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Development and Validation of Advanced Test Methods to Generate Fatigue Crack Growth and Threshold Data for Use in Damage Tolerance Analyses

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16. Abstract

This report describes the results of a research program that determined the damage tolerance properties of metallic propeller materials. Three alloys were selected for investigation: 2025-T6 aluminum alloy, D6AC steel, and 4340 steel. Mechanical response, fatigue stress life, and fatigue crack growth rate data are presented for all the alloys. The mechanical response can be characterized using tensile tests per American Standard Test Method (ASTM) E 8. This data was used to compute yield and ultimate stresses and the elastic modulus that can be used in damage tolerance analysis tools. Fatigue testing allowed the manufacturers to verify the integrity of their in-house data and determine if material or manufacturing changes over the past years have altered the response of the material. Furthermore, this data can be used to determine an equivalent initial flaw size if the designer wishes to relate stress-life results to damage tolerance. Most importantly, the fatigue crack growth rate response of the material must be understood to predict the life of the structure from an initial detectable flaw and to set inspection intervals. This fatigue crack growth rate data was generated using ASTM E 647 and an alternative method using compression precracking. Alternative precracking methods were used to reduce load history effects when generating threshold data, producing material response data that was unaffected by the test method.

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LIST OF ACRONYMS AND SYMBOLS

a/W	Crack length divided by width
ASTM	American Standard Test Methods
B	Specimen thickness
C(T)	Compact tension specimen
da/dN	Crack growth rate
DT	Damage tolerance
ΔK	Stress-intensity factor range
ΔK_{eff}	Effective stress-intensity factor range
E	Young's Modulus
EIFS	Equivalent initial flaw size
FAA	Federal Aviation Administration
K_{max}	Maximum stress-intensity factor
K_{min}	Minimum stress-intensity factor
K_t	Stress concentration factor
L	Longitudinal direction
LR	Load reduction
M(T)	Middle crack tension specimen
N	Number of cycles
NASA	National Aeronautics and Space Administration
R	Stress ratio (minimum/maximum)
S	Short direction
S-N	Stress-life fatigue
T	Transverse direction
W	Specimen width

EXECUTIVE SUMMARY

This report describes the results of a research program to determine the damage tolerance properties of metallic propeller materials. Three alloys were selected for investigation: 2025-T6 aluminum alloy, D6AC steel, and 4340 steel. Mechanical response, stress-life fatigue, and fatigue crack growth rate data are presented for all of the alloys. The mechanical response was characterized using tensile tests per American Standard Test Methods (ASTM) E 8. This data was used to compute yield and ultimate stresses and the elastic modulus that could be used in damage tolerance analysis tools. Fatigue testing will allow the manufacturers to verify the integrity of their in-house data and determine if material or manufacturing changes over the past years have altered the response of the material. Furthermore, this data could be used to determine an equivalent initial flaw size if the designer wishes to relate stress-life results to damage tolerance. Most importantly, the fatigue crack growth rate response of the material must be understood to predict the life of the structure from an initial detectable flaw and to set inspection intervals. The fatigue crack growth rate data was generated using the ASTM E 647 standard and an alternative method using compression precracking. Alternative precracking methods are under development to reduce load history effects when generating threshold data and to produce material response data that is unaffected by the test method.

1. INTRODUCTION.

This report describes the results of a research program funded by the Federal Aviation Administration (FAA) William J. Hughes Technical Center to generate damage tolerance (DT) data for propeller applications. The FAA is currently planning to initiate a rulemaking process to implement DT requirements for propellers. While DT methodology has been extensively and successfully used in fixed-wing aircraft structures, and has begun to be used for dynamic components in rotorcraft, propellers have been exclusively designed and certified using the safe-life approach. Generally, safe-life, in flight hours, is experimentally determined using the mission profile, flight loads, and stress-life fatigue (S-N) data. Using Miner's cumulative fatigue damage rule, a fatigue damage rate for each flight condition is typically calculated by assessing the damaging load cycles per hour from the flight spectrum and loads data, the ratio of the alternating load to the endurance limit, and the cycles-to-failure from a standard component S-N curve. A reciprocal summation of each fatigue damage rate for each flight condition then determines the retirement life of the part being analyzed.

In contrast to safe-life, DT assumes that an inherent flaw exists in the manufactured part. The life of the part is determined using fracture mechanics methodologies, load spectrum, manufacturing process, and operating environment. Based on the computed crack growth life of the inherent flaw, suitable inspection intervals are established so that cracks can be found and repaired long before they achieve a critical length. The effectiveness of the damage tolerance analysis depends on several factors that include fatigue crack growth data, initial crack sizes, effects of shot-peening and cold working, and inspection techniques.

The success of implementing DT approaches to fixed-wing aircraft structures, coupled with the FAA's goal to enhance aircraft safety, has led to several DT research and development efforts for rotorcraft. Critical DT research for rotorcraft is being conducted to support the FAA rulemaking and development of guidance material for compliance. Rotorcraft research efforts include DT assessments of rotorcraft principal structural elements (PSE), enhancement and development of fatigue crack growth databases, and nondestructive inspection/evaluation (NDI/E) techniques, and computational fatigue crack growth codes. Probabilistic DT approaches are also being investigated for potential use in rotorcraft.

