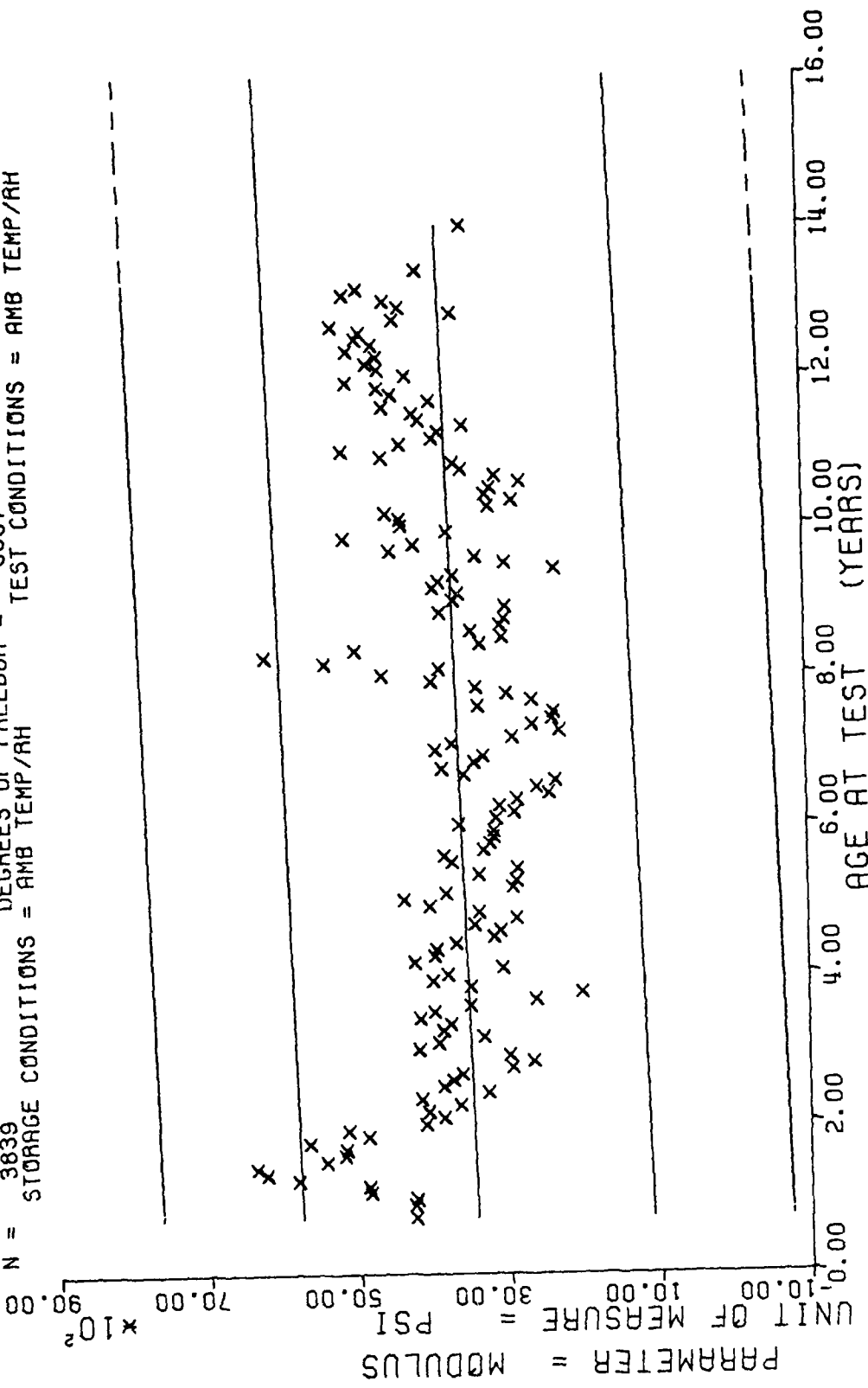
WING 6, H.R. HYDROSTATIC STRAIN AT RUPTURE, 1750 IN/MIN, 800 PSI

$Y = ((+4.5305291E+02) + (+4.9960702E-01) * X)$
 $F = +1.4926585E+02$ SIGNIFICANCE OF F = SIGNIFICANT $G_r = +9.2918873E+01$
 $R = +1.9348292E-01$ SIGNIFICANCE OF R = SIGNIFICANT $S_e = +4.0892936E-02$
 $t = +1.2217440E+01$ SIGNIFICANCE OF t = SIGNIFICANT $S_e = +9.1174921E+01$
 $N = 3840$ DEGREES OF FREEDOM = 3838
 STORAGE CONDITIONS = AMB TEMP/AH TEST CONDITIONS = AMB TEMP/AH



WING 6.H.R.HYDROSTATIC STRESS AT RUPTURE, 1750 IN/MIN, 800 PSI

$Y = ((+3.4180922E+03) + (+2.3131462E+00) * X)$
 $F = +1.3604335E+01$ SIGNIFICANCE OF F = SIGNIFICANT
 $R = +5.9439373E-02$ SIGNIFICANCE OF R = SIGNIFICANT
 $t = +3.6884056E+00$ SIGNIFICANCE OF t = SIGNIFICANT
 $N = 3839$ DEGREES OF FREEDOM = 3837
 STORAGE CONDITIONS = AMB TEMP/RH TEST CONDITIONS = AMB TEMP/RH



WING 6, H.R. HYDROSTATIC MODULUS, 1750 IN/MIN, 800 PSI

Figure 25

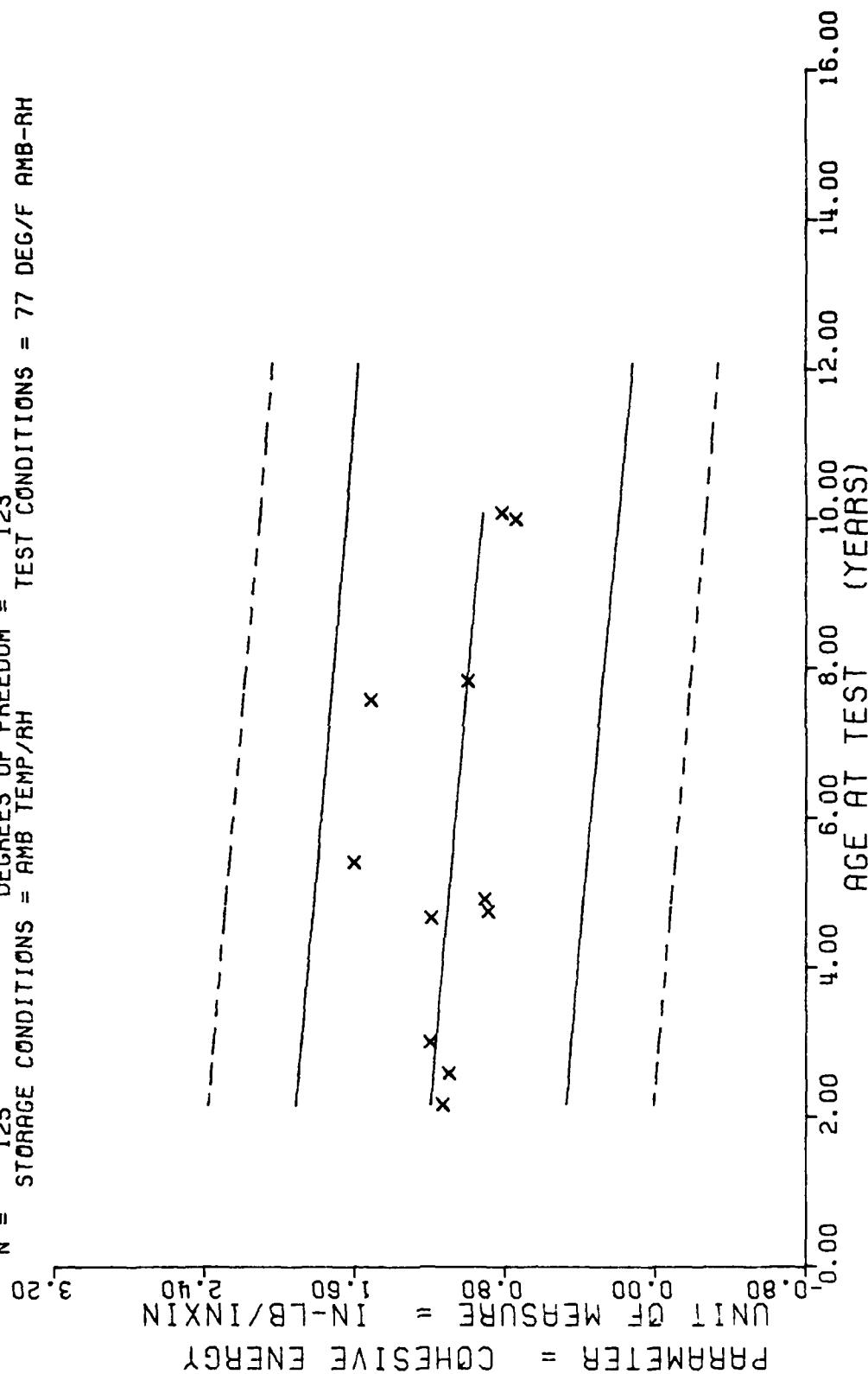
*** SAMPLE SIZE SUMMARY ***

AGE (MOS)	NR SAVED
26	13
31	12
36	11
50	5
57	13
59	14
65	12
91	7
94	14
120	12
121	12

STAGE I WING C YD-F1C11 YEAR ENERGY TEST/TEMP=77 DEG F

This sample size summary is applicable to figure 26

$Y = ((+1.2718053E+00) + (-2.9404487E-03) * X)$
 $F = +7.3959993E+00$ SIGNIFICANCE OF F = SIGNIFICANT $\sigma_r = +4.0501268E-01$
 $R = -2.3815861E-01$ SIGNIFICANCE OF R = SIGNIFICANT $S_e = +1.0812227E-03$
 $t = +2.7195586E+00$ SIGNIFICANCE OF t = SIGNIFICANT $S_e = +3.9495474E-01$
 $N = 125$ DEGREES OF FREEDOM = 123
 STORAGE CONDITIONS = AMB TEMP/RH TEST CONDITIONS = 77 DEG/F AMB-RH

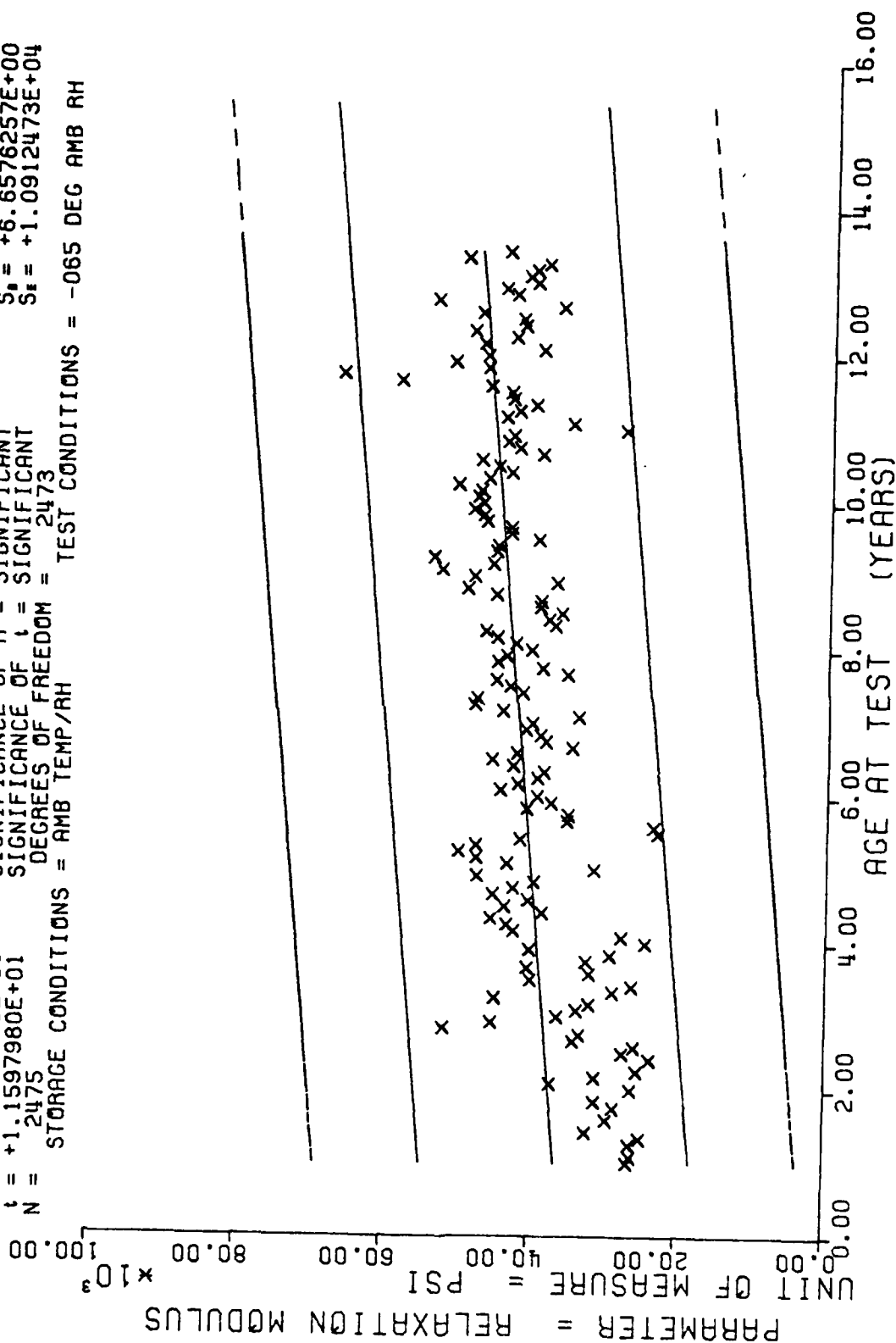


STAGE I WING 6 TP-H1011 TEAR ENERGY TEST/TEMP=77 DEG F

AGE (MOS)	NR SAMP	AGE (MOS)	NR SAMP	AGE (MOS)	NR SAMP	AGE (MOS)	NR SAMP	AGE (MOS)	NR SAMP	AGE (MOS)	NR SAMP
12	2	42	6	67	9	92	9	117	27	142	18
13	3	43	12	68	9	93	25	118	21	143	38
15	1	44	3	69	20	94	26	119	19	144	9
16	3	45	6	70	30	95	26	120	36	145	3
17	4	46	3	71	41	96	51	121	21	146	6
19	3	47	6	72	30	97	54	122	6	147	9
21	4	48	6	73	39	98	55	123	6	148	3
22	3	49	2	74	32	99	41	124	27	149	12
24	6	50	26	75	32	100	23	125	20	150	3
25	6	51	45	76	17	101	27	126	21	151	12
26	9	52	46	77	40	102	8	127	12	152	3
27	3	53	18	78	28	103	18	128	23	153	32
29	3	54	27	79	15	104	12	129	2	154	6
30	3	55	27	80	17	105	9	130	36	155	6
31	3	56	21	81	23	106	3	131	36	156	6
32	6	57	24	82	35	107	9	132	8	157	6
33	6	58	20	83	12	108	15	133	18	158	3
34	3	59	9	84	17	109	15	134	28	159	3
35	6	60	9	85	18	110	9	135	18	160	3
36	19	61	21	86	9	111	6	136	2	161	9
37	9	62	46	87	33	112	17	137	9		
38	6	63	23	88	19	113	45	138	34		
39	6	64	30	89	21	114	35	139	45		
40	8	65	9	90	30	115	46	140	6		
41	6	66	2	91	14	116	36	141	12		

This sample size summary is applicable to figure 27 and 28

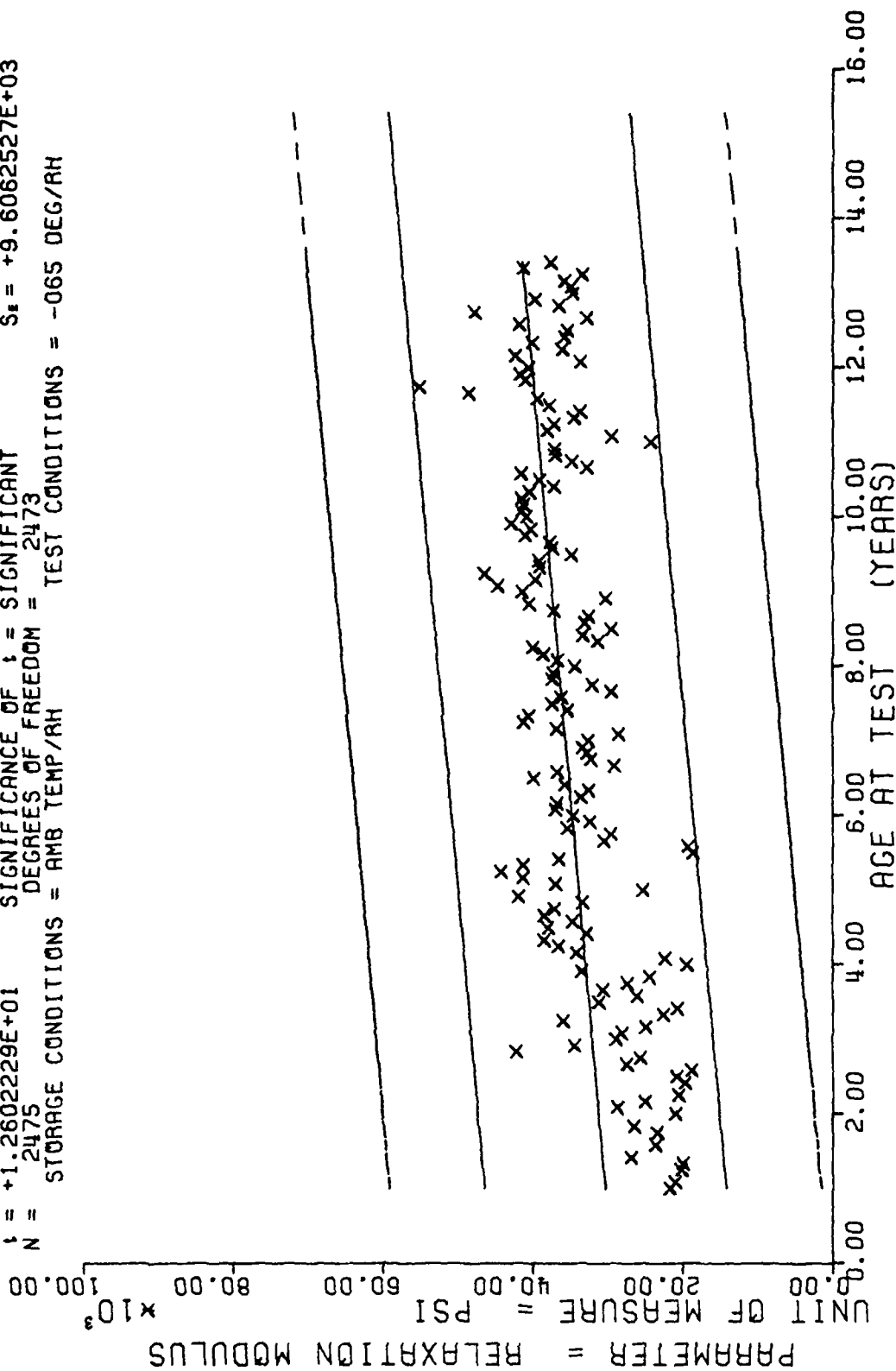
$F = +1.3451316E+02$
 $R = +2.2712719E-01$
 $t = +1.1597980E+01$
 $N = 2475$
 $Y = ((+3.5477401E+04) + (+7.7215016E+01) * X)$
 SIGNIFICANCE OF F = SIGNIFICANT
 SIGNIFICANCE OF R = SIGNIFICANT
 SIGNIFICANCE OF t = SIGNIFICANT
 DEGREES OF FREEDOM = 2473
 STORAGE CONDITIONS = AMB TEMP/RH
 TEST CONDITIONS = -065 DEG AMB RH



WING 6, STRESS RELAXATION MODULUS, 0.5% STRAIN, 10 SEC, -65 DEG F, TPH-1011

Figure 27

$Y = ((+2.9437334E+04) + (+7.3858003E+01) * X)$
 $F = +1.5881618E+02$ SIGNIFICANCE OF F = SIGNIFICANT
 $R = +2.4565160E-01$ SIGNIFICANCE OF R = SIGNIFICANT
 $t = +1.2602229E+01$ SIGNIFICANCE OF t = SIGNIFICANT
 $N = 2475$ DEGREES OF FREEDOM = 2473
 STORAGE CONDITIONS = AMB TEMP/RH TEST CONDITIONS = -065 DEG/RH



WING 6, STRESS RELAXATION MODULUS, 0.5% STRAIN, 50 SEC. -65 DEG F, TPH-1011

Figure 28

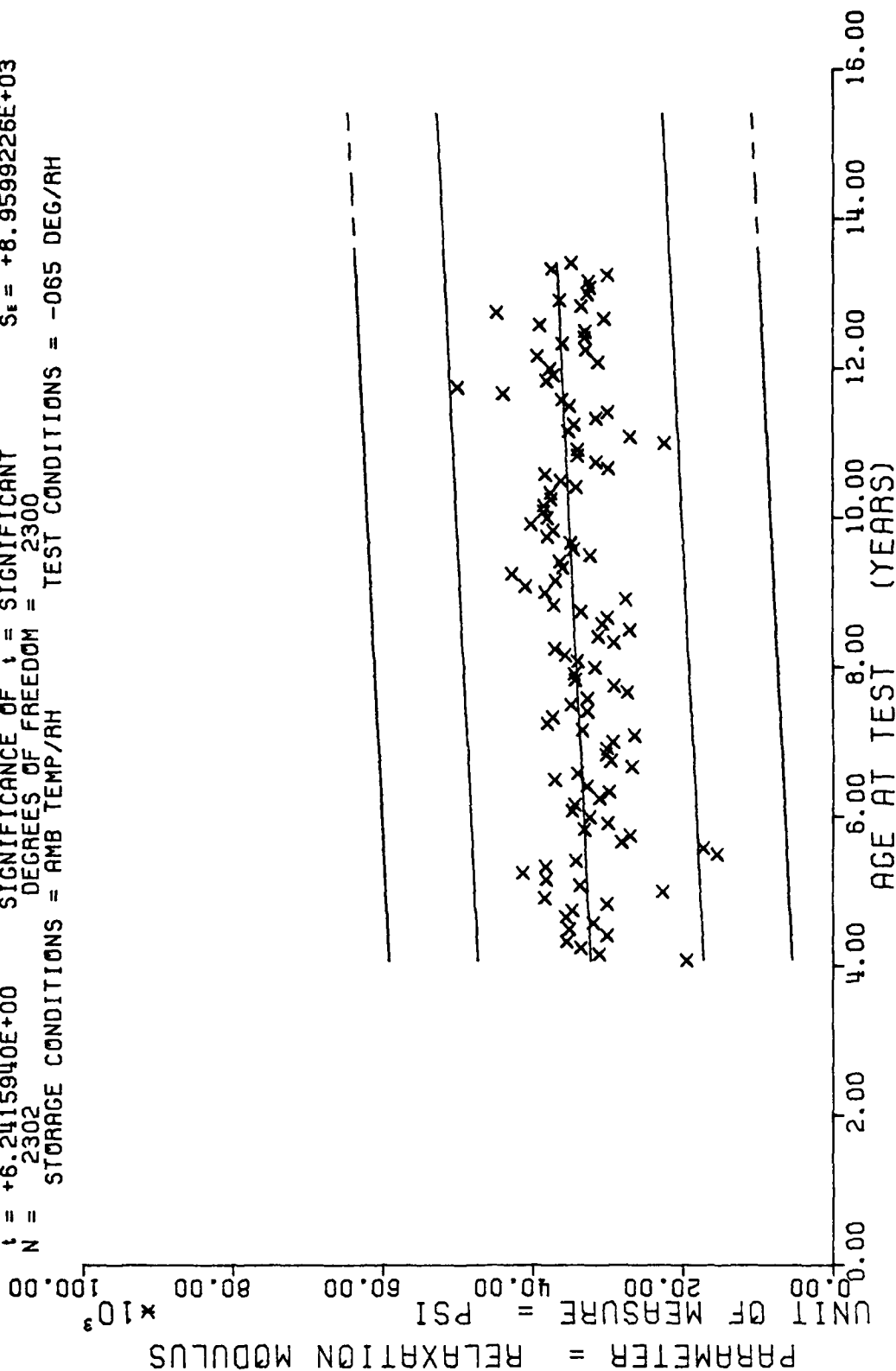
*** SAMPLE SIZE SUMMARY ***

AGE (MOS)	NO SAMP	AGE (MOS)	NP SAMP	AGE (MOS)	NP SAMP	AGE (MOS)	NP SAMP
49	2	74	32	99	41	124	27
50	26	75	32	100	23	125	20
51	49	76	17	101	27	126	21
52	46	77	40	102	3	127	12
53	19	78	28	103	18	128	23
54	27	79	15	104	12	129	2
55	27	80	17	105	9	130	36
56	21	81	23	106	3	131	36
57	24	82	35	107	9	132	8
58	20	83	12	108	15	133	18
59	9	84	17	109	15	134	28
60	9	85	18	110	9	135	18
61	21	86	9	111	6	136	2
62	46	87	33	112	17	137	9
63	23	88	19	113	45	138	34
64	30	89	21	114	35	139	45
65	9	90	30	115	46	140	6
66	2	91	14	116	36	141	12
67	9	92	9	117	27	142	18
68	9	93	25	118	21	143	38
69	20	94	26	119	19	144	9
70	70	95	26	120	36	145	3
71	41	96	51	121	21	146	6
72	30	97	54	122	6	147	9
73	19	98	55	123	6	148	3

WING C. STRESS RELAXATION MODULUS, 0.5% STRAIN, 1000 SEC, -65 DEG F, TDPH-1011

This sample size summary is applicable to figures 29 and 30

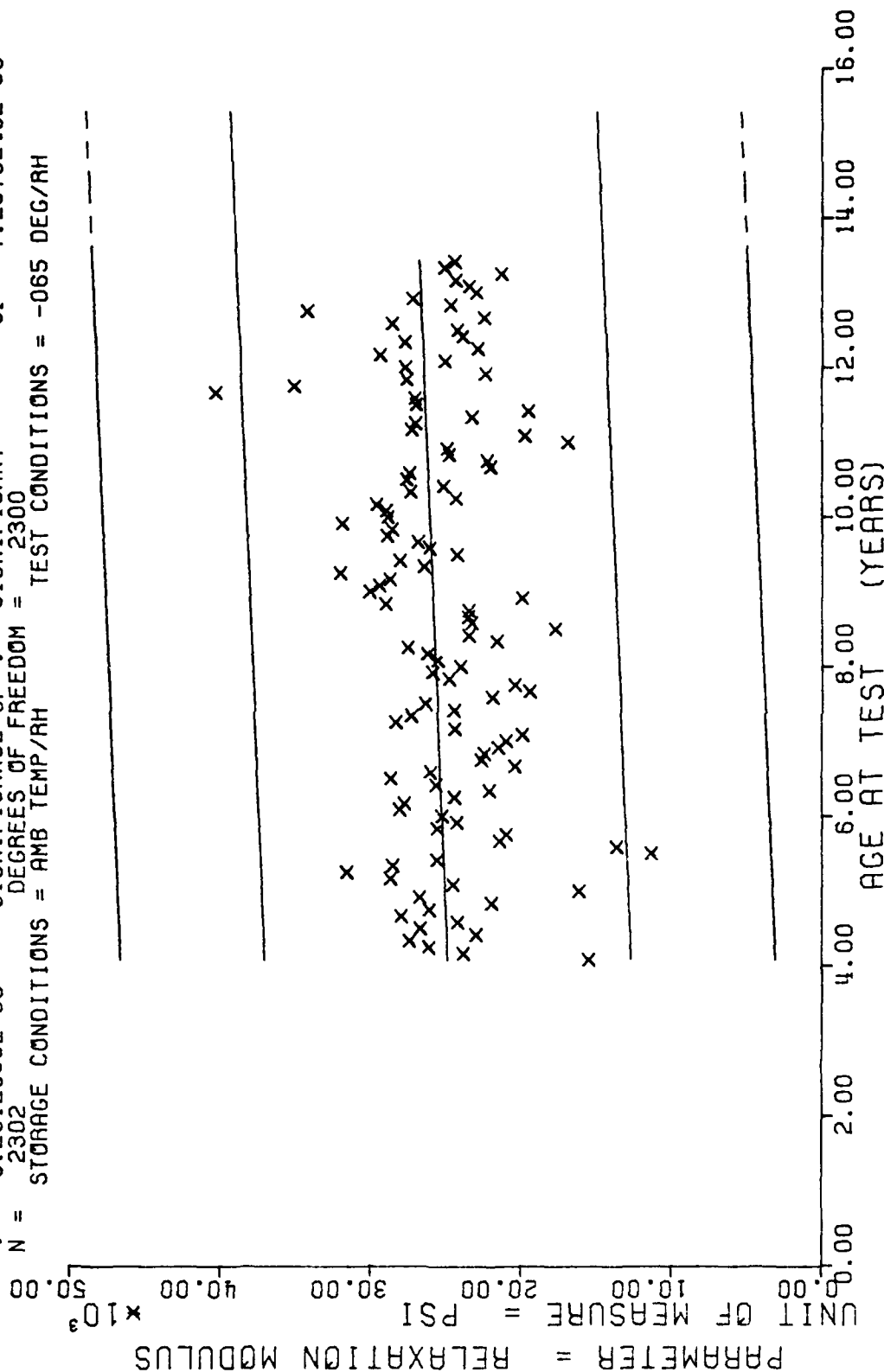
$Y = ((+3.0357516E+04) + (+3.9383466E+01) \times X)$
 F = +3.8957496E+01 SIGNIFICANCE OF F = SIGNIFICANT $\sigma_f = +9.0335222E+03$
 R = +1.2905782E-01 SIGNIFICANCE OF R = SIGNIFICANT $S_R = +6.3098409E+00$
 t = +6.2415940E+00 SIGNIFICANCE OF t = SIGNIFICANT $S_t = +8.9599226E+03$
 N = 2302 DEGREES OF FREEDOM = 2300
 STORAGE CONDITIONS = AMB TEMP/RH TEST CONDITIONS = -065 DEG/RH



WING 6, STRESS RELAXATION MODULUS, 0.5% STRAIN, 100 SEC, -65 DEG F, TPH-1011

Figure 29

$Y = ((+2.4005239E+04) + (+1.6667028E+01) * X)$
 $F = +1.0635816E+01$ SIGNIFICANCE OF F = SIGNIFICANT $\sigma_r = +7.2722039E+03$
 $R = +6.7845285E-02$ SIGNIFICANCE OF R = SIGNIFICANT $S_a = +5.1106102E+00$
 $t = +3.2612600E+00$ SIGNIFICANCE OF t = SIGNIFICANT $S_e = +7.2570248E+03$
 $N = 2302$ DEGREES OF FREEDOM = 2300
 STORAGE CONDITIONS = AMB TEMP/RH TEST CONDITIONS = -065 DEG/RH



WING 6. STRESS RELAXATION MODULUS, 0.5% STRAIN, 1000 SEC, -65 DEG F, TPH-1011

Figure 30

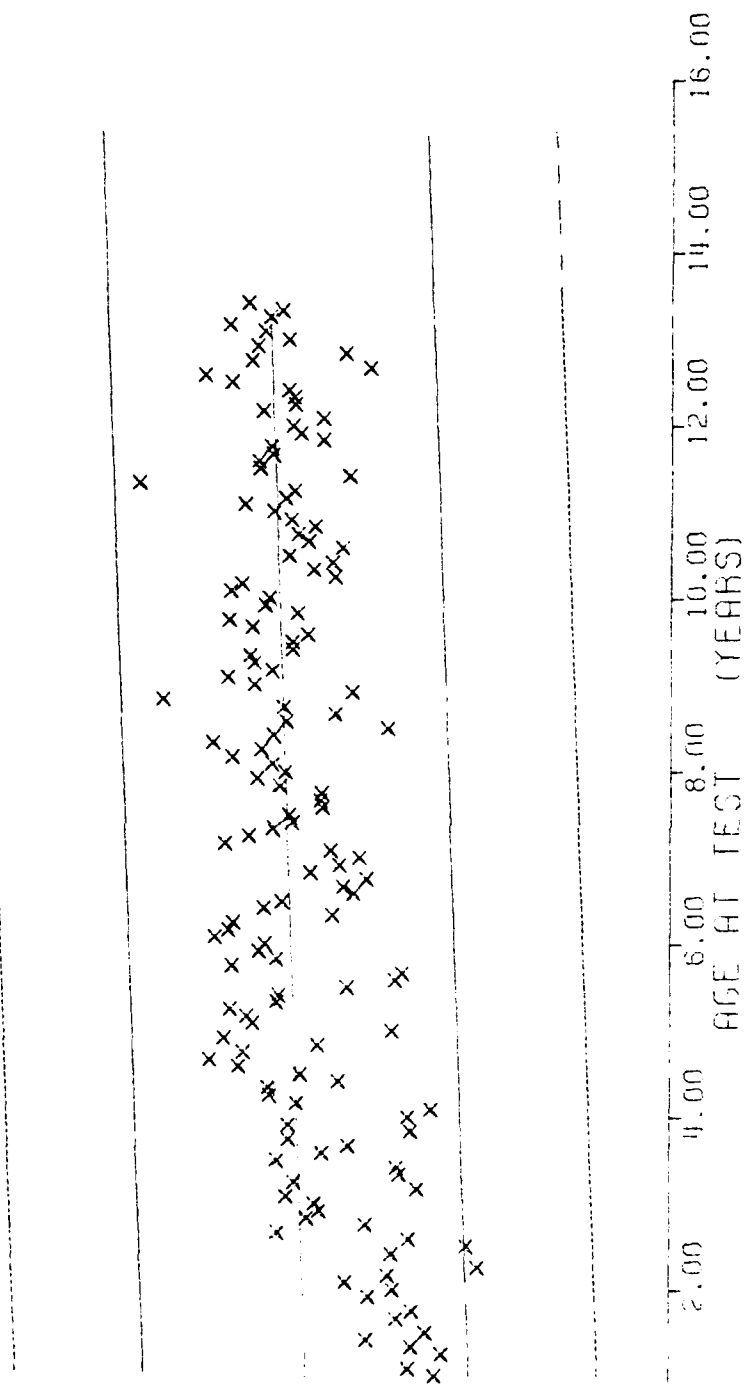
[illegible]

