WADC TECHNICAL REPORT 55-103
SUPPLEMENT 2

DESIGN PROPERTIES OF HIGH-STRENGTH STEELS IN THE PRESENCE OF STRESS-CONCENTRATIONS

Effects of a Number of Variables on the Mechanical Properties of Aircraft High-Strength Steels

B. B. MUVDI
E. P. KLIER
G. SACHS

SYRACUSE UNIVERSITY

JANUARY 1956

MATERIALS LABORATORY
CONTRACT No. AF 33(616)-2362
PROJECT No. 7360

WRIGHT AIR DEVELOPMENT CENTER
AIR RESEARCH AND DEVELOPMENT COMMAND
UNITED STATES AIR FORCE
WRIGHT-PATTERSON AIR FORCE BASE, OHIO

Carpenter Litho & Prtg. Co., Springfield, O.
500 - April 1956

FOREWORD

This report was prepared by Syracuse University under USAF Contract No. AF 33(616)-2362. The contract was initiated under Project No. 7360, "Materials Analysis and Evaluation Techniques", Task No. 73605, "Design and Evaluation Data for Structural Metals" formerly RDO No. 614-13 "Design and Evaluation Data for Structural Metals", and was administered under the direction of the Materials Laboratory, Directorate of Research, Wright Air Development Center, with Mr. A. W. Brisbane as project engineer. This work was performed in the period between March 1954 and June 1955.

ABSTRACT

Supplement 2 of WADC TR 55-103 is a summary of all test results assembled in this investigation. The results are presented in tables which indicate both individual and average test values. The abstract of the basic report is pertinent to this supplement also.

PUBLICATION REVIEW

This report has been reviewed and is approved.

FOR THE COMMANDER:

M. R. WHITMORE
Technical Director
Materials Laboratory
Directorate of Research

LIST OF TABLES

4340 Steel - Heat No. 1 (4-1/4 In. Dia.)

Table		Page
1	Results of 0.28 In. Dia. Tensile Specimens From 4-1/4 In. Dia. 4340 - Heat No. 1 (1525°F/Oil)	2
2	Results of 0.3 In. Dia. Notch-Tensile Specimens (K = 3) From 4-1/4 In. Dia. 4340 - Heat No. 1 (1525°F/Oil)	3
3	Results of 0.3 In. Dia. Notch-Tensile Specimens (K = 5) From 4-1/4 In. Dia. 4340 - Heat No. 1 (1525°F/Oil)	4
4	Results of 0.3 In. Dia. Notch-Tensile Specimens (K = 10) From 4-1/4 In. Dia. 4340 - Heat No. 1 (1525°F/Oil)	5
5	Results of 0.5 In. Dia. Notch-Tensile Specimens (K = 3) From 4-1/4 In. Dia. 4340 - Heat No. 1 (1525°F/Oil)	6
6	Results of 0.5 In. Dia. Notch-Tensile Specimens (K = 5) From 4-1/4 In. Dia. 4340 - Heat No. 1 (1525°F/Oil)	7
7	Results of 0.5 In. Dia. Notch-Tensile Specimens (K = 10) From 4-1/4 In. Dia. 4340 - Heat No. 1 (1525°F/Oil)	8
8	Results of 0.3 & 0.5 In. Dia. Notch-Tensile Specimens From 4-1/4 In. Dia. 4340 - Heat No. 1 (1525°F/Oil)	9
9	Results of 0.3 In. Dia. Eccentric Notch-Tensile Specimens (K = 3) From 4-1/4 In. Dia. 4340 - Heat No. 1 (1525°F/Oil)	10
10	Results of 0.3 In. Dia. Eccentric Notch-Tensile Specimens (K = 5) From 4-1/4 In. Dia. 4340 - Heat No. 1 (1525°F/Oil)	11
11	Results of 0.3 In. Dia. Eccentric Notch-Tensile Specimens (K = 10) From 4-1/4 In. Dia. 4340 - Heat No. 1 (1525°F/Oil)	12
12	Results of 0.3 In. Dia. Eccentric Notch-Tensile Specimens From 4-1/4 In. Dia. 4340 - Heat No. 1 (1525°F/Oil)	13
13	Results of Impact Tests for Charpy Specimens From 4-1/4 In. Dia. 4340 - Heat No. 1 (1525°F/Oil), Tempered at 400°F	14
14	Results of Impact Tests for Charpy Specimens From 4-1/4 In. Dia. 4340 - Heat No. 1 (1525°F/Oil), Tempered at 500°F	15
15	Results of Impact Tests for Charpy Specimens From 4-1/4 In. Dia. 4340 - Heat No. 1 (1525°F/Oil), Tempered at 600°F	16
16	Results of Impact Tests for Charpy Specimens From 4-1/4 In. Dia. 4340 - Heat No. 1 (1525°F/Oil), Tempered at 700°F	17
17	Results of Impact Tests for Charpy Specimens From 4-1/4 In. Dia. 4340 - Heat No. 1 (1525°F/Oil), Tempered at 800°F	18
18	Rotating Beam Fatigue Data for Smooth & Notched Specimens From 4-1/4 In. Dia. 4340 - Heat No. 1 (1525°F/Oil), Tempered at 400°and 600°F, Test Temp. = R.T.	19
19	Rotating Beam Fatigue Data for Smooth and Notched Specimens From 4-1/4 In. Dia. 4340 - Heat No. 1 (1525°F/Oil), Tempered at 500° and 700°F, Test Temp. = R.T.	20

LIST OF TABLES (CONT.)

Table		Page
20	Rotating Beam Fatigue Data for Smooth and Notched Specimens From 4-1/4 In. Dia. 4340 - Heat No. 1 (1525°F/Oil), Tempering Temp. = 800°F, Test Temp. = R. T.	22
21	Rotating Beam Fatigue Data for Smooth and Notched Longitudinal and Transverse Specimens From 4-1/4 In. Dia. 4340 - Heat No. 1 (1525°F/Oil) Test Temp. = R. T.	23
	4340 Heat No. 1 (1-1/2 In. Dia.)	
22	Results of 0.28 In. Dia. Tensile Specimens From 1-1/2 In. Dia. 4340 - Heat No. 1 (1525°F/Oil). Test Temp. = R.T.	24
23	Results of 0.3 In. Dia. Notch-Tensile Specimens (K = 3) From 1-1/2 In. Dia. 4340 - Heat No. 1 (1525°F/Oil) Test Temp. = R.T.	25
24	Results of 0.3 In. Dia. Notch-Tensile Specimens (K = 5) From 1-1/2 In. Dia. 4340 - Heat No. 1 (1525°F/Oil) Test Temp. = R.T.	26
25	Results of 0.3 In. Dia. Notch-Tensile Specimens (K = 10) From 1-1/2 In. Dia. 4340 - Heat No. 1 (1525°F/Oil) Test Temp. = R.T.	27
26	Results of 0.3 In. Dia. Notch-Tensile Specimens From 1-1/2 In. Dia. 4340 - Heat No. 1 (1525°F/Oil), Test Temp. = R.T.	28
	4340 - Heats 2,3, and 4 (4, 3-1/2, 3-1/4 In. Dia. Respectively)	
27	Results of 0.28 In. Dia. Tensile Specimens From Three Heats of 4340 (1525°F/Oil), Test Temp. = R.T.	29
28	Results of 0.3 In. Dia. Notch-Tensile Specimens (K = 3) From Three Heats of 4340 (1525°F/Oil) Test Temp. = R.T.	30
29	Results of 0.3 In. Dia. Notch-Tensile Specimens (K = 5) From Three Heats of 4340 (1525°F/Oil) Test Temp. = R.T.	31
30	Results of 0.3 In. Dia. Notch-Tensile Specimens (K = 10) From Three Heats of 4340 (1525°F/Oil) Test Temp. = R.T.	32
31	Results of 0.3 In. Dia. Notch-Tensile Specimens From Three Heats of 4340, Test Temp. = R.T.	33
32	Results of 0.3 In. Dia. Eccentric Notch-Tensile Specimens (K = 3) From Three Heats of 4340 (1525°F/Oil) Test Temp. = R.T.	34
33	Results of 0.3 In. Dia. Eccentric Notch-Tensile Specimens (K = 5) From Three Heats of 4340 (1525°F/Oil) Test Temp. = R.T.	35
34	Results of 0.3 In. Dia. Eccentric Notch-Tensile Specimens (K = 10) From Three Heats of 4340 (1525°F/Oil) Test Temp. = R.T.	36
35	Results of 0.3 In. Dia. Notch-Tensile Specimens From Three Heats of 4340 (1525°F/Oil), Test Temp. = R.T.	37
36	Results of Impact Tests for Charpy Specimens From 4 In. Dia. 4340 Heat No. 2 (1525°F/Oil), Tempered at 500°F	38

LIST OF TABLES (CONT.)

Table		Page
37	Results of Impact Tests for Charpy Specimens From 4 In. Dia. 4340 Heat No. 2 (1525°F/Oil) Tempered at 700°F	39
38	Results of Impact Tests for Charpy Specimens From 3-1/2 In. Dia. 4340 - Heat No. 3, (1525°F/Oil), Tempered at 500°F	40
39	Results of Impact Tests for Charpy Specimens From 3-1/2 In. Dia. 4340 - Heat No. 3 (1525°F/Oil) Tempered at 700°F	41
40	Results of Impact Tests for Charpy Specimens From 3-1/4 In. Dia. 4340 - Heat No. 4, (1525°F/Oil), Tempered at 500°F	42
41	Results of Impact Tests for Charpy Specimens From 3-1/4 In. Dia. 4340 Heat No. 4, (1525°F/Oil), Tempered at 700°F	43
	98B40 Steel	
42	Results of 0.28 In. Dia. Tensile Specimens From 4-1/2 In. Dia. 98B40 (1550°F/Oil) Test Temp. = R.T.	44
43	Results of 0.3 In. Dia. Notch-Tensile Specimens (K = 3) From 4-1/2 In. Dia. 98B40 (1550°F/Oil) Test Temp. = R.T.	45
44	Results of 0.3 In. Dia Notch-Tensile Specimens (K = 5) From 4-1/2 In. Dia. 98B40 (1550°F/Oil) Test Temp. = R.T.	46
45	Results of 0.3 In. Dia. Notch-Tensile Specimens (K = 10) From 4-1/2 In. Dia. 98B40 (1550°F/Oil) Test Temp. = R.T.	47
46	Results of 0.5 In. Dia. Notch-Tensile Specimens (K = 3) From 4-1/2 In. Dia. 98B40 (1550°F/Oil) Test Temp. = R.T.	48
47	Results of 0.5 In. Dia. Notch-Tensile Specimens (K = 5) From 4-1/2 In. Dia. 98B40 (1550°F/Oil) Test Temp. = R.T.	49
48	Results of 0.5 In. Dia. Notch-Tensile Specimens (K = 10) From 4-1/2 In. Dia. 98B40 (1550°F/Oil) Test Temp. = R.T.	50
49	Results of 0.3 and 0.5 In. Dia. Notch-Tensile Specimens From 4-1/2 In. Dia. 98B40 (1550°F/Oil) Test Temp. = R.T.	51
50	Results of Impact Tests on V-Notch Charpy Specimens From 4-1/2 In. Dia. 98B40 (1550°F/Oil), Tempered at 400°F	52
51	Results of Impact Tests on V-Notch Charpy Specimens From 4-1/2 In. Dia. 98B40 (1550°F/Oil), Tempered at 500°F	53
52	Results of Impact Tests on V-Notch Charpy Specimens From 4-1/2 In. Dia. 98B40 (1550°F/Oil), Tempered at 575°F	54
53	Results of Impact Tests on V-Notch Charpy Specimens From 4-1/2 In. Dia. 98B40 (1550°F/Oil), Tempered at 650°F	55
54	Results of Impact Tests on V-Notch Charpy Specimens From 4-1/2 In. Dia. 98B40 (1550°F/Oil), Tempered at 800°F	56
55	Rotating Beam Fatigue Data for Smooth & Notched Longitudinal Specimens From 4-1/2 In. Dia. 98B40 (1550°F/Oil), Tempered at 400 and 500°F, Test Temp. = R.T.	57

Table		Page
56	Rotating Beam Fatigue Data for Smooth and Notched Longitudinal Specimens From 4-1/2 In. Dia. 98B40 (1550°F/Oil), Tempered at 575° and 650°F, Test Temp. = R.T.	58
57	Rotating Beam Fatigue Data for Smooth and Notched Longitudinal Specimens From 4-1/2 In. Dia. 98B40 (1550°F/Oil), Tempered at 800°F, Test Temp. = R.T.	59
58	Rotating Beam Fatigue Data for Smooth and Notched Longitudinal Specimens From 4-1/2 In. Dia. 98B40 (1550°F/Oil) at Various Strength Levels, Test Temp. = R. T.	60
	Super Hi-Tuf Steel	
59	Results of 0.28 In. Dia. Tensile Specimens From 3 In. Dia. Super Hy-Tuf (1700°F/Oil), Test Temp. = R.T.	61
60	Results of 0.3 In. Dia. Notch Tensile Specimens (K = 3) From 3 In. Dia. Super Hy-Tuf (1700°F/Oil), Test Temp. = R.T.	62
61	Results of 0.3 In. Dia. Notch Tensile Specimens (K = 5) From 3 In. Dia. Super Hy-Tuf (1700°F/Oil), Test Temp. = R.T.	63
62	Results of 0.3 In. Dia. Notch Tensile Specimens (K = 10) From 3 In. Dia. Super Hy-Tuf (1700°F/Oil), Test Temp. = R.T.	64
63	Results of 0.3 and 0.5 In.Dia. Notch-Tensile Specimens From 3 In. Dia. Super Hy-Tuf (1700°F/Oil), Test Temp. = R. T.	65
64	Results of Impact Tests for V-Notch Charpy Specimens From 3 In. Dia. Super Hy-Tuf (1700°F/Oil), Test Tempered at 800°F	66
65	Rotating Beam Fatigue Data for Smooth and Notched Specimens From 3 In. Dia. Super Hy-Tuf (1700°F/Oil) Test Temp. = R.T.	67
	Super TM-2 Steel	
66	Results of 0.28 In. Dia. Tensile Specimens From 3 In.Dia. Super TM-2 (1600°F/Oil), Test Temp. = R.T.	68
67	Results of 0.3 In. Dia. Notch Tensile Specimens (K = 3) From 3 In. Dia. Super TM-2 (1600°F/Oil), Test Temp. = R. T.	69
68	Results of 0.3 In. Dia. Notch-Tensile Specimens (K = 5) From 3 In. Dia. Super TM-2 (1600°F/Oil), Test Temp. = R.T.	70
69	Results of 0.3 In. Dia. Notch-Tensile Specimens (K = 10) From 3 In. Dia. Super TM-2 (1600°F/Oil), Test Temp. = R.T.	71
70	Results of 0.3 In. Dia. Notch-Tensile Specimens From 3 In. Dia. Super TM-2 (1600°F/Oil), Test Temp. = R.T.	72
71	Results of Impact Tests for Charpy Specimens From 3 In. Dia. Super TM-2, (1600°F/Oil), Tempered at 500°F	73
	Inco Steel	
72	Results of 0.28 In. Dia. Tensile Specimens From 4-1/2 In. Sq. Inco (1600°F/Oil), Test Temp. = R. T.	74

LIST OF TABLES (CONT.)

