AD NUMBER

AD862119

NEW LIMITATION CHANGE

TO

Approved for public release, distribution unlimited

FROM

Distribution authorized to U.S. Gov't. agencies and their contractors; Administrative/Operational Use; Jun 1969. Other requests shall be referred to Air Force Materials Laboratory, Materials Applications Division, Attn: MAAE, Wright-Patterson AFB, OH 45433.

AUTHORITY

AFSC/USAF ltr, 2 Mar 1972

DEVELOPMENT OF FATIGUE DATA FOR SEVERAL ALLOYS FOR USE IN AEROSPACE DESIGN

T. A. Roach

Standard Pressed Steel Co.

Technical Report AFML-TR-69-175

June, 1969

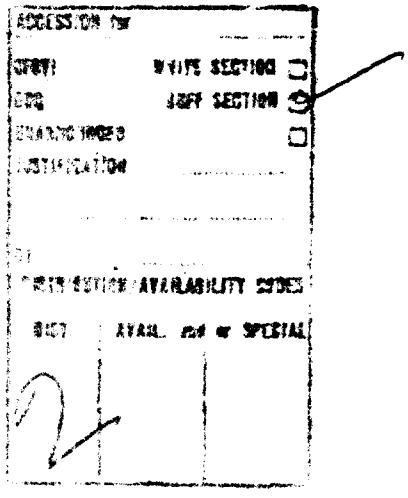
AIR FORCE FLIGHT DYNAMICS LABORATORY
AIR FORCE SYSTEMS COMMAND
WRIGHT-PATTERSON AIR FORCE BASE, OHIO

NOTICE

When Government drawings, specifications, or other data are used for any purpose other than in connection with a definitely related Government procurement operation, the United States Government thereby incurs no responsibility nor any obligation whatsoever; and the fact that the government may have formulated, furnished, or in any way supplied the said drawings, specifications, or other data, is not to be regarded by implication or otherwise as in any manner licensing the holder or any other person or corporation, or conveying any rights or permission to manufacture, use, or sell any patented invention that may in any way be related thereto.

This document is subject to special export controls and each transmittal to foreign government or foreign nationals may be made only with prior approval of the Air Force Materials Laboratory, Materials Applications Division (MAAE), Wright-Patterson Air Force Base, Ohio.

The distribution of this report is limited because information in this report is embargoed under the Department of State ITIAR.



Copies of this report should not be returned unless return is required by security considerations, contractual obligations, or notice on a specific document.

AFML-TR-69-175

DEVELOPMENT OF FATIGUE DATA FOR SEVERAL ALLOYS FOR USE IN AEROSPACE DESIGN

T. A. Roach

FOREWORD

This report presents the results of work performed by Standard Pressed Steel Co., Jenkintown, Pa. under contract to the Air Force Materials Laboratory, Air Force Systems Command, Wright-Patterson Air Force Base Ohio 45433. The work was performed under Air Force Contract AF33(615)-3737 which was initiated under Project No. 7381, "Materials Applications", Task No. 738106, "Engineering and Design Data". The Air Force Project Engineer was Mr. Clay Harmsworth (MAAM).

This report covers work in the period March 1966 to November 1968. The manuscript of this report was released by the author in May 1969 for publication as a Technical Report.

This report was prepared by Thomas A. Roach.

This technical report has been reviewed and is approved.

A. Olevitch

A. OLEVITCH
Chief, Materials Engineering Branch
Materials Support Division
Air Force Materials Laboratory

ABSTRACT

A test program was conducted to develop fatigue data on 17-7 PH and PH 15-7 stainless steels at room and elevated temperatures. Limited stress-rupture and tensile data were also obtained. This program is part of an overall effort to obtain fatigue data for alloys which are currently in MIL-HDBK-5, but for which fatigue data is currently lacking. All data were generated to be compatible with the MIL-HDBK-5 format and are presented in tabular form as well as stress rupture curves, S-N curves, and constant life diagrams.

TABLE OF CONTENTS

LIST OF TABLES & ILLUSTRATIONS

LIST OF TABLES & ILLUSTRATIONS (continued)

An Index of data and figures generated therefrom is contained in Section V by material, form and heat treatment as follows:

SECTION I

INTRODUCTION

The importance of using fatigue data for the selection of structural materials and the design of aerospace systems has been well recognized in recent years. However, there are many gaps where data doesn't exist, or is incomplete for alloys which are otherwise well characterized in Mil-Handbook 5. It was the purpose of this program to obtain axial fatigue data and fill some of these more critical areas by supplying S-N curves and constant life curves.

The program obtained axial loading fatigue data for several alloys -- AM350, 17-7 PH, and PH 15-7 Mo -- at room and elevated temperature in the unnotched and notched conditions. In addition, limited tensile and stress rupture data to complement the fatigue data were obtained.

The selected materials are alloys now included in Mil-Handbook 5 and are covered by AMS or Mil specifications. The tests were designed to provide data that will be applicable to the Mil-Handbook 5 format.

SECTION II

PROGRAM DESCRIPTION

A. Materials and Conditions

The test materials consisted of AM 350 sheet in the sub-zero cooled and tempered (SCT) condition, 17-7 PH, and PH 15-7 Mo sheet and forging in the RH 950 and TH 1050 condition. All of these materials were purchased in the annealed condition and heat treated by Standard Pressed Steel Co. The materials included are summarized in Table I.

TABLE I

SELECTED MATERIALS & CONDITIONS FOR TESTING

Alloy	Condition	Form	Thickness
AM350	SCT	Sheet	.050 inches
17-7 PH	TH 1050	Sheet	.050 inches
17-7 PH	TH 1050	Forging	
17-7 PH	RH 950	Sheet	.050 inches
17-7 PH	RH 950	Forging	
PH 15-7 Mo	TH 1050	Sheet	.050 inches
PH 15-7 Mo	TH 1050	Forging	
PH 15-7 Mo	RH 950	Sheet	.050 inches
PH 15-7 Mo	RH 950	Forging	

B. Test Program

The primary portion of this program consisted of axial fatigue tests of AM350 sheet, 17-7 PH sheet and forgings and PH 15-7 Mo sheet and forgings. Sufficient tensile and stress-rupture tests were performed to provide the basis for fatigue tests and provide the necessary data for the completion of characteristic constant life diagrams. The tests on the AM 350 (SCT) and 17-7 PH (1050) sheet were conducted at the Air Force Materials Laboratory and will be reported separately.

Fatigue tests were run at three specified alternating stress/mean stress ratios (A ratio), various temperatures on notched and smooth specimens at varied heat treatment levels. Stress levels were varied to produce a complete S-N curve on each lot of specimens to provide the data necessary for the constant life diagram. The entire program is summarized in Tables II, III and IV.

TABLE II

TENSILE TESTS

	Test Temp. °F	AM350-SCT Sheet*	17-7 PH				PH 15-7 Mo			
			TH1050 Sheet*	TH1050 Forging	RH950 Sheet	RH950 Forging	RH950 Sheet	RH950 Forging	TH1050 Sheet	TH1050 Forging
Smooth specimens Longitudinal and Transverse (3 tests/condition)										
	R.T.	8	8	6	6	6	—	6	—	—
	500	8	—	—	—	—	—	—	—	—
	600	—	8	6	6	6	6	6	—	—
	700	—	—	—	—	—	—	—	6	6
	800	8	8	6	6	6	—	—	—	—
	1000	—	—	—	—	—	6	6	6	6
Notched Specimens Longitudinal and Transverse(3 tests/condition)										
K_t = 3.0	R.T.	8	8	6	6	6	6	6	—	—
	500	8	—	—	—	—	—	—	—	—
	600	—	8	6	6	6	6	6	—	—
	700	—	—	—	—	—	—	—	6	6
	800	8	8	6	6	6	—	—	—	—
	1000	—	—	—	—	—	6	6	6	6

*Specimens to AFML for testing, K_t = 3.3 on these notched specimens

TABLE III

STRESS RUPTURE TESTS

	Test Temp. °F	AM 350-SCT Sheet*	17-7 PH				PH 15-7 Mo			
			TH 1050 Sheet*	TH 1050 Forging	RH 950 Sheet	RH 950 Forging	RH 950 Sheet	RH 950 Forging	TH 1050 Sheet	TH 1050 Forging
Smooth Specimen	500	6	—	—	—	—	—	—	—	—
	600	—	6	5	5	5	5	5	—	—
	700	—	—	—	—	—	—	—	5	5
	800	6	6	5	5	5	—	—	—	—
	1000	—	—	—	—	—	5	5	5	5
Notched Specimen K_t = 3.0	600	—	—	5	5	5	5	5	—	—
	700	—	—	—	—	—	—	—	5	5
	800	—	—	5	5	5	—	—	—	—
	1000	—	—	—	—	—	5	5	5	5
Notched Specimen K_t = 3.3	500	6	—	—	—	—	—	—	—	—
	600	—	6	—	—	—	—	—	—	—
	800	6	6	—	—	—	—	—	—	—

* Specimens to AFML for testing.

All sheet specimens transverse
All forging specimens longitudinal

TABLE IV

FATIGUE TESTS

	Test Temp. °F	AM350-SCT Sheet*	17-7 PH				PH 15-7 Mo			
			TH1050 Sheet*	TH1050 Forging	RH950 Sheet	RH950 Forging	RH950 Sheet	RH950 Forging	TH1050 Sheet	TH1050 Forging
Smooth specimens										
Longitudinal	R.T.	—	—	20	—	30	—	10	—	—
A = ∞	600	—	—	30	—	30	—	30	—	—
A = 0.98	700	—	—	—	—	—	—	—	—	30
A = 0.50	800	—	—	30	—	—	—	—	—	—
10 tests/condition	1000	—	—	—	—	30	—	30	—	30
Notched Specimens										
Longitudinal	R.T.	—	—	30	—	30	—	30	—	—
K_t = 3.0 A = ∞	600	—	—	30	—	30	—	30	—	—
A = 0.98	700	—	—	—	—	—	—	—	—	30
A = 0.50	800	—	—	30	—	—	—	—	—	—
10 tests/condition	1000	—	—	—	—	30	—	30	—	30
Smooth specimens										
Transverse	R.T.	—	22	—	20	—	—	—	—	—
A = 0.98	500	11	—	—	—	—	—	—	—	—
A = 0.50	600	—	22	—	20	—	20	—	—	—
10 tests/condition	700	—	—	—	—	—	—	—	20	—
	800	22	22	—	—	—	—	—	—	—
	1000	—	—	—	20	—	20	—	20	—
Notched Specimens		**								
Transverse	R.T.	11	22	—	20	—	20	—	—	—
K_t = 3.0 A = 0.98	500	11	—	—	—	—	—	—	—	—
A = 0.50	600	—	22	—	20	—	20	—	—	—
	700	—	—	—	—	—	—	—	20	—
	800	22	22	—	—	—	—	—	—	—
	1000	—	—	—	20	—	20	—	20	—

* Specimens to AFML for testing.

** K_t = 3.3 10 test/condition.

C. Specimen Preparation

1. Sheet Specimens

All sheet material was ordered and received in the annealed condition to facilitate specimen manufacture.

Blanks for the specimens were sheared from the sheets 1/32" oversize. They were identified and then heat treated. The specimens were clamped securely during the cycle to prevent distortion. The heat treatment cycles were as follows:

AM350 SCT

Anneal by heating to 1710°F and air cooling to room temperature
Cool to -100°F and hold for 3 hours
Precipitation harden at 850°F for 3 hours and air cool

17-7 PH RH 950

Destabilize by heating to 1750°F, holding for 10 minutes and cooling to room temperature
Cool to -100°F and hold 8 hours
Precipitation harden at 950°F for 1 hour and air cool

17-7 PH TH 1050

Destabilize by heating to 1400°F, holding 90 minutes and air cooling to room temperature
Cool to 55°F within one hour of the destabilization and hold 30 minutes
Precipitation harden at 1050°F for 90 minutes and air cool

PH 15-7 Mo RH 950

Destabilize by heating to 1750°F, holding for 10 minutes and air cooling to room temperature
Cool to -100°F and hold 8 hours
Precipitation harden at 950°F for 1 hour and air cool

PH 15-7 Mo TH 1050

Destabilize by heating to 1400°F, holding 90 minutes and air cooling to room temperature
Cool to 55°F within one hour of the destabilization and hold 30 minutes
Precipitation harden at 1050°F for 90 minutes and air cool

Following heat treatment the specimens were machined to finished dimensions and polished to remove machining marks and transverse scratches. The final polishing was done in the longitudinal direction using wet 600 grit silicon carbide paper.

2. Forging Specimens

Longitudinal and transverse specimens were cut from the four inch square forged billets according to the approved layout. The rough cut pieces were identified and heat treated using the cycles shown for the sheet specimens. All machining was performed after heat treatment. The specimens were polished as described for the sheet specimens.

3. Specimen Configurations

Drawings of the sheet and forgings specimens are shown in Figures 1 and 2.

D. Test Procedures

1. Tensile Tests

Tensile tests for sheet and forging specimens were performed in accordance with ASTM Standard E8. Unnotched specimens were tested at room and applicable elevated temperatures listed in Table III. Both longitudinal and transverse directional specimens were tested for each condition. Notched specimens were tested at room temperature to determine notch strengths for use in conjunction with fatigue tests.

The tensile tests were run on Tinius Olsen Universal Testing Machines employing a uniform loading rate of 0.005 inches per inch per minute for the unnotched specimens and 65,000 psi per minute for the notched specimens. Tinius Olsen "S" type extensometers which exceed the requirements of ASTM Class B-1 were used for determining the 0.2 percent offset yield strength of unnotched specimens. This method is in accordance with ASTM Standard designation A370-61T.

Automatically controlled infra red furnaces were used for the elevated temperature testing. A minimum of two thermocouples were attached to each test specimen for all high temperature tests.

2. Axial Load Fatigue Tests

These tests were run on notched and unnotched specimens at room and applicable elevated temperatures listed in Table IV. Sheet specimens were machined in the longitudinal direction. The tests were conducted using stress ratios (A) of infinity (forgings only), 0.98, and 0.50 where:

$$A = \frac{\text{Alternating Stress}}{\text{Mean Stress}}$$

D. Test Procedures (continued)

Stress levels were selected to produce fatigue life from 1,000 to 10,000,000 cycles. The tests were conducted on the following type of fatigue machines:

Manufacturer	Type	Range Cycles/Minute
Krouse	Tension	1050/1650
Ivy (Baldwin)	Tension	1200
Sonntag	Tension	1800
Amsler Vibraphore	Tension Compression	3500/4300

Automatically controlled resistance-wound and infrared furnaces were used for the elevated temperature tests. A minimum of two thermocouples were attached to each test specimen for all tests. Temperatures were monitored at regular intervals throughout the tests by means of a direct reading potentiometer.

Two representative test set-ups are shown in Figures 3 and 4. One program stipulation was that no elevated temperature tests could be run at above 3600 cycles per minute at any "A" ratio other than infinity. This was inadvertently violated on a few curves early in the program by running at 4300 cycles per minute. Later in the program two of these curves were partially rerun at 1800 cycles per minute to determine the influence, if any, of frequency on the fatigue performance.

3. Stress Rupture Tests

Stress rupture tests were conducted at the applicable elevated temperature as listed for the fatigue tests as shown in Table IV. These tests were run to provide the stress rupture to complement the fatigue tests in establishing constant life.

Stress rupture tests were run on Satec Stress Rupture Machines. These machines employ a lever arm that has a ratio of 20:1. Load is applied by dead weights which provided a constant stress.

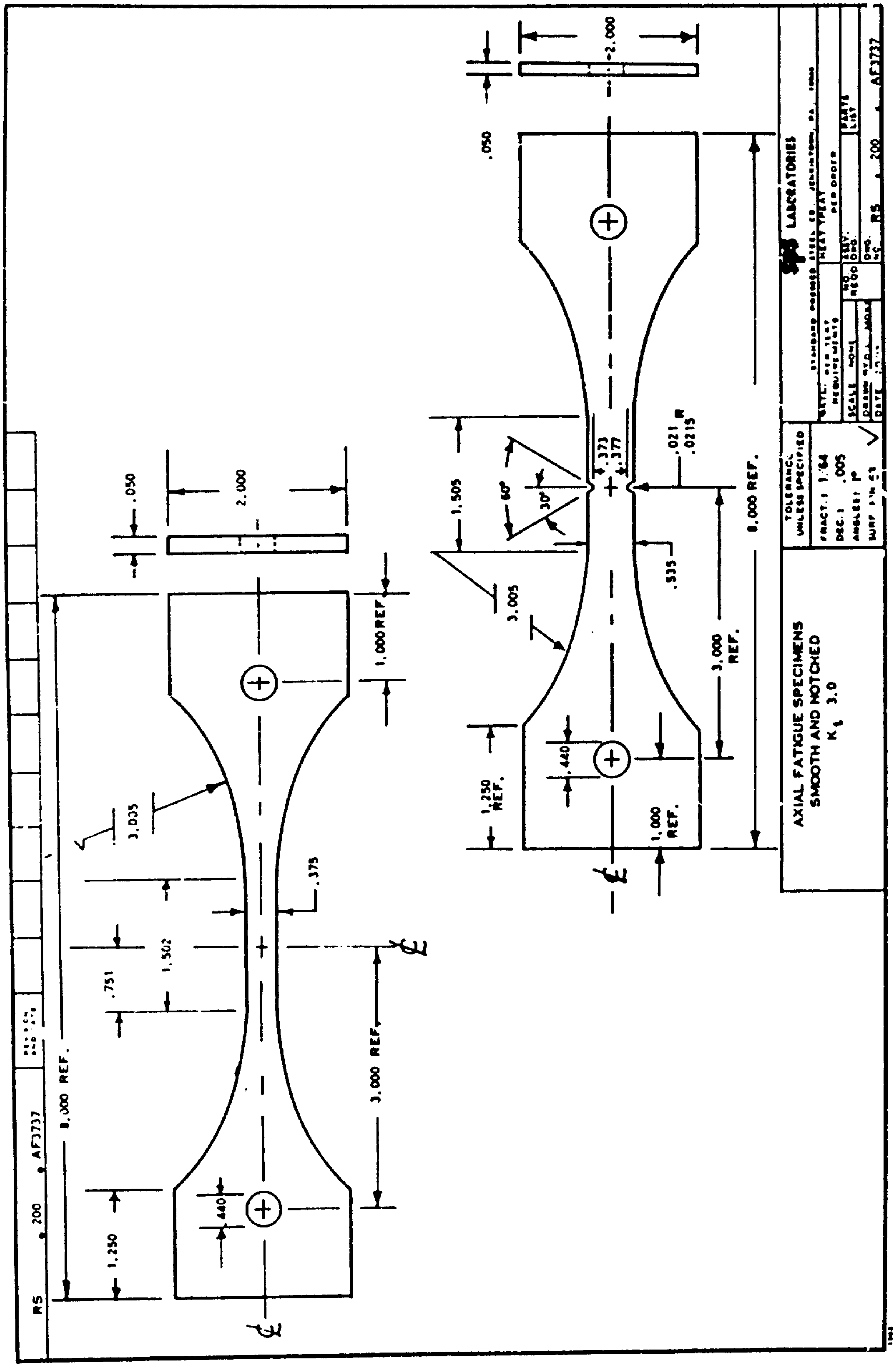

AXIAL FATIGUE SPECIMENS
SMOOTH AND NOTCHED
Kt 3.0
LABORATORIES
TOLERANCE UNLESS SPECIFIED
FRACT.: 1/64
DEC.: .005
ANGLES: 1°
AF3737
8.000 REF.
3.000 REF.
1.000 REF.
1.250 REF.
2.000
.050
.440
.375
1.502
.751
3.005
1.505
.535
60°
30°
.373
.377
.021 R
.0215

Figure 1

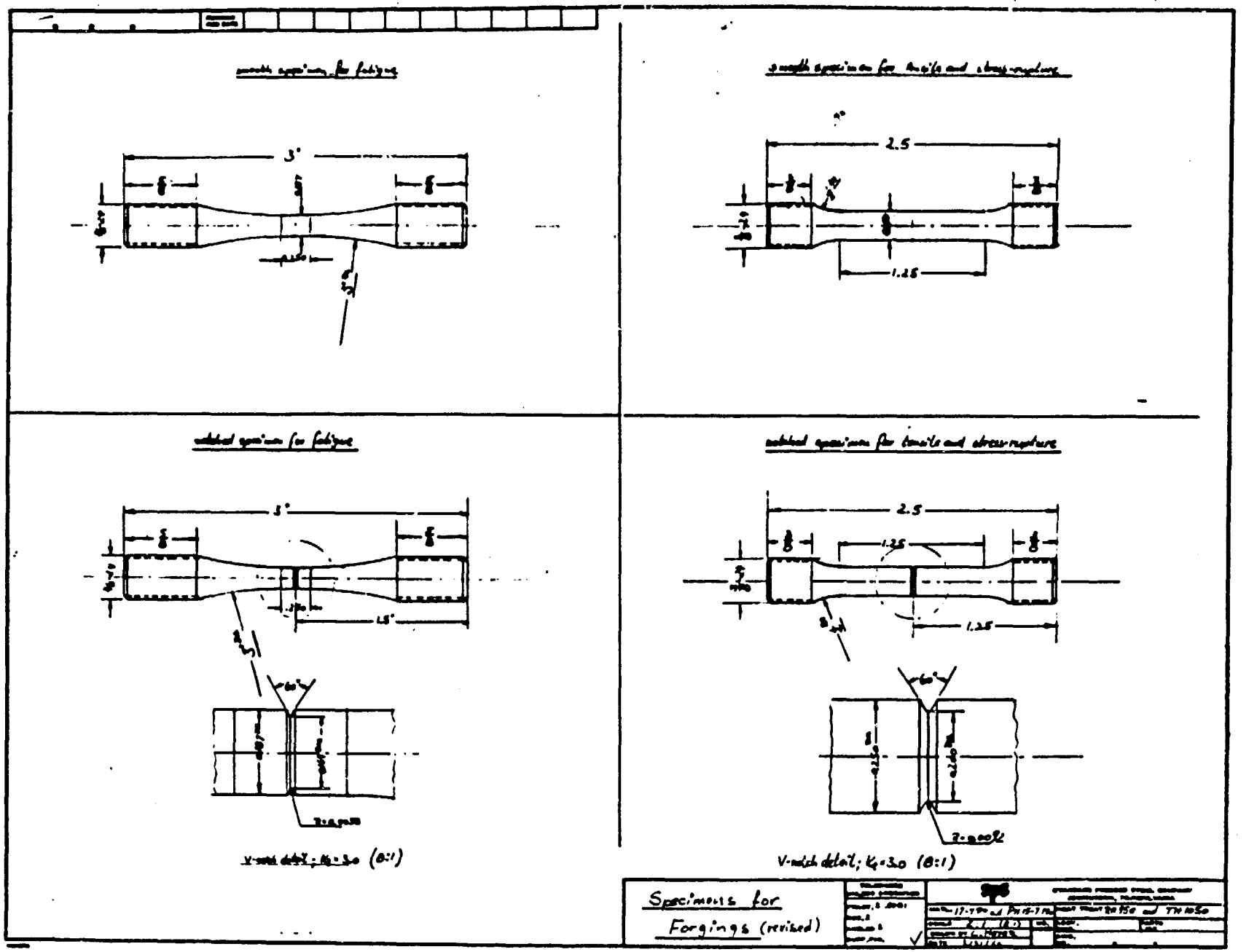

3"
2.5
1.25
1.5"
V-notch detail; K_t=3.0 (8:1)
V-notch detail; K_t=3.0 (8:1)
Specimens for Forgings (revised)

Figure 2

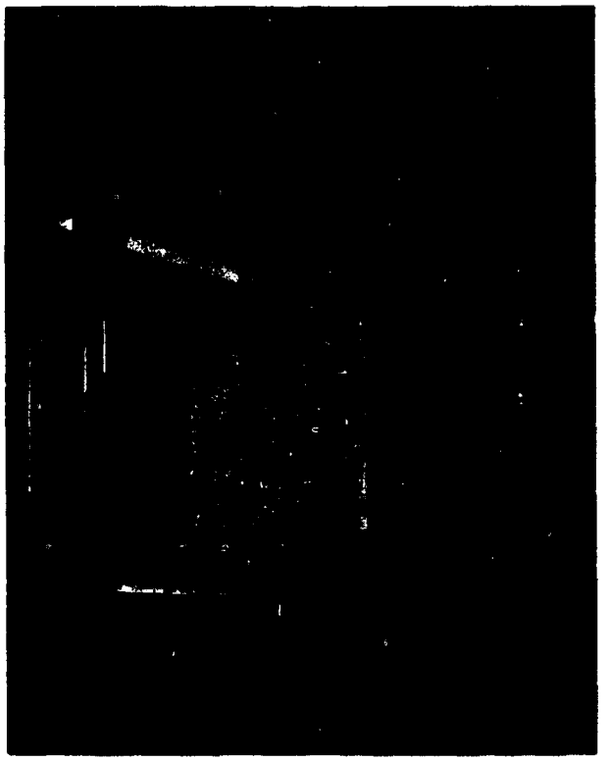


Figure 3. Elevated temperature fatigue test on sheet specimen in Amsler Vibraphore.

Figure 4. Elevated temperature fatigue test on sheet specimens in Sonntag Machine.

SECTION III

METALLOGRAPHY

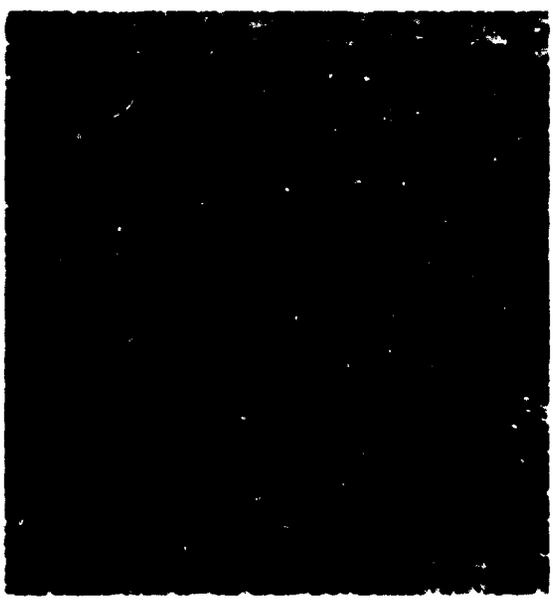
Specimens of all materials were mounted and examined metallographically. Transverse and longitudinal photomicrographs of all materials are shown in Figures 5 through 30.

Transverse

Figure 5. AM 350 sheet, as-received

Longitudinal

Figure 6. AM 350 sheet, as-received.



Transverse

Figure 7. AM 350 SCT sheet

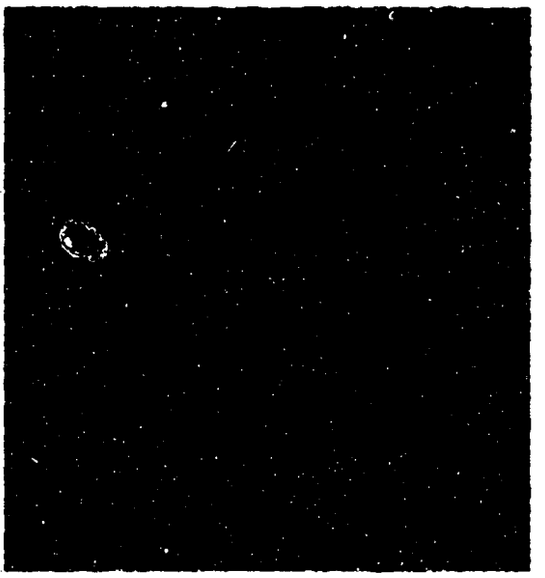
Longitudinal

Figure 8. AM 350 SCT sheet

Magnification: X500
Etchant: Mixture of picric, nitric, and hydrochloric acids

Transverse

Figure 9. 17-7 PH sheet, as-received.

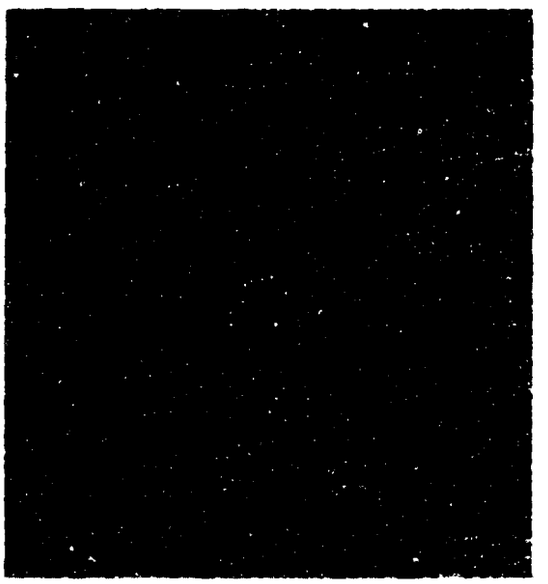


Longitudinal

Figure 10. 17-7 PH sheet, as-received.

Transverse

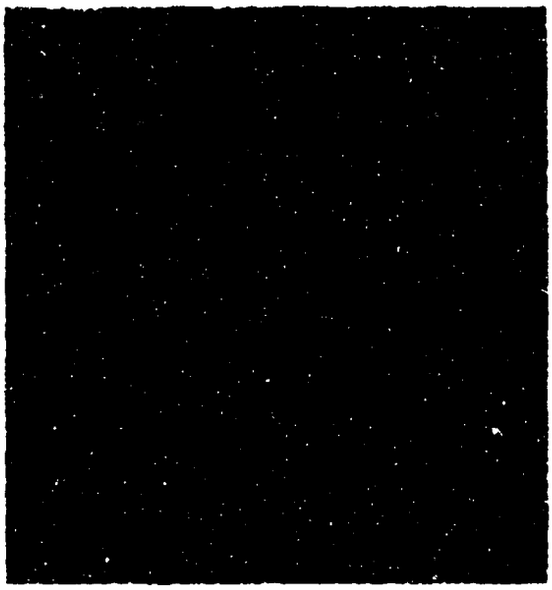
Figure 11. 17-7 PH RH 950 sheet.



Longitudinal

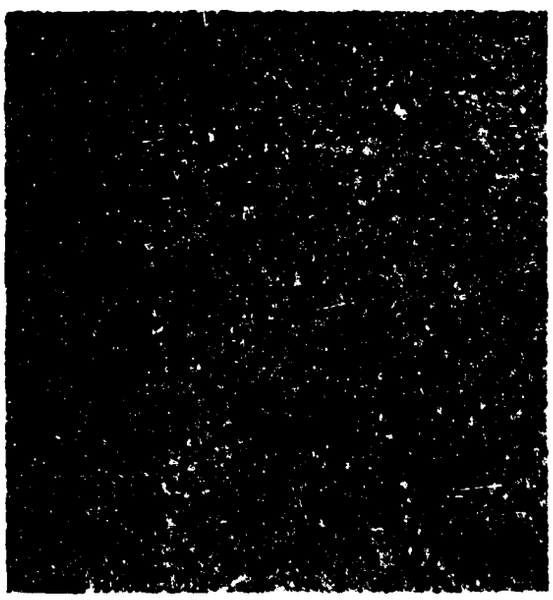
Figure 12. 17-7 PH RH 950 sheet.

Magnification: X500
Etchant: Mixture of picric, nitric, and hydrochloric acids

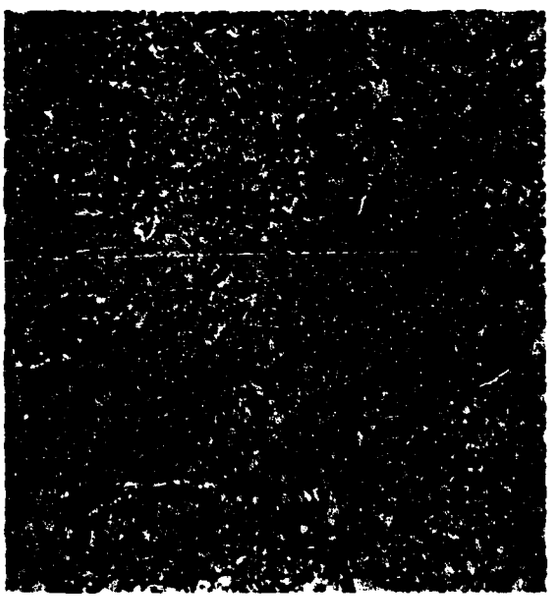


Transverse
Figure 13. PH 15-7 Mo sheet as-received.

Longitudinal
Figure 14. PH 15-7 Mo sheet as-received.

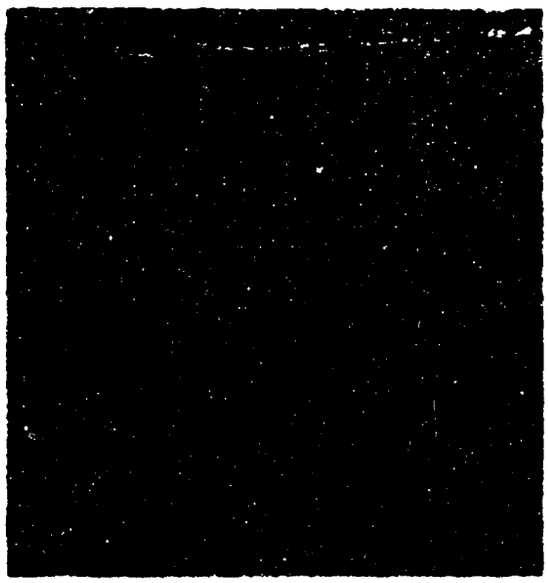


Transverse
Figure 15. PH 15-7 Mo RH 950 Sheet



Longitudinal
Figure 16. PH 15-7 Mo RH 950 Sheet

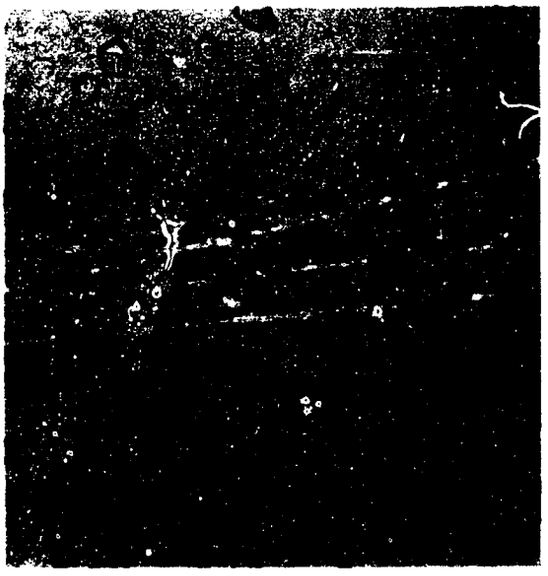
Magnification: X500
Etchant: Mixture of picric, nitric, and hydrochloric acids



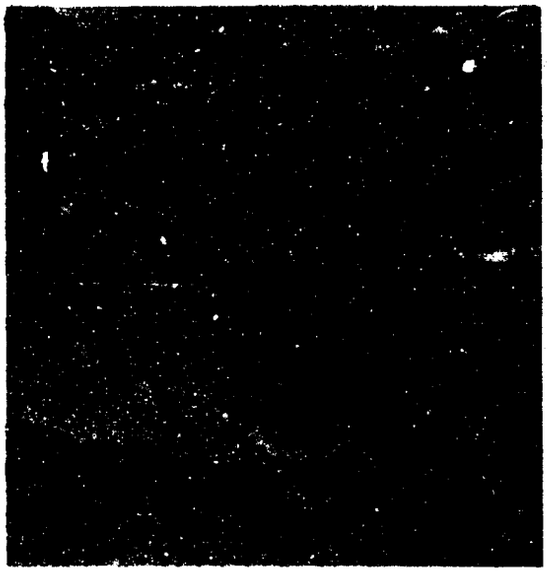
Transverse
Figure 17. PH 15-7 Mo TH 1050 Sheet

Longitudinal
Figure 18. PH 15-7 Mo TH 1050 Sheet

Magnification: X500
Etchant: Mixture of picric, nitric and hydrochloric acids.

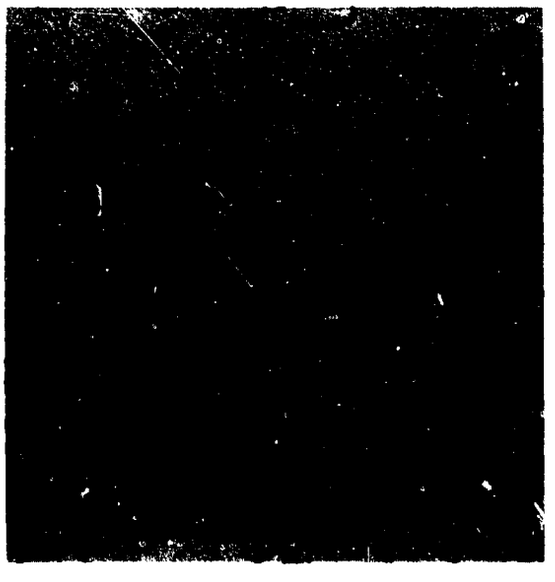


Transverse
Figure 19. 17-7 PH Forging, as-received.



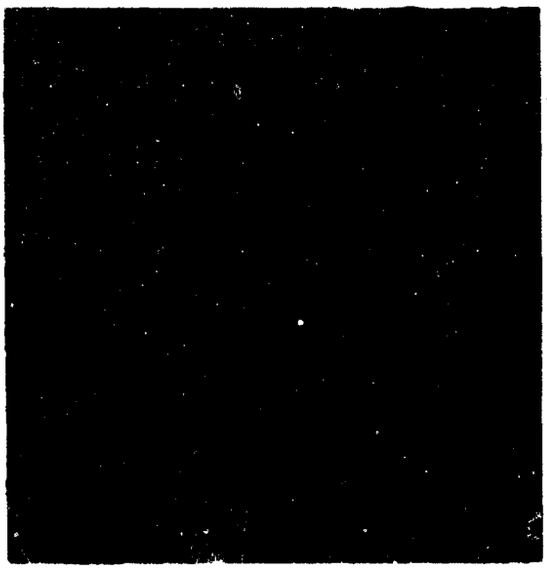
Longitudinal
Figure 20. 17-7 PH Forging, as-received.

Transverse
Figure 21. 17-7 PH RH 950 forging



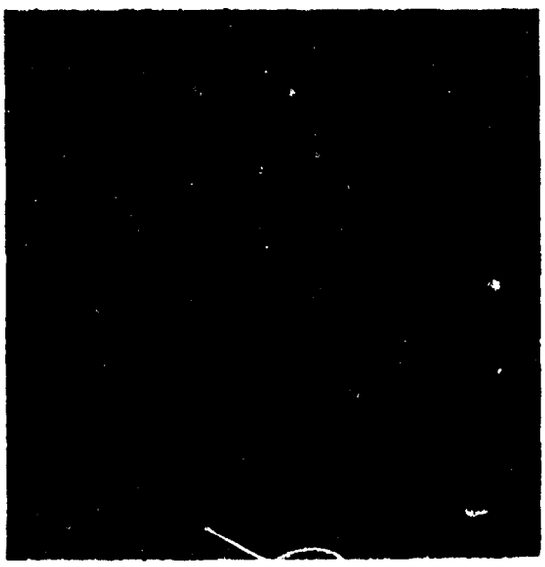
Longitudinal
Figure 22. 17-7 PH RH 950 forging

Magnification: X500
Etchant: Mixture of picric, nitric, and hydrochloric acids.

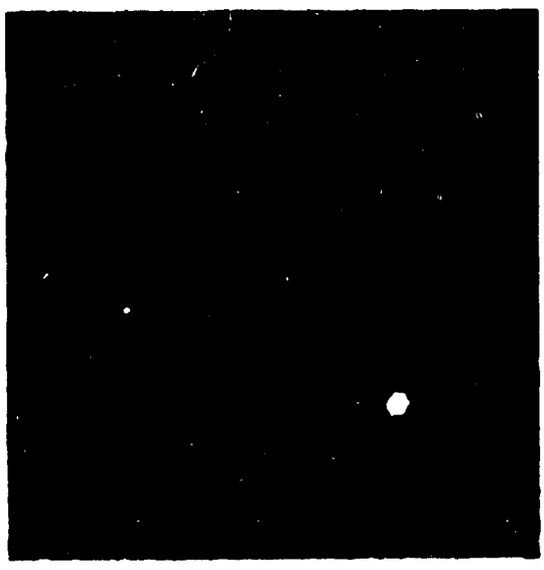


Transverse
Figure 23. 17-7 PH TH 1050 forging

Longitudinal
Figure 24. 17-7 PH TH 1050 forging

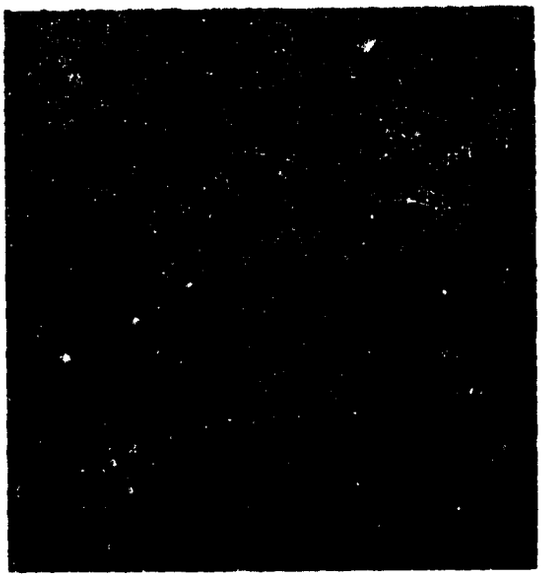


Transverse
Figure 25. PH 15-7 Mo forging as-received.

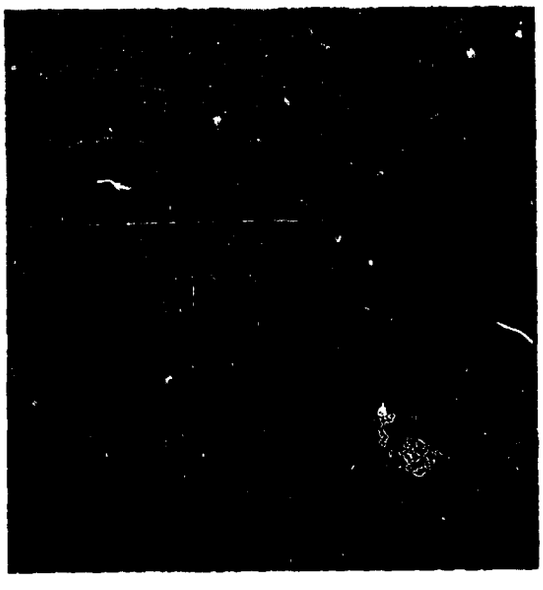


Longitudinal
Figure 26. PH 1507 Mo forging as-received.

Magnification: X500
Etchant: Mixture of picric, nitric, and hydrochloric acids.



Transverse
Figure 27. PH 15-7 Mo RH 950 forging.



Longitudinal
Figure 28. PH 15-7 Mo RH 950 forging.

Transverse
Figure 29. PH 15-7 Mo TH 1050 forging.

Longitudinal
Figure 30. PH 15-7 Mo TH 1050 forging.

Magnification: X500
Etchant: Mixture of picric, nitric, and hydrochloric acids.

SECTION IV

DISCUSSION

A. Variation of Fatigue Life with Test Frequency

It has been mentioned in Section IID that a few elevated temperature S-N curves were inadvertently run at 4300 cycles per minute at ratios of .5 and .98. This frequency being above the 3600 cycles per minute maximum stipulated by the contract, it was decided that we would partially rerun two of these curves to determine if the 4300 cycles per minute data is valid. The curves thus checked are the .5 A ratio curves in Figures C7 and C8 and the rerun points are indicated as having been run at 1800 cycles per minute. It is obvious from these curves that the effect of a frequency change from 4300 to 1800 cycles per minute does not significantly alter the shape of the S-N curve under the above conditions.

B. Effect of Temperature on Fatigue Life

The change in shape and position of the S-N curves between room temperature and an intermediate temperature (such as in this case 600°F) has been discussed at great length in previous Mil Handbook 5 data generation reports such as AFML-TR-69-12, Fatigue, Creep, and Stress-Rupture Properties of Several Super Alloys by Blatherwick and Cers of the University of Wisconsin. This characteristic behavior is again in evidence in the results of this program. The effect is one of producing a 10^7 stress level at 600°F which is higher than the 10^7 stress level at room temperature. Generally the 10^5 stress level at 600°F is lower than the room temperature 10^5 stress level. Examination of the data in all places where a room temperature vs 600°F comparison is possible reveals that in 14 of 21 cases the 600°F -10^7 stress level is higher than the room temperature -10^7 stress level. Of the other 7, three are equal and four decrease a maximum of 5 KSI from room temperature to 600°F.

Of the fourteen cases where an increase occurs, one is worthy of further note. This is the 17-7 PH RH 950 forging, notched, .5 A ratio. The 10^7 stress level increases from 45 KSI to 90 KSI with the temperature change from room to 600°F. This behavior is readily explained by reference to Table BI where it can be seen that the notched/smooth tensile ratio goes from 0.78 (166/213) at room temperature to 1.25 (227/181) at 600°F.

SECTION V

RESULTS

This section contains the results of all tests performed under this contract.

The results are collected in sections according to material-form-heat treat combinations involved.

The sections are identified as follows:

The tables and figures are listed on the first page of each section.