Fatigue design and evaluation of propellers for fixed-wing aircraft are similar to those of rotorcraft dynamic components, e.g., tiltrotor propellers or rotorcraft main/tail rotor systems. Rotorcraft and propeller similarities include combined low- and high-cycle fatigue phenomenon caused by unique loading conditions, short and nonplanar crack growth, and irregular geometries that generate a complex or nonuniform stress field. One difference is that accumulated cycles of fixed-wing propellers are typically higher than those of rotorcraft dynamic components. So, technologies that are being used or developed for propellers should be transferable to rotorcraft.

The results that were obtained in this project are described in the following sections of this report.

- Section 2 describes material response, fatigue, and fatigue crack growth rate data generated from 2025-T6 aluminum alloy.
- Section 3 describes material response, fatigue, and fatigue crack growth rate data generated from D6AC steel alloy.
- Section 4 describes material response, fatigue, and fatigue crack growth rate data generated from 4340 steel alloy.
- Section 5 discusses results in the context of the state-of-the-art fatigue crack growth rate testing methods.
- Section 6 draws three conclusions from the research program.

2. 2025-T6 ALUMINUM ALLOY.

2.1 2025-T6 MATERIAL DESCRIPTION.

Aluminum alloy 2025 was developed in the 1930s and is one of the oldest wrought aluminum alloys produced in the United States. This alloy is used almost exclusively by the propeller industry. The chemical composition [1 and 2] is listed in table 2-1.

Table 2-1. Chemical Composition of Aluminum Alloy 2025 [1]

Element	Symbol	2025 Aluminum (%)
Aluminum	Al	Balance
Chromium	Cr	0.1
Copper	Cu	3.9-5.0
Iron	Fe	1
Magnesium	Mg	0.05
Manganese	Mn	0.4-1.2
Silicon	Si	0.5-1.2
Titanium	Ti	0.15
Zinc	Zn	0.25

Test specimens were machined from forged aluminum alloy 2025-T6 propeller spars that were provided by a propeller manufacturer. A photograph of a propeller spar (approximate overall length of 54 inches) is shown in figure 2-1. These spars are processed into near-net-shape form, so a finished propeller requires little additional machining. The hub (nearest the center of rotation) and tip (furthest from the center of rotation) regions of the propeller spar are labeled in figure 2-1. The hub region of the spar is nearly cylindrical (approximate diameter of 5 inches). Approximately 7 inches from the hub end, the propeller blade begins and the spar is forged into a cross section that is somewhat elliptical and shaped like an airfoil. The orientation of this cross section rotates slightly about the blade neutral axis with distance from the hub, giving the spar a twisted configuration. Each propeller spar is forged from uniform material stock, e.g., cylindrical billets, so the near-tip material is deformed more than the near-hub material during the forging process. Therefore, the near-tip and near-hub material may be different in terms of microstructural character and mechanical performance.

Samples were cut from the near-tip and near-hub regions of a propeller spar for microstructural analysis. Three samples were mounted and polished from each location to obtain the three-dimensional character of the microstructures. Material directions were defined with respect to the local blade geometry (see figures 2-2 and 2-3). The longitudinal direction (L) coincided with the length of the blade. The long-transverse (T) and short-transverse (S) directions coincided with the longest and shortest cross-sectional dimensions, respectively. Each microstructural sample was defined by the direction normal to the exposed plane of the blade. Micrographs of these samples were taken and arranged to appear as a three-dimensional cube to provide visual information about the three-dimensional nature of the microstructure. Metallurgical cubes of the near-tip and near-hub locations are shown in figures 2-4(a) and 2-4(b), respectively.