Table		Page
73	Results of 0.3 In. Dia. Notch-Tensile Specimens (K = 3) From 4-1/2 In. Sq. Inco (1600°F/Oil), Test Temp. = R.T.	75
74	Results of 0.3 In. Dia. Notch-Tensile Specimens (K = 5) From 4-1/2 In. Sq. Inco (1600°F/Oil), Test Temp. = R.T.	76
75	Results of 0.3 In. Dia. Notch-Tensile Specimens (K = 10) From 4-1/4 In. Sq. Inco (1600°F/Oil), Test Temp. = R.T.	77
76	Results of 0.3 In. Dia. Notch-Tensile Specimens From 4-1/4 In. Sq. Inco (1600°F/Oil, Test Temp. = R.T.	78
77	Results of Impact Tests for Charpy Specimens From 4 In. Sq. Inco Steel, (1600°F/Oil), Tempered at 600°F	79
	V-Mod. 4330 Steel	
78	Results of 0.3 In. Dia. Tensile Specimens From 4 In. Sq. V-Mod. 4330 (1600°F/Oil) Test Temp. = R.T.	80
79	Results of 0.3 In. Dia. Notch Tensile Specimens (K = 3) From 4 In. Sq. V-Mod. 4330 (1600°F/Oil) Test Temp. = R.T.	81
80	Results of 0.3 In. Dia. Notch Tensile Specimens (K = 5) From 4 In. Sq. V-Mod 4330 (1600°F/Oil) Test Temp. R.T.	82
81	Results of 0.3 In. Dia. Notch Tensile Specimens (K = 10) From 4 In. Sq. V-Mod. 4330 (1600°F/Oil) Test Temp. = R.T.	83
82	Results of 0.5 In. Dia. Notch Tensile Specimens (K = 3) From 4 In. Sq. V-Mod. 4330 (1600°F/Oil) Test Temp. = R.T.	84
83	Results of 0.5 In. Dia. Notch Tensile Specimens (K = 5) From 4 In. Sq. V-Mod. 4330 (1600°F/Oil) Test Temp. = R.T.	85
84	Results of 0.5 In. Dia. Notch Tensile Specimens (K = 10) From 4 In. Sq. V-Mod. 4330 (1600°F/Oil) Test Temp. = R.T.	86
85	Results of 0.3 and 0.5 In. Dia. Notch Tensile Specimens From 4 In. Sq. V-Mod. 4330 (1600°F/Oil) Test Temp. = R.T.	87
86	Results of Impact Tests on V-Notch Charpy Specimens From 4 In. Sq. V-Mod. 4330 (1600°F/Oil) Tempered at 250°F	88
87	Results of Impact Tests on V-Notch Charpy Specimens From 4 In. Sq. V-Mod. 4330 (1600°F/Oil) Tempered at 400°F	89
88	Results of Impact Tests on V-Notch Charpy Specimens From 4 In. Sq. V-Mod. 4330 (1600°F/Oil) Tempered at 500°F	90
89	Results of Impact Tests on V-Notch Charpy Specimens From 4 In. Sq. V-Mod. 4330 (1600°F/Oil) Tempered at 650°F	91
90	Results of Impact Tests on V-Notch Charpy Specimens From 4 In. Sq. V-Mod. 4330 (1600°F/Oil) Tempered at 800°F	92
91	Rotating Beam Fatigue Data for Smooth and Notched Specimens From 4 In. Sq. V-Mod. 4330 (1600°F/Oil) Tempered at 250°F, Test Temp. = R. T.	93
92	Rotating Beam Fatigue Data for Smooth and Notch Specimens From 4 In. Sq. V-Mod. 4330 (1600°F/Oil) Tempered at 400°F Test Temp. = R.T. ..	94

Table		Page
93	Rotating Beam Fatigue Data for Smooth Specimens From 4 In. Sq. V-Mod. 4330 (1600°F/Oil) Tempered at 500°F	95
94	Rotating Beam Fatigue Data for Smooth Specimens from 4 In. Sq. V-Mod. 4330 (1600°F/Oil) Tempered at 650°F Test Temp. = R. T.	96
95	Rotating Beam Fatigue Data for Smooth and Notched Specimens From 4 In. Sq. V-Mod. 4330 (1600°F/Oil) Tempered at 800°F, Test Temp.= R. T.	97
96	Rotating Beam Fatigue Data for Smooth and Notched Longitudinal Specimens from 4 In. Sq. V-Mod. 4330 (1600°F/Oil) Test Temp. = R.T.	98
	Hy-Tuf Steel	
97	Results of 0.28 In. Dia. Tensile Specimens From 3 In. Dia. Hy-Tuf (1575°F/Oil) Test Temp. = R.T.	99
98	Results of 0.3 In. Dia. Notch Tensile Specimens (K = 3) From 3 In. Dia. Hy-Tuf (1575°F/Oil) Test Temp. = R.T.	100
99	Results of 0.3 In. Dia. Notch Tensile Specimens (K = 5) From 3 In. Dia. Hy-Tuf (1575°F/Oil) Test Temp. = R.T.	101
100	Results of 0.3 In. Dia. Notch Tensile Specimens (K = 10) From 3 In. Dia. Hy-Tuf (1575°F/Oil) Test Temp. = R. T.	102
101	Results of 0.3 and 0.5 In. Dia. Notch Tensile Specimens From 3 In. Dia. Hy-Tuf (1575°F/Oil) Test Temp. = R.T.	103
102	Results of Impact Tests for V-Notch Charpy Specimens From 3 In. Dia. Hy-Tuf (1575°F/Oil) Tempered at 500°F, Test Temp. R.T.	104
103	Rotating Beam Fatigue Data for Smooth and Notched Specimens From 3 In. Dia. Hy-Tuf (1575°F/Oil) Test Temp. = R.T.	105

SYMBOLS USED

SYMBOL	
K:	Theoretical stress concentration factor as derived by Neuber's theory.
L:	Longitudinal specimens, i.e. specimens taken along the direction of rolling.
Tr:	Transverse specimens, i.e. specimens taken perpendicular to the direction of rolling.
R.L. & C.L:	Longitudinal specimens taken from the rim and from the core of V-Mod. 4330 bar respectively.
R.T. & C.T:	Transverse specimens taken from the rim and from the core of V-Mod. 4330 bar respectively.
e:	Eccentricity, i.e. the distance from the center of the specimen to the line of load application.
D:	Shank diameter of notch-tension or notch-fatigue specimens.
d:	Notch diameter of notch-tension or notch-fatigue specimens.

INTRODUCTION

Supplement 2 of this report summarizes in table form all data obtained in this investigation with the exception of the program covering hydrogen embrittlement which were submitted as separate reports.

The data are presented for each steel in the following order: tension, notch-tension, impact, fatigue and notch-fatigue.

TABLE 1

RESULTS OF 0.28IN. DIA. TENSILE SPECIMENS FROM

4-1/4 IN. DIA. 4340 - HEAT NO. 1 (1525°F/OIL)

TEST TEMP. = R.T.

TEMPERING TEMP.-°F	TYPE OF SPECIMEN	TENSILE STRENGTH- 1000 PSI	TENSILE STRENGTH- AVE.	0.2% YIELD STRENGTH- 1000 PSI	0.2% YIELD STRENGTH- AVE.	%REDUCTION OF AREA	%REDUCTION OF AVE.	%ELONGATION	%ELONGATION AVE.
400	L	267.2 283.7	275.5	223.8 225.1	224.4	43.0 46.5	44.8	11.9 10.7	11.3
	Tr	275.9 281.9	278.9	222.9 218.1	220.5	9.1 17.1	13.1	1.3 6.0	3.7
500	L	270.2 268.1	269.1	226.5 224.7	225.6	47.2 47.8	47.5	11.8 11.5	11.7
	Tr	270.6 270.2	270.4	232.6 233.9	233.2	18.7 19.2	19.0	5.8 4.9	5.3
600	L	242.7 235.1	238.9	228.2 226.2	227.2	47.6 48.5	48.0	11.2 11.9	11.4
	Tr	245.1 242.7	243.9	228.2 229.0	228.6	19.4 9.4	14.4	6.5 1.3	3.9
700	L	232.6 238.7	235.7	216.5 217.7	217.1	45.4 47.7	46.6	12.1 11.2	11.7
	Tr	236.3 237.5	236.9	217.7 218.1	217.9	17.7 14.2	16.0	5.3 5.1	5.2
800	L	216.4 214.4	215.4	207.5 203.9	205.7	50.6 52.6	51.6	11.7 13.0	12.3
	Tr	210.7 214.4	212.6	205.8 207.1	206.5	18.6 17.3	18.0	6.1 5.2	5.7

TABLE 2

RESULTS OF 0.3 IN. DIA. NOTCH-TENSILE SPECIMENS (K = 3)

FROM 4-1/4 IN. DIA. 4340 - HEAT NO. 1 (1525°F/OIL)

TEST TEMP. = R.T.

TEMPERING TEMP.-°F	TYPE OF SPECIMEN	NOTCH STRENGTH-1000 PSI	AVG.	% REDUCTION OF AREA	AVG.
400	L	377.5 / 377.5	377.5	4.2 / 6.8	5.5
	Tr	331.9 / 331.4	331.7	2.8 / 2.3	2.6
500	L	353.1 / 363.5	358.3	3.4 / 4.0	3.7
	Tr	326.7 / 304.0	315.4	3.4 / 1.4	2.4
600	L	340.9 / 347.5	344.2	5.1 / 5.1	5.1
	Tr	304.2 / 264.9	284.6	3.4 / 3.1	3.3
700	L	330.5 / 337.6	334.1	7.4 / 5.7	6.6
	Tr	297.5 / 299.1	298.3	3.7 / 6.8	5.3
800	L	315.0 / 316.2	315.6	6.2 / 7.1	6.7
	Tr	282.7 / 293.4	288.1	4.8 / 6.3	5.6

TABLE 3

RESULTS OF 0.3 IN. DIA. NOTCH-TENSILE SPECIMENS (K = 5)

FROM 4-1/4 IN. DIA. 4340 - HEAT NO. 1 (1525°F/OIL)

TEST TEMP. = R.T.

TEMPERING TEMP.-°F	TYPE OF SPECIMEN	NOTCH STRENGTH-1000 PSI	AVG.	% REDUCTION OF AREA	AVG.
400	L	330.5 346.5	388.5	5.7 5.6	5.7
	Tr	292.1 340.0	316.1	2.5 1.1	1.8
500	L	328.7 329.6	329.2	3.1 2.2	2.7
	Tr	280.6 280.6	280.6	4.4 2.8	3.6
600	L	320.0 322.9	321.5	2.6 1.1	1.9
	Tr	291.1 288.9	290.0	1.4 0.8	1.1
700	L	308.8 300.0	304.4	2.0 5.0	3.5
	Tr	267.0 277.0	272.0	2.8 2.0	2.4
800	L	291.9 294.5	293.2	7.2 6.7	7.0
	Tr	281.9 271.6	276.8	2.8 2.5	2.7

TABLE 4

RESULTS OF 0.3 IN. DIA. NOTCH-TENSILE SPECIMENS (K = 10)

FROM 4-1/4 IN. DIA. 4340 - HEAT NO. 1 (1525°F/OIL)

TEST TEMP. = R.T.

TEMPERING TEMP.-°F	TYPE OF SPECIMEN	NOTCH STRENGTH-1000 PSI	NOTCH STRENGTH-AVG.	% REDUCTION OF AREA	% REDUCTION OF AREA-AVG.
400	L	291.0 320.6	305.8	2.5 1.5	2.0
	Tr	251.4 253.5	252.5	0.9 1.7	1.3
500	L	304.2 299.1	301.7	2.2 2.6	2.4
	Tr	280.9 265.9	273.4	2.8 3.3	3.1
600	L	307.9 308.1	308.0	2.8 4.2	3.5
	Tr	276.4 255.0	265.7	5.1 1.4	3.3
700	L	308.8 306.6	307.7	3.1 0.9	2.0
	Tr	270.1 262.8	266.5	3.4 1.1	2.3
800	L	292.1 294.6	293.4	4.8 4.8	4.8
	Tr	283.7 287.9	285.8	5.6 2.7	4.2

TABLE 5

RESULTS OF 0.5 IN. DIA. NOTCH-TENSILE SPECIMENS (K = 9)

FROM 4-1/4 IN. DIA. 4340 - HEAT NO. 1 (1525°F/OIL)

TEST TEMP. = R.T.

TEMPERING TEMP.-°F	TYPE OF SPECIMEN	NOTCH STRENGTH-1000 PSI	AVG.	% REDUCTION OF AREA	AVG.
400	L	365.9 360.8	363.4	5.2 7.7	6.5
	Tr	258.1 289.1	273.6	2.4 4.2	3.3
500	L	352.7 354.1	353.4	4.0 3.3	3.7
	Tr	289.2 290.1	289.7	1.9 3.3	2.6
600	L	319.7 326.8	323.3	4.6 7.0	5.8
	Tr	271.7 266.4	269.1	2.8 4.2	3.5
700	L	321.1 321.4	321.3	3.9 3.1	3.5
	Tr	248.7 265.6	257.2	2.6 4.4	3.5
800	L	315.6 317.2	316.4	4.5 7.3	5.9
	Tr	257.2 268.6	262.9	2.1 4.0	3.1

TABLE 6

RESULTS OF 0.5 IN. DIA. NOTCH-TENSILE SPECIMENS (K = 5)

FROM 4-1/4 IN. DIA. 4340 - HEAT NO. 1 (1525°F/OIL)

TEST TEMP. = R.T.

TEMPERING TEMP.-°F	TYPE OF SPECIMEN	NOTCH STRENGTH-1000 PSI	AVG.	% REDUCTION OF AREA	AVG.
400	L	309.6 / 323.0	316.3	3.3 / 3.3	3.3
	Tr	225.6 / 224.7	225.2	2.4 / 1.9	2.2
500	L	293.1 / 309.9	301.5	3.5 / 2.1	2.8
	Tr	228.7 / 239.8	234.3	1.9 / 2.1	2.0
600	L	277.7 / 291.4	284.6	3.1 / 2.3	2.7
	Tr	191.6 / 219.6	205.6	1.8 / 1.6	1.7
700	L	284.7 / 287.0	285.9	3.7 / 1.9	2.8
	Tr	215.4 / 234.5	225.0	2.3 / 1.7	2.0
800	L	277.5 / 280.2	278.9	4.0 / 3.5	3.8
	Tr	251.0 / 253.0	252.0	2.0 / 2.5	2.3

TABLE 7

RESULTS OF 0.5 IN. DIA. NOTCH-TENSILE SPECIMENS (K = 10)

FROM 4-1/4 IN. DIA. 4340 - HEAT NO. 1 (1525°F/OIL)

TEST TEMP. = R.T.

TEMPERING TEMP.-°F	TYPE OF SPECIMEN	NOTCH STRENGTH-1000 PSI	AVG.	% REDUCTION OF AREA	AVG.
400	L	284.2 / 272.4	278.3	1.59 / 1.8	1.7
	Tr	217.3 / 214.4	215.9	1.8 / 2.1	2.0
500	L	310.3 / 301.2	305.8	2.9 / 3.7	3.3
	Tr	277.0 / 261.2	269.1	1.8 / 1.9	1.9
600	L	279.7 / 283.1	281.4	1.7 / 2.3	2.0
	Tr	197.9 / 179.8	188.9	1.4 / 1.7	1.6
700	L	265.8 / 274.3	270.1	2.4 / 1.4	1.9
	Tr	192.6 / 195.3	194.0	1.2 / 1.5	1.4
800	L	279.5 / 276.1	277.8	3.1 / 2.6	2.9
	Tr	233.4 / 219.9	226.7	3.5 / 1.5	2.5

TABLE 8

RESULTS OF 0.3 & 0.5 IN. DIA. NOTCH-TENSILE SPECIMENS

FROM 4-1/4 IN. DIA. 4340 - HEAT NO. 1 (1525°F/OIL)

TEST TEMP. = R.T.

TEMPERING TEMP. °F	TYPE OF SPECIMEN	NOTCH STRENGTH RATIO					
		0.3 IN. DIA. SPECIMENS			0.5 IN. DIA. SPECIMENS*		
		K = 3	K = 5	K = 10	K = 3	K = 5	K = 10
400	L	1.37	1.23	1.11	1.32	1.15	1.01
	Tr	1.19	1.13	0.91	0.98	0.81	0.77
500	L	1.33	1.22	1.12	1.31	1.12	1.14
	Tr	1.17	1.04	1.01	1.07	0.87	1.00
600	L	1.44	1.35	1.29	1.35	1.19	1.18
	Tr	1.17	1.19	1.09	1.10	0.84	0.77
700	L	1.42	1.29	1.31	1.36	1.21	1.15
	Tr	1.26	1.15	1.12	1.09	0.95	0.82
800	L	1.47	1.36	1.36	1.47	1.29	1.29
	Tr	1.36	1.30	1.34	1.24	1.19	1.07

*BASED ON TENSILE STRENGTH OF 0.28 IN. DIA. SPECIMENS

TABLE 9

RESULTS OF 0.3 IN.DIA. ECCENTRIC NOTCH-TENSILE SPECIMENS (K = 3)
FROM 4-1/4 IN.DIA. 4340 HEAT NO. 1 (1525°F/OIL)
TEST TEMP. = R.T.

TEMPERING TEMP. °F	TYPE OF SPECIMEN	NOTCH-STRENGTH 1000 PSI	NOTCH-STRENGTH AVERAGE	% REDUCTION OF AREA	% REDUCTION AVERAGE
400	L	146.1 157.3	151.7	2.3 2.8	2.5
500	L	145.3 165.2	150.8	1.4 3.1	2.3
600	L	127.5 127.8	127.65	0.9 0.3	0.6
700	L	144.5 136.8	140.65	4.5 1.7	3.1
800	L	136.0 142.3	139.2	5.4 2.8	4.1

TABLE 10

RESULTS OF 0.3 IN.DIA. ECCENTRIC NOTCH-TENSILE SPECIMENS (K = 5)
FROM 4-1/4 IN.DIA. 4340 HEAT NO. 1 (1525°F/OIL)
TEST TEMP. = R.T.

TEMPERING TEMP. °F	TYPE OF SPECIMEN	NOTCH-STRENGTH 1000 PSI	AVERAGE	% REDUCTION OF AREA	AVERAGE
400	L	123.6 111.1	117.4	3.1 1.7	2.4
500	L	125.7 118.0	121.9	0.6 1.7	1.1
600	L	125.7 95.5	110.6	1.4 1.7	1.6
700	L	109.8 109.6	109.7	4.5 0.9	2.7
800	L	118.2 112.7	110.5	2.0 1.1	1.6

TABLE 11

RESULTS OF 0.3 IN.DIA. ECCENTRIC NOTCH-TENSILE SPECIMENS (K = 10)
FROM 4-1/4 IN.DIA. 4340 HEAT NO. 1 (1525°F/OIL)
TEST TEMP. = R.T.

TEMPERING TEMP. °F	TYPE OF SPECIMEN	NOTCH-STRENGTH 1000 PSI	AVERAGE	% REDUCTION OF AREA	AVERAGE
400	L	93.0	90.2	0.6	0.4
		87.3		0.3	
500	L	112.1	104.9	0.6	0.9
		97.7		1.2	
600	L	85.5	89.9	0.6	0.3
		93.8		.0	
700	L	103.9	104.7	.6	1.1
		105.4		1.7	
800	L	108.6	110.0	0.3	0.7
		111.4		1.1	

TABLE 12

RESULTS OF 0.3 IN.DIA. ECCENTRIC NOTCH-TENSILE SPECIMENS FROM 4-1/4 IN.DIA. 4340 HEAT NO. 1 (1525°F/OIL)
TEST TEMP.R.T.

TEMPERING TEMP. °F	TYPE OF SPECIMEN	ECCENTRIC NOTCH-STRENGTH RATIO 0.3 IN. DIA. SPECIMENS		
		K = 3	K = 5	K = 10
400	L	.57	.44	.34
500	L	.56	.45	.39
600	L	.53	.46	.39
700	L	.60	.47	.44
800	L	.64	.51	.51

TABLE 13

RESULTS OF IMPACT TESTS FOR CHARPY SPECIMENS FROM 4-1/4 IN.DIA. 4340 HEAT NO. 1 (1525°F/OIL) TEMPERED AT 400°F.