SECTION VA

17-7 PH RH 950 SHEET

TABLE AI

TENSILE TEST DATA FOR 17-7 PH, RH950 SHEET MATERIAL . 050 THICK

			SMOOTH				NOTCHED - 3.0 K_t	
Test Temp.	Specimen Orientation	Spec. No.	Ult. Tensile Strength, Ksi	0.2% Offset Yield Str. Ksi	Elongation in 2", %	Tensile Modulus (E) 10^6 psi	Spec. No.	Ultimate Tensile Strength, Ksi
Room	L	PB-1	213.5	189.2	11.5	30.4	QC1	241.2
		PB-11	212.3	186.8	12.5	30.4	QC2	237.3
		PB-12	218.3	199.6	10.5	30.0	QC3	248.4
			214.7	191.5	11.5	30.3		242.3
	T	SC-43	218.6	201.3	8.0	31.9	UC-10	245.0
		SC-44	217.1	199.4	7.0	31.8	UC-11	242.5
		TB-28	219.8	201.6	6.5	31.3	UC-12	245.0
			218.5	204.1	7.2	31.7		244.2
600°F	L	PB-2	186.1	136.4	7.0		QC-4	202.6
		PB-3	186.3	144.2	6.5	—	QC-5	204.0
		PB-4	180.3	133.3	9.0		QC-6	200.8
			184.2	137.9	7.5			202.5
	T	UC-8	188.1	132.7	7.0		TB-12	210.2
		UC-9	179.7	134.5	5.5	—	TB-13	210.5
		UC-20	180.8	135.7	6.0		TB-23	205.6
			182.9	134.3	6.2			208.8
800°F	L	PB-5	158.9	119.7	10.5		QC-7	181.4
		PB-6	158.7	119.1	13.0	—	QC-8	183.6
		PB-7	156.4	120.5	8.0		QC-9	176.0
			158.2	119.8	10.5			180.3
	T	TB-25	162.7	127.0	9.5		TB-24	189.2
		TB-26	163.7	128.5	11.5	—	TB-16	183.8
		TB-27	162.1	129.4	8.0		TB-33	178.7
			162.8	128.3	9.7			183.9

TABLE AII

STRESS RUPTURE TEST DATA FOR
17-7 PH, RH 950 SHEET MATERIAL
.050 INCHES THICK - TRANSVERSE

Spec. No.	K_t	Test Temp.	Stress ksi	Life Hrs.
SC-33	1.0	600°F	185	<0.05
SC-37			180	19.1
SC-36			175	152.1
SC-35			160	200.0+
SC-34			130	190.3+
SC-41	1.0	800°F	110	5.5
SC-42			106	136.6
SC-40			100	191.7
SC-39			80	207.4+
SC-38			60	187.0+
TB-42	3.0	600°F	200	<0.05
TB-40			196.0	51.9
UC-31			194.0	72.1
UC-32			192.0	37.2
TB-20			190.0	211.1+
TB-46	3.0	800°F	140.0	15.8
TB-47			130.0	92.3
TB-49			127.0	169.6
TB-48			120.0	266.8+
TB-45			110.0	189.3+

17-7 PH RH 950 SHEET
STRESS VS. TIME TO RUPTURE

Notched ---o---
Smooth ——△——

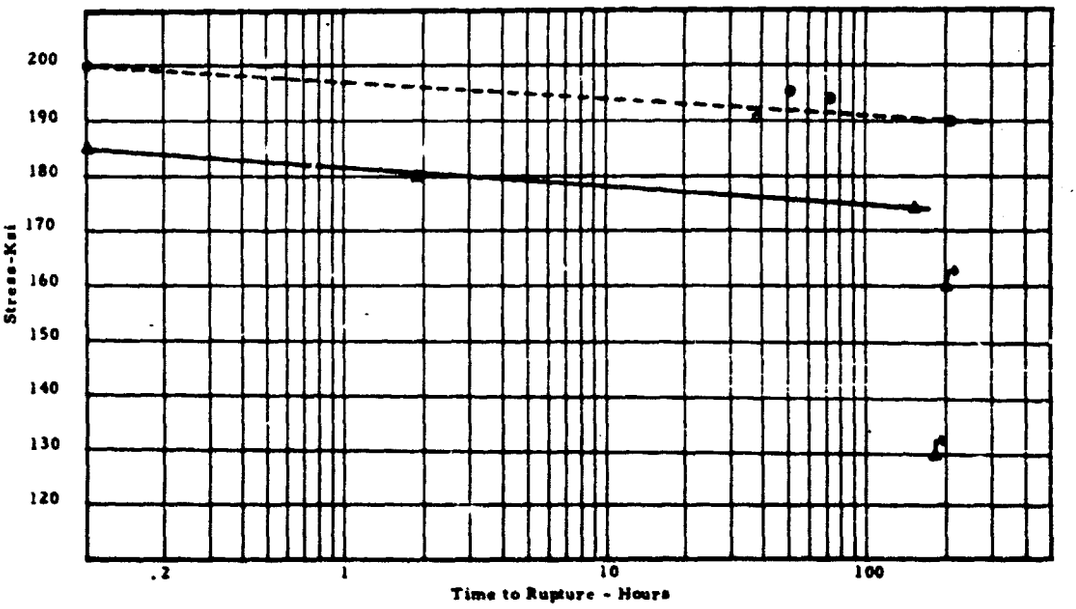


Figure A1-600°F

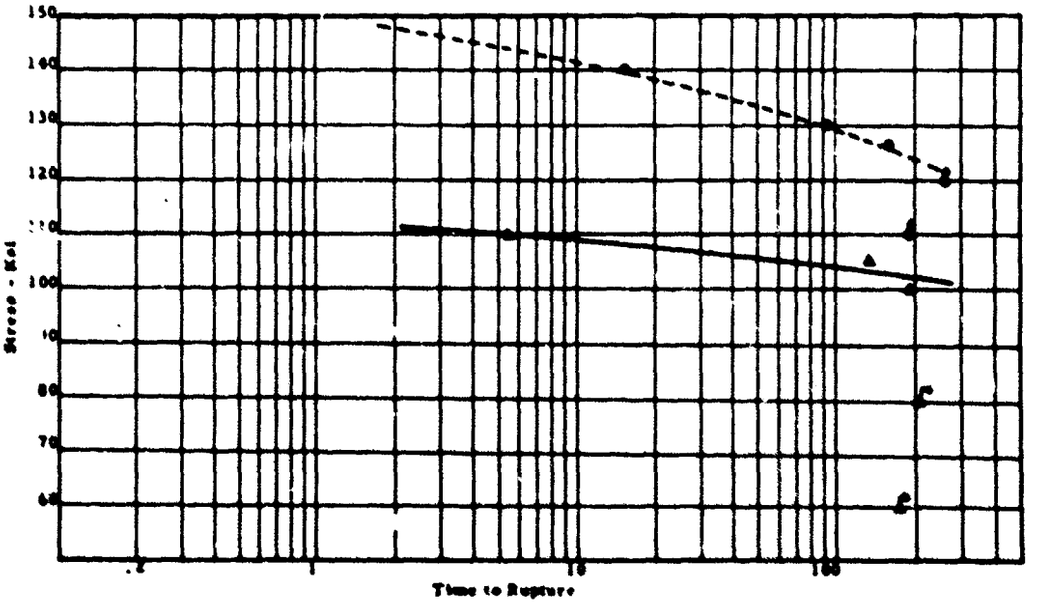


Figure A2-800°F

TABLE AIII

FATIGUE TEST DATA

Material- 17-7 PH RH 950 Sheet
Type of Specimen- Transverse Smooth
Test Temperature- Room

Test Frequency-Cycles/minute
A=. 98-1050
A=. 50-1050

Specimen No.	"A" Ratio	Applied Stress, ksi			Life, Kilocycles
		Srn	Sa	Sc	
C-20-II	.98	54.6	53.5	108.1	10,537.0+
C-21		58.6	57.5	116.1	8,371.0
C-22		59.8	58.6	118.3	8,212.0
C-19		62.2	60.9	123.1	382.0
C-23		62.4	61.1	123.5	2,524.0
C-27		65.1	63.8	128.9	463.0
C-18		69.0	67.6	136.5	151.0
C-24		73.6	72.1	145.7	233.0
C-25		77.1	75.6	152.7	41.0
C-26		84.3	82.6	166.9	28.0
RB42	.50	59.5	29.7	89.3	10,241.0+
RB41		79.3	39.6	119.0	10,134.0+
SC-8		87.4	43.6	131.0	16,000.0+
SC-5		87.4	43.6	131.0	10,030.0+
SC-9		87.4	43.6	131.0	147.0
SC-1		91.2	45.7	136.9	257.0
SC-3		95.3	47.6	142.9	254.0
SC-4		99.2	49.6	148.8	174.0
SC-6		107.1	53.6	160.7	61.0

TABLE AIV

FATIGUE TEST DATA

Material- 17-7 PH RH 950 Sheet
Type of Specimen- Transverse Smooth
Test Temperature-600°F

Test Frequency- Cycles/minute
A= .98-3600
A= .5 - 3600

Specimen No.	"A" Ratio	Applied Stress, ksi			Life, Kilocycles
		Sm	Sa	Sc	
RB-32	.98	58.1	56.9	115.0	10,000.0+
RB-31		60.6	59.4	120.0	6,296.0
RB-30		63.1	61.9	125.0	4,268.0
RB-29		65.7	64.4	130.0	115.0
RB-28		68.2	66.8	135.0	33.0
RB-26		70.7	69.3	140.0	34.0
RB-23		70.7	69.3	140.0	27.0
RB-6		73.2	71.8	145.0	68.0
RB-4		75.8	74.3	150.0	25.0
RB-3	.5	100.0	50.0	150.0	10,090.0+
RB-7		103.4	51.6	155.0	68.0
RB-2		103.4	51.6	155.0	35.0
RB-9		106.7	53.3	160.0	105.0
RB-5		106.7	53.3	160.0	64.0
SC-32		106.7	53.3	160.0	15.0
RB-8		110.1	55.0	165.0	152.0
RB-10		110.1	55.0	165.0	36.0
RB-11		113.4	56.6	170.0	36.0

TABLE AV

FATIGUE TEST DATA

Material- 17-7 PH RH 950 Sheet
Type of Specimen- Transverse Smooth
Test Temperature- 800°F

Test Frequency- Cycles/minute
A= .98-3600
A= .5 - 3600

Specimen No.	"A" Ratio	Applied Stress, ksi			Life, Kilocycles
		Sm	Sa	Sc	
SC-29	.98	55.6	54.5	110.0	14,380.0+
SC-29		58.1	56.9	115.0	5,330.0
SC-27		60.3	58.2	117.5	48.0
SC-26		60.6	59.4	120.0	3,472.0
SC-25		63.7	62.5	122.5	2,731.0
SC-20		63.1	61.9	125.0	2,567.0
SC-30		65.7	64.4	130.0	63.0
RB-46		65.7	64.4	130.0	53.0
SC-31		68.2	66.8	135.0	14.0
SC-11	.5	83.4	41.6	125.0	10,133.0+
SC-16		86.7	43.3	130.0	10,982.0+
SC-12		90.1	45.0	135.0	3,477.0
SC-13		90.1	45.0	135.0	214.5
SC-14		93.3	46.6	140.0	186.0
SC-15		96.7	48.3	145.0	332.0
SC-17		100.0	50.0	150.0	2,188.0
SC-19		100.0	50.0	150.0	1,701.0
SC-18		103.3	51.6	155.0	15.0

TABLE AVI

FATIGUE TEST DATA

Material- 17-7 PH RH 950 Sheet
Type of Specimen- Transverse Notched
Test Temperature- Room

Test Frequency-Cycles/minute
A = .98-1050
A = .50-1050

Specimen No.	"A" Ratio	Applied Stress, ksi			Life, Kilocycles
		Sm	Sa	Sc	
TB-37	.98	23.9	23.5	47.4	14,209.0+
TB-36		26.0	25.4	51.4	10,315.0+
TB-3		27.2	26.7	53.9	794.0
TB-17		28.0	27.4	55.4	4,838.0
TB-35		28.0	27.4	55.4	591.0
TB-II		28.8	28.4	57.2	132.0
UC-4		31.7	31.0	62.7	426.0
UC-3		36.0	35.2	71.2	106.0
UC-7		39.8	39.0	78.8	32.0
UC-21		39.8	39.0	78.8	6.0
TB-I		43.7	42.7	86.4	3.0
UC-28	.50	31.8	15.9	47.7	10,860.0+
UC-30		40.2	20.1	60.3	11,249.0+
UC-23		40.2	20.1	60.3	1,063.0
TB-1		41.7	20.9	62.6	1,200.0
UC-1		43.6	21.8	65.4	117.0
TB-32		48.0	24.0	72.0	194.0
UC-2		48.0	24.0	72.0	98.0
TB-31		52.0	26.0	78.0	170.0
TB-15		52.3	26.2	78.5	142.0
UC-25		59.5	29.8	89.3	8.0

TABLE AVII

FATIGUE TEST DATA

Material- 17-7 PH RH 950 Sheet
Type of Specimen- Transverse Notched
Test Temperature- 600°F

Test Frequency-Cycles/minute
A=. 98-3600
A=. 5 - 3600

Specimen No.	"A" Ratio	Applied Stress, ksi			Life, Kilocycles
		Sm	Sa	Sc	
UC-39	. 98	25. 3	24. 8	50. 0	10, 000. 0+
UC-38		25. 3	24. 8	50. 0	127. 0
UC-37		25. 3	24. 8	50. 0	44. 0
UC-36		27. 8	27. 2	55. 0	5, 350. 0
UC-40		27. 8	27. 2	55. 0	40. 0
UC-42		27. 8	27. 2	55. 0	33. 0
UC-33		30. 3	29. 7	60. 0	459. 0
UC-41		30. 3	29. 7	60. 0	17. 0
UC-35		31. 3	30. 9	62. 5	17. 0
UC-34		32. 8	32. 2	65. 0	16. 0
UC-44		32. 8	32. 2	65. 0	18. 0
UC-43		35. 4	35. 4	70. 0	11. 0
UC-48	. 5	36. 7	18. 3	55. 0	18, 696. 0+
SC-47		40. 0	20. 0	60. 0	490. 0
UC-47		40. 0	20. 0	60. 0	470. 0
SC-46		40. 0	20. 0	60. 0	47. 0
UC-46		43. 4	21. 7	65. 0	62. 0
SC-45		43. 4	21. 7	65. 0	56. 0
UC-49		46. 7	23. 3	70. 0	20. 0
UC-45		46. 7	23. 3	70. 0	7. 0

TABLE AVIII

FATIGUE TEST DATA

Material- 17-7 PH RH 950 Sheet
Type of Specimen- Transverse Notched
Test Temperature- 800°F

Test Frequency- Cycles/minute
A= .98-3600
A= .5 - 3600

Specimen No.	"A" Ratio	Applied Stress, ksi			Life, Kilocycles
		Sm	Sa	Sc	
UC-39	.98	22.7	22.3	45.0	10,000.0+
UC-48		22.7	22.3	45.0	2,801.0
TB-44		25.3	24.8	50.0	1,969.0
TB-8		27.8	27.2	55.0	7,203.0
TB-7		27.8	27.2	55.0	121.0
TB-6		30.3	29.7	60.0	312.0
TB-5		32.8	32.2	65.0	27.0
TB-4		35.4	34.7	70.0	11.0
SC-49		37.9	37.1	75.0	7.0
SC-48		40.4	39.6	80.0	4.0
TB-34	.5	40.0	20.0	60.0	27,324.0+
TB-41		43.4	21.7	65.0	1,002.0
TB-29		43.4	21.7	65.0	73.0
TB-18		46.7	23.3	70.0	89.0
TB-10		50.0	25.0	75.0	35.0
TB-9		53.4	26.6	80.0	20.0
TB-43		56.7	28.3	85.0	12.0

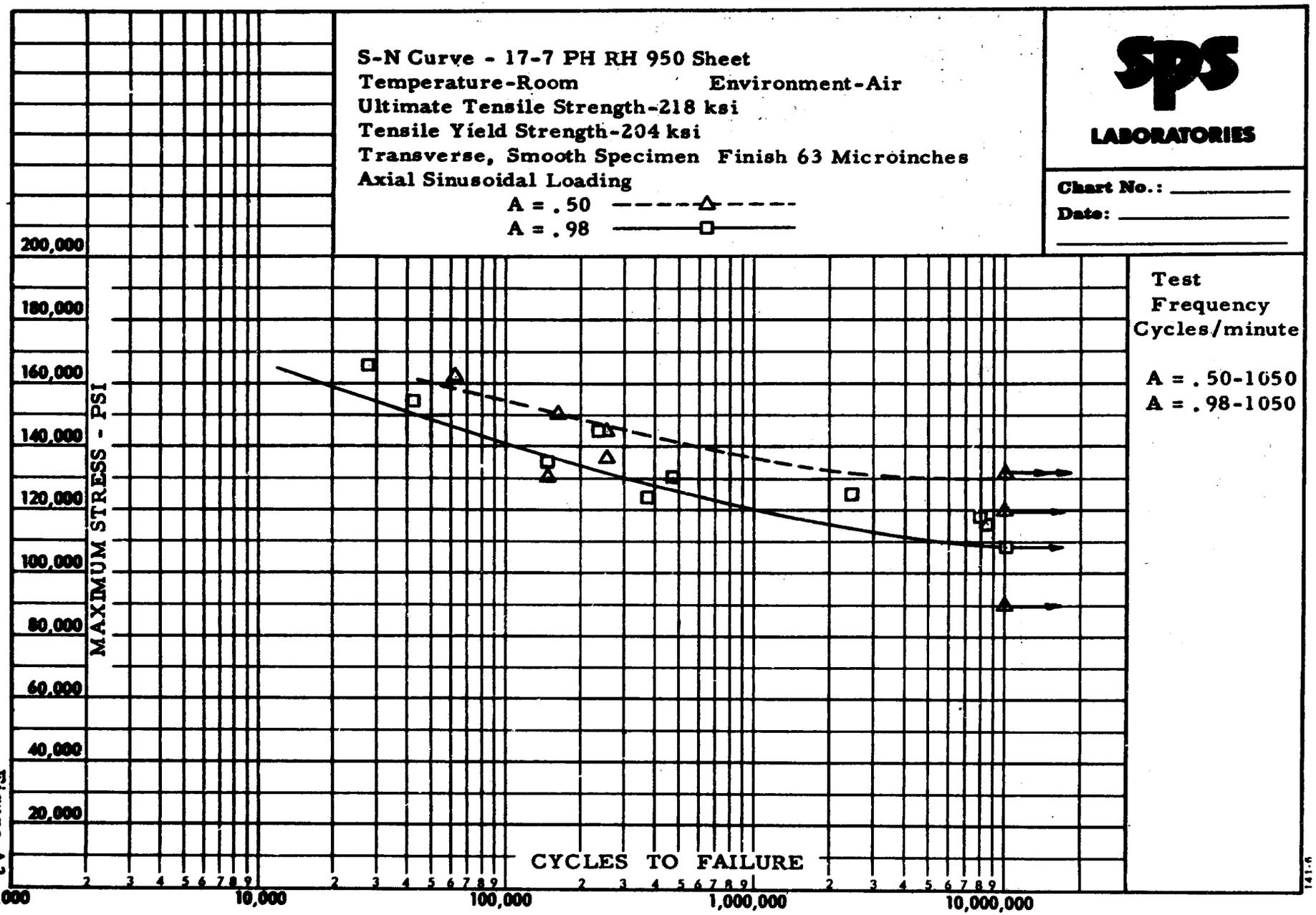

S-N Curve - 17-7 PH RH 950 Sheet
Temperature-Room Environment-Air
Ultimate Tensile Strength-218 ksi
Tensile Yield Strength-204 ksi
Transverse, Smooth Specimen Finish 63 Microinches
Axial Sinusoidal Loading
A = .50
A = .98
SPS
LABORATORIES
Chart No.:
Date:
Test
Frequency
Cycles/minute
A = .50-1050
A = .98-1050
MAXIMUM STRESS - PSI
200,000
180,000
160,000
140,000
120,000
100,000
80,000
60,000
40,000
20,000
CYCLES TO FAILURE
1,000
10,000
100,000
1,000,000
10,000,000
141-6

Figure A3

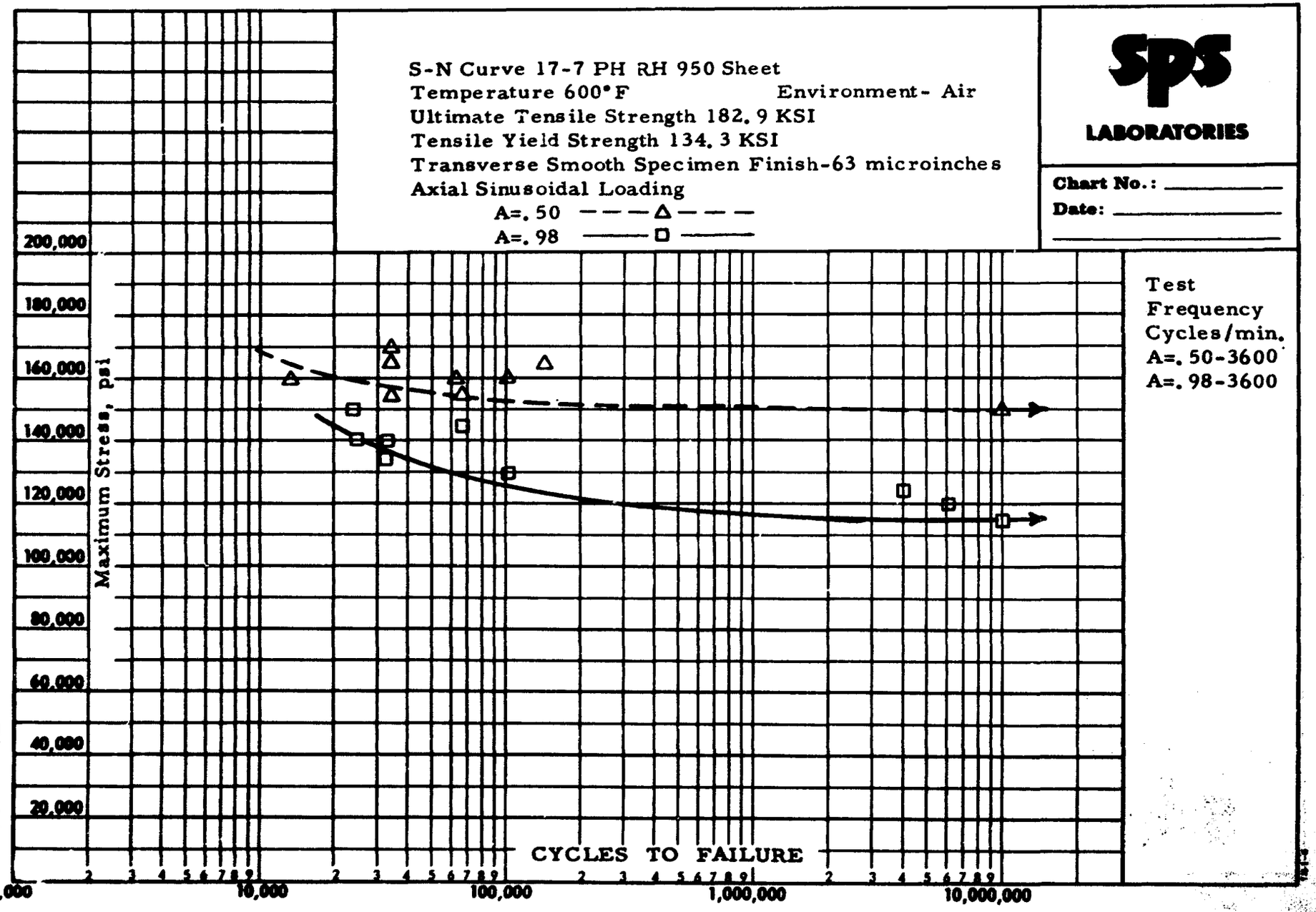

S-N Curve 17-7 PH RH 950 Sheet
Temperature 600°F Environment- Air
Ultimate Tensile Strength 182.9 KSI
Tensile Yield Strength 134.3 KSI
Transverse Smooth Specimen Finish-63 microinches
Axial Sinusoidal Loading
A=.50
A=.98
SPS
LABORATORIES
Chart No.:
Date:
Test
Frequency
Cycles/min.
A=.50-3600
A=.98-3600
Maximum Stress, psi
200,000
180,000
160,000
140,000
120,000
100,000
80,000
60,000
40,000
20,000
CYCLES TO FAILURE
1,000
10,000
100,000
1,000,000
10,000,000

Figure A4

S-N Curve- 17-7 PH RH 950 Sheet
Temperature- 800°F Environment-Air
Ultimate Tensile Strength 162.8 KSI
Tensile Yield Strength 128.3 KSI
Transverse Smooth Specimen Finish- 63 microinches
Axial Sinusoidal Loading
A=.50 - - - Δ - - -
A=.98 —— □ ——

SPS LABORATORIES

Chart No.: _____
Date: _____

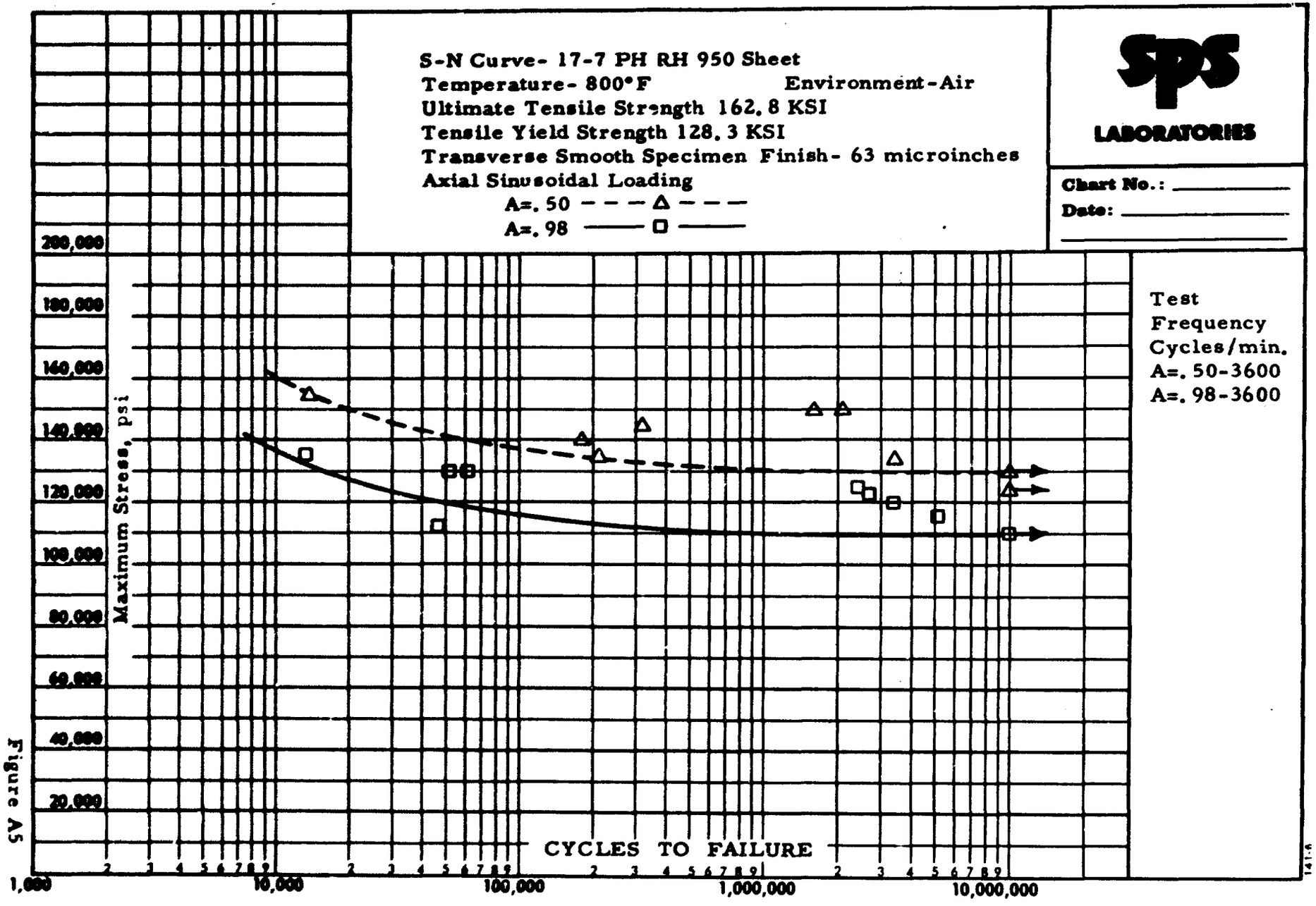


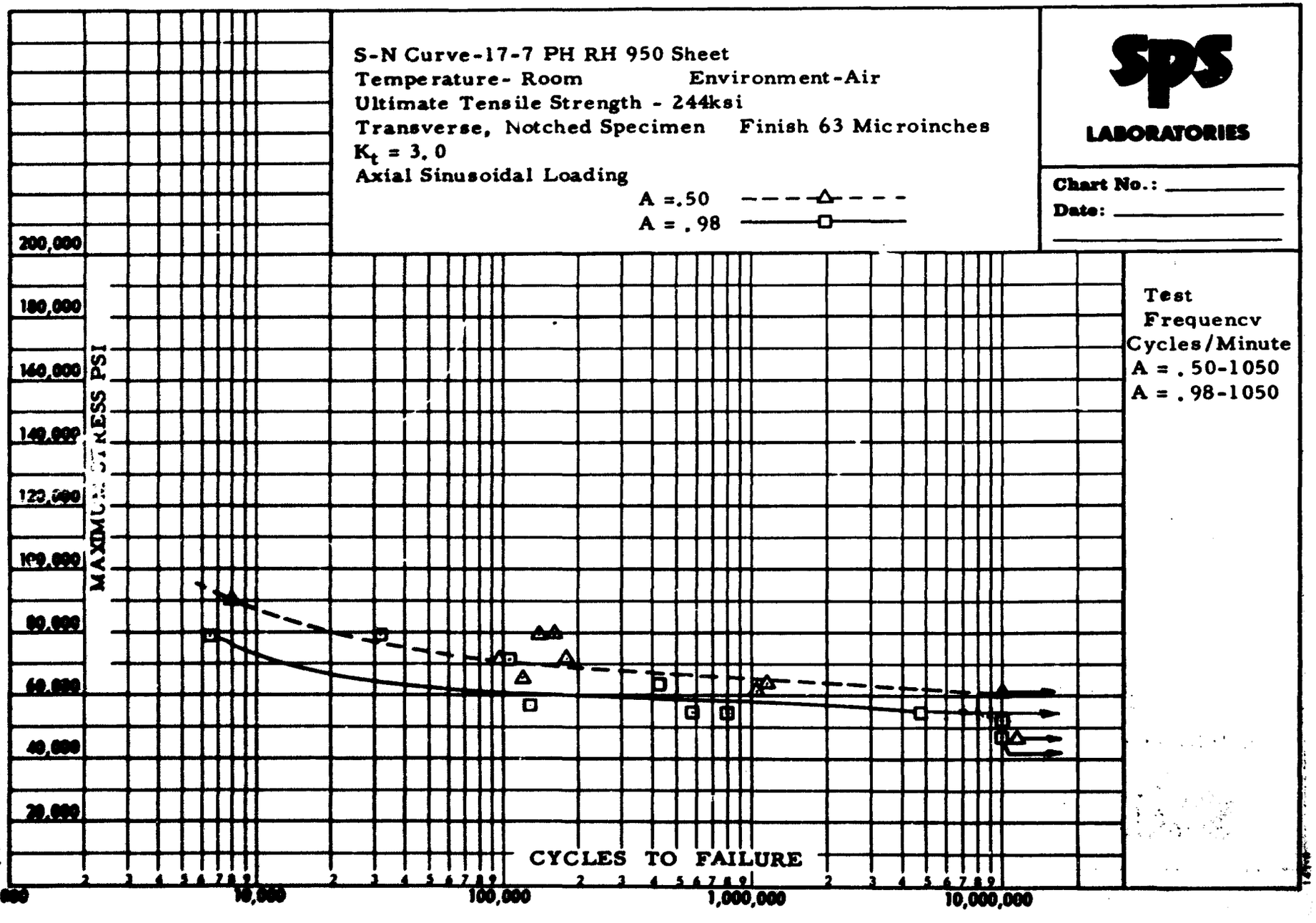
Figure A5

S-N Curve-17-7 PH RH 950 Sheet
Temperature- Room Environment-Air
Ultimate Tensile Strength - 244ksi
Transverse, Notched Specimen Finish 63 Microinches
K_t = 3.0
Axial Sinusoidal Loading

A = .50 ----△----
A = .98 ——□——

SPS LABORATORIES

Chart No.: _____
Date: _____



Test Frequency Cycles/Minute
A = .50-1050
A = .98-1050

Figure A6

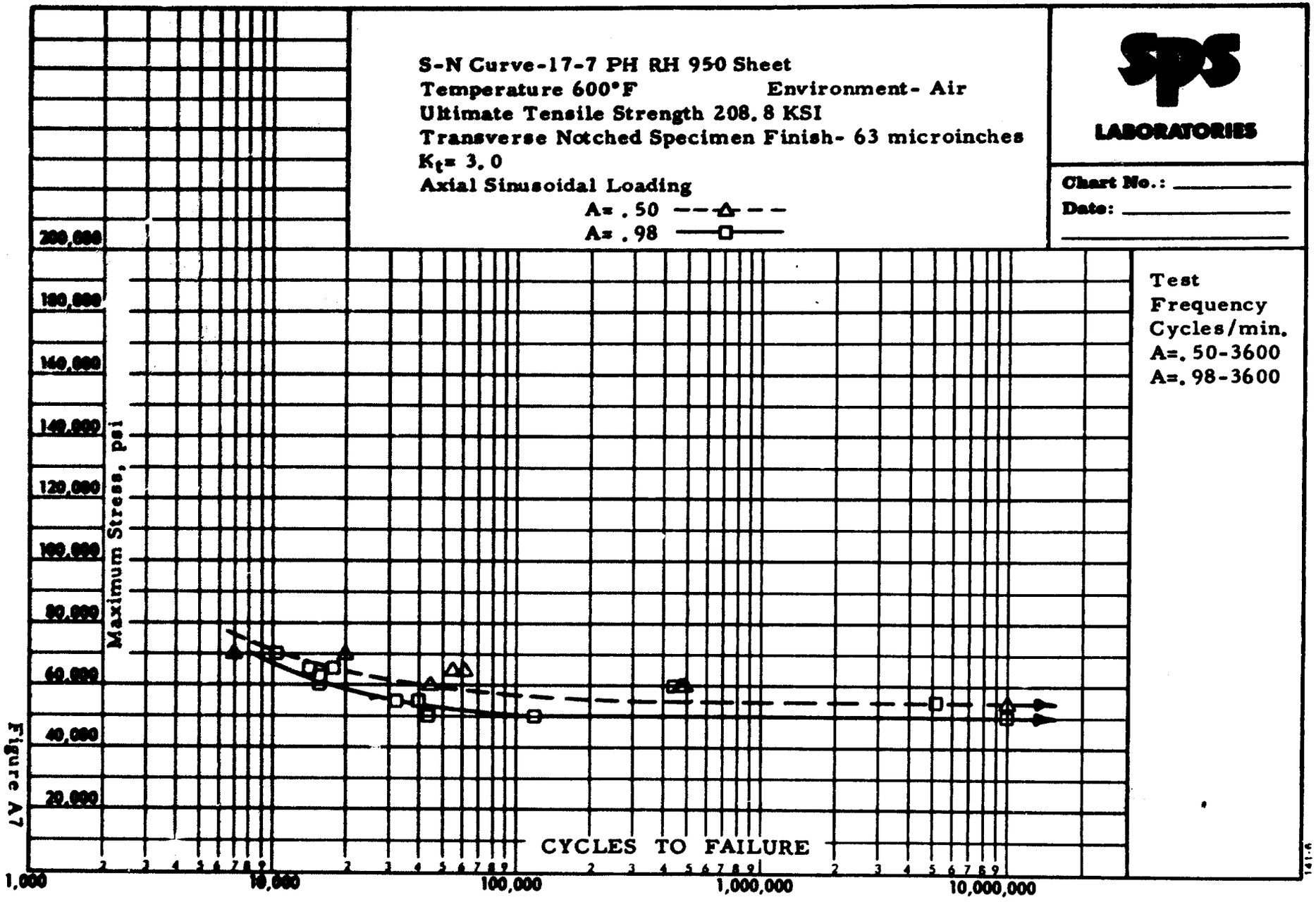

S-N Curve-17-7 PH RH 950 Sheet
Temperature 600°F Environment- Air
Ultimate Tensile Strength 208.8 KSI
Transverse Notched Specimen Finish- 63 microinches
K_t= 3.0
Axial Sinusoidal Loading
A= .50
A= .98
SPS
LABORATORIES
Chart No.:
Date:
Test
Frequency
Cycles/min.
A=.50-3600
A=.98-3600
Maximum Stress, psi
200,000
180,000
160,000
140,000
120,000
100,000
80,000
60,000
40,000
20,000
CYCLES TO FAILURE
1,000
10,000
100,000
1,000,000
10,000,000

Figure A7

S-N Curve 17-7 PH RH 950 Sheet
Temperature 800°F Environment- Air
Ultimate Tensile Strength 183.9 KSI
Transverse, Notched Specimen Finish- 63 microinches
K_t= 3.0
Axial Sinusoidal Loading

A=.50 – – –△– – –
A=.98 ——□——

SPS LABORATORIES

Chart No.: _____
Date: _____

Test Frequency Cycles/min.
A=.50-3600
A=.98-3600

Maximum Stress- psi

200,000
180,000
160,000
140,000
120,000
100,000
80,000
60,000
40,000
20,000

CYCLES TO FAILURE

1,000 2 3 4 5 6 7 8 9 10,000 2 3 4 5 6 7 8 9 100,000 2 3 4 5 6 7 8 9 1,000,000 2 3 4 5 6 7 8 9 10,000,000

Figure A8

CONSTANT LIFE DIAGRAM - 17-7 PH RH 950 Sheet
Temperature - Room
Ultimate Tensile Strength-Smooth 218 ksi, Notched 244 ksi
Tensile Yield Strength - Smooth 204 ksi
Axial Sinusoidal Loading
Environment - Air
Specimen Finish - 63 microinches

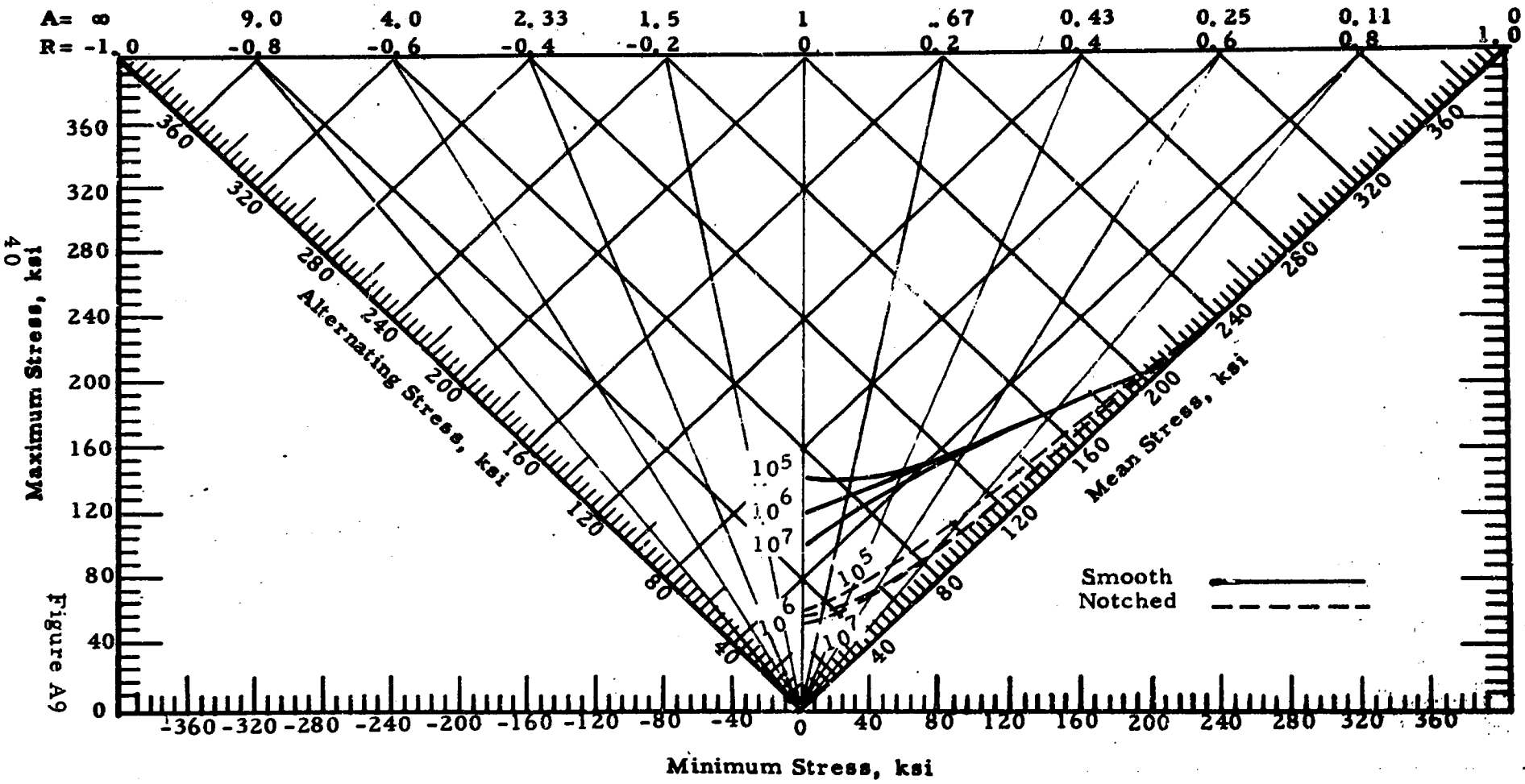
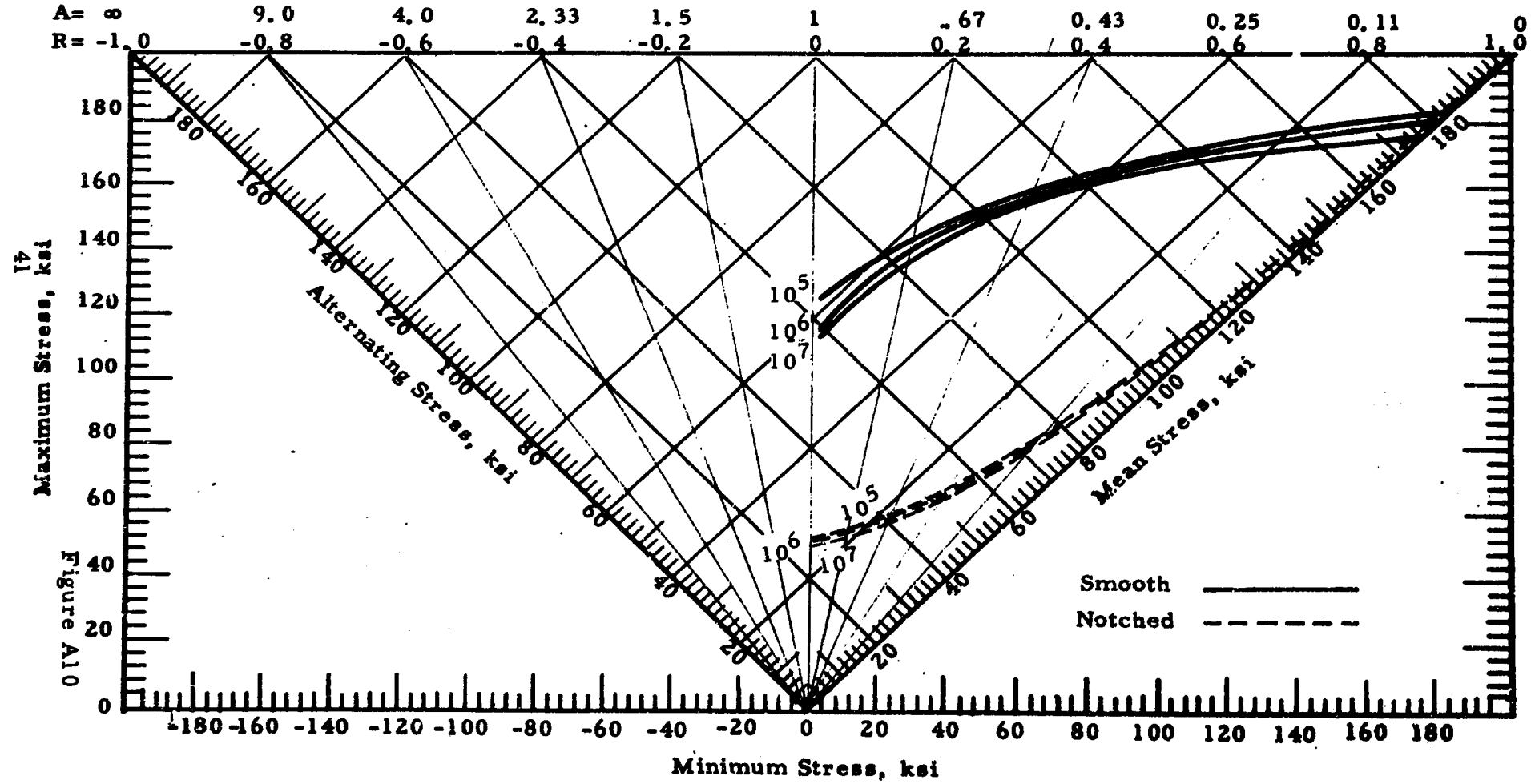


Figure A9

CONSTANT LIFE DIAGRAM- 17-7 PH RH 950 SHEET
Temperature- 600°F
Ultimate Tensile Strength- Smooth 182 KSI, Notched 208 KSI
Tensile Yield Strength- Smooth 134 KSI
Axial Sinusoidal Loading
Environment- Air
Specimen Finish- 63 microinches



CONSTANT LIFE DIAGRAM- 17-7 PH RH 950 SHEET
Temperature- 800°F
Ultimate Tensile Strength- Smooth 162 KSI, Notched 183 KSI
Tensile Yield Strength- Smooth 128 KSI
Axial Sinusoidal Loading
Environment- Air
Specimen Finish- 63 microinches

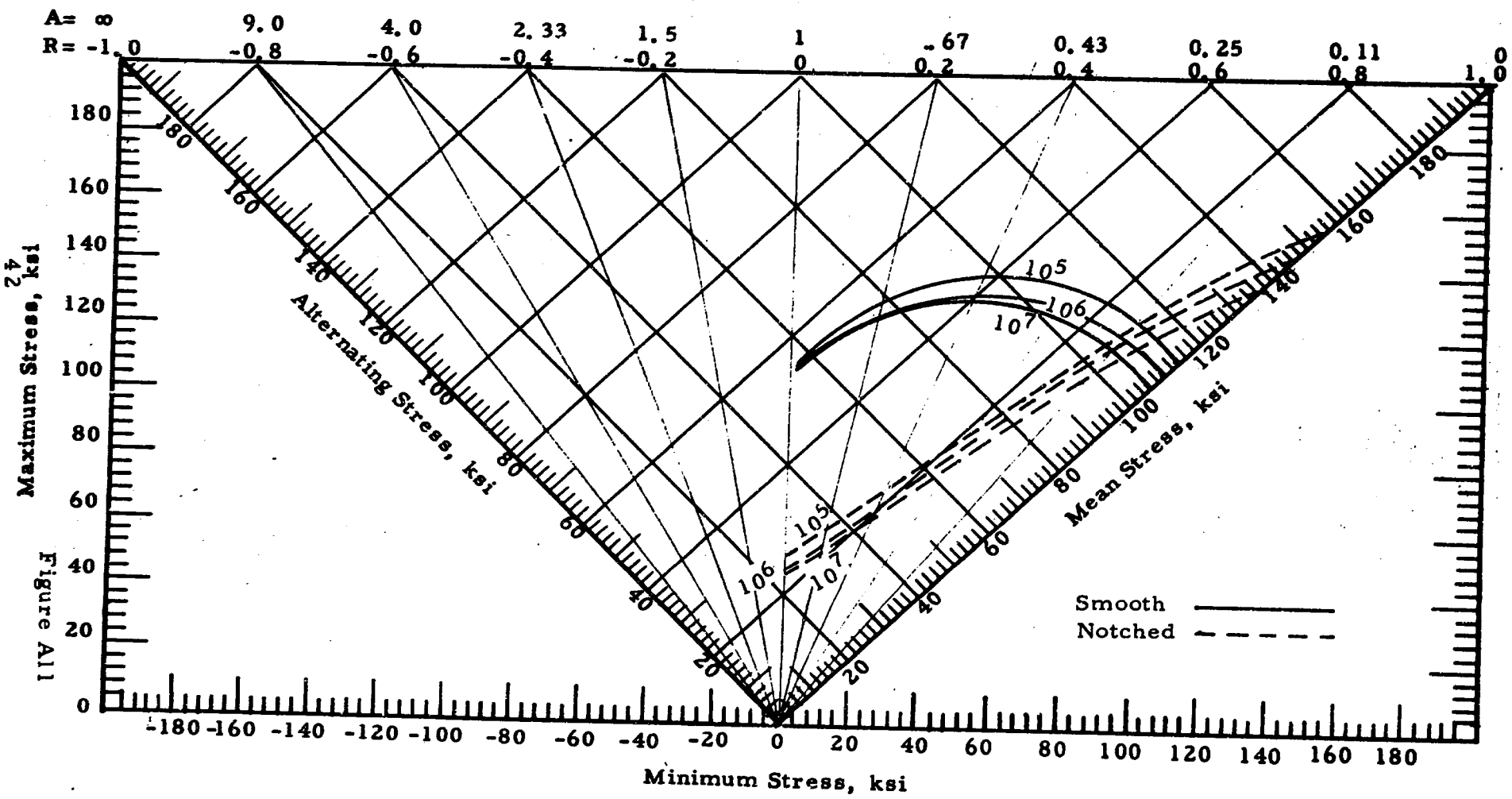


Figure A11

SECTION VB

17-7 PH RH 950 FORGING

TABLE B1

TENSILE TEST DATA FOR 17-7 PH RH 950 FORGING MATERIAL

		Smooth						Notched - 3.0 K_t	
Test Temp.	Specimen Orientation	Spec. No.	Ult. Tensile Strength, ksi	0.2% Offset Yield Str., ksi	Elongation in 2", %	Reduction of Area %	Tensile Modulus 10^6 psi	Spec. No.	Ultimate Tensile Strength, ksi
Room	L	D45	218.4	192.9	6.0	6.1	28.7	E1	155.7
		D46	207.4	169.8	-	-	29.6	E2	163.1
		D47	214.0	197.5	1.0	0.5	29.7	E3	177.6
			213.3	186.7	-	-	29.3		165.5
	T	L-5	146.9	-(1)	2.0	0.5	28.4	L1	102.8
		L-6	114.3	-(1)	3.0	0.5	29.2	K1	117.8
		M-2	146.9	-(1)	-	-	29.4	K7	156.8
			136.0				29.0		125.8
600°F	L	E22	184.1	149.1	13.0	42.1		E4	224.0
		E23	180.6	145.4	13.0	42.2	—	E5	228.0
		E24	178.5	135.2	11.0	36.6		E6	228.3
			181.1	143.2	12.3	40.3			226.8
	T	M1	179.5	144.8	7.0	6.1		L2	216.7
		N1	177.5	137.7	7.0	14.6	—	K3	156.0
		N2	177.5	140.8	6.0	13.9		K4	155.6
			178.2	141.1	6.7	11.5			176.1
800°F	L	D49	158.4	131.6	15.0	51.1		E7	219.0
		X-1	157.1	132.6	16.0	52.6	—	E8	207.1
		X-3	154.3	126.0	15.0	51.6		E9	204.5
			156.6	130.1	15.3	51.8			210.2
	T	M-3	133.8	110.5	2.0	3.2		L3	173.9
		M-5	141.8	117.3	2.0	3.9	—	K5	159.9
		M-6	146.9	122.4	2.0	3.9		K6	195.6
			140.8	116.7	2.0	3.7			176.5