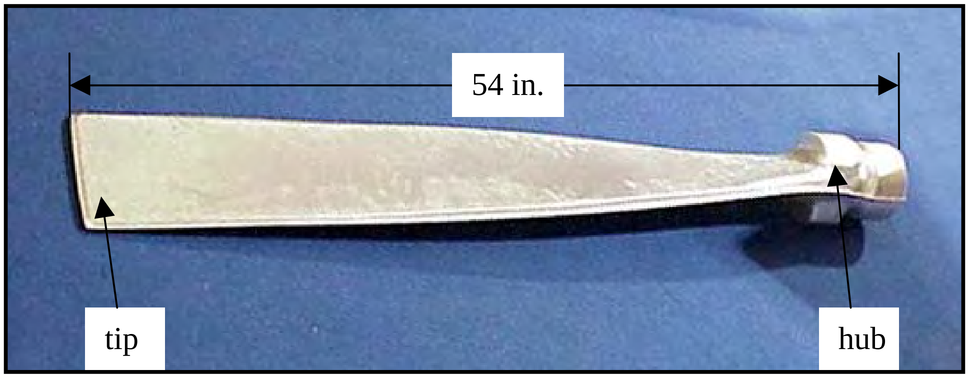


Figure 2-1. Propeller Spar Forging Made of Aluminum Alloy 2025

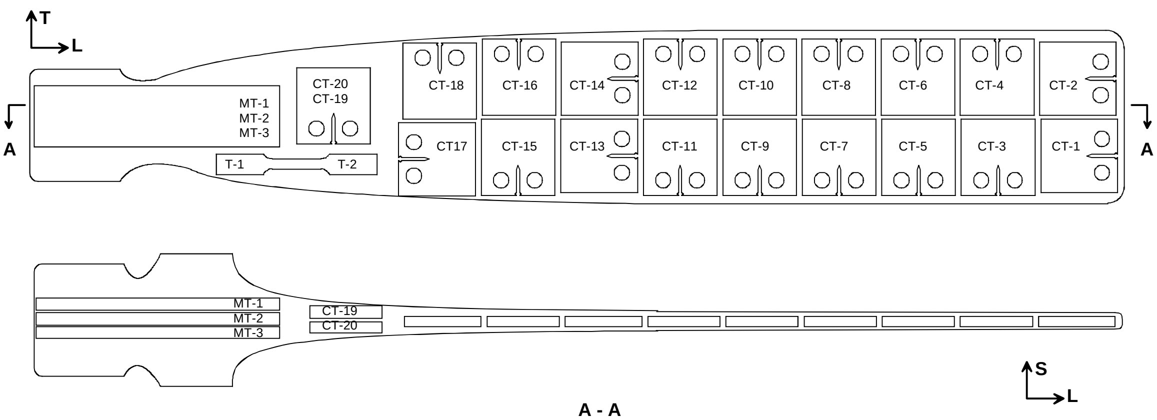


Figure 2-2. The Location and Orientation of Fatigue Crack Growth Specimens, With Respect to the Propeller Spar Forgings, Shown Schematically for Blade Numbers 1, 2, and 3

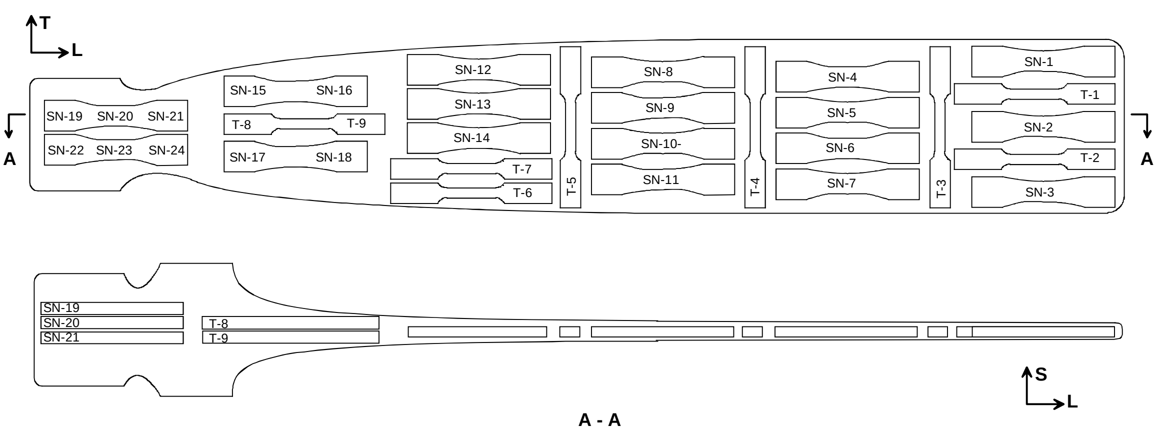


Figure 2-3. The Location and Orientation of Tensile and Uniaxial Fatigue (S-N) Specimens, With Respect to the Propeller Spar Forgings, Shown Schematically for Blade 4

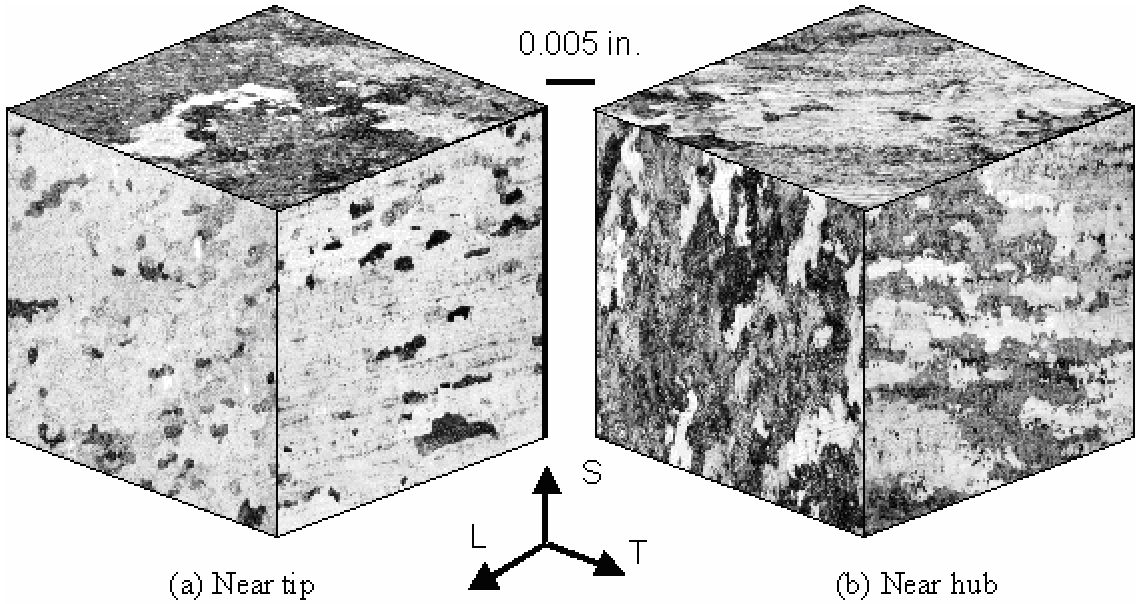


Figure 2-4. Orthogonal Metallurgical Cubes are Shown for Propeller Spar Material (a) Near the tip and (b) Near the hub

The propeller spars were cut into compact tension (C(T)), middle-crack tension (M(T)), K_t=1 (stress-life), and tensile specimens to measure specific mechanical properties. Three spars where machined into specimens, as shown in figure 2-2, to provide fatigue crack growth data. A fourth spar was also machined into K_t = 1 and tensile specimens, as shown in figure 2-3. Location and orientation were maintained in specimen numbering so that possible variation of properties with station or blade number could be noted.