TEMPERING TEMP. °F	TYPE OF SPECIMEN	TEST TEMP. °F	IMPACT ENERGY FT. -LB.	AVERAGE FT. - LB.
400	L	+212	* 21.0	21.0
	Tr		9.5 8.5	9.0
	L	R.T.	19.0 15.0	17.0
	Tr		* *	*
	L	-71	17.0 13.0	15.0
	Tr		6.0 8.0	7.0
	L	-150	13.0 12.0	12.5
	Tr		* 5.5	5.5

*Specimen Jammed

TABLE 14

RESULTS OF IMPACT TESTS FOR CHARPY SPECIMENS FROM 4-1/4 IN.DIA. 4340 HEAT NO. 1 (1525°F/OIL) TEMPERED AT 500°F.

TEMPERING TEMP. °F	TYPE OF SPECIMEN	TEST TEMP. °F	IMPACT ENERGY FT. -LB.	AVERAGE FT. - LB.
500	L	+212	17.0 19.0	18.0
	Tr		* 8.0	8.0
	L	R.T.	* 18.0	18.0
	Tr		5.5 5.0	5.5
	L	-71	10.0 11.0	10.5
	Tr		6.0 4.5	5.5
	L	-150	5.0 5.5	5.5
	Tr		4.0 *	4.0

*Specimen Jammed

TABLE 15

RESULTS OF IMPACT TESTS FOR CHARPY SPECIMENS FROM 4-1/4 IN.DIA. 4340 HEAT NO. 1 (1525°F/OIL) TEMPERED AT 600°F.

TEMPERING TEMP. °F	TYPE OF SPECIMEN	TEST TEMP. °F	IMPACT ENERGY FT. -LB.	AVERAGE FT. -LB.
600	L	+212	17.5 18.5	18.0
	Tr		8.0 7.5	8.0
	L	R.T.	15.0 14.5	15.0
	Tr		5.5 5.0	5.5
	L	-71	8.0 11.0	9.5
	Tr		9.5 *	9.5
	L	-150	8.0 8.0	8.0
	Tr		* 5.0	5.0

*Specimen Jammed

TABLE 16

RESULTS OF IMPACT TESTS FOR CHARPY SPECIMENS FROM 4-1/4 IN.DIA. 4340 HEAT NO. 1 (1525°F/OIL) TEMPERED AT 700°F.

TEMPERING TEMP. °F	TYPE OF SPECIMEN	TEST TEMP. °F	IMPACT ENERGY FT.-LB.	AVERAGE FT.-LB.
700	L	+212	21.0 20.5	21.0
	Tr		11.0 9.0	10.0
	L	R.T.	* 15.5	15.5
	Tr		5.5 5.5	5.5
	L	-71	13.0 13.0	13.0
	Tr		5.5 6.0	6.0
	L	-150	10.0 7.5	9.0
	Tr		4.5 *	4.5

*Specimen Jammed

TABLE 17

RESULTS OF IMPACT TESTS FOR CHARPY SPECIMENS FROM 4-1/4 IN. DIA. 4340 HEAT NO. 1(1525°F./OIL) TEMPERED AT 800°F.

TEMPERING TEMP. °F	TYPE OF SPECIMEN	TEST TEMP. °F	IMPACT ENERGY FT.-LB.	AVERAGE FT.-LB.
800	L	-212	37.0 28.5	33.0
	Tr		13.0 12.0	12.5
	L	R.T.	27.0 26.0	26.5
	Tr		10.0 10.0	10.0
	L	-71	16.0 16.0	16.0
	Tr		11.5 7.0	9.5
	L	-150	14.0 16.5	15.5
	Tr		* 10.0	10.0

*Specimen Jammed

TABLE 18

ROTATING BEAM FATIGUE DATA FOR SMOOTH & NOTCHED SPECIMENS FROM 4-1/4 IN. DIA. 4340 - HEAT NO. 1 (1525°F/OIL)
TEST TEMP. = R.T.
( ) DID NOT FRACTURE
TEMPERED AT 400°AND 600°F.

TEMPERING TEMP. AND STRENGTH LEVEL	STRESS - 1000 PSI		LIFE - 1000 CYCLES	
	K = 1	K = 8	K = 1	K = 8
	L	L	L	L
400°F (276,000 PSI)	187.0	153.0	11.0	2.0
	169.0	137.0	21.0	3.0
	153.0	123.0	62.0	5.0
	143.0	107.0	79.0	5.0
	126.0	92.0	614.0	12.0
	100.0	76.0	6,362.0	17.0
	107.0	61.0	7,627.0	26.0
	91.0	59.0	(14,816.0)	37.0
		55.0		115.0
		52.0		(16,487.0)
600°F (239,000 PSI)	185.0	137.0	3.0	3.0
	168.0	123.0	26.0	4.0
	139.0	107.0	40.0	6.0
	150.0	94.0	44.0	8.0
	129.0	77.0	68.0	12.0
	113.0	63.0	342.0	19.0
	97.0	54.0	(16,706.0)	39.0
		61.0		67.0
		52.0		(13,169.0)

TABLE 19

ROTATING BEAM FATIGUE DATA FOR SMOOTH & NOTCHED SPECIMENS

FROM 4-1/4 IN. DIA. 4340 - HEAT NO. 1 (1525°F/OIL)

TEMPERED AT 500°F. TEST TEMP. = R.T.

( ) DID NOT FRACTURE

TEMPERING TEMP. AND STRENGTH LEVEL	STRESS - 1000 PSI					LIFE - 1000				
	K = 1		K = 3	K = 5	K = 8	K = 1		K = 3	K = 5	K = 8
	L	Tr	L	L	L	L	Tr	L	L	L
500°F (269,000 PSI)	154.0	167.0	109.0	123.0	140.0	18.0	7.0	5.0	3.0	2.0
	174.0	151.0	93.0	95.0	122.0	19.0	9.0	8.0	15.0	3.0
	120.0	138.0	83.0	77.0	109.0	63.0	16.0	11.0	18.0	5.0
	141.0	126.0	78.0	68.0	92.0	122.0	27.0	13.0	24.0	8.0
	109.0	106.0	71.0	70.0	76.0	137.0	48.0	29.0	35.0	21.0
	107.0	93.0	62.0	65.0	61.0	3,907.0	79.0	42.0	81.0	24.0
	91.0	81.0	62.0	61.0	57.0	(14,005.0)	990.0	49.0	(11,270.0)	28.0
		63.0	53.0	62.0	55.0		(11,257.0)	227.0	(14,487.0)	38.0
			47.0		52.0			(16,453.0)		(16,201.0)

TABLE 19 CONT'D.

ROTATING BEAM FATIGUE DATA FOR SMOOTH & NOTCHED SPECIMENS

FROM 4-1/4 IN. DIA. 4340 - HEAT NO. 1 (1525°F/OIL)

TEMPERED AT 700°F. TEST TEMP. = R.T.

( ) DID NOT FRACTURE

TEMPERING TEMP. AND STRENGTH LEVEL	STRESS - 1000 PSI					LIFE - 1000				
	K = 1		K = 3	K = 5	K = 8	K = 1		K = 3	K = 5	K = 8
	L	Tr	L	L	L	L	Tr	L	L	L
700°F (236,000 PSI)	164.0	168.0	122.0	123.0	124.0	16.0	4.0	4.0	5.0	3.0
	153.0	153.0	108.0	111.0	109.0	24.0	7.0	6.0	6.0	5.0
	137.0	149.0	92.0	92.0	94.0	33.0	12.0	10.0	9.0	8.0
	107.0	121.0	77.0	76.0	77.0	70.0	22.0	20.0	21.0	12.0
	123.0	107.0	62.0	62.0	62.0	82.0	47.0	31.0	35.0	22.0
	120.0	92.0	56.0	61.0	54.0	222.0	57.0	83.0	132.0	28.0
	92.0	76.0	46.0	55.0	48.0	1,072.0	2,382.0	154.0	(16,583.0)	45.0
	79.0	64.0	40.0	48.0	43.0	(12,965.0)	(12,028.0)	(14,233.0)	(16,072.0)	60.0
			37.0		40.0			(14,346.0)		(12,062.0)

TABLE 20

ROTATING BEAM FATIGUE DATA FOR SMOOTH & NOTCHED SPECIMENS

FROM 4-1/4 IN. DIA. 4340 - HEAT NO. 1 (1525°F/OIL)

TEMP. TEMP.-800°F. TEST TEMP.-R.T..

( ) DID NOT FRACTURE

TEMPERING TEMP. AND STRENGTH LEVEL	STRESS - 1000 PSI					LIFE - 1000				
	K = 1		K = 3	K = 5	K = 8	K = 1		K = 3	K = 5	K = 8
	L	Tr	L	L	L	L	Tr	L	L	L
800°F (215,000 PSI)	165.0	165.0	124.0	122.0	123.0	7.0	4.0	4.0	4.0	5.0
	153.0	154.0	108.0	92.0	92.0	16.0	10.0	6.0	10.0	9.0
	136.0	139.0	92.0	76.0	62.0	39.0	12.0	10.0	19.0	14.0
	121.0	123.0	76.0	59.0	62.0	89.0	23.0	20.0	72.0	25.0
	108.0	107.0	62.0	62.0	52.0	611.0	31.0	34.0	82.0	48.0
	102.0	92.0	53.0	52.0	48.0	3,607.0	85.0	68.0	220.0	51.0
	93.0	63.0	46.0	46.0	46.0	(12,674.0)	4,246.0	194.0	(14,776.0)	54.0
	77.0	53.4	40.0		44.0	(11,384.0)	(14,518.0)	865.0		91.0
		75.0	37.0		34.0		(15,335.0)	(13,943.0)		127.0
					31.0					12,408.0

TABLE 21

ROTATING BEAM FATIGUE DATA FOR SMOOTH & NOTCHED LONGITUDINAL & TRANSVERSE SPECIMENS FROM 4-1/4 IN. DIA. 4340 - HEAT NO. 1 (1525°F/OIL)

TEST TEMP. = R.T.

TENSILE STRENGTH 1000 PSI	ENDURANCE LIMIT - 1000 PSI					ENDURANCE RATIO				
	K = 1		K = 2	K = 3	K = 8	K = 1		K = 3	K = 5	K = 10
	L	Tr	L	L	L	L	Tr	L	L	L
276	100				50	0.36				0.18
269	103	74	50	63	50	0.38	0.27	0.18	0.23	0.18
239	100				50	0.42				0.21
236	90	66	42	50	38	0.38	0.28	0.18	0.21	0.16
215	100	70	38	50	30	0.47	0.33	0.18	0.23	0.14

TABLE 22

RESULTS OF 0.28 IN. DIA. TENSILE SPECIMENS

FROM 1-1/2 IN. DIA. 4340 - HEAT NO. 1 (1525°F/OIL)

TEST TEMP. = R.T.

TEMPERING TEMP.-°F	TYPE OF SPECIMEN	TENSILE STRENGTH-1000 PSI	AVE.	0.2% YIELD STRENGTH-1000 PSI	AVE.	% REDUCTION OF AREA	AVE.	% ELONGATION	AVE.
400	L	298.6 296.6	297.6	231.0	231.0	38.1 44.9	41.5	12.5 12.6	12.6
	TR	300.8 301.4	301.1	221.8 221.4	221.6	5.8 8.3	7.1	3.2 5.0	4.1
500	L	262.1 264.5	263.3	233.9 243.5	238.7	49.8 50.5	50.2	12.1 13.3	12.7
	TR	269.3 269.7	269.5	237.1 238.3	237.7	7.5 9.6	8.6	5.1 4.3	4.7
600	L	251.6 253.1	252.4	201.6 205.6	203.6	52.6 49.3	51.0	13.1 12.2	12.7
	TR	255.5 257.2	256.4	227.0 230.7	228.9	5.6 6.7	6.2	2.8 2.7	2.8
700	L	232.1 229.0	230.6	221.0 217.7	219.4	47.3 49.8	48.6	12.2 12.2	12.2
	TR	235.8 235.6	235.7	222.8 223.4	223.1	10.2 11.8	11.0	3.7 4.5	4.1
800	L	209.4 207.4	208.4	202.6 203.2	202.9	51.7 52.6	52.2	13.4 13.0	13.2
	TR	214.7 210.5	212.6	210.7 203.2	207.0	12.3 14.3	13.4	4.5 4.6	4.6

TABLE 23

RESULTS OF 0.3 IN. DIA. NOTCH TENSILE SPECIMENS (K = 3)

FROM 1-1/2 IN. DIA. 4340 - HEAT NO. 1 (1525°F/OIL)

TEST TEMP. = R.T.

TEMPERING TEMP.-°F	TYPE OF SPECIMEN	NOTCH STRENGTH-1000 PSI	AVG.	% REDUCTION OF AREA	AVG.
400	L	380.7 379.3	380.0	3.7 4.5	4.1
	TR	273.2 278.6	275.9	1.7 2.0	1.9
500	L	356.0 360.0	358.0	3.0 3.1	3.1
	TR	280.6 290.0	285.3	2.2 2.0	2.1
600	L	345.6 341.8	343.7	3.9 5.0	4.5
	TR	239.4 264.0	251.7	2.2 2.2	2.2
700	L	325.8 326.1	326.0	3.1 4.0	3.6
	TR	253.5 260.5	257.0	2.2 2.5	2.4
800	L	314.7 313.0	313.9	6.5 7.6	7.1
	TR	254.2 257.8	256.0	2.8 3.4	3.1

TABLE 24

RESULTS OF 0.3 IN. DIA. NOTCH TENSILE SPECIMENS (K = 5)

FROM 1-1/2 IN. DIA. 4340 - HEAT NO. 1 (1525°F/OIL)

TEST TEMP. = R.T.

TEMPERING TEMP.-°F	TYPE OF SPECIMEN	NOTCH STRENGTH-1000 PSI	AVG.	% REDUCTION OF AREA	AVG.
400	L	340.8 324.8	341.8	2.8 4.0	2.8
	TR	231.9 256.1	244.0	0.3 0.3	0.3
500	L	323.9 327.7	325.8	2.5 2.2	2.4
	TR	219.5 235.5	227.5	0.3 1.4	0.9
600	L	320.0 319.3	319.7	3.7 1.1	2.4
	TR	217.3 232.7	225.5	1.4 1.4	1.4
700	L	333.1 304.8	319.0	3.1 3.4	3.3
	TR	236.6 221.5	229.1	3.4 1.4	2.4
800	L	296.3 296.5	296.4	4.8 4.6	4.7
	TR	248.1 235.7	241.9	2.3 2.0	2.2

TABLE 25

RESULTS OF 0.3 IN. DIA. NOTCH TENSILE SPECIMENS (K = 10)
FROM 1-1/2 IN. DIA. 4340 - HEAT NO. 1 (1525°F/OIL)
TEST TEMP. = R.T.

TEMPERING TEMP.-°F	TYPE OF SPECIMEN	NOTCH STRENGTH- 1000 PSI	AVG.	% REDUCTION OF AREA	AVG.
400	L	253.7 300.0	276.9	0.6 0.9	0.8
	TR	218.0 210.5	214.3	0.3 1.5	0.9
500	L	315.6 316.8	316.2	2.3 0.0	1.2
	TR	199.1 212.8	206.0	0.6 0.8	0.7
600	L *	310.0 308.3	309.2	1.1 1.7	1.4
	TR	211.9 209.5	210.7	0.6 0.8	0.7
700	L	305.1 302.3	303.7	3.1 1.4	2.3
	TR	209.0 207.0	208.0	0.6 2.6	1.6
800	L	302.7 297.4	300.1	2.7 1.1	1.9
	TR	211.5 226.9	219.2	0.3 1.5	0.9

TABLE 26

RESULTS OF 0.3 IN. DIA. NOTCH TENSILE SPECIMENS FROM 1-1/2 IN. DIA. 4340 - HEAT NO. 1 (1525°F/OIL) TEST TEMP. = R.T.

TEMPERING TEMP.-°F	TYPE OF SPECIMEN	NOTCH STRENGTH RATIO 0.3 IN. DIA. SPECIMENS		
		K - 3	K - 5	K - 10
400	L	1.28	1.15	0.93
	Tr	0.92	0.81	0.71
500	L	1.36	1.24	1.20
	Tr	1.06	0.84	0.76
600	L	1.36	1.27	1.23
	Tr	0.98	0.88	0.82
700	L	1.41	1.38	1.32
	Tr	1.09	0.97	0.88
800	L	1.51	1.42	1.44
	Tr	1.20	1.14	1.03

TABLE 27

RESULTS OF 0.28 IN. DIA. TENSILE SPECIMENS FROM THREE HEATS OF 4340 (1525°F/OIL)

HEAT NO. 2: 4 IN. DIA.

HEAT NO. 3: 3-1/2 IN. DIA.

HEAT NO. 4: 3-1/4 IN. DIA.

TEST TEMP. = R.T.

NUMBERS IN PARENTHESIS SHOWN BELOW TEMPERING TEMPERATURES INDICATE HEAT NUMBERS.