(1) Brittle fracture, no yield

TABLE BII

STRESS RUPTURE DATA FOR 17-7 PH, RH 950 FORGING MATERIAL - LONGITUDINAL

Spec. No.	K_t	Test Temp.	Stress ksi	Life Hours
E26	1.0	600°F	200.0	< 0.05
D44			175.0	2.8
X1			171.0	9.6
X2			166.0	156.6
D46			160.0	519.7+
E27	1.0	800°F	150.0	<0.05
E28			130.0	2.2
E29			110.0	119.4
D45			105.0	132.3
D49			97.0	202.7+
E20	3.0	600°F	233.0	<0.05
E21			229.0	161.3
E14			225.0	243.0+
E12			220.0	461.0+
E10			204.0	328.9+
E15	3.0	800°F	190.0	1.1
E16			185.0	1.6
E17			165.0	38.0
E18			155.0	49.3
E19			142.0	195.4

17-7 PH RH 950 FORGING
STRESS VS. TIME TO RUPTURE

Notched ---o---
Smooth ——△——

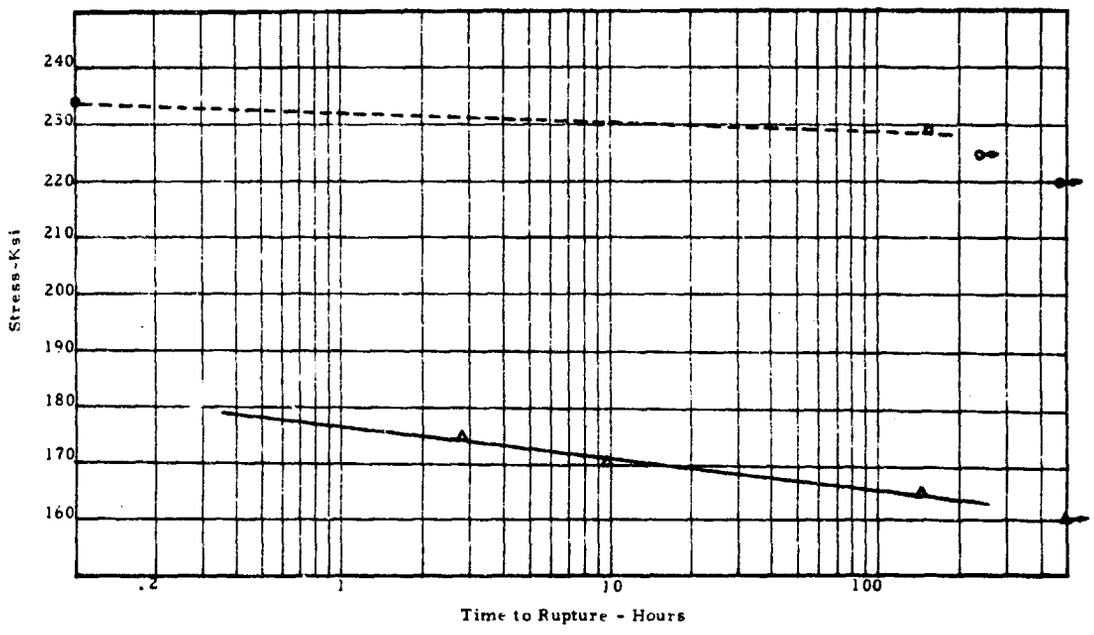


Figure B1-600°F

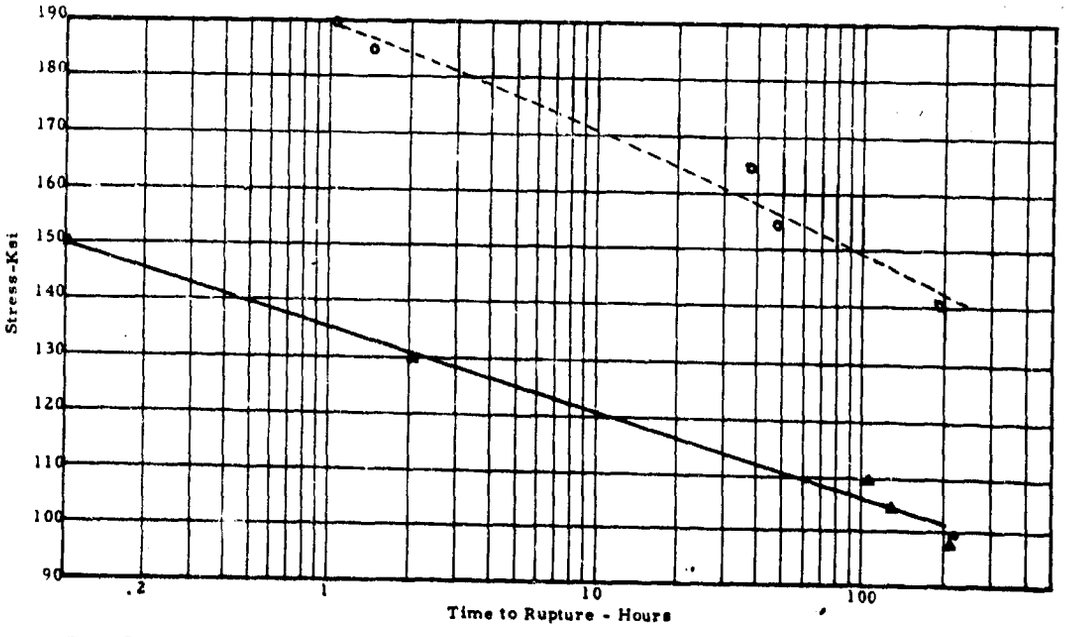


Figure B2-800°F

TABLE BIII

FATIGUE TEST DATA

Material- 17-7 PH RH 950 Forging
Type of Specimen- Longitudinal - Smooth
Test Temperature- Room

Test Frequency - Cycles/Minute
A = ∞ - 4300
A = .98 - 4300
A= .50 - 1050

Specimen No.	"A" Ratio	Applied Stress, ksi			Life, Kilocycles
		Sm	Sa	Sc	
C7	Infinity	0	50.0	50.0	10,702.0+
C10			75.0	75.0	10,679.0+
C29			75.0	75.0	10,045.0+
C30			80.0	80.0	10,184.0+
C11			80.0	80.0	1,435.0
C8			85.0	85.0	1,364.0
C14			90.0	90.0	1,021.0
C15			100.0	100.0	378.0
C28			110.0	110.0	91.0
C13			120.0	120.0	16.0
C-20-III	0.98	54.6	53.5	108.1	10,537.0+
C-21-II		58.6	57.5	116.1	8,371.0
C-22-II		59.8	58.6	118.4	8,212.0
C-23-II		62.4	61.1	123.5	2,524.0
C-19-II		62.2	60.9	123.1	382.0
C-27-II		65.1	63.8	128.9	463.0
C-18-II		69.0	67.6	136.6	151.0
C-24-II		73.6	72.1	145.7	233.0
C-25-II		77.1	75.6	152.7	41.0
C-26-II		84.3	82.6	166.9	28.0
C-17-II	0.5	92.3	46.1	138.4	10,130.0+
C-16-II		94.4	47.2	141.6	7,729.0
C-2-II		103.4	51.7	155.0	4,497.0
C-3-II		106.6	53.3	159.9	283.0
C-5-II		106.8	53.4	160.3	309.0
C-1-II		110.2	55.1	165.3	668.0
C-6-II		113.6	56.8	170.4	84.0
C-12-II		119.9	59.9	179.8	90.0
C-9-II		120.7	60.3	181.0	145.0

TABLE BIV

FATIGUE TEST DATA

Material- 17-7 PH RH 950 Forging
Type of Specimen- Longitudinal - Smooth
Test Temperature-600°F

Test Frequency - Cycles/minute
A = ∞ - 4300
A = .98-4300
A = .50-4300

Specimen No.	"A" Ratio	Applied Stress, ksi			Life, Kilocycles
		Sm	Sa	Sc	
D5	Infinity	0	85.0	85.0	10,000.0+
D4			90.0	90.0	5,942.0
D6			95.0	95.0	2,972.0
D11			95.0	95.0	174.0
L.0			95.0	95.0	52.0
D8			95.0	95.0	49.0
D7			97.5	97.5	4,462.0
D9			97.5	97.5	46.0
D3			100.0	100.0	40.0
C47	0.98	63.2	61.8	125.0	10,232.0+
C46		63.2	61.8	125.0	6,266.0
C44		65.7	64.3	130.0	5,199.0
C45		68.2	66.8	135.0	3,668.0
C43		70.7	69.3	140.0	7,145.0
C48		70.7	69.3	140.0	2,801.0
D1		73.3	71.7	145.0	1,180.0
C49		75.8	74.2	150.0	66.0
D43		80.8	79.2	160.0	21.0
C41		80.8	79.2	160.0	16.0
C36	0.5	96.7	48.3	145.0	10,000.0+
C32		100.0	50.0	150.0	7,433.0
C40		105.0	52.5	157.5	3,966.0
C33		105.0	52.5	157.5	1,061.0
C39		106.7	53.3	160.0	3,490.0
C35		106.7	53.3	160.0	614.0
C34		110.0	55.0	165.0	70.0
C31		110.0	55.0	165.0	42.0
C38		113.4	56.7	170.0	40.0
C37		113.4	56.7	170.0	24.0

TABLE BV

FATIGUE TEST DATA

Material- 17-7 PH RH 950 Forging
Type of Specimen- Longitudinal - Smooth
Test Temperature-800°F

Test Frequency - Cycles/minute
A = ∞ - 4300
A = .98 - 1800
A = .50 - 4300

Specimen No.	"A" Ratio	Applied Stress, ksi			Life, Kilocycles
		Sm	Sa	Sc	
D35	Infinity	0	80.0	80.0	10,755.0+
D33			80.0	80.0	108.0
D34			85.0	85.0	3,878.0
D32			85.0	85.0	2,539.0
D36			90.0	90.0	383.0
D42			95.0	95.0	64.0
D40			95.0	95.0	28.0
D37			105.0	105.0	15.0
D41			105.0	105.0	7.0
D38			110.0	110.0	6.0
D28	0.98	53.0	52.0	105.0	10,042.0+
D27		55.6	54.4	110.0	3,726.0
D31		55.6	54.4	110.0	3,401.0
D22		56.9	55.7	112.6	4,828.0
D29		58.1	56.9	115.0	3,206.0
D26		58.1	56.9	115.0	62.0
D30		60.6	59.4	120.0	685.0
D25		60.6	59.4	120.0	19.0
D24		65.7	64.3	130.0	18.0
D23		75.8	74.2	150.0	6.0
D15	0.5	80.0	40.0	120.0	10,000.0+
D19		81.7	40.8	122.5	2,336.0
D20		83.3	41.7	125.0	12,032.0+
D18		83.3	41.7	125.0	3,833.0
D17		83.3	41.7	125.0	794.0
D16		86.7	43.3	130.0	5,935.0
D14		93.3	46.7	140.0	1,774.0
D21		96.7	48.3	145.0	258.0
D13		100.0	50.0	150.0	71.0
D12		103.3	51.7	160.0	29.0

TABLE BVI

FATIGUE TEST DATA

Material- 17-7 PH RH 950 Forging
Type of Specimen- Longitudinal Notched
Test Temperature- Room

Test Frequency-Cycles/minute
A= ∞-4300
A= .98-1050
A=.5 -1050

Specimen No.	"A" Ratio	Applied Stress, ksi			Life, Kilocycles
		Sm	Sa	Sc	
A-15	Infinity	0	30.0	30.0	10,020.0+
A-12			35.0	35.0	2,700.0
B-42			40.0	40.0	1,496.0
A-14			40.0	40.0	484.0
A-17			45.0	45.0	508.0
B-43			45.0	45.0	413.0
A-18			50.0	50.0	117.0
A-13			70.0	70.0	12.0
A-5-II	0.98	28.0	14.6	42.0	10,015.0+
A-8-II		30.3	15.2	45.5	10,155.0+
A-12-II		31.6	15.8	47.4	611.0
A-11-II		31.6	15.8	47.4	391.0
A-10-II		32.7	16.4	49.1	401.0
A-7-II		35.0	17.5	52.5	145.0
A-4-II		37.3	18.6	55.9	132.0
A-2-II		46.7	23.4	70.1	81.0
A-3-II		56.2	28.1	84.3	22.0
A-9-II		65.9	32.7	98.1	8.0
A-24-II	0.50	23.4	22.9	46.3	10,056.0+
A-22-II		28.1	27.5	55.6	989.0
A-26-II		28.1	27.5	55.6	296.0
A-25-II		32.7	32.1	64.8	455.0
A-28-II		32.7	32.1	64.8	362.0
A-29-II		37.4	36.7	74.1	141.0
A-30-II		42.1	41.3	83.4	74.0
A-20-II		46.8	45.8	92.6	31.0
A-21-II		51.4	50.4	101.8	17.0
A-19-II		60.8	59.6	120.4	8.0

TABLE BVII

FATIGUE TEST DATA

Material- 17-7 PH RH 950 Forging
Type of Specimen- Longitudinal - Notched
Test Temperature- 600°F

Test Frequency-Cycles/Minute
A = ∞ - 4300
A = .98 - 1800
A = .50 - 1800

Specimen No.	"A" Ratio	Applied Stress, ksi			Life, Kilocycles
		Sm	Sa	Sc	
A40	Infinity	0	30.0	30.0	12,543.0+
A41			35.0	35.0	988.0
A39			40.0	40.0	115.0
A44			50.0	50.0	46.0
A38			60.0	60.0	29.0
A37			80.0	80.0	9.0
A36			100.0	100.0	15.0
A42			120.0	120.0	5.0
A47	.98	25.2	24.8	50.0	10,194.0+
A49		30.3	29.7	60.0	10,021.0+
B1		32.8	32.2	65.0	80.0
B5		35.4	34.7	70.0	54.0
B2		35.4	34.7	70.0	22.0
A48		37.9	37.1	75.0	46.0
B3		40.4	39.6	80.0	24.0
B4		45.5	44.6	90.0	13.0
A46		50.5	49.5	100.0	11.0
A45		90.9	89.1	180.0	1.0
X34	.50	60.0	30.0	90.0	10,005.0+
X23		60.0	30.0	90.0	10,004.0+
X33		61.7	30.8	92.5	35.0
X37		61.7	30.8	92.5	28.0
X24		63.4	31.6	95.0	37.0
X28		63.4	31.6	95.0	25.0
X26		66.7	33.3	100.0	19.0
X17		66.7	33.3	100.0	18.0
X25		70.0	35.0	105.0	12.0

TABLE B VIII

FATIGUE TEST DATA

Material- 17-7 PH RH 950 Forging
Type of Specimen- Longitudinal Notched
Test Temperature- 800°F

Test Frequency-Cycles/Minute
A = ∞ 4300
A = .98-1800
A = .50-1800

Specimen No.	"A" Ratio	Applied Stress, ksi			Life, Kilocycles
		Sm	Sa	Sc	
B17	Infinity	0	30.0	30.0	10,000.0+
B15			40.0	40.0	151.0
B21			40.0	40.0	72.0
B14			50.0	50.0	46.0
B19			50.0	50.0	21.0
B18			60.0	60.0	55.0
B20			60.0	60.0	11.0
B16			70.0	70.0	9.0
B13			100.0	100.0	5.0
B12			180.0	180.0	1.0
B27	0.98	20.2	19.8	40.0	10,000.0+
B28		25.25	24.75	50.0	10,000.0+
B31		27.8	27.2	55.0	71.0
B26		30.3	29.7	60.0	310.0
B30		32.8	32.18	65.0	27.0
B29		35.4	34.6	70.0	24.0
B25		40.4	39.6	80.0	14.0
B24		50.5	49.5	100.0	7.0
B23		60.6	59.4	120.0	4.0
B22		90.9	89.1	180.0	1.0
B35	0.5	46.7	23.3	70.0	10,257.0+
B39		50.0	25.0	75.0	10,277.0+
B38		50.0	25.0	75.0	3,268.0
B34		53.4	26.6	80.0	214.0
B41		53.4	26.6	80.0	41.0
B40		56.7	28.3	85.0	35.0
B37		60.0	30.0	90.0	46.0
B33		66.7	33.3	100.0	19.0
B36		73.4	36.6	110.0	11.0
B32		80.0	40.0	120.0	3.0

S-N Curve-17-7 PH RH 950 Forging

Temperature - Room Environment - Air

Ultimate Tensile Strength - 213 Ksi

Tensile Yield Strength - 187 Ksi

Longitudinal Smooth Specimen Finish - 63 Microinches

Axial Sinusoidal Loading

A = .50 ---△---

A = .98 ——□——

A = ∞ —-○-—

SPS LABORATORIES

Chart No.: _____

Date: _____

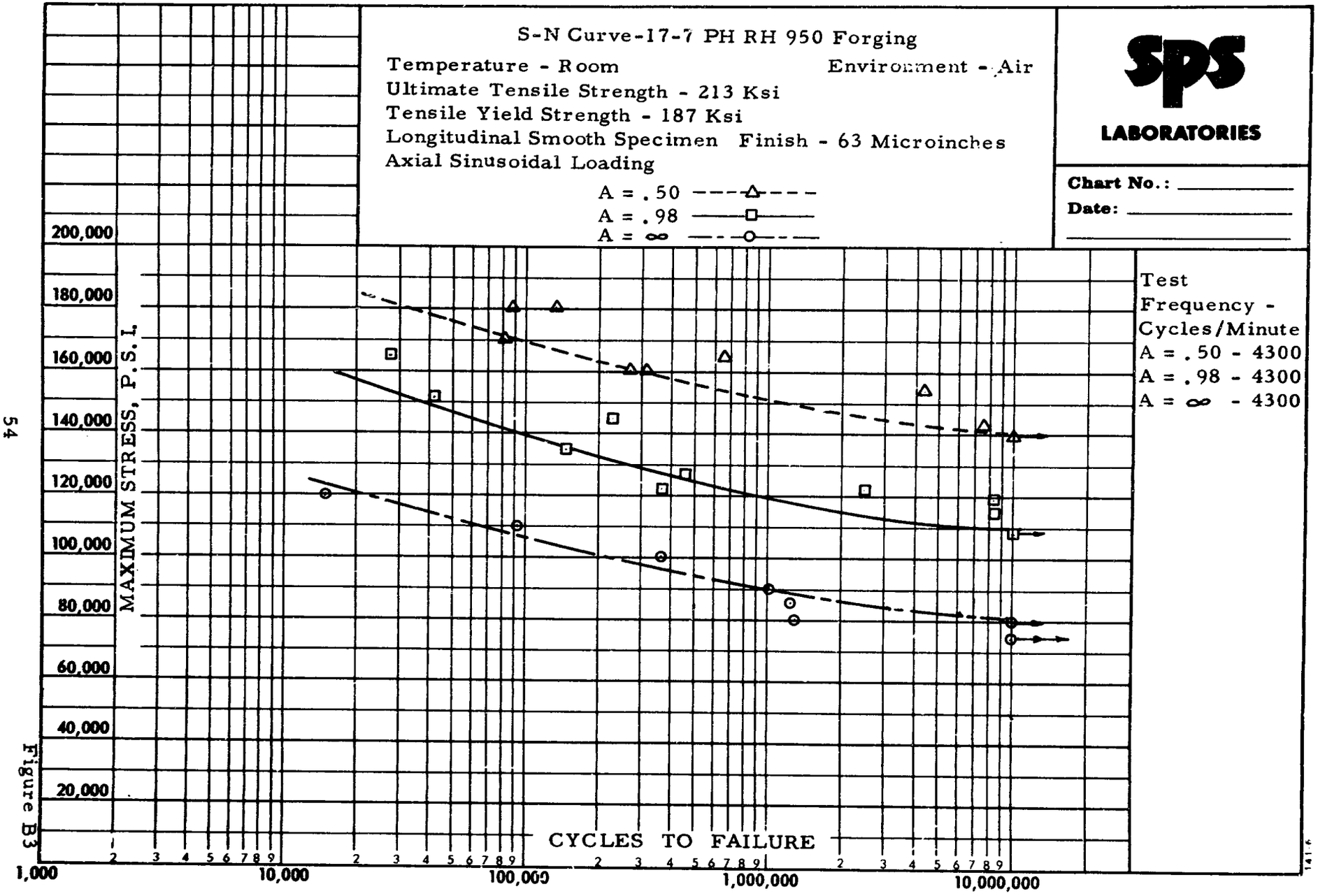


Figure B3

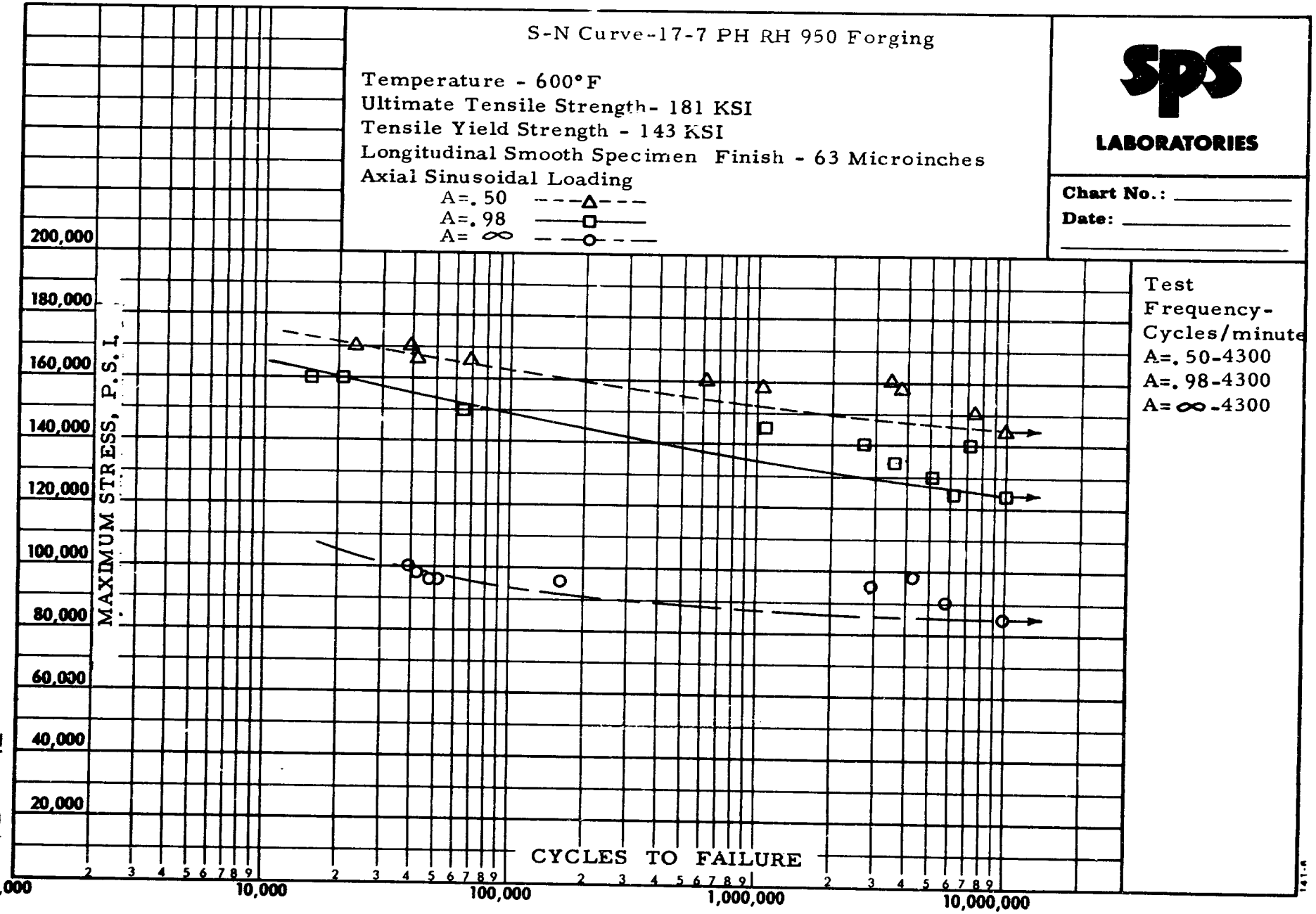

S-N Curve-17-7 PH RH 950 Forging
Temperature - 600°F
Ultimate Tensile Strength- 181 KSI
Tensile Yield Strength - 143 KSI
Longitudinal Smooth Specimen Finish - 63 Microinches
Axial Sinusoidal Loading
A=.50
A=.98
A=∞
SPS
LABORATORIES
Chart No.:
Date:
Test Frequency-Cycles/minute
A=.50-4300
A=.98-4300
A=∞-4300
MAXIMUM STRESS, P.S.I.
200,000
180,000
160,000
140,000
120,000
100,000
80,000
60,000
40,000
20,000
CYCLES TO FAILURE
1,000
10,000
100,000
1,000,000
10,000,000

Figure B4

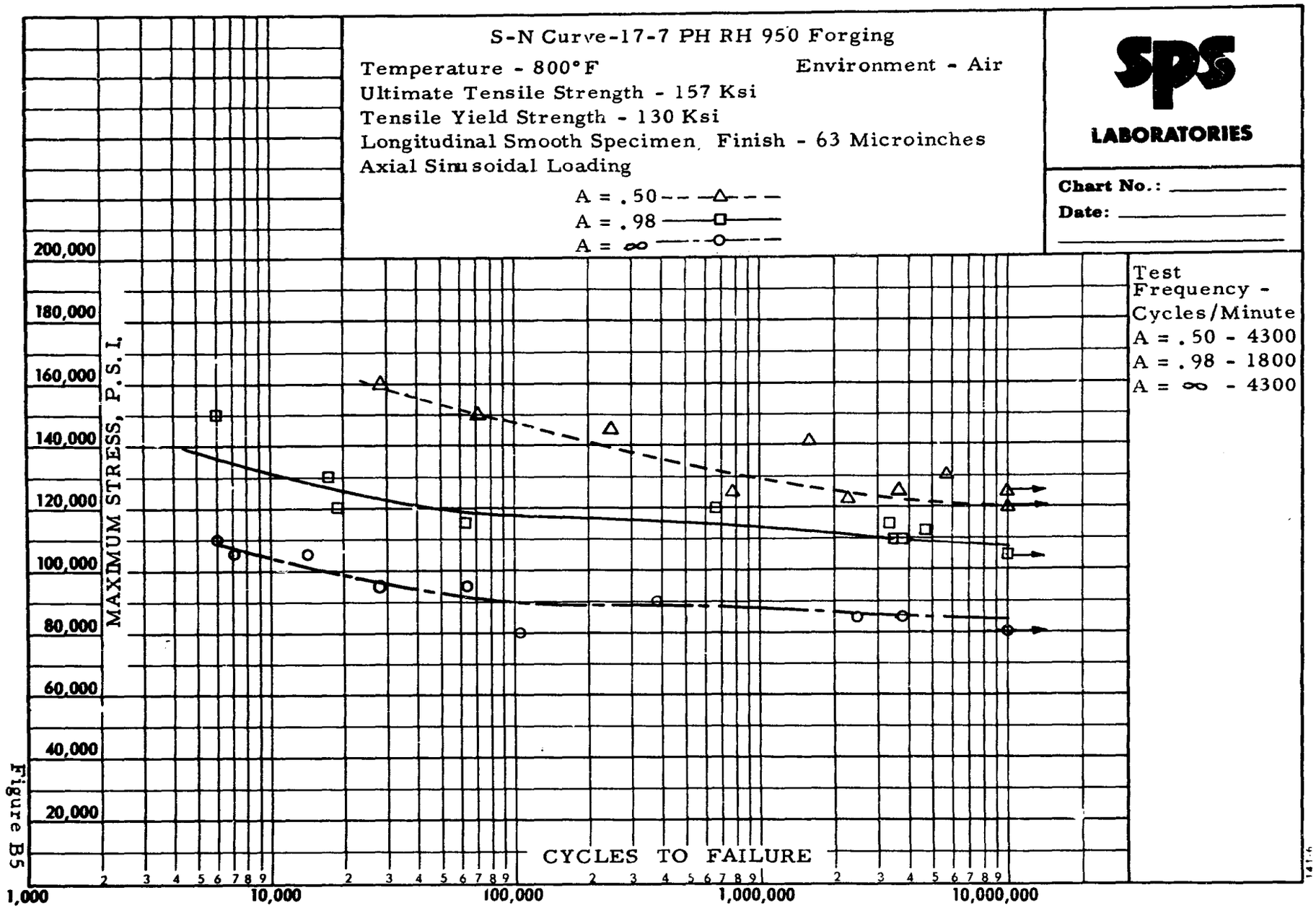

S-N Curve-17-7 PH RH 950 Forging
Temperature - 800°F
Environment - Air
Ultimate Tensile Strength - 157 Ksi
Tensile Yield Strength - 130 Ksi
Longitudinal Smooth Specimen, Finish - 63 Microinches
Axial Sinusoidal Loading
A = .50
A = .98
A = ∞
SPS
LABORATORIES
Chart No.:
Date:
Test Frequency - Cycles/Minute
A = .50 - 4300
A = .98 - 1800
A = ∞ - 4300
MAXIMUM STRESS, P.S.I.
200,000
180,000
160,000
140,000
120,000
100,000
80,000
60,000
40,000
20,000
CYCLES TO FAILURE
1,000
10,000
100,000
1,000,000
10,000,000

Figure B5

S-N Curve 17-7 PH RH 950 Forging
Temperature-Room Environment-Air
Ultimate Tensile Strength-165 KSI
Longitudinal, Notched Specimen Finish-63 Microinches
K_t=3.0
Axial Sinusoidal Loading

A=.50 ----△----
A=.98 ——□——
A= ∞ — - —○— - —

SPS LABORATORIES

Chart No.: _____
Date: _____

Test Frequency Cycles/minute
A=.50-1050
A=.98-1050
A= ∞-4300

Maximum Stress, psi

200,000
180,000
160,000
140,000
120,000
100,000
80,000
60,000
40,000
20,000

CYCLES TO FAILURE

1,000 10,000 100,000 1,000,000 10,000,000

141-6

Figure B6

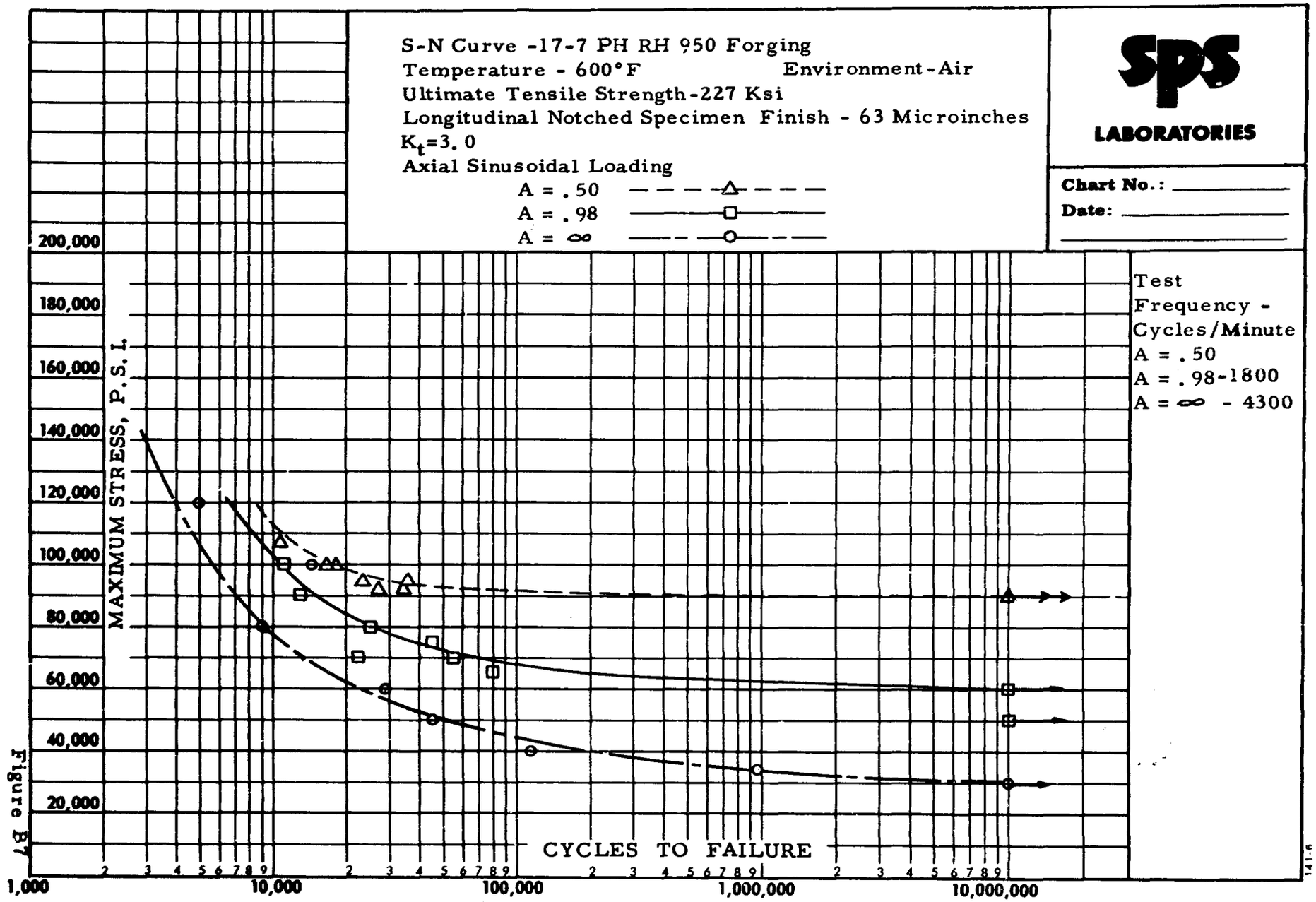

S-N Curve -17-7 PH RH 950 Forging
Temperature - 600°F
Environment-Air
Ultimate Tensile Strength-227 Ksi
Longitudinal Notched Specimen Finish - 63 Microinches
K_t=3.0
Axial Sinusoidal Loading
A = .50
A = .98
A = ∞
SPS
LABORATORIES
Chart No.:
Date:
Test Frequency - Cycles/Minute
A = .50
A = .98-1800
A = ∞ - 4300
MAXIMUM STRESS, P.S.I.
200,000
180,000
160,000
140,000
120,000
100,000
80,000
60,000
40,000
20,000
CYCLES TO FAILURE
1,000
10,000
100,000
1,000,000
10,000,000
141-6

Figure B7

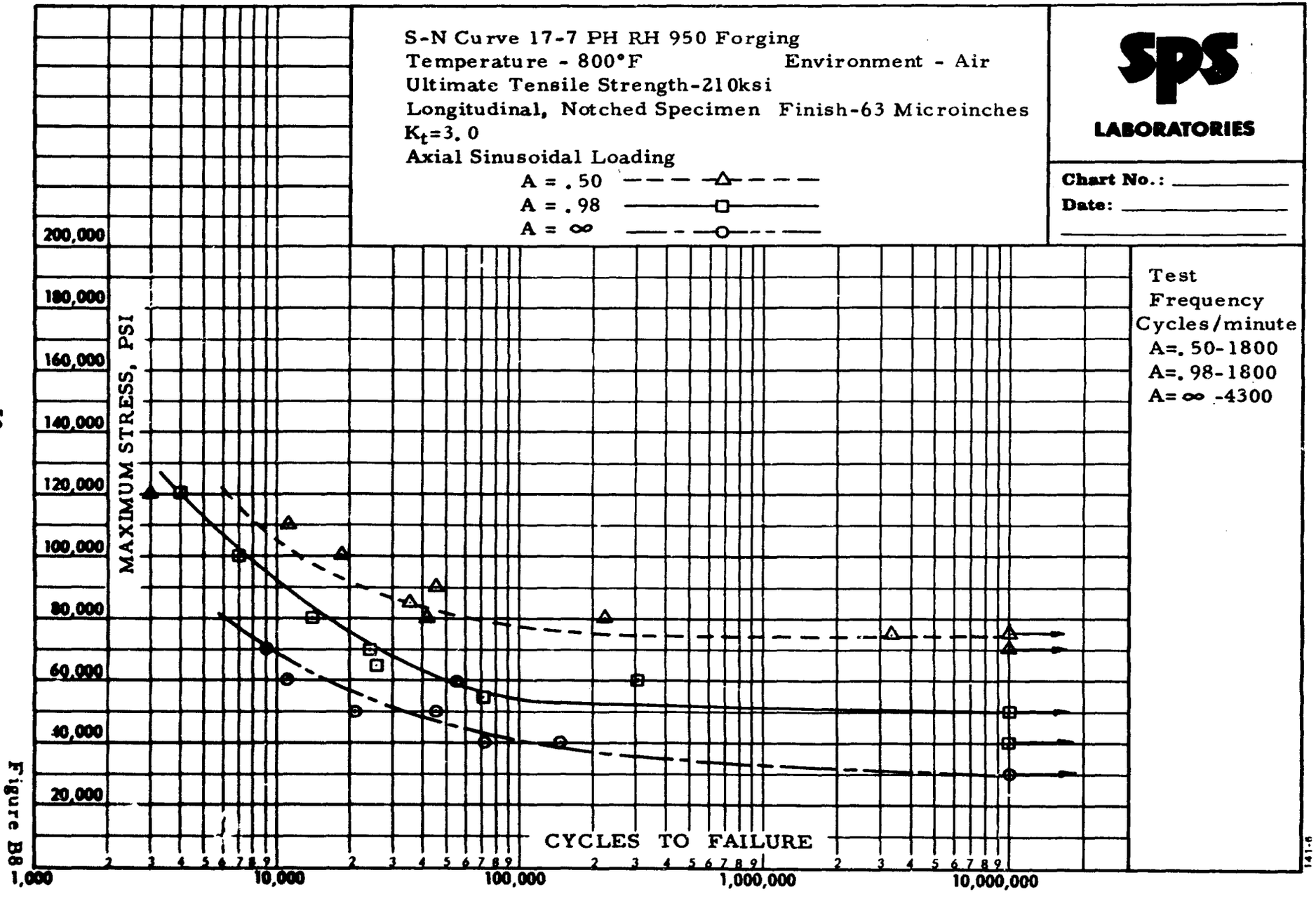

S-N Curve 17-7 PH RH 950 Forging
Temperature - 800°F
Environment - Air
Ultimate Tensile Strength-210ksi
Longitudinal, Notched Specimen
Finish-63 Microinches
K_t=3.0
Axial Sinusoidal Loading
A = .50
A = .98
A = ∞
SPS
LABORATORIES
Chart No.:
Date:
Test
Frequency
Cycles/minute
A=.50-1800
A=.98-1800
A=∞ -4300
MAXIMUM STRESS, PSI
200,000
180,000
160,000
140,000
120,000
100,000
80,000
60,000
40,000
20,000
CYCLES TO FAILURE
1,000
10,000
100,000
1,000,000
10,000,000
141-6

Figure D8

CONSTANT LIFE DIAGRAM - 17-7 PH RH 950 FORGING
Temperature - Room
Ultimate Tensile Strength - Smooth - 213 KSI -- Notched (K_t=3.0)-166 KSI
Tensile Yield Strength - Smooth 187 KSI
Axial Sinusoidal Loading
Environment - Air
Specimen Finish - 63 Microinches

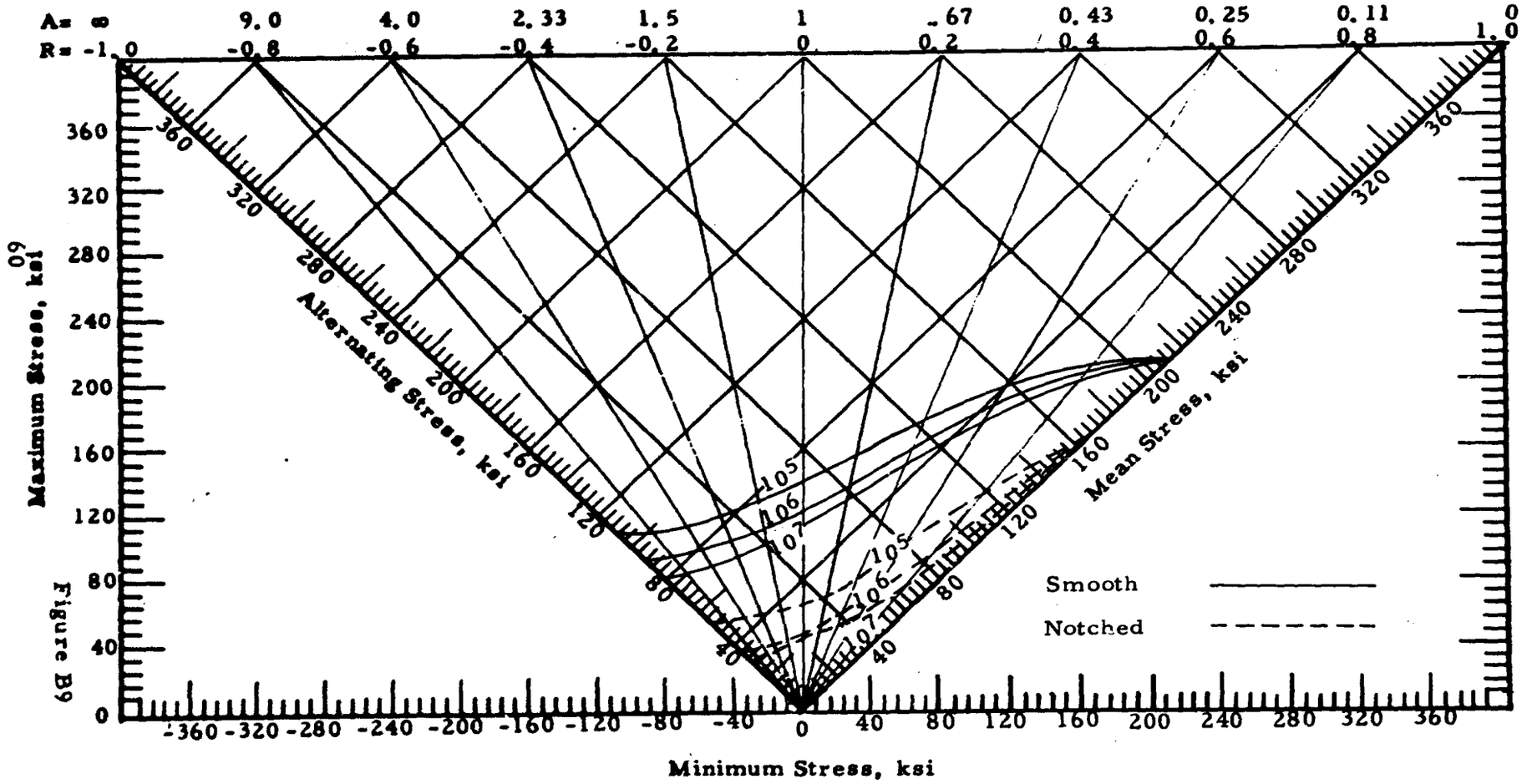


Figure B9

CONSTANT LIFE DIAGRAM -17-7 PH RH 950 FORGING
Temperature - 600°F
Ultimate Tensile Strength - Smooth - 181 Ksi -- Notched (K_t=3.0)-227 Ksi
Tensile Yield Strength - Smooth - 143 Ksi
Axial Sinusoidal Loading
Environment - Air
Specimen Finish - 63 Microinches

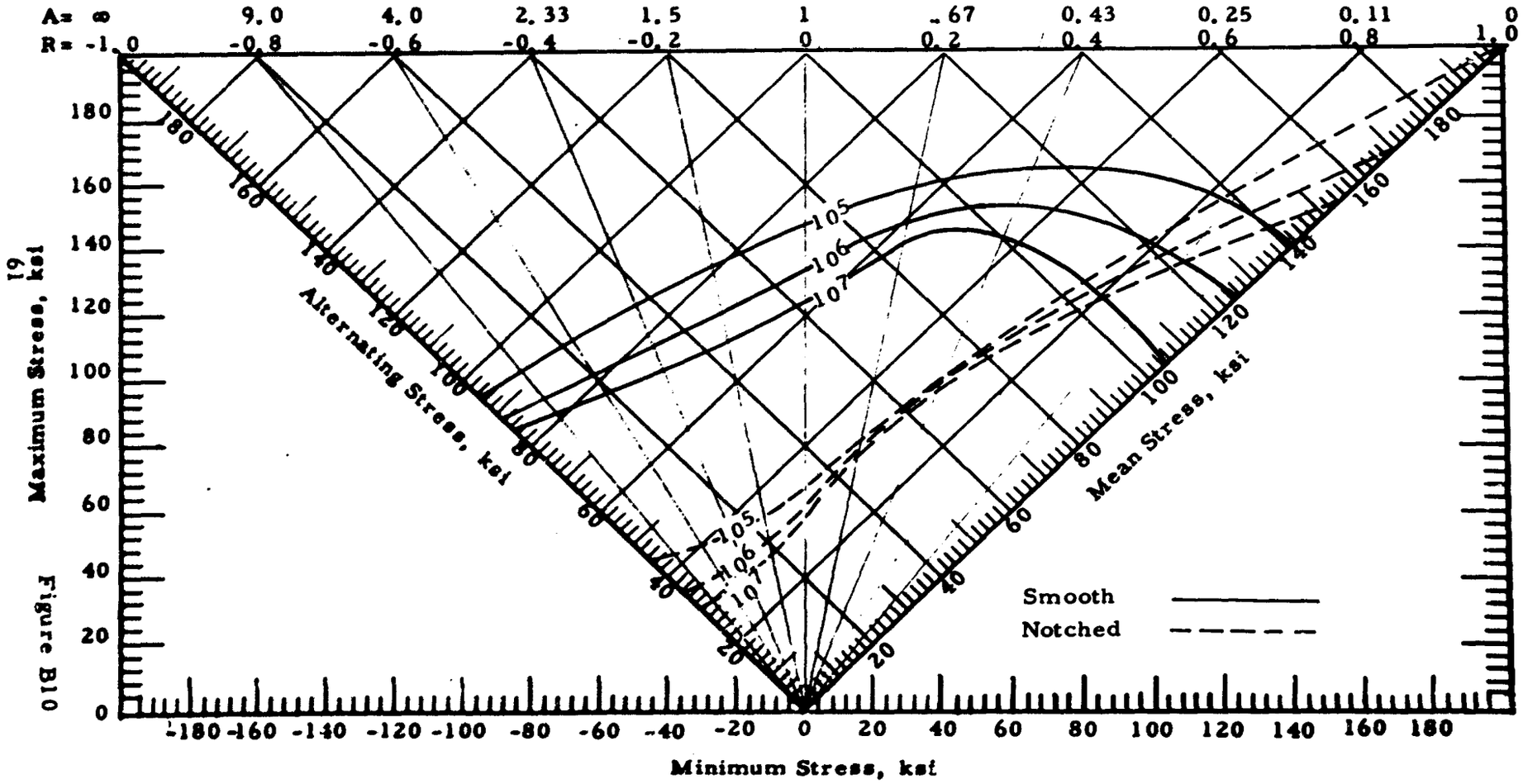


Figure B10

CONSTANT LIFE DIAGRAM -17-7 PH RH 950 FORGING
Temperature - 800°F
Ultimate Tensile Strength - Smooth - 157 Ksi -- Notched (K_t=3.0)-210 Ksi
Tensile Yield Strength - Smooth - 130 Ksi
Axial Sinusoidal Loading
Environment - Air
Specimen Finish - 63 Microinches