FWING 6, STRESS RELAXATION MODULUS, 0.5% STRAIN, 1000 SEC, -40 DEG C, YPH-1011

This sample size summary is applicable to figures 31 thru 34

$Y = (C + 1.6530380E+04) + (+1.1915452E+01) * X$
 $F = +1.9518587E+01$ SIGNIFICANCE OF F = SIGNIFICANT
 $R = +8.0835748E-02$ SIGNIFICANCE OF R = SIGNIFICANT
 $S = +4.4179845E+00$ SIGNIFICANCE OF S = SIGNIFICANT
 $N = 2571$ DEGREES OF FREEDOM = 2569
 STORAGE CONDITIONS = HMB TEMP/HH TEST CONDITIONS = -0100 DEG/HH

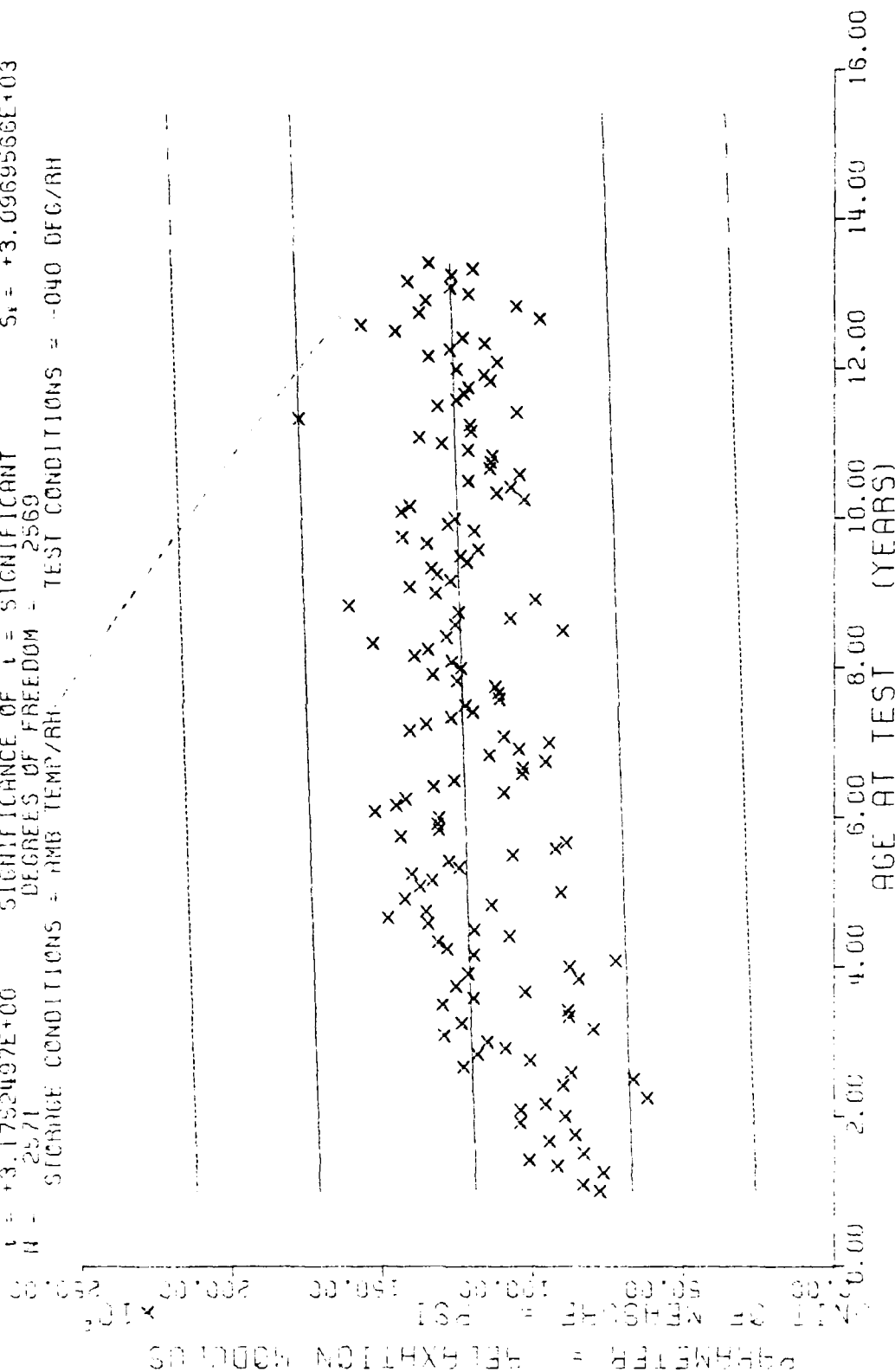
PARAMETER = RELAXATION MODULUS
 UNIT OF MEASURE = PSI
 100.00 80.00 60.00 40.00 20.00 0.00



WING 6, STRESS RELAXATION MODULUS, 0.5% STRAIN, 10 SEC, -40 DEG F, TPH-1011

Figure 31

$Y = (1.1822145E+04) + (5.9470353E+00) * X$
 $F = +1.0062210E+01$ SIGNIFICANCE OF F = SIGNIFICANT $S_1 = +3.1024239E+03$
 $R = +3.2523790E+02$ SIGNIFICANCE OF R = SIGNIFICANT $S_2 = +1.8729346E+00$
 $t = +3.1752497E+00$ SIGNIFICANCE OF t = SIGNIFICANT $S_3 = +3.0969566E+03$
 $N = 2571$ DEGREES OF FREEDOM = 2569
 STORAGE CONDITIONS = RMB TEMP/RH TEST CONDITIONS = -040 DEG/RH

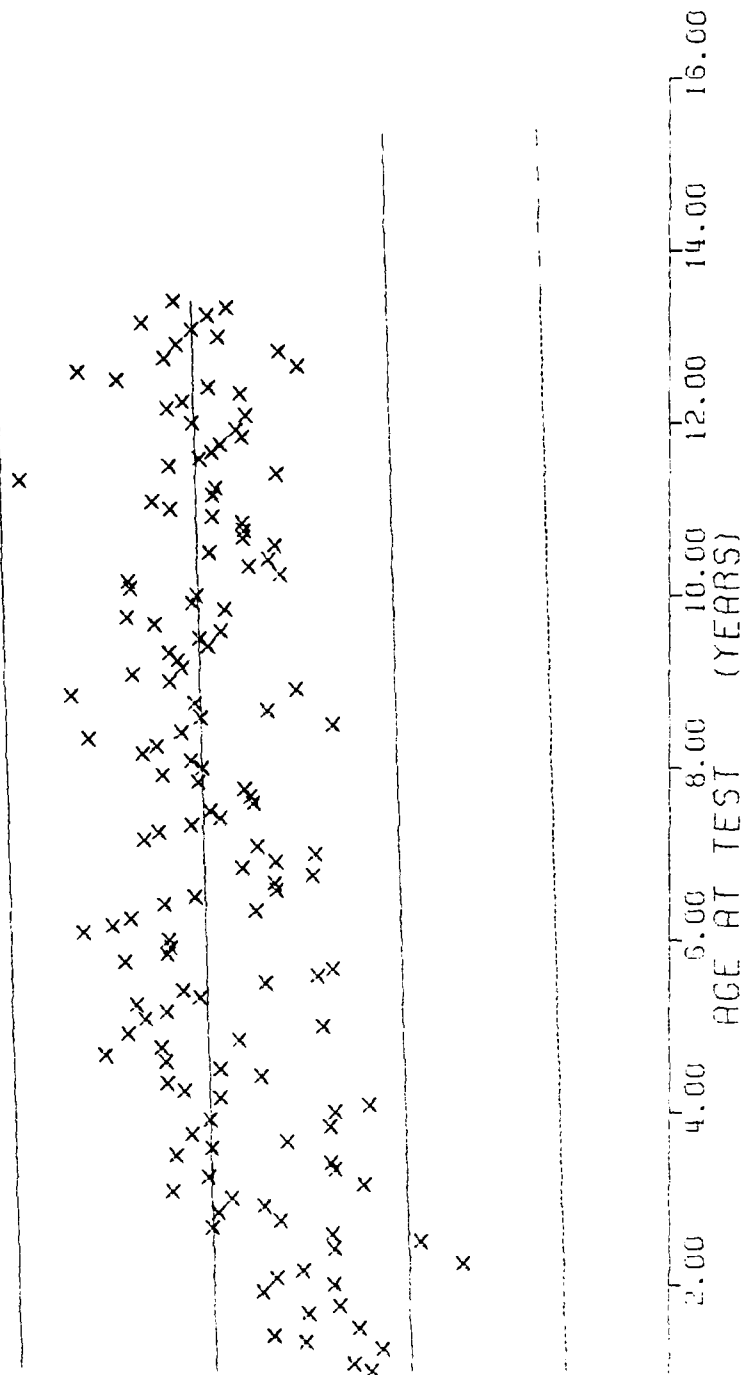


WING 5, STRESS RELAXATION MODULUS, 0.5% STRAIN, 50 SEC, -40 DEG F, TPH-1011

Figure 32

$t = +3.4912545E+00$ SIGNIFICANCE OF F = (+4.1320294E+00) * X)
 $R = +5.0184945E-02$ SIGNIFICANCE OF R = SIGNIFICANT
 $S_e = +2.5456308E+00$ SIGNIFICANCE OF S_e = SIGNIFICANT
 $N = 2571$ DEGREES OF FREEDOM = 2569
 STORAGE CONDITIONS = AMB TEMP/RH TEST CONDITIONS = -040 DEG/RH

RELAXATION MODULUS =
 PRESSURE =
 TIME OF MEASUREMENT = PSI
 200.00
 150.00
 100.00
 50.00
 0.00



WHIC 6, STRESS RELAXATION MODULUS, 0.5% STRAIN, 100 SEC, -40 DEG F, TPH-1011

Figure 33

$Y = ((+6.8486045E+03) + (+7.7485571E-01) \times X)$
 $F = +5.3180318E-01$ SIGNIFICANCE OF F = NOT SIGNIFICANT $G_1 = +1.7567754E+03$
 $R = +1.4385345E-02$ SIGNIFICANCE OF R = NOT SIGNIFICANT $S_0 = +1.0625352E+00$
 $t = +7.2925180E-01$ SIGNIFICANCE OF t = NOT SIGNIFICANT $S_t = +1.7569355E+03$
 $N = 2571$ DEGREES OF FREEDOM = 2569
 STORAGE CONDITIONS = HMB TEMP/RH TEST CONDITIONS = -040 DEG/RH

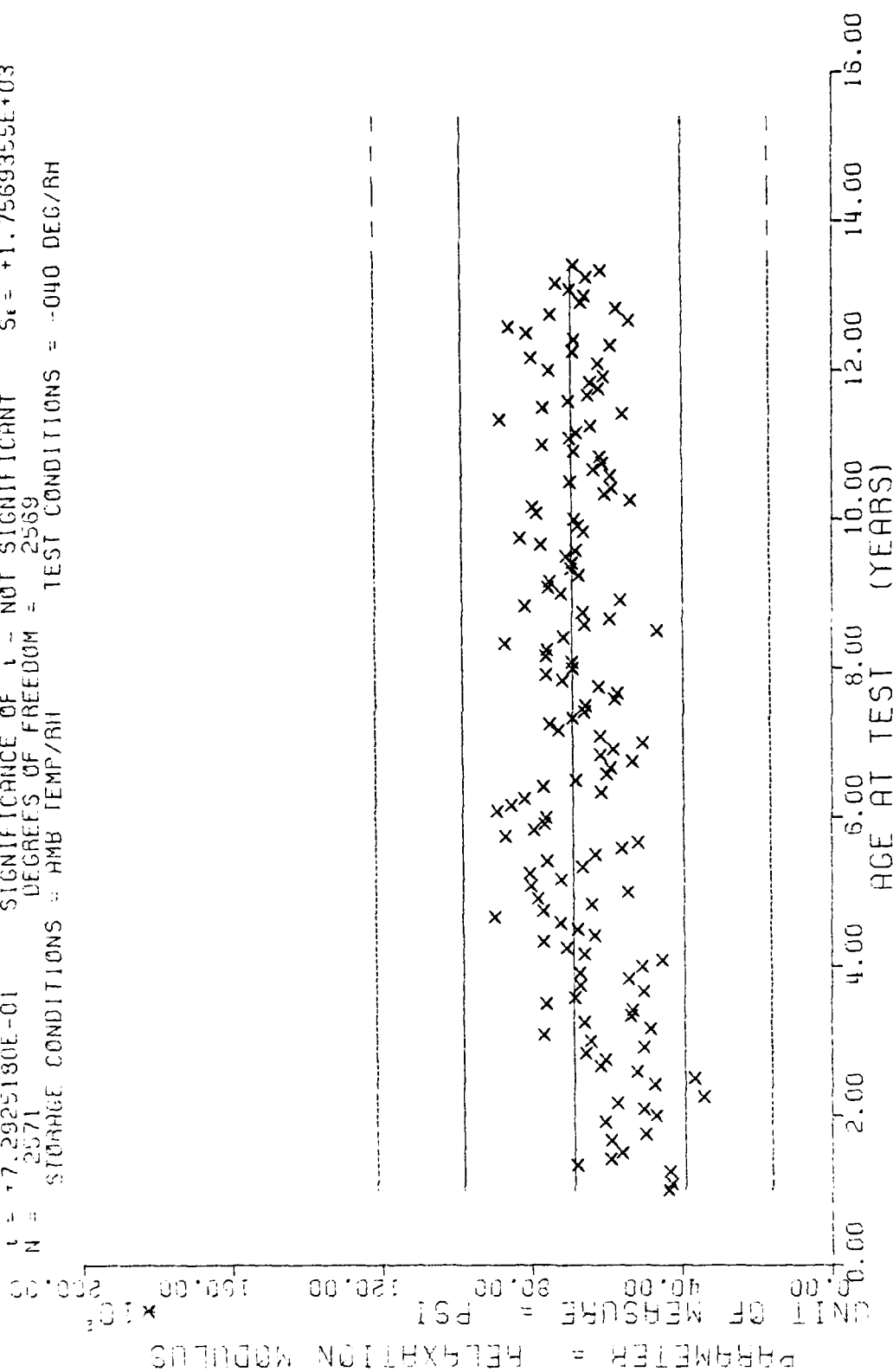


Figure 34

[illegible]

WING C. STRESS RELAXATION MODULUS, 3.0% STRAIN, 1000 SEC. 20 DFG F, TPH-1011

This sample size summary is applicable to figures 35 thru 38

$Y = ((+1.5626671E+03) + (+1.5145891E+00) * X)$
 $F = +1.0012545E+02$ SIGNIFICANCE OF F = SIGNIFICANT
 $R = +1.8946902E-01$ SIGNIFICANCE OF R = SIGNIFICANT
 $t = +1.0006270E+01$ SIGNIFICANCE OF t = SIGNIFICANT
 $N = 2691$ DEGREES OF FREEDOM = 2689
 STORAGE CONDITIONS = AMB TEMP/RH TEST CONDITIONS = +020 DEG/RH

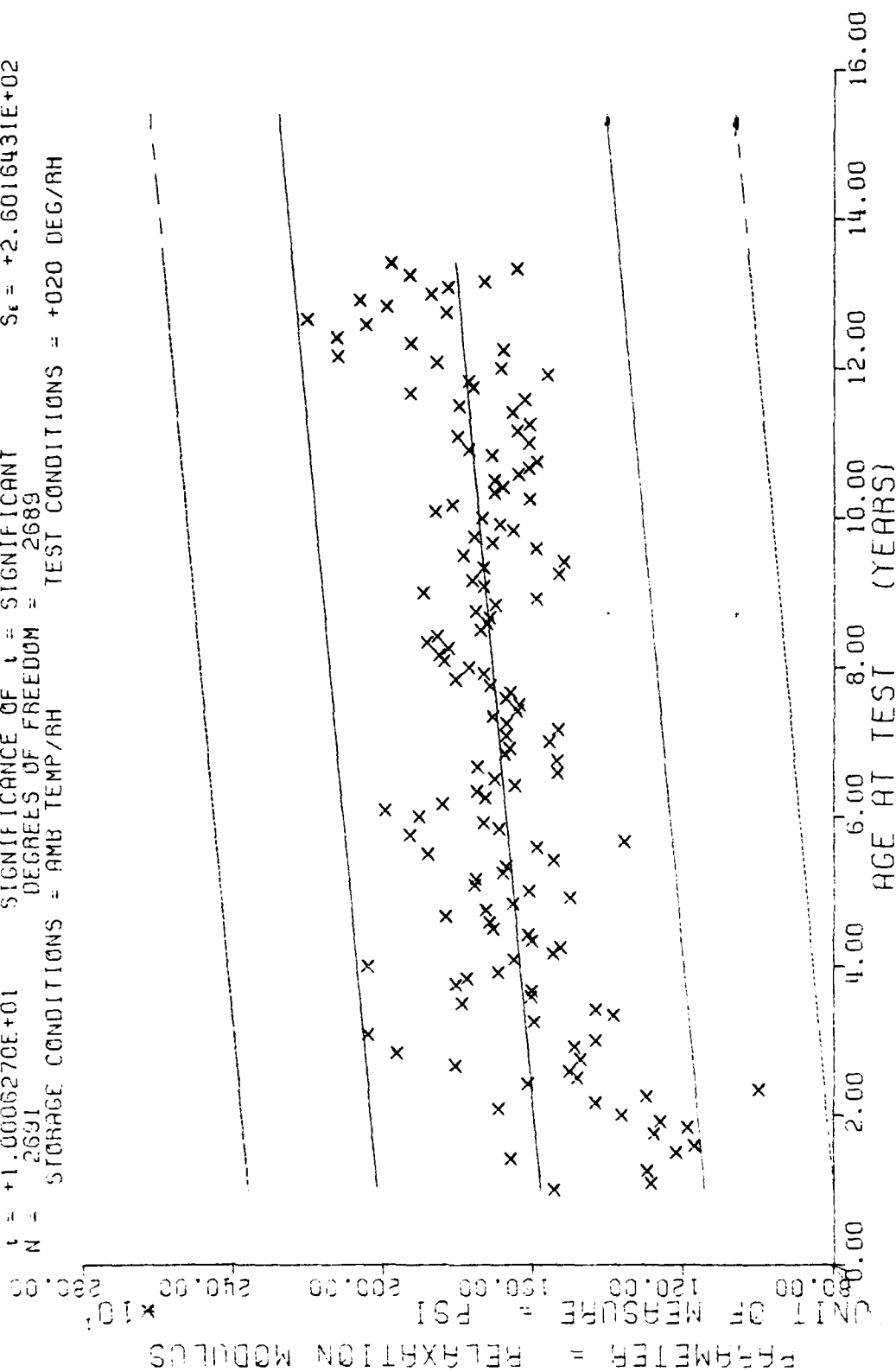
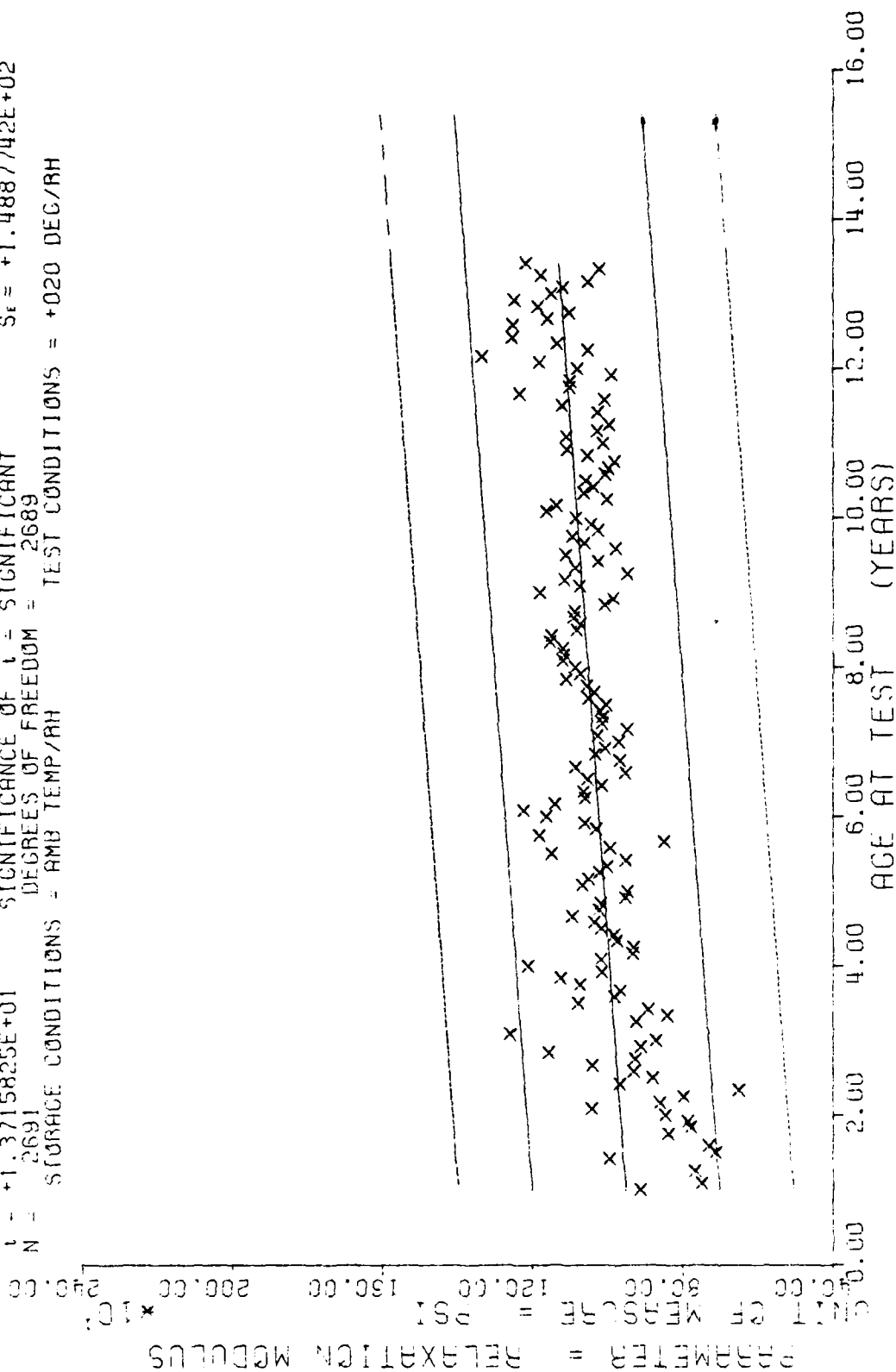


Figure 35

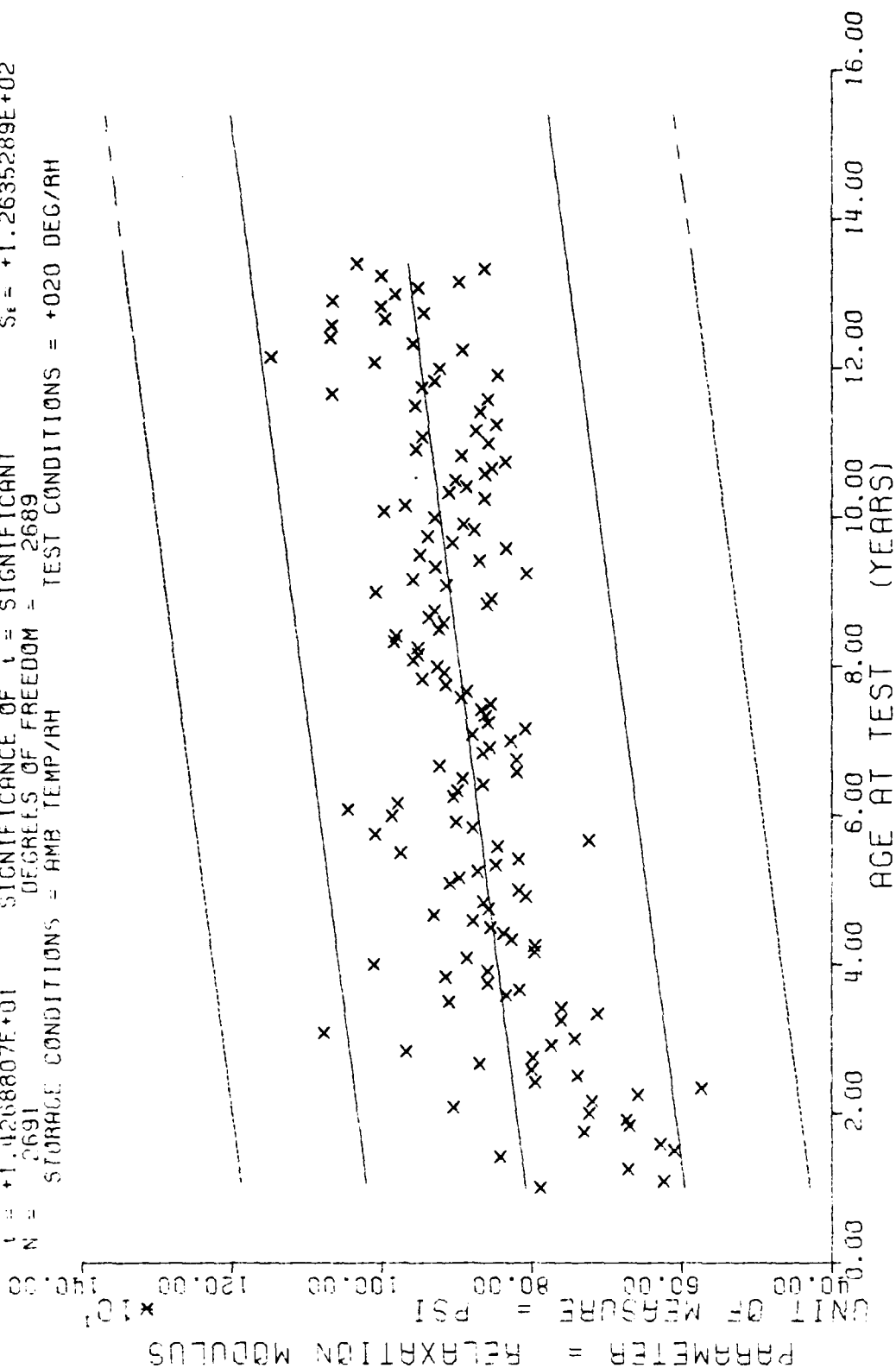
$Y = (+1.8812387E+02) + ((+9.3734557E+02) + (+1.1880253E+00) * X)$
 $R = +2.5570703E-01$ SIGNIFICANCE OF F = SIGNIFICANT $G_A = +1.5396854E+02$
 $t = +1.3715825E+01$ SIGNIFICANCE OF R = SIGNIFICANT $S_B = +8.6617117E-02$
 $N = 2691$ SIGNIFICANCE OF t = SIGNIFICANT $S_E = +1.4887742E+02$
 DEGREES OF FREEDOM = 2689
 STORAGE CONDITIONS = AMB TEMP/RH TEST CONDITIONS = +020 DEG/RH



WING 6, STRESS RELAXATION MODULUS, 3.0% STRAIN, 50 SEC, 20 DEG F, TPH-1011

Figure 36

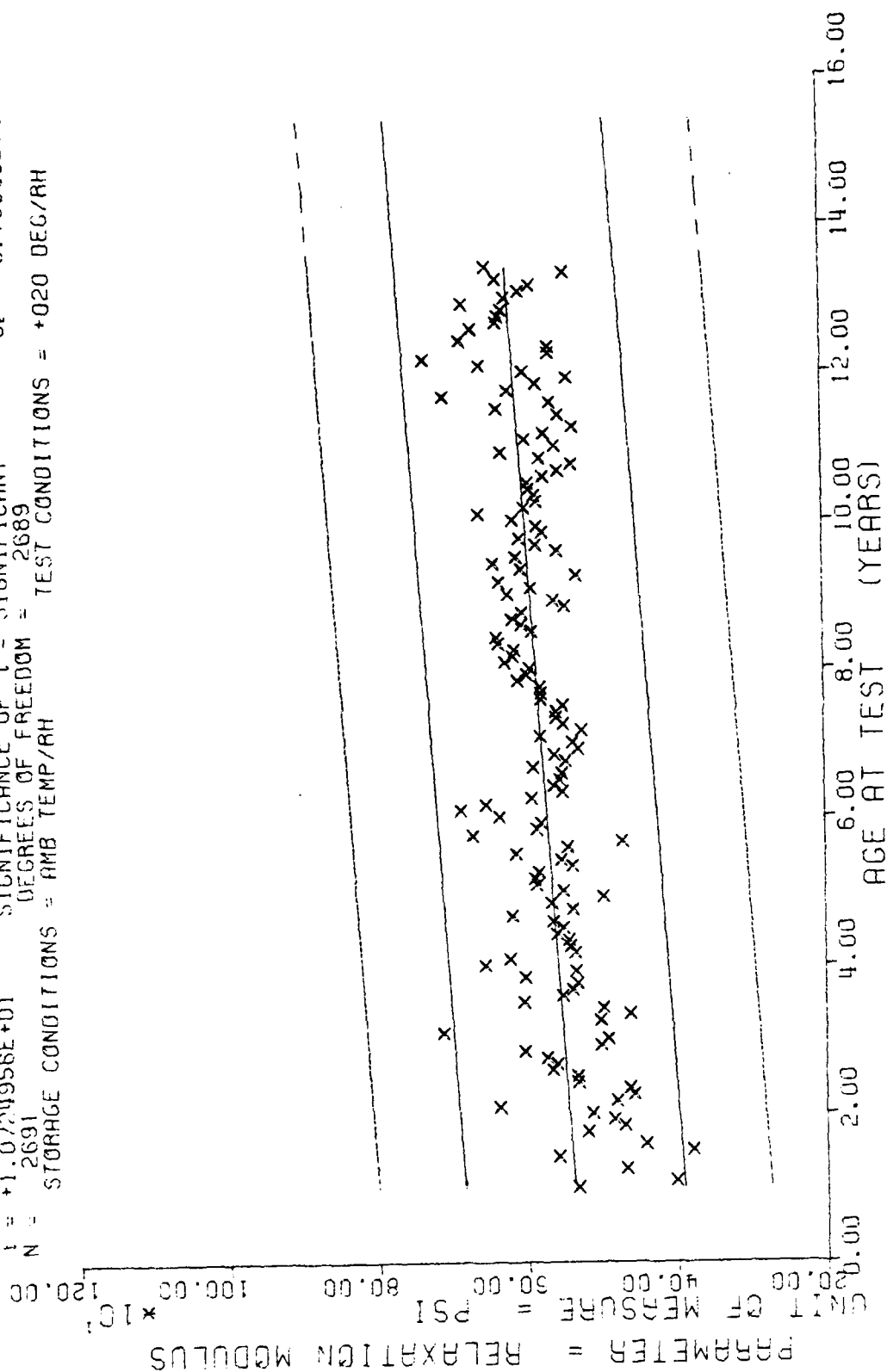
$Y = ((+2.9536687E+02) + (+1.0489330E+00) * X)$
 SIGNIFICANCE OF F = SIGNIFICANT
 SIGNIFICANCE OF R = SIGNIFICANT
 SIGNIFICANCE OF t = SIGNIFICANT
 DEGREES OF FREEDOM = 2689
 STORAGE CONDITIONS = AMB TEMP/RH
 TEST CONDITIONS = +020 DEG/RH



WING 6, STRESS RELAXATION MODULUS, 3.0% STRAIN, 100 SEC, 20 DEG F, TPH-1011

Figure 37

$\gamma = ((+5.3112892E+02) + (+5.4699942E-01) \times X)$
 $F = +1.1502469E+02$ SIGNIFICANCE OF F = SIGNIFICANT $G_1 = +8.9501691E+01$
 $R = +2.0253711E-01$ SIGNIFICANCE OF R = SIGNIFICANT $S_0 = +5.1002484E-02$
 $t = +1.0724956E+01$ SIGNIFICANCE OF t = SIGNIFICANT $S_e = +8.7663027E+01$
 $N = 2691$ DEGREES OF FREEDOM = 2689
 STORAGE CONDITIONS = RMB TEMP/RH TEST CONDITIONS = +020 DEG/RH