TEMPERING TEMP.-°F	TYPE OF SPECIMEN	TENSILE STRENGTH- 1000 PSI	AVG.	0.2% YIELD STRENGTH 1000 PSI	AVG.	% REDUCTION OF AREA	AVG.	% ELONGATION	AVG.
500 (2)	L	258.9 260.9	259.9	227.4 224.2	225.8	46.8 46.9	46.8	10.2 10.9	10.6
	Tr	271.0 256.8	258.9	233.0 222.2	227.6	16.5 10.8	14.2	5.3 3.3	4.3
700 (2)	L	273.5 271.5	272.5*	228.2 231.0	229.6	49.2 64.2	56.7	11.8 11.8	11.8
	Tr	225.0 225.0	225.0	212.9 213.7	213.3	14.1 11.0	12.6	5.6 4.6	5.1
500 (3)	L	266.1 266.5	266.3	225.8 227.1	226.5	40.0 42.2	41.6	8.4 10.3	9.4
	Tr	265.7 266.9	266.3	233.5 237.9	235.7	17.4 20.8	19.1	5.0 5.8	5.4
700 (3)	L	231.8 234.6	233.2	219.7 219.4	219.6	47.3 44.2	45.8	11.4 10.5	11.0
	Tr	232.6 235.5	234.1	221.3 208.1	214.7	23.1 22.9	23.0	6.6 8.5	7.6
500 (4)	L	271.2 267.7	269.5	224.0 229.0	226.5	41.4 46.1	43.8	11.0 11.1	11.0
	Tr	270.5 270.2	270.4	231.1 229.8	230.5	8.8 26.1	17.5	4.7 6.9	5.8
700 (4)	L	227.5 224.6	226.0	205.8 205.9	205.8	43.7 46.5	45.1	9.7 11.6	10.7
	Tr	222.1 227.0	224.6	206.0	206.0	29.4 28.1	28.8	7.5 7.9	7.7

*QUESTIONABLE

TABLE 28

RESULTS OF 0.3 IN. DIA. NOTCH-TENSILE SPECIMENS (K = 3)

FROM THREE HEATS OF 4340 (1525°F/OIL)

HEAT NO. 2: 4 IN. DIA.

HEAT NO. 3: 3-1/2 IN. DIA.

HEAT NO. 4: 3-1/4 IN. DIA.

TEST TEMP. = R.T.

TEMPERING TEMP.-°F	TYPE OF SPECIMEN	NOTCH STRENGTH-1000 PSI	AVG.	% REDUCTION OF AREA	AVG.	HEAT NO.
500	L	357.8 336.2	347.0	3.7 3.6	3.7	2
	Tr	309.1 324.8	317.0	2.3 3.7	3.0	
700	L	326.2 321.9	324.1	3.4 1.7	2.6	
	Tr	276.8 274.5	275.7	3.1 1.4	2.3	
500	L	349.9 349.0	349.5	4.0 2.6	3.3	3
	Tr	298.3 315.9	307.1	1.7 2.8	2.3	
700	L	330.0 310.7	320.4	2.8 3.7	3.3	
	Tr	280.7 290.4	285.6	5.9 4.5	5.2	
500	L	358.4 356.7	357.6	5.7 2.5	4.1	4
	Tr	324.8 331.9	328.4	3.7 3.1	3.4	
700	L	319.6 323.9	321.8	2.6 4.8	3.7	
	Tr	308.6 304.0	306.3	2.9 4.3	3.6	

TABLE 29

RESULTS OF 0.3 IN. DIA. NOTCH-TENSILE SPECIMENS (K = 5)

FROM THREE HEATS OF 4340 (1525°F/OIL)

HEAT NO. 2: 4 IN. DIA.

HEAT NO. 3: 3-1/2 IN. DIA.

HEAT NO. 4: 3-1/4 IN. DIA.

TEST TEMP. = R.T.

TEMPERING TEMP.-°F	TYPE OF SPECIMEN	NOTCH STRENGTH-1000 PSI	AVG.	% REDUCTION OF AREA	AVG.	HEAT NO.
500	L	318.8 / 317.4	318.1	3.9 / 1.1	2.5	2
	Tr	236.1 / 258.3	247.2	0.8 / 4.2	2.5	
700	L	302.8 / 292.7	297.8	3.9 / 2.8	3.4	
	Tr	259.2 / 259.2	259.2	2.5 / 1.7	2.1	
500	L	318.1 / 302.9	310.5	2.2 / 2.9	2.6	3
	Tr	274.3 / 259.2	266.8	2.9 / 1.1	2.0	
700	L	311.8 / 300.0	305.9	4.8 / 2.8	3.8	
	Tr	275.3 / 263.2	269.3	1.4 / 0.9	1.2	
500	L	325.2 / 337.1	331.2	6.0 / 2.0	4.0	4
	Tr	250.7 / 221.6	236.2	3.9 / 4.4	4.2	
700	L	300.6 / 296.6	298.6	2.5 / 2.8	2.7	
	Tr	290.4 / 285.7	288.1	6.8 / 2.9	4.9	

TABLE 30

RESULTS OF 0.3 IN. DIA. NOTCH-TENSILE SPECIMENS (K = 10)

FROM THREE HEATS OF 4340 (1525°F/OIL)

HEAT NO. 2: 4 IN. DIA.

HEAT NO. 3: 3-1/2 IN. DIA.

HEAT NO. 4: 3-1/4 IN. DIA.

TEST TEMP. = R.T.

TEMPERING TEMP.-°F	TYPE OF SPECIMEN	NOTCH STRENGTH-1000 PSI	AVG.	% REDUCTION OF AREA	AVG.	HEAT NO.
500	L	282.5 289.6	286.1	1.4 1.7	1.6	2
	Tr	273.0 233.9	253.5	2.2 0.3	1.3	
700	L	294.6	294.6	1.7	1.7	
	Tr	233.8 253.5	243.7	1.4 1.4	1.4	
500	L	288.5 291.8	290.2	1.4 1.7	1.6	3
	Tr	228.6 263.5	246.1	1.7 1.1	1.4	
700	L	294.6 296.6	295.6	2.0 3.4	2.7	
	Tr	281.1 262.0	271.6	1.8 2.0	1.9	
500	L	308.1 309.9	309.0	1.4 1.7	1.6	4
	Tr	284.9 282.5	283.7	0.9 1.1	1.0	
700	L	294.6 297.1	295.9	2.0 3.1	2.6	
	Tr	266.9 270.7	268.8	2.5 1.1	1.8	

TABLE 31

RESULTS OF 0.3 IN. DIA. NOTCH-TENSILE SPECIMENS FROM THREE HEATS OF 4340 (1525°F/OIL)

HEAT NO. 2: 4 IN. DIA.

HEAT NO. 3: 3-1/2 IN. DIA.

HEAT NO. 4: 3-1/4 IN. DIA.

TEST TEMP. = R.T.

TEMPERING TEMP.- °F	TYPE OF SPECIMEN	NOTCH-STRENGTH RATIO			HEAT NO.
		K = 3	K = 5	K = 10	
500	L	1.34	1.22	1.10	2
	Tr	1.22	0.95	0.98	
700	L	1.38*	1.26*	1.25*	
	Tr	1.23	1.15	1.08	
500	L	1.31	1.17	1.09	3
	Tr	1.15	1.00	0.92	
700	L	1.37	1.31	1.27	
	Tr	1.22	1.15	1.16	
500	L	1.33	1.23	1.15	4
	Tr	1.21	0.87	1.05	
700	L	1.42	1.32	1.31	
	Tr	1.36	1.28	1.20	

*BASED ON TENSILE STRENGTH AT 700°F OF HEAT NO. 1

TABLE 32

RESULTS OF 0.3 IN. DIA. ECCENTRIC NOTCH-TENSILE SPECIMENS (K = 3) FROM THREE HEATS OF 4340 (1525°F/OIL)

HEAT NO. 2: 4 IN. DIA.

HEAT NO. 3: 3-1/2 IN. DIA.

HEAT NO. 4: 3-1/4 IN. DIA.

TEST TEMP. = R.T.

TEMPERING TEMP.-°F	TYPE OF SPECIMEN	NOTCH STRENGTH-1000 PSI	NOTCH STRENGTH-AVG.	% REDUCTION OF AREA	% REDUCTION OF AREA-AVG.	HEAT NO.
500	L	145.7 133.1	139.6	1.1 2.8	1.5	2
700	L	124.6 147.3	136.0	1.4 0.3	0.9	
500	L	140.4 143.7	142.1	3.9 1.7	2.8	3
700	L	140.8 126.8	133.8	1.4 1.4	1.4	
500	L	156.3 147.3	151.8	3.1 3.4	3.3	4
700	L	147.3 133.1	140.2	1.4 2.6	2.0	

TABLE 33

RESULTS OF 0.3 IN. DIA. ECCENTRIC NOTCH-TENSILE SPECIMENS (K = 5) FROM THREE HEATS OF 4340 (1525°F/OIL)

HEAT NO. 2: 4 IN. DIA.

HEAT NO. 3: 3-1/2 IN. DIA.

HEAT NO. 4: 3-1/4 IN. DIA.

TEST TEMP. = R.T.

TEMPERING TEMP.-°F	TYPE OF SPECIMEN	NOTCH STRENGTH-1000 PSI	NOTCH STRENGTH-AVG.	% REDUCTION OF AREA	% REDUCTION OF AREA-AVG.	HEAT NO.
500	L	93.0 101.7	97.4	0.9 1.4	1.1	2
700	L	98.6 93.4	96.0	1.4 0.6	1.0	
500	L	111.1 107.0	109.1	0.2 1.4	1.7	3
700	L	105.7 105.7	105.7	1.7 1.7	1.7	
500	L	120.0 118.0	119.0	1.7 1.7	1.7	4
700	L	104.2 107.6	105.9	4.8 0	2.4	

TABLE 34

RESULTS OF 0.3 IN. DIA. ECCENTRIC NOTCH-TENSILE SPECIMENS (K = 10) FROM THREE HEATS OF 4340 (1525°F/OIL)

HEAT NO. 2: 4 IN. DIA.

HEAT NO. 3: 3-1/2 IN. DIA.

HEAT NO. 4: 3-1/4 IN. DIA.

TEST TEMP. = R.T.

TEMPERING TEMP.-°F	TYPE OF SPECIMEN	NOTCH STRENGTH- 1000 PSI	NOTCH STRENGTH- AVG.	% REDUCTION OF AREA	% REDUCTION OF AREA AVG.	HEAT NO.
500	L	71.4 86.2	78.8	0.6 2.6	1.6	2
700	L	66.1 68.4	67.3	0.6 1.1	0.9	
500	L	85.2 90.0	87.6	1.1 2.3	1.7	3
700	L	92.7 102.9	97.8	--- 0.9	.4	
500	L	96.9 88.1	92.7	1.7 0.3	1.0	4
700	L	116.1 95.8	106.0	1.1 1.7	1.4	

TABLE 35

RESULTS OF 0.3 IN. DIA. NOTCH-TENSILE SPECIMENS FROM THREE HEATS OF 4340 (1525°F/OIL)

HEAT NO. 2: 4 IN. DIA.

HEAT NO. 3: 3-1/2 IN. DIA.

HEAT NO. 4: 3-1/4 IN. DIA.

TEST TEMP. = R.T.

TEMPERING TEMP.-°F	TYPE OF SPECIMEN	ECCENTRIC NOTCH-STRENGTH RATIO 0.3 IN. DIA. SPECIMENS			HEAT NO.
		K = 3	K = 5	K = 10	
500	L	.54	.37	.30	2
700	L	.54	.41	.29	
500	L	.53	.41	.33	3
700	L	.57	.45	.42	
500	L	.56	.44	.34	4
700	L	.62	.47	.47	

TABLE 36

RESULTS OF IMPACT TESTS FOR CHARPY SPECIMENS

FROM 4 IN. DIA. 4340 - HEAT NO. 2, 1525°F/OIL TEMPERED AT 500°F.

TEMPERING TEMP.- °F	TYPE OF SPECIMEN	TEST TEMP.- °F	IMPACT ENERGY- FT.-LB.	AVERAGE FT.-LB.
500	L	+212	* 14.0	14.0
	Tr		* 6.0	7.5
	L	R.T.	12.5 16.5	14.5
	Tr		6.0 5.5	6.0
	L	-71	7.0 5.5	6.5
	Tr		3.5 *	3.5
	L	-150	6.0 5.0	5.5
	Tr		* *	

TABLE 37

RESULTS OF IMPACT TESTS FOR SHARPY SPECIMENS

FROM 4 IN. DIA. 4340 - HEAT NO. 2, 1525°F/OIL TEMPERED AT 700°F.

TEMPERING °F	TYPE OF SPECIMEN	TEST TEMP.- °F	IMPACT ENERGY- FT.-LB.	AVERAGE FT.-LB.
700	L	+212	16.0 *	16.0
	Tr		* 7.0	7.0
	L	R.T.	15.5 9.0	12.5
	Tr		9.0 7.5	8.5
	L	-71	7.0 8.0	7.5
	Tr		* 2.5	2.5
	L	-150	6.5 6.0	6.5
	Tr		* 3.5	3.5

TABLE 38

RESULTS OF IMPACT TESTS FOR CHARPY SPECIMENS

FROM 3-1/2 IN. DIA. 4340 - HEAT NO. 3, 1525°F/OIL TEMPERED AT 500°F.

TEMPERING °F	TYPE OF SPECIMEN	TEST TEMP.- °F	IMPACT ENERGY- FT.-LB.	AVERAGE FT.-LB.
500	L	+212	14.0 15.0	14.5
	Tr		8.5 *	8.5
	L	R.T.	* 10.0	10.0
	Tr		5.0 6.0	5.5
	L	-71	7.5 8.0	8.0
	Tr		5.5 4.0	5.0
	L	-150	7.0 5.0	6.0
	Tr		4.0 4.0	4.0

TABLE 39

RESULTS OF IMPACT TESTS FOR CHARPY SPECIMENS

FROM 3-1/2 IN. DIA. 4340 - HEAT NO. 3, 1525°F/OIL TEMPERED AT 700°F.

TEMPERING °F	TYPE OF SPECIMEN	TEST TEMP.- °F	IMPACT ENERGY- FT.-LB.	AVERAGE FT.-LB.
700	L	+212	16.5 14.5	15.5
	Tr		6.0 *	6.0
	L	R.T.	12.0 13.0	12.5
	Tr		* 6.5	6.5
	L	-71	8.0 10.0	9.0
	Tr		* *	*
	L	-150	8.0 8.0	8.0
	Tr		* 4.5	4.5

TABLE 40

RESULTS OF IMPACT TESTS FOR CHARPY SPECIMENS

FROM 3 1/4 IN. DIA. 4340 - HEAT NO. 4, 1525°F/OIL TEMPERED AT 500°F.

TEMPERING TEMP.- °F	TYPE OF SPECIMEN	TEST TEMP.- °F	IMPACT ENERGY- FT.-LB.	AVERAGE FT.-LB.
500	L	+212	17.0 *	17.0
	Tr		* 11.0	11.0
	L	R.T.	16.5 13.0	15.0
	Tr		9.0 8.5	9.0
	L	-71	11.5 13.5	12.5
	Tr		6.5 5.5	6.0
	L	-150	10.0 9.5	10.0
	Tr		6.0 6.5	6.5

TABLE 41

RESULTS OF IMPACT TESTS FOR CHARPY SPECIMENS

FROM 3-1/4 IN. DIA. 4340 - HEAT NO. 4, 1525°F/OIL TEMPERED AT 700°F.

TEMPERING TEMP.- °F	TYPE OF SPECIMEN	TEST TEMP.- °F	IMPACT ENERGY- FT.-LB.	AVERAGE FT.-LB.
700	L	+ 212	20.5 21.0	21.0
	Tr		10.0 11.0	10.5
	L	R.T.	14.0 16.0	15.0
	Tr		* 7.5	7.5
	L	-71	13.0 13.0	13.0
	Tr		5.0 8.0	6.5
	L	-150	12.5 11.5	12.0
	Tr		5.0 5.5	5.5

TABLE 42

RESULTS OF 0.28 IN. DIA. TENSILE SPECIMENS FROM 4-1/2 IN. DIA. 98B40 (1550°/oil)
TEST TEMP. = R.T.

TEMP. TEMP.-°F	TYPE OF SPECIMEN	TENSILE STRENGTH 1000 PSI	AVG.	0.2% YIELD STRENGTH 1000 PSI	AVG.	% REDUCTION OF AREA	AVG.	% ELONGATION	AVG.
400	L	300.6 303.6	302.1	228.5 235.4	232.0	35.8 36.6	36.2	8 9	8.5
	Tr	291.7 299.5	295.6	226.9 ---	226.9	2.3 ---	2.3	2 --	2.0
500	L	284.0 283.6	283.8	250.1 239.9	245.0	33.3 38.4	35.9	9.1 10.0	9.6
	Tr	274.4 287.3	280.9	246.8 248.4	247.6	5.7 3.4	4.6	2.0 2.0	2.0
575	L	270.3 268.7	269.5	235.4 232.1	233.8	36.0 40.7	38.4	8 9	8.5
	Tr	265.4 269.0	267.2	227.3 231.8	229.6	9.6 10.4	10.0	3 4	3.5
650	L	251.6 238.6	245.1	230.5 219.2	224.9	39.3 37.7	38.5	7.9 8	8.0
	Tr	247.2 246.8	247.0	218.8 219.2	219.0	9.2 ---	9.2	4 --	4.0
800	L	205.4 202.9	204.2	191.6 198.1	194.9	37.7 39.9	38.8	8 11.1	9.6
	Tr	207.5 202.0	204.8	194.5 192.2	193.4	17.5 20.0	18.8	6.1 6.1	6.1

---Broke under head

TABLE 43

RESULTS OF 0.3 IN. DIA. NOTCH-TENSILE SPECIMENS (K = 3)
FROM 4-1/2 IN. DIA. 98B40 (1550°F/oil)
TEST TEMP. = R.T.