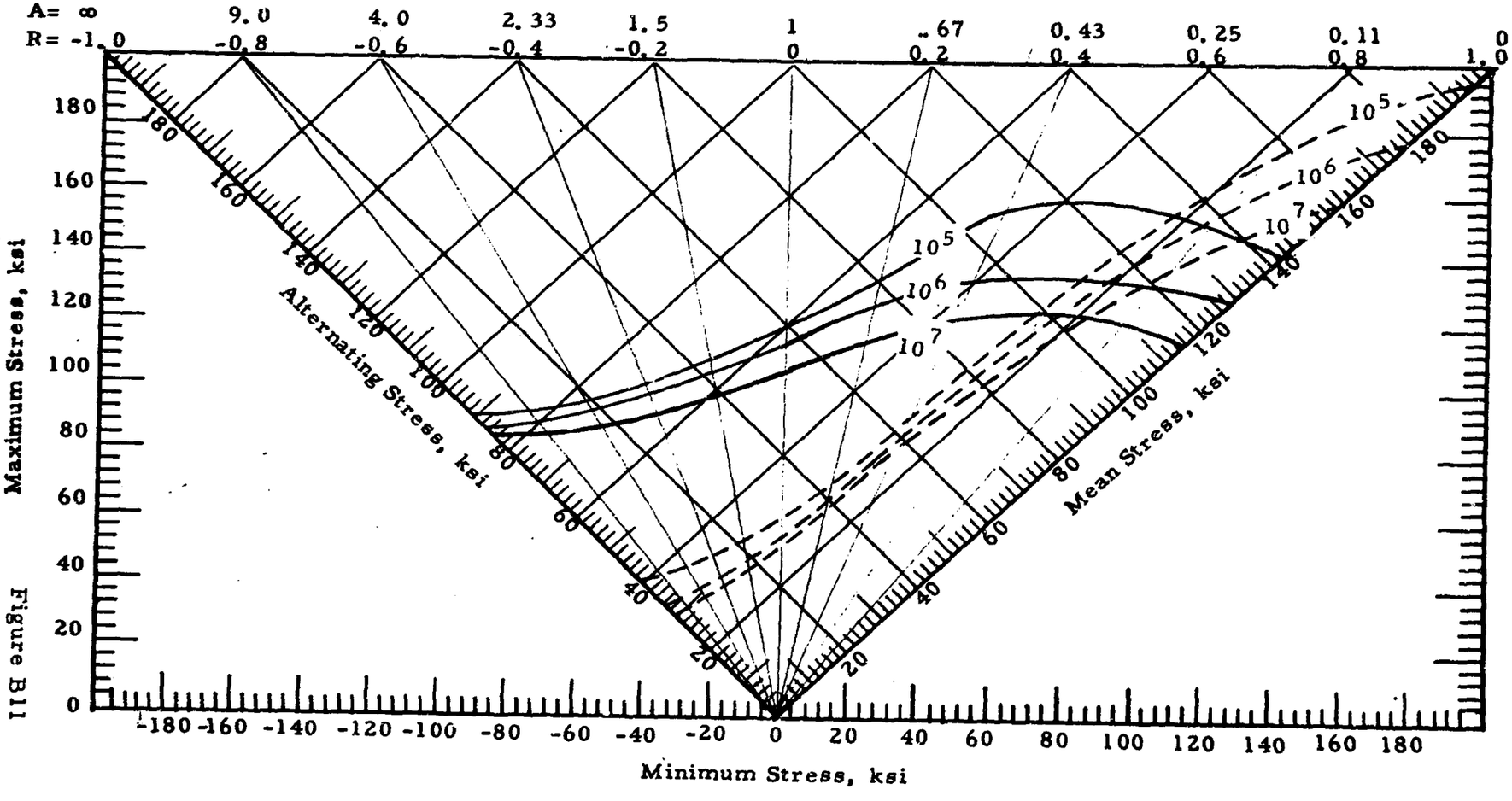


Figure B11

SECTION VC

17-7 PH TH 1050 FORGING

TABLE CI

TENSILE TEST DATA FOR 17-7 PH, TH 1050 FORGING MATERIAL

		Smooth						Notched K_t = 3.0	
Test Temp.	Specimen Orientation	Spec. No.	Ult. Tensile Strength, ksi	0.2% Offset Yield Strength, ksi	Elongation in 1", %	Reduction of Area, %	Tensile Modulus, 10^6 psi	Spec. No.	Ultimate Tensile Strength, ksi
Room	L	E43	196.9	183.6	14.0	40.4	30.2	G45III	203.9
		E42	196.3	183.6	14.0	39.3	29.9	G46III	210.8
		E48	196.9	181.1	14.0	39.3	30.5	G47III	234.0
			196.4	182.8	14.0	39.7	30.2		216.2
	T	O5	167.9	166.8	2.0	1.0	30.1	S1III	109.2
		P2	173.5	165.3	-	-	29.4	S2III	147.1
		U4	155.1	128.6	1.0	0.2	29.1	S3	233.2
			165.5	153.6	-	-	29.5		163.2
600°F	L	E44	167.8	155.1	12.0	42.2		G48	223.1
		E45	167.8	155.1	11.0	41.6	—	G49	225.8
		E46	168.3	158.1	11.0	39.8		J35	218.8
			168.0	156.1	11.3	41.2			222.6
	T	P5	144.8	-(1)	1.0	3.2		S4	161.2
		P6	153.0	148.9	1.0	3.9	—	S5	211.8
		P7	168.3	158.1	4.0	6.1		S6	216.8
			155.0	153.5	2.0	3.3			196.6
800°F	L	E47	145.9	136.3	13.0	45.8		J36	200.7
		E49	144.3	135.2	12.0	45.8	—	J37	193.1
		J34	146.4	137.7	12.0	46.4		J38	192.3
			145.5	136.4	12.3	46.0			195.4
	T	P1	142.8	130.6	7.0	23.4		U1	196.4
		P3	125.5	-(1)	2.0	4.7	—	U2	200.8
		P4	126.5	120.4	2.0	3.2		U3	200.9
			132.9	125.5	4.7	10.4			199.4

(1) Brittle fracture, no yield

TABLE CII

STRESS RUPTURE DATA FOR 17-7 PH, TH 1050 FORGING MATERIAL 0.252 SPECIMENS - LONGITUDINAL

Spec. No.	K_t	Test Temp	Stress ksi	Life Hours
E36	1.0	600°F	160	0.1
E39			158	< 0.05
E38			155	25.3
E40			153	200.0+
E37			150	207.3+
E31	1.0	800°F	180	< 0.05
E32			160	< 0.05
E33			130	0.6
E34			100	79.4
E35			80.0	187.0+
J41	3.0	600°F	225	4.6
J42			228	9.3
J39			220	24.0
J40			210	87.3
J43			190	240.0+
J44	3.0	800°F	200	0.1
J46			180	0.7
J47			170	4.0
J48			160	8.9
J49			148	24.2

17-7 PH TH 1050 FORGING
STRESS VS. TIME TO RUPTURE

Notched
Smooth

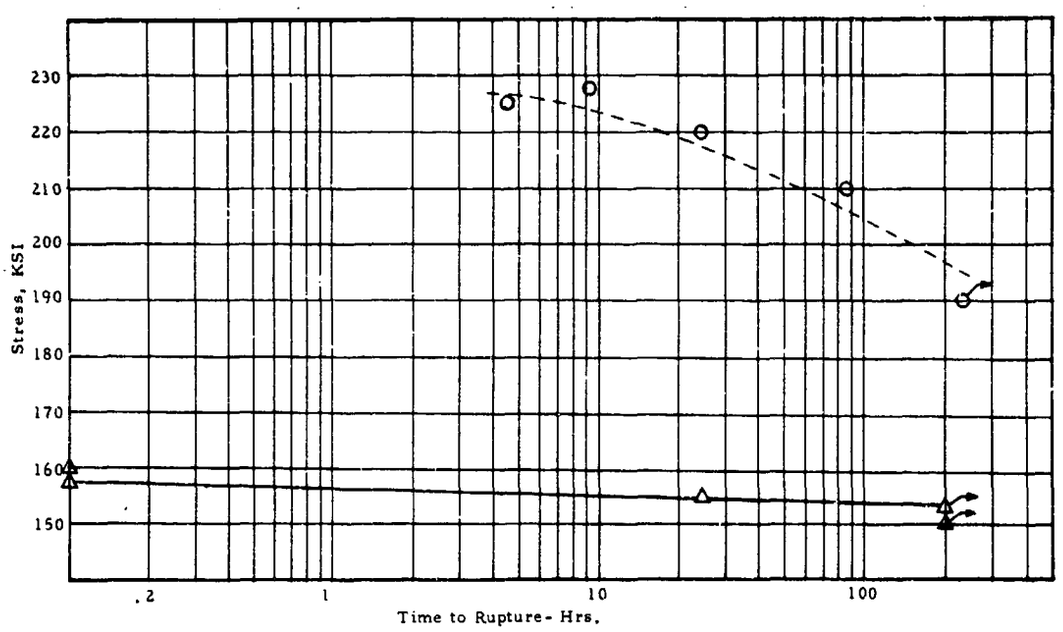


Figure C1-600°F

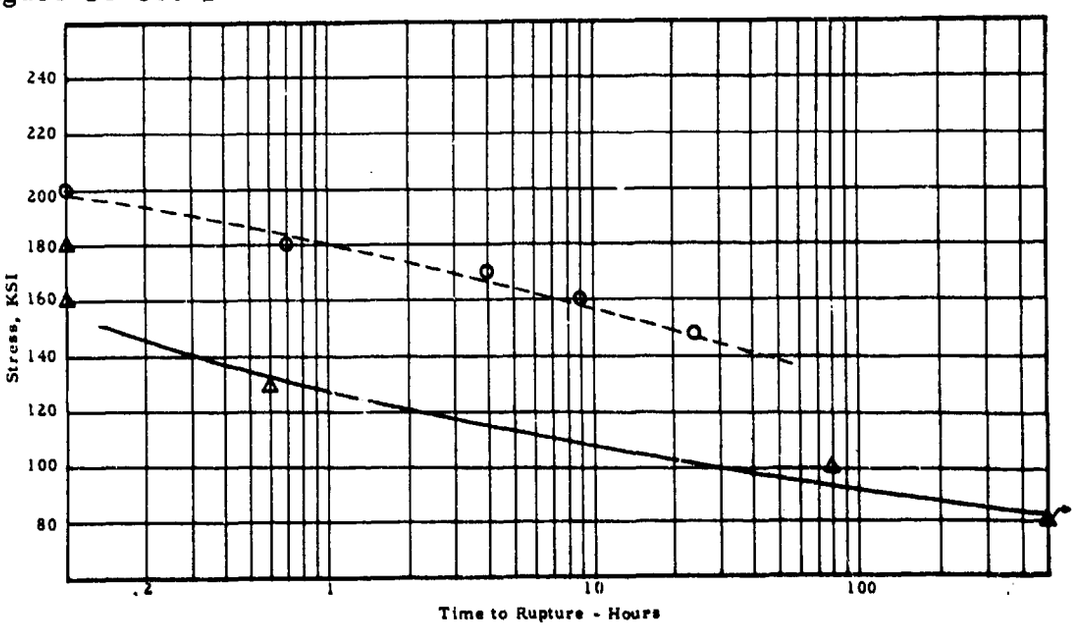


Figure C2-800°F

TABLE CIII

FATIGUE TEST DATA

Material- 17-7 PH, TH 1050 Forging
Type of Specimen- Longitudinal- Smooth
Test Temperature- Room

Test Frequency - Cycles/Minute

A = .98 - 1050
A = .50 - 1050

Specimen No.	"A" Ratio	Applied Stress, ksi			Life, Kilocycles
		Sm	Sa	Sc	
H-8-III	0.98	60.0	58.8	118.8	4,228.
H-13-III		61.7	60.5	122.2	3,275.0
H-23-III		61.7	60.5	122.2	3,175.0
H-42-III		65.5	64.2	129.7	833.0
H-14-III		65.5	64.2	129.7	6,257.0
J-31-III		69.0	67.6	136.6	1,129.0
H-25-III		72.7	71.2	143.9	174.0
H-12-III		72.7	71.2	143.9	609.0
J-32-III		76.4	74.9	151.3	198.0
H-21-III		76.4	74.9	151.3	333.0
J-27-III	0.5	43.6	21.8	65.4	10,342.0+
J-26-III		87.4	43.7	131.1	9,000.0+
J-19-III		102.0	51.0	153.0	1,909.0
J-29-III		105.5	52.8	158.3	795.0
J-11-III		108.9	54.4	163.3	177.0
J-20-III		108.9	54.4	163.3	324.0
J-10-III		108.9	54.4	163.3	146.0
J-9-III		116.3	58.2	174.5	197.0
J-8-III		123.9	62.0	185.9	136.0
J-13-III		130.5	65.2	195.7	Failed Loading

TABLE CIV

FATIGUE TEST DATA

Material- 17-7 PH TH 1050 Forging
Type of Specimen- Longitudinal - Smooth
Test Temperature-600°F

Test Frequency-Cycles/Minute
A = ∞ - 4300
A = .98 - 1800
A = .50 - 1800

Specimen No.	"A" Ratio	Applied Stress, ksi			Life, Kilocycles
		Sm	Sa	Sc	
J-1	Infinity	0	80.0	80.0	12,092.0+
J-14			85.0	85.0	11,616.0+
J-6			90.0	90.0	5,103.0
J-15			90.0	90.0	3,675.0
J-17			95.0	95.0	120.0
J-5			95.0	95.0	56.0
J-16			95.0	95.0	41.0
J-18			100.0	100.0	102.0
J-4			100.0	100.0	70.0
J-21			105.0	105.0	41.0
H-5	0.98	50.2	49.2	99.4	10,088.0+
H-11		54.6	53.5	108.1	10,028.0+
H-7		55.0	53.9	108.9	13,032.0+
H-3		60.0	58.8	118.8	6,504.0
H-9		60.1	58.9	119.0	12.0
H-10		60.4	59.2	119.6	1,908.0
H-15		64.9	63.6	128.5	79.0
H-2		80.0	78.4	158.4	Failed Loading
H-20	0.50	90.0	45.0	135.0	10,052.0+
H-19		95.5	47.5	142.5	7,417.0
H-16		99.4	49.7	149.1	5,038.0
H-27		100.0	50.0	150.0	5,462.0
H-28		105.0	52.5	157.5	46.0
H-26		106.0	53.0	159.0	28.0
H-24		106.1	53.0	159.2	29.0
H-22		110.0	55.0	165.0	4,748.0
H-29		110.1	55.0	165.1	51.0

TABLE CV

FATIGUE TEST DATA

Material- 17-7 PH TH 1050 Forging
Type of Specimen- Longitudinal - Smooth
Test Temperature- 800°F

Test Frequency - Cycles/Minute
A = ∞ - 4300
A = .98 - 1800
A = .50 - 1800

Specimen No.	"A" Ratio	Applied Stress, ksi			Life, Kilocycles
		Sm	Sa	Sc	
J-3	Infinity	0	75.0	75.0	10,249.0+
J-7			80.0	80.0	10,953.0+
J-2			80.0	80.0	5,676.0
J-22			85.0	85.0	7,890.0
J-30			85.0	85.0	7,365.0
J-24			90.0	90.0	37.0
X-8			90.0	90.0	27.0
J-23			95.0	95.0	38.0
X-15			95.0	95.0	15.0
J-25			100.0	100.0	17.0
H-43-III	0.98	55.0	53.9	108.9	10,051.0+
H-47-III		55.0	53.9	108.9	13,653.0+
H-40-III		58.0	56.8	114.8	8,303.0
H-39-III		58.0	56.8	114.8	2,934.0
H-45-III		58.0	56.8	114.8	2,328.0
H-48-III		60.0	58.8	118.8	506.0
H-32-III		60.0	58.8	118.8	109.0
H-44-III		60.0	58.8	118.8	51.0
H-49-III		65.0	63.7	128.7	26.0
H-46-III		65.0	63.7	128.7	26.0
J-12	0.50	75.0	37.5	112.5	10,000.0+
H-36		75.0	37.5	112.5	9,517.0+
H-33		75.0	37.5	112.5	3,009.0
H-35		80.0	40.0	120.0	10,281.0+
H-30		80.0	40.0	120.0	6,219.0
H-37		85.0	42.5	127.5	7,851.0
J-28		90.0	45.0	135.0	1,999.0
H-34		90.0	45.0	135.0	278.0
H-38		95.0	47.5	142.5	42.0
H-31		96.7	48.3	145	8.0

TABLE CVI

FATIGUE TEST DATA

Material- 17-7 PH, TH 1050 Forging
Type of Specimen- Longitudinal - Notched
Test Temperature- Room

Test Frequency - Cycles/Minute
A = ∞ - 4300
A = .98 - 1050
A = .50 - 1050

Specimen No.	"A" Ratio	Applied Stress, ksi			Life, Kilocycles
		Sm	Sa	Sc	
F-14	Infinity	0	30.0	30.0	10,000.0+
F-19			32.0	32.0	4,491.0
F-16			35.0	35.0	4,348.0
F-15			35.0	35.0	189.0
F-13			40.0	40.0	580.0
F-17			50.0	50.0	125.0
F-20			55.0	55.0	102.0
F-18			60.0	60.0	10.0
F-12			70.0	70.0	9.0
F-11			100.0	100.0	6.0
F-27-III	0.98	28.0	27.5	55.5	10,141.0+
F-28-III		30.4	29.8	60.2	3,457.0
F-29-III		32.6	31.9	64.5	2,266.0
F-22-III		35.1	34.4	69.5	214.0
F-30-III		37.3	36.5	73.8	141.0
F-24-III		46.7	45.6	92.3	54.0
F-21-III		46.7	45.6	92.3	37.0
F-23-III		51.4	50.3	101.7	29.0
F-25-III		56.1	55.0	111.1	9.4
F-26-III		65.4	64.0	129.4	4.1
F-5-III	0.5	32.6	16.3	48.9	11,415.0+
F-8-III		37.3	18.6	55.9	10,699.0+
F-4-III		42.1	21.0	63.1	1,747.0
F-6-III		46.7	23.4	70.1	387.0
F-3-III		56.1	28.0	84.1	108.0
F-2-III		65.4	32.7	98.1	74.0
F-1-III		70.0	35.0	105.0	66.0
F-9-III		84.0	42.0	126.0	59.0
F-10-III		84.0	42.0	126.0	24.0
F-7-III		93.5	46.8	140.3	16.0

TABLE CVII

FATIGUE TEST DATA

Material- 17-7 PH TH 1050 Forging
Type of Specimen- Longitudinal, Notched
Test Temperature- 600°F

Test Frequency - Cycles/Minute
A = ∞ - 4300
A = .98 - 1800
A = .50 - 4300

Specimen No.	"A" Ratio	Applied Stress, ksi			Life, Kilocycles
		Sm	Sa	Sc	
G-4	Infinity	0	30.0	30.0	12,098.0+
G-3			35.0	35.0	1,917.0
G-8			35.0	35.0	337.0
G-5			40.0	40.0	141.0
G-2			40.0	40.0	78.0
F-49			45.0	45.0	98.0
G-6			45.0	45.0	71.0
F-48			50.0	50.0	52.0
G-7			60.0	60.0	22.0
F-47			70.0	70.0	12.0
F-35	0.98	20.2	19.8	40.0	10,037.0+
F-36		30.6	29.4	60.0	10,112.0+
F-38		32.8	32.2	65.0	10,000.0+
F-41		33.3	32.7	66.0	109.0
F-40		33.8	33.2	67.0	75.0
F-39		34.3	33.7	68.0	66.0
F-37		35.4	34.6	70.0	37.0
F-34		40.4	39.6	80.0	27.0
F-33		50.5	49.5	100.0	8.0
F-32		60.6	59.4	120.0	6.0
G-10	0.5	50.0	25.0	75.0	10,000.0+
G-43		50.0	25.0	75.0	5,286.0
G-11		51.7	25.8	77.5	10,258.0+
B-36		53.4	26.6	80.0	12,721.0+
G-12		53.3	26.7	80.0	9,512.0
G-41		53.3	26.7	80.0	75.0
G-13		56.7	28.3	85.0	12,179.0+
B-35		56.7	28.3	85.0	57.0
G-42		60.0	30.0	90.0	37.0
B-34		60.0	30.0	90.0	29.0
B-43		63.4	31.6	95.0	30.0
B-33		66.6	33.3	100.0	24.0
X-22		93.3	46.7	140.0	13.0
X-16		120.0	60.0	180.0	4.0

TABLE C VIII

FATIGUE TEST DATA

Material- 17-7 PH, TH 1050 Forging
Type of Specimen- Longitudinal - Notched
Test Temperature- 800°F

Test Frequency - Cycles/Minute
A = ∞ - 4300
A = .98 - 1800
A = .50 - 1800*

Specimen No.	"A" Ratio	Applied Stress, ksi			Life, Kilocycles
		Sm	Sa	Sc	
G-14	Infinity	0	30.0	30.0	11,286.0+
G-17			32.5	32.5	11,953.0+
G-16			35.0	35.0	5,044.0
G-19			35.0	35.0	555.0
G-18			37.5	37.5	162.0
G-20			37.5	37.5	148.0
G-15			40.0	40.0	115.0
G-21			45.0	45.0	48.0
G-22			50.0	50.0	22.0
G-23			60.0	60.0	12.0
F-45	0.98	25.3	24.7	50.0	10,402.0+
G-35		27.8	27.2	55.0	10,031.0+
G-37		29.0	28.5	57.5	15,103.0+
G-38		29.8	29.2	59.0	85.0
F-44		30.3	29.7	60.0	51.0
G-40		35.4	34.6	70.0	29.0
F-43		35.4	34.6	70.0	19.0
G-39		37.9	37.1	75.0	22.0
F-46		40.4	39.6	80.0	20.0
G-44		40.4	39.6	80.0	15.0
G-24	0.5	43.3	21.7	65.0	10,919.0+
G-33		43.3	21.7	65.0	10,498.0+
G-32		45.0	22.5	67.5	11,701.0+
B-42		46.6	23.3	70.0	12,402.0+*
G-34		46.6	23.3	70.0	12,166.0+
G-31		46.6	23.3	70.0	92.0
G-27		50.0	25.0	75.0	5,378.0
G-30		50.0	25.0	75.0	88.0
B-41		50.0	25.0	75.0	48.0 *
G-28		51.6	25.8	77.5	73.0
G-29		51.6	25.8	77.5	67.0
B-37		53.4	26.6	80.0	635.0
G-25		53.3	26.7	80.0	66.0
B-40		53.4	26.6	80.0	40.0 *
B-39		56.7	28.3	85.0	51.0 *
B-38		60.0	30.0	90.0	30.0 *

S-N Curve - 17-7 PH TH 1050 Forging

Temperature - Room Environment - Air

Ultimate Tensile Strength - 196 Ksi

Tensile Yield Strength - 183 Ksi

Longitudinal, Smooth Specimen Finish 63 Microinches

Axial Sinusoidal Loading

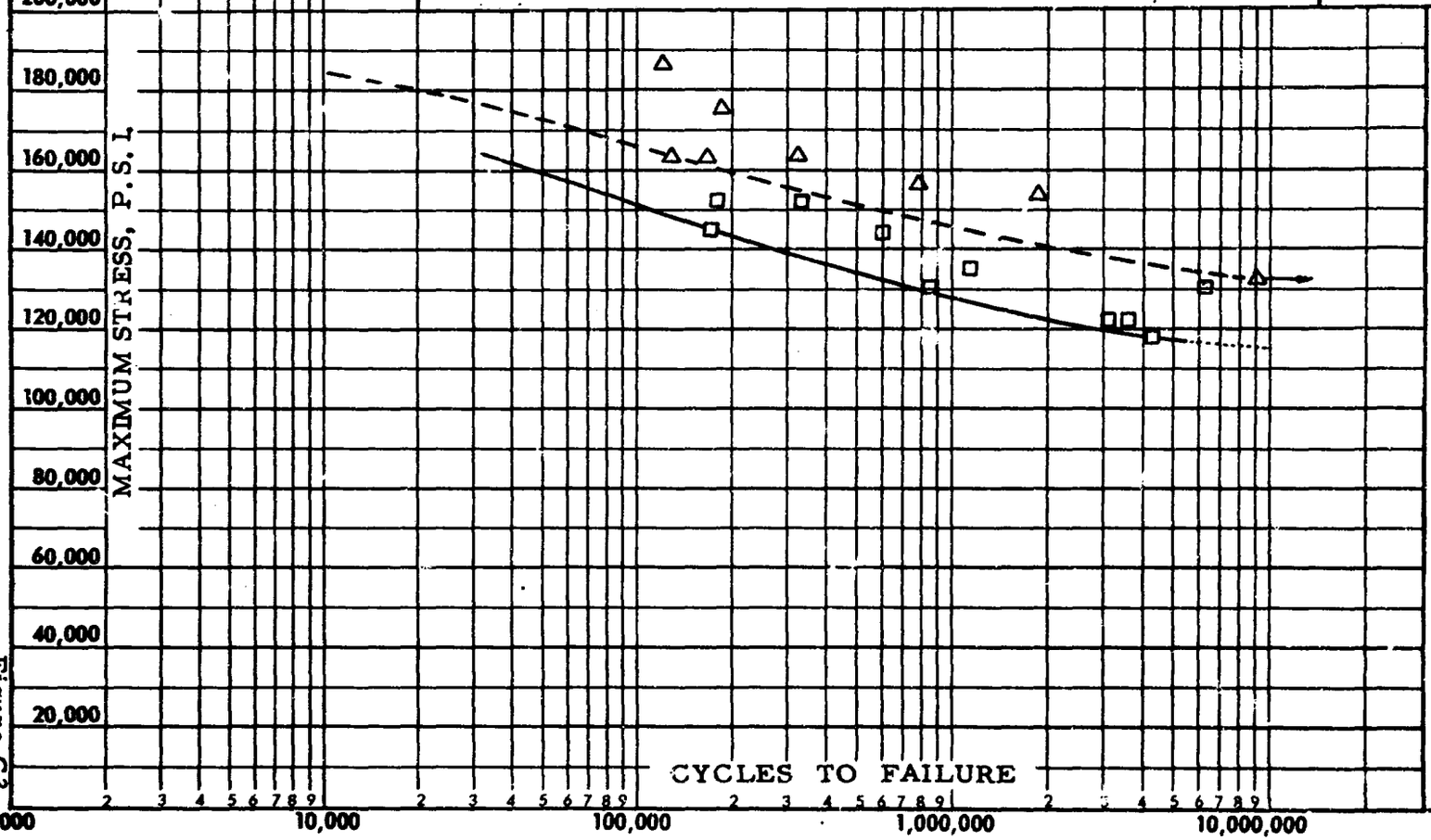
A=. 50 - - - △ - - -

A=. 98 ——□——

SPS LABORATORIES

Chart No.: _____

Date: _____



Test Frequency-Cycles/Minute

A= . 50 - 1050

A= . 98 - 1050

Figure C3

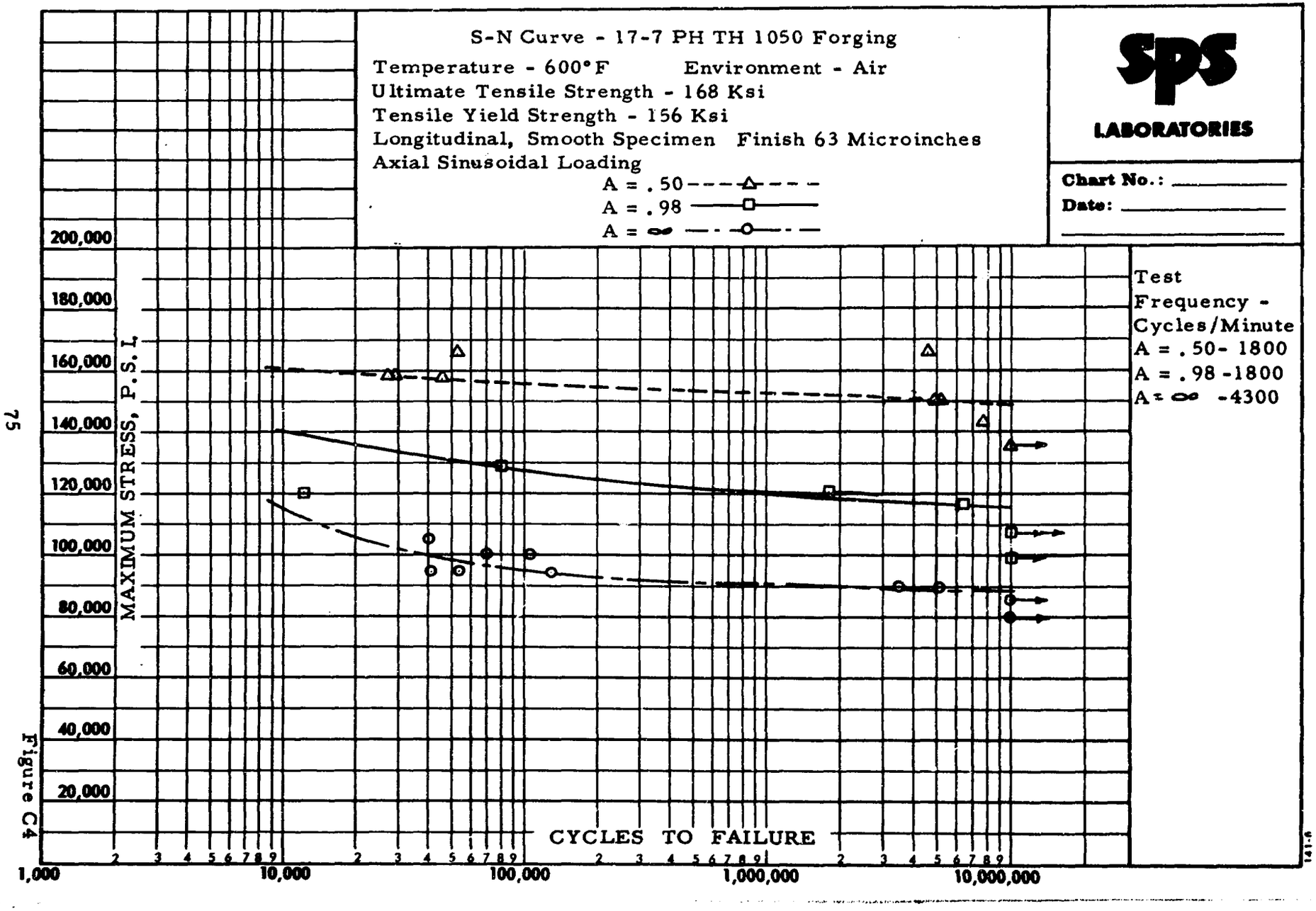

S-N Curve - 17-7 PH TH 1050 Forging
Temperature - 600°F Environment - Air
Ultimate Tensile Strength - 168 Ksi
Tensile Yield Strength - 156 Ksi
Longitudinal, Smooth Specimen Finish 63 Microinches
Axial Sinusoidal Loading
A = .50
A = .98
A = ∞
SPS
LABORATORIES
Chart No.:
Date:
Test Frequency - Cycles/Minute
A = .50 - 1800
A = .98 - 1800
A = ∞ - 4300
MAXIMUM STRESS, P.S.I.
200,000
180,000
160,000
140,000
120,000
100,000
80,000
60,000
40,000
20,000
CYCLES TO FAILURE
1,000
10,000
100,000
1,000,000
10,000,000
141-6

Figure C4

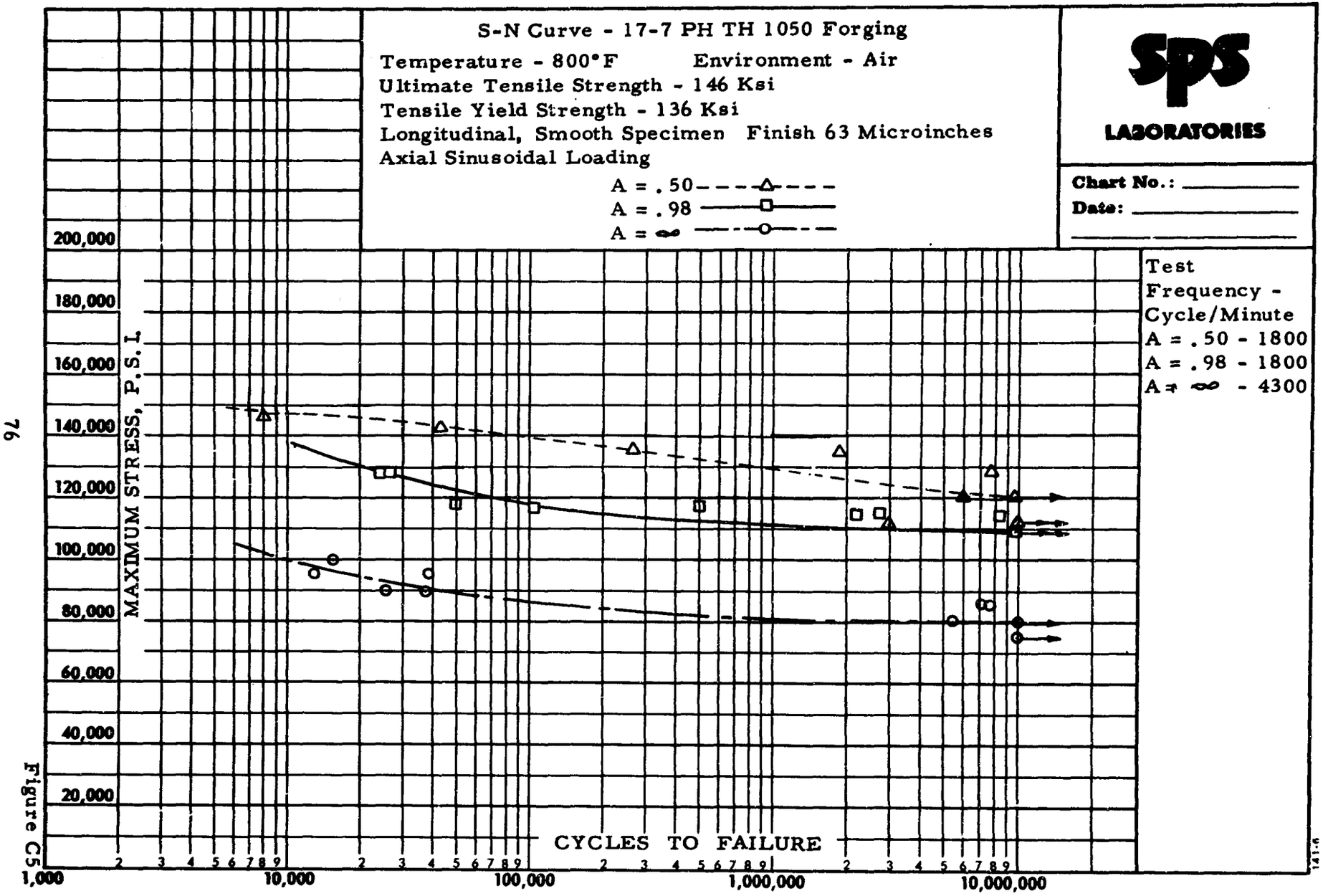
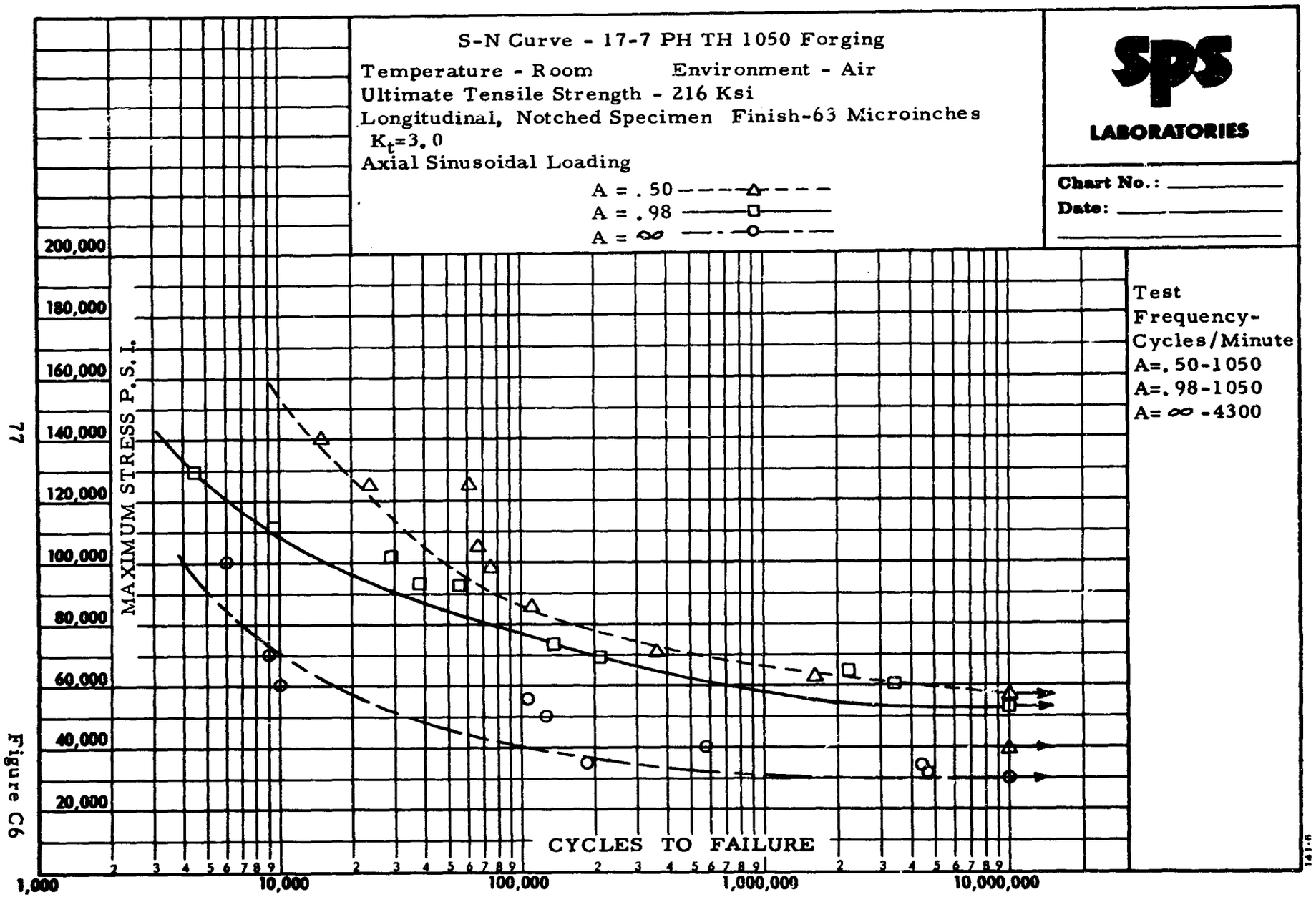
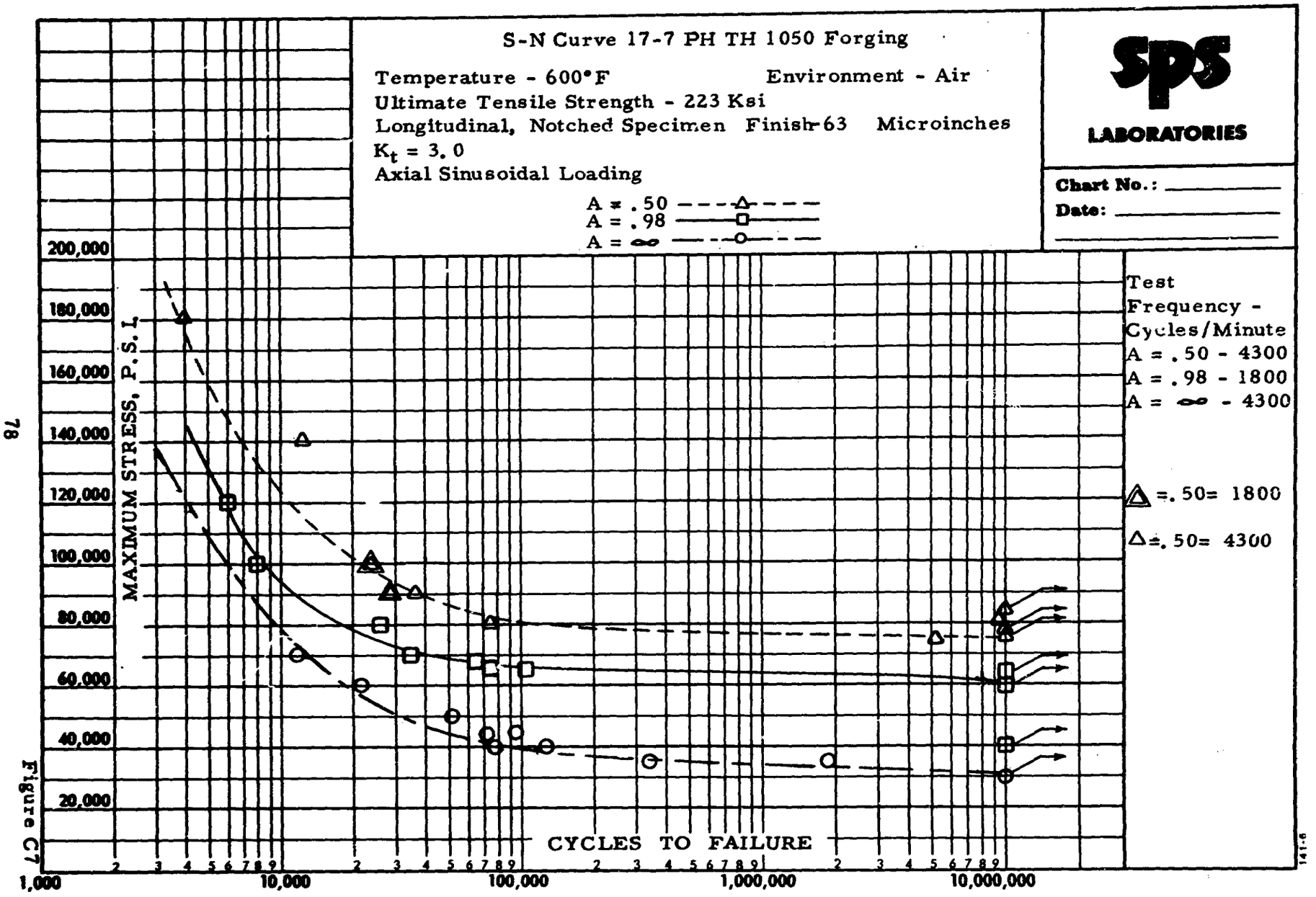

S-N Curve - 17-7 PH TH 1050 Forging
Temperature - 800°F Environment - Air
Ultimate Tensile Strength - 146 Ksi
Tensile Yield Strength - 136 Ksi
Longitudinal, Smooth Specimen Finish 63 Microinches
Axial Sinusoidal Loading
A = .50
A = .98
A = ∞
SPS
LABORATORIES
Chart No.:
Date:
Test Frequency - Cycle/Minute
A = .50 - 1800
A = .98 - 1800
A = ∞ - 4300
MAXIMUM STRESS, P.S.I.
200,000
180,000
160,000
140,000
120,000
100,000
80,000
60,000
40,000
20,000
CYCLES TO FAILURE
1,000
10,000
100,000
1,000,000
10,000,000
141-6

Figure C5


S-N Curve - 17-7 PH TH 1050 Forging
Temperature - Room Environment - Air
Ultimate Tensile Strength - 216 Ksi
Longitudinal, Notched Specimen Finish-63 Microinches
K_t=3.0
Axial Sinusoidal Loading
A = .50
A = .98
A = ∞
SPS LABORATORIES
Chart No.:
Date:
Test Frequency-Cycles/Minute
A=.50-1050
A=.98-1050
A= ∞ -4300
MAXIMUM STRESS P.S.I.
200,000
180,000
160,000
140,000
120,000
100,000
80,000
60,000
40,000
20,000
CYCLES TO FAILURE
1,000
10,000
100,000
1,000,000
10,000,000
141-6

77

Figure C6


S-N Curve 17-7 PH TH 1050 Forging
Temperature - 600°F
Environment - Air
Ultimate Tensile Strength - 223 Ksi
Longitudinal, Notched Specimen Finish-63 Microinches
K_t = 3.0
Axial Sinusoidal Loading
A = .50
A = .98
A = ∞
SPS
LABORATORIES
Chart No.:
Date:
Test Frequency - Cycles/Minute
A = .50 - 4300
A = .98 - 1800
A = ∞ - 4300
△ = .50 = 1800
△ = .50 = 4300
MAXIMUM STRESS, P.S.I.
200,000
180,000
160,000
140,000
120,000
100,000
80,000
60,000
40,000
20,000
CYCLES TO FAILURE
1,000
10,000
100,000
1,000,000
10,000,000
141-6