WING 6, STRESS RELAXATION MODULUS, 3.0% STRAIN, 1000 SEC, 20 DEG F, TPH-1011

Figure 38

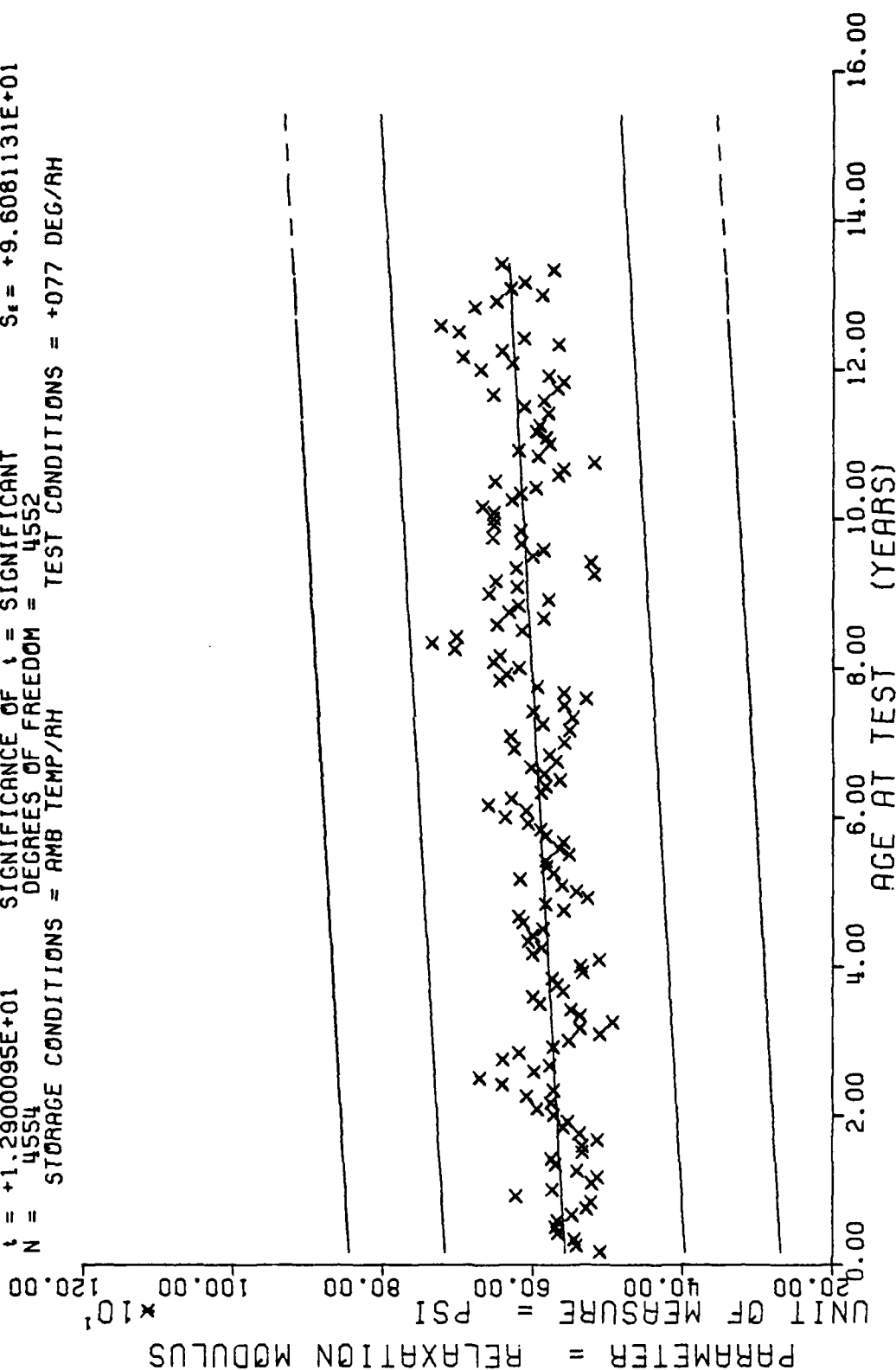
AGE (YRS)	NR SAMP	AGE (MOS)	NR SAMP	AGE (MOS)	NR SAMP	AGE (MOS)	NR SAMP	AGE (MOS)	NR SAMP	AGE (MOS)	NR SAMP
2	3	27	24	52	72	77	33	102	15	127	15
3	6	28	27	53	18	78	39	103	26	128	24
4	18	29	48	54	39	79	21	104	12	129	3
5	22	30	43	55	22	80	21	105	6	130	42
6	21	31	30	56	36	81	45	106	3	131	42
7	35	32	60	57	51	82	21	107	10	132	14
8	30	33	29	58	45	83	15	108	24	133	9
9	45	34	51	59	39	84	21	109	9	134	36
10	34	35	36	60	74	85	15	110	9	135	15
11	47	36	58	61	60	86	21	111	9	137	15
12	65	37	18	62	82	87	36	112	30	138	45
13	51	38	24	63	63	88	21	113	56	139	48
14	46	39	42	64	51	89	39	114	44	140	9
15	57	40	18	65	36	90	42	115	27	141	12
16	36	41	24	66	39	91	14	116	65	142	27
17	46	42	12	67	33	92	23	117	18	143	30
18	13	43	9	68	51	93	19	118	21	144	6
19	10	44	9	69	75	94	18	119	21	145	3
20	4	45	6	70	99	95	33	120	33	146	6
21	27	46	18	71	62	96	57	121	15	147	9
22	9	47	30	72	51	97	69	122	9	148	3
23	6	48	36	73	33	98	60	123	9	149	6
24	34	49	42	74	48	99	39	124	24	150	6
25	27	50	30	75	39	100	20	125	18	151	12
26	30	51	81	76	27	101	34	126	22	154	9
										155	3
										156	6
										157	6
										158	6
										160	3
										161	9

WING 6-STEP STRESS RELAXATION MODULUS, 3.0% STRAIN, 1000 SEC., 77 DEG F, TPH-1011

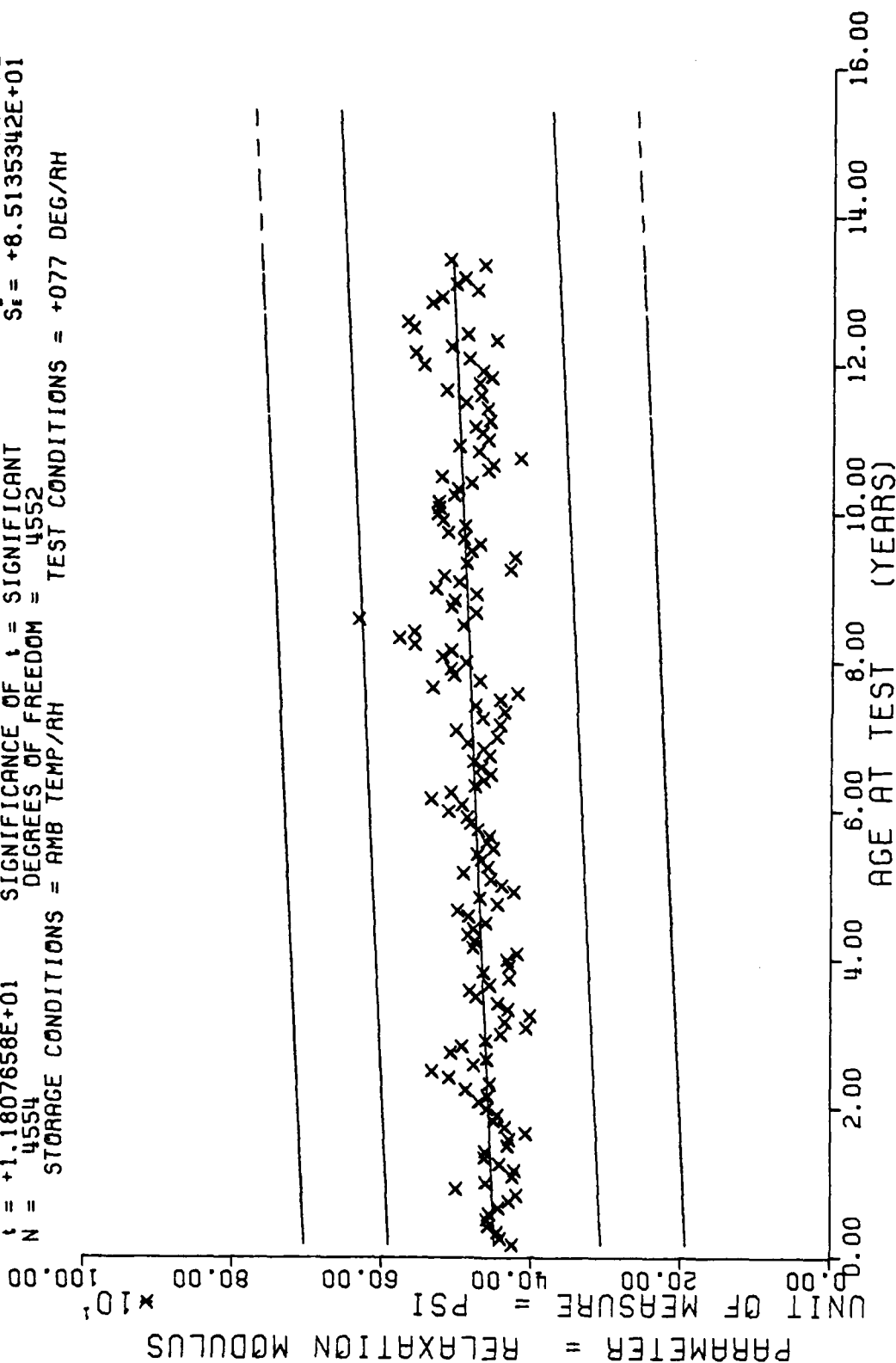
WING 6, STRESS RELAXATION MODULUS, 3.0% STRAIN, 1000 SEC, 77 DEG F, TPH-1011

This sample size summary is applicable to figures 39 thru 42

$Y = ((+5.5630417E+02) + (+4.7002300E-01) * X)$
 $F = +1.6641246E+02$ SIGNIFICANCE OF F = SIGNIFICANT
 $R = +1.8779973E-01$ SIGNIFICANCE OF R = SIGNIFICANT
 $t = +1.2900095E+01$ SIGNIFICANCE OF t = SIGNIFICANT
 $N = 4554$ DEGREES OF FREEDOM = 4552
 STORAGE CONDITIONS = AMB TEMP/RH TEST CONDITIONS = +077 DEG/RH



$Y = ((+4.4800936E+02) + (+3.8120776E-01) * X)$
 F = +1.3942079E+02 SIGNIFICANCE OF F = SIGNIFICANT $\sigma_1 = +8.6419799E+01$
 R = +1.7238980E-01 SIGNIFICANCE OF R = SIGNIFICANT $S_1 = +3.2284789E-02$
 t = +1.1807658E+01 SIGNIFICANCE OF t = SIGNIFICANT $S_2 = +8.5135342E+01$
 N = 4554 DEGREES OF FREEDOM = 4552
 STORAGE CONDITIONS = AMB TEMP/RH TEST CONDITIONS = +077 DEG/RH



WING 6, STRESS RELAXATION MODULUS, 3.0% STRAIN, 50 SEC, 77 DEG F, TPH-1011

Figure 40

Y = ((+4.1941472E+02) + (+3.4806929E-01) * X)
 F = +1.3772793E+02 SIGNIFICANCE OF F = SIGNIFICANT σ^2 = +7.9376440E+01
 R = +1.7137094E-01 SIGNIFICANCE OF R = SIGNIFICANT S_e = +2.9658876E-02
 t = +1.1735754E+01 SIGNIFICANCE OF t = SIGNIFICANT S_e = +7.8210780E+01
 N = 4554 DEGREES OF FREEDOM = 4552
 STORAGE CONDITIONS = AMB TEMP/RH TEST CONDITIONS = +077 DEG/RH

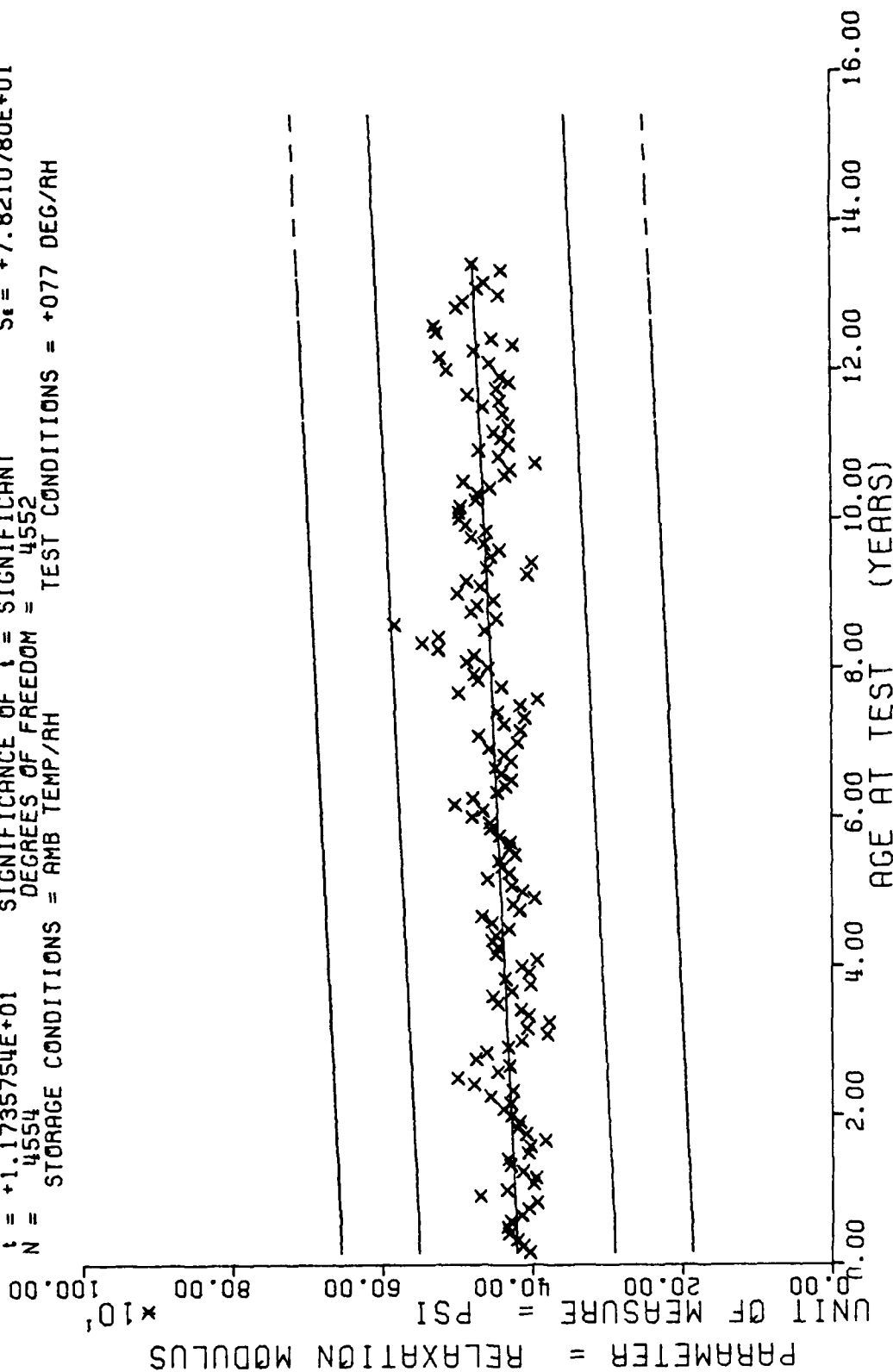
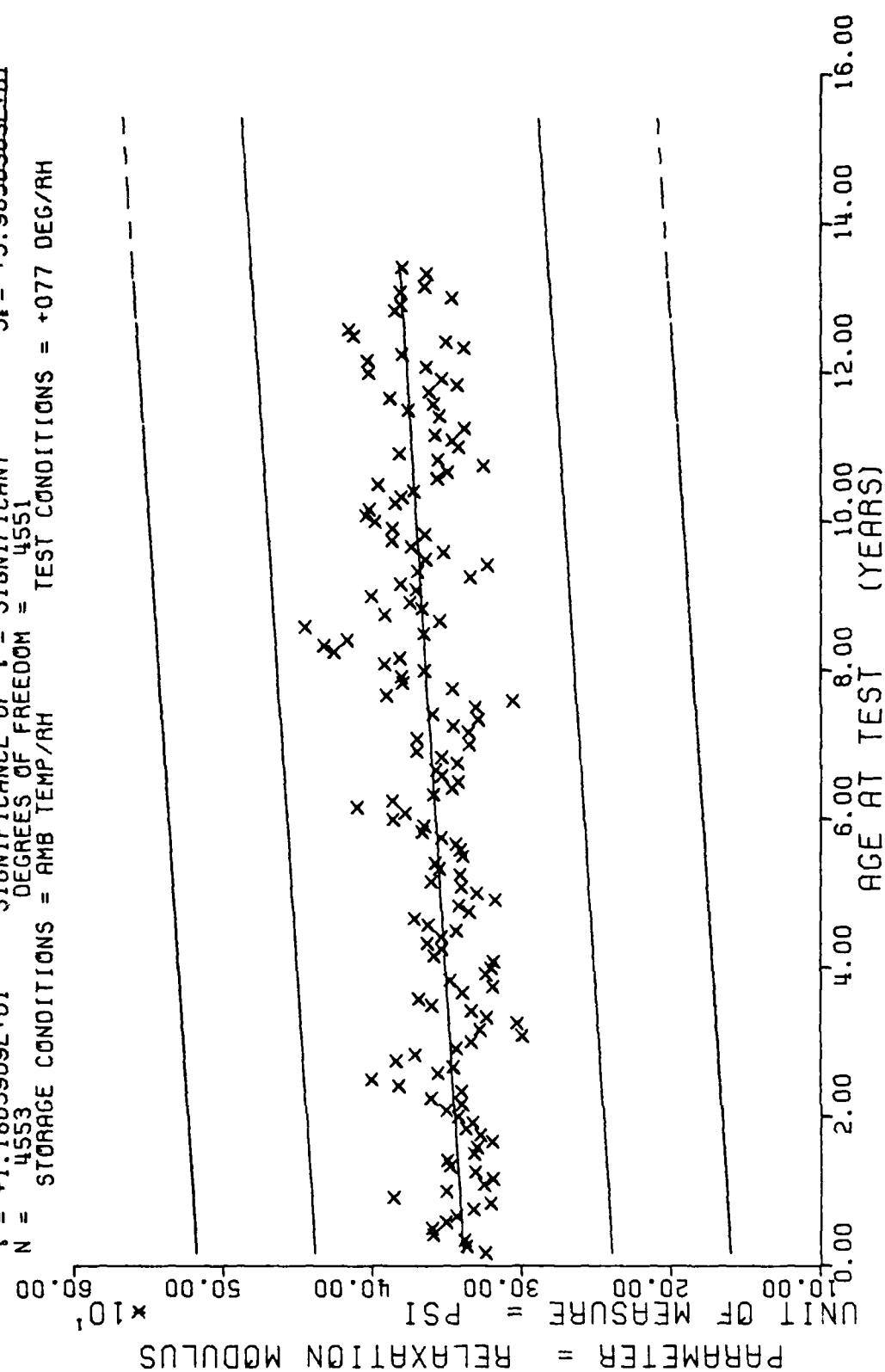


Figure 41

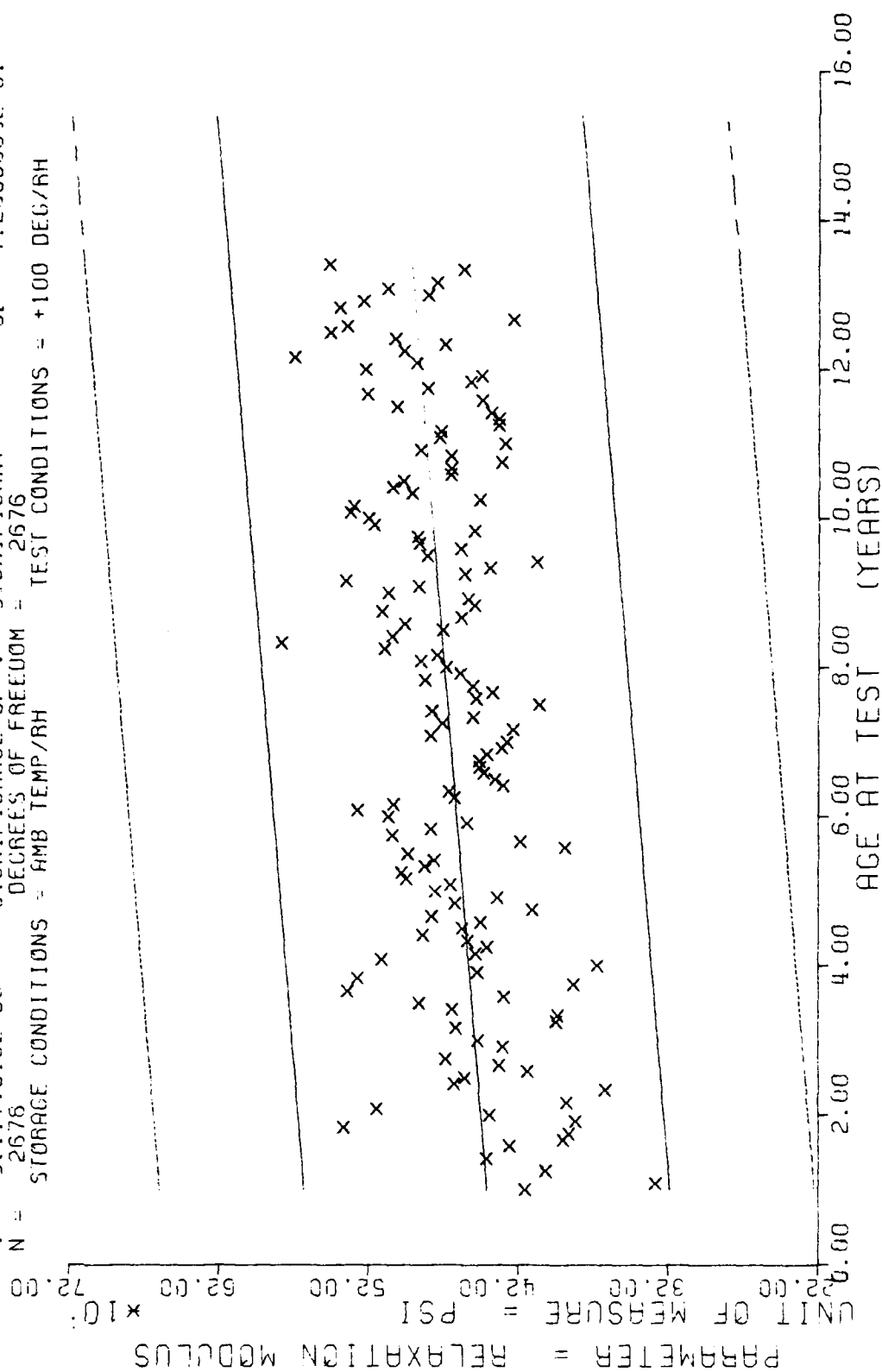
$Y = ((+3.3839122E+02) + (+2.6706182E-01) * X)$
 $F = +1.3937949E+02$ SIGNIFICANCE OF F = SIGNIFICANT $\sigma_1 = +6.0550252E+01$
 $R = +1.7238340E-01$ SIGNIFICANCE OF R = SIGNIFICANT $S_1 = +2.2621029E-02$
 $t = +1.1805909E+01$ SIGNIFICANCE OF t = SIGNIFICANT $S_t = +5.9650363E+01$
 $N = 4553$ DEGREES OF FREEDOM = 4551
 STORAGE CONDITIONS = AMB TEMP/RH TEST CONDITIONS = +077 DEG/RH



[illegible]

This sample size summary is applicable to figures 43 thru 46

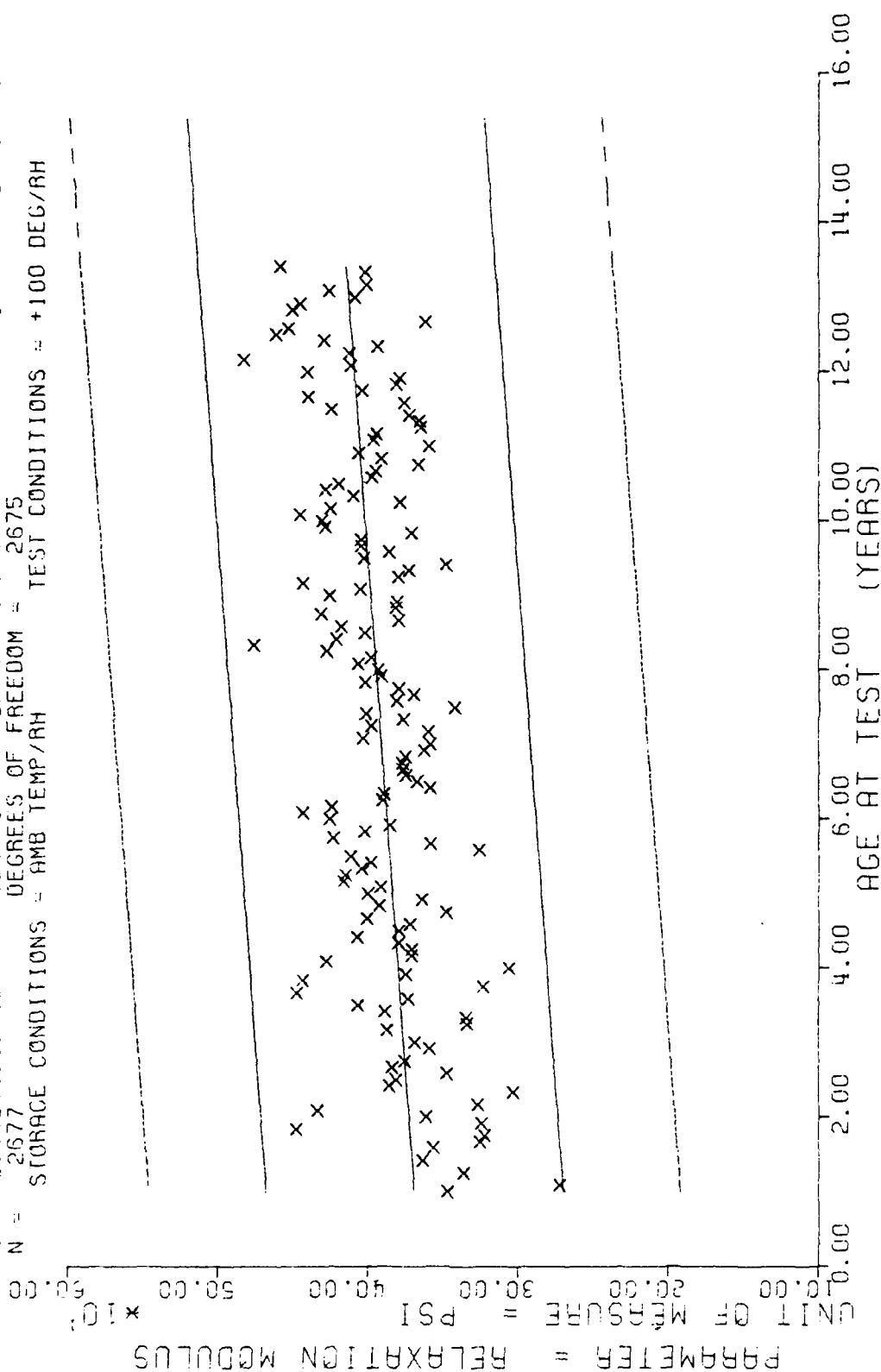
$Y = ((+4.3667243E+02) + (+3.3913267E-01) \times X)$
 $F = +6.5888790E+01$ SIGNIFICANCE OF F = SIGNIFICANT
 $R = +1.5501754E-01$ SIGNIFICANCE OF R = SIGNIFICANT
 $t = +8.1171910E+00$ SIGNIFICANCE OF t = SIGNIFICANT
 $N = 2676$ DEGREES OF FREEDOM = 2676
 STORAGE CONDITIONS = AMB TEMP/RH TEST CONDITIONS = +100 DEG/RH



WING 6, STRESS RELAXATION MODULUS, 3.0% STRAIN, 10 SEC, 100 DEG F, TPH-1011

Figure 43

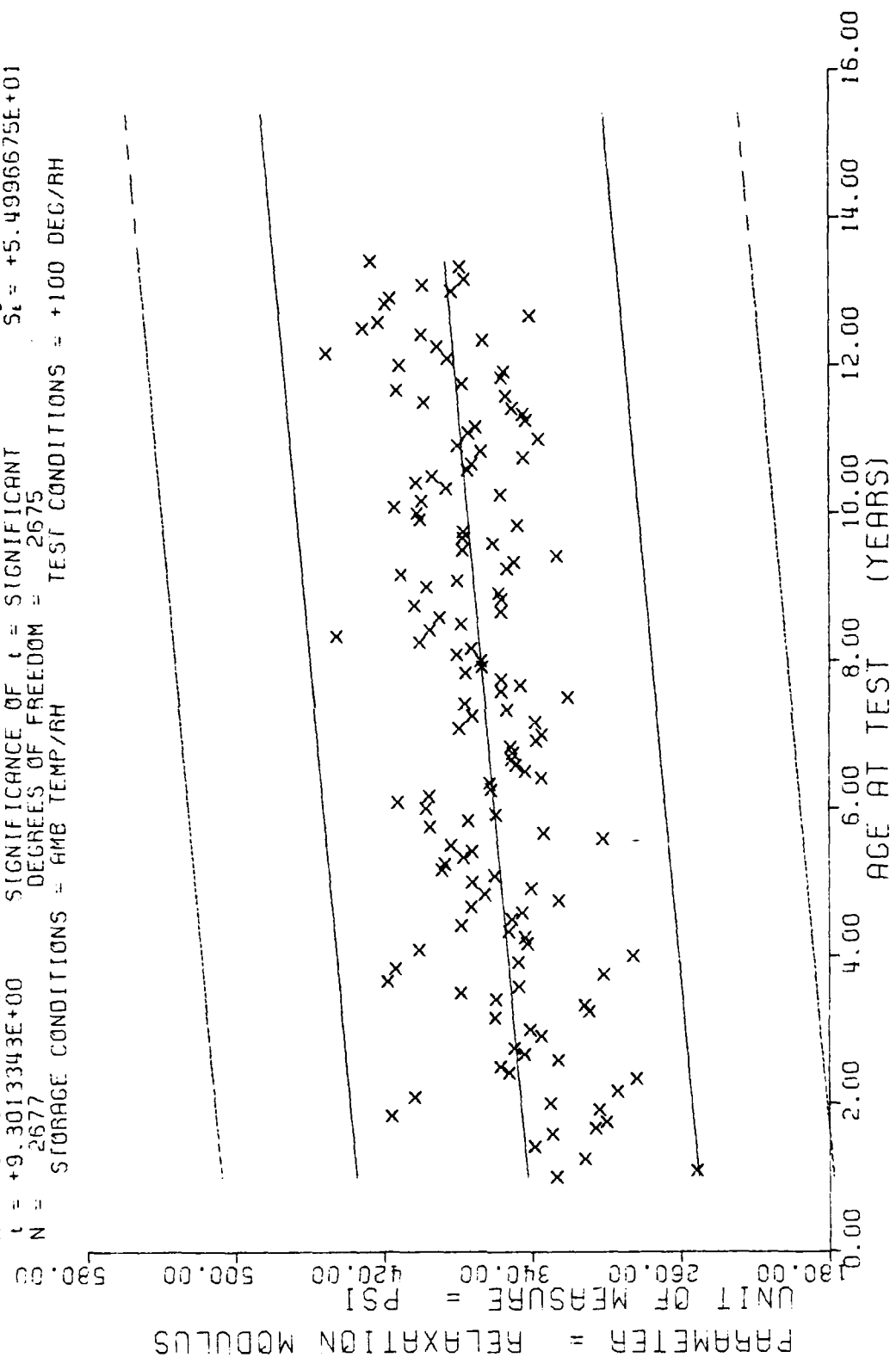
$Y = (1 + 3.6527150E+02) + (+ 3.0101345E-01) * X$
 $F = +7.8917129E+01$ SIGNIFICANCE OF F = SIGNIFICANT $G_1 = +5.9912318E+01$
 $R = +1.6928177E-01$ SIGNIFICANCE OF R = SIGNIFICANT $S_a = +3.3884437E-02$
 $t = +8.6835313E+00$ SIGNIFICANCE OF t = SIGNIFICANT $S_t = +5.9058681E+01$
 $N = 2677$ DEGREES OF FREEDOM = 2675
 STORAGE CONDITIONS = AMB TEMP/RH TEST CONDITIONS = +100 DEG/RH