TEMPERING TEMP.-°F	TYPE OF SPECIMEN	NOTCH-STRENGTH 1000 PSI	AVG.	% REDUCTION OF AREA	AVG.
400	L	367.1	367.1	3.4	3.4
	Tr	321.1 323.3	322.2	2.3 2.0	2.2
500	L	344.1 351.3	347.7	3.1 3.4	3.3
	Tr	302.9	302.9	2.3	2.3
575	L	337.1 314.6	325.9	3.1 2.5	2.8
	Tr	296.0 303.1	299.6	1.7 2.5	2.1
650	L	320.2 317.9	319.1	2.8 3.4	3.1
	Tr	278.9 273.8	276.4	2.3 2.3	2.3
800	L	296.3 294.3	295.3	6.5 5.6	6.1
	Tr	292.9 278.4	285.7	5.4 4.5	5.0

TABLE 44

RESULTS OF 0.3 IN. DIA. NOTCH-TENSILE SPECIMENS (K = 5)
FROM 4-1/2 IN. DIA. 98B40 (1550°F/oil)
TEST TEMP. = R.T.

TEMPERING TEMP.-°F	TYPE OF SPECIMEN	NOTCH-STRENGTH 1000 PSI	AVG.	% REDUCTION OF AREA	AVG.
400	L	323.8 325.8	324.8	2.3 2.5	2.4
	Tr	270.4 287.9	279.2	2.0 1.4	1.7
500	L	316.3 323.9	320.1	3.2 2.0	2.6
	Tr	270.3 252.1	261.2	2.0 1.7	1.9
575	L	311.2 307.9	309.6	2.0 2.5	2.3
	Tr	261.8 259.9	260.9	1.1 1.4	1.3
650	L	296.6 300.3	298.5	2.0 1.7	1.9
	Tr	224.0 255.2	239.6	1.7 1.2	1.5
800	L	279.5 277.7	278.6	3.5 4.0	3.8
	Tr	255.6 260.1	257.9	2.8 2.0	2.4

TABLE 45

RESULTS OF 0.3 IN. DIA. NOTCH-TENSILE SPECIMENS (K = 10)
FROM 4-1/2 IN. DIA. 98B40 (1550°F/oil)
TEST TEMP. = R.T.

TEMPERING TEMP.-°F	TYPE OF SPECIMEN	NOTCH-STRENGTH 1000 PSI	AVG.	% REDUCTION OF AREA	AVG.
400	L	296.3 295.3	295.8	1.7 0.9	1.3
	Tr	251.1 250.3	250.7	1.1 0.8	1.0
500	L	280.6 279.9	280.3	1.4 1.7	1.6
	Tr	212.5 264.4	238.5	0.6 2.3	1.5
575	L	283.2 273.4	278.3	2.5 2.0	2.3
	Tr	231.7 238.3	235.0	0.8 0.8	0.8
650	L	280.0 274.4	277.2	2.0 1.4	1.7
	Tr	206.8 251.4	229.1	0.8 1.7	1.3
800	L	283.2 275.2	279.2	2.3 1.7	2.0
	Tr	253.0 239.9	246.5	1.7 0.8	1.3

TABLE 46

RESULTS OF 0.5 IN. DIA. NOTCH-TENSILE SPECIMENS (K = 3)
FROM 4-1/2 IN. DIA. 98B40 (1550°F/oil)
TEST TEMP. = R.T.

TEMPERING TEMP.-°F	TYPE OF SPECIMEN	NOTCH-STRENGTH 1000 PSI	AVG.	% REDUCTION OF AREA	AVG.
400	L	343.1 344.1	343.6	2.8 2.9	2.9
	Tr	236.7 176.1	206.4	1.5 1.3	1.4
500	L	328.8	328.8	2.5	2.5
	Tr	240.2 184.0	212.1	2.1 1.3	1.7
575	L	287.8 310.9	299.3	2.3 2.5	2.4
	Tr	219.6 207.9	213.7	0.9 2.5	1.7
650	L	317.7 286.8	302.2	2.8 2.7	2.8
	Tr	174.7 195.6	185.2	1.6 1.7	1.7
800	L	298.7 300.6	299.7	3.4 4.7	4.1
	Tr	252.3 250.8	251.6	2.2 2.0	2.1

TABLE 47

RESULTS OF 0.5 IN. DIA. NOTCH-TENSILE SPECIMENS (K = 5)
FROM 4-1/2 IN. DIA. 98B40 (1550°F/oil)
TEST TEMP. = R. T.

TEMPERING TEMP.-°F	TYPE OF SPECIMEN	NOTCH-STRENGTH 1000 PSI	AVG.	% REDUCTION OF AREA	AVG.
400	L	248.7 241.0	244.8	2.3 1.2	1.8
	Tr	187.4 169.4	178.4	1.1 1.6	2.4
500	L	268.1 196.3	232.2	0.9 1.1	1.0
	Tr	172.6 181.7	177.1	1.4 0.3	0.9
575	L	273.8 235.1	254.5	2.0	2.0
	Tr	168.7 173.7	171.2	0.5 0.8	0.7
650	L	232.4 270.3	251.3	1.4 1.2	1.3
	Tr	177.7 182.8	180.3	0.5 0.7	0.6
800	L	266.8 267.5	267.2	2.8 2.9	2.9
	Tr	206.3 206.7	206.5	6.9 1.1	4.0

TABLE 48

RESULTS OF 0.5 IN. DIA. NOTCH-TENSILE SPECIMENS (K = 10)
FROM 4-1/2 IN. DIA. 98B40 (1550°F/oil)
TEST TEMP. = R. T.

TEMPERING TEMP. -°F	TYPE OF SPECIMEN	NOTCH-STRENGTH 1000 PSI	AVG.	% REDUCTION OF AREA	AVG.
400	L	188.7 194.4	191.6	1.1 0.6	0.9
	Tr	173.3 178.9	176.1	0.2 1.0	0.6
500	L	178.6 217.2	197.9	0.7 0.8	0.8
	Tr	147.6 136.1	141.9	0.5 0.7	0.6
575	L	221.6 225.4	223.5	2.4 1.2	1.8
	Tr	173.0 143.6	158.3	0.1 0.5	0.3
650	L	227.9 206.8	217.4	1.6 1.3	1.5
	Tr	126.5 155.4	141.0	0.2 0.8	0.5
800	L	218.9 267.9	243.4	2.6 1.6	2.1
	Tr	192.9 170.0	181.5	0.8 0.9	0.9

TABLE 49

RESULTS OF 0.3 AND 0.5 IN. DIA. NOTCH-TENSILE SPECIMENS FROM 4-1/2 IN. DIA. 98B40 (1550°/oil)
TEST TEMP. = R. T.

TEMPERING TEMP. -°F	TYPE OF SPECIMEN	NOTCH-STRENGTH RATIO					
		0.3 IN. DIA. SPECIMENS			0.5 IN. DIA. SPECIMENS*		
		K = 3	K = 5	K = 10	K = 3	K = 5	K = 10
400	L	1.25	1.08	0.98	1.14	0.81	0.63
	Tr	1.09	0.94	0.85	0.70	0.60	0.60
500	L	1.23	1.13	0.99	1.16	0.82	0.70
	Tr	1.08	0.93	0.85	0.76	0.63	0.51
575	L	1.21	1.15	1.03	1.11	0.94	0.83
	Tr	1.12	1.01	0.88	0.80	0.64	0.59
650	L	1.30	1.22	1.13	1.23	1.02	0.89
	Tr	1.12	0.97	0.93	0.75	0.73	0.57
800	L	1.45	1.36	1.37	1.47	1.31	1.19
	Tr	1.40	1.26	1.20	1.23	1.01	0.89

* BASED ON TENSILE STRENGTH OF 0.28 IN. DIA. SPECIMENS.

TABLE 50

RESULTS OF IMPACT TESTS ON V-NOTCH CHARPY SPECIMENS
FROM 4-1/2 IN. DIA. 98B40 (1550°/oil)
TEMPERED AT 400°F.

TEMPERING TEMP. °F	TYPE OF SPECIMEN	TEST TEMP. °F	IMPACT ENERGY FT.-LB.	AVERAGE FT.-LB.
400	L	+212	16.0 14.0	15.0
	Tr		* 13.0	13.0
	L	R.T.	* 14.0	14.0
	Tr		7.0 7.0	7.0
	L	-71	10.5 12.0	11.5
	Tr		5.0 5.5	5.5
	L	-166	8.0 8.0	8.0
	Tr		5.0 4.5	8.0

*Specimen jammed

TABLE 51

RESULTS OF IMPACT TESTS ON V-NOTCH CHARPY SPECIMENS FROM 4-1/2 IN. DIA. 98B40 (1550°/oil) TEMPERED AT 500°F.

TEMPERING TEMP. °F	TYPE OF SPECIMEN	TEST TEMP. °F	IMPACT ENERGY FT.-LB.	AVERAGE FT.-LB.
500	L	+212	12.5 *	12.5
	Tr		5.5 6.5	6.0
	L	R.T.	9.0 7.5	8.5
	Tr		* 4.5	4.5
	L	-71	5.0 10.0	7.5
	Tr		4.0 5.0	4.5
	L	-166	5.5 5.5	5.5
	Tr		4.0 5.0	4.5

*Specimen jammed

TABLE 52

RESULTS OF IMPACT TESTS ON V-NOTCH CHARPY SPECIMENS FROM 4-1/2 IN. DIA. 98B40 (1550°/oil)

TEMPERING TEMP. °F	TYPE OF SPECIMEN	TEST TEMP. °F	IMPACT ENERGY FT.-LB.	AVERAGE FT.-LB.
575	L	+212	*	*
			*	
	Tr		*	*
			*	
	L	R.T.	10.0	10.5
			10.5	
	Tr		6.0	5.5
			5.0	
	L	-71	7.5	6.5
			5.5	
	Tr		3.0	4.0
			4.5	
	L	-166	6.0	6.0
			6.0	
	Tr		4.0	4.0
			4.0	

*Specimen jammed

TABLE 53

RESULTS OF IMPACT TESTS ON V-NOTCH CHARPY SPECIMENS FROM 4-1/2 IN. DIA. 98B40 (1550°/oil) TEMPERED AT 650°F.

TEMPERING TEMP. °F	TYPE OF SPECIMEN	TEST TEMP. °F	IMPACT ENERGY FT.-LB	AVERAGE FT.-LB.
650	L	+212	*	*
			*	
			*	
	Tr		5.5	5.5
	L	R.T.	12.0	11.5
			10.5	
	Tr		5.5	5.0
			4.0	
	L	-71	5.5	5.5
			5.0	
	Tr		3.5	3.5
			3.5	
	L	-166	6.0	5.5
			5.0	
	Tr		4.0	4.0
			4.0	

* Specimen jammed

TABLE 54

RESULTS OF IMPACT TESTS ON V-NOTCH CHARPY SPECIMENS
FROM 4-1/2 IN. DIA. 98B40 (1550°/oil)
TEMPERED AT 800°F.

TEMPERING TEMP. °F	TYPE OF SPECIMEN	TEST TEMP. °F	IMPACT ENERGY FT.-LB.	AVERAGE FT.-LB.
800	L	+212	19.0 15.5	17.5
	Tr		9.0 *	9.0
	L	R.T.	* 10.5	10.5
	Tr		5.0 4.5	5.0
	L	-71	13.0 9.0	11.0
	Tr		4.5 6.0	5.5
	L	-166	5.5 *	5.5
	Tr		5.0 5.0	5.0

*Specimen Jammed

TABLE 55

ROTATING BEAM FATIGUE DATA FOR SMOOTH AND NOTCHED LONGITUDINAL SPECIMENS FROM 4-1/2 IN. DIA. 98B40 (1550°F/OIL)

TEST TEMPERATURE = R.T. TEMPERED AT 400° AND 500°F.

TEMPERING TEMP. AND STRENGTH LEVEL	STRESS - 1000 PSI		LIFE - 1000 CYCLES	
	K = 1	K = 8	K = 1	K = 8
400°F (300,000 PSI)		138.0		* 2.0
		104.0		3.0
	173.0	123.0	45.0	* 4.0
	157.0	104.0	107.0	* 6.0
	149.0	92.0	146.0	* 9.0
	124.0	92.0	300.0	16.0
	125.0	77.0	2,483.0	39.0
	108.0	77.0	(14,125.0)	48.0
	93.0	74.0	(14,587.0)	51.0
		61.0		273.0
		62.0		(10,049.0)
		68.0		(12,394.0)
500°F (280,000 PSI)	169.0	123.0	18.0	4.5
	155.0	92.0	28.0	7.0
	142.0	77.0	168.0	24.0
	124.0	83.0	1,076.0	32.0
	107.0	62.0	2,146.0	61.0
	110.0	59.0	3,120.0	70.0
	97.0	56.0	(13,805.0)	84.0
	94.0	56.0	(16,629.0)	97.0
		53.0		(10,396.0)

*Understressed Specimens
() Did not Fracture

TABLE 56

ROTATING BEAM FATIGUE DATA FOR SMOOTH AND NOTCHED LONGITUDINAL SPECIMENS FROM 4-1/2 IN. DIA. 98B40 (1550°F/OIL)

TEST TEMPERATURE = R.T. TEMPERED AT 575°AND 650°F.

TEMPERING TEMP. AND STRENGTH LEVEL	STRESS - 1000 PSI		LIFE - 1000 CYCLES	
	K = 1	K = 8	K = 1	K = 8
575°F (270,000 PSI)	173.0	123.0	11.0	3.0
	153.0	104.0	33.0	7.0
	152.0	92.0	53.0	11.0
	144.0	77.0	135.0	14.0
	107.0	62.0	144.0	64.0
	101.0	56.0	6,982.0	175.0
	85.0	53.0	(13,572.0)	(10,000.0)
		50.0		(10,053.0)
650°F (240,000 PSI)	167.0	123.0	9.0	6.0
	152.0	104.0	17.0	6.0
	123.0	92.0	23.0	11.0
	150.0	77.0	28.0	36.0
	106.0	53.0	189.0	117.0
	84.0	47.0	374.0	131.0
	92.0	62.0	499.0	173.0
	79.0	43.0	(12,438.0	225.0
		40.0		(13,649.0)

( ) Did not Fracture

TABLE 57

ROTATING BEAM FATIGUE DATA FOR SMOOTH AND NOTCHED LONGITUDINAL SPECIMENS FROM 4-1/2 IN. DIA. 98B40 (1550°F/OIL)

TEST TEMPERATURE = R. T. TEMPERED AT 800°F.

TEMPERING TEMP. AND STRENGTH LEVEL	STRESS - 1000 PSI		LIFE - 1000 CYCLES	
	K = 1	K = 8	K = 1	K = 8
800°F (200,000 PSI)		123.0		2.0
		104.0		3.0
	169.0	92.0	5.0	4.0
	153.0	77.0	13.0	8.0
	139.0	62.0	25.0	68.0
	94.0	53.0	36.0	140.0
	125.0	47.0	87.0	250.0
	109.0	43.0	340.0	1,262.0
	89.0	40.0	(13,813.0)	(11,063.0)
	82.0		(15,093.0)	

( )Did not Fracture

TABLE 58

ROTATING BEAM FATIGUE DATA FOR SMOOTH AND NOTCHED LONGITUDINAL SPECIMENS FROM 4-1/2 IN. DIA. 98B40 (1550°F/OIL)

TEST TEMPERATURE = R.T.

TENSILE STRENGTH 1000 PSI	ENDURANCE LIMIT 1000 PSI		ENDURANCE RATIO	
	K = 1	K = 8	K = 1	K = 8
302	113	60	0.37	0.20
284	103	52	0.36	0.18
270	94	50	0.35	0.19
245	83	40	0.34	0.16
204	90	40	0.44	0.20

TABLE 59

RESULTS OF 0.28 IN.DIA. TENSILE SPECIMENS FROM
3 IN.DIA. SUPER HY-TUF (1700°F/OIL)
TEST TEMPERATURE = R.T.

TEMPERING TEMP. °F	TYPE OF SPECIMEN	TENSILE STRENGTH 1000 PSI	AVERAGE	0.2% YIELD STRENGTH 1000 PSI	AVERAGE	% REDUCTION OF AREA	AVERAGE	% ELONGATION	AVG.
400	L	311.7 302.4	307.1	251.6 243.9	247.8	28.7 33.8	31.3	9.6 9.6	9.6
	Tr	251.1 262.6	256.9	--- 221.9	221.9	--- 1.6	1.6	-- 0.8	0.8
500	L	288.7 291.8	290.3	--- 250.0	250.0	34.2 32.3	33.3	9.5 9.0	9.3
	Tr	240.5 251.1		--- ---		--- ---		-- --	
700	L	219.2 293.9	293.9	--- 253.6	253.6	--- 29.1	29.1	-- 7.8	7.8
	Tr	238.3 290.9	264.6	228.1	228.1	--- 5.2	5.2	-- 2.6	2.6
800	L	261.4 259.3	260.4	214.3 208.1	211.2	33.4 32.7	33.1	8.0 9.0	8.5
	Tr	241.6 ---	241.6	207.9 ---	207.9	3.4 ---	3.4	2.0 ---	2.0

---Broke under head

TABLE 60

RESULTS OF 0.3 IN.DIA. NOTCH TENSILE SPECIMENS (K = 3)
FROM 3 IN.DIA. SUPER HY-TUF (1700°F/OIL)
TEST TEMPERATURE = R.T.

TEMPERING TEMP. °F	TYPE OF SPECIMEN	NOTCH STRENGTH 1000 PSI	AVERAGE	% REDUCTION OF AREA	AVERAGE
400	L	360.9 347.4	354.2	3.0 2.6	2.8
	Tr	280.3 261.8	271.1	1.7 2.2	2.0
500	L	373.9 ---	373.9	3.0 ---	3.0
	Tr	246.7 217.1	231.9	2.2 2.6	2.4
700	L	364.0 389.9	376.9	4.2 3.4	3.8
	Tr	279.0 221.6	250.3	1.7 0.6	1.2
800	L	338.0 336.7	337.4	3.7 3.4	3.6
	Tr	194.1 210.1	202.1	0.8 2.0	1.4
800 *	L	287.3 281.5	284.4	2.3 2.4	2.4
	Tr	124.2 151.3	137.8	1.0 1.5	1.3

*0.5 IN.DIA. SPECIMENS

TABLE 61

RESULTS OF 0.3 IN.DIA. NOTCH TENSILE SPECIMENS (K = 5)
FROM 3 IN.DIA. SUPER HY-TUF (1700°F/OIL)
TEST TEMPERATURE = R.T.