78

Figure C7

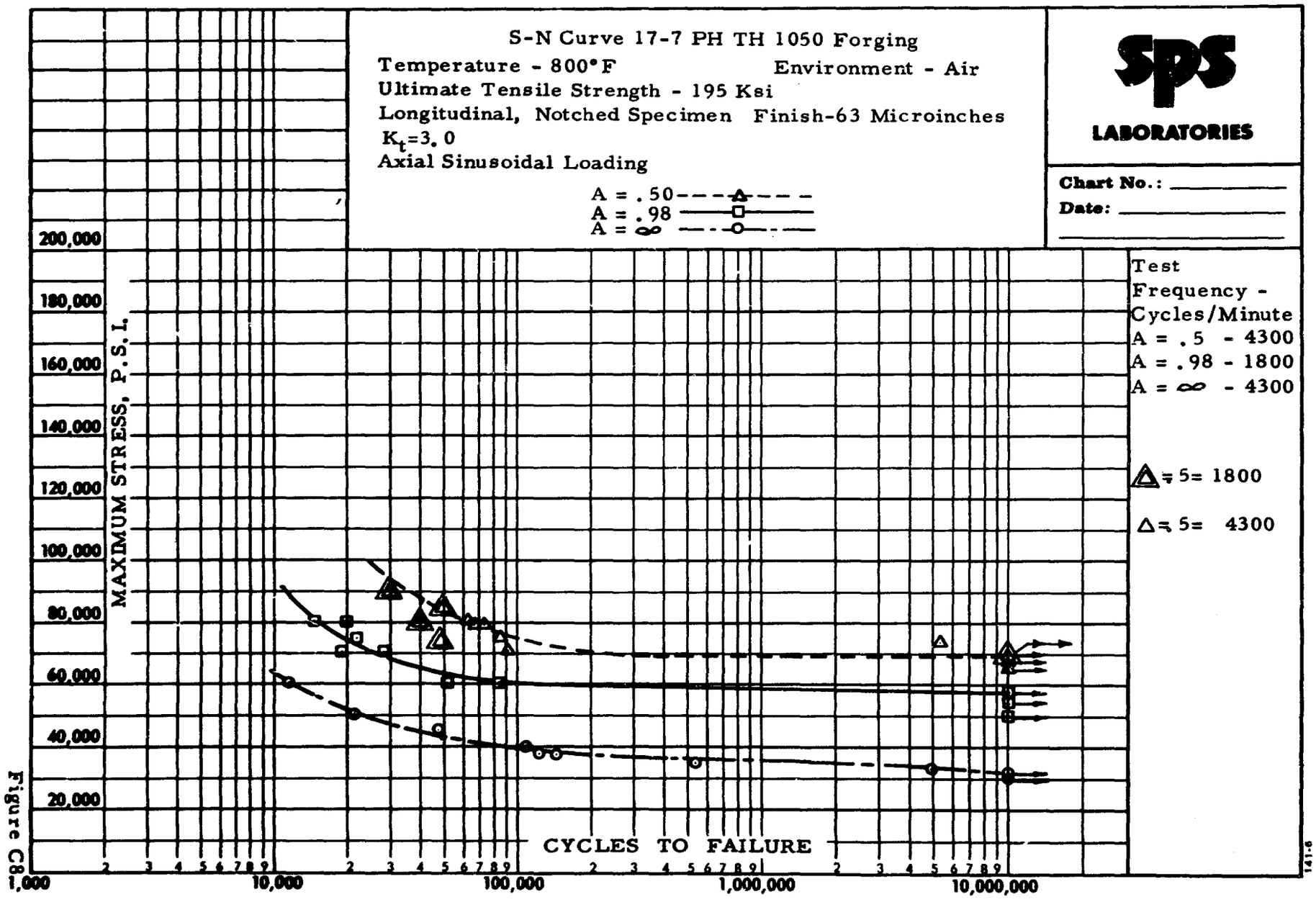
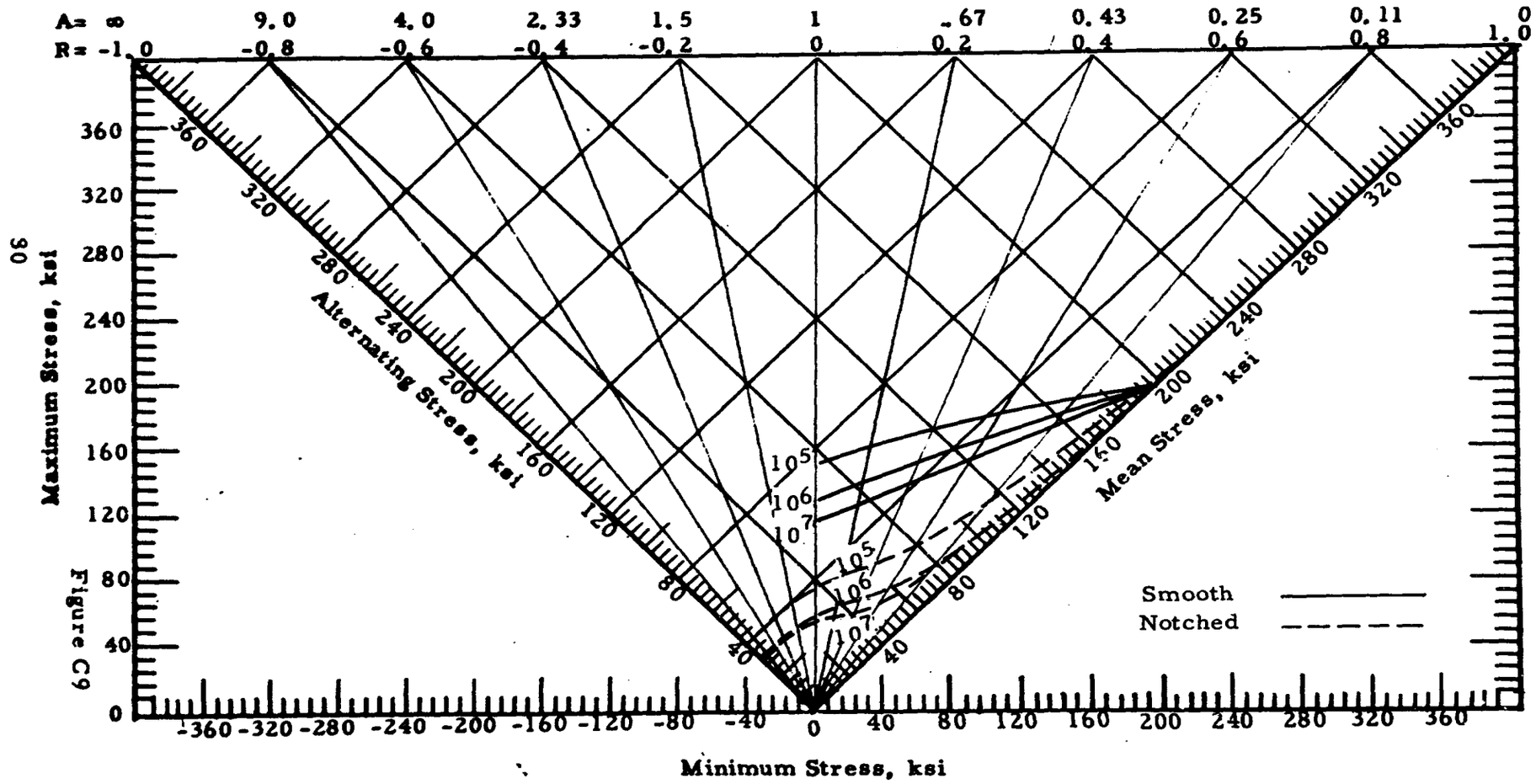
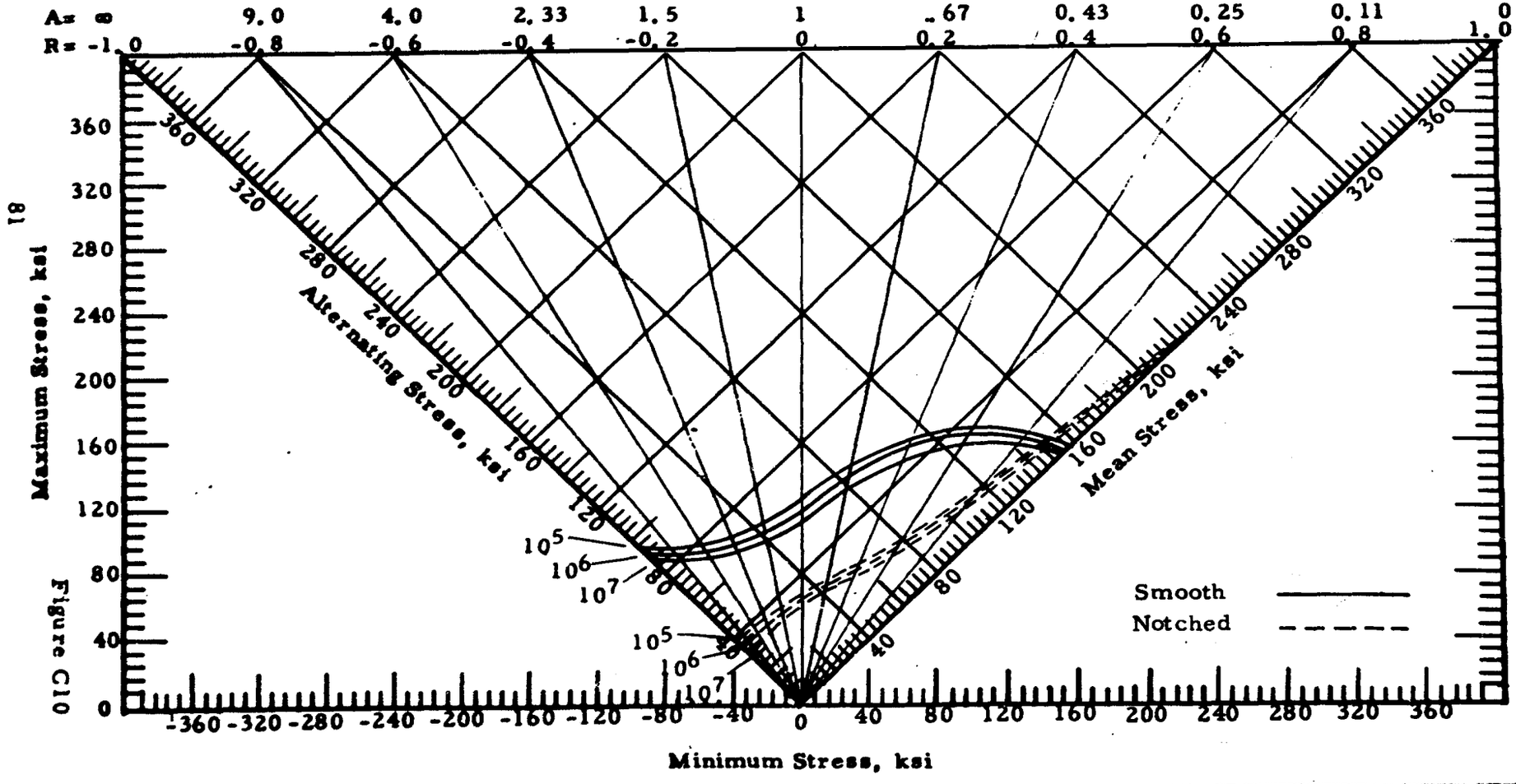

S-N Curve 17-7 PH TH 1050 Forging
Temperature - 800°F
Environment - Air
Ultimate Tensile Strength - 195 Ksi
Longitudinal, Notched Specimen Finish-63 Microinches
K_t=3.0
Axial Sinusoidal Loading
A = .50
A = .98
A = ∞
SPS
LABORATORIES
Chart No.:
Date:
Test Frequency - Cycles/Minute
A = .5 - 4300
A = .98 - 1800
A = ∞ - 4300
= 5= 1800
= 5= 4300
MAXIMUM STRESS, P.S.I.
200,000
180,000
160,000
140,000
120,000
100,000
80,000
60,000
40,000
20,000
CYCLES TO FAILURE
1,000
10,000
100,000
1,000,000
10,000,000
141-6

Figure C8

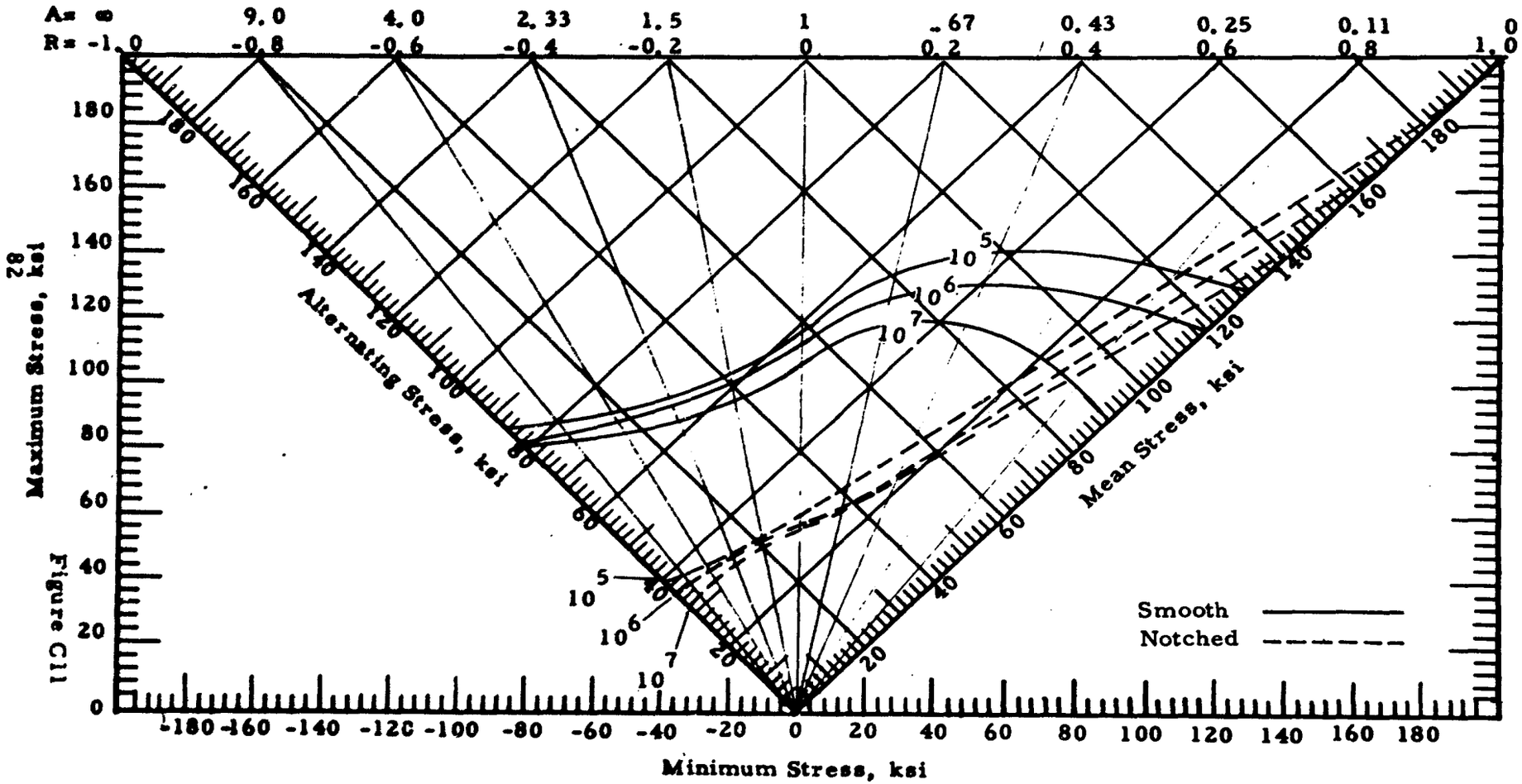
CONSTANT LIFE DIAGRAM- 17-7 PH TH 1050 FORGING
Temperature - Room
Ultimate Tensile Strength - Smooth- 196 KSI-- Notched (K_t=3.0)-216 KSI
Tensile Yield Strength- Smooth- 183 KSI
Axial Sinusoidal Loading
Environment - Air
Specimen Finish - 63 Microinches



CONSTANT LIFE DIAGRAM 17-7 PH TH 1050 FORGING
Temperature - 600°F
Ultimate Tensile Strength - Smooth - 168 KSI -- Notched (K_t=3.0)-223 KSI
Tensile Yield Strength - Smooth - 156 KSI
Axial Sinusoidal Loading
Environmental - Air
Specimen Finish - 63 Microinches



CONSTANT LIFE DIAGRAM - 17-7 PH TH 1050 FORGING
Temperature - 800°F
Ultimate Tensile Strength - Smooth 146 Ksi - Notched (K_t=3.0)-195 Ksi
Tensile Yield Strength - Smooth - 136 Ksi
Axial Sinusoidal Loading
Environment - Air
Specimen Finish - 63 Microinches



SECTION VD

PH 15-7 Mo RH 950 SHEET

TABLE DI

TENSILE TEST DATA FOR PH 15-7 Mo, RH 950 SHEET MATERIAL

		Smooth				Notched K_t = 3.0	
Test Temp.	Specimen Orientation	Spec. No.	Ult. Tensile Strength, ksi	0.2% Offset Yield Strength, ksi	Elongation in 2 inches %	Specimen	Ultimate Tensile Strength, ksi
Room	L	—	—	—	—	QA-1	263.4
						QA-2	263.8
						QA-3	264.9
							264.0
	T	—	—	—	—	TA-30	272.0
						TA-31	274.7
						TA-32	273.8
							273.5
600°F	L	P-14	206.2	176.8	5.5	QA-9	226.3
		P-15	204.7	175.8	5.5	QA-8	226.4
		P-16	204.7	188.1	5.0	QA-7	223.3
			205.2	180.2	5.3		225.3
	T	U-1	209.1	177.2	5.0	RA-40	225.4
		U-2	209.8	185.3	5.0	RA-42	224.2
		U-3	210.1	181.2	5.0	RA-39	224.0
			209.3	181.2	5.0		224.5
1000°F	L	P-5	106.8	89.0	14.5	QA-6	138.4
		P-12	112.7	94.5	12.0	QA-5	137.2
		P-13	109.4	83.0	13.0	QA-4	138.1
			109.6	88.8	13.2		137.9
	T	U-4	106.0	100.4	7.5	TA-33	102.1
		U-5	113.2	95.7	11.0	TA-34	131.1
		U-6	120.6	101.2	10.5	TA-35	121.8
			113.3	99.1	9.7		118.3

PRECEDING PAGE BLANK

TABLE DII

STRESS RUPTURE DATA FOR PH 15-7 MO, RH 950 SHEET MATERIAL 0.050 THICK - TRANSVERSE

Spec. No.	K_t	Test Temp.	Stress ksi	Life Hours
U-8	1.0	600°F	205.0	<0.05
S-11			200	14.6
S-26			197.5	46.2
U-9			195.0	190.2
U-7			185.0	572.2+
S-31	1.0	1000°F	100	0.1
S-30			75	7.5
S-29			65	24.7
S-27			60	98.2
S-28			55	183.2+
TA29	3.0	600°F	220.0	0.1
TA27			216.0	6.1
TA26			214.0	35.8
TA25			212	7.0
TA28			210	279.5+
U-48	3.0	1000°F	70	19.5
TA37			68	26.1
TA36			65	100.0
U-47			60	138.8
U-49			58	285.5+

PH 15-7 Mo RH 950 SHEET
STRESS VS. TIME TO RUPTURE

Notched ----o----

Smooth ——△——

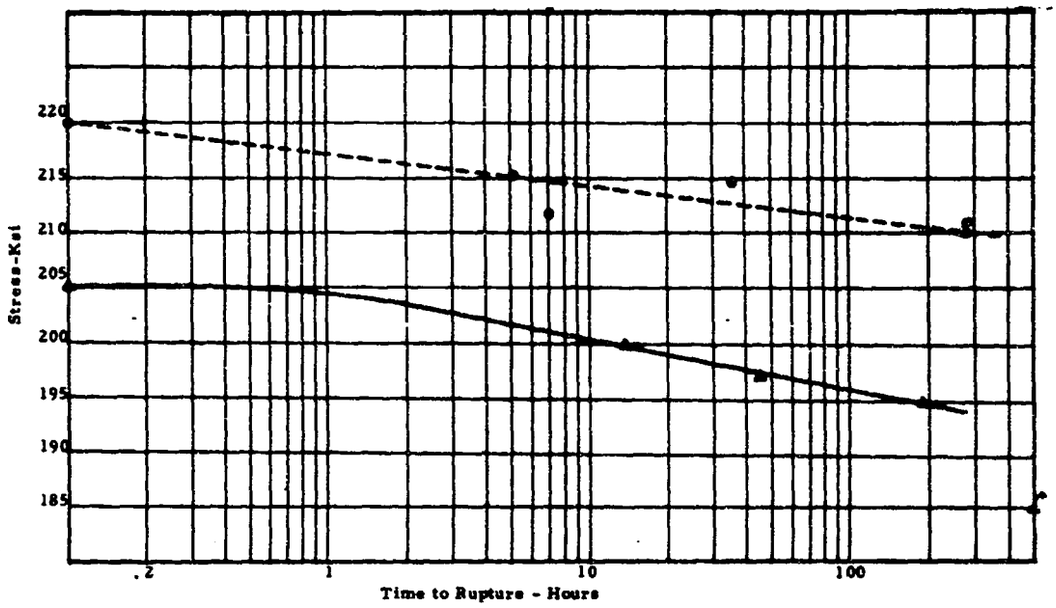


Figure D1-600°F

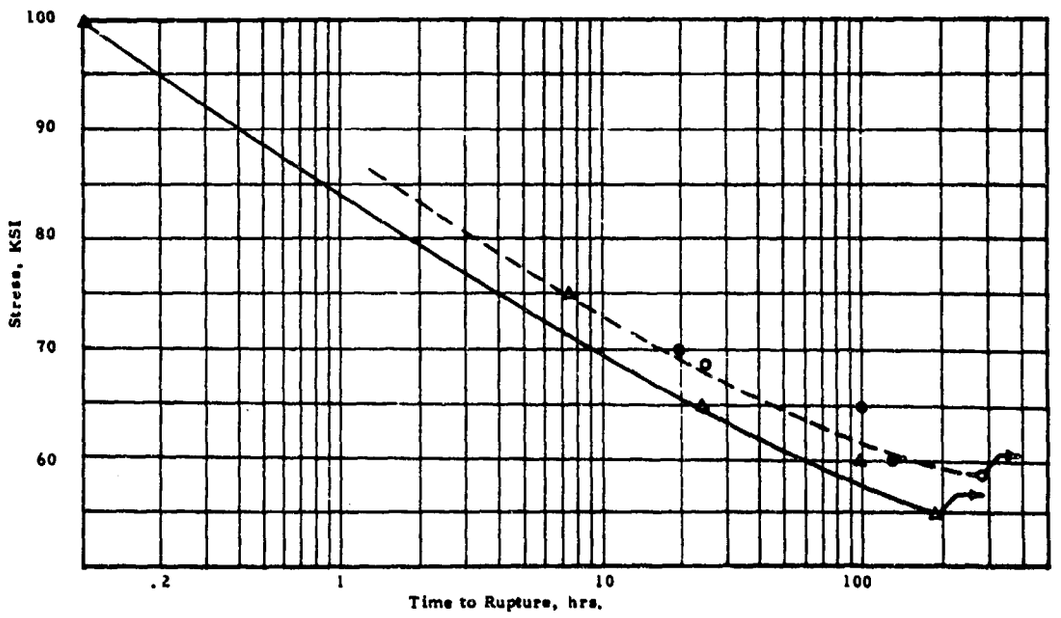


Figure D2-1000°F

TABLE DIII

FATIGUE TEST DATA

Material- PH 15-7 Mo, RH 950 Sheet Material
Type of Specimen- Transverse- Smooth
Test Temperature-600°F

Test Frequency - Cycles/Minute
A = .98 - 1200
A = .50 - 1200

Specimen No.	"A" Ratio	Applied Stress, ksi			Life, Kilocycles
		Sm	Sa	Sc	
S34	0.98	50.5	49.5	100.0	10,000.0+
S45		50.5	49.5	100.0	10,000.0+
S36		55.5	54.5	110.0	7,231.0
S37		60.6	59.4	120.0	2,776.0
S38		63.1	61.9	125.0	1,763.0
S40		65.7	64.3	130.0	902.0
S46		70.7	69.3	140.0	660.0
S39		70.7	69.3	140.0	350.0
S24		75.7	74.3	150.0	20.0
S32	0.5	48.0	24.0	72.0	10,000.0+
S20		52.0	26.0	78.0	10,000.0+
S18		64.0	32.0	96.0	8,900.0+
S16		72.0	36.0	108.0	10,000.0+
TA14		80.0	40.0	120.0	10,584.0+
TA12		85.0	42.5	127.5	7,916.4
TA11		90.0	45.0	135.0	9,086.0
S14		100.0	50.0	150.0	57.0
S15		103.3	51.7	155.0	24.0
S17		106.5	53.5	160.0	22.0

TABLE DIV

FATIGUE TEST DATA

Material- PH 15-7 Mo RH950 Sheet Material
Type of Specimen- Transverse-Smooth
Test Temperature- 1000°F

Test Frequency - Cycles/Minute
A=. 98 - 3600
A=. 50 - 1200

Specimen No.	"A" Ratio	Applied Stress, ksi			Life, Kilocycles
		Sm	Sa	Sc	
TA-48	0.98	36.1	35.3	72.8	10,000.0+
TA-47		37.9	37.1	75.0	6,566.0
TA-46		38.5	37.7	77.5	3,220.0
RA-47		40.4	39.6	80.0	8,503.0
RA-46		42.9	42.1	85.0	4,690.0
TA-42		45.5	44.6	90.0	2,657.0
TA-43		48.0	47.0	95.0	964.0
TA-44		50.5	49.5	100.0	50.0
TA-45		53.0	52.0	105.0	29.0
TA-49		58.3	57.2	116.0	2,111.0
TA 10	0.50	53.4	26.6	80.0	10,000.0+
TA 20		56.7	28.3	85.0	9,238.0
TA 3		60.0	30.0	90.0	3,218.0
TA 2		63.4	31.6	95.0	1,931.0
TA 6		66.7	33.3	100.0	647.0
TA 1		73.4	36.6	110.0	383.0
S 12		80.0	40.0	120.0	178.0
S 13		86.7	43.3	130.0	63.0

TABLE DV

FATIGUE TEST DATA

Material- PH 15-7 Mo RH 950 Sheet Material
Type of Specimen- Transverse Notched
Test Temperature- Room

Test Frequency-Cycles/minute
A= .98-1200
A= .50-1200

Specimen No.	"A" Ratio	Applied Stress, ksi			Life, Kilocycles
		Sm	Sa	Sc	
RA-32	0.98	21.9	21.5	43.4	10,130.0+
RA-21		24.1	23.9	48.0	11,600.0
RA-27		25.9	25.4	51.3	2,259.0
RA-23		26.0	25.4	51.4	2,437.0
RA-3		26.2	25.7	51.9	191.0
RA-24		27.8	27.2	55.0	247.0
RA-22		28.2	27.3	55.5	218.0
RA-32		32.0	31.4	63.4	64.0
RA-25		39.6	38.8	78.4	26.0
RA-28		48.3	47.2	95.5	10.0
U-14	0.50	40.3	20.1	60.4	4,042.0
RA-9		43.4	21.7	65.0	1,477.0
RA-20		43.8	21.9	65.7	10,147.4+
RA-13		44.2	22.1	66.3	10,000.0+
RA-11		46.0	23.0	69.0	1,759.6
RA-5		46.7	23.3	70.0	68.0
RA-8		50.0	25.0	75.0	52.0
RA-7		53.4	26.6	80.0	34.0
RA-6		60.0	30.0	90.0	14.0

TABLE DVI

FATIGUE TEST DATA

Material- PH 15-7 Mo, RH 950 Sheet Material
Type of Specimen- Transverse, Notched
Test Temperature-600°F

Test Frequency-Cycles/Minute
A = .98 -1200
A = .50 -1200

Specimen No.	"A" Ratio	Applied Stress, ksi			Life, Kilocycles
		Sm	Sa	Sc	
U-16	0.98	25.3	24.8	50.0	12,750.0+
RA-45		27.8	27.2	55.0	10,294.0+
RA-44		30.3	29.7	60.0	8,900.0+
RA-43		32.8	32.2	65.0	47.0
U-17		35.4	34.7	70.0	20.0
U-15		35.4	34.7	70.0	15.0
U-18		50.5	49.5	100.0	4.0
U-19		63.1	61.9	125.0	2.0
RA-36	0.50	33.3	16.7	50.0	10,885.0+
TA-22		40.0	20.0	60.0	10,317.0+
TA-21		43.4	21.6	65.0	3,208.0
RA-38		46.7	23.3	70.0	9,297.0
RA-37		53.4	26.6	80.0	1,072.0
TA-24		56.7	28.3	85.0	11.0
TA-23		60.0	30.0	90.0	11.0
RA-35		66.7	33.3	100.0	5.0
RA-34		100.0	50.0	150.0	2.0
RA-33		133.3	66.7	200.0	1.0

TABLE DVII

FATIGUE TEST DATA

Material- PH 15-7 Mo RH 950 Sheet Material
Type of Specimen- Transverse, Notched
Test Temperature-1000°F

Test Frequency- Cycles/Minute
A= .98-1200
A= .50-1200

Specimen No.	"A" Ratio	Applied Stress, ksi			Life, Kilocycles
		Sm	Sa	Sc	
U-46	0.98	15.2	14.9	30.0	10,034.0+
U-44		16.4	15.3	32.5	2,798.0
U-45		16.4	15.3	32.5	518.0
U-43		17.7	17.3	35.0	8,230.0
RA-29		20.2	19.8	40.0	1,643.0
U-42		20.2	19.8	40.0	548.0
RA-26		22.7	22.3	45.0	924.0
TA-38		22.7	22.3	45.0	90.0
RA-14		25.3	24.8	50.0	8.0
TA-40		40.4	39.6	80.0	3.0
U-27	0.50	26.7	13.3	40.0	10,000.0+
U-25		30.0	15.0	45.0	6,410.0
U-23		33.3	16.7	50.0	4,422.0
U-29		36.7	18.3	55.0	668.0
U-30		40.0	20.0	60.0	794.0
U-26		43.4	21.6	65.0	58.0
U-31		46.7	23.3	70.0	123.0
U-22		53.4	26.6	80.0	28.0
U-24		60.0	30.0	90.0	8.0

S-N Curve for PH 15-7 Mo RH950 Sheet

Temperature - 600°F Environment - Air

Ultimate Tensile Strength - 209 Ksi

Tensile Yield Strength - 181 Ksi

Transverse, Smooth Specimen Finish - 63 Microinches

Axial Sinusoidal Loading

A = .50 - - - △ - - -

A = .98 ——□——

SPS LABORATORIES

Chart No.: _____

Date: _____

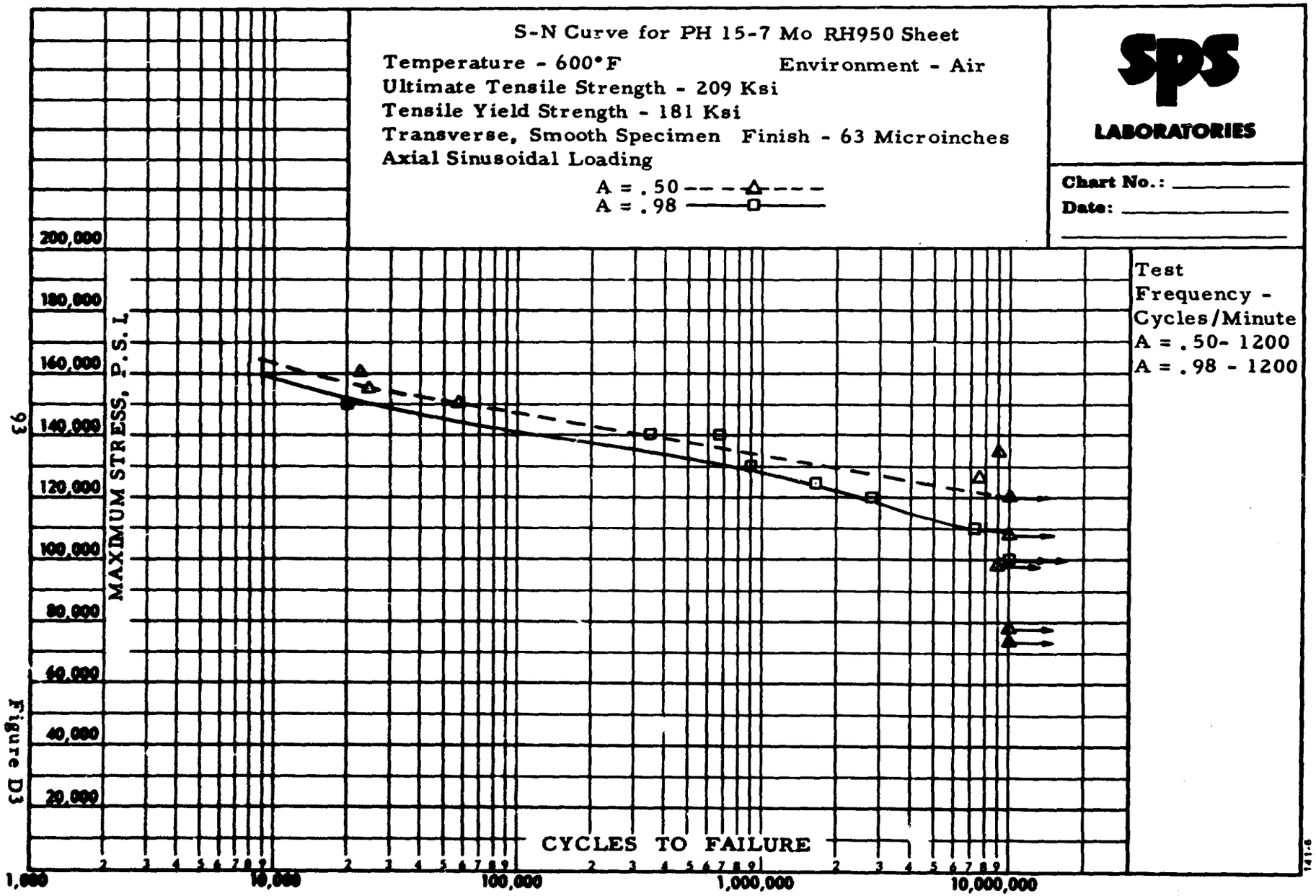


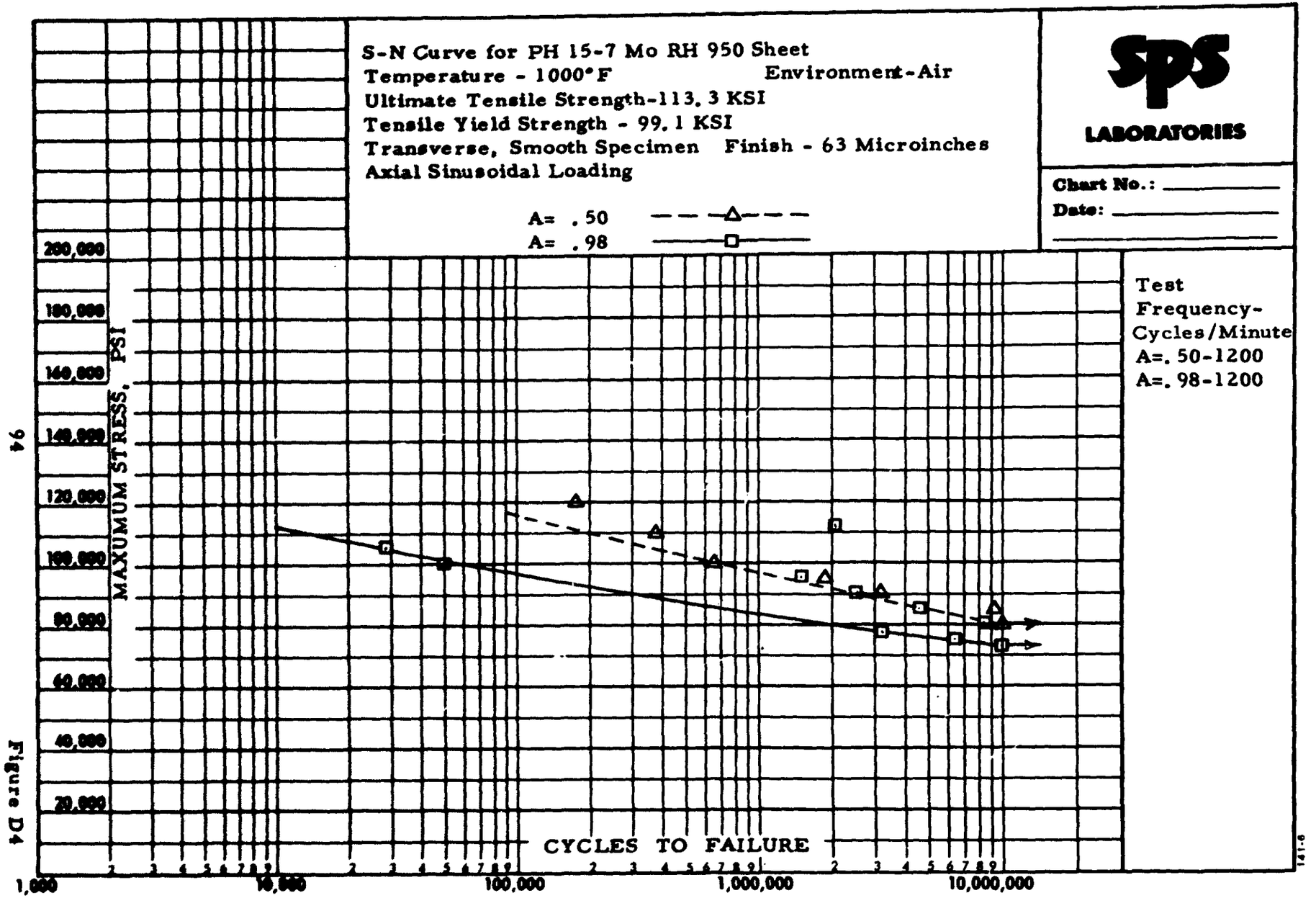
Figure D3

S-N Curve for PH 15-7 Mo RH 950 Sheet
Temperature - 1000°F Environment-Air
Ultimate Tensile Strength-113.3 KSI
Tensile Yield Strength - 99.1 KSI
Transverse, Smooth Specimen Finish - 63 Microinches
Axial Sinusoidal Loading

A= .50 — — —△— — —
A= .98 ———□———

SPS LABORATORIES

Chart No.: _____
Date: _____



Test Frequency-Cycles/Minute
A=.50-1200
A=.98-1200

141-6

94

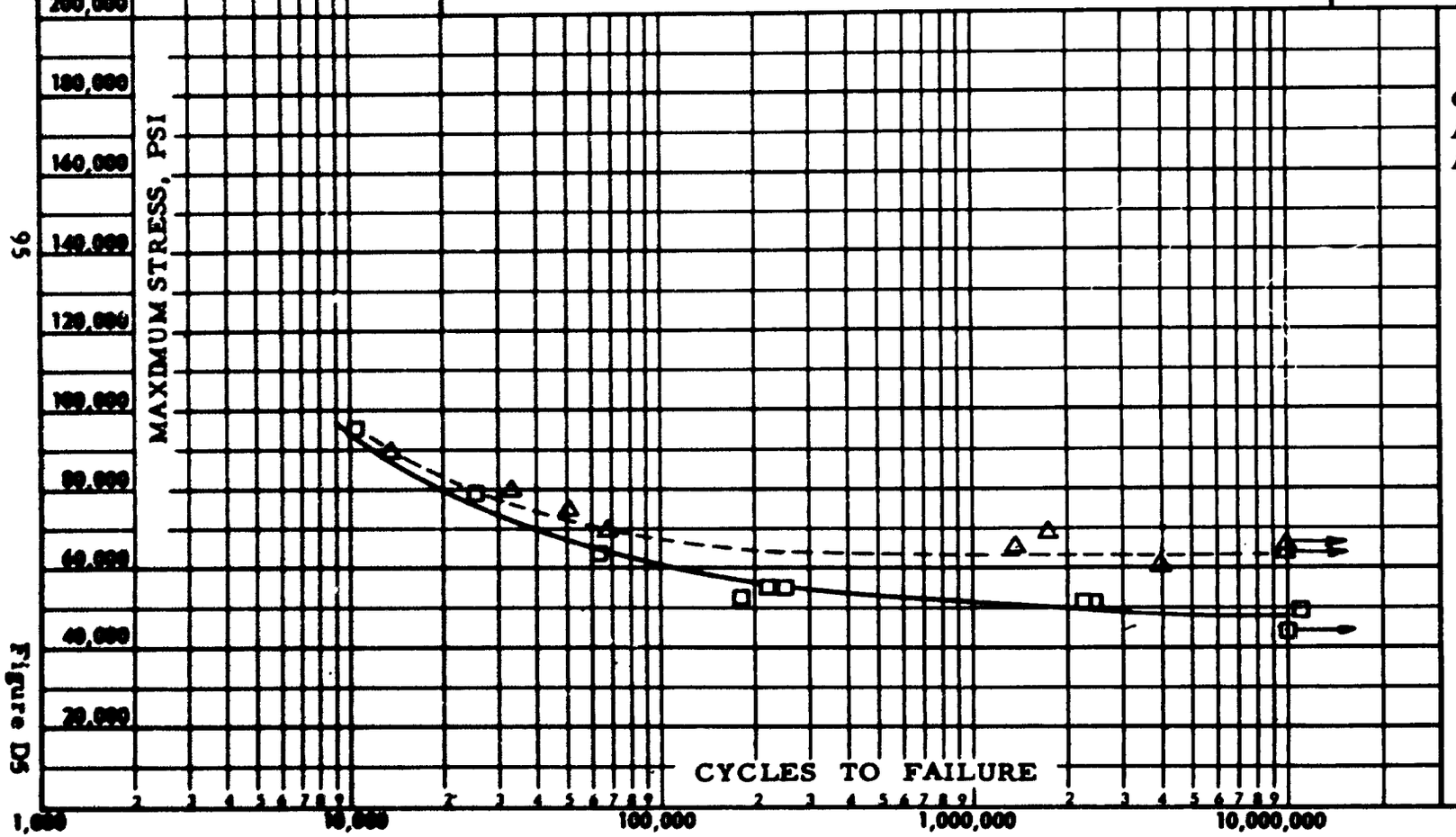
Figure D4

S-N Curve PH 15-7 Mo RH 950 Sheet
Temperature - Room Environment - Air
Ultimate Tensile Strength - 273 ksi
Transverse, Notched Specimen Finish-63 Microinches
K_t=3.0
Axial, Sinusoidal Loading
A=.50 - - - △ - - -
A=.98 ——□——

SPS LABORATORIES

Chart No.: _____
Date: _____

Test Frequency-Cycles/minute
A=.50-1200
A=.98-1200



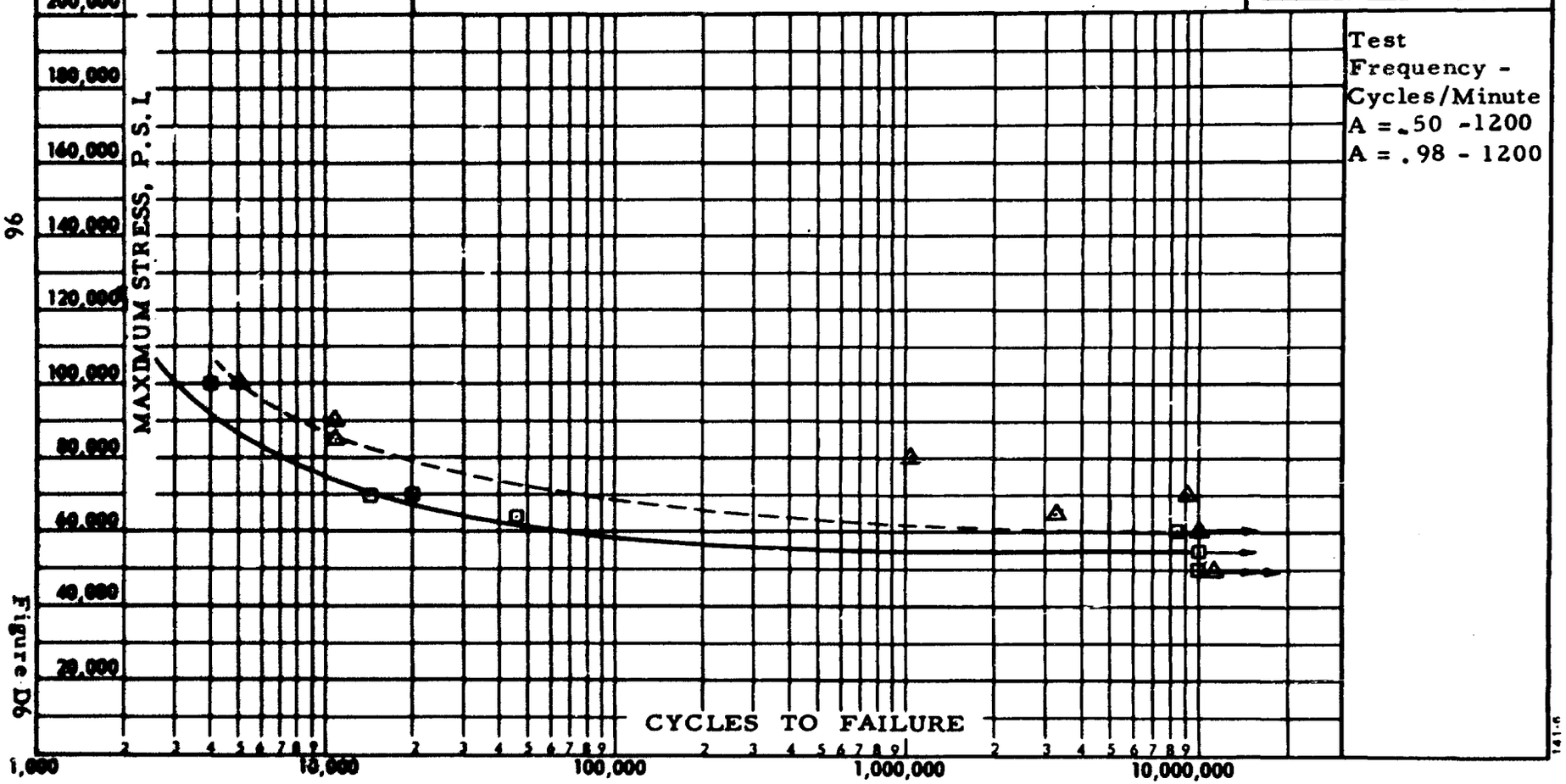
95

Figure D5

S-N Curve - PH 15-7 Mo RH 950 Sheet
Temperature - 600°F Environment - Air
Ultimate Tensile Strength - 225 Ksi
Transverse, Notched Specimen Finish-63 Microinches
K_t=3.0
Axial Sinusoidal Loading
A = .50
A = .98

SPS LABORATORIES

Chart No.: _____
Date: _____



96

Figure D6

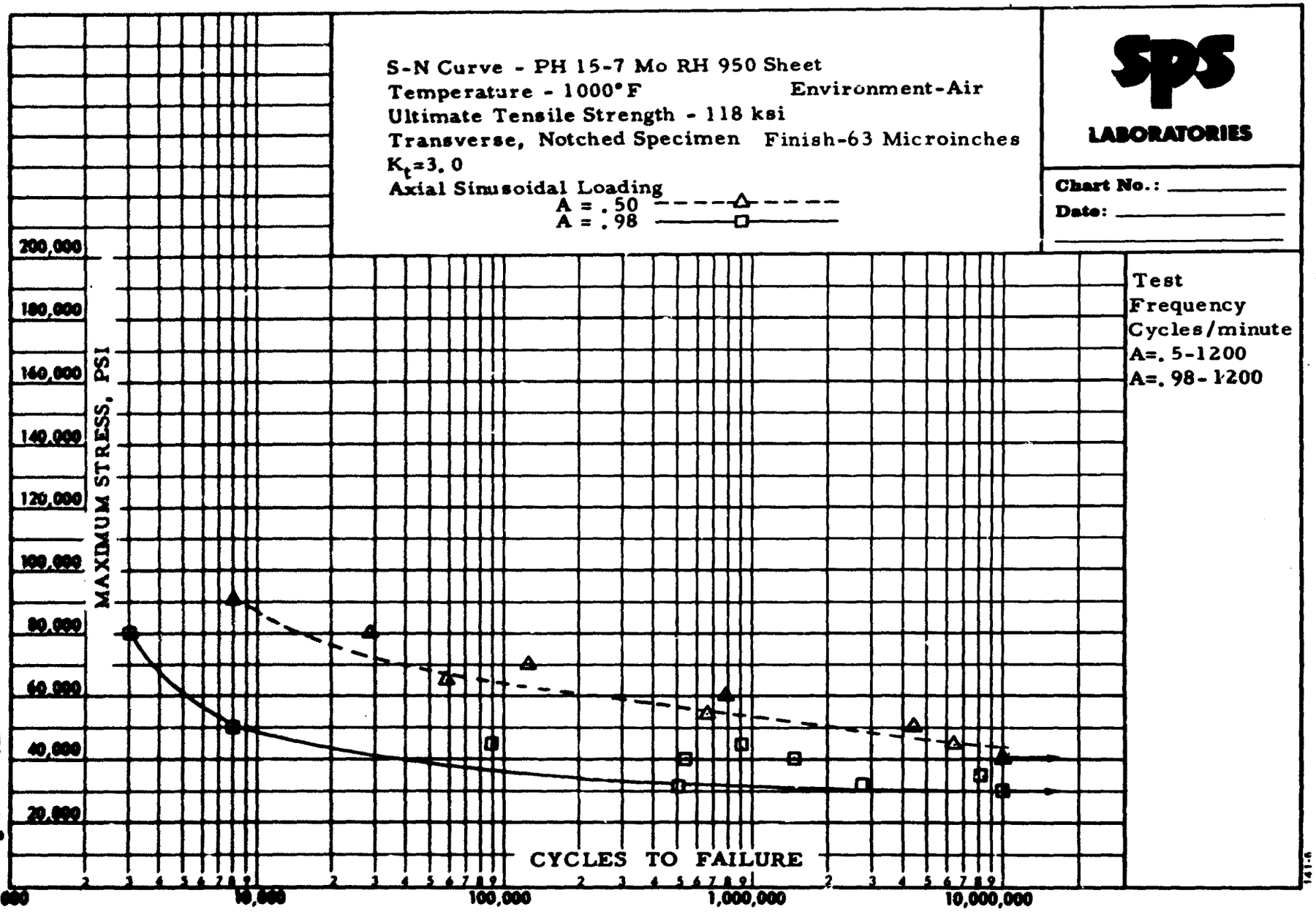
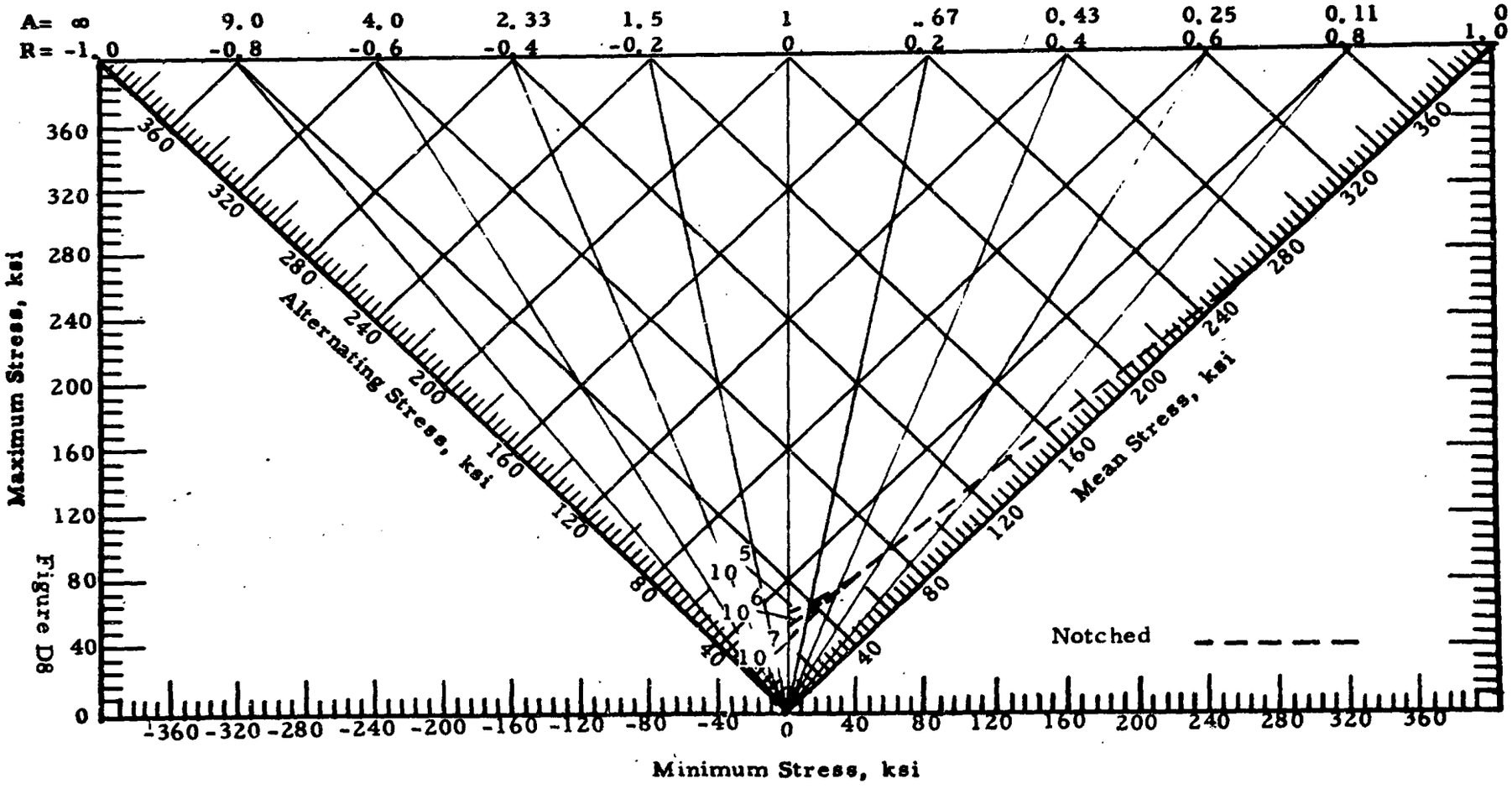