WING 6, STRESS RELAXATION MODULUS, 3.0% STRAIN, 50 SEC, 100 DEG F, TPH-1011

Figure 44

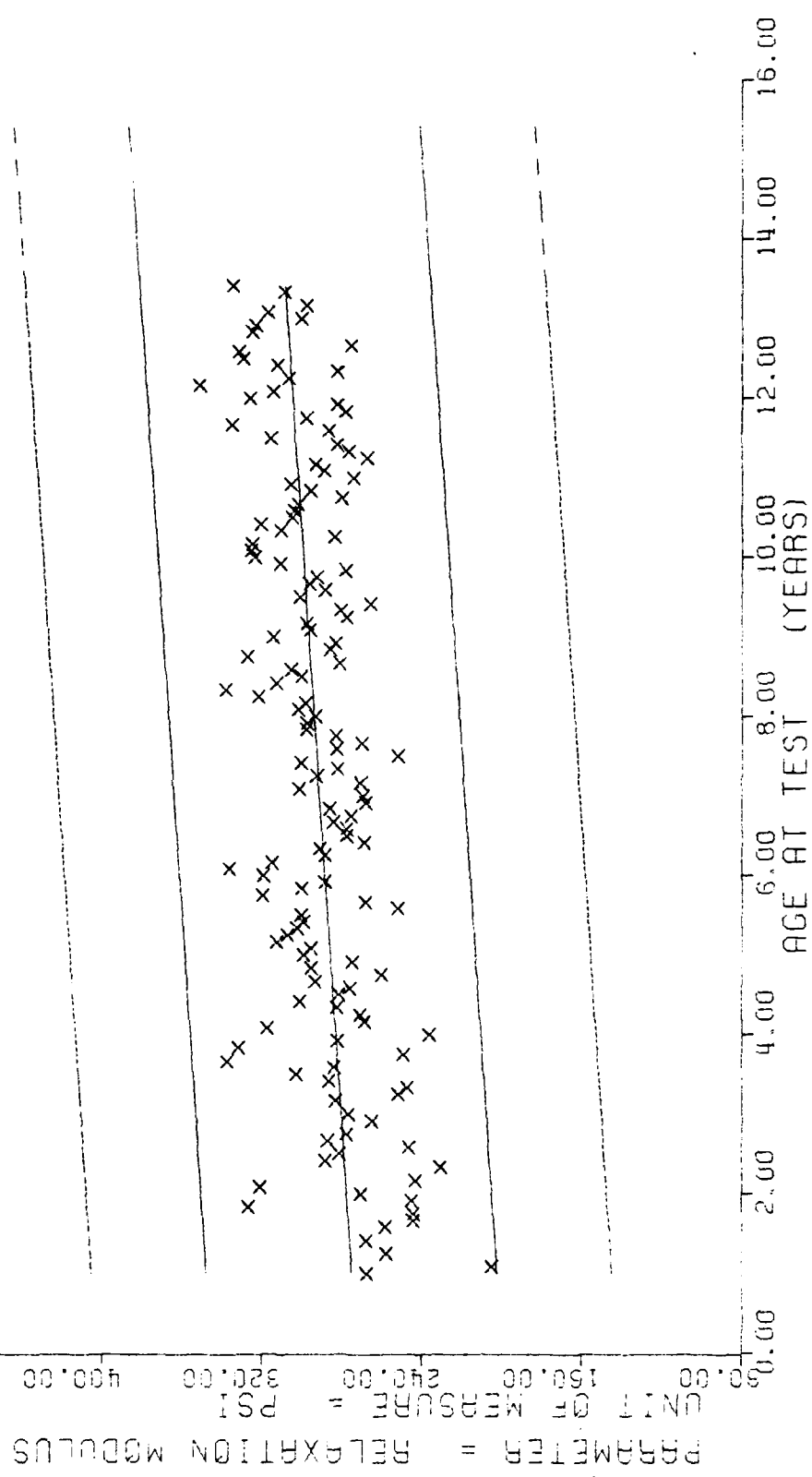
$Y = ((+3.4166181E+02) + (+2.9349332E-01) * X)$
 $F = +8.6514820E+01$ SIGNIFICANCE OF F = SIGNIFICANT $G_r = +5.5868507E+01$
 $R = +1.7699930E-01$ SIGNIFICANCE OF R = SIGNIFICANT $S_B = +3.1553894E-02$
 $t = +9.3013343E+00$ SIGNIFICANCE OF t = SIGNIFICANT $S_t = +5.4996675E+01$
 $N = 2677$ DEGREES OF FREEDOM = 2675
 STORAGE CONDITIONS = AMB TEMP/RH TEST CONDITIONS = +100 DEG/RH



WING 6, STRESS RELAXATION MODULUS, 3.0% STRAIN, 100 SEC, 100 DEG F, TPH-1011

Figure 45

$Y = (1 + 2.7232574E+02) + (+2.2354248E-01) * X$
 $F = +8.0292771E+01$ SIGNIFICANCE OF F = SIGNIFICANT $S_1 = +4.4084184E+01$
 $R = +1.7089435E-01$ SIGNIFICANCE OF R = SIGNIFICANT $S_2 = +2.4947202E-02$
 $t = +8.9606233E+00$ SIGNIFICANCE OF t = SIGNIFICANT $S_3 = +4.3443814E+01$
 $N = 2671$ DEGREES OF FREEDOM = 2669
 STORAGE CONDITIONS = AMB TEMP/RH TEST CONDITIONS = +100 DEG/RH



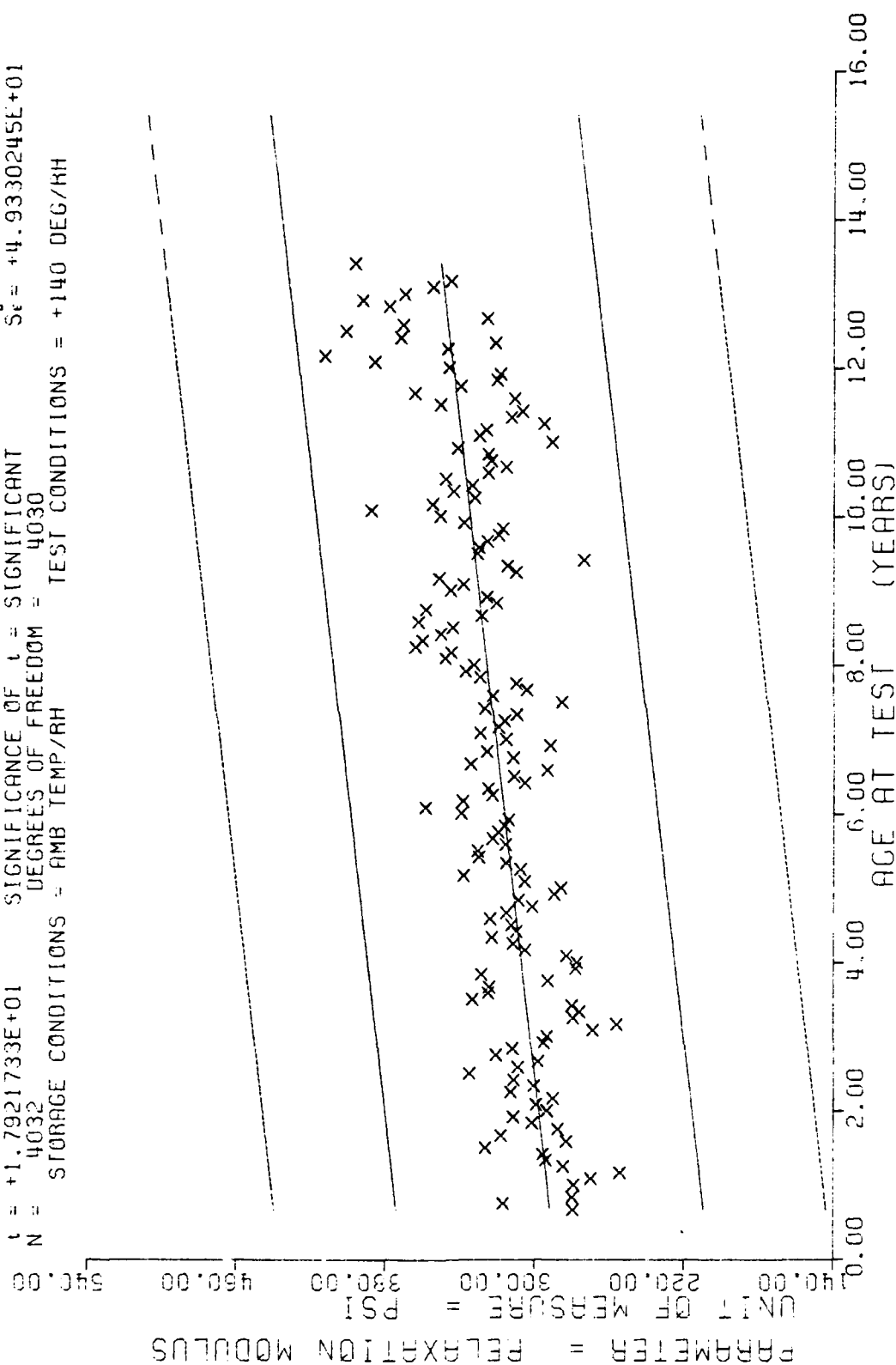
WING 6, STRESS RELAXATION MODULUS, 3.0% STRAIN, 1000 SEC, 100 DEG F, TPH-1011

Figure 46

AGE (MOS)	NR SAMP	AGE (MOS)	NR SAMP	AGE (MOS)	NP SAMP	AGE (MOS)	NP SAMP	AGE (MOS)	NP SAMP
3	3	34	57	59	42	84	21	109	9
5	9	35	36	60	65	85	12	110	12
10	6	36	51	61	75	86	18	111	9
12	24	37	21	62	72	87	24	112	30
13	27	38	18	63	60	88	15	113	45
14	9	39	48	64	57	89	21	114	44
15	27	40	18	65	33	90	24	115	24
16	15	41	21	66	45	91	27	116	33
17	39	42	15	67	30	92	18	117	21
18	10	43	9	68	48	93	24	118	27
19	6	44	9	69	79	94	24	119	21
20	6	45	3	70	84	95	26	120	30
21	18	46	12	71	69	96	60	121	21
22	6	47	30	72	54	97	54	122	9
23	9	48	39	73	33	98	58	123	12
24	13	49	39	74	44	99	39	124	21
25	30	50	36	75	33	100	21	125	15
26	30	51	66	76	36	101	21	126	24
27	21	52	65	77	36	102	8	127	14
28	27	53	27	78	36	103	21	128	18
29	43	54	30	79	17	104	5	129	2
30	45	55	33	80	23	105	9	130	36
31	33	56	42	81	33	106	3	131	48
32	57	57	51	82	27	107	6	132	9
33	27	58	57	83	18	108	24	133	12

This sample size summary is applicable to figures 47 thru 50

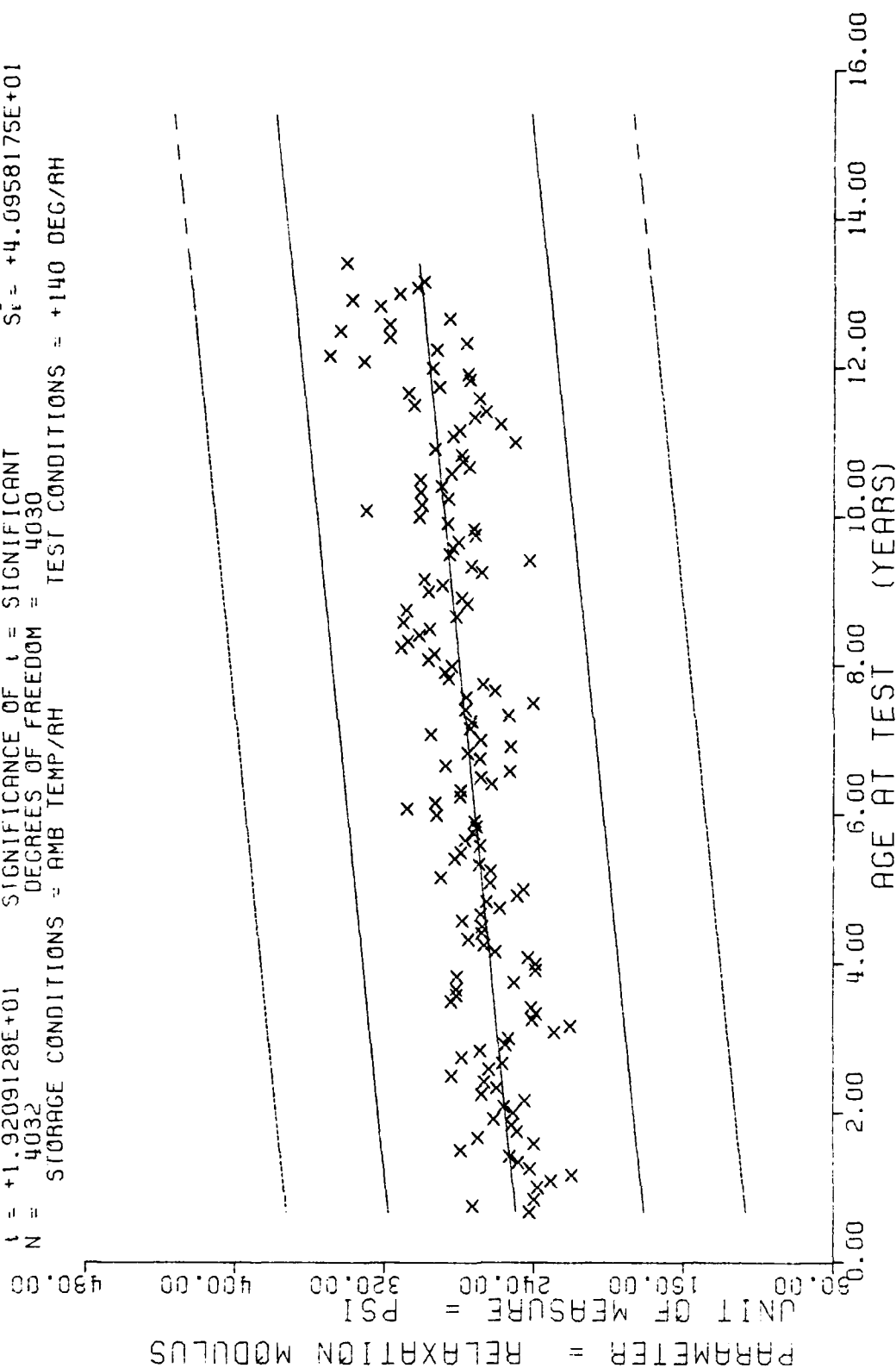
$Y = ((+2.8869935E+02) + (+3.8306123E-01) \times X)$
 $F = +3.2118851E+02$ SIGNIFICANCE OF F = SIGNIFICANT $G_r = +5.1252000E+01$
 $R = +2.7169150E-01$ SIGNIFICANCE OF R = SIGNIFICANT $S_g = +2.1374117E-02$
 $t = +1.7921733E+01$ SIGNIFICANCE OF t = SIGNIFICANT $S_e = +4.9330245E+01$
 $N = 4032$ DEGREES OF FREEDOM = 4030
 STORAGE CONDITIONS = AMB TEMP/RH TEST CONDITIONS = +140 DEG/RH



WING 6, STRESS RELAXATION MODULUS, 3.0% STRAIN, 10 SEC, 140 DEG F, ITPH-1011

Figure 47

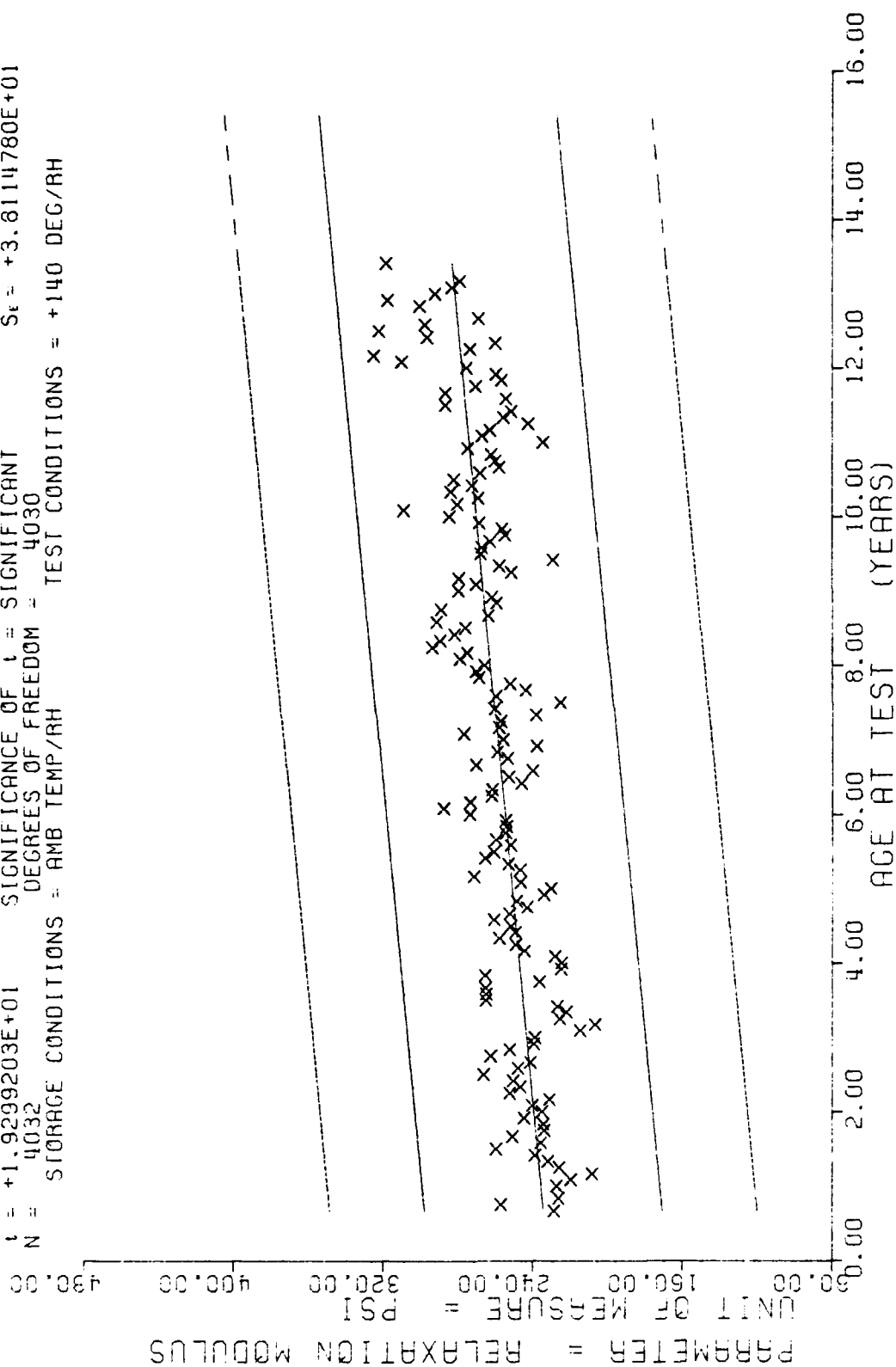
$Y = ((+2.4677747E+02) + (+3.4089701E-01) * X)$
 $F = +3.6899062E+02$ SIGNIFICANCE OF F = SIGNIFICANT $G_1 = +4.2786890E+01$
 $R = +2.8962173E-01$ SIGNIFICANCE OF R = SIGNIFICANT $S_a = +1.7746615E-02$
 $t = +1.9209128E+01$ SIGNIFICANCE OF t = SIGNIFICANT $S_t = +4.0958175E+01$
 $N = 4032$ DEGREES OF FREEDOM = 4030
 STORAGE CONDITIONS = AMB TEMP/RH TEST CONDITIONS = +140 DEG/RH



WING 6. STRESS RELAXATION MODULUS, 3.0% STRAIN, 50 SEC, 140 DEG F, TPH-1011

Figure 48

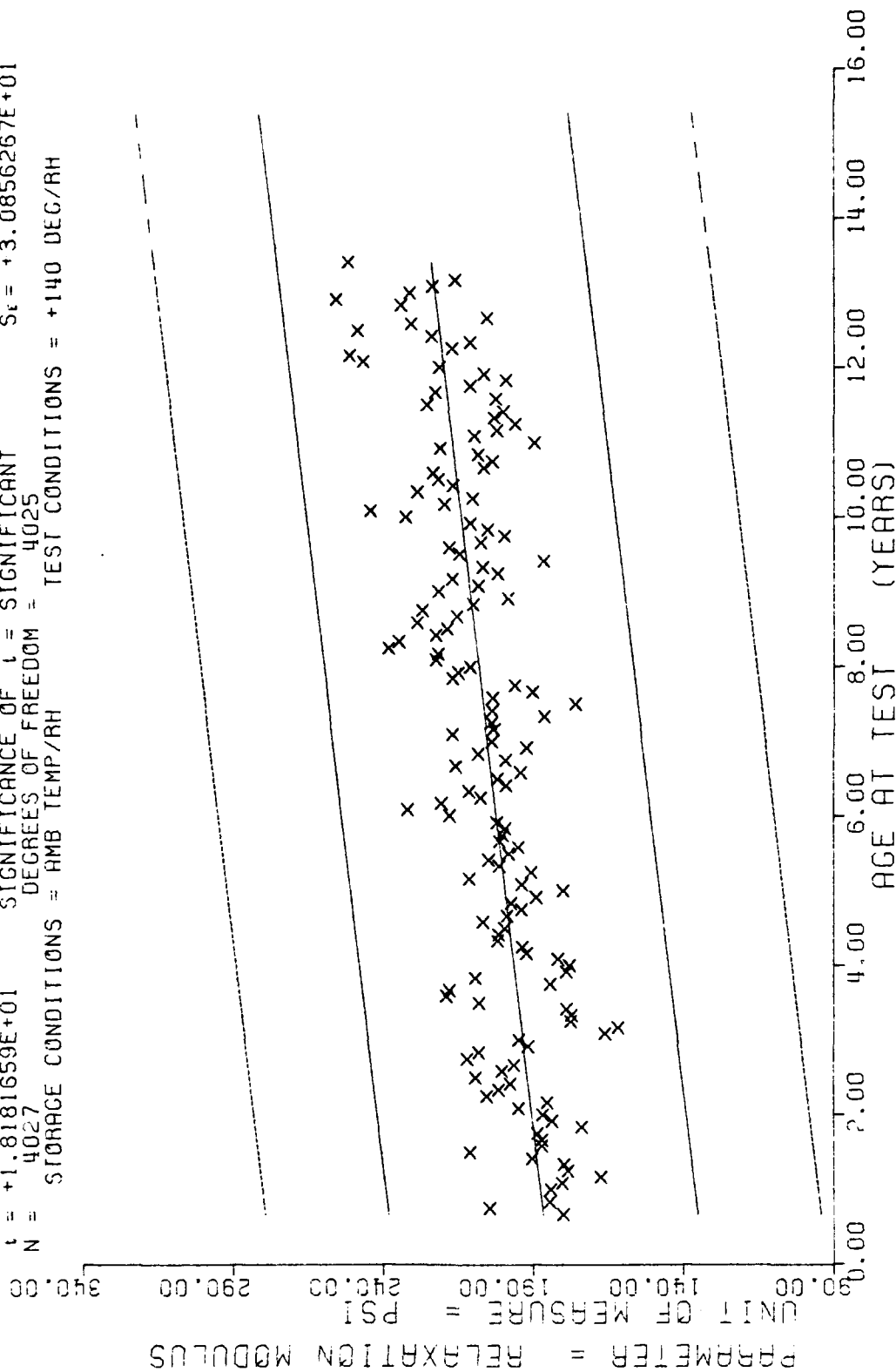
$Y = ((+2.3173528E+02) + (+3.1871884E-01) * X)$
 $F = +3.7245927E+02$ SIGNIFICANCE OF F = SIGNIFICANT
 $R = +2.9086517E-01$ SIGNIFICANCE OF R = SIGNIFICANT
 $t = +1.9299203E+01$ SIGNIFICANCE OF t = SIGNIFICANT
 $N = 4032$ DEGREES OF FREEDOM = 4030
 STORAGE CONDITIONS = AMB TEMP/RH TEST CONDITIONS = +140 DEG/RH



WING 6, STRESS RELAXATION MODULUS, 3.0% STRAIN, 100 SEC, 140 DEG F, TPH-1011

Figure 49

$Y = ((+1.8469401E+02) + (+2.4314521E-01) * X)$
 $F = +3.3057272E+02$ SIGNIFICANCE OF F = SIGNIFICANT
 $R = +2.7549319E-01$ SIGNIFICANCE OF R = SIGNIFICANT
 $t = +1.8181659E+01$ SIGNIFICANCE OF t = SIGNIFICANT
 $N = 4027$ DEGREES OF FREEDOM = 4025
 STORAGE CONDITIONS = AMB TEMP/RH TEST CONDITIONS = +140 DEG/RH



WING G, STRESS RELAXATION MODULUS, 3.0% STRAIN, 1000 SEC, 140 DEG F, TPH-1011

Figure 50

AGE (MOS)	NP SAMP	AGE (MOS)	NP SAMP	AGE (MOS)	NP SAMP	AGE (MOS)	NP SAMP	AGE (MOS)	NP SAMP
4	3	34	51	55	42	84	24	109	9
9	9	35	33	60	63	85	9	110	9
10	6	36	57	61	69	86	21	111	6
12	24	37	21	62	73	87	27	112	36
13	24	38	18	63	66	88	30	113	48
14	12	39	48	64	51	89	30	114	41
15	24	40	18	65	36	90	39	115	21
16	18	41	21	66	45	91	27	116	33
17	33	42	18	67	30	92	18	117	21
18	18	43	9	68	51	93	24	118	20
19	9	44	6	69	78	94	23	119	15
20	6	45	6	70	80	95	24	120	29
21	18	46	6	71	45	96	63	121	12
22	9	47	30	72	60	97	57	122	9
23	9	48	42	73	38	98	63	123	12
24	30	49	42	74	36	99	39	124	21
25	35	50	36	75	36	100	20	125	15
26	24	51	57	76	39	101	19	126	24
27	24	52	68	77	27	102	9	127	14
28	26	53	27	78	42	103	21	128	15
29	50	54	33	79	18	104	6	129	6
30	42	55	33	80	24	105	12	130	30
31	31	56	42	81	36	106	3	131	48
32	54	57	54	82	27	107	6	132	12
33	30	58	57	83	18	108	27	133	12

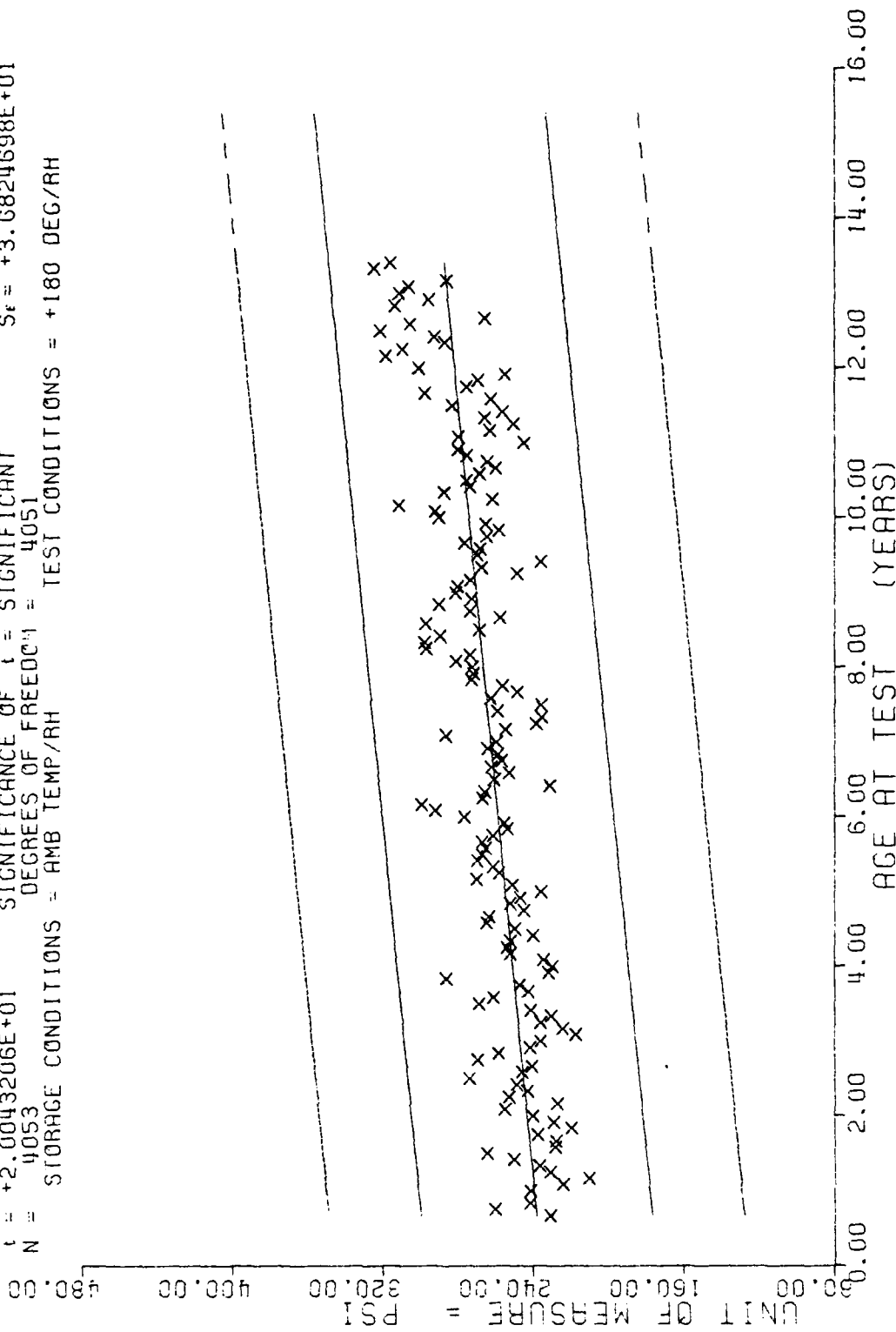
FIG. 6. STRESS RELAXATION MODULUS, 3.0% STRAIN, 1000 SEC., 180 DEG F., TPEH-1011

This sample size summary is applicable to figures 51 thru 54

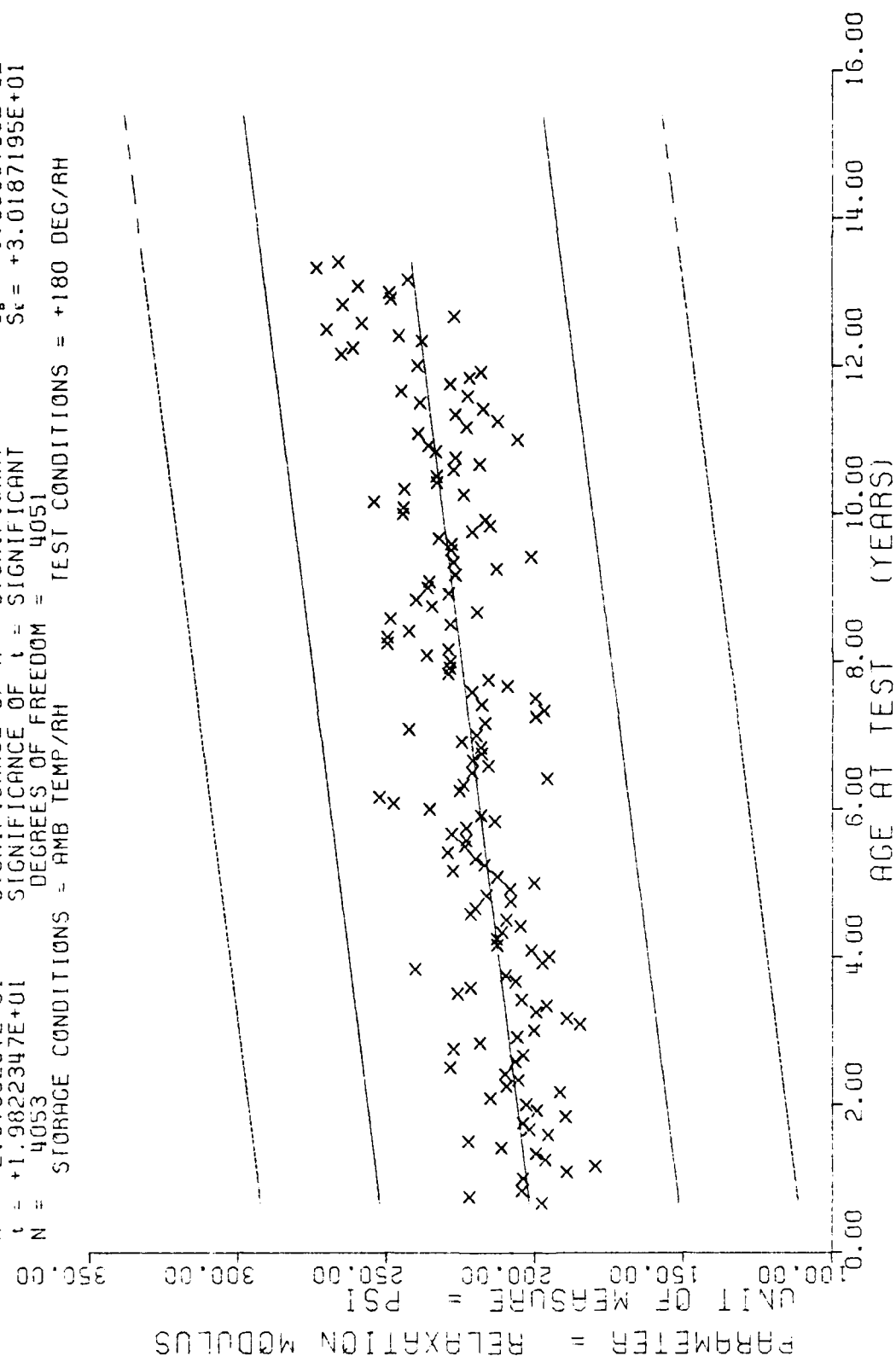
PARAMETER = RELAXATION MODULUS

- 77 -

$F = +4.0173013E+02$
 $R = +3.0036824E-01$
 $t = +2.0043206E+01$
 $N = 4053$
 $Y = ((+2.3579932E+02) + (+3.1860582E-01) * X)$
 SIGNIFICANCE OF F = SIGNIFICANT
 SIGNIFICANCE OF R = SIGNIFICANT
 SIGNIFICANCE OF t = SIGNIFICANT
 DEGREES OF FREEDOM = 4051
 STORAGE CONDITIONS = AMB TEMP/RH
 TEST CONDITIONS = +180 DEG/RH