2.2 2025-T6 TENSILE TESTING.

Tensile tests were conducted according to ASTM E 8 using the standard 0.5-inch-wide rectangular tension specimens, as shown in figure 2-5. The specimens were tested in the L and T directions from various locations in the blade forgings, as shown in figures 2-2 and 2-3. Tests were conducted at three temperatures. Young's modulus, yield stress, and ultimate tensile stress were calculated from the test data. The results from the tensile tests are summarized in tables 2-2 and 2-3 and presented in figure 2-6. The data show an expected trend of decreasing ultimate strength with increasing test temperature.

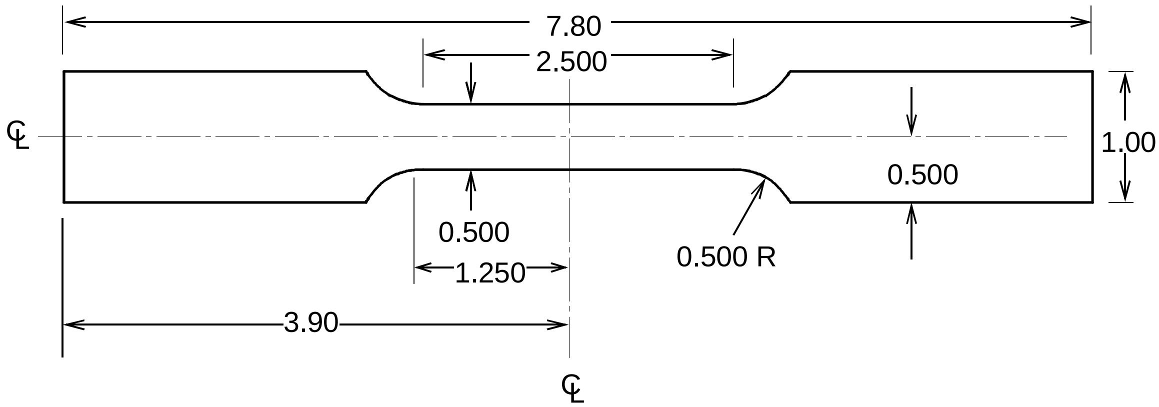


Figure 2-5. Dimensions of Tensile Specimen Used for Static Tests
(All dimensions are inches.)

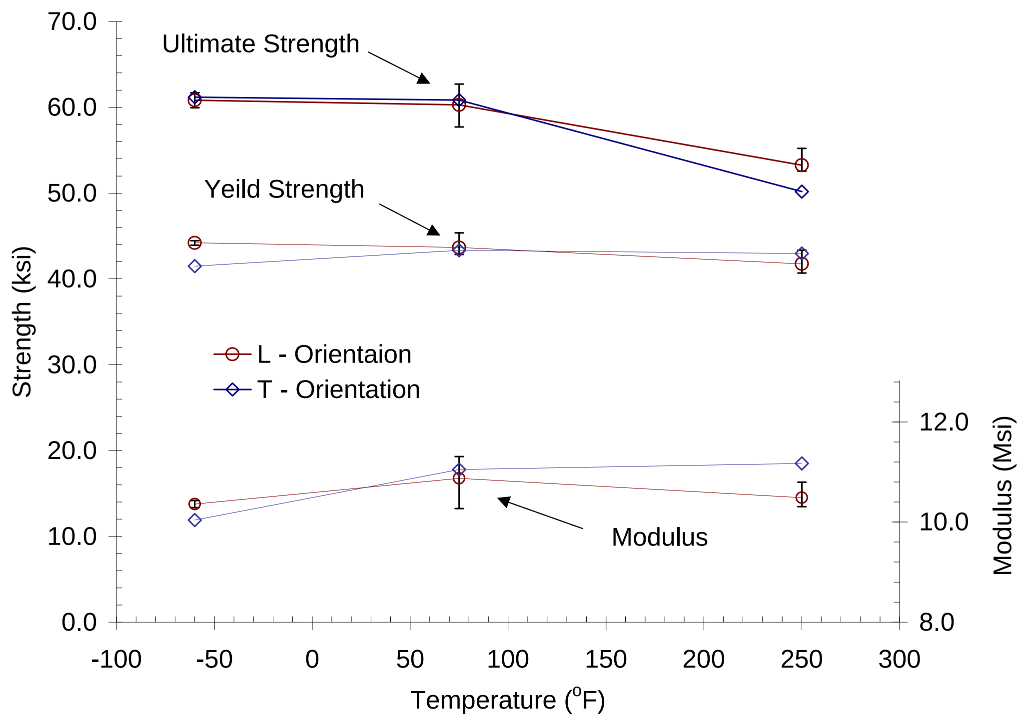


Figure 2-6. Average Measured Tensile Properties for Aluminum Alloy 2025 Tested
(Scatter bars are shown for L orientation.)