S-N Curve - PH 15-7 Mo RH 950 Sheet
Temperature - 1000°F
Environment-Air
Ultimate Tensile Strength - 118 ksi
Transverse, Notched Specimen
Finish-63 Microinches
K_t=3.0
Axial Sinusoidal Loading
A = .50
A = .98
SPS
LABORATORIES
Chart No.:
Date:
Test
Frequency
Cycles/minute
A=.5-1200
A=.98-1200
MAXIMUM STRESS, PSI
200,000
180,000
160,000
140,000
120,000
100,000
80,000
60,000
40,000
20,000
CYCLES TO FAILURE
1,000
10,000
100,000
1,000,000
10,000,000
141-6

Figure D7

CONSTANT LIFE DIAGRAM - PH 15-7 Mo RH 950 SHEET
Temperature - Room
Ultimate Tensile Strength - Notched (K_t=3.0)-273.5 KSI
Axial Sinusoidal Loading
Environment - Air
Specimen Finish - 63 Microinches



CONSTANT LIFE DIAGRAM - PH 15-7 Mo RH 950 SHEET
Temperature - 600°F
Ultimate Tensile Strength-Smooth-209 KSI-Notched (K_t=3.0)-224 KSI
Tensile Yield Strength- Smooth - 181 KSI
Axial Sinusoidal Loading
Environment - Air
Specimen Finish - 63 Microinches

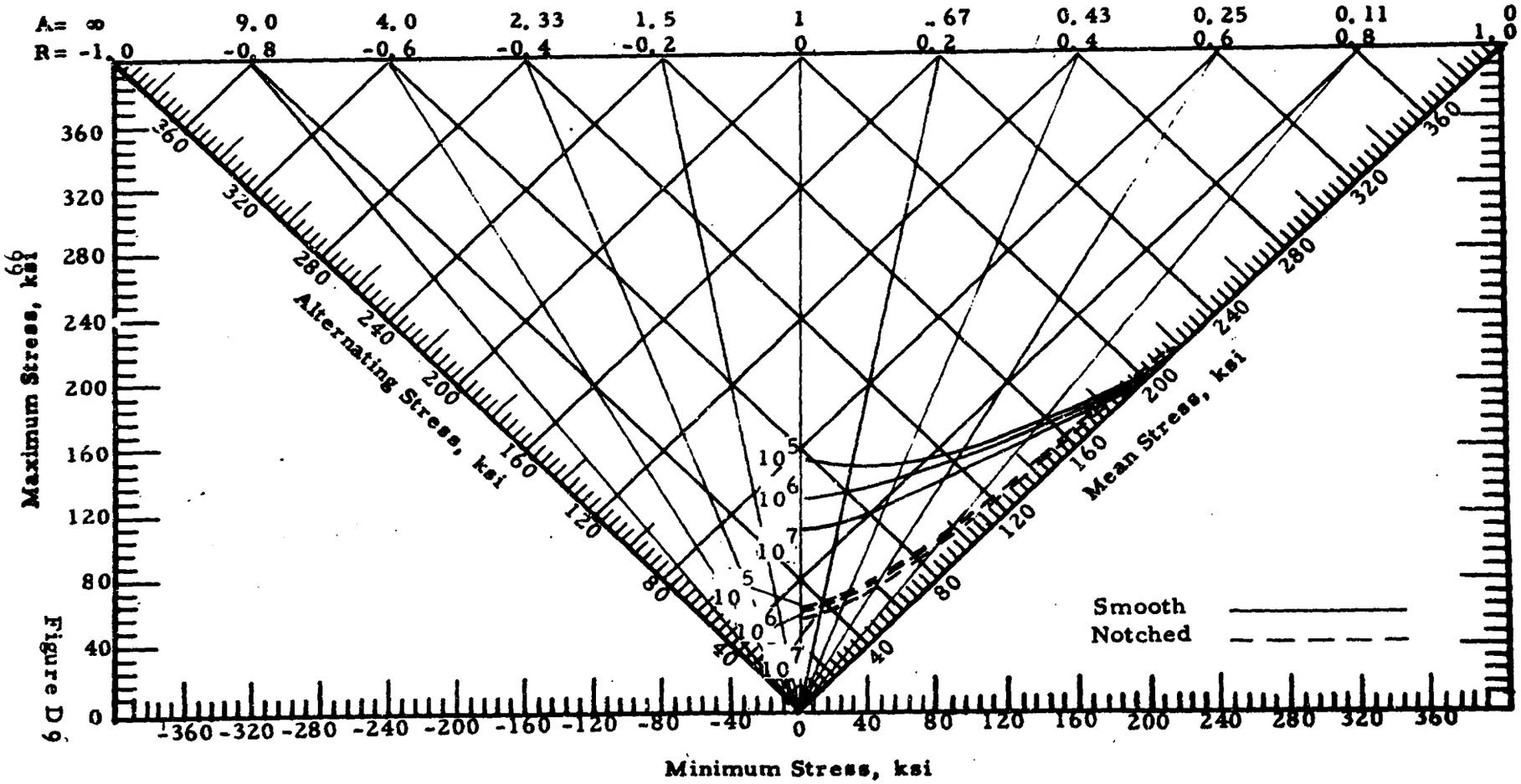


Figure D 9

CONSTANT LIFE DIAGRAM - PH 15-7 Mo RH 950 SHEET
Temperature - 1000°F
Ultimate Tensile Strength-Smooth-113.3 KSI- Notched (K_t=3.0)-118 KSI
Tensile Yield Strength - Smooth - 99.1 KSI
Axial Sinusoidal Loading
Environment - Air
Specimen Finish - 63 Microinches

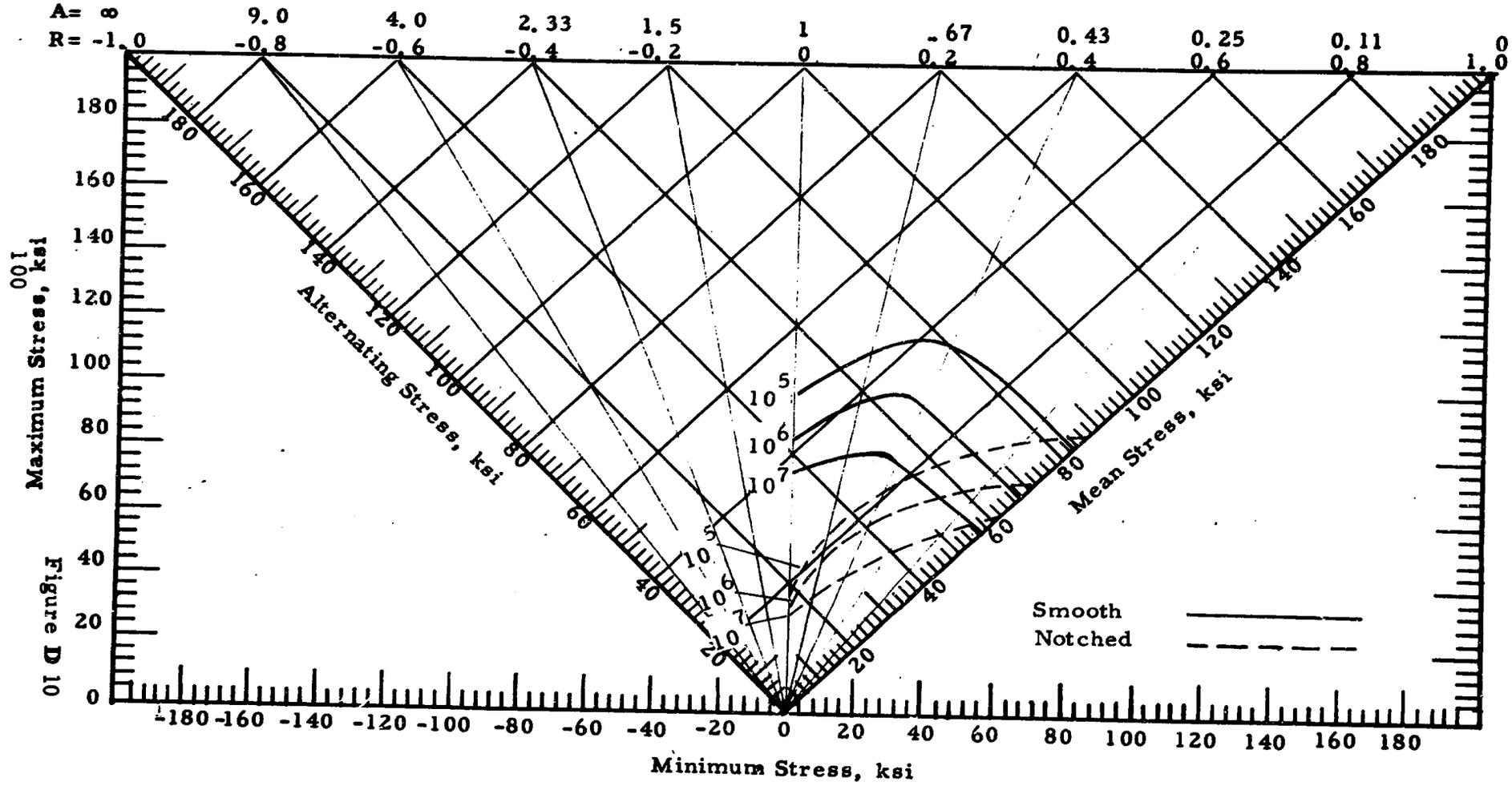


Figure D 10

SECTION VE

PH 15-7 Mo-RH 950 FORGING

TABLE E I

TENSILE TEST DATA FOR PH 15-7 Mo, RH 950 FORGING MATERIAL

		SMOOTH						Notched K_t = 3.0	
Test Temp.	Specimen Orientation	Spec. No.	Ult. Tensile Strength, ksi	0.2% Offset Yield Strength, ksi	Elongation in 1", %	Reduction of Area, %	Tensile Modulus, 10^6 psi	Specimen	Ult. Tensile Strength, ksi
Room	L	F35	234.6	198.9	11.0	30.6	29.6	H-44	178.9
		F32	232.6	197.9	10.0	25.2	29.7	H-45	185.8
		F34	234.6	202.0	6.0	10.8	29.7	H-46	166.2
			233.9	199.6	9.0	22.2	29.7		177.0
	T	O-1	123.4	-	1.0	-	29.7	S-1	126.6
		O-2	151.1	-	1.0	-	29.9	S-2	110.9
		O-4	140.8	-	1.0	-	29.2	S-3	129.7
			138.4		1.0		29.6		122.4
600°F	L	F38	198.9	168.3	12.0	44.0		H-42	253.7
		F37	197.9	158.1	13.0	45.2	—	H-43	274.3
		F36	198.4	161.2	13.0	45.2		H-47	271.1
			198.4	162.5	12.7	44.8			266.4
	T	U-1	199.4	160.2	6.0	14.6		S-4	236.2
		U-2	195.9	160.2	5.0	7.9	—	S-5	254.2
		U-4	187.7	151.0	3.0	4.7		S-6	268.3
			194.3	157.1	4.7	9.1			252.9
1000°F	L	F48	131.6	96.9	17.0	65.9		J-11	178.1
		F49	122.4	102.0	17.0	68.2	—	J-12	176.5
		F39	124.4	103.0	20.0	69.5		J-13	183.0
			126.1	100.6	18.0	67.9			179.2
	T	U-5	130.6	100.0	15.0	49.3		S-7	177.1
		U-6	129.5	96.9	16.0	48.7	—	T-1	179.6
		U-7	126.5	91.8	16.0	56.9		T-2	179.6
			128.8	96.2	15.7	51.6			178.8

TABLE EII

STRESS RUPTURE DATA FOR PH 15-7 Mo, RH950 FORGING MATERIAL-LONGITUDINAL

Spec. No.	K_t	Test Temp.	Stress ksi	Life Hrs.
F26	1.0	600°F	150	254.8+
F27			180	189.0+
F28			190	283.6+
F29			200	<0.05
F25			210	<0.05
F41	1.0	1000°F	50	257.7+
F46			60	192.4+
F44			70	68.3
F43			75	53.5
F40			100	<0.05
J1	3.0	600°F	160	642.3+
J2			230	189.3+
J3			260	255.9+
J4			270	<0.05
J5			280	<0.05
J10	3.0	1000°F	65	189.0+
H49			90	130.1
H48			110	17.6
J7			140	0.1
J6			160	<0.05

PH 15-7 Mo RH 950 FORGING
STRESS VS. TIME TO RUPTURE

Notched
Smooth

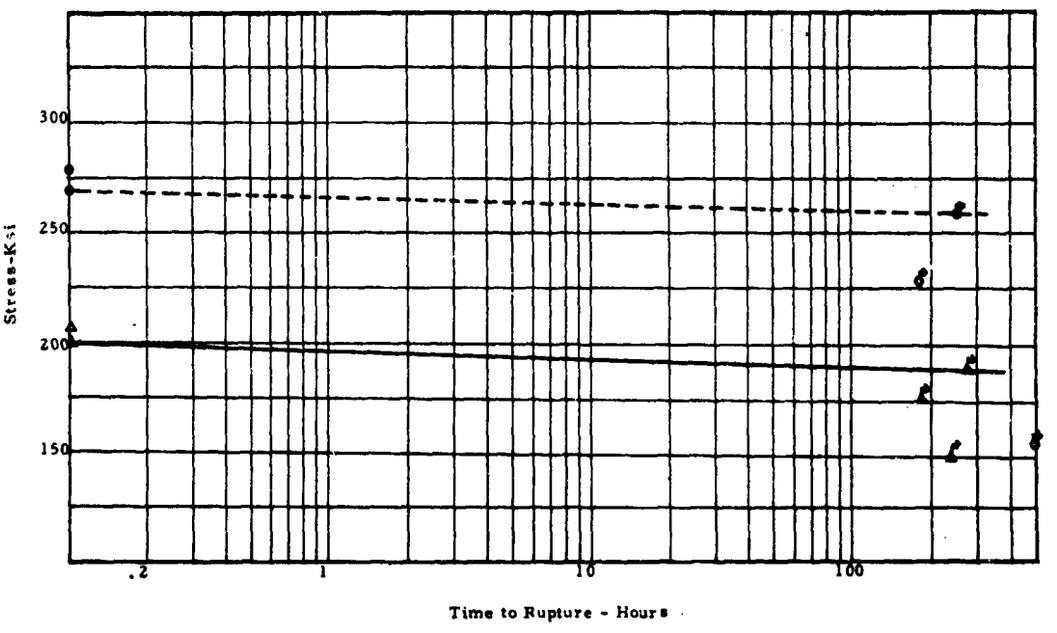


Figure E1-600°F

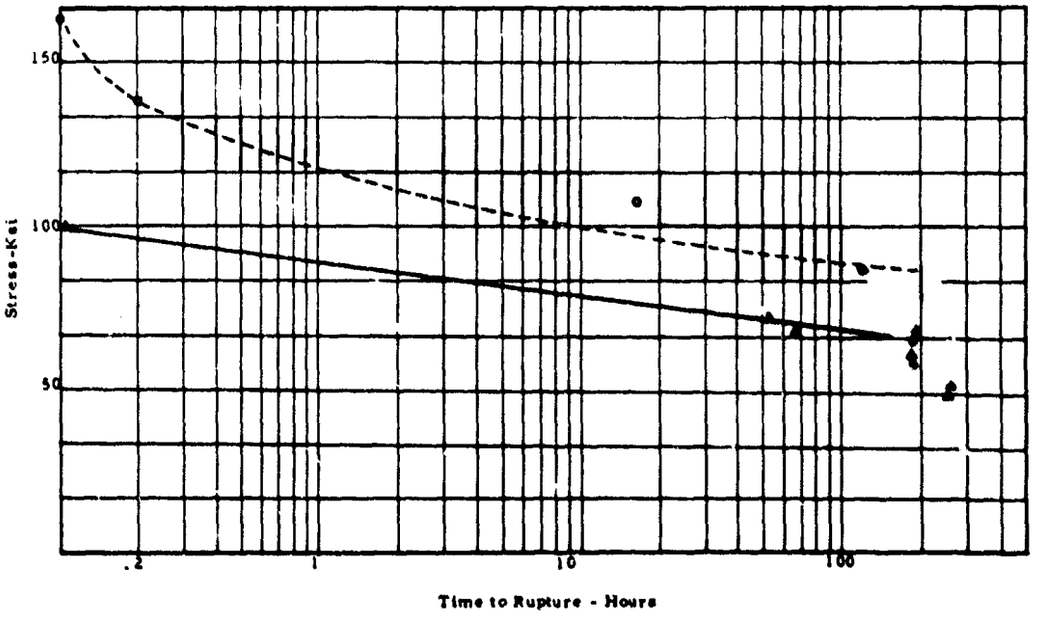


Figure E2-1000°F

TABLE EIII

FATIGUE TEST DATA

Material- PH 15-7 Mo RH950 Forging
Type of Specimen- Longitudinal Smooth
Test Temperature- Room

Test Frequency-Cycles/Minute
A= ϵ_{∞} - 4300

Specimen No.	"A" Ratio	Applied Stress, ksi			Life, Kilocycles
		Sm	Sa	Sc	
E-2	Infinity	0	80.0	80.0	12,038.0+
E-11			85.0	85.0	8,343.0
E7			85.0	85.0	3,967.0
E-6			90.0	90.0	7,049.0
E-10			90.0	90.0	1,354.0
E-5			100.0	100.0	429.0
E-4			110.0	110.0	185.0
E-8			110.0	110.0	161.0
E-3			120.0	120.0	51.0
E-9			180.0	180.0	14.0

TABLE EIV

FATIGUE TEST DATA

Material- PH 15-7 Mo RH 950 Forging
Type of Specimen- Longitudinal Smooth
Test Temperature- 600°F

Test Frequency-Cycles/Minute
A = ∞ -4300
A = .98-1800
A = .50-1800

Specimen No.	"A" Ratio	Applied Stress, ksi			Life, Kilocycles
		Sm	Sa	Sc	
E-20	Infinity	0	85.0	85.0	11,146.0+
E-19			90.0	90.0	7,803.0
			100.0	100.0	6,133.0
E-24			110.0	110.0	399.0
E-25			110.0	110.0	36.0
E-22			120.0	120.0	39.0
E-26			120.0	120.0	35.0
E-21			130.0	130.0	15.0
E-23			130.0	130.0	15.0
			150.0	150.0	7.0
E-41	.98	63.1	61.9	125.0	12,414.0+
J-32		65.7	64.4	130.0	10,006.0+
E-40		68.2	66.8	135.0	3,201.0
J-31		68.2	66.8	135.0	3,090.0
J-28		68.2	66.8	135.0	2,180.0
E-37		70.7	69.3	140.0	566.0
E-38		73.2	71.8	145.0	1,467.0
E-35		80.8	79.2	160.0	5.0
J-26	.50	98.4	49.2	147.5	10,000.0
J-25		100.0	50.0	150.0	6,480.0
J-24		103.4	51.6	155.0	4,528.0
J-21		106.7	53.3	160.0	3,858.0
E-30		110.1	55.0	165.0	2,855.0
J-19		110.1	55.0	165.0	20.0
J-17		113.4	56.6	170.0	75.0
J-18		113.4	56.6	170.0	16.0
E-32		120.0	60.0	180.0	12.0

TABLE EV

FATIGUE TEST DATA

Material- PH 15-7 Mo RH 950 Forging
Type of Specimen- Longitudinal Smooth
Test Temperature- 1000°F

Test Frequency-Cycles/minute
A= ∞ -4300
A=.98 - 1800
A=.50 - 1800

Specimen No.	"A" Ratio	Applied Stress, ksi			Life, Kilocycles
		Sm	Sa	Sc	
E43	Infinity	0	50.0	50.0	10,628.0+
E46			60.0	60.0	18,066.0+
F2			65.0	65.0	10,000.0+
E45			70.0	70.0	4,987.0+
E44			80.0	80.0	1,095.0
F3			85.0	85.0	828.0
E42			90.0	90.0	80.0
E49			100.0	100.0	31.0
F4			110.0	110.0	9.0
E47			110.0	110.0	4.0
F12	0.98	45.5	44.6	90.0	10,075.0+
F11		48.0	47.0	95.0	3,735.0
F5		50.5	49.5	100.0	6,561.0
F6		55.6	54.5	110.0	1,328.0
F14		55.6	54.5	110.0	1,272.0
F7		60.6	59.4	120.0	757.0
F13		60.6	59.4	120.0	440.0
F8		65.7	64.4	130.0	87.0
F10		70.7	69.3	140.0	Failed Loading
F24	0.50	66.7	33.3	100.0	10,066.0+
F23		70.0	35.0	105.0	6,204.0
F22		73.4	36.6	110.0	4,073.0
F21		76.7	38.3	115.0	605.0
F20		80.0	40.0	120.0	485.0
F17		83.4	41.6	125.0	216.0
F15		86.7	43.3	130.0	210.0
F16		93.4	46.6	140.0	Failed Loading

TABLE E VI

FATIGUE TEST DATA

Material- PH 15-7 Mo, RH 950 Forging
Type of Specimen-Longitudinal - Notched
Test Temperature- Room

Test Frequency-Cycles/Minute
A = ∞ -4300
A = .98 -1050
A = .50 -1050

Specimen No.	"A" Ratio	Applied Stress, ksi			Life, Kilocycles
		Sm	Sa	Sc	
G22	Infinity	0	30.0	30.0	11,579.0+
G23			35.0	35.0	10,244.0+
G30			37.0	37.0	10,138.0+
G24			40.0	40.0	4,138.0
G28			40.0	40.0	1,164.0
G21			40.0	40.0	184.0
G27			45.0	45.0	416.0
G20			50.0	50.0	133.0
G26			50.0	50.0	118.0
J15			60.0	60.0	45.0
G16	0.98	23.6	23.0	46.6	10,010.0+
G17		25.9	25.4	51.3	10,025.0+
G18		28.4	27.8	56.3	10,833.0+
G15		28.4	27.8	56.3	626.0
G14		33.0	32.3	65.3	339.0
G19		37.8	37.0	74.8	703.0
G13		37.5	36.8	74.3	88.0
G12		42.3	41.5	83.8	105.0
G11		47.0	46.1	93.0	38.0
J14		50.5	49.5	100.0	12.0
G4	0.50	37.5	18.8	56.5	10,035.0+
G5		42.3	21.2	63.5	10,006.0+
G10		47.2	23.6	70.8	10,090.0+
G3		47.0	23.5	70.6	10,052.0+
G6		47.0	23.5	70.5	150.0
C8		52.0	26.0	78.0	677.0
G2		52.1	26.0	78.1	330.0
G1		56.5	28.2	84.7	8,000.0
G9		56.7	28.3	85.0	106.0
C7		66.7	33.3	100.0	108.0

TABLE EVII

FATIGUE TEST DATA

Material- PH 15-7 Mo RH 950 Forging
Type of Specimen-Longitudinal Notched
Test Temperature- 600°F

Test Frequency -Cycles/Minute
A = ∞ -4300
A = .98 -1800
A = .5 -1800

Specimen No.	"A" Ratio	Applied Stress, ksi			Life, Kilocycles
		Sm	Sa	Sc	
G40	Infinity	0	32.5	32.5	10,000.0+
G38			35.0	35.0	10,000.0+
G37			35.0	35.0	2,963.0
G31			40.0	40.0	5,257.0
G35			40.0	40.0	2,681.0
G34			50.0	50.0	852.0
G39			50.0	50.0	61.0
G36			55.0	55.0	23.0
G32			60.0	60.0	19.0
G33			70.0	70.0	10.0
H-3	.98	35.4	34.7	70.0	10,000.0+
H-10		36.2	35.9	72.5	12,000.0+
H-4		37.9	37.1	75.0	253.0
H-5		40.4	39.6	80.0	36.0
H-2		40.4	39.6	80.0	18.0
H-9		42.9	42.1	85.0	24.0
H-11		45.5	44.6	90.0	20.0
H-6		50.5	49.5	100.0	45.0
H-8		50.5	49.5	100.0	9.0
H-7		55.6	54.5	110.0	8.0
G43	.50	53.4	26.6	80.0	12,287.0+
G47		56.7	28.3	85.0	3,342.0
G45		60.0	30.0	90.0	4,686.0
G49		63.4	31.6	95.0	32.0
G46		63.4	31.6	95.0	22.0
G44		66.7	33.3	100.0	35.0
G42		73.4	36.6	110.0	20.0
G41		80.0	40.0	120.0	15.0
G48		86.7	43.3	130.0	10.0

TABLE EVIII

FATIGUE TEST DATA

Material- PH 15-7 Mo RH950 Forging
Type of Specimen- Longitudinal Notched
Test Temperature- 1000°F

Test Frequency-Cycles/Minute
A= ∞ -4300
A=.98 - 1800
A=.50 - 1800

Specimen No.	"A" Ratio	Applied Stress, ksi			Life, Kilocycles
		Sm	Sa	Sc	
H-14	Infinity	0	30.0	30.0	10,000.0+
H-21			32.5	32.5	3,727.0
H-13			35.0	35.0	5,864.0
H-19			35.0	35.0	3,059.0
H-15			37.5	37.5	703.0
H-12			40.0	40.0	195.0
H-17			45.0	45.0	59.0
H-20			45.0	45.0	33.0
H-16			50.0	50.0	17.0
H-18			60.0	60.0	10.0
H-27	.98	25.3	24.8	50.0	16,390.0+
H-26		27.8	27.2	55.0	558.0
H-30		27.8	27.2	55.0	451.0
H-25		30.3	29.7	60.0	200.0
H-24		32.8	32.2	65.0	102.0
H-29		35.4	34.7	70.0	48.0
H-23		35.4	34.7	70.0	26.0
H-22		40.4	39.6	80.0	24.0
H-28		45.5	44.6	90.0	7.0
H-36	.50	45.0	22.5	67.5	10,022.0+
H-35		46.7	23.3	70.0	5,834.0
H-38		50.0	25.0	75.0	2,848.0
H-34		50.0	25.0	75.0	258.0
H-37		53.4	26.6	80.0	2,749.0
H-33		53.4	26.6	80.0	124.0
H-32		56.7	28.3	85.0	30.0
H-31		60.0	30.0	90.0	23.0
H-40		66.7	33.3	100.0	12.0

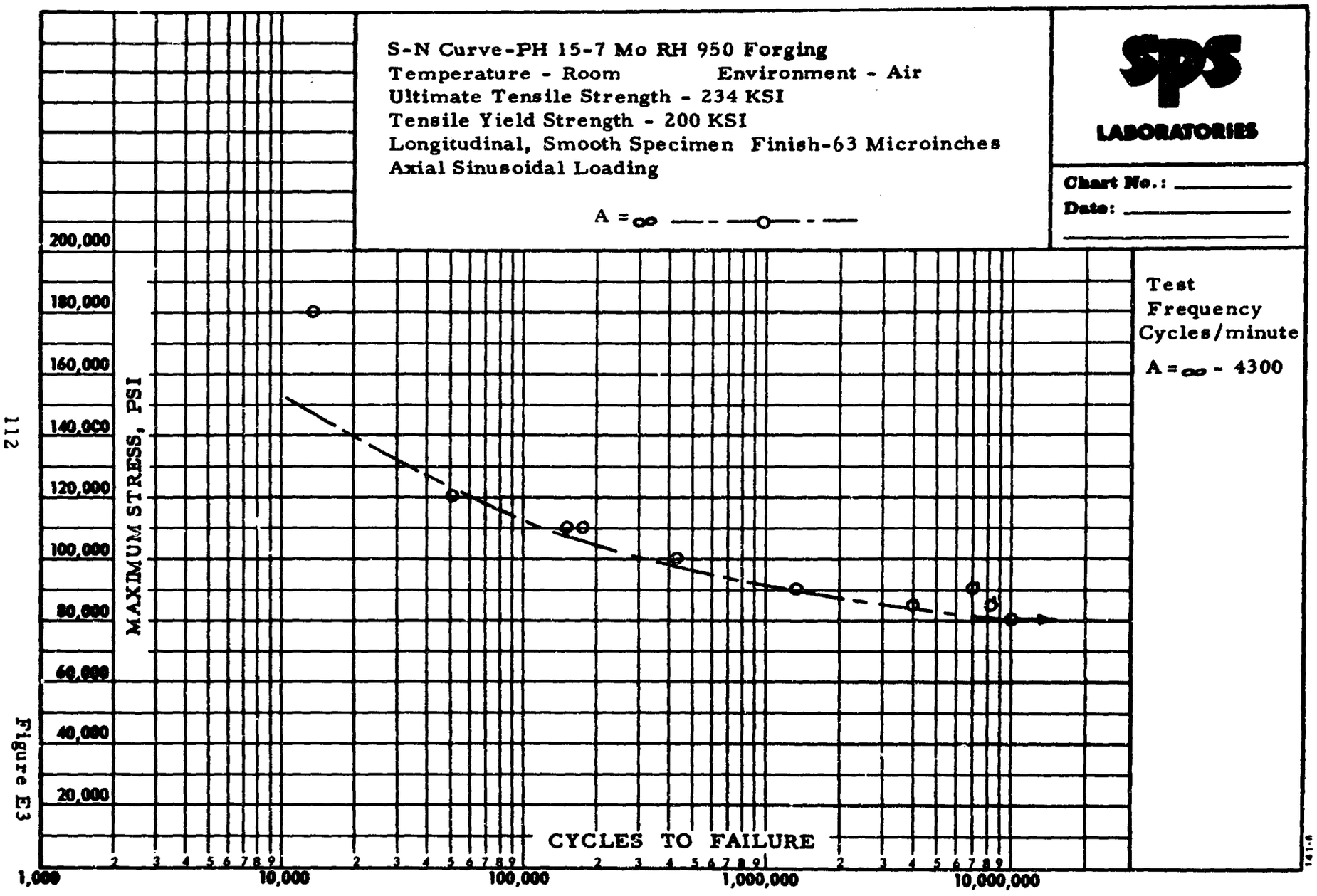

S-N Curve-PH 15-7 Mo RH 950 Forging
Temperature - Room Environment - Air
Ultimate Tensile Strength - 234 KSI
Tensile Yield Strength - 200 KSI
Longitudinal, Smooth Specimen Finish-63 Microinches
Axial Sinusoidal Loading
A = ∞
SPS
LABORATORIES
Chart No.:
Date:
Test
Frequency
Cycles/minute
A = ∞ - 4300
MAXIMUM STRESS, PSI
200,000
180,000
160,000
140,000
120,000
100,000
80,000
60,000
40,000
20,000
CYCLES TO FAILURE
1,000
10,000
100,000
1,000,000
10,000,000

Figure E3

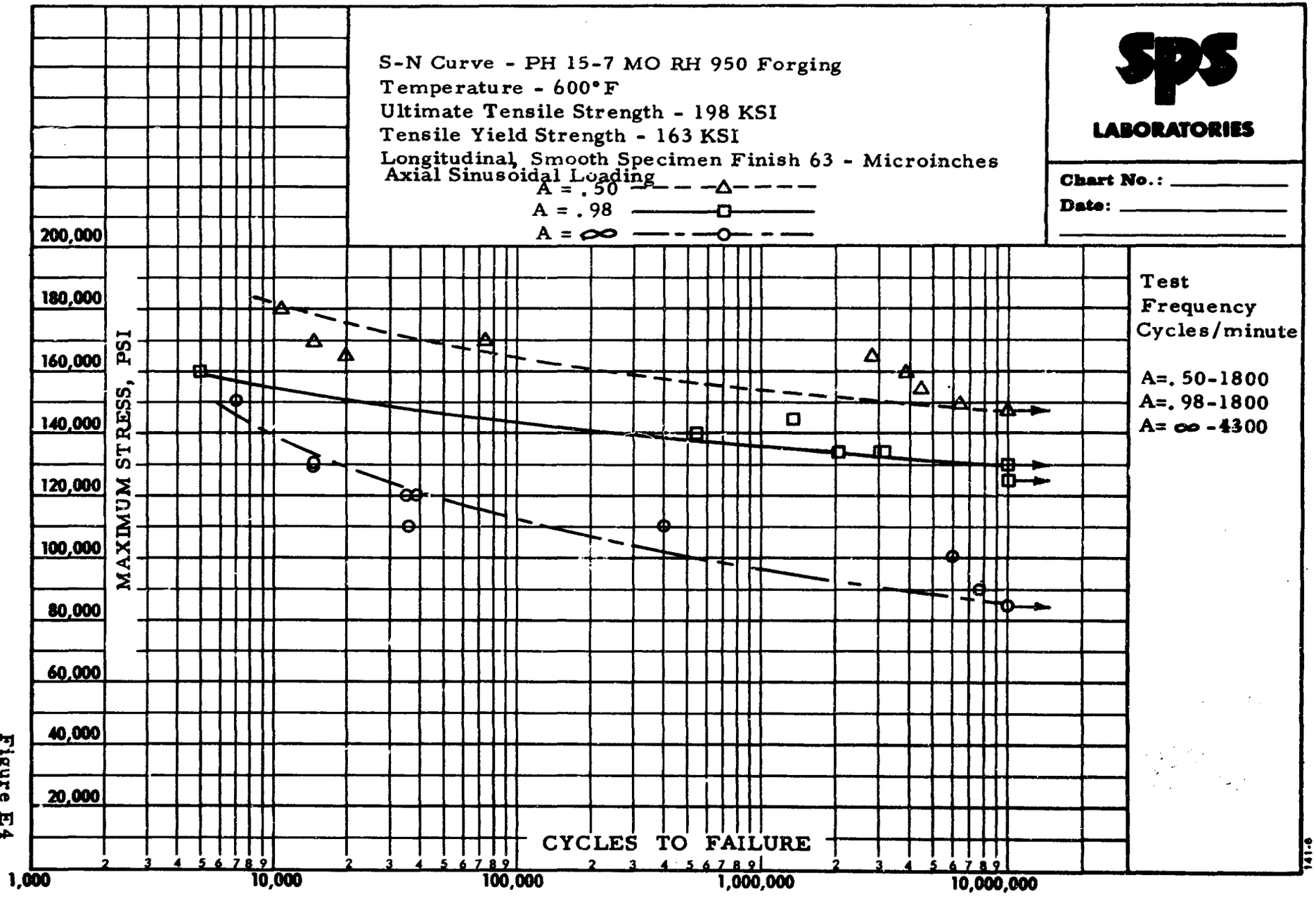

S-N Curve - PH 15-7 MO RH 950 Forging
Temperature - 600°F
Ultimate Tensile Strength - 198 KSI
Tensile Yield Strength - 163 KSI
Longitudinal, Smooth Specimen Finish 63 - Microinches
Axial Sinusoidal Loading
A = .50
A = .98
A = ∞
SPS
LABORATORIES
Chart No.:
Date:
Test
Frequency
Cycles/minute
A=.50-1800
A=.98-1800
A= ∞ -4300
MAXIMUM STRESS, PSI
200,000
180,000
160,000
140,000
120,000
100,000
80,000
60,000
40,000
20,000
CYCLES TO FAILURE
1,000
10,000
100,000
1,000,000
10,000,000
141-6

Figure E4

S-N Curve - PH 15-7 Mo RH 950 Forging
Temperature - 1000°F Environment - Air
Ultimate Tensile Strength - 126 ksi
Tensile Yield Strength - 101 ksi
Longitudinal, Smooth Specimen Finish 63-Microinches
A= .50
A =.98
A = ∞

SPS LABORATORIES

Chart No.: _____
Date: _____

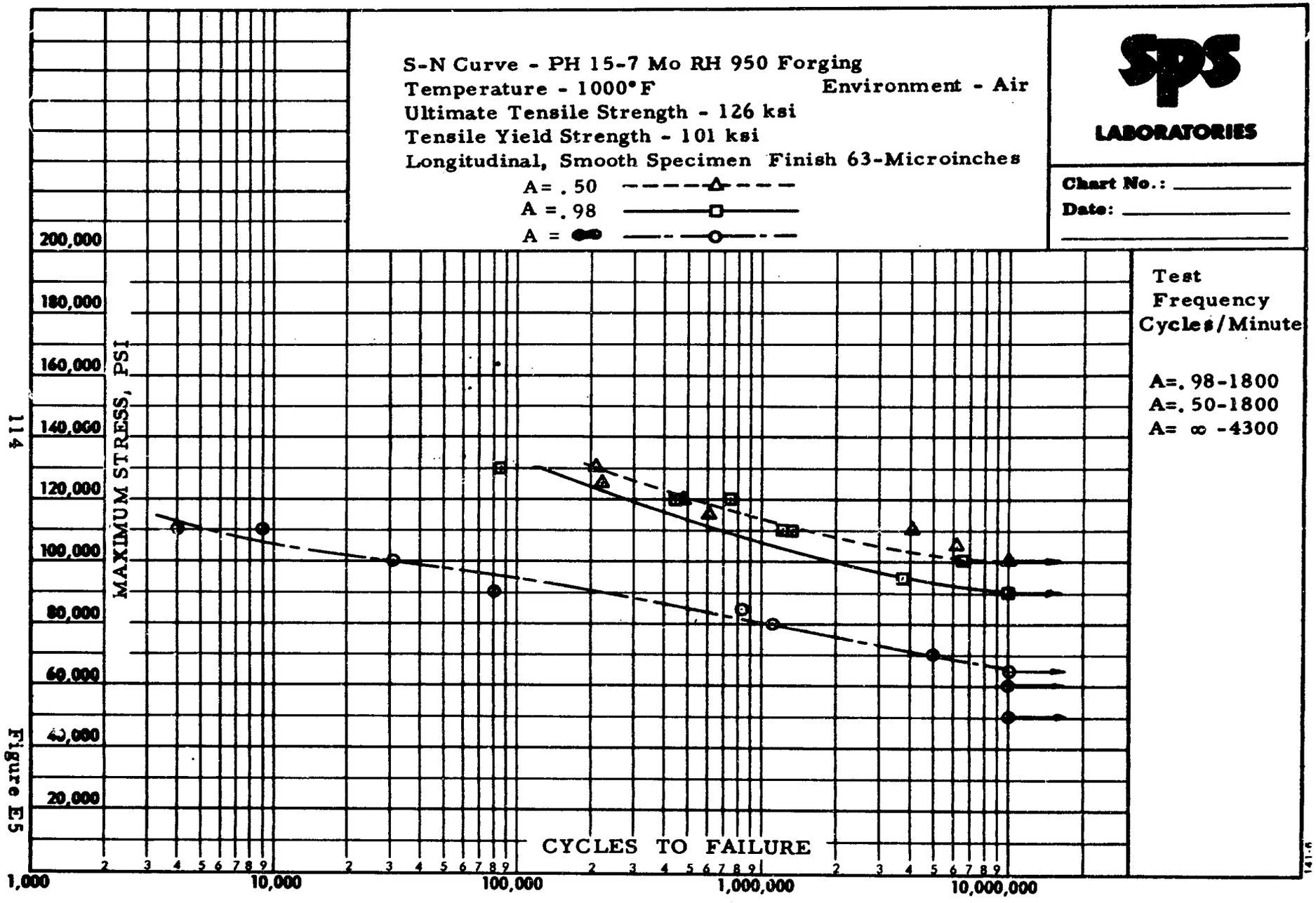


Figure E5

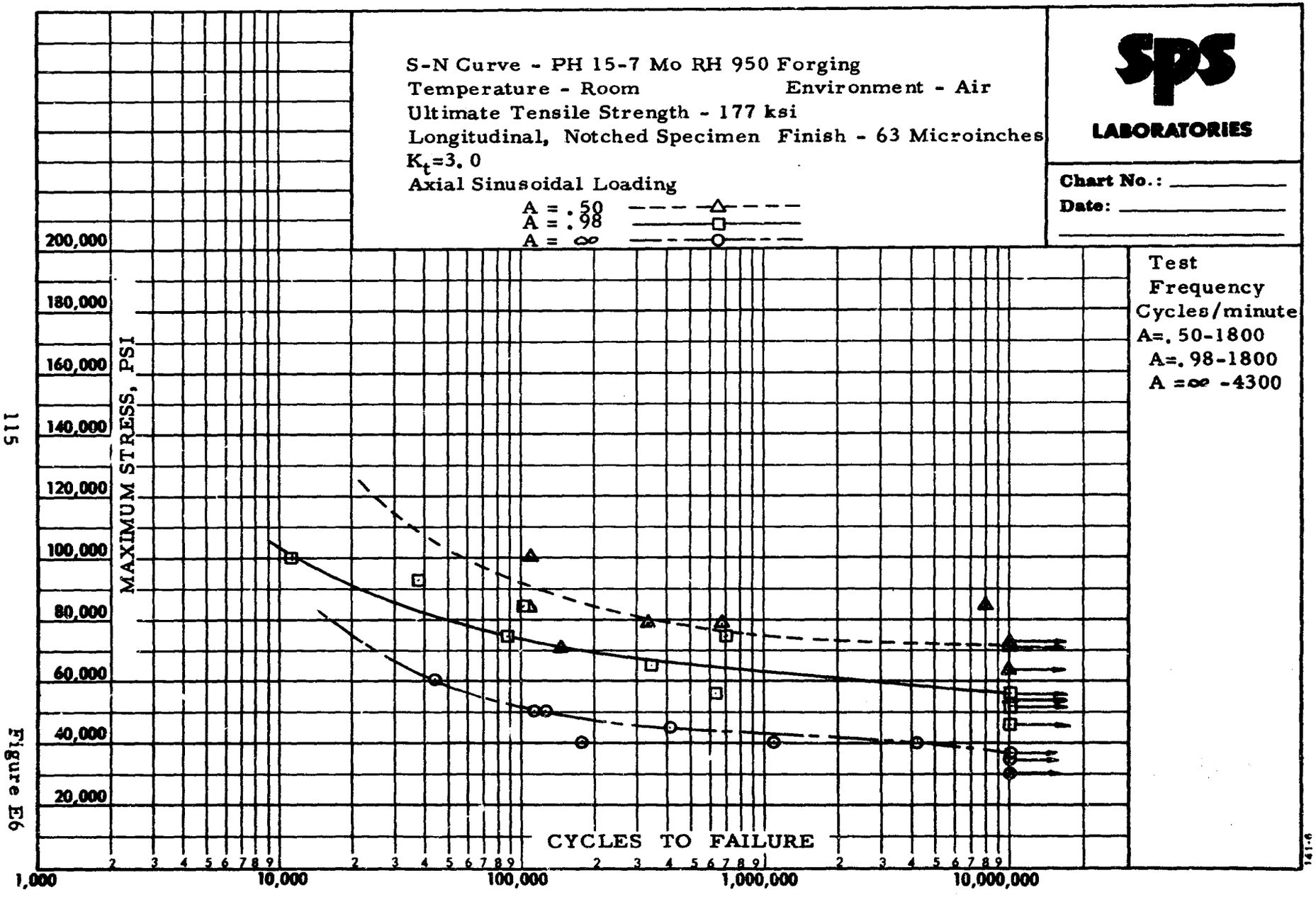

S-N Curve - PH 15-7 Mo RH 950 Forging
Temperature - Room
Environment - Air
Ultimate Tensile Strength - 177 ksi
Longitudinal, Notched Specimen Finish - 63 Microinches
K_t=3.0
Axial Sinusoidal Loading
A = .50
A = .98
A = ∞
SPS
LABORATORIES
Chart No.:
Date:
Test Frequency Cycles/minute
A=.50-1800
A=.98-1800
A =∞ -4300
MAXIMUM STRESS, PSI
200,000
180,000
160,000
140,000
120,000
100,000
80,000
60,000
40,000
20,000
CYCLES TO FAILURE
1,000
10,000
100,000
1,000,000
10,000,000
141-6

Figure E6

S-N Curve - PH 15-7 Mo RH 950 Forging
Temperature - 600°F
Ultimate Tensile Strength - 266 ksi
Longitudinal, Notched Specimen Finish-63 Microinches
K_t=3.0
Axial Sinusoidal Loading