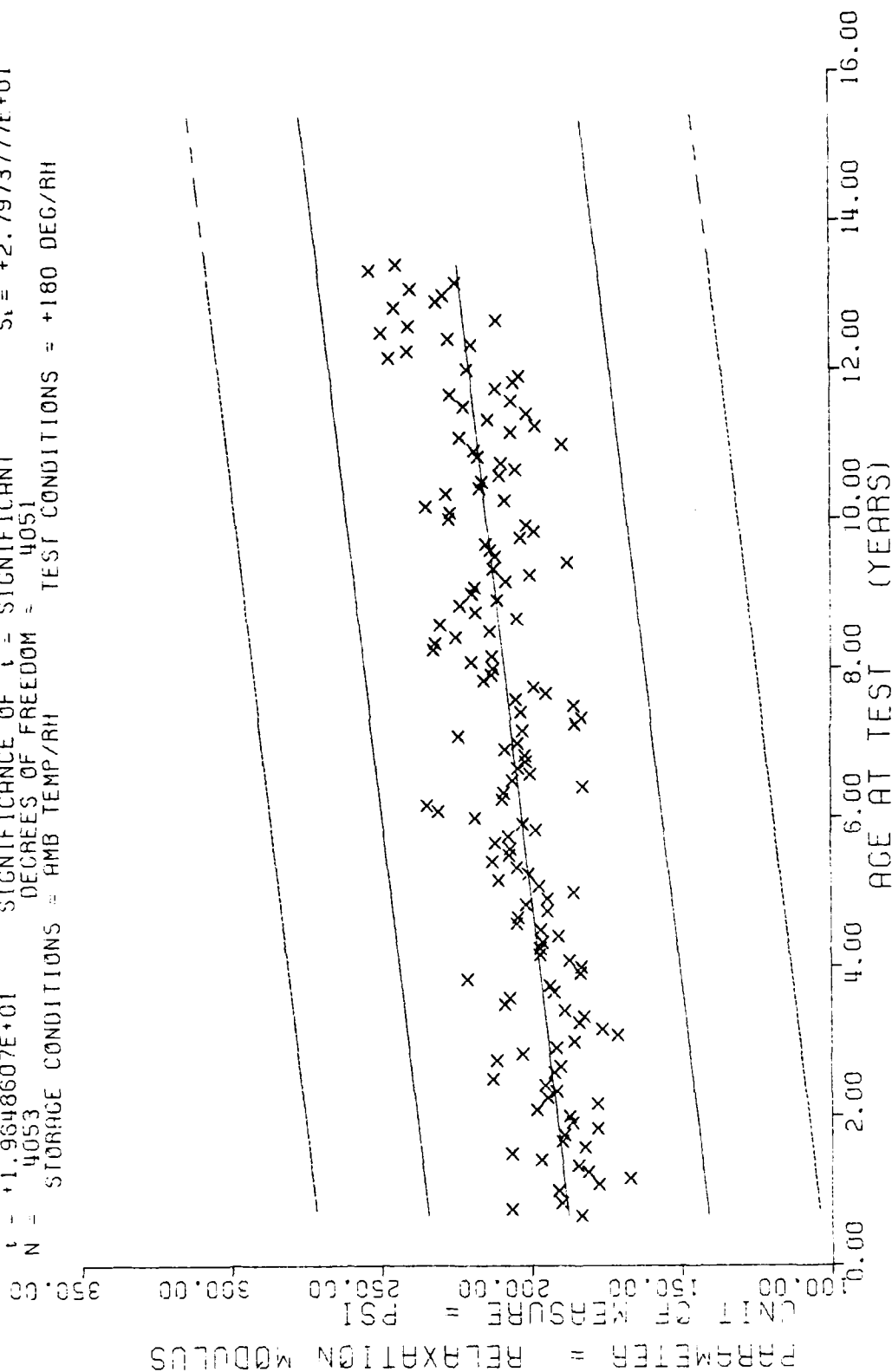
$Y = ((+1.9984113E+02) + (+2.5830044E-01) * X)$
 F = +3.9292546E+02 SIGNIFICANCE OF F = SIGNIFICANT $\sigma_A = +3.1613416E+01$
 R = +2.9735257E-01 SIGNIFICANCE OF R = SIGNIFICANT $S_B = +1.3030769E-02$
 t = +1.9822347E+01 SIGNIFICANCE OF t = SIGNIFICANT $S_C = +3.0187195E+01$
 N = 4053 DEGREES OF FREEDOM = 4051
 STORAGE CONDITIONS = AMB TEMP/RH TEST CONDITIONS = +180 DEG/RH



WING 6, STRESS RELAXATION MODULUS, 3.0% STRAIN, 50 SEC, 180 DEG F, TPH-1011

Figure 52

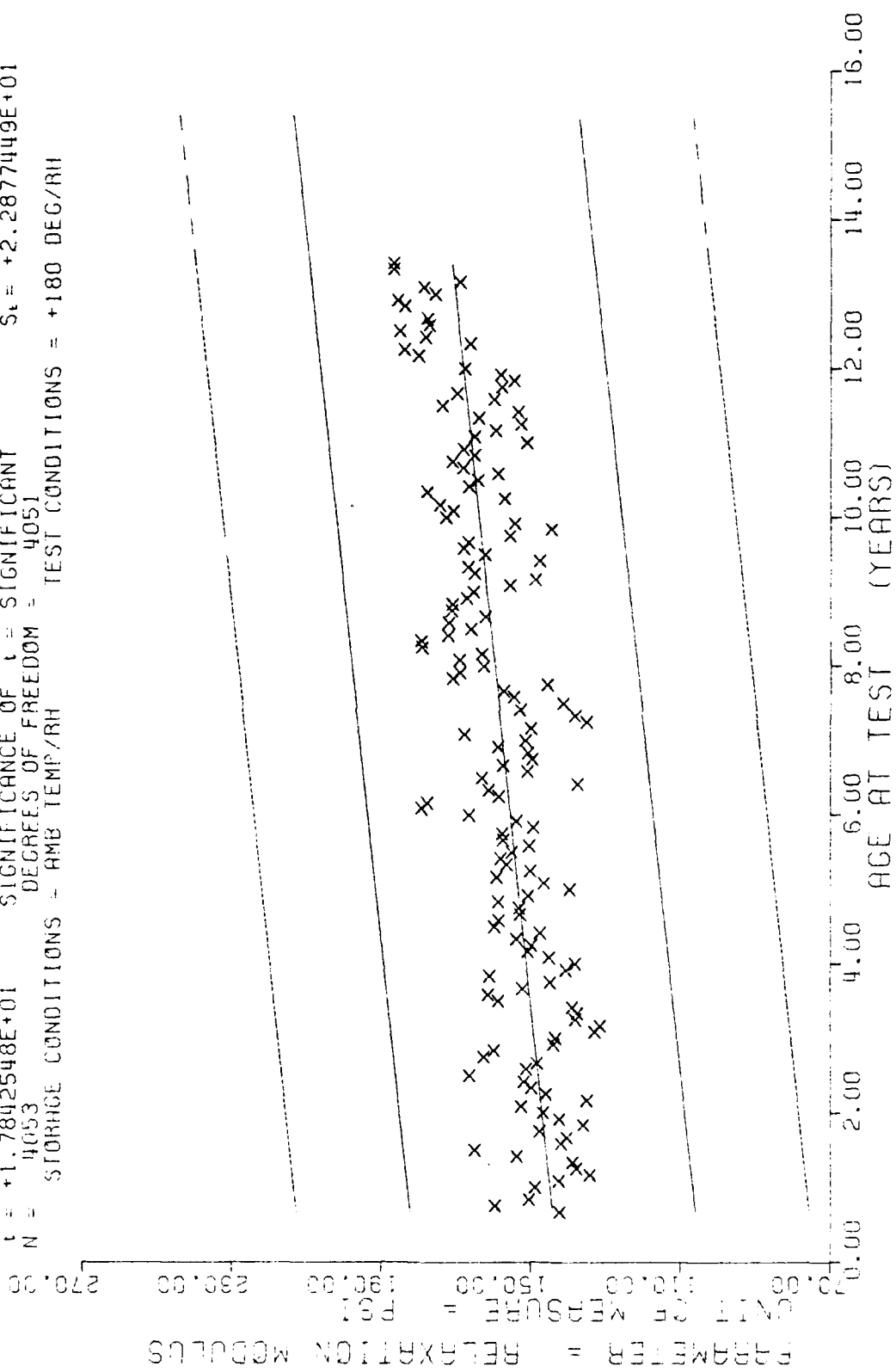
$Y = ((+1.8587963E+02) + (+2.3726310E-01) * X)$
 $F = +3.8606779E+02$ SIGNIFICANCE OF F = SIGNIFICANT
 $R = +2.9497401E-01$ SIGNIFICANCE OF R = SIGNIFICANT
 $t = +1.9648607E+01$ SIGNIFICANCE OF t = SIGNIFICANT
 $N = 4053$ DEGREES OF FREEDOM = 4051
 STORAGE CONDITIONS = HMB TEMP/RH TEST CONDITIONS = +180 DEG/RH



WING 6, STRESS RELAXATION MODULUS, 3.0% STRAIN, 100 SEC, 180 DEG F, TPH-101

Figure 53

$Y = ((+1.4273172E+02) + (+1.7620239E-01) * X)$
 F = +3.1835652E+02 SIGNIFICANCE OF F = SIGNIFICANT $G_1 = +2.3756455E+01$
 R = +2.6992812E-01 SIGNIFICANCE OF R = SIGNIFICANT $S_0 = +9.8754050E-03$
 t = +1.7842548E+01 SIGNIFICANCE OF t = SIGNIFICANT $S_t = +2.2877449E+01$
 N = 4053 DEGREES OF FREEDOM = 4051
 STORAGE CONDITIONS = AMB TEMP/RH TEST CONDITIONS = +180 DEG/RH



WING 6, STRESS RELAXATION MODULUS, 3.0% STRAIN, 1000 SEC, 180 DEG F, TPH-1011

*** SAMPLE SIZE SUMMARY ***

AGE (YRS)	SEX	AGE (YRS)	NO. SAMP	AGE (MOS)	NR SAMP	AGE (MOS)	NP SAMP	AGE (MOS)	NR SAMP
1	3	34	48	59	44	84	16	110	24
2	4	35	64	60	73	85	13	111	60
3	34	36	47	61	64	86	16	112	20
4	12	37	56	62	74	87	16	113	20
5	32	38	47	63	74	88	28	114	76
6	36	39	36	64	80	89	44	115	76
7	20	40	45	65	90	90	44	116	71
8	20	41	36	66	39	91	48	117	32
9	38	42	26	67	52	92	32	118	120
10	32	43	20	68	64	93	23	119	98
11	32	44	4	69	67	94	32	120	104
12	32	45	12	70	50	95	39	121	76
13	32	46	19	71	84	96	36	122	60
14	32	47	36	72	100	97	44	123	8
15	34	48	36	73	60	98	36	124	12
16	3	49	44	74	107	99	80	125	7
17	32	50	24	75	64	100	80	126	28
18	32	51	60	76	40	101	56	127	4
19	32	52	103	77	44	102	32	128	4
20	44	53	112	78	54	103	36	129	48
21	43	54	30	79	38	104	12	130	24
22	34	55	42	80	50	105	4	131	74
23	32	56	70	81	40	106	28	132	128
24	32	57	42	82	20	107	16	133	79
25	32	58	86	83	40	108	12	134	52
26	32	59						135	48

STAGE 1, WING 6, RP-H1011, SOL GEL, DENSITY

This sample size summary is applicable to figures 55 thru 57

AD-A085 630

OGDEN AIR LOGISTICS CENTER HILL AFB UT PROPELLANT LAB--ETC F/G 21/8.2
PROPELLANT SURVEILLANCE REPORT LGM-30 F & G STAGE I. PHASE G. S--ETC(U)
APR 80 J A THOMPSON

UNCLASSIFIED

MANCP-438(80)

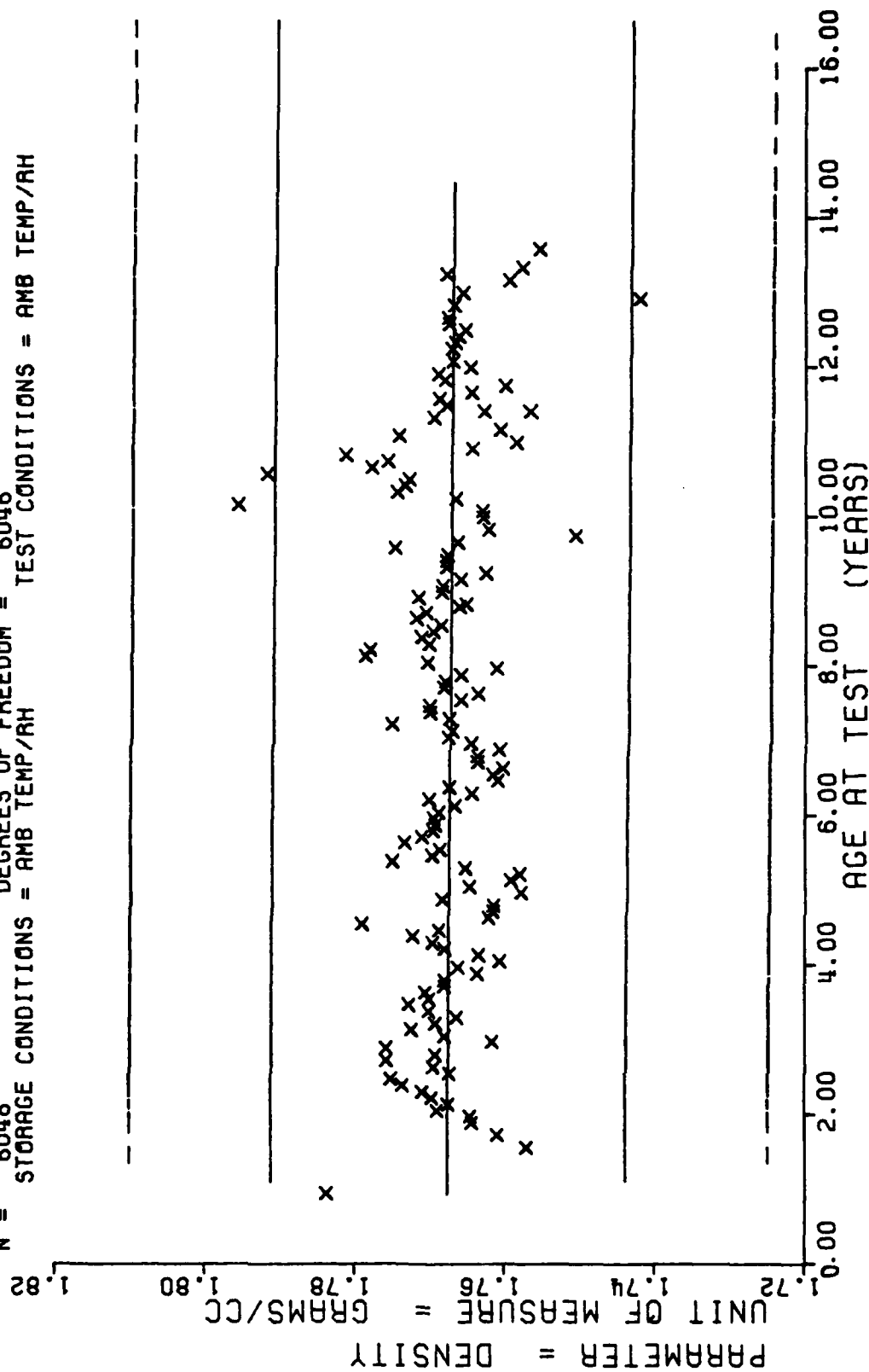
NL

202
20-10-80



END
DATE
FILED
8-80
DTIC

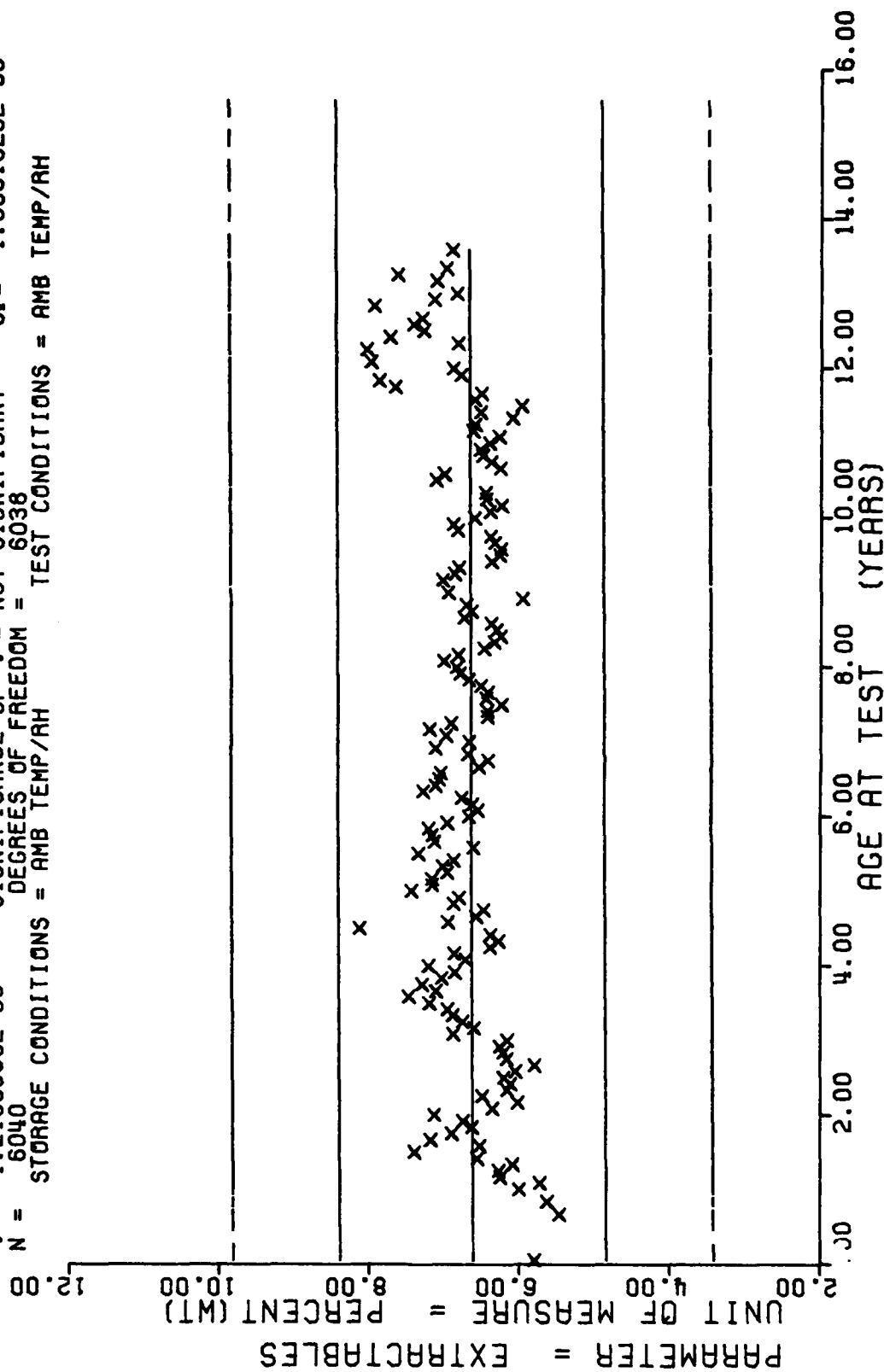
$Y = ((+1.7686006E+00) + (-5.6685804E-06) * X)$
 $F = +1.3444083E+00$ SIGNIFICANCE OF F = NOT SIGNIFICANT $G = +1.4187460E-02$
 $R = -1.4910192E-02$ SIGNIFICANCE OF R = NOT SIGNIFICANT $S = +4.8888725E-06$
 $t = +1.1594862E+00$ SIGNIFICANCE OF t = NOT SIGNIFICANT $S_1 = +1.4187056E-02$
 $N = 6048$ DEGREES OF FREEDOM = 6046
 STORAGE CONDITIONS = AMB TEMP/RH TEST CONDITIONS = AMB TEMP/RH



STAGE 1, WING 6, TP-H1011, SOL GEL, DENSITY

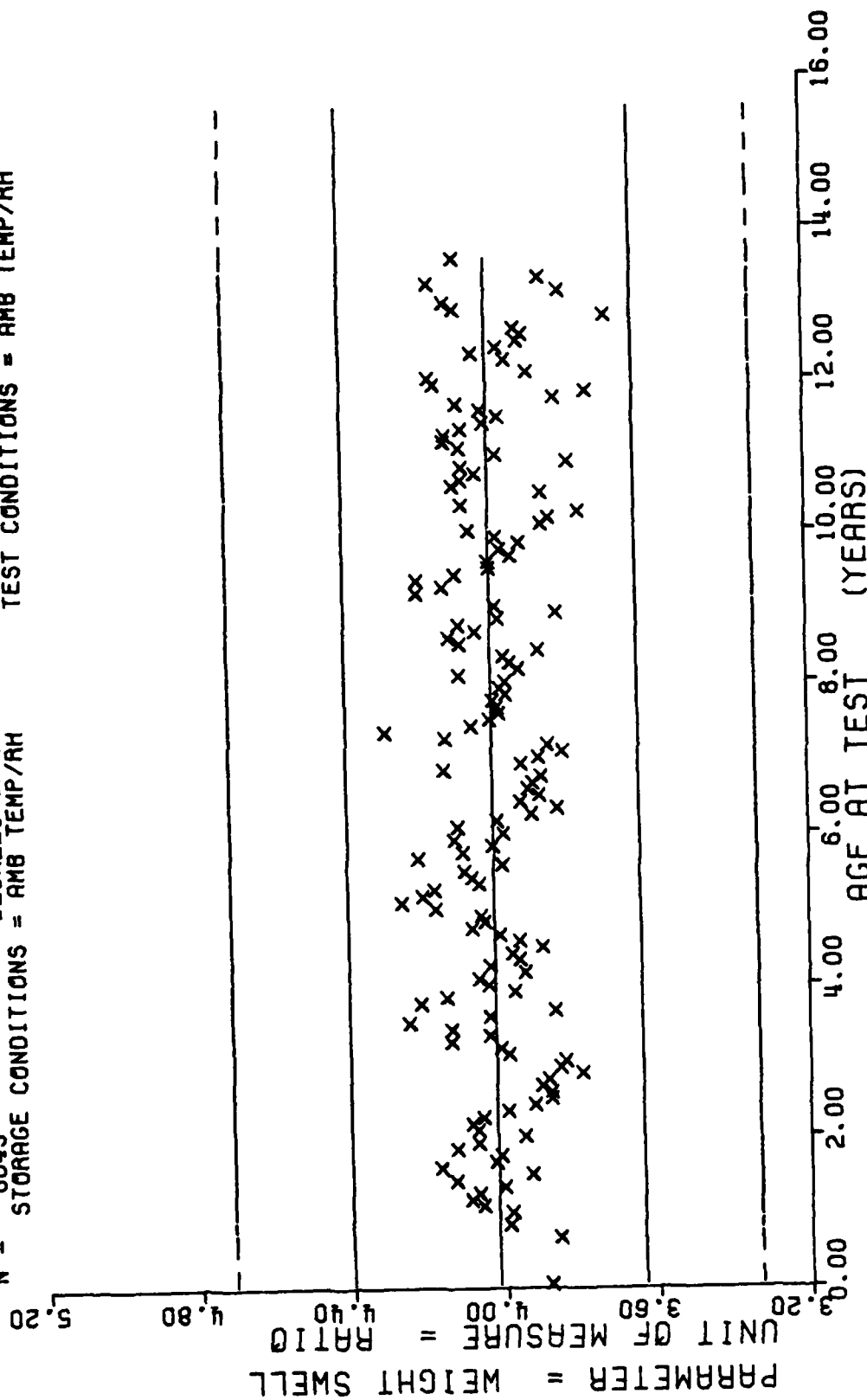
Figure 55

$Y = ((+6.6107046E+00) + (+4.4727716E-04) * X)$
 $F = +1.4810776E+00$ SIGNIFICANCE OF F = NOT SIGNIFICANT $\sigma^2 = +1.0662054E+00$
 $R = +1.5659904E-02$ SIGNIFICANCE OF R = NOT SIGNIFICANT $S_e = +3.6752578E-04$
 $t = +1.2169953E+00$ SIGNIFICANCE OF t = NOT SIGNIFICANT $S_t = +1.0661629E+00$
 $N = 6040$ DEGREES OF FREEDOM = 6038
 STORAGE CONDITIONS = AMB TEMP/AH TEST CONDITIONS = AMB TEMP/AH



STAGE 1, WING 6 TP-H1011, SOL GEL, PERCENT EXTRACTABLES

$Y = ((+4.0198191E+00) + (+6.7271838E-05) * X)$
 $F = +7.1798500E-01$ SIGNIFICANCE OF F = NOT SIGNIFICANT $\alpha = +2.3033705E-01$
 $R = +1.0901279E-02$ SIGNIFICANCE OF R = NOT SIGNIFICANT $S_e = +7.9391793E-05$
 $t = +8.4733995E-01$ SIGNIFICANCE OF t = NOT SIGNIFICANT $S_e = +2.3034243E-01$
 $N = 6043$ DEGREES OF FREEDOM = 6041
 STORAGE CONDITIONS = AMB TEMP/RH TEST CONDITIONS = AMB TEMP/RH



STAGE 1, WING 6, TP-H1011, SOL GEL, GEL SWELL RATIO

Figure 57

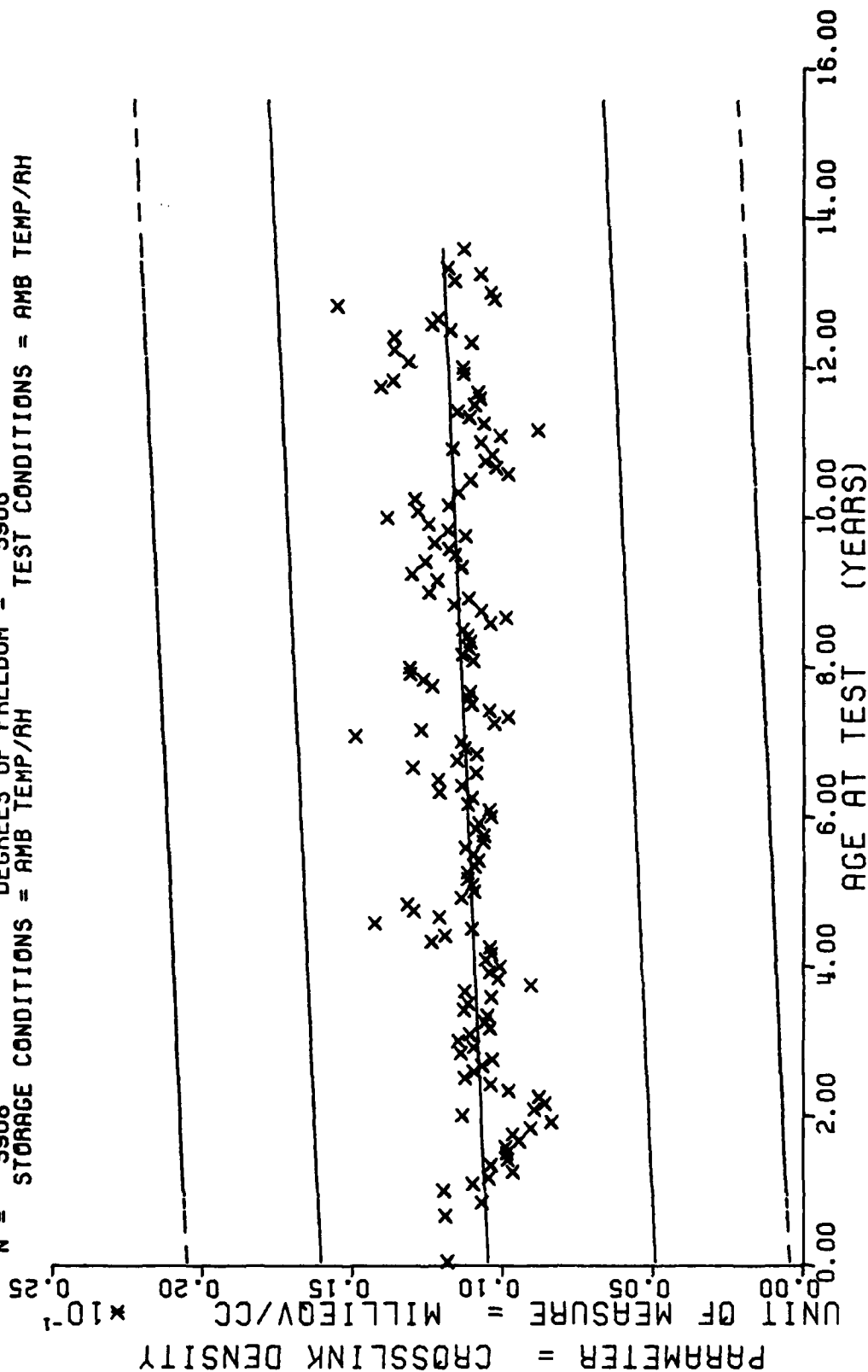
*** SAMPLE SIZE SUMMARY ***

AGE (MOS)	NR SAMP	AGE (MOS)	NR SAMP	AGE (MOS)	NR SAMP	AGE (MOS)	NR SAMP	AGE (MOS)	NR SAMP	AGE (MOS)	NR SAMP	AGE (MOS)	NR SAMP
1	3	34	48	59	44	84	16	110	24	136	24	136	24
2	4	35	64	60	73	85	13	111	60	137	15	137	15
3	24	36	47	61	64	86	16	112	20	138	30	138	30
4	12	37	56	62	74	87	16	113	20	139	62	139	62
5	32	38	47	63	74	88	28	114	76	140	29	140	29
6	36	39	36	64	79	89	44	115	76	141	4	141	4
7	20	40	45	65	90	90	44	116	71	142	4	142	4
8	20	41	36	66	39	91	48	117	32	143	12	143	12
9	28	42	26	67	52	92	32	118	120	144	15	144	15
10	32	43	20	68	64	93	23	119	98	145	4	145	4
11	52	44	4	69	67	94	32	120	104	147	4	147	4
12	12	45	12	70	56	95	39	121	76	148	12	148	12
13	32	46	19	71	84	96	36	122	60	149	4	149	4
14	28	47	36	72	100	97	43	123	8	150	12	150	12
15	24	48	36	73	60	98	36	124	12	151	11	151	11
16	8	49	44	74	107	99	80	126	7	152	12	152	12
17	40	50	24	75	64	100	80	127	28	154	4	154	4
18	56	51	60	76	40	101	56	128	20	155	4	155	4
19	32	52	103	77	44	102	32	129	48	156	12	156	12
20	44	53	112	78	54	103	36	130	24	158	4	158	4
21	43	54	14	79	38	104	12	131	74	159	7	159	7
22	44	55	42	80	50	105	4	132	128	160	4	160	4
23	72	56	70	81	40	106	28	133	79	163	4	163	4
24	64	57	43	82	20	107	16	134	40				
25	52	58	86	83	39	108	12	135	28				

STAGE 1, WING 6, TP-H1011, SOL GEL, CROSSLINK DENSITY

This sample size summary is applicable to figure 58

$Y = ((+1.0486504E-02) + (+9.2195494E-06) \times X)$
 $F = +6.0859487E+01$ SIGNIFICANCE OF F = SIGNIFICANT
 $R = +1.0099299E-01$ SIGNIFICANCE OF R = SIGNIFICANT
 $t = +7.8012490E+00$ SIGNIFICANCE OF t = SIGNIFICANT
 $N = 5908$ DEGREES OF FREEDOM = 5906
 STORAGE CONDITIONS = AMB TEMP/RH TEST CONDITIONS = AMB TEMP/RH