Table 2-2. 2025-T6 Tensile Data From the L-Orientation

Specimen ID	Temperature (^oF)	E (Msi)	$\sigma_{y0.2\%}$ (ksi)	σ_{ult} (ksi)
T2-L-B1	-60	10.4	43.9	59.9
T6-L-B4	-60	10.3	44.5	61.7
T9-L-B4	75	10.3	42.9	61.1
T1-L-B1	75	11.0	42.9	57.7
T1-L-B2	75	11.3	43.6	59.5
T1-L-B3	75	10.9	45.4	62.7
T1-L-B4	250	10.3	40.7	52.6
T7-L-B4	250	10.5	43.4	55.2
T2-L-B2	250	10.8	40.9	52.6
T2-L-B3	250	10.3	42.1	52.6

Table 2-3. 2025-T6 Tensile Data From the T-Orientation

Specimen ID	Temperature (^oF)	E (Msi)	$\sigma_{y0.2\%}$ (ksi)	σ_{ult} (ksi)
T4-T-B4	-60	10.0	41.5	61.2
T3-T-B4	75	11.1	43.3	60.8
T5-T-B4	250	11.2	43.0	50.2

The variation of the room temperature stress-strain results from the four tensile specimens tested with the L orientation is depicted in figure 2-7. This figure shows the results from the 75 degree tests and contains one specimen machined from near the hub section of each propeller. The data demonstrates the wide variety in mechanical properties for the material at room temperature. The modulus variations from these tests binds all the test data at other temperatures, making it impossible to determine any trends. This indicates that the amount of mechanical work from the forging process might be more of a factor affecting properties than range of temperatures selected for testing.

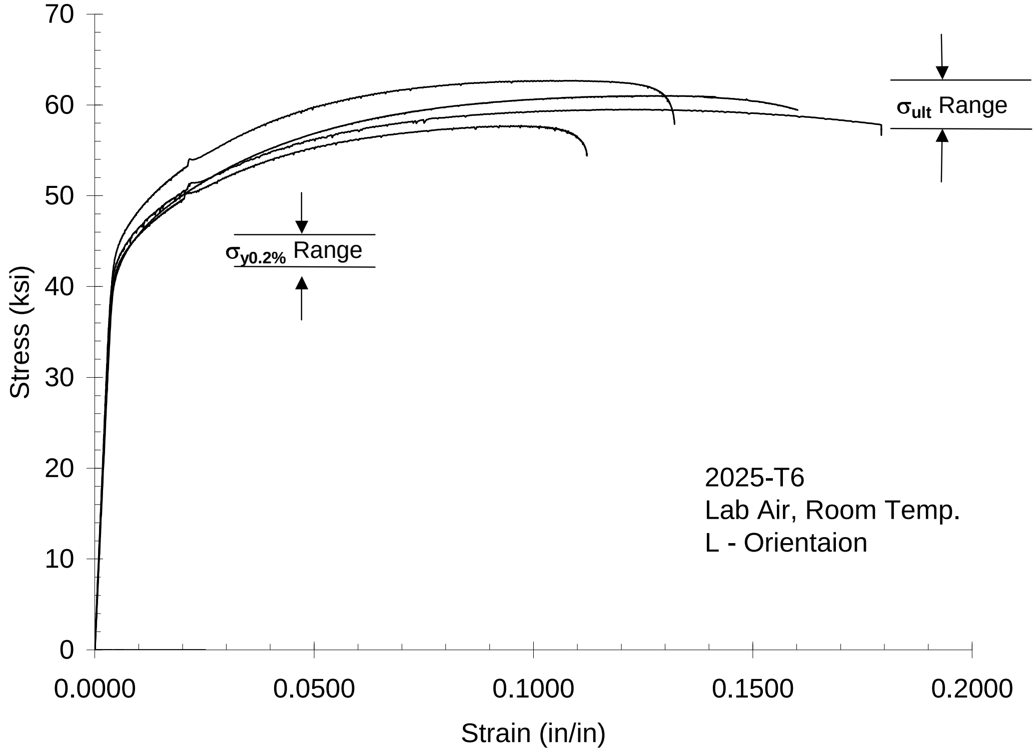


Figure 2-7. Stress-Strain Variation for the L Orientation Tested at Room Temperature

2.3 2025-T6 FATIGUE (STRESS-LIFE) TESTING.

Stress-life data was generated using axially loaded $K_t = 1$ specimens as shown in figures 2-8 and 2-9. The specimen geometry shown in figure 2-8 was originally used for testing. However, several grip failures caused a redesign to the specimen geometry shown in figure 2-9. The redesigned specimens were machined from the original fatigue specimens and were numbered to preserve the positioning information of the propeller blade. The specimen configuration is noted in the data summary as differentiated in the Cross-Sectional Area column of table 2-4. The specimens were cycled at a fully reversed stress ratio (minimum/maximum)(R = -1) constant-amplitude load. Figure 2-10 shows specimen cycles to failure for each load levels investigated. Vibratory stress is computed using the applied load and area of the gage section. Specimens that did not fail after 50,000,000 cycles are considered run-outs.