A = .50
A = .98
A = ∞

SPS LABORATORIES

Chart No.: _____
Date: _____

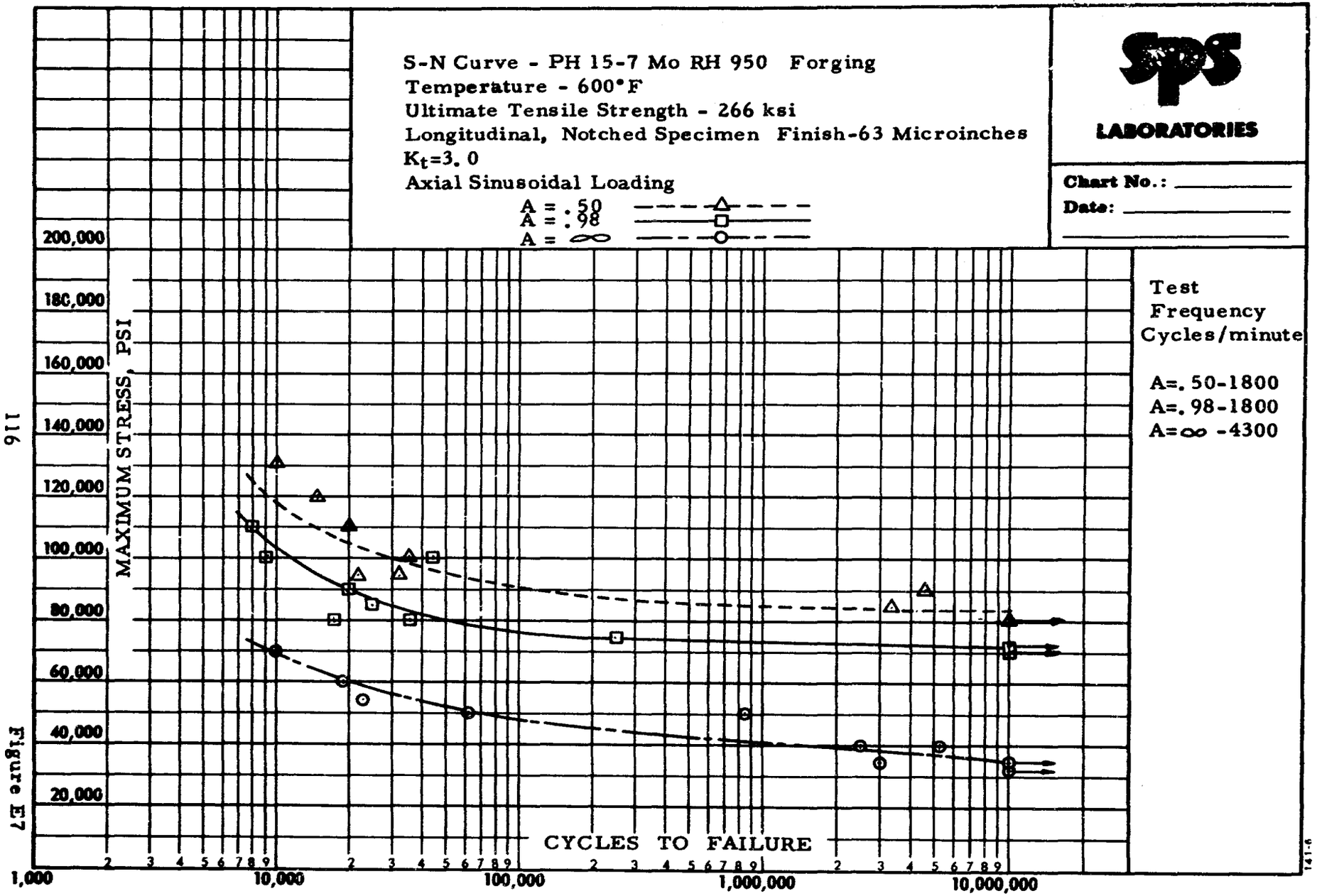


Figure E7

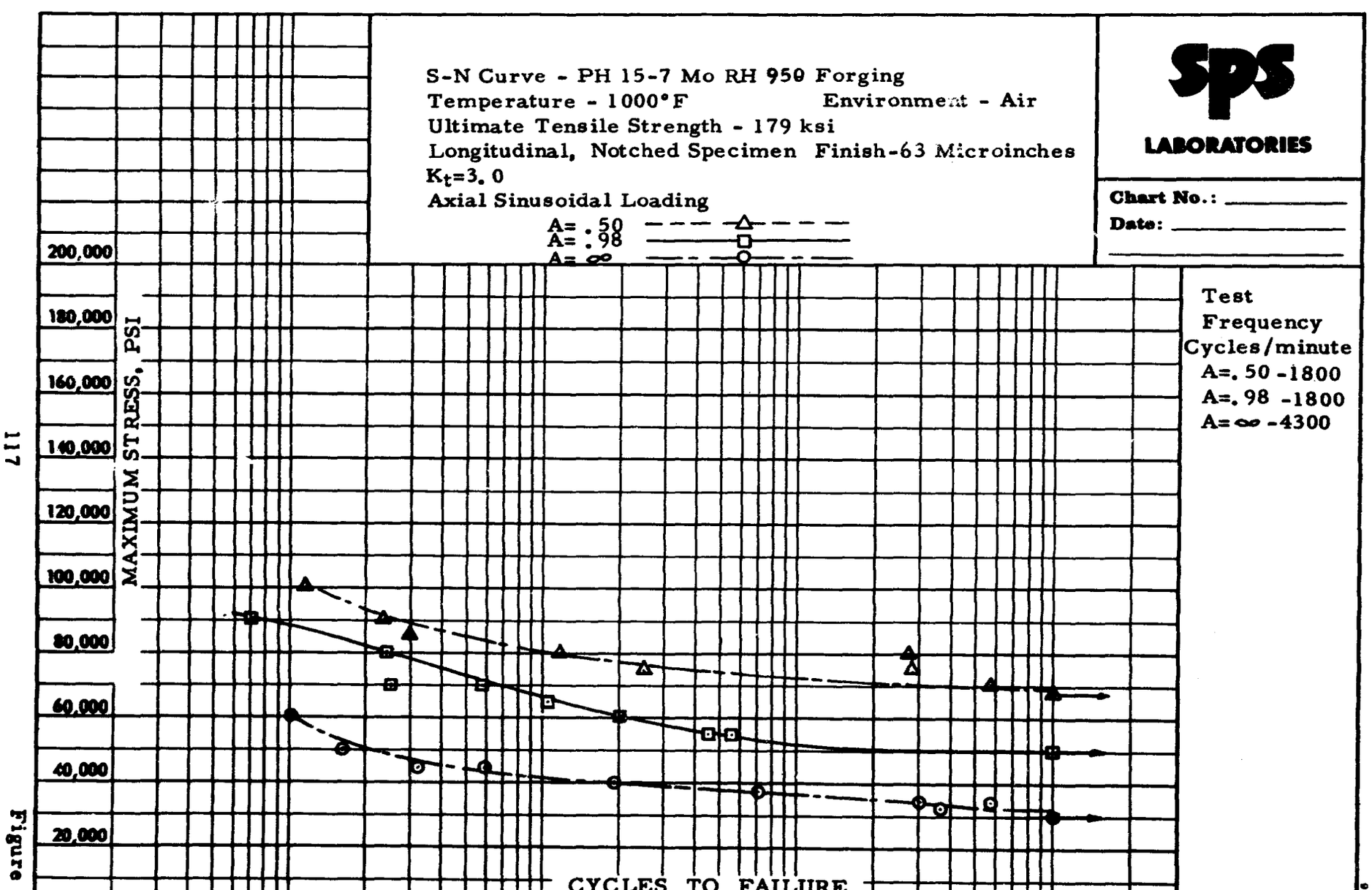

S-N Curve - PH 15-7 Mo RH 950 Forging
Temperature - 1000°F
Environment - Air
Ultimate Tensile Strength - 179 ksi
Longitudinal, Notched Specimen Finish-63 Microinches
K_t=3.0
Axial Sinusoidal Loading
A= .50
A= .98
A= ∞
SPS
LABORATORIES
Chart No.:
Date:
Test Frequency Cycles/minute
A=.50 -1800
A=.98 -1800
A=∞ -4300
MAXIMUM STRESS, PSI
200,000
180,000
160,000
140,000
120,000
100,000
80,000
60,000
40,000
20,000
CYCLES TO FAILURE
1,000
10,000
100,000
1,000,000
10,000,000
141-6

Figure E8

CONSTANT LIFE DIAGRAM-15-7 Mo RH 950 FORGING
Temperature - Room
Ultimate Tensile Strength-Smooth 234 KSI, Notched 177 KSI
Tensile Yield Strength - Smooth 200 KSI
Axial Sinusoidal Loading
Environment - Air
Specimen Finish - 63 microinches

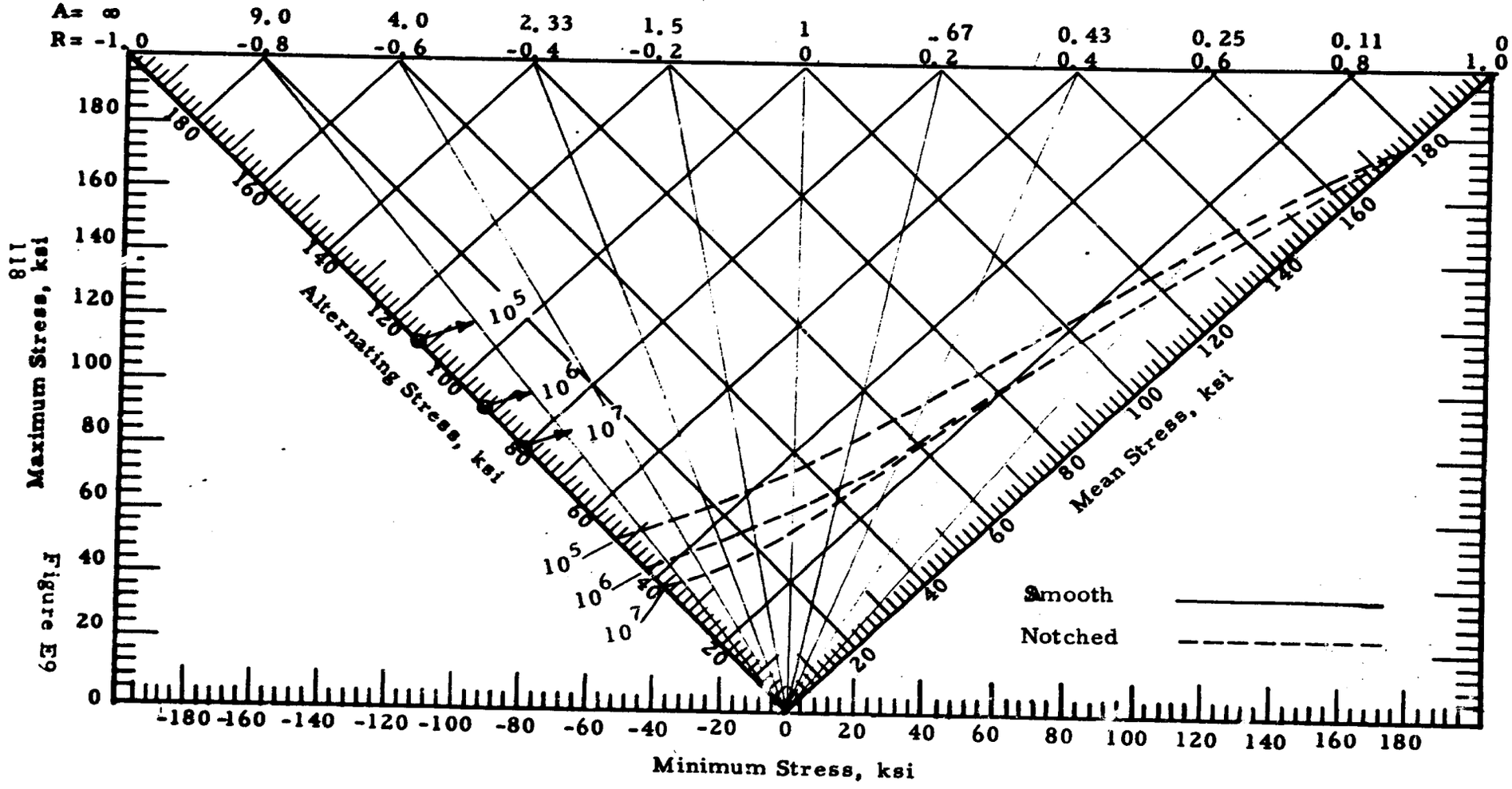
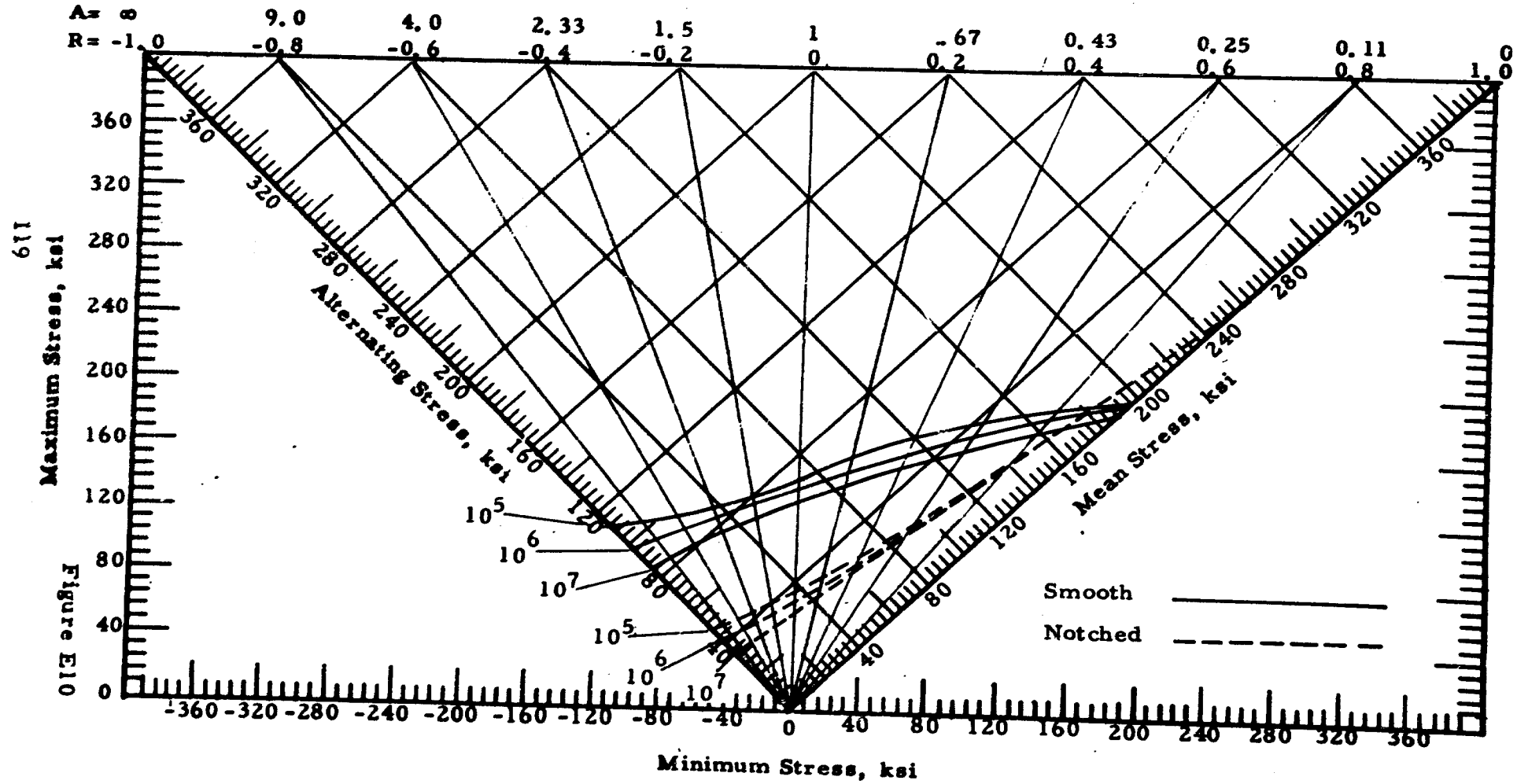
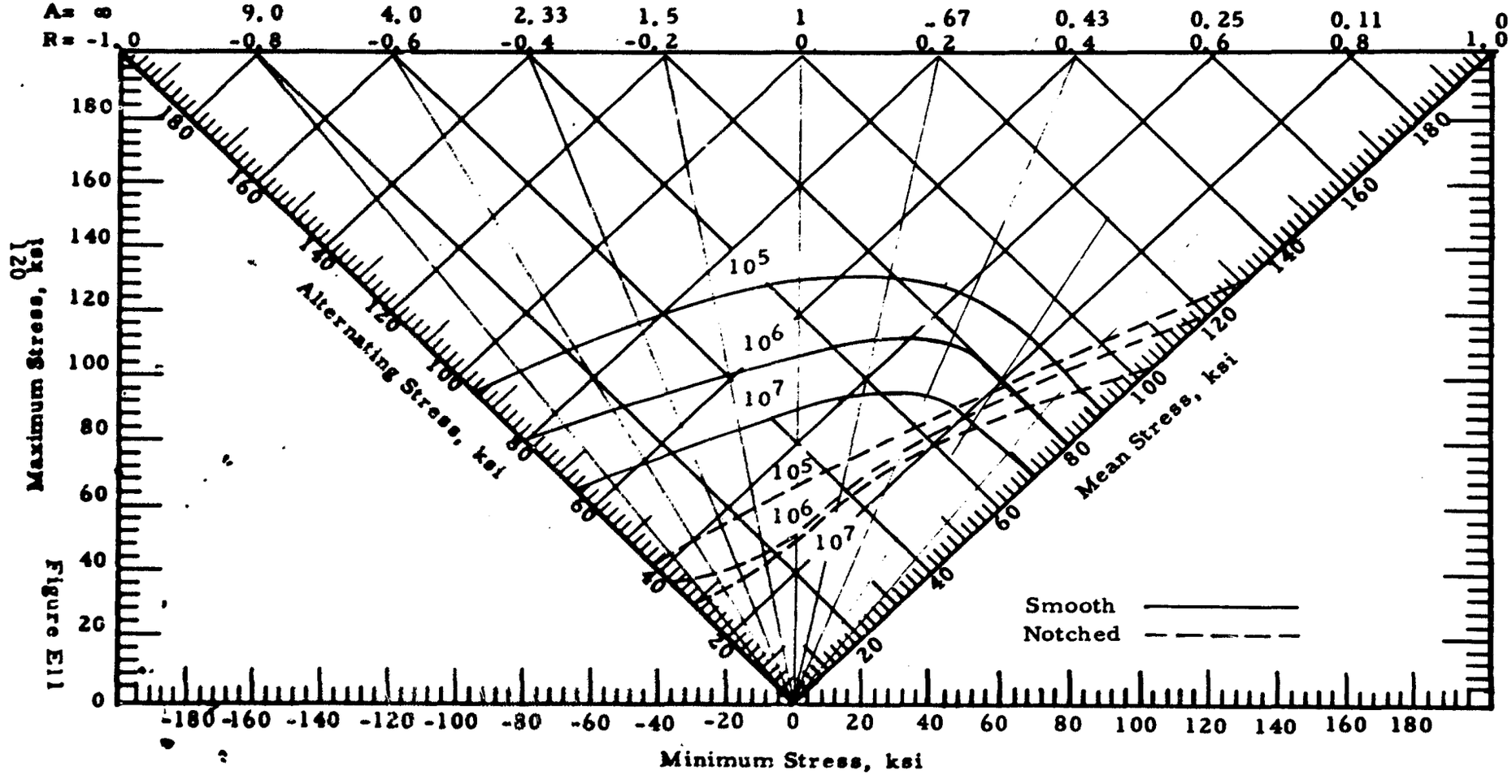


Figure E9

CONSTANT LIFE DIAGRAM - PH 15-7 Mo RH 950 FORGING
Temperature - 600°F
Ultimate Tensile Strength-Smooth-198 KSI- Notched (K_t=3.0)-266 KSI
Tensile Yield Strength-Smooth-162 KSI
Axial Sinusoidal Loading
Environment - Air
Specimen Finish - 63 Microinches



CONSTANT LIFE DIAGRAM-PH15-7 Mo RH950 FORGING
Temperature - 1000°F
Ultimate Tensile Strength - Smooth- 126 KSI-Notched (K_t=3.0)-179 KSI
Tensile Yield Strength-Smooth-101 KSI
Axial Sinusoidal Loading
Environment - Air
Specimen Finish - 63 Microinches



SECTION VF

PH 15-7 Mo TH 1050 SHEET

TABLE FI

TENSILE TEST DATA FOR PH 15-7 Mo, TH 1050 SHEET MATERIAL

		Smooth				Notched K_t=3.0	
Test Temp.	Specimen Orientation	Spec. No.	Ult. Tensile Strength, ksi	0.2% Offset Yield Strength, ksi	Elongation in 2", %	Specimen	Ult. Tensile Strength, ksi
700°F	L	PA14	167.3	144.8	5.5	PA-7	185.8
		Q-1	166.6	146.6	6.4	PA-8	186.6
		Q-2	170.6	153.3	7.1	PA13	189.0
			168.2	148.2	6.3		187.1
	T	SA3	176.4	167.0	4.5	T34	188.7
		SA4	174.2	151.0	5.0	T35	189.5
		UA1	174.1	165.7	5.0	T36	191.8
			174.9	161.2	4.8		190.0
1000°F	L	Q-3	102.6	84.0	16.4	PA10	94.8
		Q-4	111.6	90.7	17.0	PA12	85.5
		Q-5	95.4	77.1	20.0		
			103.2	83.9	17.8		90.3
	T	UA2	80.3	76.8	15.0	T38	85.1
		UA3	85.8	76.1	16.0	T40	97.2
		UA4	98.5	89.6	18.0	T41	109.8
			88.2	80.8	16.3		97.4

TABLE FII

STRESS RUPTURE TEST DATA FOR PH 15-7 Mo, TH 1050 SHEET MATERIAL - TRANSVERSE

Spec. No.	K_t	Test Temp.	Stress ksi	Life Hrs.
R33	1.0	700°F	168	0.2
R32			165	2.6
R31			150	135.8
R30			145	187.0+
R29			110	193.7+
R24	1.0	1000°F	60	22.1
R25			55	75.2
R27			52.5	167.1
R28			52.0	179.5
R26			50	191.3+
T14	3.0	700°F	167.0	9.1
T12			166.	57.5
T11			165	100.1
T15			164	30.7
T16			160	200.0
T18	3.0	1000°F	68	11.8
T19			65	18.1
T21			60	61.0
T22			58	80.0
T17			56	184.5

PH 15-7 Mo TH 1050 FORGING
STRESS VS. TIME TO RUPTURE

Notched ----o----
Smooth ——△——

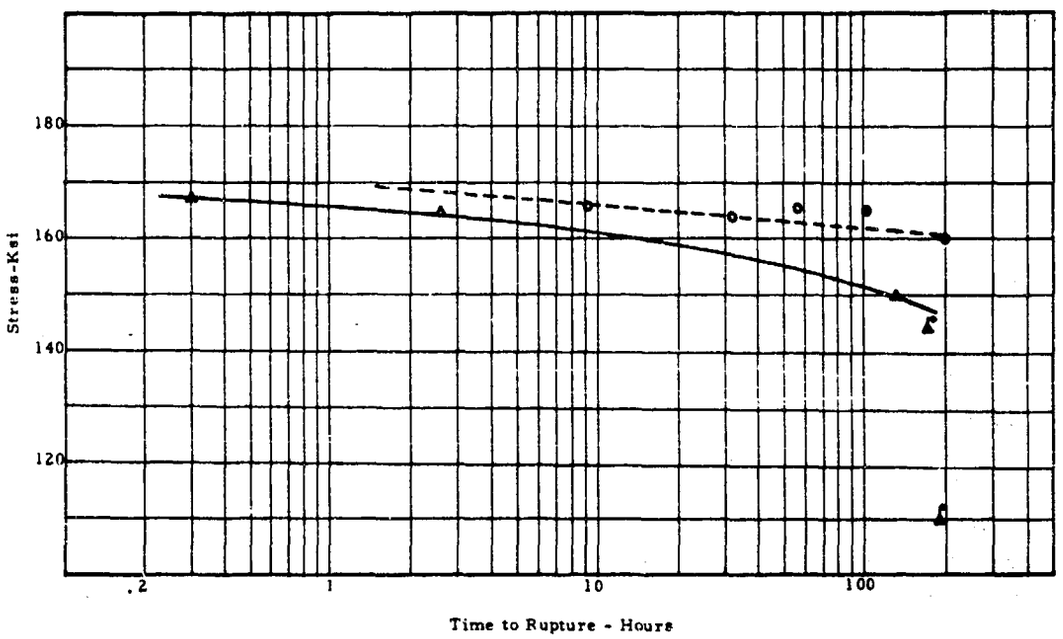


Figure F1-700°F

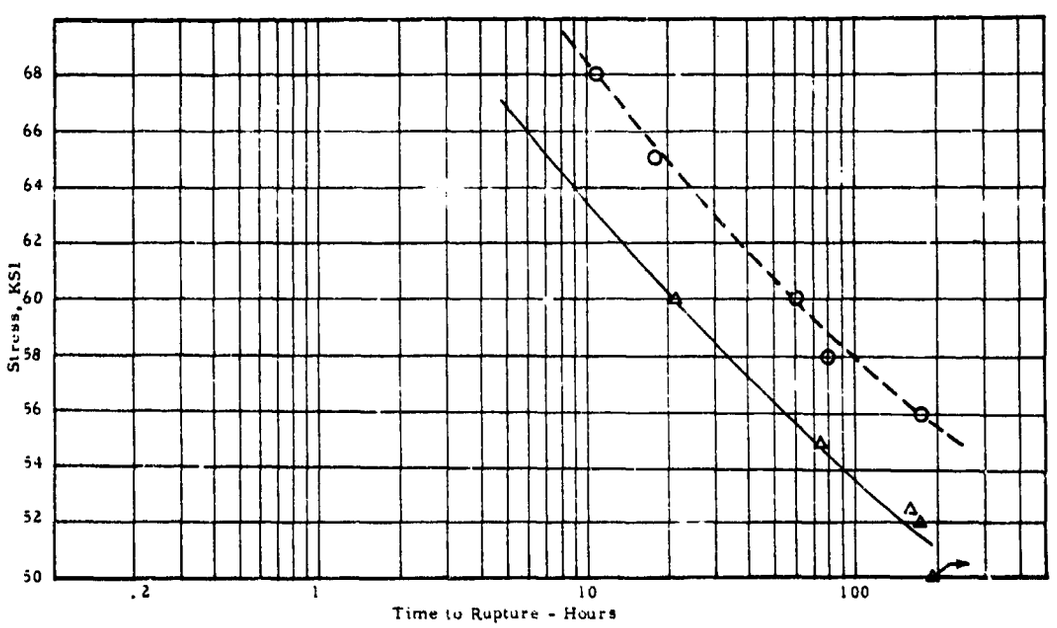


Figure F2-1000°F

TABLE FIII

FATIGUE TEST DATA

Material- PH15-7 Mo TH1050 Sheet
Type of Specimen- Transverse-Smooth
Test Temperature-700°F

Test Frequency-Cycles/Minute
A= .50-1200
A= .98-1200

Specimen No.	"A" Ratio	Applied Stress, ksi			Life, Kilocycles
		Sm	Sa	Sc	
SA39	0.98	55.6	54.4	110.0	10,044.0+
SA37		56.9	55.7	112.5	6,311.0
SA36		58.1	56.9	115.0	3,073.0
SA48		60.6	59.4	120.0	4,833.0
SA46		60.6	59.4	120.0	1,705.0
SA49		63.1	61.9	125.0	21.0
SA38		65.7	64.3	130.0	126.0
SA40		68.2	66.8	135.0	31.0
SA47		70.7	69.3	140.0	691.0
SA7	0.50	90.0	45.0	135.0	10,007.0+
SA6		93.4	46.6	140.0	3,822.0
SA14		96.7	48.3	145.0	6,428.0
SA15		100.0	50.0	150.0	3,483.0
SA8		103.4	51.6	155.0	3,736.0
SA13		103.4	51.6	155.0	1,862.0
SA12		106.7	53.3	160.0	2,521.0
SA11		106.7	53.3	160.0	35.0
SA9		108.4	54.1	162.5	34.0
SA10		110.1	54.9	165.0	18.0

TABLE FIV

FATIGUE TEST DATA

Material- PH15-7 Mo TH1050 Sheet
Type of Specimen- Transverse-Smooth
Test Temperature-1000°F

Test Frequency-Cycles/Minute
A=. 50-1200
A=. 98-1200

Specimen No.	"A" Ratio	Applied Stress, ksi			Life, Kilocycles
		Sm	Sa	Sc	
SA23	0.98	32.8	32.2	65.0	10,087.0
SA22		35.4	34.7	70	2,852.0
SA21		37.8	37.1	75	2,727.0
SA25		37.9	37.1	75	2,707.0
SA19		40.4	39.6	80	1,566.0
SA24		42.9	42.1	85	807.0
SA16		45.5	44.6	90	22.0
SA18		45.5	44.6	90	12.0
SA17		50.5	49.5	100	Failed Loading
SA30	0.50	46.7	23.3	70.0	10,695.0+
SA31		50.0	25.0	75.0	2,361.0
SA29		53.4	26.6	80.0	526.0
SA33		56.7	28.3	85.0	2,208.0
SA32		56.7	28.3	85.0	465.0
SA35		56.7	28.3	85.0	188.0
SA27		60.0	30.0	90.0	81.0
SA26		66.7	33.3	100.0	43.0
SA34		73.7	36.6	110.0	23.0

TABLE FV

FATIGUE TEST DATA

Material- PH 15-7 Mo TH 1050 Sheet
Type of Specimen- Transverse Notched
Test Temperature-700°F

Test Frequency-Cycles/Minute
A=. 50-1200
A=. 98-1200

Specimen No.	"A" Ratio	Applied Stress, ksi			Life, Kilocycles
		Sm	Sa	Sc	
R-8	.98	20.2	19.8	40.0	10,302.0+
R-19		22.7	22.3	45.0	10,570.0+
T-47		25.3	24.8	50.0	6,212.0
R-7		25.3	24.8	50.0	31.0
R-6		30.3	29.7	60.0	14.0
T-48		30.3	29.7	60.0	9.0
R-5		35.4	34.7	70.0	12.0
R-4		40.4	39.6	80.0	6.0
R-3		45.5	44.6	90.0	3.0
R-2		50.5	49.5	100.0	3.0
T-27	.50	41.7	20.8	62.5	10,326.0+
T-29		43.4	21.7	65.0	8,357.0
T-26		43,4	21.7	65.0	39.0
T-30		46.7	23.3	70.0	4,097.0
T-28		46.7	23.3	70.0	27.0
T-25		46.7	23.3	70.0	21.0
T-31		50.0	25.0	75.0	40.0
T-32		53.4	26.6	80.0	17.0
T-23		53.4	26.6	80.0	14.0

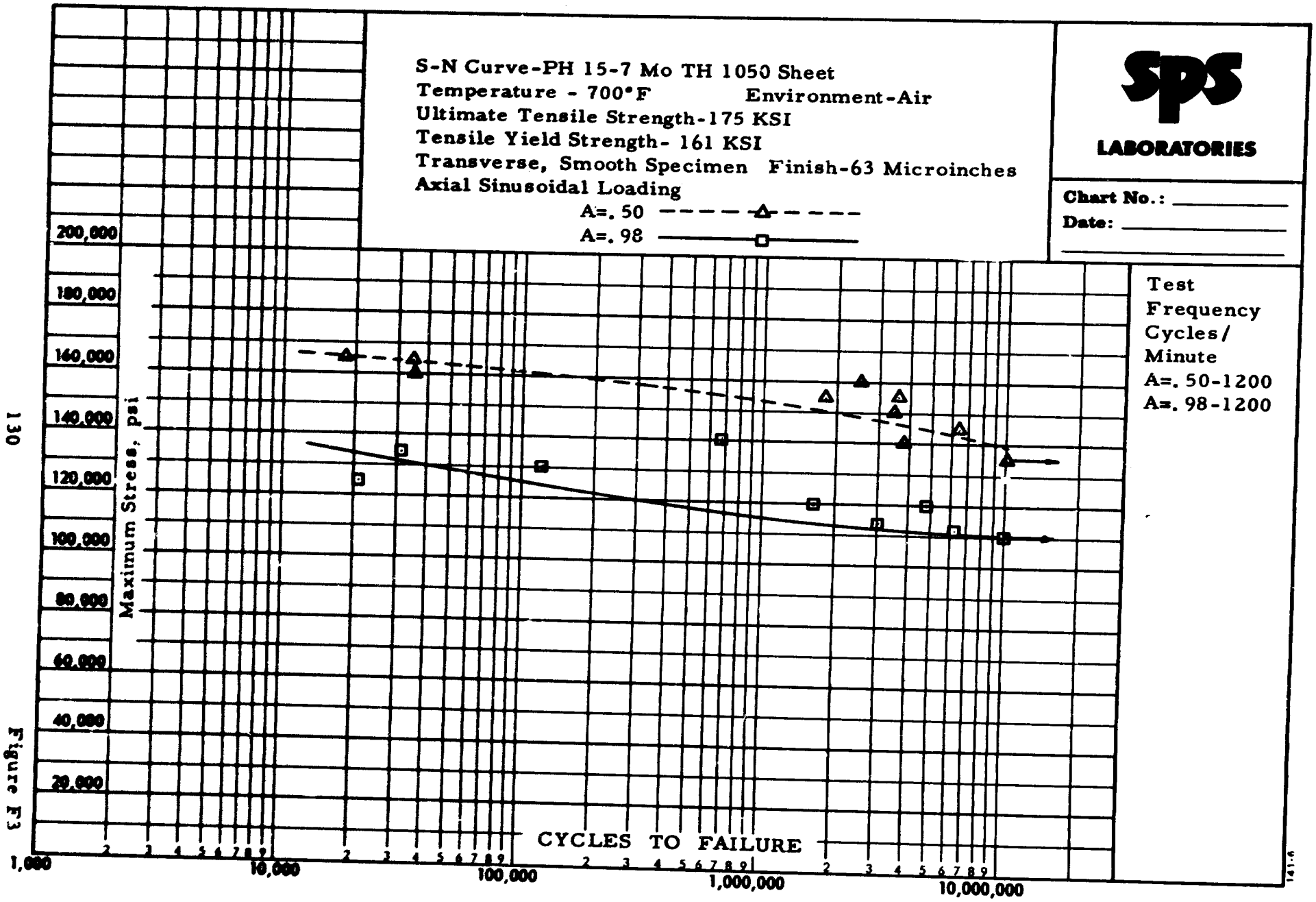
TABLE FVI

FATIGUE TEST DATA

Material- PH 15-7 Mo TH 1050 Sheet
Type of Specimen- Transverse Notched
Test Temperature-1000°F

Test Frequency-Cycles/Minute
A=. 50-1200
A=. 98-1200

Specimen No.	"A" Ratio	Applied Stress, ksi			Life, Kilocycles
		Sm	Sa	Sc	
T-8	.98	15.2	14.9	30.0	10,006.0+
T-7		17.7	17.3	35.0	2,143.0
T-9		17.7	17.3	35.0	874.0
T-6		20.2	19.8	40.0	57.0
T-5		22.7	22.3	45.0	28.0
T-4		25.3	24.8	50.0	19.0
T-3		27.8	27.2	55.0	13.0
T-2		30.3	29.7	60.0	5.0
T-1		32.8	32.2	65.0	5.0
R-18	.50	35.0	12.4	37.5	10,000.0+
R-17		26.7	13.3	40.0	5,735.0
R-16		30.0	15.0	45.0	1,290.0
R-23		30.0	15.0	45.0	893.0
R-15		33.3	16.7	50.0	885.0
R-22		33.3	16.7	50.0	76.0
R-21		36.7	18.3	55.0	314.0
R-14		36.7	18.3	55.0	57.0
R-10		40.0	20.0	60.0	18.0
R-20		43.4	21.7	65.0	16.0


S-N Curve-PH 15-7 Mo TH 1050 Sheet
Temperature - 700°F Environment-Air
Ultimate Tensile Strength-175 KSI
Tensile Yield Strength- 161 KSI
Transverse, Smooth Specimen Finish-63 Microinches
Axial Sinusoidal Loading
A=. 50
A=. 98
SPS
LABORATORIES
Chart No.:
Date:
Test Frequency Cycles/ Minute
A=. 50-1200
A=. 98-1200
Maximum Stress, psi
200,000
180,000
160,000
140,000
120,000
100,000
80,000
60,000
40,000
20,000
CYCLES TO FAILURE
1,000
10,000
100,000
1,000,000
10,000,000
130
Figure F3

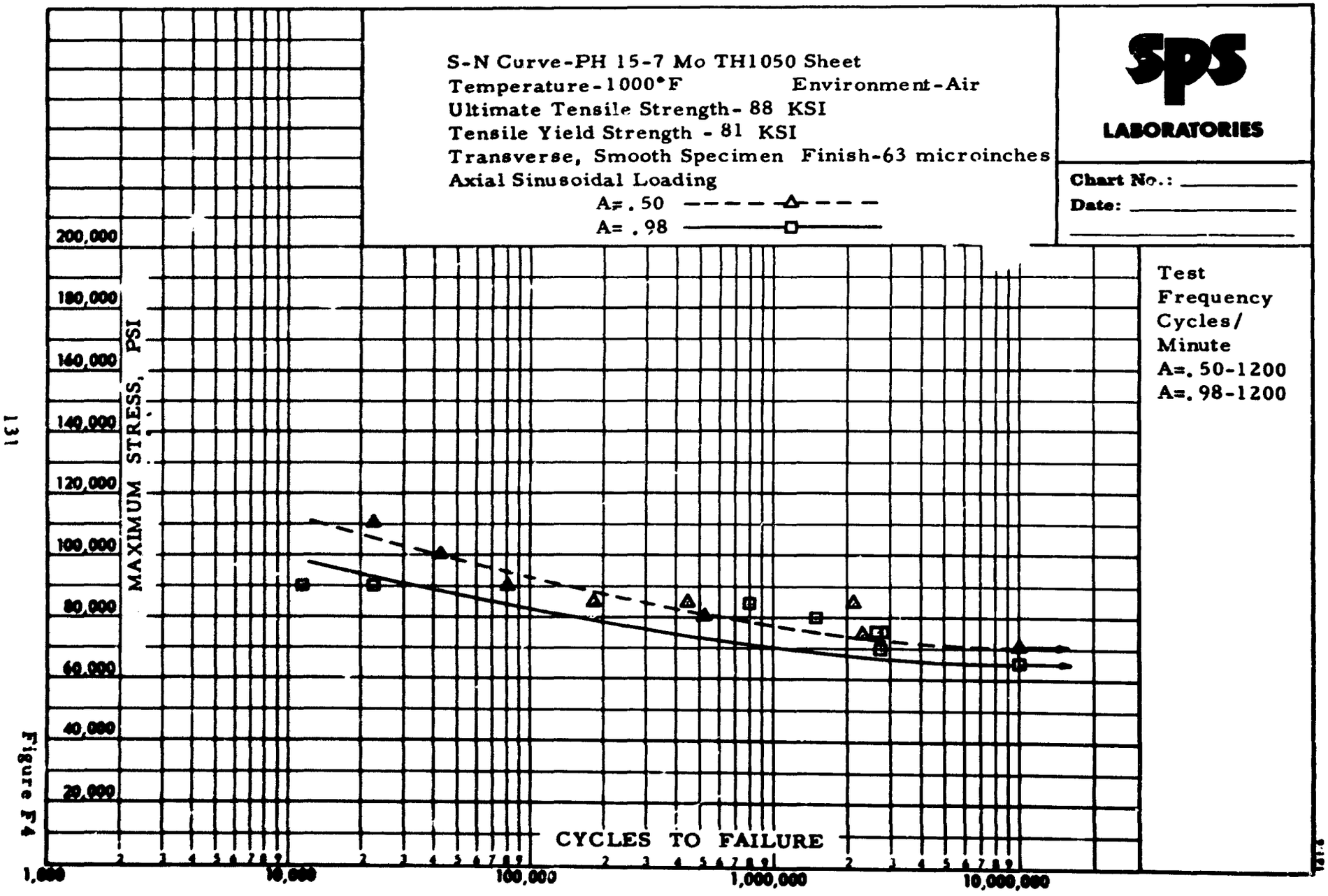

S-N Curve-PH 15-7 Mo TH1050 Sheet
Temperature-1000°F Environment-Air
Ultimate Tensile Strength- 88 KSI
Tensile Yield Strength - 81 KSI
Transverse, Smooth Specimen Finish-63 microinches
Axial Sinusoidal Loading
A=.50
A=.98
SPS
LABORATORIES
Chart No.:
Date:
Test Frequency Cycles/ Minute
A=.50-1200
A=.98-1200
MAXIMUM STRESS, PSI
200,000
180,000
160,000
140,000
120,000
100,000
80,000
60,000
40,000
20,000
CYCLES TO FAILURE
1,000
10,000
100,000
1,000,000
10,000,000

Figure F4

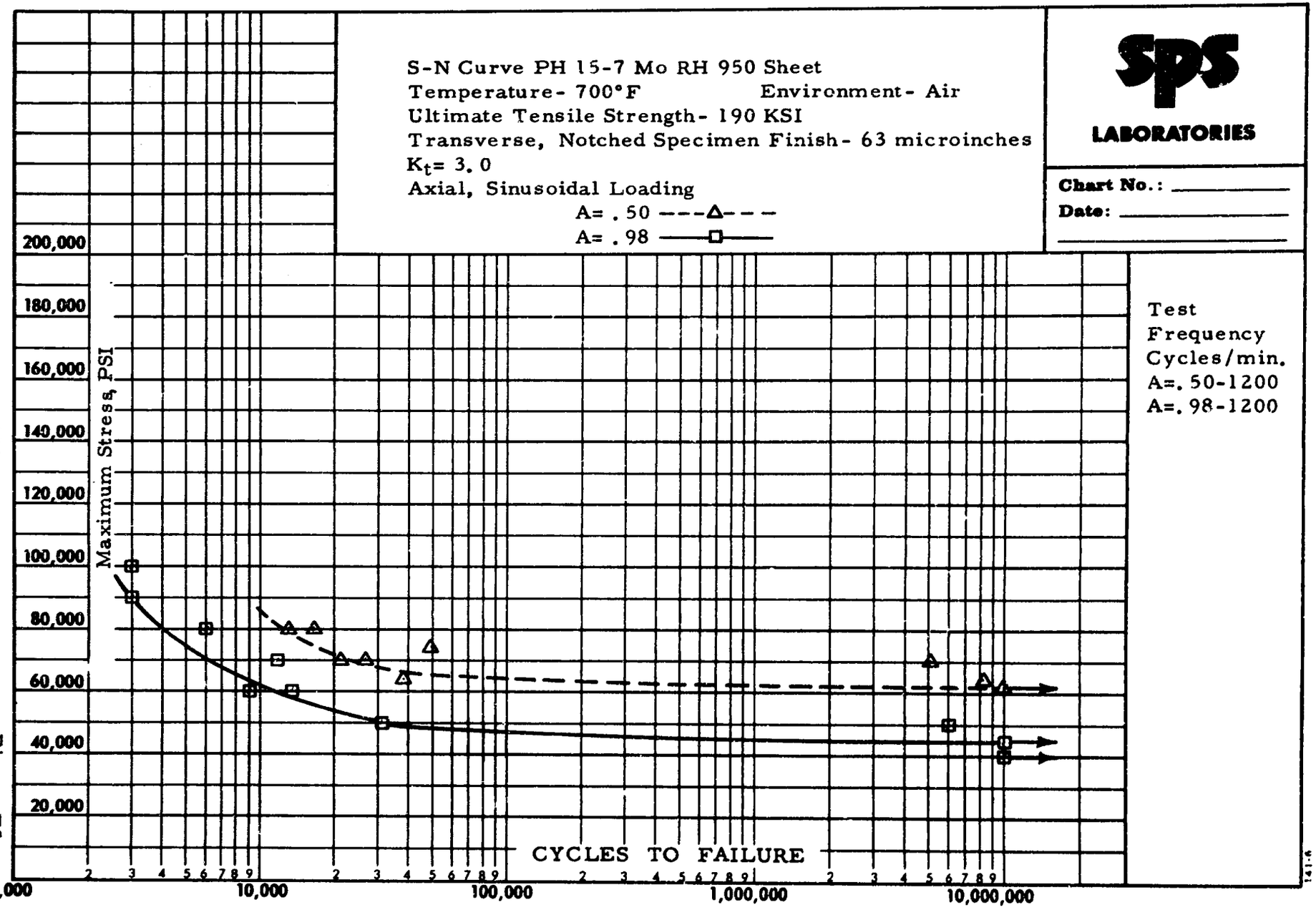

S-N Curve PH 15-7 Mo RH 950 Sheet
Temperature- 700°F Environment- Air
Ultimate Tensile Strength- 190 KSI
Transverse, Notched Specimen Finish- 63 microinches
K_t= 3.0
Axial, Sinusoidal Loading
A= .50
A= .98
SPS
LABORATORIES
Chart No.:
Date:
Test
Frequency
Cycles/min.
A=.50-1200
A=.98-1200
Maximum Stress, PSI
200,000
180,000
160,000
140,000
120,000
100,000
80,000
60,000
40,000
20,000
CYCLES TO FAILURE
1,000
10,000
100,000
1,000,000
10,000,000

Figure F5

S-N Curve PH 15-7 Mo RH 950 Sheet
Temperature- 1000°F Environment - Air
Ultimate Tensile Strength- 97 KSI
Transverse, Notched Specimen Finish-63 Microinches
K_t= 3.0
Axial, Sinusoidal Loading
A= .50
A= .98
SPS
LABORATORIES
Chart No.:
Date:
Test
Frequency
Cycles/min.
A= .50-1200
A= .98-1200
Maximum Stress, PSI
200,000
180,000
160,000
140,000
120,000
100,000
80,000
60,000
40,000
20,000
CYCLES TO FAILURE
1,000
10,000
100,000
1,000,000
10,000,000
141-A

Figure F6

CONSTANT LIFE DIAGRAM- PH 15-7 Mo TH 1050 SHEET
Temperature - 700°F
Ultimate Tensile Strength-Smooth 175 KSI, Notched 190 KSI
Tensile Yield Strength- Smooth 161 KSI
Axial Sinusoidal Loading
Environment - Air
Specimen Finish - 63 microinches

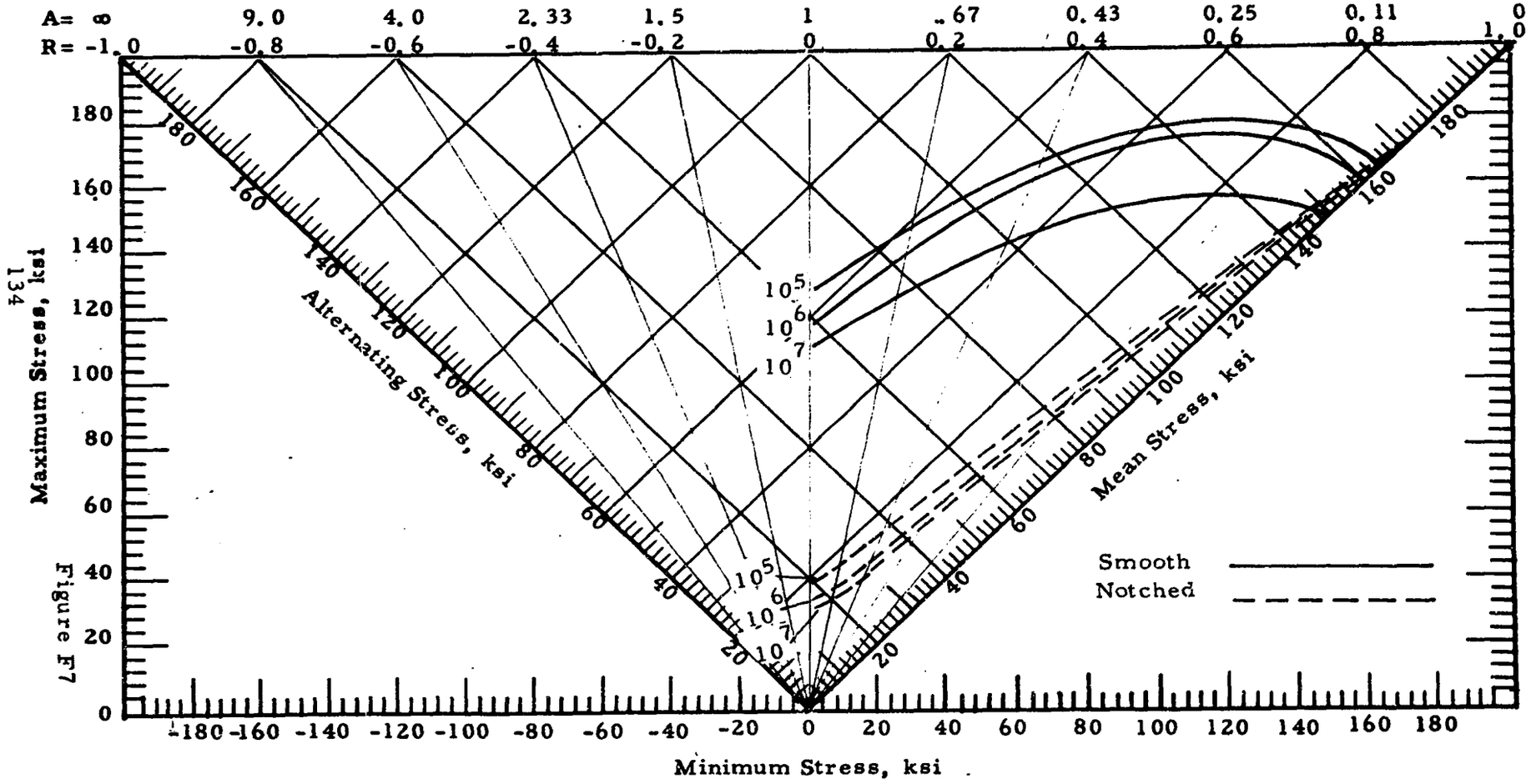
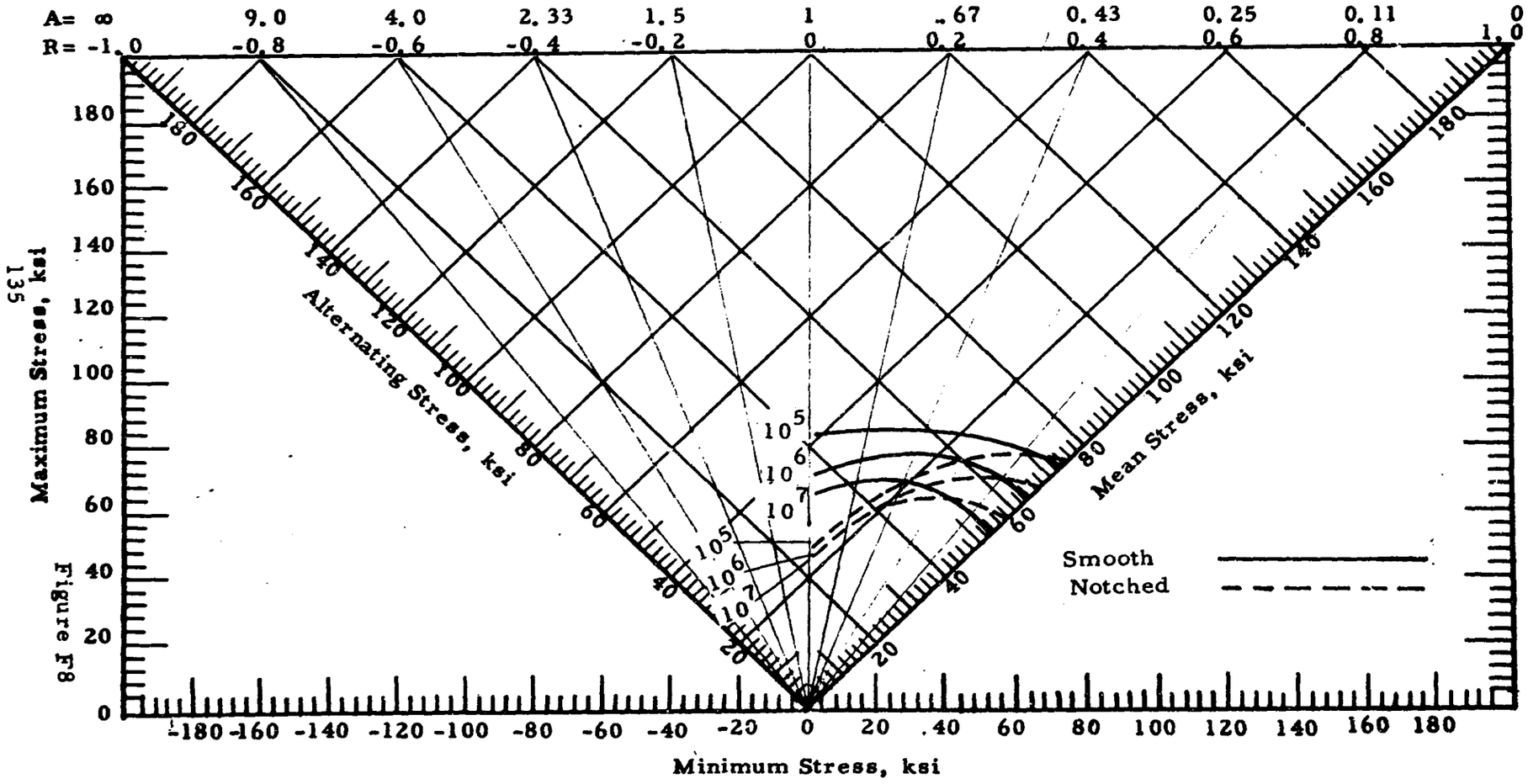