TEMPERING TEMP. °F	TYPE OF SPECIMEN	NOTCH STRENGTH 1000 PSI	AVERAGE	% REDUCTION OF AREA	AVERAGE
400	L	340.0 293.0	316.5	1.7 ---	1.7
	Tr	217.7 228.3	223.0	0.3 0.8	0.6
500	L	320.5 302.0	311.3	1.1 1.7	1.4
	Tr	205.3 227.7	216.5	1.1 1.4	1.3
700	L	245.9 296.0	271.0	2.0 1.4	1.7
	Tr	201.7 205.6	203.7	0.6 0.3	0.5
800	L	268.3 262.9	265.6	1.1 2.0	1.6
	Tr	194.2 164.8	179.5	1.4 1.4	1.4
800*	L	204.6 242.5	223.6	2.8 2.8	2.8
	Tr	142.4 132.0	137.2	1.0 0.8	0.9

*0.5 IN.DIA. SPECIMENS

TABLE 62

RESULTS OF 0.3 IN.DIA. NOTCH TENSILE SPECIMENS (K = 10)
FROM 3 IN.DIA. SUPER HY-TUF (1700°F/OIL)
TEST TEMPERATURE = R.T.

TEMPERING TEMP. °F	TYPE OF SPECIMEN	NOTCH STRENGTH 1000 PSI	AVERAGE	% REDUCTION OF AREA	AVERAGE
400	L	300.3 285.9	293.1	0.8 0.8	0.8
	Tr	251.0 213.5	232.3	2.5 0.8	1.7
500	L	282.7 287.3	285.0	--- 0.6	0.6
	Tr	214.1 214.7	214.4	3.4 0.8	2.1
700	L	294.4 309.4	301.9	2.3 1.1	1.7
	Tr	214.4 192.0	203.2	1.4 1.3	1.4
800	L	259.3 251.1	255.2	0.6 0.6	0.6
	Tr	157.6 172.5	165.1	1.1 1.7	1.4
800*	L	193.1 159.5	176.3	0.5 1.0	0.8
	Tr	100.2 89.1	94.7	0.8 1.2	1.0

*0.5 IN.DIA. SPECIMENS

TABLE 63

RESULTS OF 0.3 IN.DIA. AND 0.5 IN.DIA. NOTCH TENSILE SPECIMENS FROM 3 IN.DIA. SUPER HY-TUF (1700°F/OIL)

TEST TEMPERATURE = R.T.

TEMPERING TEMP. °F	TYPE OF SPECIMEN	NOTCH STRENGTH RATIO					
		0.3 IN.DIA. SPECIMENS			0.5 IN.DIA. SPECIMENS *		
		K = 3	K = 5	K = 10	K = 3	K = 5	K = 10
400	L Tr	1.15 1.05	1.03 0.87	0.95 0.90			
500	L Tr	1.29	1.07	0.98			
700	L Tr	1.28 0.95	0.92 0.77	1.03 0.77			
800	L Tr	1.30 0.84	1.02 0.74	0.98 0.68	1.09 0.57	0.86 0.57	0.68 0.39

* BASED ON TENSILE STRENGTH OF 0.3 IN.DIA. SPECIMENS

TABLE 64

RESULTS OF IMPACT TESTS FOR V-NOTCH CHARPY SPECIMENS FROM 3 IN.DIA. SUPER HY-TUF (1700°F/OIL) TEMPERED AT 800°F.

TEMPERING TEMP. °F	TYPE OF SPECIMEN	TEST TEMP. °F	IMPACT ENERGY FT.- LB.	AVERAGE FT. - LB.
800	L	+212	11.5 14.0	13.0
	Tr		* *	*
	L	R.T.	8.5 8.5	8.5
	Tr		4.0 4.0	4.0
	L	-71	4.0 3.0	3.5
	Tr		5.5 *	5.5
	L	-166	4.0 4.0	4.0
	Tr		6.0 3.5	5.0

*SPECIMEN JAMMED

TABLE 65

ROTATING BEAM FATIGUE DATA FOR SMOOTH AND NOTCHED SPECIMENS FROM 3 IN.DIA. SUPER HY-TUF (1700°F/OIL)

TEST TEMPERATURE = R.T.

TEMPERING TEMPERATURE AND STRENGTH LEVEL	STRENGTH - 1000 PSI		LIFE - 1000 CYCLES	
	K = 1	K = 8	K = 1	K = 8
800°F (260,000 PSI)	186.5	104.0	5.0	5.0
	167.0	92.5	16.0	6.0
	151.0	77.0	27.0	24.0
	137.5	61.8	54.0	66.0
	122.0	46.4	158.0	125.0
	105.0	43.5	858.0	652.0
	92.0	37.3	(10,210.0)	(11,341.0)
	99.5	52.5	(15,356.0)	(14,641.0)

( ) DID NOT FRACTURE

TABLE 66

RESULTS OF 0.28 IN. DIA. TENSILE SPECIMENS FROM 3 IN. DIA. SUPER TM-2 (1600°F/OIL)

TEST TEMP. = R.T.

TEMPERING TEMP.- °F	TYPE OF SPECIMEN	TENSILE STRENGTH- 1000 PSI	AVG.	0.2% YIELD STRENGTH- 1000 PSI	AVG.	% REDUCTION OF AREA	AVG.	% ELONGATION	AVG.
400	L	283.1 287.1	285.1	222.6 222.6	222.6	41.9 43.5	42.7	11.4 12.5	12.0
	Tr	286.9 286.1	286.5	226.2	226.2	14.8 11.5	13.2	6.5 5.5	6.0
500	L	274.2 271.0	272.6	225.8 230.6	228.3	45.2 45.2	45.2	11.8 11.7	11.8
	Tr	272.2 277.0	274.6	229.0 234.4	231.7	22.6 19.7	21.2	6.8 6.3	6.6
600	L	260.5 260.5	260.5	221.0 225.8	223.4	43.5 46.8	45.2	11.1 11.6	11.4
	Tr	262.7 258.1	260.4	234.4 238.7	236.6	11.5 24.2	17.9	4.6 7.0	5.8
700	L	247.6 246.8	247.2	211.3 212.9	212.1	45.2 45.2	45.2	11.8 11.8	11.8
	Tr	246.0 246.3	246.2	225.8	225.8	22.6 24.2	23.4	6.3 7.2	6.8
800	L	227.4 232.3	229.9	206.5 204.8	205.7	43.5 45.2	44.4	11.5 12.6	12.1
	Tr	229.8 229.0	229.4	201.6 201.6	201.6	17.7 19.4	18.6	6.0 6.9	6.5

TABLE 67

RESULTS OF 0.3 IN. DIA. NOTCH-TENSILE SPECIMENS (K = 3)

FROM 3 IN. DIA. SUPER TM-2 (1600°F/OIL)

TEST TEMP. = R.T.

*0.5 IN. DIA. SPECIMENS

TEMPERING TEMP.- °F	TYPE OF SPECIMEN	NOTCH STRENGTH- 1000 PSI	AVG.	% REDUCTION OF AREA	AVG.
400	L	384.2 392.6	388.4	3.1 4.5	3.8
	Tr	329.4 341.1	335.3	2.6 2.8	2.7
500	L	379.4 391.2	385.3	4.8 3.1	4.0
	Tr	329.4 342.1	335.8	2.6 3.6	3.1
600	L	373.1 323.5	348.3	8.4 2.3	5.4
	Tr	311.8	311.8	2.9	2.9
700	L	347.2 340.3	343.7	3.7 4.0	3.9
	Tr	306.1 319.6	312.9	2.6 3.4	3.0
800	L	310.7 318.2	314.5	5.3 7.0	6.2
	Tr	286.5 290.7	288.6	3.1 2.3	2.7
500*	L	332.7 359.2	340.0	3.1 4.1	3.6
	Tr	275.5 310.2	292.9	2.0 3.1	2.6

TABLE 68

RESULTS OF 0.3 IN. DIA. NOTCH-TENSILE SPECIMENS (K = 5)

FROM 3 IN. DIA. SUPER TM-2 (1600°F/OIL)

TEST TEMP. = R.T.

*0.5 IN. DIA. SPECIMENS

TEMPERING TEMP.- °F	TYPE OF SPECIMEN	NOTCH STRENGTH- 1000 PSI	AVG.	% REDUCTION OF AREA	AVG.
400	L	334.3 / 324.7	329.5	2.5 / 2.0	2.5
	Tr	261.4 / 289.8	275.6	1.7 / 1.7	1.7
500	L	332.4 / 354.0	343.2	2.8 / 3.4	3.1
	Tr	309.0 / 292.4	300.7	2.6 / 2.0	2.3
600	L	342.1 / 324.4	333.3	4.5 / 3.5	4.0
	Tr	310.7 / 286.5	298.6	2.6 / 1.1	1.9
700	L	313.4 / 306.6	310.0	4.9 / 2.2	3.6
	Tr	284.1 / 270.7	277.4	6.8 / 1.4	4.1
800	L	290.8 / 292.8	291.8	3.4 / 2.5	3.0
	Tr	284.9 / 270.6	277.8	4.0 / 2.0	3.0
500*	L	302.0 / 319.4	310.7	3.1 / 3.1	3.1
	Tr	258.2 / 233.7	246.0	3.1 / 2.0	2.6

TABLE 69

RESULTS OF 0.3 IN. DIA. NOTCH-TENSILE SPECIMENS (K = 10)

FROM 3 IN. DIA. SUPER TM-2 (1600°F/OIL)

TEST TEMP. = R.T.

*0.5 IN. DIA. SPECIMENS

TEMPERING TEMP. -°F	TYPE OF SPECIMEN	NOTCH STRENGTH- 1000 PSI	AVG.	% REDUCTION OF AREA	AVG.
400	L	340.2 346.0	343.1	2.9 5.0	4.0
	Tr	275.6 241.9	258.8	1.1 1.5	1.3
500	L	310.9 327.5	319.2	.8 3.4	2.1
	Tr	285.8 269.6	277.7	1.7 2.0	1.9
600	L	321.6 310.7	316.2	2.8 1.1	2.0
	Tr	266.7 271.7	269.2	.6 1.7	1.2
700	L	305.5 294.3	299.9	2.8 1.4	2.1
	Tr	257.9 247.9	252.9	1.1 1.1	1.1
800	L	282.0 289.6	285.8	3.1 3.2	3.2
	Tr	257.8 265.3	261.6	1.1 2.0	1.6
500*	L	268.4 268.4	268.4	2.0 2.0	2.0
	Tr	186.5 202.0	194.3	2.1 3.1	2.6

TABLE 70

RESULTS OF 0.3 IN. DIA. NOTCH-TENSILE SPECIMENS FROM 3 IN. DIA. SUPER TM-2 (1600°F/OIL)

TEST TEMP. = R.T.

TEMPERING TEMP. -°F	TYPE OF SPECIMEN	NOTCH STRENGTH RATIO					
		0.3 IN. DIA. SPECIMENS			0.5 IN. DIA. SPECIMENS		
		K = 3	K = 5	K = 10	K = 3	K = 5	K = 10
400	L	1.36	1.16	1.20			
	Tr	1.17	0.96	0.90			
500	L	1.41	1.26	1.17	1.27	1.14	0.98
	Tr	1.22	1.10	1.01	1.07	0.90	0.71
600	L	1.34	1.28	1.21			
	Tr	1.20	1.15	1.03			
700	L	1.39	1.25	1.21			
	Tr	1.27	1.13	1.03			
800	L	1.37	1.27	1.24			
	Tr	1.26	1.21	1.14			

TABLE 71

RESULTS OF IMPACT TESTS FOR CHARPY SPECIMENS

FROM 3 IN. DIA. SUPER TM-2 1600°F/OIL
TEMPERED AT 500°F.

TEMPERING TEMP.- °F	TYPE OF SPECIMEN	TEST TEMP.- °F	IMPACT ENERGY- FT.-LB.	AVERAGE FT.-LB.
500	L	+212	20.5 *	20.5
	Tr		9.5 9.0	9.5
	L	R.T.	15.0 15.0	15.0
	Tr		7.0 7.0	7.0
	L	-71	14.0 14.5	14.5
	Tr		6.0 6.5	6.5
	L	-150	8.5 7.5	8.0
	Tr		4.5 5.0	5.0

TABLE 72

RESULTS OF 0.28 IN. DIA. TENSILE SPECIMENS FROM 4-1/4 IN. SQ. INCO (1600°F/OIL)

TEST TEMP. = R.T.

TEMPERING TEMP.- °F	TYPE OF SPECIMEN	TENSILE STRENGTH- 1000 PSI	AVG.	0.2% YIELD STRENGTH- 1000 PSI	AVG.	% REDUCTION OF AREA	AVG.	% ELONGATION	AVG.
400	L	286.3 300.0	293.2	203.2 219.4	211.3	37.1 37.1	37.1	11.4 12.1	11.8
	Tr	310.0 282.3	296.2	224.1 221.0	222.6	17.2 9.7	13.5	8.6 5.9	7.3
500	L	287.1 282.3	284.7	238.7 222.6	230.7	35.5 38.7	37.1	11.2 12.1	11.7
	Tr	275.8 275.0	275.4	233.9 230.6	232.3	21.0 19.4	20.2	7.1 7.2	7.2
600	L	273.7 271.0	272.4	237.3 225.8	231.6	40.7 41.9	41.3	11.5 11.3	11.4
	Tr	280.6	280.6	238.7	238.7	16.1	16.1	3.1	3.1
700	L	281.0 271.0	276.0	253.4 235.5	244.5	39.7 38.7	39.2	11.1 11.8	11.5
	Tr	280.2 262.1	271.2	243.1 229.0	236.1	12.1 22.6	17.4	4.7 7.9	6.3
800	L	249.2 231.8	240.5	198.4 193.5	196.0	29.0 46.8	37.9	10.5 10.7	10.6
	Tr	239.5 241.1	240.3	201.6 204.8	203.2	14.5 16.1	15.3	4.1 7.9	6.0

TABLE 73

RESULTS OF 0.3 IN. DIA. NOTCH-TENSILE SPECIMENS (K = 3)

FROM 4-1/4 IN. SQ. INCO (1600°F/OIL)

TEST TEMP. = R.T.

*0.5 IN. DIA. SPECIMENS

TEMPERING TEMP.- °F	TYPE OF SPECIMEN	NOTCH-STRENGTH- 1000 PSI	AVG.	% REDUCTION OF AREA	AVG.
400	L	381.8 385.3	383.6	4.6 4.2	4.4
	Tr	388.1 355.9	372.0	4.8 4.5	4.7
500	L	391.5 390.9	391.2	5.1 3.7	4.4
	Tr	337.1 376.8	357.0	5.7 4.0	4.9
600	L	387.5 384.8	386.2	3.1 3.1	3.1
	Tr	379.6 388.1	383.9	4.0 2.3	3.2
700	L	373.9 376.4	375.2	3.1 4.2	3.7
	Tr	336.2 373.2	354.7	2.8 2.8	2.8
800	L	331.4 311.6	321.5	3.4 3.7	3.6
	Tr	299.4 284.5	292.0	2.8 3.1	3.0
600 *	L	365.3 348.5	356.9	4.1 2.1	3.1
	Tr	346.9 320.4	333.7	4.1 4.1	4.1

TABLE 74

RESULTS OF 0.3 IN. DIA. NOTCH-TENSILE SPECIMENS (K = 5)

FROM 4-1/4 IN. SQ. INCO (1600°F/OIL)

TEST TEMP. = R.T.

*0.5 IN. DIA. SPECIMENS

TEMPERING TEMP.- °F	TYPE OF SPECIMEN	NOTCH-STRENGTH- 1000 PSI	AVG.	% REDUCTION OF AREA	AVG.
400	L	327.7 330.5	329.1	1.7 0.2	1.0
	Tr	328.7 302.0	315.4	1.7 0.9	1.3
500	L	342.7 325.8	334.3	2.8 2.8	2.8
	Tr	324.7 328.6	326.7	3.2 3.4	3.3
600	L	338.0 348.3	343.2	1.4 1.7	1.6
	Tr	342.7 279.2	311.0	1.7 2.8	2.3
700	L	321.1 331.5	326.3	2.5 2.5	2.5
	Tr	320.2 339.9	330.1	1.7 0.6	1.2
800	L	280.9 269.7	275.3	1.7 1.4	1.6
	Tr	274.8 254.3	364.6	1.7 2.0	1.9
* 600	L	320.4 290.8	305.6	2.0 2.0	2.0
	Tr	300.0 321.4	310.7	2.0 2.0	2.0

TABLE 75

RESULTS OF 0.3 IN. DIA. NOTCH-TENSILE SPECIMENS (K = 10)

FROM 4-1/4 IN. SQ. INCO (1600°F/OIL)

TEST TEMP. = R.T.