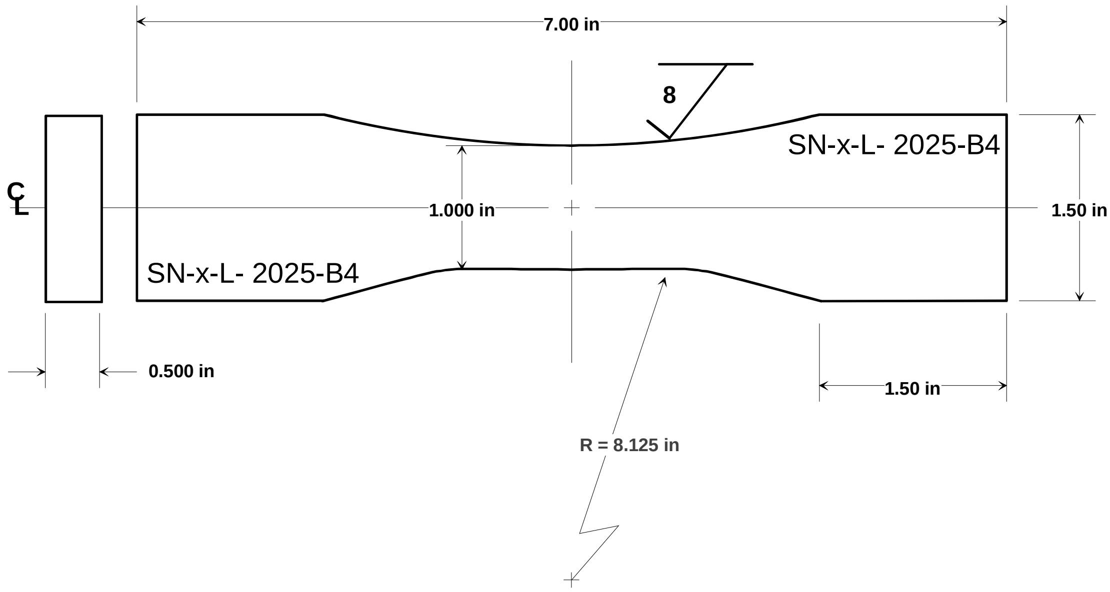


Figure 2-8. Original Fatigue (Stress-Life) Specimen

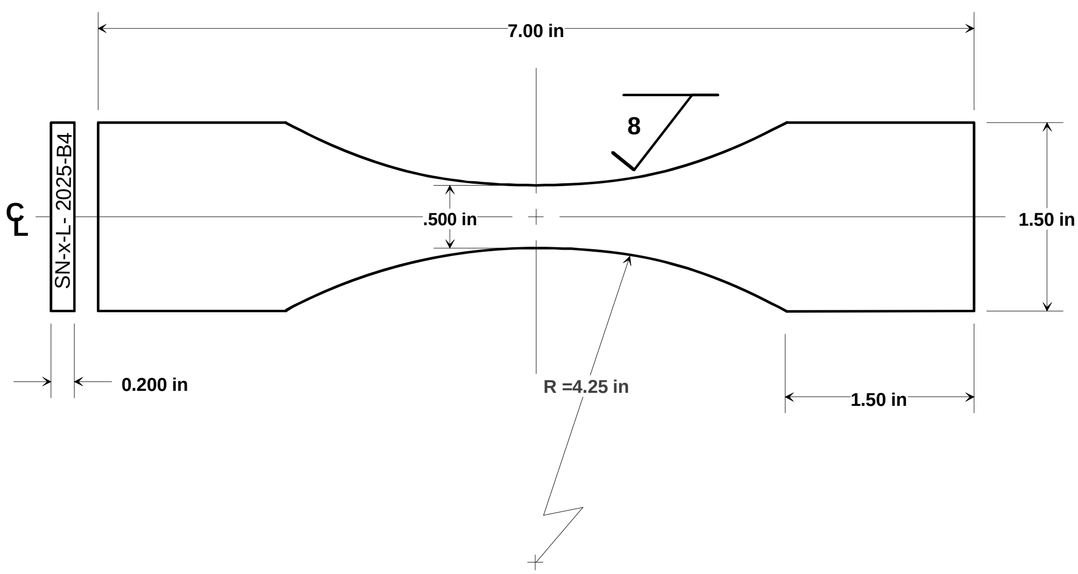


Figure 2-9. Redesigned Fatigue (Stress-Life) Specimen

Table 2-4. The 2025-T6 S-N Data From the L-Orientation (*R* = -1)

Specimen ID	Cross-Sectional Area (in.^{2})	Vibratory Stress (ksi)	Cycles to Failure
SN-17B-L-B-4	0.100	50.0	3,076
SN-16B-L-B-4	0.101	50.0	7,775
SN-19A-L-B-4	0.100	50.0	2,684
SN-17A-L-B-4	0.101	40.0	30,528
SN-14A-L-B-4	0.099	40.0	24,958
SN-21B-L-B-4	0.101	40.0	28,480
SN-15-L2-B-4	0.120	30.0	118,100
SN-16A-L-B-4	0.100	30.0	101,450
SN-21A-L-B-4	0.100	29.9	137,539
SN-18B-L-B-4	0.100	25.0	6,113,880
SN-9B-L-B-4	0.100	25.0	9,541,822
SN-14B-L-B4	0.100	20.0	37,801,084
SN-10A-L-B4	0.101	19.9	>53,507,408
SN-22B-L-B4	0.099	18.1	46,890,132
SN-9A-L-B4	0.099	18.1	>50,394,272
SN-4-L-B-4	0.500	18.0	>50,000,000
SN-5-L-B-4	0.500	18.0	>50,000,000
SN-24-L-B-4	0.500	18.0	>50,577,015