STAGE 1, WING 6, TP-H1011, SOL GEL, CROSSLINK DENSITY

Figure 58

[illegible]

This sample size summary is applicable to figure 59

$Y = ((+2.5953240E+01) + (-1.7918979E-02) * X)$
 $F = +3.8489694E+02$ SIGNIFICANCE OF F = SIGNIFICANT
 $R = -2.4930173E-01$ SIGNIFICANCE OF R = SIGNIFICANT
 $t = +1.9618790E+01$ SIGNIFICANCE OF t = SIGNIFICANT
 $W = 5810$ DEGREES OF FREEDOM = 5808
 STORAGE CONDITIONS = AMB TEMP/RH TEST CONDITIONS = AMB TEMP/RH

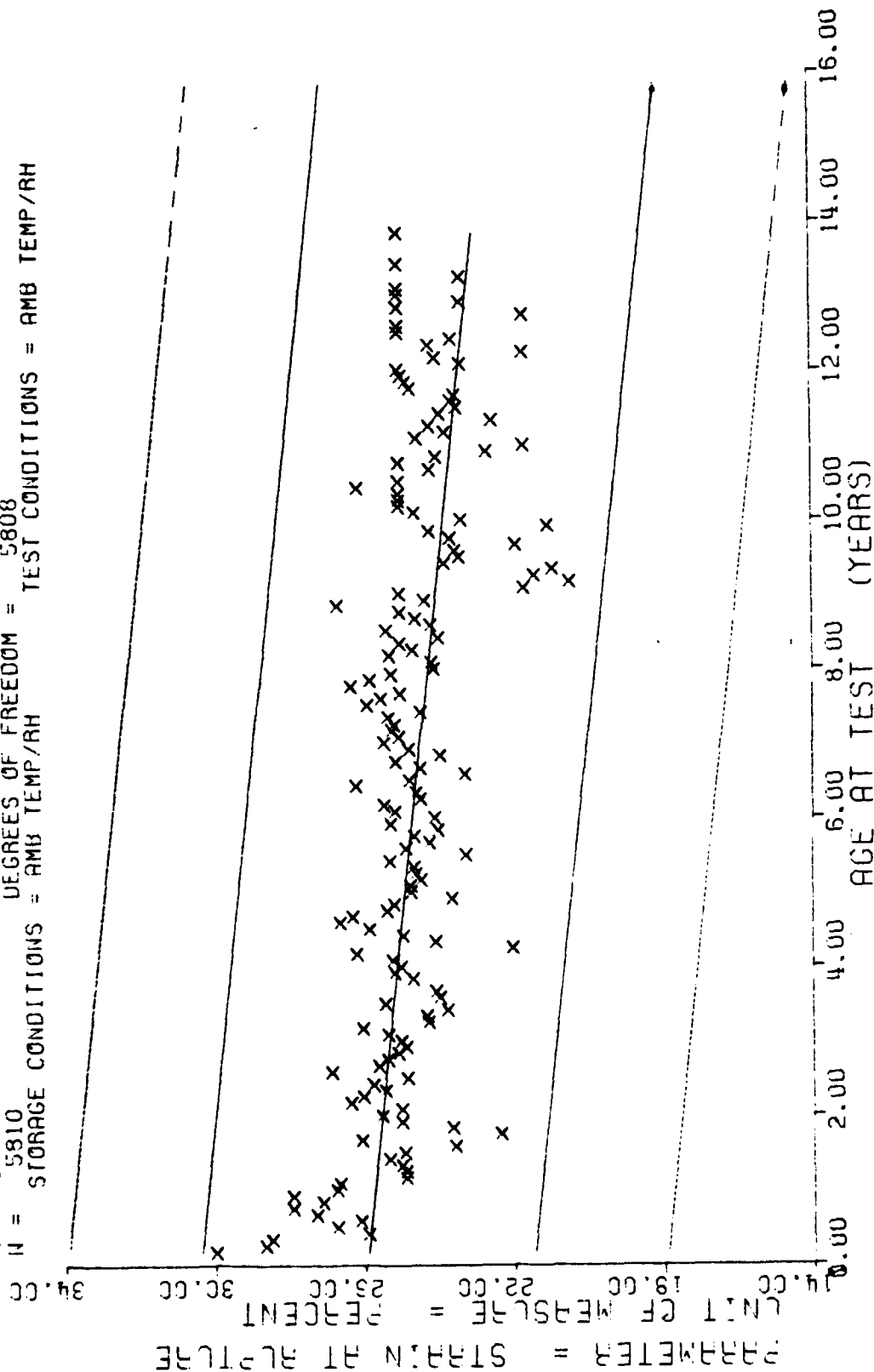


Figure 59

[illegible]

STAGE 1 WING 6 TP-H 1011 SHORE A. 10 SECOND HARDNESS

This sample size summary is applicable to figure 60

$Y = ((+6.4377682E+01) + (+1.5380124E-02) * X)$
 $F = +3.3841704E+02$ SIGNIFICANCE OF F = SIGNIFICANT
 $R = +2.8323789E-01$ SIGNIFICANCE OF R = SIGNIFICANT
 $t = +1.8396114E+01$ SIGNIFICANCE OF t = SIGNIFICANT
 $N = 3882$ DEGREES OF FREEDOM = 3880
 STORAGE CONDITIONS = AMB TEMP/RH TEST CONDITIONS = AMB TEMP/RH

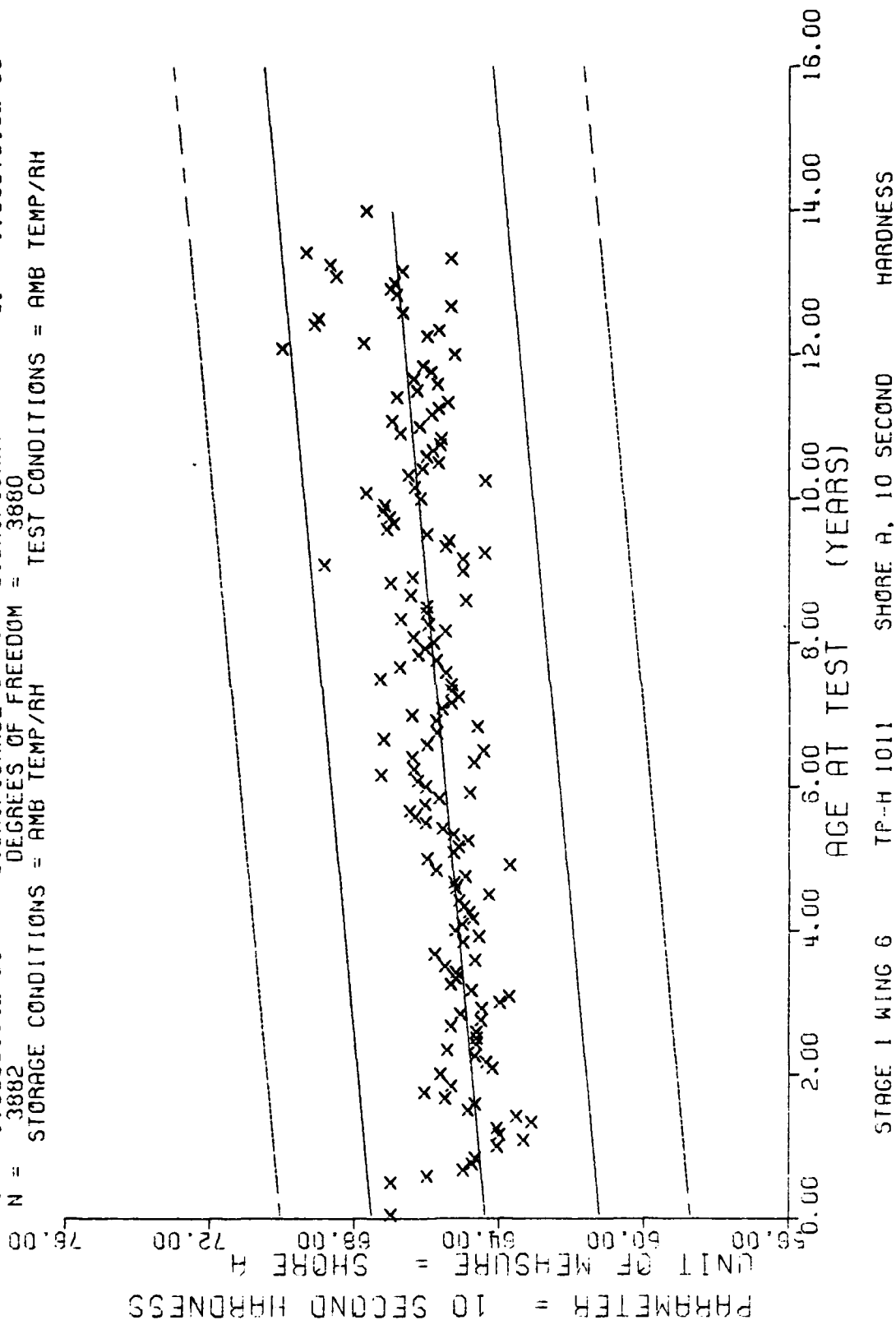


Figure 60

AGE (MOS)	NR SAMP	AGE (MOS)	NP SAMP	AGE (MOS)	NR SAMP	AGE (MOS)	NP SAMP
3	3	34	39	59	57	84	5
10	15	35	50	60	43	85	3
11	1	36	39	61	34	86	3
12	6	37	13	62	79	87	3
13	15	38	11	63	46	88	12
14	13	39	10	64	80	89	24
15	16	40	11	65	72	90	36
16	17	41	13	66	38	91	24
17	18	42	30	67	59	92	5
18	19	43	4	68	38	93	17
19	22	44	10	69	40	94	15
20	35	45	7	70	46	95	19
21	16	46	12	71	11	96	18
22	19	47	16	72	12	97	38
23	21	48	4	73	8	98	40
24	19	49	36	74	4	99	26
25	25	50	13	75	36	100	23
26	27	51	38	76	26	101	21
27	36	52	29	77	22	102	8
28	39	53	47	78	13	103	6
29	43	54	37	79	7	105	9
30	24	55	25	80	21	106	6
31	51	56	21	81	24	108	3
32	42	57	25	82	7	113	3
33	54	58	22	83	9	114	11

STAGE	WING 6	TF-11 1^11	TIME TO MAXIMUM PRESSURE	PPRESSURE TIME
1	1.0	1.0	1.0	1.0
2	1.0	1.0	1.0	1.0
3	1.0	1.0	1.0	1.0
4	1.0	1.0	1.0	1.0
5	1.0	1.0	1.0	1.0
6	1.0	1.0	1.0	1.0
7	1.0	1.0	1.0	1.0
8	1.0	1.0	1.0	1.0
9	1.0	1.0	1.0	1.0
10	1.0	1.0	1.0	1.0
11	1.0	1.0	1.0	1.0
12	1.0	1.0	1.0	1.0
13	1.0	1.0	1.0	1.0
14	1.0	1.0	1.0	1.0
15	1.0	1.0	1.0	1.0
16	1.0	1.0	1.0	1.0
17	1.0	1.0	1.0	1.0
18	1.0	1.0	1.0	1.0
19	1.0	1.0	1.0	1.0
20	1.0	1.0	1.0	1.0
21	1.0	1.0	1.0	1.0
22	1.0	1.0	1.0	1.0
23	1.0	1.0	1.0	1.0
24	1.0	1.0	1.0	1.0
25	1.0	1.0	1.0	1.0
26	1.0	1.0	1.0	1.0
27	1.0	1.0	1.0	1.0
28	1.0	1.0	1.0	1.0
29	1.0	1.0	1.0	1.0
30	1.0	1.0	1.0	1.0
31	1.0	1.0	1.0	1.0
32	1.0	1.0	1.0	1.0
33	1.0	1.0	1.0	1.0
34	1.0	1.0	1.0	1.0
35	1.0	1.0	1.0	1.0
36	1.0	1.0	1.0	1.0
37	1.0	1.0	1.0	1.0
38	1.0	1.0	1.0	1.0
39	1.0	1.0	1.0	1.0
40	1.0	1.0	1.0	1.0
41	1.0	1.0	1.0	1.0
42	1.0	1.0	1.0	1.0
43	1.0	1.0	1.0	1.0
44	1.0	1.0	1.0	1.0
45	1.0	1.0	1.0	1.0
46	1.0	1.0	1.0	1.0
47	1.0	1.0	1.0	1.0
48	1.0	1.0	1.0	1.0
49	1.0	1.0	1.0	1.0
50	1.0	1.0	1.0	1.0
51	1.0	1.0	1.0	1.0
52	1.0	1.0	1.0	1.0
53	1.0	1.0	1.0	1.0
54	1.0	1.0	1.0	1.0
55	1.0	1.0	1.0	1.0
56	1.0	1.0	1.0	1.0
57	1.0	1.0	1.0	1.0
58	1.0	1.0	1.0	1.0
59	1.0	1.0	1.0	1.0
60	1.0	1.0	1.0	1.0
61	1.0	1.0	1.0	1.0
62	1.0	1.0	1.0	1.0
63	1.0	1.0	1.0	1.0
64	1.0	1.0	1.0	1.0
65	1.0	1.0	1.0	1.0
66	1.0	1.0	1.0	1.0
67	1.0	1.0	1.0	1.0
68	1.0	1.0	1.0	1.0
69	1.0	1.0	1.0	1.0
70	1.0	1.0	1.0	1.0
71	1.0	1.0	1.0	1.0
72	1.0	1.0	1.0	1.0
73	1.0	1.0	1.0	1.0
74	1.0	1.0	1.0	1.0
75	1.0	1.0	1.0	1.0
76	1.0	1.0	1.0	1.0
77	1.0	1.0	1.0	1.0
78	1.0	1.0	1.0	1.0
79	1.0	1.0	1.0	1.0

This sample size summary is applicable to figures 61 and 62

$Y = ((+3.5807481E+03) + (-9.1527797E-02) \times X)$
 $F = +2.4176891E+00$ SIGNIFICANCE OF F = NOT SIGNIFICANT $S_y = +9.9522726E+01$
 $R = -2.9734980E-02$ SIGNIFICANCE OF R = NOT SIGNIFICANT $S_e = +5.8864407E-02$
 $t = +1.5548920E+00$ SIGNIFICANCE OF t = NOT SIGNIFICANT $S_e = +9.9496819E+01$
 $N = 2723$ DEGREES OF FREEDOM = 2721
 STORAGE CONDITIONS = AMB TEMP/AH TEST CONDITIONS = 500 PSI INT PRES

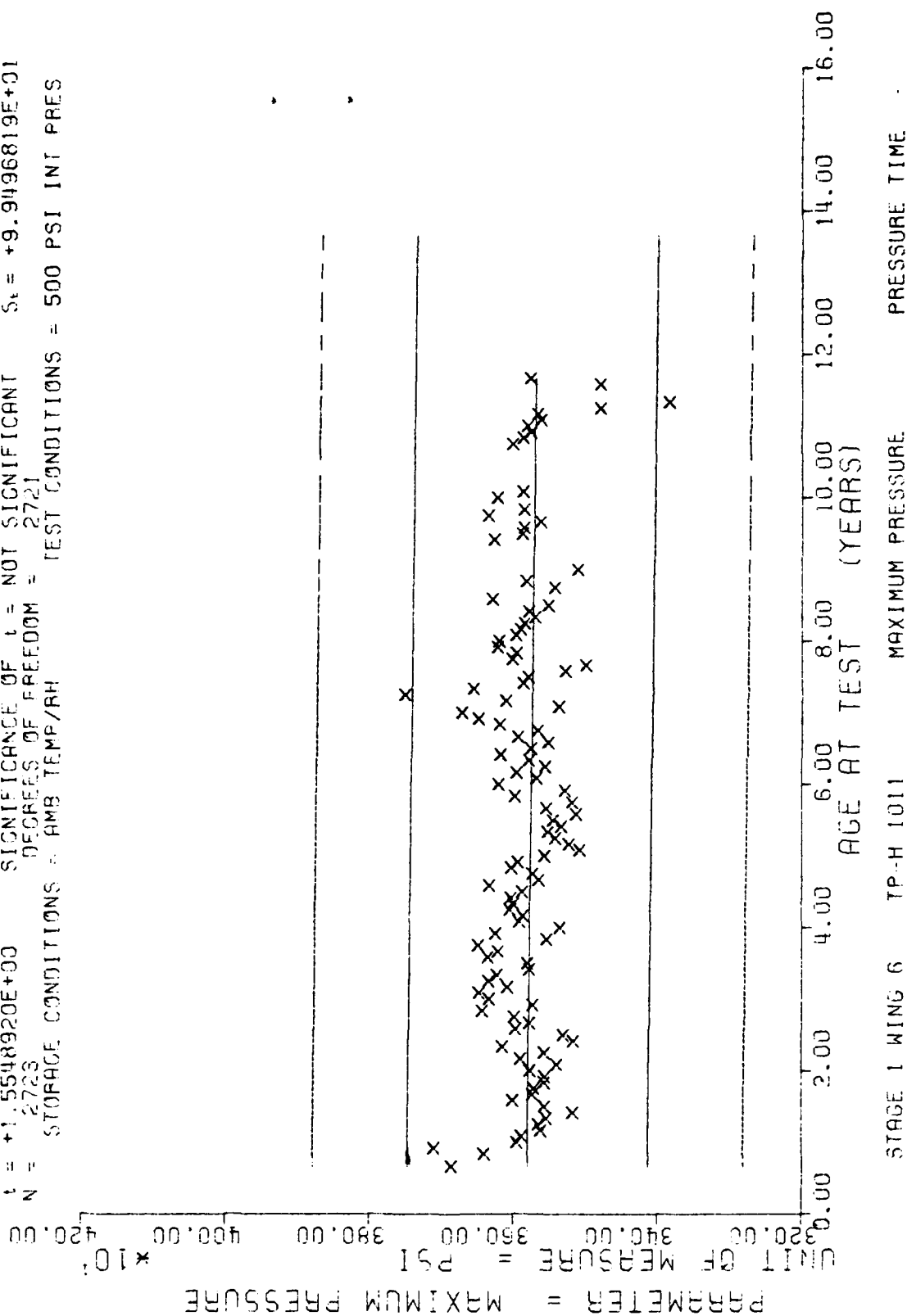


Figure 61

F = +9.45096/5E+00
 R = -5.8832993E 02
 L = +3.0742426E+00
 N = 2/23
 SIGNIFICANCE OF F = 1.4611/99E 04) * X)
 SIGNIFICANCE OF R = SIGNIFICANT
 SIGNIFICANCE OF L = SIGNIFICANT
 SIGNIFICANCE OF F = SIGNIFICANT
 DEGREES OF FREEDOM = 2/21
 STORAGE CONDITIONS = HMR (FHP/HH)
 TEST CONDITIONS = 500 PSI INT PRES

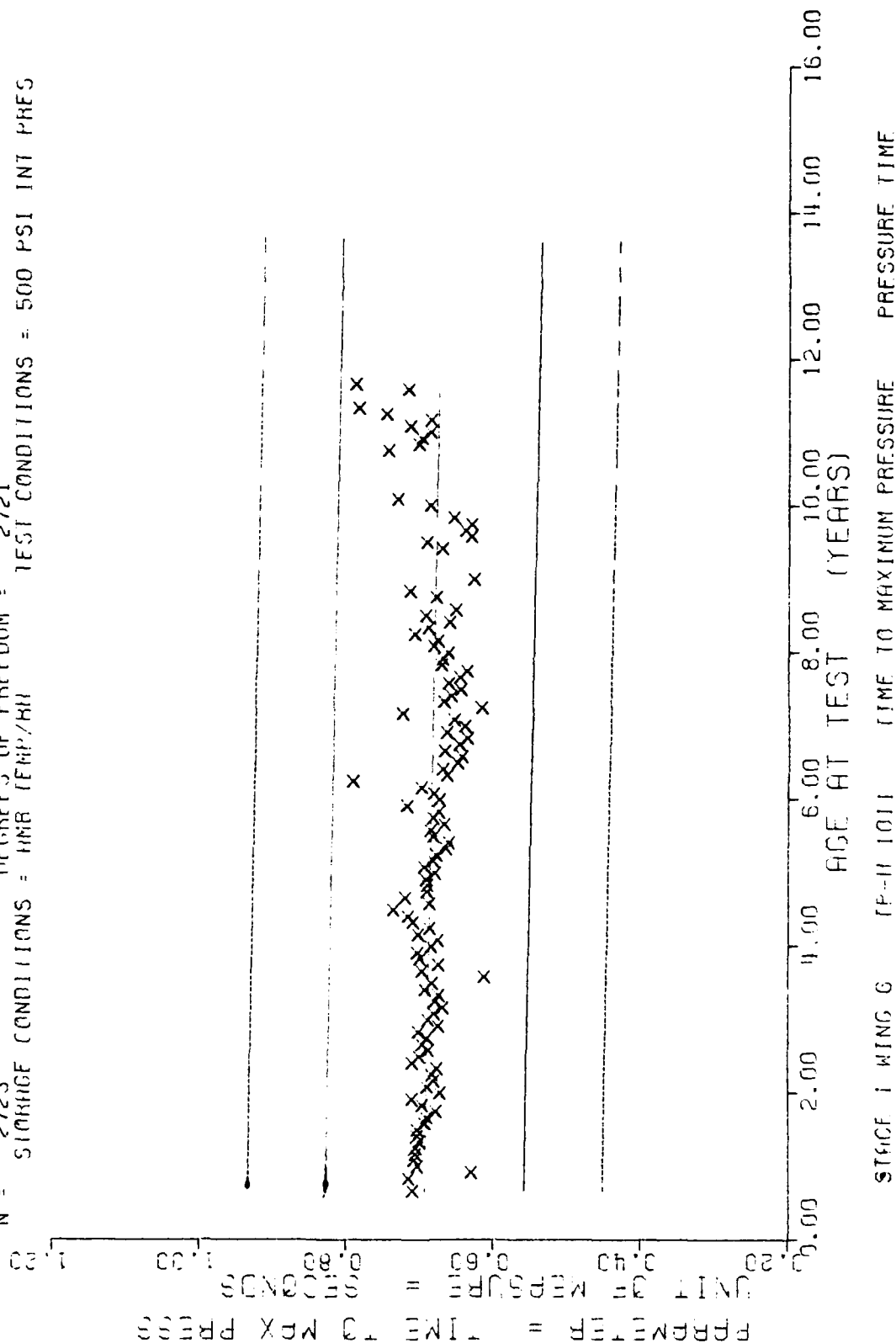
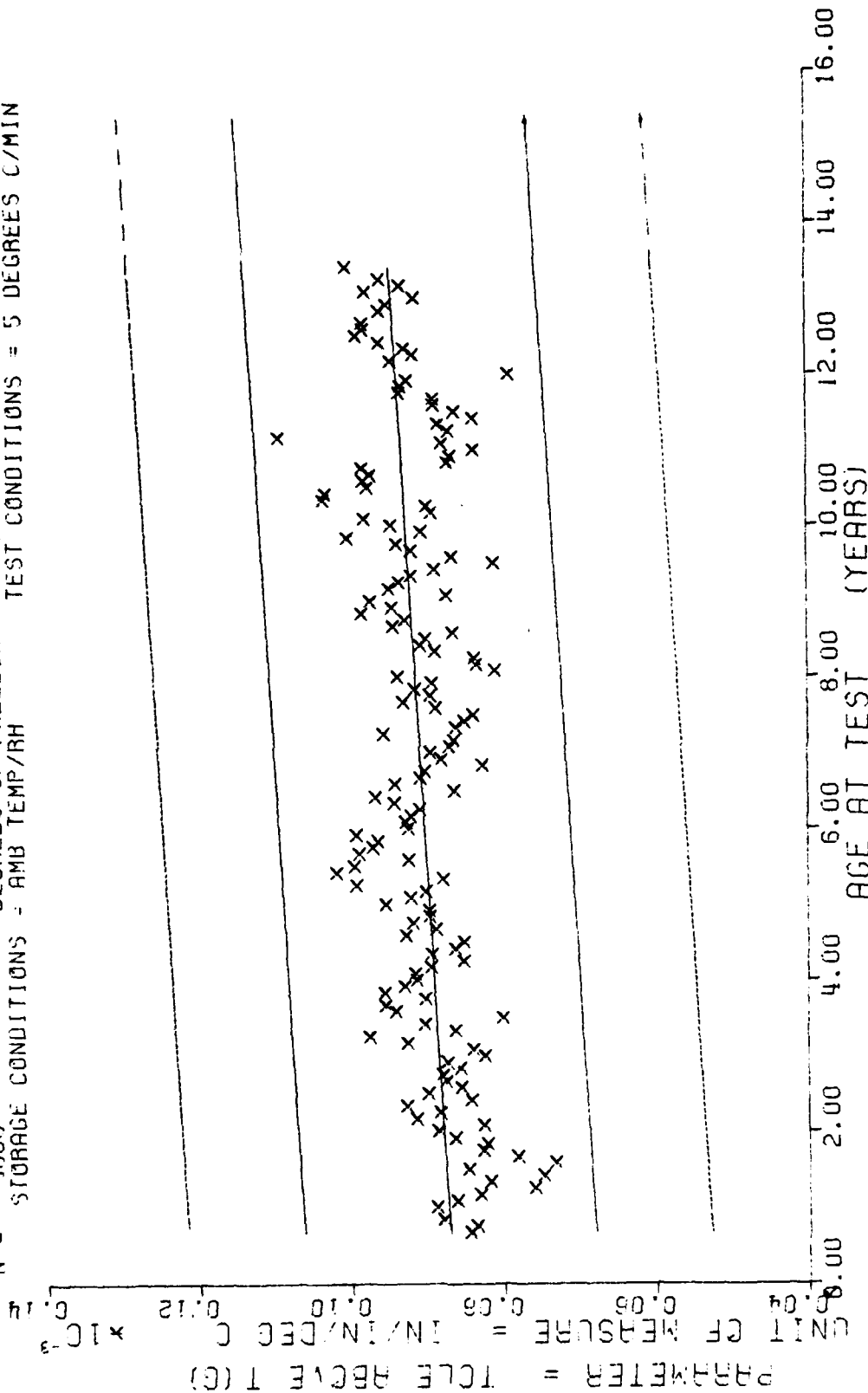


Figure 62

[illegible]

This sample size summary is applicable to figures 63 and 64

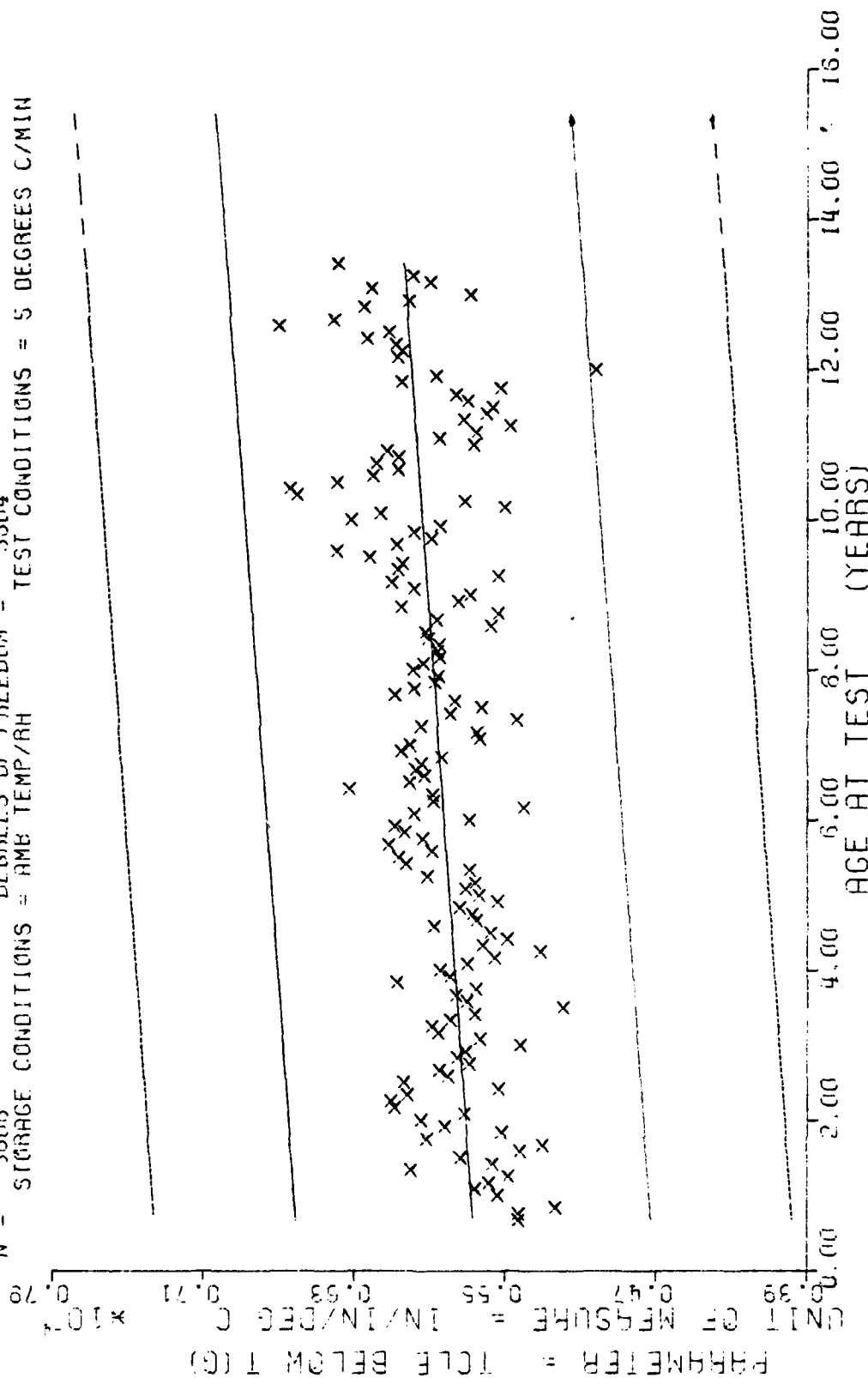
$Y = ((+8.6827809E-05) + (+4.7928594E-08) * X)$
 $F = +9.3906591E+01$ SIGNIFICANCE OF F = SIGNIFICANT
 $R = +1.5521451E-01$ SIGNIFICANCE OF R = SIGNIFICANT
 $t = +9.6905413E+00$ SIGNIFICANCE OF t = SIGNIFICANT
 $N = 3806$ DEGREES OF FREEDOM = 3804
 STORAGE CONDITIONS = AMB TEMP/RH TEST CONDITIONS = 5 DEGREES C/MIN



STAGE 1, WING 6, TP-H1011, THERMAL COEFFICIENT OF LINEAR EXPANSION ABOVE TG

Figure 63

$Y = (1 + 5.6508165E-05) + (+2.3839470E-08) * X$
 $F = +0.6588486E+01$ SIGNIFICANCE OF F - SIGNIFICANT $\sigma_t = +5.7080582E-06$
 $R = +1.5736118E-01$ SIGNIFICANCE OF R - SIGNIFICANT $S_b = +2.4307699E-09$
 $t = +0.8279441E+00$ SIGNIFICANCE OF t - SIGNIFICANT $S_e = +5.6376830E-06$
 $N = 3806$ DEGREES OF FREEDOM = 3804
 STORAGE CONDITIONS = AMB TEMP/RH TEST CONDITIONS = 5 DEGREES C/MIN



STAGE 1, WING 6, TP-H1011 THERMAL COEFFICIENT OF LINEAR EXPANSION BELOW TG

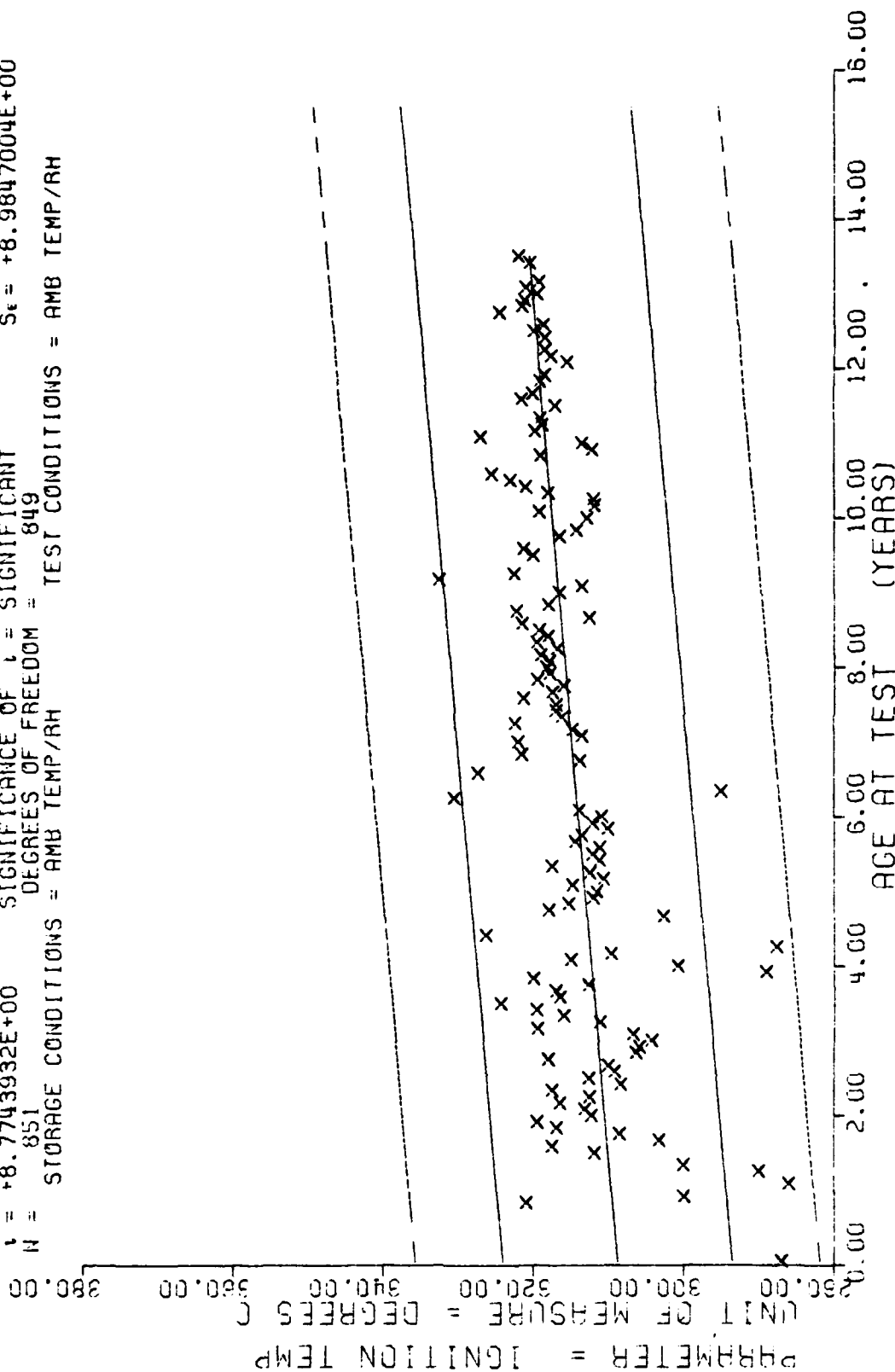
Figure 64

AGE (MOS)	NR SAMP	AGE (MOS)	NR SAMP	AGE (MOS)	NR SAMP	AGE (MOS)	NR SAMP	AGE (MOS)	NR SAMP
1	3	37	13	65	14	95	7	125	2
10	1	38	4	66	23	96	4	126	2
11	1	39	7	67	34	97	6	127	2
12	1	40	5	68	20	98	4	130	4
15	1	41	17	69	16	99	5	131	6
16	1	42	5	70	31	100	2	132	8
18	7	43	2	71	10	101	2	133	5
19	2	44	2	72	8	102	5	134	4
20	4	45	3	73	12	103	8	135	4
21	4	46	3	75	2	104	11	136	4
22	20	47	1	76	1	105	4	138	2
23	4	48	4	79	6	106	4	139	4
24	4	49	3	81	8	108	2	140	2
25	6	50	3	82	2	109	2	142	8
26	14	51	3	84	2	110	2	143	2
27	2	52	3	85	4	111	2	145	2
28	4	56	3	86	8	114	2	146	6
29	14	57	9	87	3	115	4	147	6
30	12	58	4	88	6	117	2	149	6
31	10	59	10	89	2	118	4	150	4
32	2	60	18	90	4	120	8	151	6
33	6	61	23	91	3	121	14	153	2
34	10	62	21	92	2	122	16	154	2
35	9	63	32	93	2	123	4	155	6
36	22	64	23	94	4	124	2	156	2

IGA IGNITION TEMPERATURE, 9 DEGREE C RISE/MINUTE

This sample size summary is applicable to figure 65 .