*0.5 IN. DIA. SPECIMENS

TEMPERING TEMP.- °F	TYPE OF SPECIMEN	NOTCH STRENGTH- 1000 PSI	AVG.	% REDUCTION OF AREA	AVG.
400	L	328.7 294.3	311.5	2.2 2.6	2.4
	Tr	284.9 278.3	281.6	1.7 2.0	1.9
500	L	327.6 325.7	326.7	2.3 2.6	2.5
	Tr	323.9 326.8	325.2	3.9 1.4	2.7
600	L	309.0 328.6	318.8	1.7 3.4	2.6
	Tr	317.4 334.3	325.9	2.0 2.5	2.3
700	L	304.2 317.9	311.1	3.1 2.3	2.7
	Tr	308.8 313.2	311.0	2.8 1.4	2.1
800	L	265.0 265.7	265.4	1.4 2.3	1.9
	Tr	271.7 261.2	266.5	0.9 0.8	0.9
600	L	293.9 256.1	275.0	1.0 1.0	1.0
	Tr	229.6 256.1	242.9	2.0 1.0	1.5

TABLE 76

RESULTS OF 0.3 IN. DIA. NOTCH-TENSILE SPECIMENS FROM

4-1/4 IN. SQ. INCO (1600°F/OIL)

TEST TEMP. = R.T.

TEMPERING TEMP. -°F	TYPE OF SPECIMEN	NOTCH STRENGTH RATIO					
		0.3 IN. DIA. SPECIMENS			0.5 IN. DIA. SPECIMENS		
		K = 3	K = 5	K = 10	K = 3	K = 5	K = 10
400	L	1.31	1.12	1.06			
	Tr	1.26	1.06	0.95			
500	L	1.37	1.17	1.15			
	Tr	1.30	1.19	1.18			
600	L	1.42	1.26	1.17	1.31	1.12	1.01
	Tr	1.37	1.11	1.16	1.19	1.11	0.87
700	L	1.36	1.18	1.13			
	Tr	1.31	1.22	1.15			
800	L	1.34	1.14	1.10			
	Tr	1.22	1.10	1.11			

TABLE 77

RESULTS OF IMPACT TESTS FOR CHARPY SPECIMENS FROM 4 IN. SQ. INCO STEEL, 1600°F/OIL TEMPERED AT 600° F

TEMPERING TEMP.- °F	TYPE OF SPECIMEN	TEST TEMP.- °F	IMPACT ENERGY- FT.-LB.	AVERAGE FT.-LB.
600	L	+212	21.0 19.0	20.0
	Tr		13.5 18.0	16.0
	L	R.T.	18.5 20.0	19.5
	Tr		13.5 *	13.5
	L	-71	11.5 14.5	13.0
	Tr		?? 20.0 ?? 18.0	??
	L	-150	9.5 8.5	9.0
	Tr		6.5 8.0	7.5

*SPECIMEN JAMMED.

TABLE 78

RESULTS OF 0.3 IN. DIA. TENSILE SPECIMENS FROM 4 IN. SQ. V-MOD. 4330
(1600°F/OIL)

TEST TEMPERATURE - R.T.

TEMPERING TEMP. °F	TYPE OF SPECIMEN	TENSILE STRENGTH 1000 PSI	AVG.	0.2% YIELD STRENGTH 1000 PSI	AVERAGE	% REDUCTION OF AREA	AVERAGE	% ELONGATION	AVERAGE
250	R.L	269.8 268.0	263.0	184.9 190.9	181.2	51.1 47.2	49.0	17.3 14.3	16.5
	C.L.	257.1 257.1		176.6 172.2		49.2 48.4		17.2 17.2	
	R.T.	261.0 265.9	257.5	201.6 187.4	187.3	7.2 11.6	11.3	5.1 7.2	5.7
	C.T.	255.6 247.2		182.6 177.6		17.4 8.8		6.1 4.0	
400	R.L.	251.4 251.4	249.5	199.4 200.6	198.9	53.8 53.0	52.8	16.8 16.0	16.2
	C.L.	248.2 246.8		189.2 206.5		53.7 50.5		16.0 16.0	
	R.T.	250.4 248.2	245.6	199.4 195.2	198.8	9.2 14.7	10.0	3.9 8.0	5.0
	C.T.	233.7 249.6		193.2 207.2		3.0 12.9		2.0 6.0	
500	R.L.	238.4 238.3	236.2	197.5 ---	194.2	55.7 55.6	55.7	15.8 15.0	15.9
	C.L	230.8 237.0		185.9 199.2		54.8 56.6		16.3 16.2	
	R.T.	239.4 237.6	236.0	196.0 194.5	195.0	23.3 26.0	17.1	7.8 13.4	8.1
	C.T.	231.2 235.5		191.5 198.0		13.9 5.2		6.0 5.1	
650	R.L.	223.4 223.5	222.0	193.6 187.6	190.4	57.2 57.3	57.3	14.9 15.7	15.6
	C.L.	220.3 220.7		187.1 193.2		57.8 57.0		15.7 15.8	
	R.T.	222.8 224.0	221.5	194.8 192.6	195.3	14.1 22.8	14.2	6.9 8.1	6.5
	C.T.	221.3 217.8		194.3 199.8		11.3 8.5		6.9 4.0	
800	R.L.	201.7 203.7	201.1	189.4 187.4	186.0	56.6 55.2	55.3	16.0 15.0	15.5
	C.L.	199.0 200.0		184.1 182.9		54.7 54.5		14.9 16.0	
	R.T.	207.9 203.0	202.7	186.7 183.2	185.2	16.5 11.0	14.0	7.0 6.0	6.5
	C.T.	199.4 200.1		187.0 183.7		14.1 14.5		6.0 7.0	

TABLE 79

RESULTS OF 0.3 IN. DIA. NOTCH TENSILE SPECIMENS (K = 3)

FROM 4 IN. SQ. V-MOD. 4330 (1600°F/OIL)

TEST TEMPERATURE = R T.

TEMPERING TEMP. °F	TYPE OF SPECIMEN	NOTCH STRENGTH 1000 PSI	NOTCH STRENGTH AVERAGE	% REDUCTION OF AREA	% REDUCTION OF AREA AVERAGE
250	R L.	369.3 363.6	366.1	10.7 10.5	8.4
	C.L.	364.1 367.5		5.9 6.3	
	R.T.	317.9 310.1	294.8	3.9 4.2	4.0
	C.T.	268.7 282.4		2.0 5.6	
400	R.L.	385.3 382.4	371.3	5.7 7.1	7.5
	C.L.	364.4 352.9		8.8 8.4	
	R T.	317.2 319.52	305.6	4.0 6.2	4.1
	C.T.	303.4 282.1		3.4 2.6	
650	R.L.	330.2 323.9	325.8	6.8 9.9	7.2
	C.L.	329.7 319.0		4.5 7.3	
	R.T.	273.8 295.8	268.9	5.4 4.8	4.1
	C.T.	241.9 264.0		3.7 2.5	
800	R.L.	303.4 304.5	304.1	7.4 8.7	6.9
	C.L.	309.7 298.6		4.8 6.4	
	R.T.	268.5 261.3	256.0	4.5 6.2	4.4
	C.T.	241.8 252.4		3.1 3.7	

TABLE 80

RESULTS OF 0.3 IN. DIA. NOTCH TENSILE SPECIMENS (K = 5)

FROM 4 IN. SQ. V-MOD. 4330 (1600°F/OIL)

TEST TEMPERATURE = R.T.

TEMPERING TEMP. °F	TYPE OF SPECIMEN	NOTCH STRENGTH 1000 PSI	AVERAGE	%REDUCTION OF AREA	AVERAGE
250	R.L.	352.4	330.9	1.7	3.1
		333.5		3.1	
	C.L.	333.9		3.6	
		303.7		3.7	
	R.L.	257.0	242.5	0.5	1.8
		237.2		1.7	
	C.L.	240.6		1.9	
		235.1		1.9	
400	R.L.	336.1	341.3	3.9	5.0
		332.4		4.4	
	C.L.	346.3		6.1	
		350.1		5.3	
	R.L.	284.4	276.9	2.8	2.0
		283.4		0.3	
	C.L.	272.3		2.0	
		267.2		2.8	
650	R.L.	306.2	305.0	2.0	3.3
		302.2		3.4	
	C.L.	302.8		4.8	
		308.7		2.8	
	R.L.	224.6	227.9	0.8	1.4
		---		---	
	C.L.	222.9		2.2	
		239.4		1.7	
800	R.L.	286.9	286.5	5.0	5.1
		287.1		6.2	
	C.L.	287.4		5.0	
		284.6		3.9	
	R.L.	246.6	234.0	2.8	2.7
		237.8		2.8	
	C.L.	215.4		2.2	
		235.9		1.7	

TABLE 81

RESULTS OF 0.3 IN. DIA. NOTCH TENSILE SPECIMENS (K = 10)

FROM 4 IN. SQ. V-MOD. 4330 (1600°F/OIL)

TEST TEMPERATURE = R.T.

TEMPERING TEMP. °F	TYPE OF SPECIMEN	NOTCH STRENGTH 1000 PSI	AVERAGE	% REDUCTION OF AREA	AVERAGE
250	R.L.	316.1	317.9	4.2	3.5
	C.L.	321.8 315.7		3.7 2.6	
	R.T.	254.2 263.2	247.0	0.3 0.3	1.4
	C.T.	241.4 228.7		1.1 1.7	
400	R.L.	330.2 332.5	330.7	2.3 3.4	2.5
	C.L.	331.4 328.5		2.0 2.5	
	R.T.	260.5 268.6	261.2	2.5 2.6	2.1
	C.T.	267.6 248.0		2.0 1.3	
650	R.L.	310.8 311.3	310.9	1.4 3.1	3.3
	C.L.	310.5 310.8		5.1 3.7	
	R.T.	254.7 247.2	243.8	2.8 1.7	2.1
	C.T.	236.6 236.8		1.4 2.3	
800	R.L.	289.0 288.0	288.1	5.1 3.6	4.7
	C.L.	287.0 288.4		4.7 5.4	
	R.T.	--- 242.2	234.6	-- 2.6	3.9
	C.T.	232.4 229.1		5.1 4.0	

TABLE 82

RESULTS OF 0.5 IN. DIA. NOTCH TENSILE SPECIMENS (K = 3)

FROM 4 IN. SQ. V-MOD. 4330 (1600°F/OIL)

TEST TEMPERATURE = R.T.

TEMPERING TEMP. °F	TYPE OF SPECIMEN	NOTCH STRENGTH 1000 PSI	AVERAGE	%REDUCTION OF AREA	AVERAGE
250	R.L.	367.9 362.3	360.4	10.4 6.0	6.4
	C.L.	355.9 355.5		3.4 5.9	
	R.T.	284.5 308.7	286.6	4.4 2.7	3.2
	C.T.	273.9 279.3		2.5 3.3	
400	R.L.	348.6 343.3	350.9	6.7 3.0	6.1
	C.L.	356.2 355.7		7.5 7.3	
	R.T.	263.7 292.2	263.7	3.9 2.1	2.8
	C.T.	252.3 246.4		1.5 3.6	
500	R.L.	312.7 331.3	318.8	4.2 6.5	5.4
	C.L.	312.9 318.2		7.5 3.2	
	R.T.	275.8 269.2	248.9	2.9 2.6	4.3
	C.T.	240.5 210.2		2.0 1.5	
650	R.L.	334.3 321.1	318.1	5.4 4.9	4.0
	C.L.	310.0 307.1		5.0 0.8	
	R.T.	265.1 259.1	244.2	2.2 2.2	2.2
	C.T.	232.3 220.3		2.1 3.7	
800	R.L.	293.9 307.8	302.8	5.6 7.3	5.8
	C.L.	293.9 305.1		4.0 6.2	
	R.T.	259.1 226.1	240.9	3.9 2.3	3.3
	C.T.	231.4 247.2		3.1 3.7	

TABLE 83

RESULTS OF 0.5 IN. DIA. NOTCH TENSILE SPECIMENS (K = 5)
FROM 4 IN. SQ. V-MOD. 4330 (1600°F/OIL)
TEST TEMPERATURE - R.T.

TEMPERING TEMP. °F	TYPE OF SPECIMEN	NOTCH STRENGTH 1000 PSI	AVERAGE	% REDUCTION OF AREA	AVERAGE
250	R.L.	328.6 342.3	337.8	5.1 3.4	4.3
	C.L.	341.4 339.0		4.0 4.7	
	R.T.	254.9 249.0	245.0	4.0 3.1	2.3
	C.T.	236.5 239.9		2.0 0.2	
400	R.L.	326.6 318.1	321.8	1.7 3.4	3.6
	C.L.	323.7 318.7		4.8 4.4	
	R.T.	261.1 254.3	240.6	2.2 1.5	2.1
	C.T.	226.6 220.3		2.7 2.0	
500	R.L.	294.3 309.9	305.3	5.3 4.2	4.5
	C.L.	304.8 312.0		5.2 3.4	
	R.T.	247.7 227.6	224.4	2.4 1.1	2.0
	C.T.	210.5 211.8		1.3 3.0	
650	R.L.	297.2 301.6	302.7	4.0 3.4	3.7
	C.L.	305.0 306.9		3.3 3.9	
	R.T.	226.1 232.5	217.6	1.8 1.5	1.1
	C.T.	223.5 188.5		0.5 0.6	
800	R.L.	291.3 278.2	285.3	3.8 3.3	4.4
	C.L.	283.1 288.7		5.0 5.3	
	R.T.	223.5 237.7	218.3	1.6 1.1	1.9
	C.T.	197.6 214.5		1.9 2.8	

TABLE 84

RESULTS OF 0.5 IN. DIA. NOTCH TENSILE SPECIMENS (K = 10)
FROM 4 IN. SQ. V-MOD. 4330 (1600°F/OIL)
TEST TEMPERATURE - R.T.

TEMPERING TEMP. °F	TYPE OF SPECIMEN	NOTCH STRENGTH 1000 PSI	AVERAGE	% REDUCTION OF AREA	AVERAGE
250	R.L.	295.7 279.1	294.7	2.8 3.9	3.7
	C.L.	310.4 293.6		3.5 3.7	
	R.T.	234.6 220.6	219.1	1.7 1.6	1.5
	C.T.	208.9 212.3		1.3 1.2	
400	R.L.	302.6 310.5	307.7	3.8 3.0	3.2
	C.L.	309.1 308.6		1.8 4.1	
	R.T.	228.8 227.3	222.8	0.7 1.8	1.5
	C.T.	212.3 ---		2.0 --	
500	R.L.	297.3 298.0	299.6	4.0 4.1	3.5
	C.L.	--- 303.6		-- 2.5	
	R.T.	233.6 219.6	215.0	0.8 1.2	1.4
	C.T.	188.7 217.9		0.7 3.0	
650	R.L.	295.4 297.1	297.2	3.0 2.9	2.7
	C.L.	299.9 296.4		2.9 2.1	
	R.T.	209.1 216.3	201.4	0.7 1.0	1.3
	C.T.	198.4 182.1		2.6 1.0	
800	R.L.	279.9 280.7	283.0	3.6 2.8	3.6
	C.L.	287.1 284.1		3.5 4.4	
	R.T.	239.7 228.2	216.6	5.7 3.2	3.5
	C.T.	192.0 210.6		2.2 2.9	

TABLE 85

RESULTS OF 0.3 AND 0.5 IN. DIA. NOTCH TENSILE SPECIMENS FROM 4 IN. SQ. V-MOD. 4330 (1600°F/OIL)

TEST TEMP. = R.T.

TEMPERING TEMP. °F	TYPE OF SPECIMEN	NOTCH STRENGTH RATIO					
		0.3 IN.DIA. SPECIMENS			0.5 IN.DIA. SPECIMENS *		
		K = 3	K = 5	K = 10	K = 3	K = 5	K = 10
250	L	1.39	1.26	1.21	1.37	1.29	1.12
	Tr	1.14	0.94	0.96	1.11	0.95	0.85
400	L	1.49	1.37	1.33	1.41	1.29	1.23
	Tr	1.24	1.13	1.06	1.03	0.98	0.91
500	L				1.35	1.29	1.27
	Tr				1.05	0.95	0.91
650	L.	1.47	1.37	1.40	1.44	1.36	1.34
	Tr	1.21	1.03	1.10	1.10	0.98	0.91
800	L	1.51	1.42	1.43	1.50	1.42	1.41
	Tr	1.26	1.15	1.16	1.19	1.07	1.07

*Based on Tensile Strength of 0.3 in.dia. Specimens.

TABLE 86

RESULTS OF IMPACT TESTS FOR V-NOTCH CHARPY SPECIMENS FROM 4 IN. SQ V-MOD. 4330 (1600°F/OIL) TEMPERED AT 250°F.

TEMPERING TEMP. °F	TYPE OF SPECIMEN	TEST TEMP. °F	IMPACT ENERGY FT.-LB.	AVERAGE FT. -LB.
250	R.L.	+212	29.0	28.5
			25.5	
	C.L.		30.0	
			30.0	
	R.T.		7.5	8.0
			*	
	C.T.		9.0	
			7.5	
	R.L.	R.T.	25.5	24.5
			*	
	C.L.		23.0	

	R.T.		11.0	10.5
			12.0	
	C.T.		8.0	
			10.0	
	R.L.	-71	21.0	21.0
			22.0	
	C.L.		20.5	
			20.5	
	R.T.		7.5	8.0
			9.0	
	C.T.		*	
			8.0	
	R.L.	-166	14.0	15.5
			17.5	
	C.L.		14.5	
			16.0	
	R.T.		4.5	6.5
			8.0	
	C.T.		6.0	
			6.5	

*Specimen Jammed

TABLE 87

RESULTS OF IMPACT TESTS FOR V-NOTCH CHARPY SPECIMENS FROM 4 IN.SQ. V-MOD. 4330 (1600°F/OIL) TEMPERED AT 400°F.