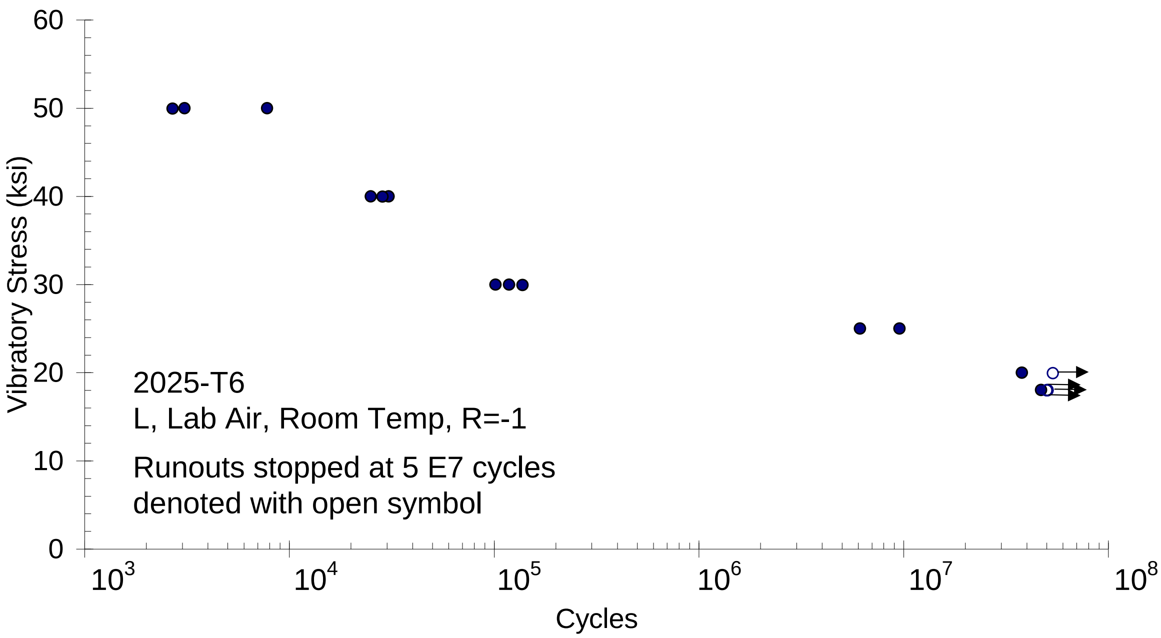


Figure 2-10. Fatigue (Stress-Life) Data for Aluminum Alloy 2025-T6

2.4 2025-T6 FATIGUE CRACK GROWTH RATE TESTING.

Development of the fatigue crack growth data presented herein was conducted in accordance to ASTM E 647 with the following two exceptions: (1) the compact tension specimen notch height exceeded the tolerances set by less than 10% (figure 2-11) and (2) the precracking crack growth rate exceeded the recommended values for threshold testing. It was discovered through trial and error, that a precracking level near a ΔK of 10 ksi-in$^{1/2}$ minimized the occurrence of nonplanar crack growth. It is believed that the impact of the out-of-tolerance notch height on the fatigue crack growth data is minimal because the specimens were precracked to a crack length divided by specimen width (*a/W*) of 0.3 before load reduction testing was performed.

2.4.1 Material Product Form and Nonplanar Cracking.

The 2025-T6 specimens were machined from a propeller blade forging as shown in figure 2-1. A schematic of the specimen layout is shown in figure 2-2. The experimental testing for baseline fatigue crack growth rate properties in this report was performed on laboratory coupons designed to promote mode I crack growth, where cracking is perpendicular to the applied load. However, material microstructure, residual stresses, or other factors have caused out-of-plane mixed-mode cracking to occur. ASTM E 647, the testing standard used to develop fatigue crack growth rate data, limits the out-of-plane crack growth to within 20 degrees of the specimen symmetry plane to maintain reasonable accuracy of the mode I equations. Cracks with out-of-plane angles less than 10 degrees are considered straight. Figure 2-11 shows the average out-of-plane angle for each of the specimens. The data are cross-referenced to the blade number for each specimen. No obvious correlation exists, but blade 2 did not produce any straight cracks. For the 45 specimens tested, there were 12 straight cracks and 18 tests outside the ASTM E 647 limit of 20 degrees. The remaining specimens were not straight, but were within the 20 degree limit for crack path straightness. Forth, et al. [3] examined the nonplanar cracking data.