Figure F7

CONSTANT LIFE DIAGRAM- PH 15-7 Mo TH 1050 SHEET
Temperature- 1000°F
Ultimate Tensile Strength- Smooth 88 KSI, Notched 97 KSI
Tensile Yield Strength- Smooth 81 KSI
Axial Sinusoidal Loading
Environment- Air
Specimen Finish - 63 microinches



SECTION VG

PH 15-7 Mo TH 1050 FORGING

TABLE GI

TENSILE TEST DATA FOR PH 15-7 Mo, TH 1050 FORGING MATERIAL

		Smooth					Notched K_t=3.0	
Test Temp.	Specimen Orientation	Spec. No.	Ult. Tensile Strength, ksi	0.2% Offset Yield Strength, ksi	Elongation in 1", %	Reduction of Area, %	Specimen	Ult. Tensile Strength, ksi
700°F	L	B21	167.3	158.1	12.0	44.6	D-15	221.8
		B22	166.3	155.6	12.0	44.6	D-16	224.3
		B23	165.3	153.0	12.0	45.2	D-17	220.5
			166.3	155.6	12.0	44.8		222.2
	T	K-1	166.8	155.6	5.0	6.1	L-1	225.3
		K-2	165.3	155.1	8.0	26.3	L-2	224.2
		K-3	162.2	150.5	8.0	23.4	L-3	222.0
			164.8	153.7	7.0	18.6		223.8
1000°F	L	B-24	106.1	97.9	22.0	71.3	D-18	141.4
		B-25	104.0	94.3	22.0	69.9	D-19	145.1
		B-26	108.1	100.0	25.0	70.4	D-20	157.6
			106.1	97.4	23.0	70.5		148.0
	T	K-5	103.5	93.3	23.0	59.0	L-4	154.2
		K-6	108.1	97.9	21.0	60.0	L-5	143.7
		K-7	104.0	93.8	20.0	58.0	L-6	140.2
			105.2	95.0	21.3	59.0		146.0

TABLE GII

STRESS RUPTURE DATA FOR PH 15-7 Mo, TH 1050 FORGING MATERIAL - LONGITUDINAL

Spec. No.	K_t	Test Temp.	Stress, ksi	Life, Hrs.
B17	1.0	700°F	145	192.7+
B19			147.0	147.7
B18			148	51.4
B15			150	77.4
B16			160	4.3
B31	1.0	1000°F	55.0	187.0+
B32			58.0	94.7
B30			60.0	92.1
B29			70	6.8
B28			80	0.2
D21	3.0	700°F	200.0	214.0+
D25			202.0	43.6
D24			205.0	33.6
D23			210.0	27.8
D22			216.0	6.9
D32	3.0	1000°F	65	189.6
D14			75	242.9
D31			80	33.6
D28			110	1.2
D27			130	0.2

PH 15-7 Mo TH 1050 FORGING
STRESS VS. TIME TO RUPTURE

Notched
Smooth

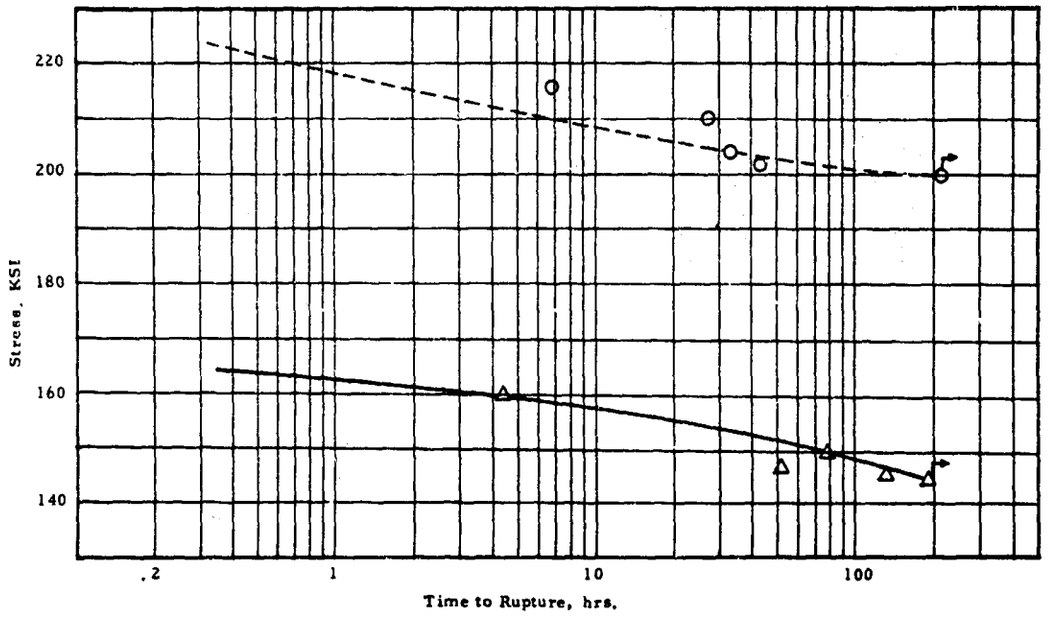


Figure G1-700°F

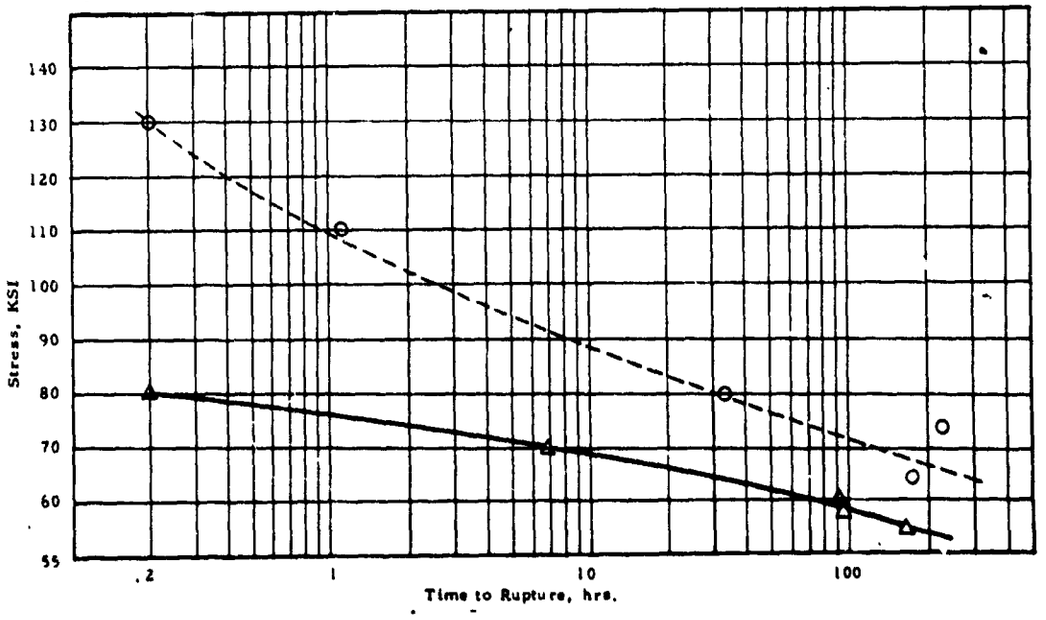


Figure G2-1000°F

TABLE GIII

FATIGUE TEST DATA

Material- PH 15-7 Mo TH1050 Forging
Type of Specimen- Longitudinal Smooth
Test Temperature-700° F

Test Frequency-Cycles/Minute
A= ∞ -4300
A=. 98 - 3500
A=. 50 - 3500

Specimen No.	"A" Ratio	Applied Stress, ksi			Life, Kilocycles
		Sm	Sa	Sc	
A4	Infinity	0	95. 0	95 0	10, 000. 0+
A7			100. 0	100. 0	12, 180. 0+
A3			100. 0	100. 0	2, 939. 0
A10			102. 0	102. 0	95. 0
A8			105. 0	105. 0	48. 0
A9			105. 0	105. 0	38 0
A6			110. 0	110. 0	27. 0
A2			120. 0	120. 0	16. 0
A5			130. 0	130. 0	4. 0
A1			140. 0	140. 0	2. 0
A27	0. 98	63. 1	61. 9	125. 0	19, 706. 0+
A30		65. 7	64. 4	130. 0	10, 341. 0+
A25		65. 7	64. 4	130. 0	300. 0
A26		68. 2	66. 8	135. 0	487. 0
A24		68. 2	66. 8	135. 0	40. 0
A21		70. 7	69. 3	140. 0	280. 0
A28		73. 2	71. 8	145. 0	1, 631. 0
A22		75. 8	74. 2	150. 0	28. 0
A23		78. 3	76. 7	155. 0	29. 0
A29		80. 8	79. 2	160. 0	18. 0
A11	0. 50	86. 7	43. 3	130. 0	10, 000. 0+
A19		100. 0	50. 0	150. 0	10, 042. 0+
A12		100. 0	50. 0	150. 0	2, 303. 0
A15		103. 4	51. 6	155. 0	10, 005. 0+
A18		103. 4	51. 6	155. 0	8, 703. 0
A17		105. 0	52. 5	157. 5	6, 394. 0
A20		105. 0	52. 5	157. 5	51. 0
A16		106. 7	53. 3	160. 0	29. 0
A13		106. 7	53. 3	160. 0	21. 0
A14		110. 0	55. 0	165. 0	25. 0

TABLE GIV

FATIGUE TEST DATA

Material- PH 15-7 Mo TH 1050 Forging
Type of Specimen- Longitudinal Smooth
Test Temperature- 1000°F

Test Frequency-Cycles/Minute
A= ∞ -4300
A= .98 - 3500
A= .50 - 3500

Specimen No.	"A" Ratio	Applied Stress, ksi			Life, Kilocycles
		Sm	Sa	Sc	
A35	Infinity	0	60.0	60.0	16,632.0+
E34			65.0	65.0	5,394.0
A33			70.0	70.0	342.0
A31			75.0	75.0	1,725.0
E36			75.0	75.0	1,441.0
A32			80.0	80.0	257.0
E40			85.0	85.0	25.0
A37			90.0	90.0	33.0
A38			95.0	95.0	21.0
E39			110.0	110.0	3.0
A42	0.98	42.9	42.1	85.0	18,494.0+
A41		45.5	44.6	90.0	1,870.0
A49		48.0	47.0	95.0	10,269.0+
A48		50.5	49.5	100.0	6,161.0
A43		50.5	49.5	100.0	4,978.0
B1		53.0	51.9	105.0	543.0
A47		53.0	51.9	105.0	134.0
A44		55.6	54.5	110.0	418.0
A45		60.6	59.4	120.0	56.0
A46		63.1	61.8	125.0	16.0
B8	0.50	50.0	25.0	75.0	10,061.0+
B7		53.4	26.6	80.0	2,047.0
B6		56.7	28.3	85.0	438.0
B4		60.0	30.0	90.0	592.0
B9		63.4	31.6	95.0	10,374.0+
B5		66.7	33.3	100.0	168.0
B10		70.0	35.0	105.0	183.0
B3		73.4	36.7	110.0	91.0
B2		80.0	40.0	120.0	96.0

TABLE GV

FATIGUE TEST DATA

Material- PH 15-7 Mo TH 1050 Forging
Type of Specimen- Longitudinal Notched
Test Temperature- 700°F

Test Frequency-Cycles/Minute
A=∞ -4300
A= .98-3500
A= .50-3500

Specimen No.	"A" Ratio	Applied Stress, ksi			Life, Kilocycles
		Sm	Sa	Sc	
C25	Infinity	0	40.0	40.0	10,000.0+
C26			42.5	42.5	7,878.0
C24			45.0	45.0	2,775.0
C30			50.0	50.0	156.0
C23			50.0	50.0	59.0
C22			55.0	55.0	37.0
C29			60.0	60.0	23.0
C21			60.0	60.0	22.0
C28			65.0	65.0	22.0
C27			70.0	70.0	11.0
C45	0.98	32.8	32.2	65.0	15,531.0+
C46		34.1	33.4	67.5	10,375.0+
C44		35.4	34.6	70.0	62.0
C47		37.9	37.1	75.0	10,113.0+
D2		39.2	38.4	77.5	417.0
C49		39.2	38.4	77.5	72.0
C48		40.4	39.6	80.0	51.0
C43		40.4	39.6	80.0	48.0
D1		42.9	42.1	85.0	37.0
D3		45.5	44.5	90.0	35.0
D8	0.50	63.4	31.6	95.0	10,209.0+
D10		65.0	32.5	97.5	11,601.0+
D9		65.0	32.5	97.5	46.0
D7		66.7	33.3	100.0	85.0
D6		70.0	35.0	105.0	39.0
D11		70.0	35.0	105.0	27.0
D5		73.4	36.6	110.0	52.0
D4		76.7	38.3	115.0	26.0
D12		80.0	40.0	120.0	17.0

TABLE GVI

FATIGUE TEST DATA

Material- PH 15-7 Mo TH 1050 Forging
Type of Specimen- Longitudinal Notched
Test Temperature- 1000°F

Test Frequency-Cycles/Minute
A= ∞ -4300
A= .98 3500
A= .50 3500

Specimen No.	"A" Ratio	Applied Stress, ksi			Life, Kilocycles
		Sm	Sa	Sc	
C42	Infinity	0	25.0	25.0	12,911.0+
C41			27.5	27.5	5,327.0
C36			30.0	30.0	4,411.0
C33			32.0	32.0	4,141.0
C32			35.0	35.0	823.0
C31			40.0	40.0	124.0
C38			45.0	45.0	36.0
C34			50.0	50.0	29.0
C35			55.0	55.0	12.0
C37			60.0	60.0	9.0
C5	0.98	26.5	26.0	52.5	10,012.0+
C4		26.5	26.0	52.5	4,272.0
C3		27.8	27.2	55.0	8,057.0
C1		30.3	29.7	60.0	1,776.0
C8		32.8	32.2	65.0	305.0
C2		35.4	34.7	70.0	158.0
C10		37.9	37.1	75.0	51.0
C9		37.9	37.1	75.0	28.0
C6		40.4	39.6	80.0	31.0
C7		45.5	44.6	90.0	11.0
C19	0.50	41.7	20.8	62.5	13,924.0+
C18		43.4	21.7	65.0	3,414.0
C17		45.1	22.5	67.5	1,438.0
C16		46.7	23.3	70.0	3,666.0
C15		48.4	24.2	72.5	899.0
C14		50.0	25.0	75.0	1,345.0
C13		53.4	26.6	80.0	360.0
C12		56.7	28.3	85.0	219.0
C11		60.0	30.0	90.0	114.0
C20		66.7	33.3	100.0	13.0

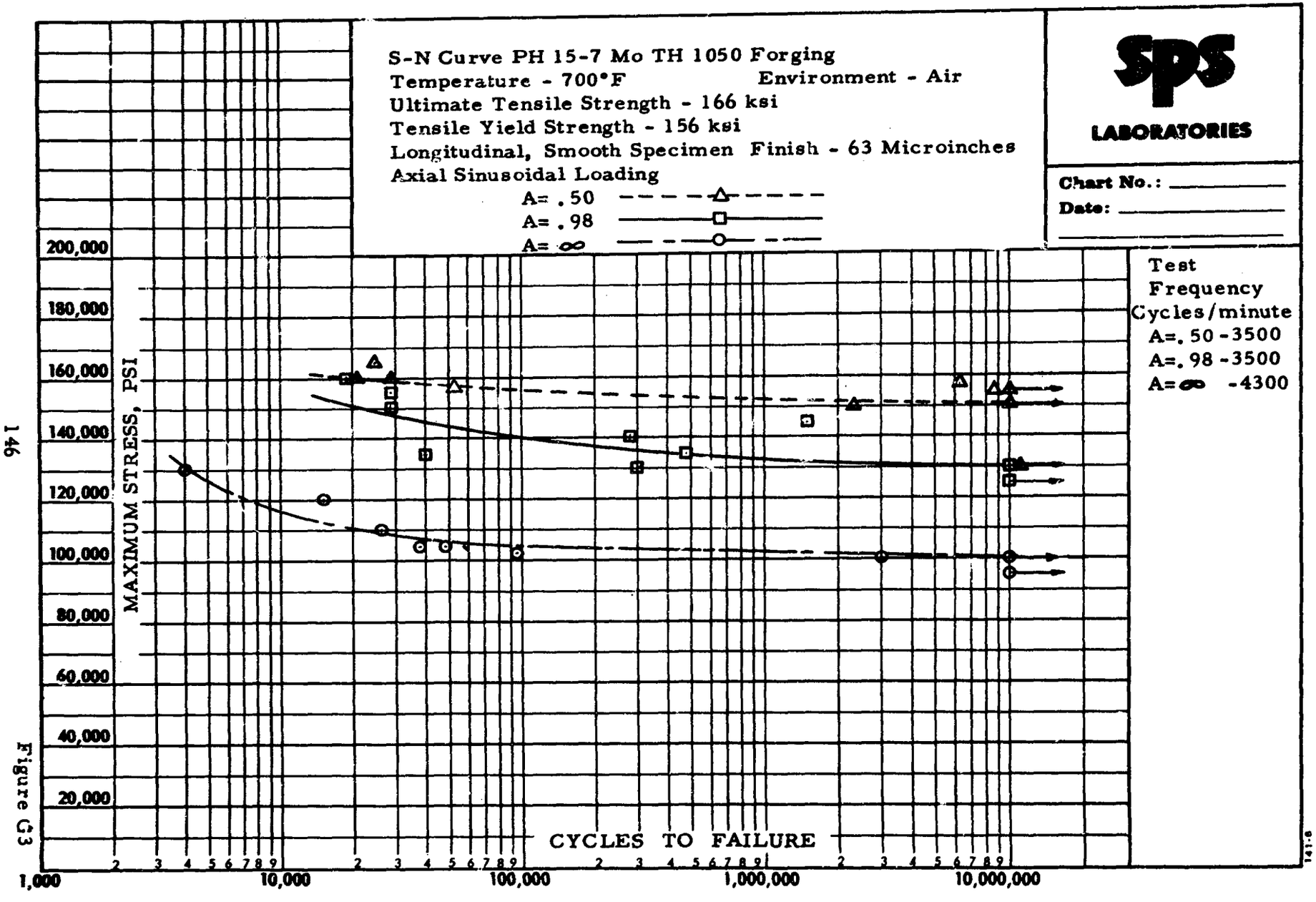
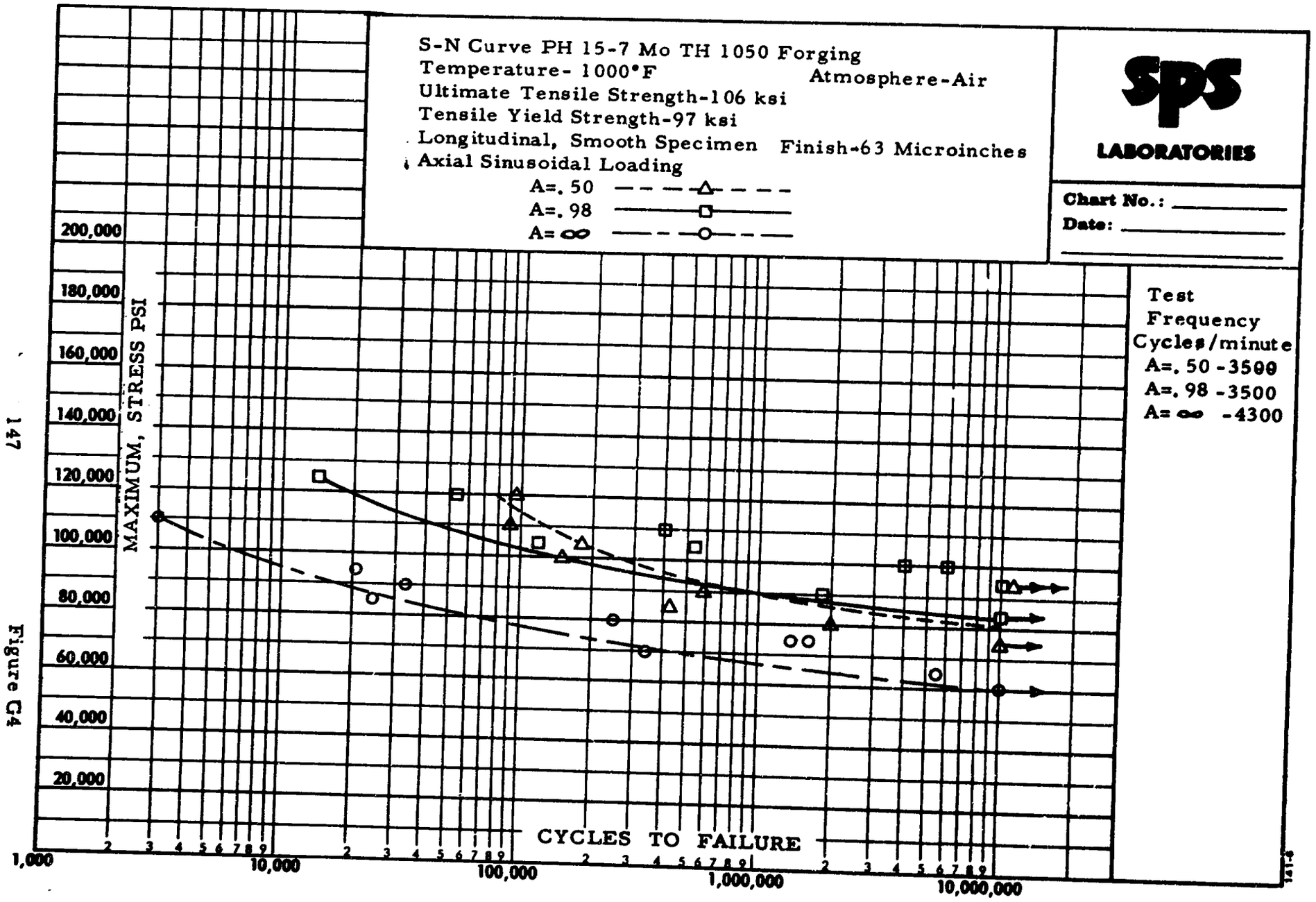

S-N Curve PH 15-7 Mo TH 1050 Forging
Temperature - 700°F
Environment - Air
Ultimate Tensile Strength - 166 ksi
Tensile Yield Strength - 156 ksi
Longitudinal, Smooth Specimen Finish - 63 Microinches
Axial Sinusoidal Loading
A= .50
A= .98
A= ∞
SPS
LABORATORIES
Chart No.:
Date:
Test Frequency Cycles/minute
A=.50 -3500
A=.98 -3500
A=∞ -4300
MAXIMUM STRESS, PSI
200,000
180,000
160,000
140,000
120,000
100,000
80,000
60,000
40,000
20,000
CYCLES TO FAILURE
1,000
10,000
100,000
1,000,000
10,000,000

Figure G3



147

Figure C4

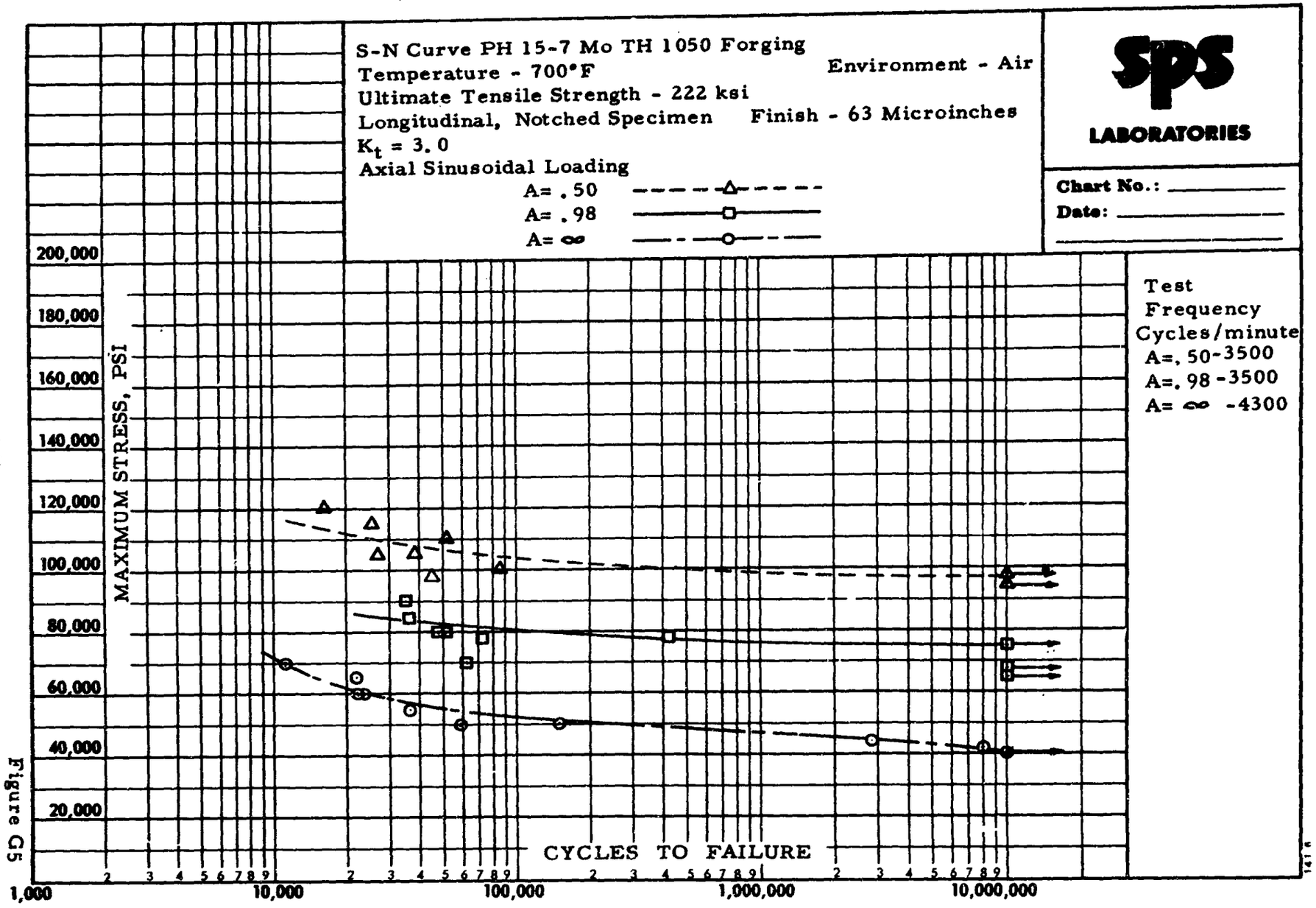

S-N Curve PH 15-7 Mo TH 1050 Forging
Temperature - 700°F
Environment - Air
Ultimate Tensile Strength - 222 ksi
Longitudinal, Notched Specimen
Finish - 63 Microinches
K_t = 3.0
Axial Sinusoidal Loading
A= .50
A= .98
A= ∞
SPS LABORATORIES
Chart No.:
Date:
Test Frequency Cycles/minute
A=.50 -3500
A=.98 -3500
A= ∞ -4300
MAXIMUM STRESS, PSI
200,000
180,000
160,000
140,000
120,000
100,000
80,000
60,000
40,000
20,000
CYCLES TO FAILURE
1,000
10,000
100,000
1,000,000
10,000,000

Figure C5

S-N Curve PH 15-7 Mo TH 1050 Forging
Temperature - 1000°F Environment-Air
Ultimate Tensile Strength-148 ksi
Longitudinal, Notched Specimen Finish-63 Microinches
K_t=3.0
Axial Sinusoidal Loading
A=.50
A=.98
A= ∞

SPS LABORATORIES

Chart No.: _____
Date: _____

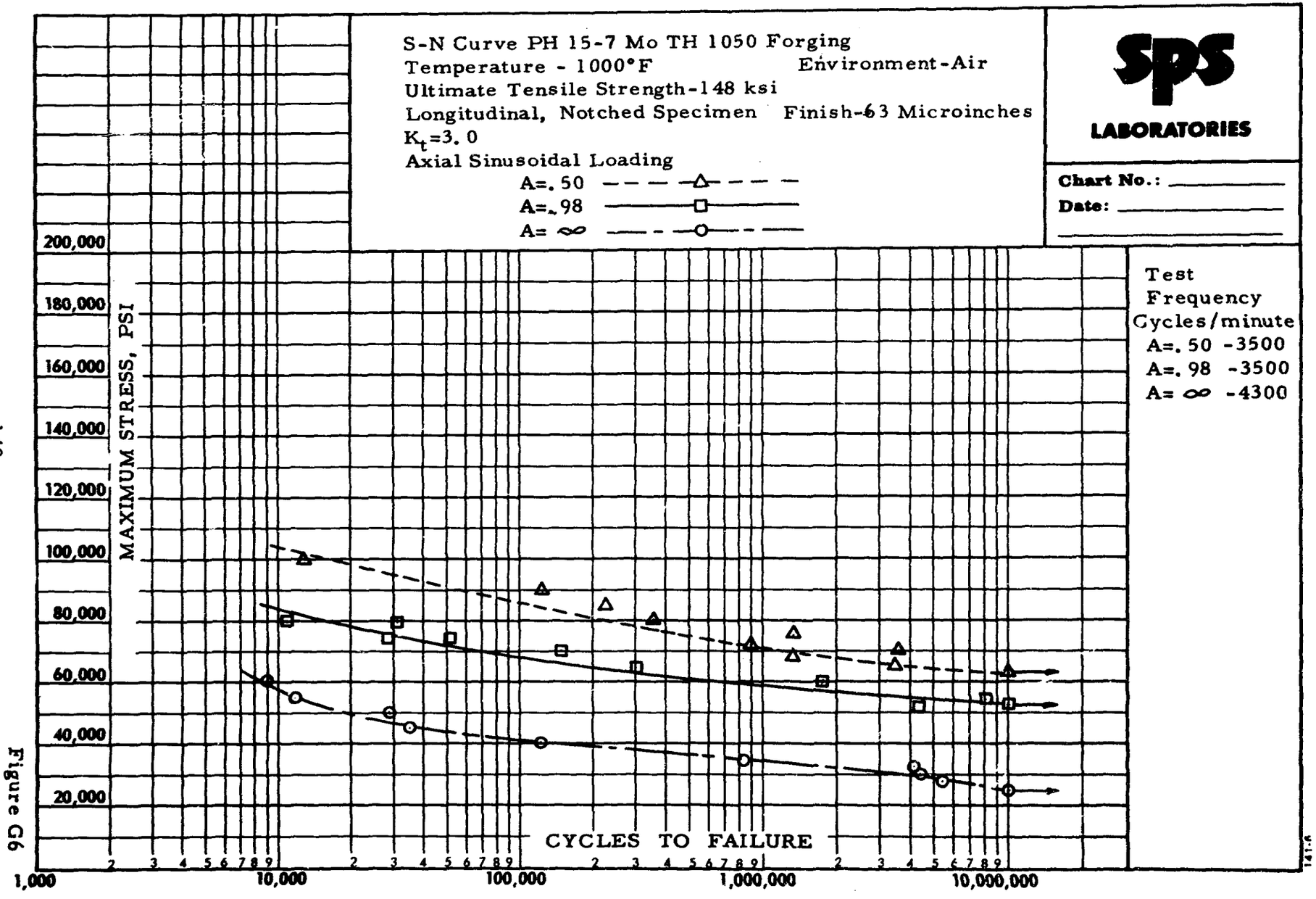


Figure C6

CONSTANT LIFE DIAGRAM-PH15-7 Mo TH1050 Forging
Temperature - 700°F
Ultimate Tensile Strength-Smooth-166 KSI-Notched -222 KSI
Tensile Yield Strength- Smooth-156 KSI
Axial Sinusoidal Loading
Environment Air
Specimen Finish - 63 Microinches

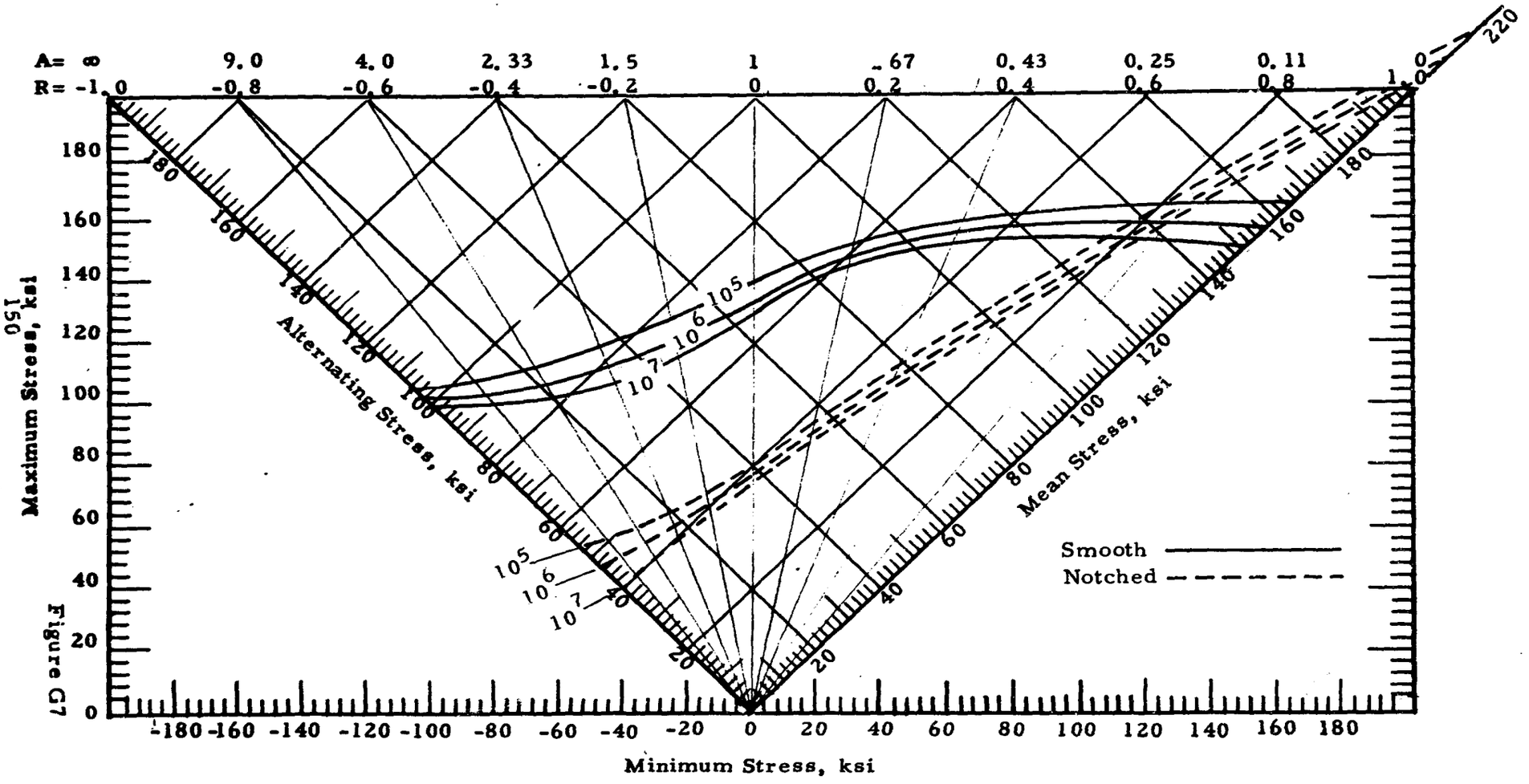


Figure G7

CONSTANT LIFE DIAGRAM-PH15-7 Mo TH1050 Forging
Temperature - 1000°F
Ultimate Tensile Strength-Smooth-106 KSI-Notched-148 KSI
Tensile Yield Strength-Smooth- 97 KSI
Axial Sinusoidal Loading
Environment-Air
Specimen Finish-63 Microinches

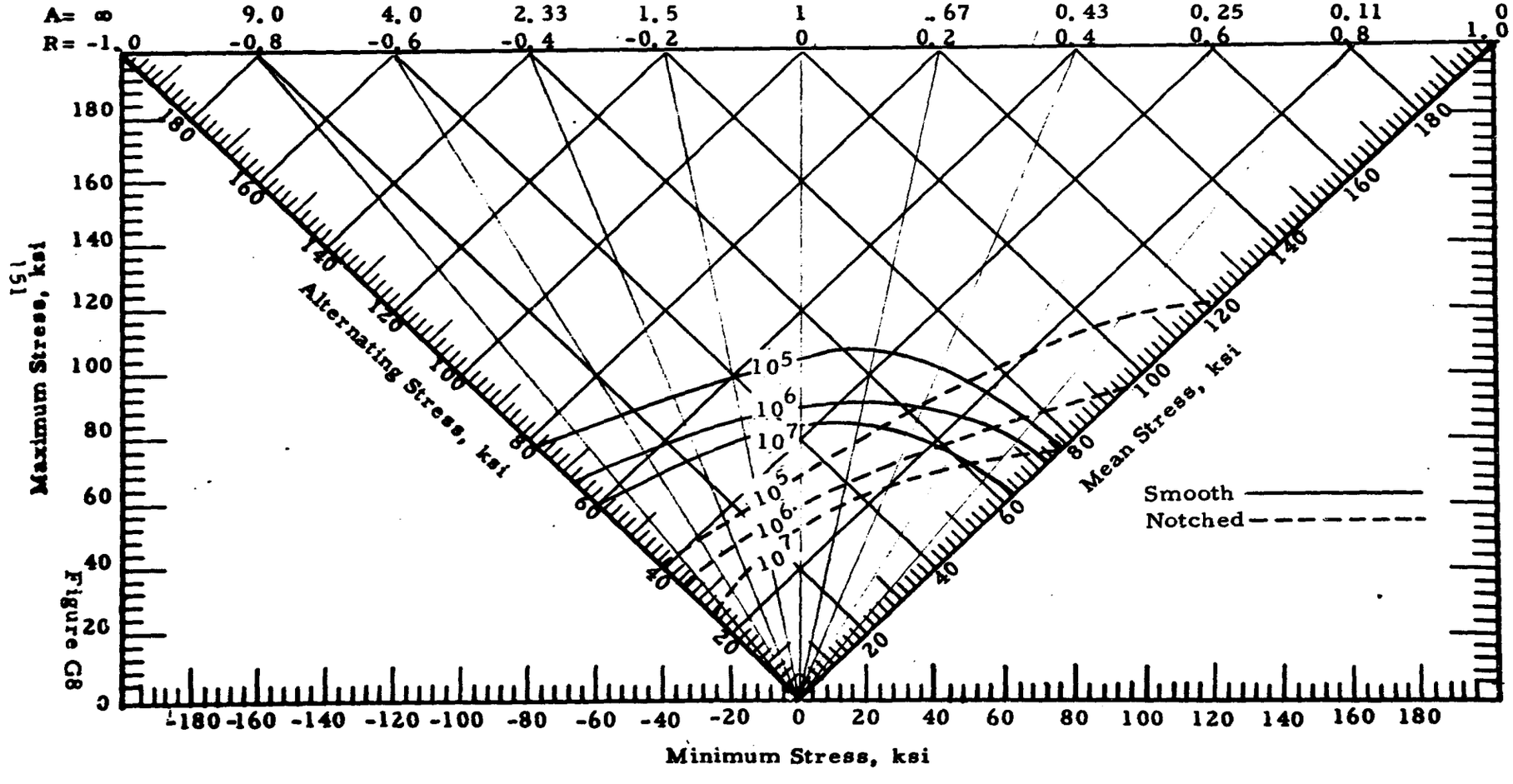


Figure C8
151

Unclassified

Security Classification

DOCUMENT CONTROL DATA - R&D

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

1. ORIGINATING ACTIVITY (Corporate author) Standard Pressed Steel Company Jenkintown, Penna .	2a. REPORT SECURITY CLASSIFICATION Unclassified 2b GROUP

3. REPORT TITLE

Development of Fatigue Data for Several Alloys for Use in Aerospace Design

4. DESCRIPTIVE NOTES (Type of report and inclusive dates)

Final Report - March, 1966 to November, 1968

5. AUTHOR(S) (Last name, first name, initial)

Roach, Thomas A.

6. REPORT DATE	7a. TOTAL NO. OF PAGES	7b. NO. OF REFS
May, 1969	151	-

8a. CONTRACT OR GRANT NO.	9a. ORIGINATOR'S REPORT NUMBER(S)
AF33(615)-3737 b. PROJECT NO. 7381 c. d. Task No. 738106	9b. OTHER REPORT NO(S) (Any other numbers that may be assigned this report)

10. AVAILABILITY/LIMITATION NOTICES This document is subject to special export controls and each transmittal to foreign governments or foreign nationals may be made only with prior approval of the Air Force Flight Dynamics Laboratory (FDTS), Wright-Patterson Air Force Base, Ohio 45433.

11. SUPPLEMENTARY NOTES	12. SPONSORING MILITARY ACTIVITY
	Air Force Materials Laboratory (MAAE) Wright-Patterson AFB, Ohio 45433

13. ABSTRACT

A test program was conducted to develop fatigue data on 17-7 PH and PH 15-7 stainless steels at room and elevated temperatures. Limited stress-rupture and tensile data were also obtained. This program is part of an overall effort to obtain fatigue data for alloys which are currently in MIL-HDBK-5, but for which fatigue data is currently lacking. All data were generated to be compatible with the MIL-HDBK-5 format and are presented in tabular form as well as stress rupture curves, S-N curves, and constant life diagrams.

DD FORM 1 JAN 64 1473

Security Classification

Security Classification

14. KEY WORDS	LINK A		LINK B		LINK C	
	ROLE	WT	ROLE	WT	ROLE	WT
Fatigue Mechanical properties AM350 17-7 PH PH 15-7 Mo						

INSTRUCTIONS

1. ORIGINATING ACTIVITY: Enter the name and address of the contractor, subcontractor, grantee, Department of Defense activity or other organization *(corporate author)* issuing the report.

2a. REPORT SECURITY CLASSIFICATION: Enter the overall security classification of the report. Indicate whether "Restricted Data" is included. Marking is to be in accordance with appropriate security regulations.

2b. GROUP: Automatic downgrading is specified in DoD Directive 5200.10 and Armed Forces Industrial Manual. Enter the group number. Also, when applicable, show that optional markings have been used for Group 3 and Group 4 as authorized.

3. REPORT TITLE: Enter the complete report title in all capital letters. Titles in all cases should be unclassified. If a meaningful title cannot be selected without classification, show title classification in all capitals in parenthesis immediately following the title.

4. DESCRIPTIVE NOTES: If appropriate, enter the type of report, e.g., interim, progress, summary, annual, or final. Give the inclusive dates when a specific reporting period is covered.

5. AUTHOR(S): Enter the name(s) of author(s) as shown on or in the report. Enter last name, first name, middle initial. If military, show rank and branch of service. The name of the principal author is an absolute minimum requirement.

6. REPORT DATE: Enter the date of the report as day, month, year; or month, year. If more than one date appears on the report, use date of publication.

7a. TOTAL NUMBER OF PAGES: The total page count should follow normal pagination procedures, i.e., enter the number of pages containing information.

7b. NUMBER OF REFERENCES: Enter the total number of references cited in the report.

8a. CONTRACT OR GRANT NUMBER: If appropriate, enter the applicable number of the contract or grant under which the report was written.

8b, 8c, & 8d. PROJECT NUMBER: Enter the appropriate military department identification, such as project number, subproject number, system numbers, task number, etc.

9a. ORIGINATOR'S REPORT NUMBER(S): Enter the official report number by which the document will be identified and controlled by the originating activity. This number must be unique to this report.

9b. OTHER REPORT NUMBER(S): If the report has been assigned any other report numbers *(either by the originator or by the sponsor)*, also enter this number(s).

10. AVAILABILITY/LIMITATION NOTICES: Enter any limitations or further dissemination of the report, other than those imposed by security classification, using standard statements such as:

(1) "Qualified requesters may obtain copies of this report from DDC."

(2) "Foreign announcement and dissemination of this report by DDC is not authorized."

(3) "U. S. Government agencies may obtain copies of this report directly from DDC. Other qualified DDC users shall request through

_____."

(4) "U. S. military agencies may obtain copies of this report directly from DDC. Other qualified users shall request through

_____."

(5) "All distribution of this report is controlled. Qualified DDC users shall request through

_____."

If the report has been furnished to the Office of Technical Services, Department of Commerce, for sale to the public, indicate this fact and enter the price, if known.

11. SUPPLEMENTARY NOTES: Use for additional explanatory notes.

12. SPONSORING MILITARY ACTIVITY: Enter the name of the departmental project office or laboratory sponsoring *(paying for)* the research and development. Include address.

13. ABSTRACT: Enter an abstract giving a brief and factual summary of the document indicative of the report, even though it may also appear elsewhere in the body of the technical report. If additional space is required, a continuation sheet shall be attached.

It is highly desirable that the abstract of classified reports be unclassified. Each paragraph of the abstract shall end with an indication of the military security classification of the information in the paragraph, represented as *(TS)*, *(S)*, *(C)*, or *(U)*.

There is no limitation on the length of the abstract. However, the suggested length is from 150 to 225 words.

14. KEY WORDS: Key words are technically meaningful terms or short phrases that characterize a report and may be used as index entries for cataloging the report. Key words must be selected so that no security classification is required. Identifiers, such as equipment model designation, trade name, military project code name, geographic location, may be used as key words but will be followed by an indication of technical context. The assignment of links, rules, and weights is optional.

Security Classification