$Y = ((+3.0876636E+02) + (+7.2394553E-02) * X)$
 $F = +7.6989976E+01$ SIGNIFICANCE OF F = SIGNIFICANT
 $R = +2.8834601E-01$ SIGNIFICANCE OF R = SIGNIFICANT
 $t = +8.7743932E+00$ SIGNIFICANCE OF t = SIGNIFICANT
 $N = 851$ DEGREES OF FREEDOM = 849
 STORAGE CONDITIONS = AMB TEMP/RH TEST CONDITIONS = AMB TEMP/RH



STAGE I WING G TGA IGNITION TEMPERATURE, 9 DEGREE C RISE/MINUTE

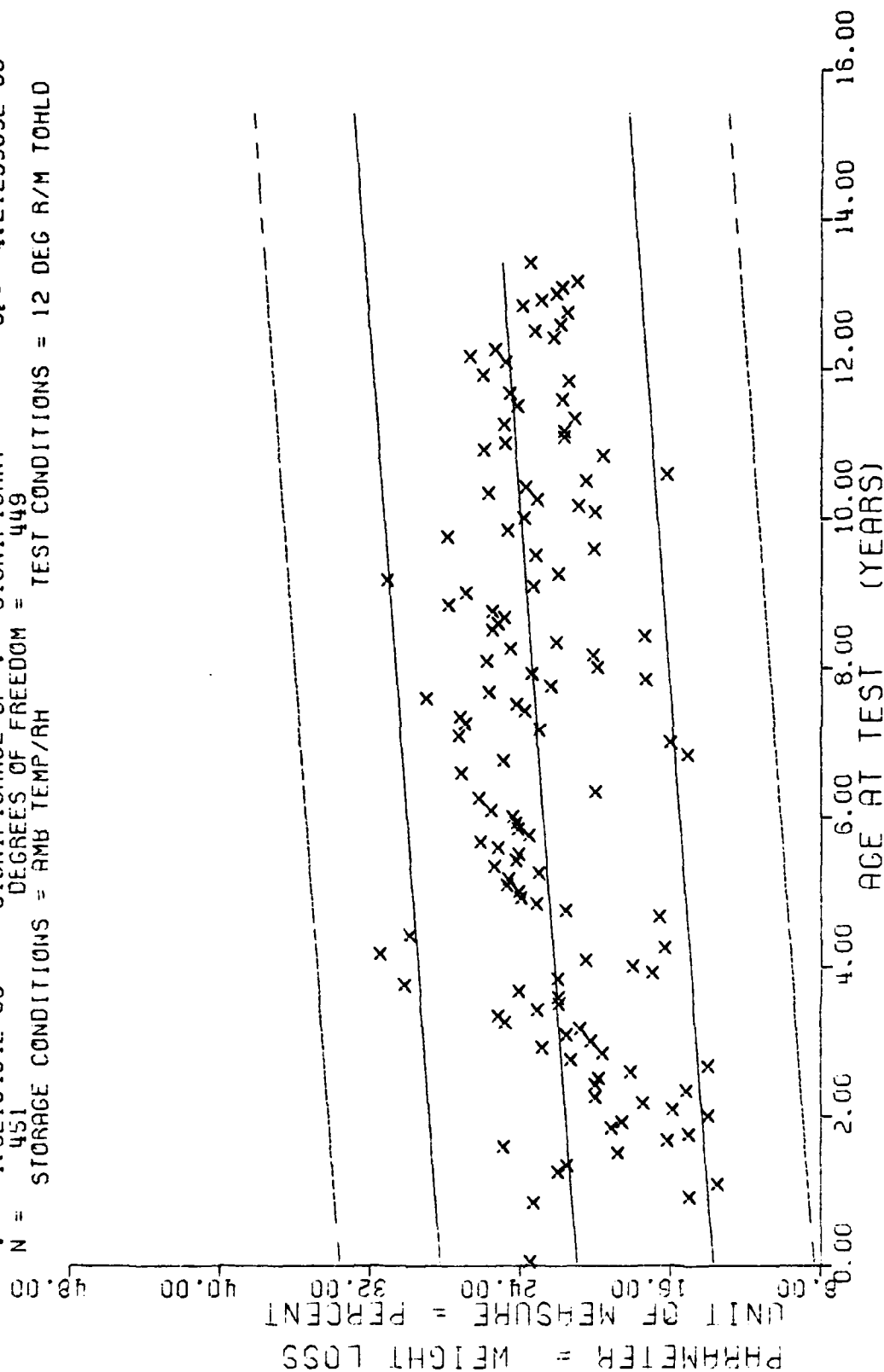
Figure 65

[illegible]

MESSAGE I	WING 6	TGA	% WT LOSS AT 250 DEG C HLD, 12 DEG RISE/MIN TO HOLD
1	1	1	1
2	2	2	2
3	3	3	3
4	4	4	4
5	5	5	5
6	6	6	6
7	7	7	7
8	8	8	8
9	9	9	9
10	10	10	10
11	11	11	11
12	12	12	12
13	13	13	13
14	14	14	14
15	15	15	15
16	16	16	16
17	17	17	17
18	18	18	18
19	19	19	19
20	20	20	20
21	21	21	21
22	22	22	22
23	23	23	23
24	24	24	24
25	25	25	25
26	26	26	26
27	27	27	27
28	28	28	28
29	29	29	29
30	30	30	30
31	31	31	31
32	32	32	32
33	33	33	33
34	34	34	34
35	35	35	35
36	36	36	36
37	37	37	37
38	38	38	38
39	39	39	39
40	40	40	40
41	41	41	41
42	42	42	42
43	43	43	43
44	44	44	44
45	45	45	45
46	46	46	46
47	47	47	47
48	48	48	48
49	49	49	49
50	50	50	50
51	51	51	51
52	52	52	52
53	53	53	53
54	54	54	54
55	55	55	55
56	56	56	56
57	57	57	57
58	58	58	58
59	59	59	59
60	60	60	60
61	61	61	61
62	62	62	62
63	63	63	63
64	64	64	64
65	65	65	65
66	66	66	66
67	67	67	67
68	68	68	68
69	69	69	69
70	70	70	70
71	71	71	71
72	72	72	72
73	73	73	73
74	74	74	74
75	75	75	75
76	76	76	76
77	77	77	77
78	78	78	78
79	79	79	79
80	80	80	80
81	81	81	81
82	82	82	82
83	83	83	83
84	84	84	84
85	85	85	85
86	86	86	86
87	87	87	87
88	88	88	88
89	89	89	89
90	90	90	90
91	91	91	91
92	92	92	92
93	93	93	93
94	94	94	94
95	95	95	95
96	96	96	96
97	97	97	97
98	98	98	98
99	99	99	99
100	100	100	100

This sample size summary is applicable to figure 66

$Y = ((+2.0990458E+01) + (+2.4800693E-02) \times X)$
 $F = +2.1354060E+01$ SIGNIFICANCE OF F = SIGNIFICANT
 $R = +2.1307268E-01$ SIGNIFICANCE OF R = SIGNIFICANT
 $t = +4.6210454E+00$ SIGNIFICANCE OF t = SIGNIFICANT
 $N = 451$ DEGREES OF FREEDOM = 449
 STORAGE CONDITIONS = AMB TEMP/RH TEST CONDITIONS = 12 DEG R/M TOHLD



SAGE 1 WING 6 TGA % WT LOSS AT 250 DEG C HOLD, 12 DEG RISE/MIN TO HOLD

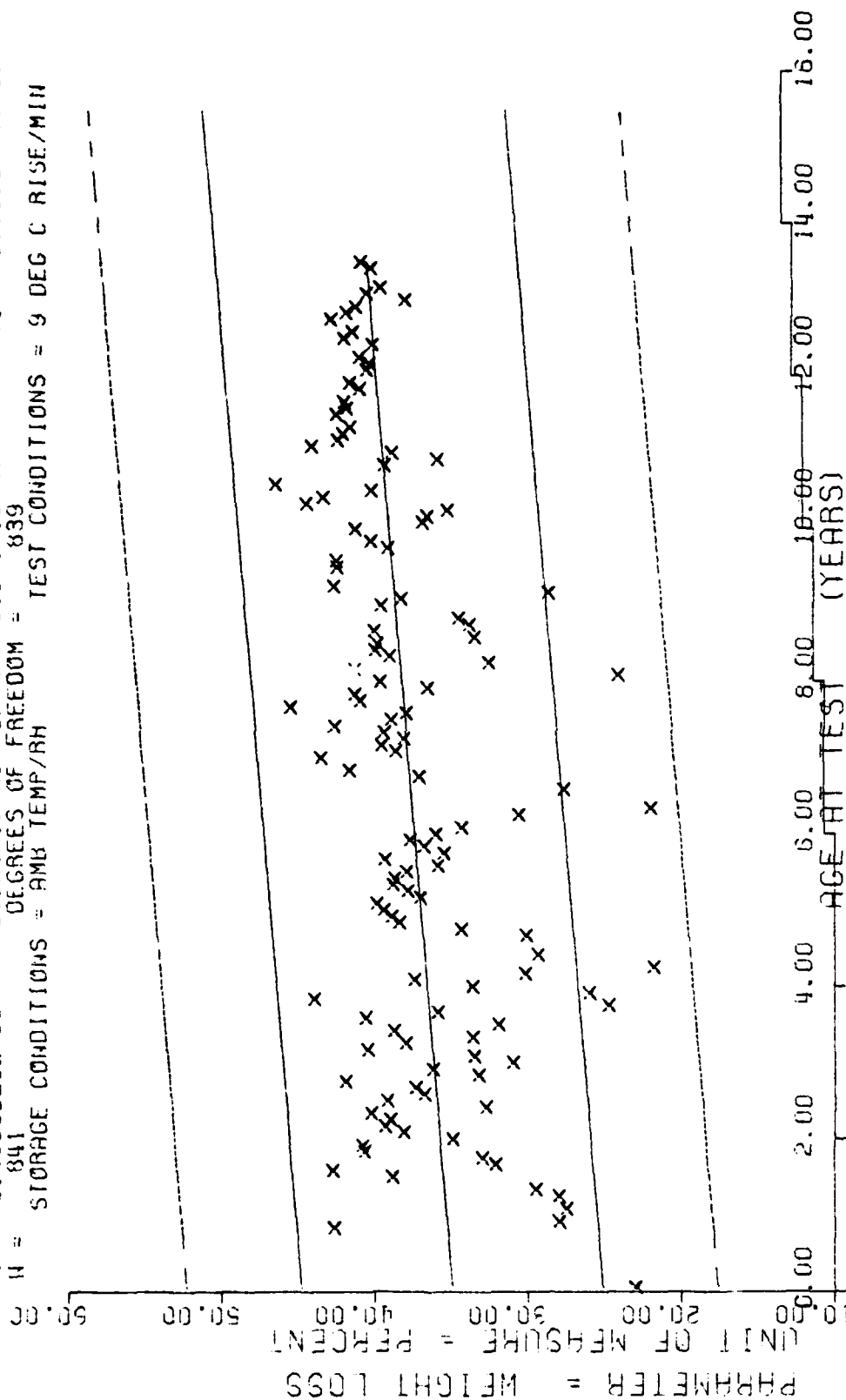
Figure 66

AGE (MOS)	NO SAMP	AGE (MOS)	NR SAMP	AGE (MOS)	NR SAMP	AGE (MOS)	NR SAMP	AGE (MOS)	NR SAMP
1	3	37	13	65	14	95	7	125	2
10	1	38	4	66	23	96	4	126	2
11	1	39	5	67	34	97	5	127	2
13	1	40	4	68	20	98	4	130	4
15	1	41	17	69	16	99	4	131	6
16	1	42	5	70	31	100	2	132	8
18	7	43	2	71	10	101	2	133	5
19	2	44	2	72	8	102	5	134	4
20	4	45	2	73	12	103	7	135	4
21	4	46	3	75	2	104	9	136	4
22	20	47	1	76	1	105	4	138	2
23	4	48	4	79	6	106	4	139	4
24	4	49	3	81	8	108	2	140	2
25	6	50	2	82	2	109	2	142	8
26	14	51	3	84	2	110	2	143	2
27	2	53	3	85	4	111	2	145	2
28	4	56	3	86	8	114	2	146	6
29	14	57	9	87	3	115	4	147	6
30	12	58	4	88	6	117	2	149	6
31	10	59	13	89	2	118	4	150	4
32	2	60	18	90	4	120	8	151	6
33	6	61	23	91	3	121	14	153	2
34	10	62	21	92	2	122	16	154	2
35	9	63	32	93	2	123	4	155	6
36	22	64	23	94	4	124	2	156	2

TGA PERCENT WEIGHT LOSS AT IGNITION, 9 DEG C RISE/MIN

This sample size summary is applicable to figure 67

$Y = ((+3.4931751E+01) + (+3.4472161E-02) * X)$
 $F = +4.1856921E+01$ SIGNIFICANCE OF F = SIGNIFICANT $G_1 = +5.9196096E+00$
 $R = +2.1798718E-01$ SIGNIFICANCE OF R = SIGNIFICANT $S_1 = +5.3282535E-03$
 $t = +6.4696925E+00$ SIGNIFICANCE OF t = SIGNIFICANT $S_2 = +5.7806946E+00$
 $n = 841$ DEGREES OF FREEDOM = 839
 STORAGE CONDITIONS = AMB TEMP/RH TEST CONDITIONS = 9 DEG C RISE/MIN



STAGE I WING 6 TGA PERCENT WEIGHT LOSS AT IGNITION, 9 DEG C RISE/MIN

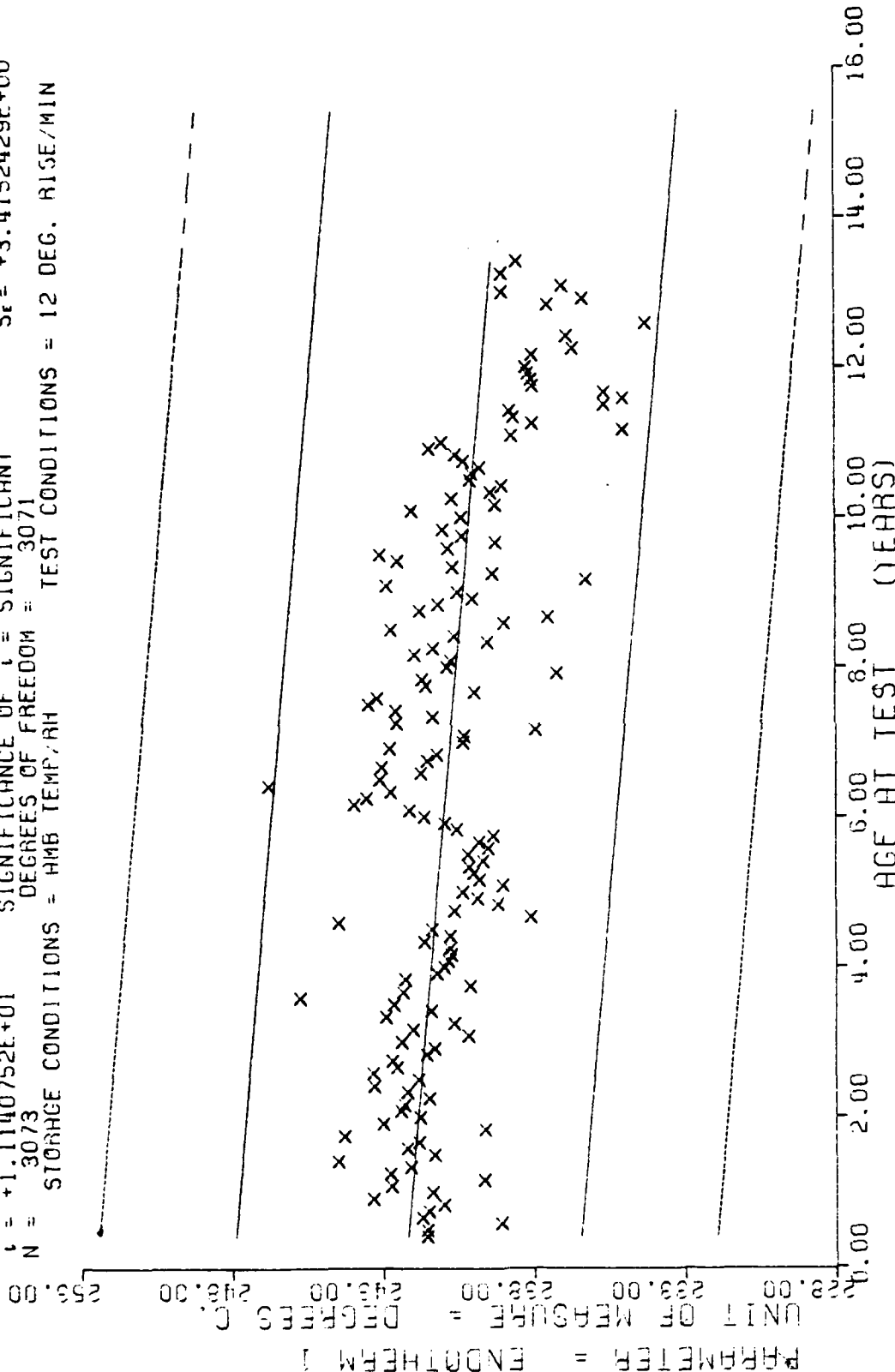
Figure 67

[illegible]

STAGE 1 WING 6, TE-H 1011, DIA, EXOTHERM 1, 12 DEGREE CENTIGRADE RISE/MIN

This sample size summary is applicable to figures 68 and 69

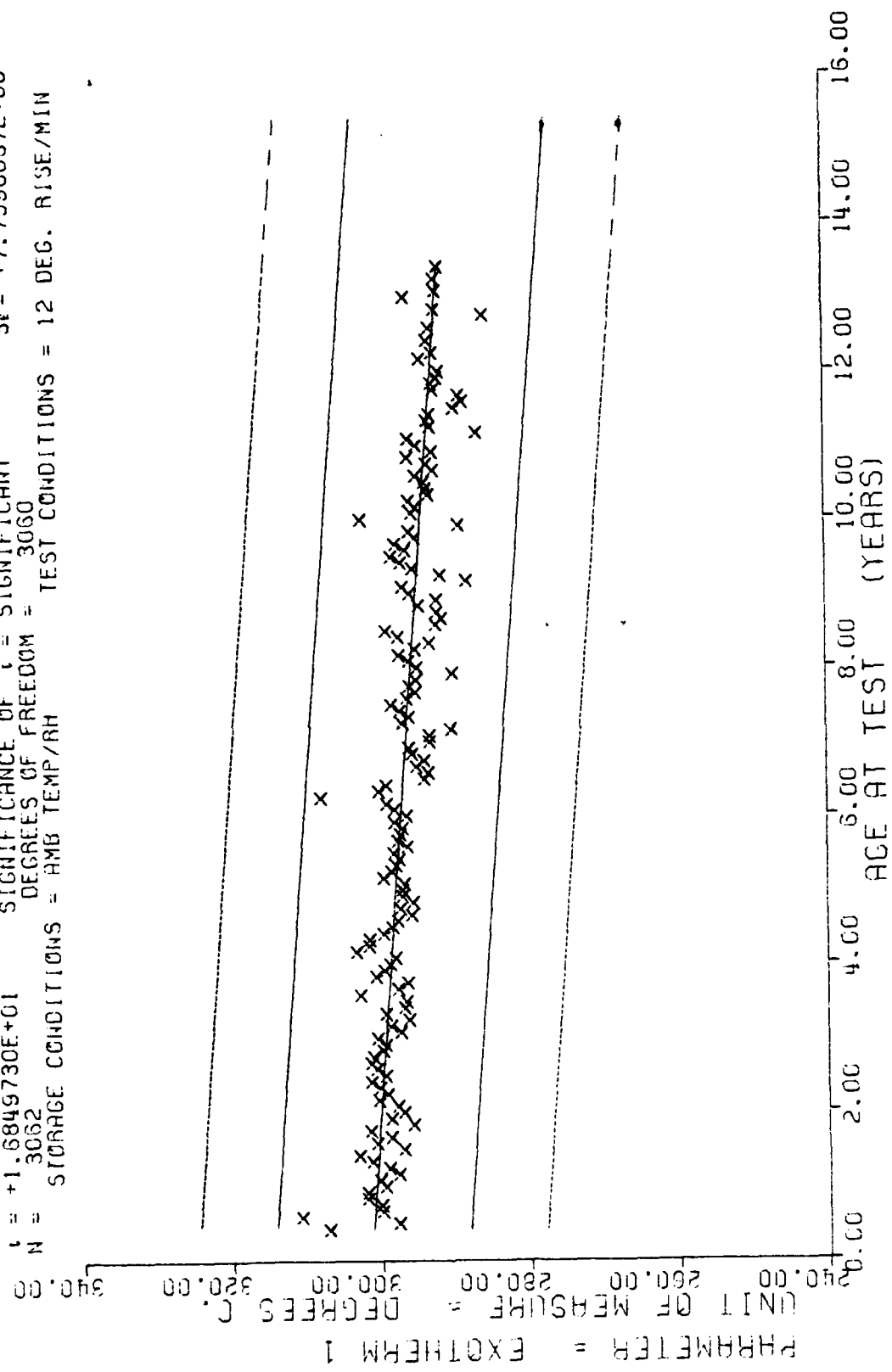
$t = \frac{F}{\sqrt{1.2411636E+02}} = ((+2.4227392E+02) + (-1.8291114E-02) * X)$
 SIGNIFICANCE OF F = SIGNIFICANT
 $R = -1.9709299E-01$
 SIGNIFICANCE OF R = SIGNIFICANT
 $t = +1.1140752E+01$
 SIGNIFICANCE OF t = SIGNIFICANT
 N = 3073
 DEGREES OF FREEDOM = 3071
 STORAGE CONDITIONS = HMB TEMP/RH
 TEST CONDITIONS = 12 DEG. RISE/MIN



STAGE 1 WING 6, TP-H 1011, DHA, ENDOTHERM 1, 12 DEGREE CENTIGRADE RISE/MIN

Figure 68

$F = +2.8391341E+02$ SIGNIFICANCE OF $F =$ (-6.2882344E-02) * X)
 $R = -2.5138382E-01$ SIGNIFICANT
 $t = +1.6849730E+01$ SIGNIFICANCE OF $t =$ SIGNIFICANT
 $N = 3062$ DEGREES OF FREEDOM = 3060
 STORAGE CONDITIONS = HMB TEMP/RH TEST CONDITIONS = 12 DEG. RISE/MIN



STAGE 1 WING 3, TP-H 1011, DTA, EXOTHERM 1, 12 DEGREE CENTIGRADE RISE/MIN

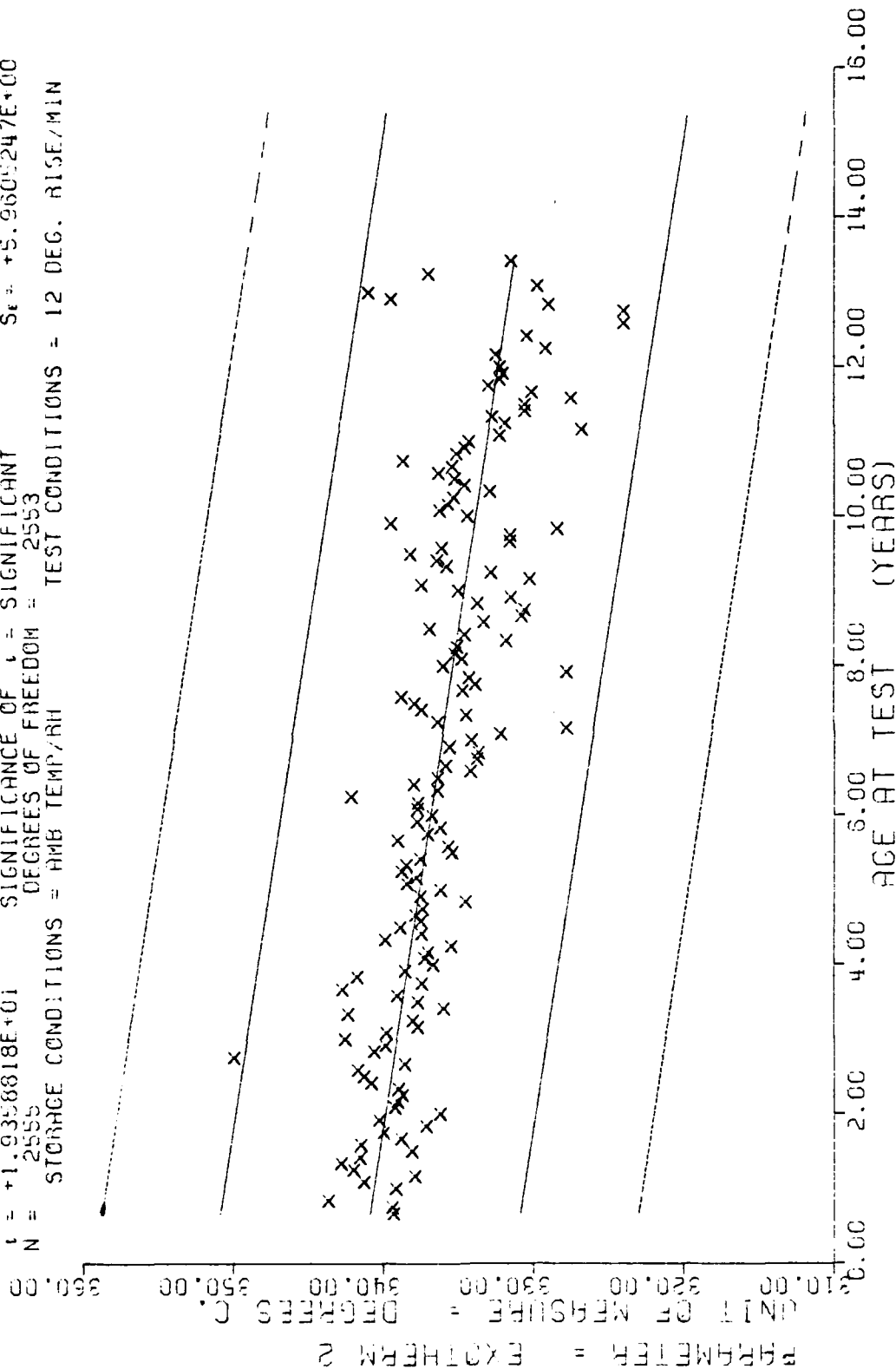
Figure 69

AGE (MOS)	NR SAMP	AGE (MOS)	NR SAMP	AGE (MOS)	NR SAMP	AGE (MOS)	NR SAMP	AGE (MOS)	NR SAMP
5	13	109	16	84	29	59	26	34	3
5	13	134	16	85	42	60	21	35	5
9	4	135	15	86	34	61	29	36	3
8	6	136	17	87	28	62	19	37	17
7	9	137	18	88	30	63	7	38	10
7	35	138	17	89	16	64	18	39	9
6	57	139	32	90	22	65	19	40	5
8	29	140	31	91	24	66	5	41	22
7	7	141	13	92	48	67	11	42	14
16	20	142	13	93	26	68	10	43	18
35	41	143	14	94	29	69	4	44	4
12	2	144	14	95	56	70	9	45	11
8	10	146	9	96	47	71	9	46	22
5	12	147	28	97	15	72	42	47	13
13	13	149	33	98	16	73	31	48	10
3	3	151	32	99	14	74	30	49	0
2	9	153	25	100	17	75	17	50	20
2	17	154	16	101	16	76	14	51	16
6	16	155	14	102	9	77	18	52	12
2	3	156	10	103	21	78	25	53	19
4	19	157	17	104	26	79	9	54	18
2	10	159	9	105	34	80	15	55	22
2	10	161	7	106	33	81	30	56	21
	50		15	107	30	82	25	57	22
	37		2	108	26	83	27	58	11
	22		12						
	14								

STAGE 1 WING B, TP-H 1C11, DTA, EXOTHERM 2, 12 DEGREE CENTIGRADE RISE/MIN

This sample size summary is applicable to figure 70

$F = +3.7476386E+02$
 $R = -3.5777569E-01$
 $t = +1.9358818E+01$
 $N = 2555$
 $I = ((+3.4137156E+02) + (-6.2902116E-02) * X)$
 SIGNIFICANCE OF F = SIGNIFICANT
 SIGNIFICANCE OF R = SIGNIFICANT
 SIGNIFICANCE OF t = SIGNIFICANT
 DEGREES OF FREEDOM = 2553
 STORAGE CONDITIONS = HMB TEMP/RH
 TEST CONDITIONS = 12 DEG. RISE/MIN