TEMPERING TEMP. °F	TYPE OF SPECIMEN	TEST TEMP. °F	IMPACT ENERGY FT.-LB.	AVERAGE FT. -LB.
400	R.L. C.L.	+212	31.0 26.5 31.0 32.0	30.0
	R.T. C.T.		* 10.0 9.0 7.0	8.5
	R.L C.L.	R.T.	23.5 28.0 26.5 32.0	27.5
	R.T. C.T.		* 9.0 10.5 8.0	9.0
	R.L. C.L.	-71	* 17.0 18.5 26.0	20.5
	R.T. C.T.		9.0 * 8.5 *	9.0
	R.L. C.L.	-166	18.0 20.0 18.0 18.0	18.5
	R.T. C.T.		7.0 8.0 7.5 7.0	7.5

*Specimen Jammed

TABLE 88

RESULTS OF IMPACT TESTS FOR V-NOTCH CHARPY SPECIMENS FROM 4 IN.SQ. V-MOD. 4330 (1600/OIL) TEMPERED AT 500°F.

TEMPERING TEMP. °F	TYPE OF SPECIMEN	TEST TEMP. °F	IMPACT ENERGY FT.-LB.	AVERAGE FT. -LB.
500	R.L.	+212	23.0	23.5
			23.0	
	C.L.		24.0	
			24.0	
	R.T.		6.5	7.0
			8.0	
	C.T.		7.0	
			6.5	
	R.L.	R.T.	18.0	18.0
			18.0	
	C.L.		16.5	
			19.0	
	R.T.		*	7.5
			8.5	
	C.T.		*	
			6.0	
	R.L.	-71	14.0	13.5
			12.0	
	C.L.		14.0	

	R.T.		5.0	5.5
			7.0	
	C.T.		4.5	
			5.5	
	R.L.	-166	9.0	8.5
			8.0	
	C.L.		9.0	
			8.0	
	R.T.		4.0	4.5
			4.0	
	C.T.		4.0	
			5.0	

*Specimen Jammed

TABLE 89

RESULTS OF IMPACT TESTS FOR V-NOTCH CHARPY SPECIMENS FROM 4 IN.SQ. V-MOD. 4330 (1600°F/OIL) TEMPERED AT 650°F

TEMPERING TEMP. °F	TYPE OF SPECIMEN	TEST TEMP. °F	IMPACT ENERGY FT.-LB.	AVERAGE FT. -LB.
650	R.L. C.L.	+212	22.5 23.0 24.5 29.0	25.0
	R.T. C.T.		10.5 8.0 7.0 *	8.5
	R.L. C.L.	R.T.	18.5 15.0 17.0 20.5	17.5
	R.T. C.T.		16.5 12.5 7.0 *	12.0
	R.L. C.L.	-71	14.0 13.0 13.5 6.5	13.5
	R.T. C.T.		6.5 6.5 5.0 5.0	6.0
	R.L. C.L.	-166	9.0 10.0 10.0 9.0	9.5
	R.T. C.T.		7.0 5.0 3.5 5.0	5.0

* Specimen Jammed

TABLE 90

RESULTS OF IMPACT TESTS FOR V-NOTCH CHARPY SPECIMENS FROM 4 IN.SQ. V-MOD. 4330 (1600°F/OIL) TEMPERED AT 800°F

TEMPERING TEMP. °F	TYPE OF SPECIMEN	TEST TEMP. °F	IMPACT ENERGY FT.-LB.	AVERAGE FT. -LB.
800	R.L.	+ 212	31.0	34.0
	C.L.		29.5	
			38.0	
			36.5	
	R.T.		8.5	9.0
	C.T.		10.5	
			9.0	
			8.5	
	R.L.	R.T.	18.5	28.5
	C.L.		31.0	
			30.0	
			35.0	
	R.T.		9.0	9.0
	C.T.		9.0	
			9.0	
			*	
	R.L.	-71	18.0	18.5
	C.L.		18.0	
			15.0	
			19.0	
	R.T.		7.0	7.0
	C.T.		8.5	
			*	
			6.0	
	R.L.	-166	14.5	14.0
	C.L.		15.0	
			13.0	
			13.5	
	R.T.		8.0	6.5
	C.T.		7.5	
			5.0	
			5.0	

*Specimen Jammed

TABLE 91

ROTATING BEAM FATIGUE DATA FOR SMOOTH AND NOTCHED SPECIMENS FROM 4 IN. SQ. V-MOD. 4330 (1600°F/OIL) TEMPERED AT 250°F

TEST TEMPERATURE = R.T.

TEMPERING TEMP. AND STRENGTH LEVEL	TYPE OF SPECIMEN	STRESS - 1000 PSI		LIFE - 1000 CYCLES	
		K = 1	K = 8	K = 1	K = 8
250°F (263,000 PSI)	R.L.	154.0 157.0 124.0 138.0 110.0 86.0 92.0 76.0	169.0 86.0 80.0 86.0 80.0 73.0 72.0 74.0 77.0 71.0 74.0 71.0	39.0 27.0 186.0 204.0 231.0 4,513.0 5,035.0 (14,339.0)	14.0 21.3* 38.5 42.0 48.7* 65.3 70.0 100.0 315.0* 6,580.0 (10,800.0)* (11,500.0)
	C.L.	169.0 152.0 136.0 109.0 124.0 91.0 77.0	138.0 122.0 108.0 93.0 64.0 68.0 76.0 59.0	14.0 27.0 43.0 80.0 115.0 1,282.0 (10,262.0)	4.0 7.0 11.0 20.0 73.0 135.0 159.0 (15,503.0)

*Understressed Specimens

() Did not Fracture

TABLE 92

ROTATING BEAM FATIGUE DATA FOR SMOOTH AND NOTCHED SPECIMENS
FROM 4 IN. SQ. V-MOD. 4330 (1600°F/OIL)
TEMPERED AT 400°F

TEST TEMPERATURE = R.T.

TEMPERING TEMP. AND STRENGTH LEVEL	TYPE OF SPECIMEN	STRESS - 1000 PSI		LIFE - 1000 CYCLES	
		K = 1	K = 8	K = 1	K = 8
400°F (250,000 PSI)	R.L.	170.0 139.0 152.0 127.0 107.0 102.0 76.0 91.0	240.0 124.0 59.0 65.0 56.0 47.0 47.0 50.0 50.0 53.0 53.0 50.0	8.0 14.0 21.0 158.0 327.0 2,761.0 (10,747.0) (11,095.0)	0.7* 4.0 50.0 72.0 179.0 262.0 366.0 374.0 407.0 789.0 (10,300.0)* (11,500.0)
		169.0 152.0 140.0 120.0 106.0 94.0 85.0 85.0	123.0 93.0 77.0 55.0 61.0 46.0 40.0	9.0 18.0 38.0 71.0 213.0 2,706.0 (11,261.0) (14,345.0)	7.0 19.0 41.0 59.0 179.0 1,544.0 (11,115.0)

*Understressed Specimens
( )Did not Fracture

TABLE 93

ROTATING BEAM FATIGUE DATA FOR SMOOTH SPECIMENS
FROM 4 IN. SQ. V-MOD. 4330 (1600°F/OIL)
TEST TEMPERATURE = R.T. TEMPERED AT 500° F

TEMPERING TEMP. AND STRENGTH LEVEL	TYPE OF SPECIMEN	STRESS-1000 PSI	LIFE-1000 CYCLES
		K = 1	K = 1
500°F (236,000 PSI)	R.L.	174.0 153.0 140.0 123.0 106.0 92.0 86.0	6.0 16.0 32.0 87.0 324.0 9,645.0 (14,958.0
	C.L.	170.0 150.0 137.0 123.0 107.0 91.0 98.0 77.0	7.0 26.0 43.0 94.0 293.0 (10,365.0) (14,708.0) (16,122.0)

( )Did Not Fracture

TABLE 94

ROTATING BEAM FATIGUE DATA FOR SMOOTH SPECIMENS
FROM 4 IN. SQ. V-MOD. 4330 (1600°F/OIL)
TEST TEMPERATURE = R.T. TEMPERED AT 650°F

TEMPERING TEMP. AND STRENGTH LEVEL	TYPE OF SPECIMEN	STRESS-1000 PSI	LIFE-1000 CYCLES
		K = 1	K = 1
650°F (222,000 PSI)	R.L.	193.0 158.0 142.0 127.0 105.0 91.0 87.0 79.0	1.0 10.0 21.0 41.0 92.0 2,881.0 (11,483.0) (14,151.0)
	C.L.	169.0 151.0 136.0 123.0 107.0 91.0 85.0	6.0 20.0 33.0 34.0 88.0 14,293.0 (12,768.0)

( ) Did Not Fracture

TABLE 95

ROTATING BEAM FATIGUE DATA FOR SMOOTH AND NOTCHED SPECIMENS FROM 4 IN. SQ. V-MOD. 4330 (1600°F/OIL)

TEST TEMPERATURE = R. T. TEMPERED AT 800°F

TEMPERING TEMP. AND STRENGTH LEVEL	TYPE OF SPECIMEN	STRESS - 1000 PSI		LIFE - 1000 CYCLES	
		K = 1	K = 8	K = 1	K = 8
800°F (201,000 PSI)	R.L.	168.0	104.0	3.0	6.0
		135.0	104.0	31.0	7.0*
		123.0	93.0	55.0	9.0*
		114.0	56.0	68.0	33.0
		80.0	43.0	(14,505.0)	202.0
		91.0	40.0	(16,744.0)	428.0
			40.0		473.0
			43.0		1,249.0
			37.0		(10,000.0)
			34.0		(10,000.0)
	C.L.	168.0	124.0	2.0	7.0
		149.0	103.0	15.0	13.0
		136.0	91.0	33.0	16.0
		123.0	76.0	45.0	42.0
		108.0	62.0	79.0	80.0
		91.0	46.0	270.0	462.0
		85.0	37.0	279.0	(8,276.0)
		76.0	31.0	(12,710.0)	(11,328.0)

*Understressed Specimens
( )Did not Fracture

TABLE 96

ROTATING BEAM FATIGUE DATA FOR SMOOTH AND NOTCHED LONGITUDINAL SPECIMENS FROM 4 IN. SQ. V-MOD. 4330 (1600°F/OIL)

TEST TEMP. = R.T.

TENSILE STRENGTH 1000 PSI	ENDURANCE LIMIT 1000 PSI		ENDURANCE RATIO	
	K = 1	K = 8	K = 1	K = 8
263	83	65	0.32	0.25
250	90	47	0.36	0.19
236	92		0.39	
222	90		0.41	
201	85	40	0.42	0.20

TABLE 97

RESULTS OF 0.28 IN.DIA. TENSILE SPECIMENS FROM
3 IN.DIA. HY-TUF (1575°F/OIL)
TEST TEMPERATURE = R.T.

TEMPERING TEMP. °F	TYPE OF SPECIMEN	TENSILE STRENGTH 1000 PSI	AVERAGE	0.2%YIELD STRENGTH 1000 PSI	AVERAGE	% REDUCTION OF AREA	AVERAGE	% ELONGATION	AVG.
400	L	245.2 244.0	244.6	200.9 209.3	205.1	50.0 46.1	48.1	13.5 12.7	13.1
	Tr	241.9 226.2	234.1	194.2 194.8	194.5	22.9	22.9	6.9	6.9
500	L	244.3 241.1	242.7	209.4	209.4	50.3 50.3	50.3	12.0 13.1	12.6
	Tr	241.1 228.1	234.6	202.9 202.9	202.9	20.8	20.8	5.0	5.0
700	L	233.0 228.2	230.6	204.5 190.3	197.4	53.8 50.3	52.1	14.2 13.5	13.9
	Tr	227.5 229.1	228.3	200.9 205.0	203.0	20.1 24.8	22.5	6.6 7.4	7.0
800	L	198.9 207.3	203.1	164.3 181.5	172.9	50.6 53.9	52.3	14.3 14.2	14.3
	Tr	176.6 203.6	190.1	176.6 183.1	179.9	28.4	28.4	8.7	8.7

TABLE 98

RESULTS OF 0.3 IN.DIA. NOTCH TENSILE SPECIMENS (K = 3)
FROM 3 IN.DIA. HY-TUF (1575°F/OIL)
TEST TEMPERATURE = R.T.

TEMPERING TEMP. °F	TYPE OF SPECIMEN	NOTCH STRENGTH 1000 PSI	AVERAGE	% REDUCTION OF AREA	AVERAGE
400	L	331.6 341.7	336.7	3.4 4.8	4.1
	Tr	317.7 304.5	311.1	4.6 3.9	4.3
500	L	359.8 361.2	360.5	7.1 6.5	6.8
	Tr	306.0 300.6	303.3	4.0 4.5	4.3
700	L	347.3 341.3	344.3	5.9 8.7	7.3
	Tr	296.6 312.6	304.6	2.0 4.4	3.2
800	L	312.1 307.4	309.8	7.3 5.9	6.6
	Tr	272.0 275.1	273.6	4.0 4.6	4.3
* 500	L	254.8 252.8	253.8	5.0 5.9	5.5
	Tr	244.6 256.6	250.6	5.4 2.8	4.1

*0.5 IN.DIA. SPECIMENS

TABLE 99

RESULTS OF 0.3 IN.DIA. NOTCH TENSILE SPECIMENS (K = 5)
FROM 3 IN.DIA. HY-TUF (1575°F/OIL)
TEST TEMPERATURE = R.T.

TEMPERING TEMP. °F	TYPE OF SPECIMEN	NOTCH STRENGTH 1000 PSI	AVERAGE	% REDUCTION OF AREA	AVERAGE
400	L	328.6 329.6	329.1	3.1 5.9	4.5
	Tr	288.2 285.7	287.0	2.5 3.9	3.2
500	L	335.2 331.9	333.6	5.4 2.8	4.1
	Tr	278.6 290.7	284.7	4.1 2.2	3.2
700	L	324.5 322.0	323.3	3.9 3.9	3.9
	Tr	295.8 293.0	294.4	2.9 2.2	2.6
800	L	285.3 293.0	289.2	3.7 3.8	3.8
	Tr	257.8 266.7	262.3	3.1 3.8	3.5
500 *	L	237.8 239.8	238.8	2.9 2.7	2.8
	Tr	215.6 217.8	216.7	2.9 3.5	3.2

*0.5 IN.DIA. SPECIMENS

TABLE 100

RESULTS OF 0.3 IN.DIA. NOTCH TENSILE SPECIMENS (K = 10)
FROM 3 IN.DIA. HY-TUF (1575°F/OIL)
TEST TEMPERATURE = R.T.

TEMPERING TEMP. °F	TYPE OF SPECIMEN	NOTCH STRENGTH 1000 PSI	AVERAGE	% REDUCTION OF AREA	AVERAGE
400	L	354.4 325.3	339.8	2.4 6.5	4.5
	Tr	293.9 291.5	292.7	2.6 1.4	2.0
500	L	327.5 327.9	327.7	4.5 3.4	4.0
	Tr	260.1 282.5	271.3	2.3 3.4	2.9
700	L	329.4 338.5	334.0	3.8 3.8	3.8
	Tr	284.5 295.5	290.0	3.1 6.6	4.9
800	L	288.2 299.4	293.8	5.8 4.9	5.4
	Tr	260.1 265.2	262.7	1.7 2.4	2.1
500*	L	224.4 220.6	222.5	3.6 3.0	3.3
	Tr	205.3 200.6	203.0	2.5 3.9	3.2

*0.5 IN.DIA. SPECIMENS

TABLE 101

RESULTS OF 0.3 IN.DIA. AND 0.5 IN.DIA. NOTCH TENSILE SPECIMENS
FROM 3 IN.DIA. HY-TUF(1575°FOIL)
TEST TEMPERATURE = R.T.

TEMPERING TEMP. °F	TYPE OF SPECIMEN	NOTCH STRENGTH RATIO					
		0.3 IN.DIA. SPECIMENS			0.5 IN.DIA. SPECIMENS *		
		K = 3	K = 5	K = 10	K = 3	K = 5	K = 10
400	L Tr	1.38 1.33	1.35 1.23	1.39 1.25			
500	L Tr	1.49 1.29	1.37 1.21	1.35 1.16	1.05 1.07	0.98 0.92	0.92 0.87
700	L Tr	1.49 1.33	1.40 1.29	1.45 1.27			
800	L Tr	1.53 1.44	1.42 1.38	1.45 1.38			

*BASED ON TENSILE STRENGTH OF 0.28 IN.DIA. SPECIMENS

TABLE 102

RESULTS OF IMPACT TESTS FOR V-NOTCH CHARPY SPECIMENS FROM 3 IN.DIA. HY-TUF (1575°F/OIL) TEMPERED AT 500°F

TEMPERING TEMP. °F	TYPE OF SPECIMEN	TEST TEMP. °F	IMPACT ENERGY FT.- LB.	AVERAGE FT. - LB.
500	L	+212	35.0 38.5	37.0
	Tr		10.5 12.0	11.5
	L	R.T.	28.5 34.5	31.5
	Tr		* 10.5	10.5
	L	-71	25.5 21.0	23.5
	Tr		8.5 *	8.5
	L	-166	16.0 13.5	15.0
	Tr		7.5 8.0	8.0

*SPECIMEN JAMMED

TABLE 103

ROTATING BEAM FATIGUE DATA FOR SMOOTH AND NOTCHED SPECIMENS
FROM 3 IN. DIA. HY-TUF (1575°F/OIL)

TEST TEMPERATURE = R.T.

TEMPERING TEMPERATURE AND STRENGTH LEVEL	STRENGTH - 1000 PSI		LIFE - 1000 CYCLES	
	K = 1	K = 8	K = 1	K = 8
500°F (240,000 PSI)	195.0	104.0	4.0	5.0
	152.0	92.4	20.0	7.0
	142.0	77.0	40.0	16.0
	104.0	61.8	186.0	122.0
	93.0	55.5	4,961.0	300.0
	91.0	47.2	(10,290.0)	925.0
	78.0	52.5	(11,077.0)	(9,447.0)
		43.6		(11,110.0)

( )DID NOT FRACTURE