STAGE 1 WING 5, TP-H 1011, OTR, EXOTHERM 2, 12 DEGREE CENTIGRADE RISE/MIN

Figure 70

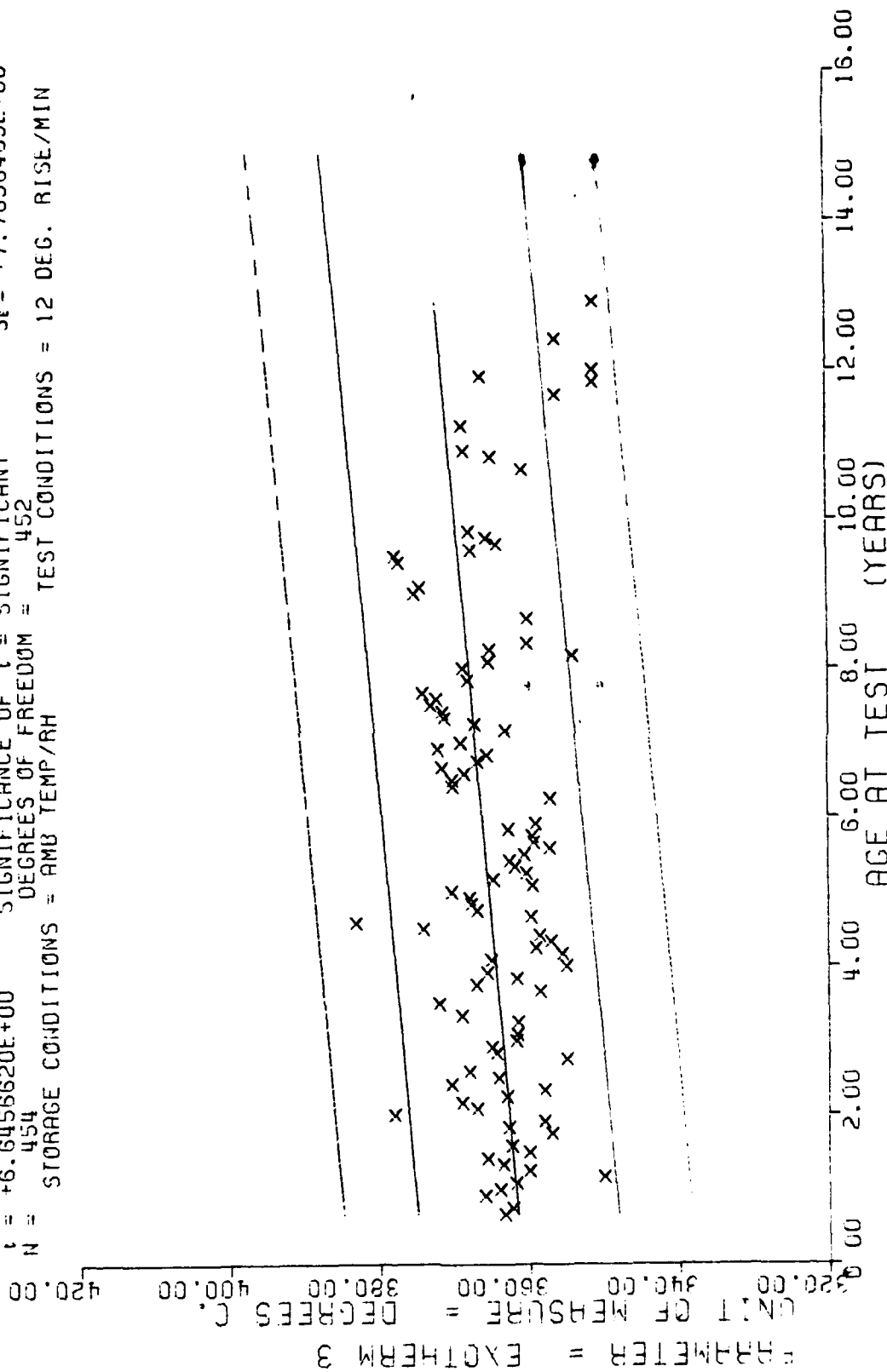
*** SAMPLE SIZE SUMMARY ***

AGE (MDS)	NR SAMP	AGE (MDS)	NR SAMP	AGE (MDS)	NR SAMP
3	3	64	4	96	6
5	7	65	5	97	4
11	3	66	2	98	1
12	4	67	5	99	1
13	5	68	3	100	1
16	3	69	2	104	1
15	1	70	1	108	3
16	4	71	5	109	4
17	5	75	7	110	1
14	5	77	8	113	11
19	6	78	2	114	21
21	2	79	2	115	7
22	4	80	1	116	2
23	1	81	3	117	3
24	1	82	4	118	3
25	1	83	1	128	2
26	2	84	1	130	9
27	4	86	3	131	4
24	3	87	7	135	2
29	5	88	5	140	1
30	3	89	7	142	2
31	4	90	4	143	4
33	4	91	7	144	1
34	5	92	6	149	1
35	4	94	5	155	1

SIAGE 1 WING C. 1P-H 1011. CIA, EXOTHERM 3. 12 DEGREE CENTIGRADE RISE/MIN

This sample size summary is applicable to figure 71

$Y = ((+3.6099975E+02) + (+7.0857652E-02) * X)$
 $F = +4.4164824E+01$ SIGNIFICANCE OF F = SIGNIFICANT $\sigma_r = +8.1316084E+00$
 $R = +2.9834946E-01$ SIGNIFICANCE OF R = SIGNIFICANT $S_e = +1.0662241E-02$
 $t = +6.6456620E+00$ SIGNIFICANCE OF t = SIGNIFICANT $S_e = +7.7698489E+00$
 $N = 454$ DEGREES OF FREEDOM = 452
 STORAGE CONDITIONS = AMB TEMP/RH TEST CONDITIONS = 12 DEG. RISE/MIN



STAGE 1 WING 6, TP-H 1011, DTA, EXOTHERM 3, 12 DEGREE CENTIGRADE RISE/MIN

Figure 71

[illegible]

This sample size summary is applicable to figure 72

$\gamma = ((+3.7013405E+02) + (+4.2118872E-03) * X)$
 F = +5.6024702E-01 SIGNIFICANCE OF F = NOT SIGNIFICANT $\sigma_1 = +1.0848851E+01$
 R = +1.4723004E-02 SIGNIFICANCE OF R = NOT SIGNIFICANT $\sigma_0 = +5.6271301E-03$
 t = +7.4849650E-01 SIGNIFICANCE OF t = NOT SIGNIFICANT $\sigma_t = +1.0849774E+01$
 N = 2586 DEGREES OF FREEDOM = 2584
 STORAGE CONDITIONS = RMB TEMP/RH TEST CONDITIONS = 12 DEG. RISE/MIN

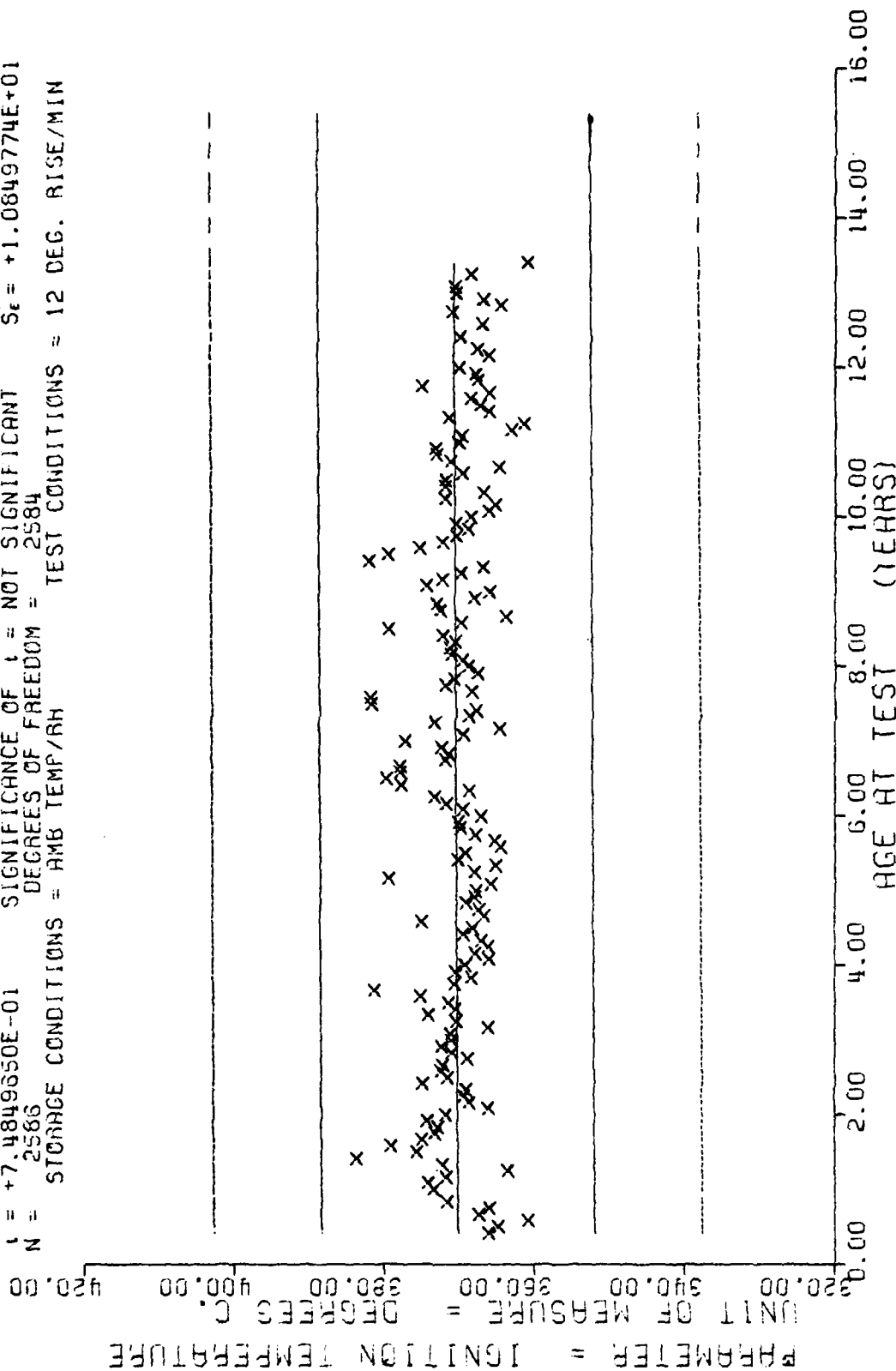


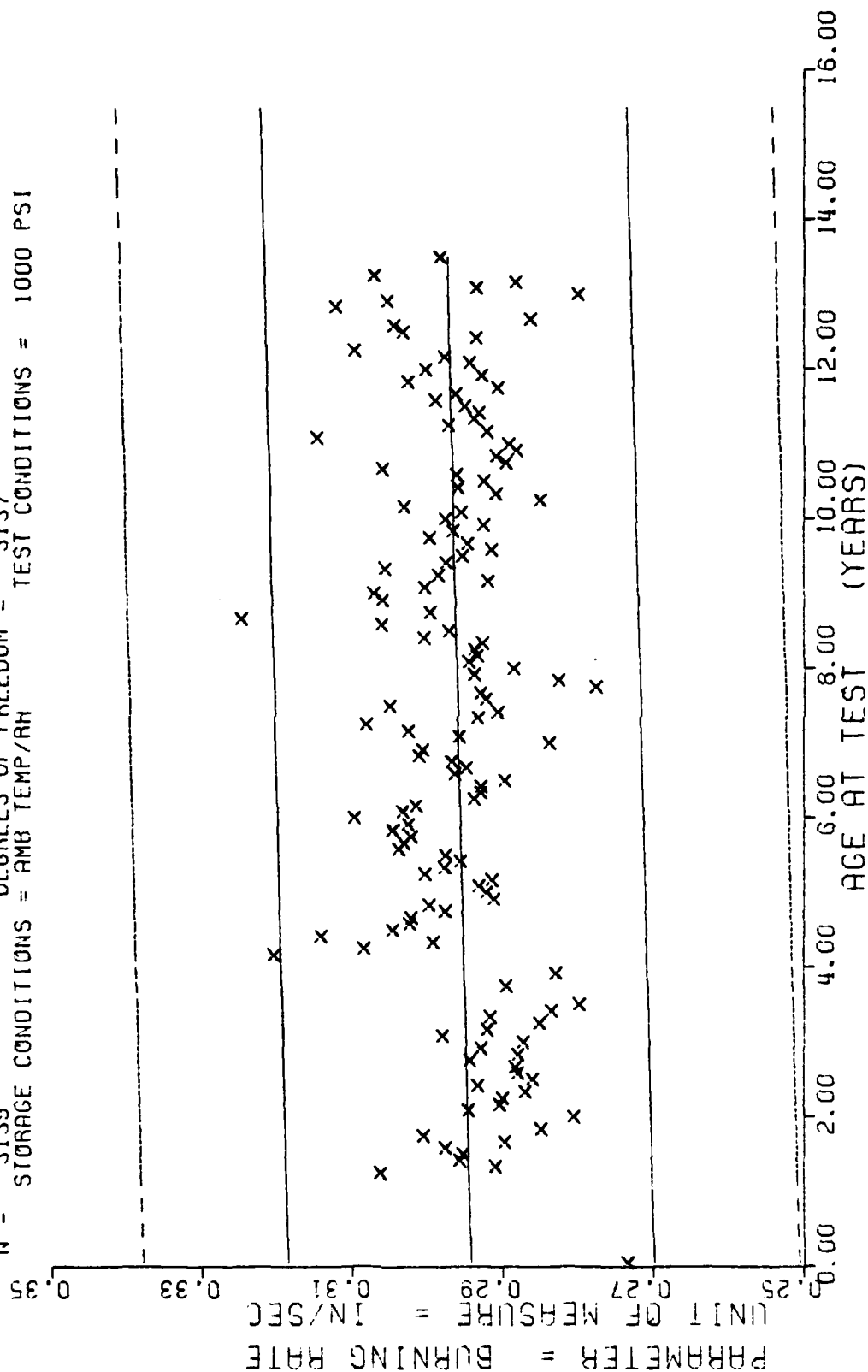
Figure 72

AGE (MOS)	NP SAMP	AGE (MOS)	NR SAMP	AGE (MOS)	NP SAMP	AGE (MOS)	NR SAMP	AGE (MOS)	NP SAMP	AGE (MOS)	NR SAMP
1	2	40	33	70	33	95	20	121	27	146	36
15	3	41	6	71	25	96	24	122	21	147	12
16	9	42	19	72	54	97	24	123	9	149	9
17	15	45	3	73	50	98	35	124	5	150	9
18	12	47	9	74	74	99	39	125	6	151	9
19	12	50	12	75	69	100	22	126	12	152	6
20	18	51	12	76	36	101	8	127	22	154	6
21	3	52	22	77	21	102	18	128	12	155	3
22	3	53	24	78	8	103	6	129	39	156	3
24	3	54	26	79	39	104	9	130	54	157	3
25	3	55	24	80	15	105	9	131	86	158	6
26	8	56	17	81	34	107	6	132	24	159	3
27	24	57	27	82	24	108	6	133	17	162	2
28	27	58	45	83	15	109	5	134	15		
29	46	59	42	84	9	110	3	135	24		
30	18	60	44	85	18	111	15	136	15		
31	42	61	22	86	12	112	14	137	9		
32	31	62	67	87	6	113	18	138	9		
33	43	63	51	88	15	114	54	139	50		
34	29	64	50	89	16	115	55	140	24		
35	43	65	37	90	28	116	22	141	27		
36	50	66	15	91	19	117	24	142	18		
37	23	67	24	92	20	118	28	143	12		
38	19	68	30	93	9	119	27	144	30		
39	21	69	27	94	6	120	79	145	27		

SIAG-- I WING 6 TC-H1111 BURNING RATE AT 1000 PSI

This sample size summary is applicable to figure 73

$F = +7.9890602E+00$
 $R = +5.0400398E-02$
 $t = +2.8264925E+00$
 $N = 3139$
 $Y = ((+2.9426397E-01) + (+1.9660798E-05) * X)$
 SIGNIFICANCE OF F = SIGNIFICANT
 SIGNIFICANCE OF R = SIGNIFICANT
 SIGNIFICANCE OF t = SIGNIFICANT
 DEGREES OF FREEDOM = 3137
 STORAGE CONDITIONS = AMB TEMP/AH
 TEST CONDITIONS = 1000 PSI



STAGE I WING 6 TP-H1011 BURNING RATE AT 1000 PSI

Figure 73

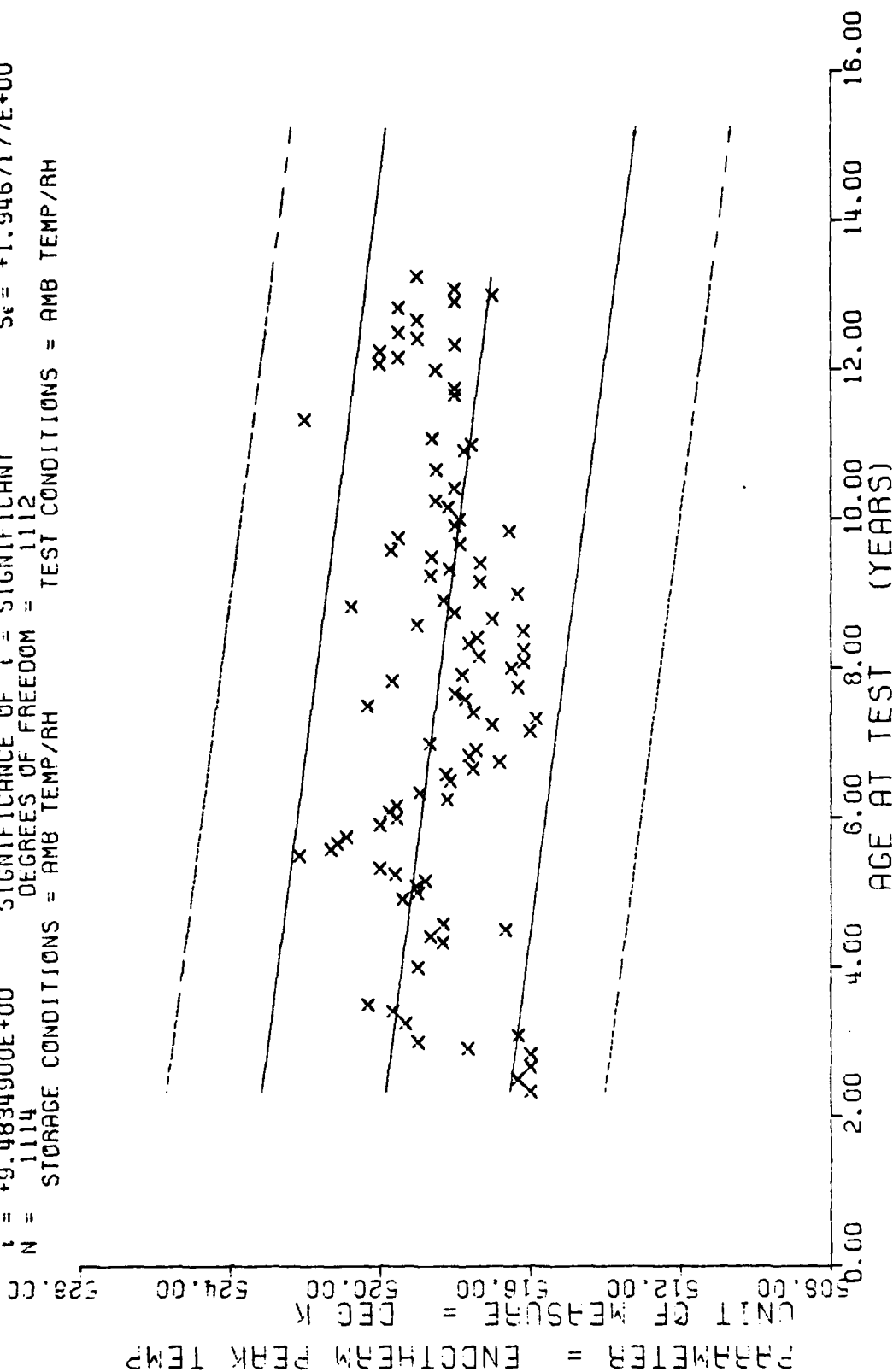
*** SAMPLE SIZE SUMMARY ***

AGE (MOS)	NO SAMP	AGE (MOS)	NR SAMP	AGE (MOS)	NR SAMP	AGE (MOS)	NR SAMP
28	6	71	17	98	14	128	2
30	3	72	16	99	18	131	8
32	2	73	21	100	8	132	54
34	2	74	11	101	5	133	5
35	3	75	14	102	6	136	2
36	7	76	20	103	3	140	2
37	3	78	30	104	7	141	2
39	6	79	42	105	8	144	2
41	3	80	56	106	4	145	2
42	3	81	42	107	7	146	2
48	3	82	32	108	3	147	2
52	3	83	50	110	3	148	2
53	3	84	3	111	34	149	2
54	3	86	5	112	13	150	2
55	3	87	2	113	6	152	2
59	10	88	6	114	13	154	2
60	18	89	2	115	23	155	2
61	21	90	3	116	14	156	5
62	15	91	15	117	6	157	2
63	5	92	5	118	44	159	2
64	3	93	6	119	22		
66	14	94	3	120	8		
67	54	95	5	122	6		
68	78	96	12	123	2		
69	36	97	6	125	2		

STAGE 1 WING C DIFFERENTIAL SCANNING CALORIMETER EXOTHERM 2 PEAK TEMP

This sample size summary is applicable to figures 74 thru 76

$Y = ((+5.2045459E+02) + (-2.1667973E-02) * X)$
 $F = +8.9936583E+01$ SIGNIFICANCE OF F = SIGNIFICANT $G_1 = +2.0230013E+00$
 $R = -2.7354414E-01$ SIGNIFICANCE OF R = SIGNIFICANT $S_d = +2.2848100E-03$
 $t = +9.4834900E+00$ SIGNIFICANCE OF t = SIGNIFICANT $S_e = +1.9467177E+00$
 $N = 1114$ DEGREES OF FREEDOM = 1112
 STORAGE CONDITIONS = AMB TEMP/RH TEST CONDITIONS = AMB TEMP/RH



STAGE I WING 6 DIFFERENTIAL SCANNING CALORIMETER ENDOTHERM PEAK TEMP

Figure 74

$F = +5.9128705E+00$
 $R = -7.2726922E-02$
 $t = +2.4316394E+00$
 $N = 1114$
 $Y = ((+5.6008078E+02) + (-3.1491413E-02) * X)$
 SIGNIFICANCE OF F = SIGNIFICANT
 SIGNIFICANCE OF R = SIGNIFICANT
 SIGNIFICANCE OF t = SIGNIFICANT
 DEGREES OF FREEDOM = 1112
 STORAGE CONDITIONS = AMB TEMP/RH
 TEST CONDITIONS = AMB TEMP/RH
 $G_1 = +1.1058653E+01$
 $S_1 = +1.2950691E-02$
 $S_2 = +1.1034326E+01$

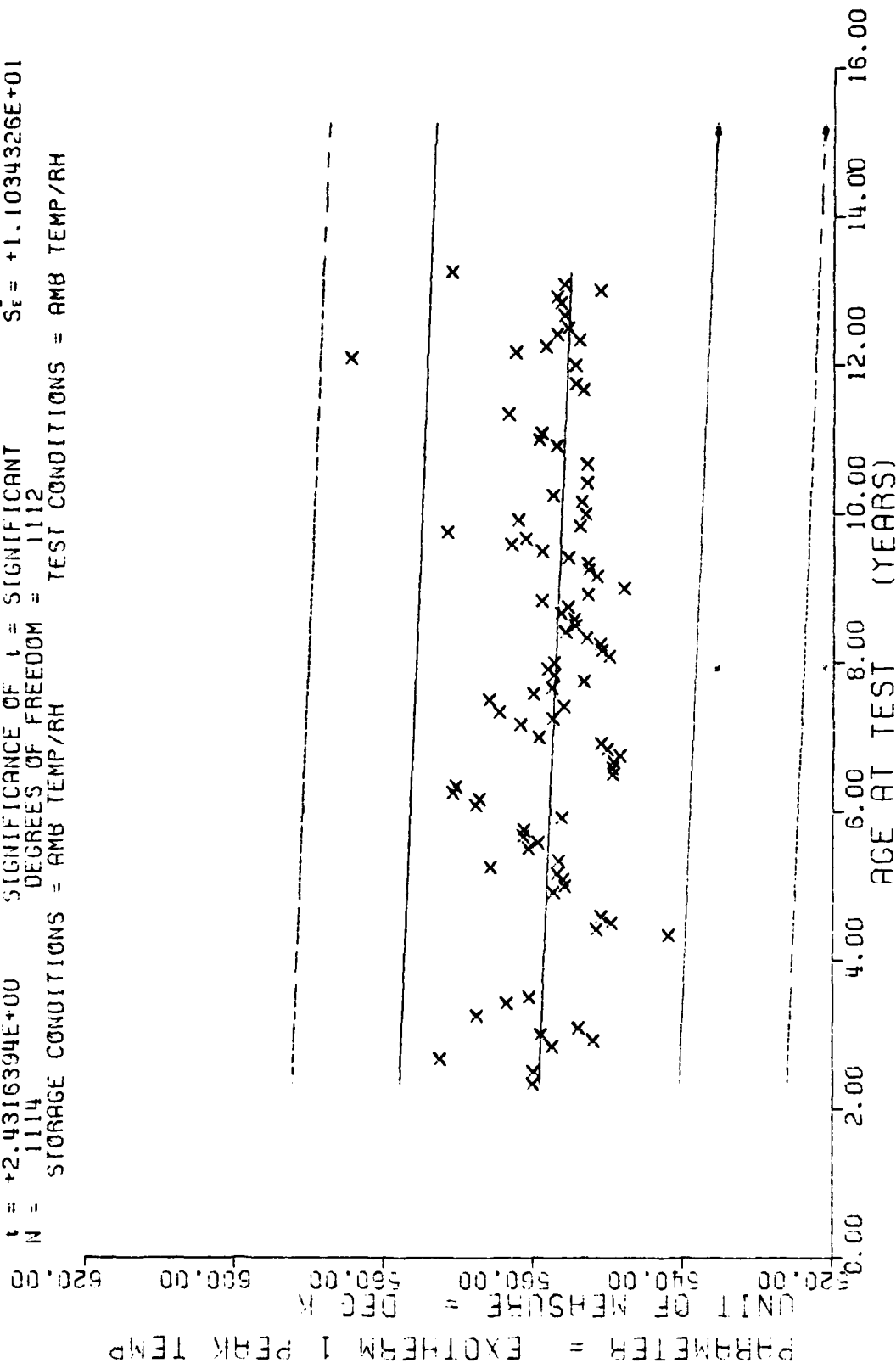
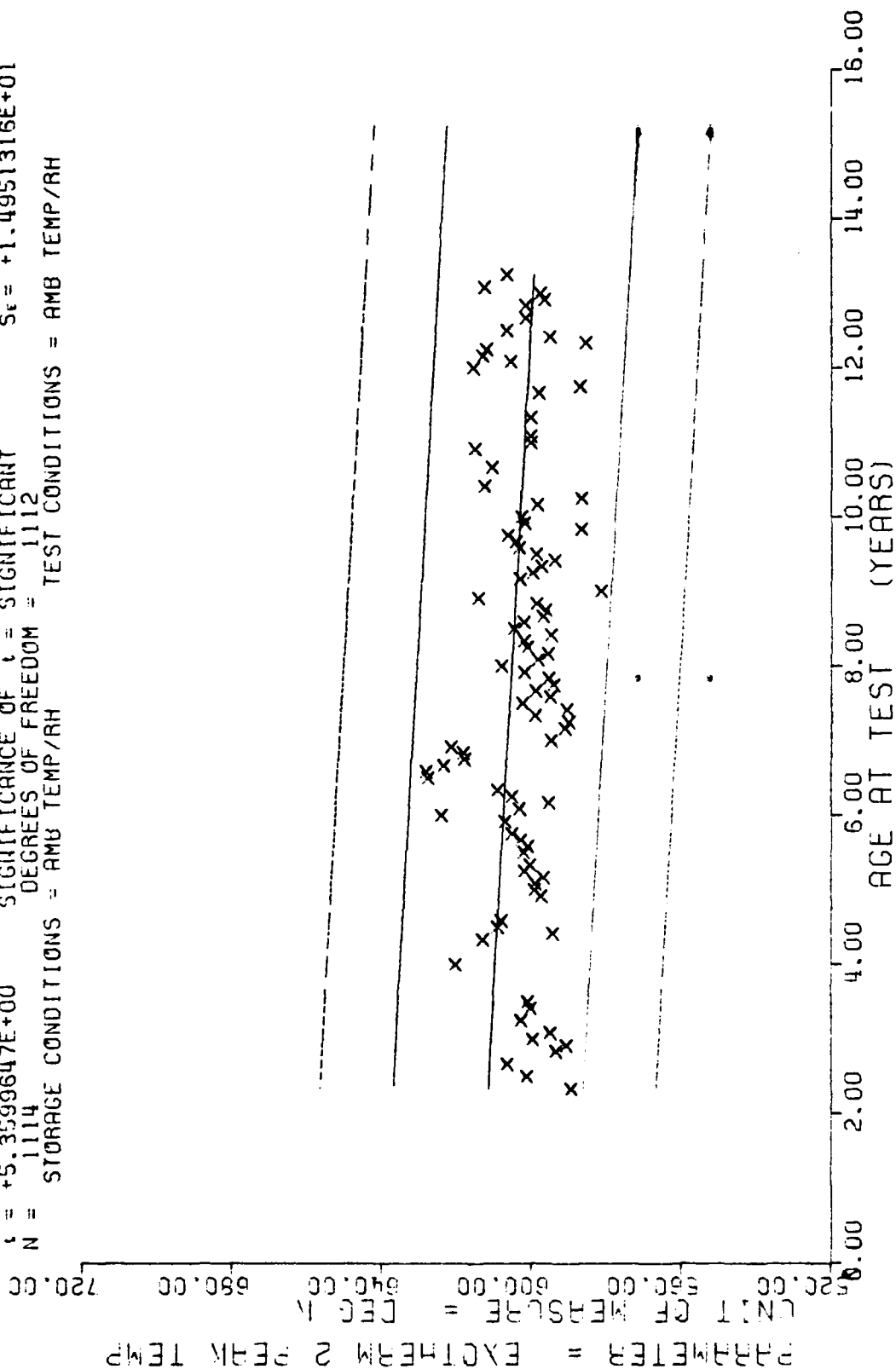


Figure 75

$Y = ((+6.1417125E+02) + (-9.4056431E-02) * X)$
 $F = +2.8729222E+01$ SIGNIFICANCE OF F = SIGNIFICANT
 $R = -1.5869770E-01$ SIGNIFICANCE OF R = SIGNIFICANT
 $t = +5.3599647E+00$ SIGNIFICANCE OF t = SIGNIFICANT
 $N = 1114$ DEGREES OF FREEDOM = 1112
 STORAGE CONDITIONS = AMB TEMP/RH TEST CONDITIONS = AMB TEMP/RH



STAGE I WING 6 DIFFERENTIAL SCANNING CALORIMETER EXOTHERM 2 PEAK TEMP

DISTRIBUTION

	NR <u>COPIES</u>
OOALC	
MMWRME	1
MMWRMT	1
DDC (TISIR) Cameron Station, Alexandria, VA 22314	2
AFPRO, Thiokol Chemical Corporation Wasatch Division P.O. Box 524 Brigham City, UT 84302 (Cy to R. E. Keating)	2
AFRPL (MKPB) Edwards AFB, CA 93523	1
SAC (LGMB) Offutt AFB, NB 68113	1
U. S. Naval Ordinance Station, Indian Head, MD 20640 Attn: Dr. James H. Wiegand Fleet Support Dept., Propulsion System Development Division, Code FS7	1
CPIA, Johns Hopkins University Attn: Dr. P. L. Nichols Applied Physics Laboratory Johns Hopkins Road Laurel, MD 20810	1
Naval Plant Branch Representative Attn: Mr. David W. Pratt P. O. Box 157, Bacchus Works Magna, UT 84044	1

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

14 REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM	
1. REPORT NUMBER MANCP Report No. 438(80)	2. GOVT ACCESSION NO. AD-A085630	3. RECIPIENT'S CATALOG NUMBER	
4. TITLE (and Subtitle) Propellant Surveillance Report LGM-30 F & G Stage I, Phase G. Series VIII, TP-H1011		5. TYPE OF REPORT & PERIOD COVERED Test Results - semi-annual	rept,
7. AUTHOR(s) 10 John A. Thompson		6. PERFORMING ORG. REPORT NUMBER	
9. PERFORMING ORGANIZATION NAME AND ADDRESS Propellant Analysis Laboratory Directorate of Maintenance OO-ALC Hill AFB, Utah 84056		8. CONTRACT OR GRANT NUMBER(s)	
11. CONTROLLING OFFICE NAME AND ADDRESS Service Engineering Division Directorate of Materiel Management OO-ALC Hill AFB, Utah 84056		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS MMWRM Project M04046C- WNL01529	
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office)		12. REPORT DATE 11 Apr 80	
		13. NUMBER OF PAGES 136	
	12 134	15. SECURITY CLASS. (of this report)	
		15a. DECLASSIFICATION/DOWNGRADING SCHEDULE	
16. DISTRIBUTION STATEMENT (of this Report) Approved for Public Release, Distribution Unlimited			
17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)			
18. SUPPLEMENTARY NOTES			
19. KEY WORDS (Continue on reverse side if necessary and identify by block number) Solid Propellant Minuteman			
20. ABSTRACT (Continue on reverse side if necessary and identify by block number) This report contains propellant test results from cartons of TP-H1011 bulk propellant representing LGM-30 F and G First Stage Minuteman Motors. This report uses a statistical approach to analyze the bulk carton propellant data. Testing was accomplished in accordance with MMWRM Project Mo4046-WNL01529. The data from this test period are combined with data from previous testing and entered into the G085 computer for storage, analysis and regression analysis. From the statistical analysis of all data tested to date (fourteen years for			

407387

13

F and G), significant degradation of the propellant does not appear likely for at least two years past the oldest data point.

Each point on the regression plot represents the mean of all samples at that particular age. The number of samples at each point is indicated on the sample size summary sheet on the page accompanying each regression plot or group of regression plots. The data range at any age can be found by suitable inquiry of the G085 system.