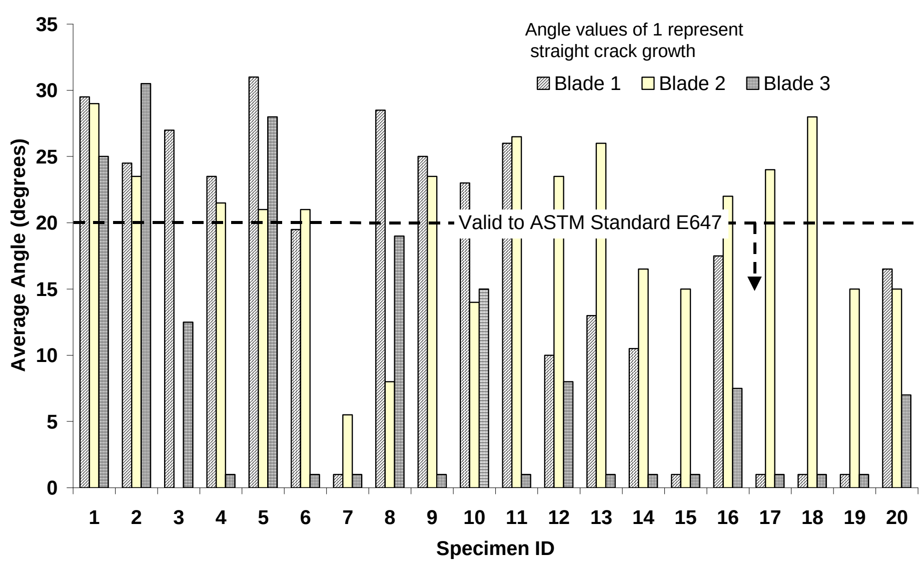


Figure 2-11. Average Angle From Centerline for Fatigue Crack Growth Tests

2.4.2 Testing Procedure and Parameters.

ASTM E 647 defines the constant K_{max} test procedure to generate fatigue crack growth threshold data by imposing a constant K_{max} [4 and 5] while increasing K_{min}, whereas the constant R test procedure increases or decreases both K_{max} and K_{min} uniformly [6]. For this study, the dimensions of the C(T) specimens were specimen width W = 3.0 inches, specimen thickness B = 0.5 inch, and an initial notch length of 0.75 inch, as shown in figure 2-12. The specimens were precracked at a constant ΔK that is equivalent to the first data point in the load reduction test. These loads were applied until the crack length was approximately one-third of the specimen width. The tests were performed in computer controlled servo-hydraulic test machines. The test systems were calibrated to meet or exceed the requirements of ASTM E 647. The displacement gages and signal conditioners were calibrated to assure linearity in the operating regime. All tests were conducted under K-control with all crack length measurements verified using microscopes on traveling stages. The visual measurements were used to correct the compliance-based crack length values prior to data reporting per ASTM E 647.

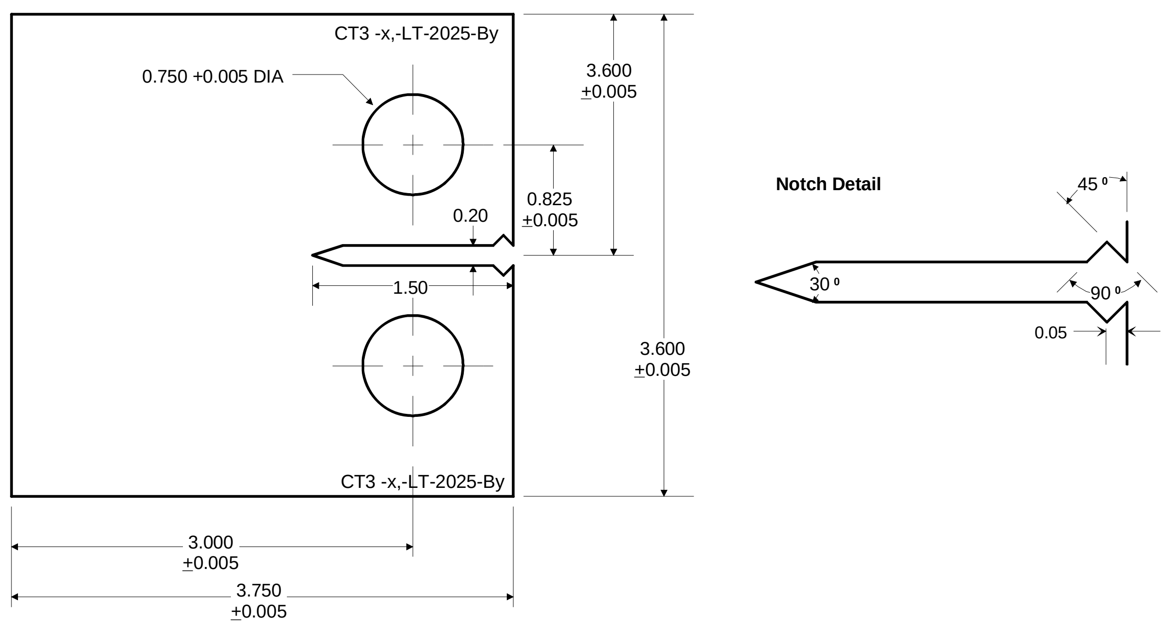


Figure 2-12. Schematics of the C(T) Specimen
(All dimensions are inches or degrees.)

2.4.3 Fatigue Crack Growth Rate Data.

The fatigue crack growth rate data was generated using fixed stress ratios of 0.5 and 0.7 and using constant K_{max} values of 10, 12.5, 15, 20, and 30 ksi-in$^{1/2}$. The specimen test data presented are grouped and plotted based on the L-T and T-L orientations in figures 2-13 and 2-14, respectively. The specimens used for these plots were tested using (1) the constant R and K_{max} load reduction methods to determine threshold and (2) the constant R load increasing method to determine the upper portion of the crack growth rate curve as indicated by the figure legends. The constant *R* load reduction test is denoted as LR in the legend of figure 2-13. The specimen number is denoted in the figure legend to correlate test data to blade location (figure 2-2). The majority of the constant *R*, increasing ΔK tests were performed following the constant K_{max} and *R* load reduction tests. Therefore, duplication of specimen number is seen in the figure legends. Finally, the (*) in the legend of figure 13 indicates that the crack plane was between 10 and 20 degrees out of plane. All fatigue crack growth rate data is in tabular form in appendix A. Several other tests were conducted at lower stress ratios. These data are not shown because all the tests exceeded the ASTM straightness standards. However, these data are discussed in Forth, et al. [3]. To properly characterize this material in a laboratory would require a significant microstructural evaluation to identify the specimen orientations that would minimize crack turning. However, this exercise could be academic, because a propeller is most likely to be loaded in the material orientations reported herein, not along the weak microstructural planes.

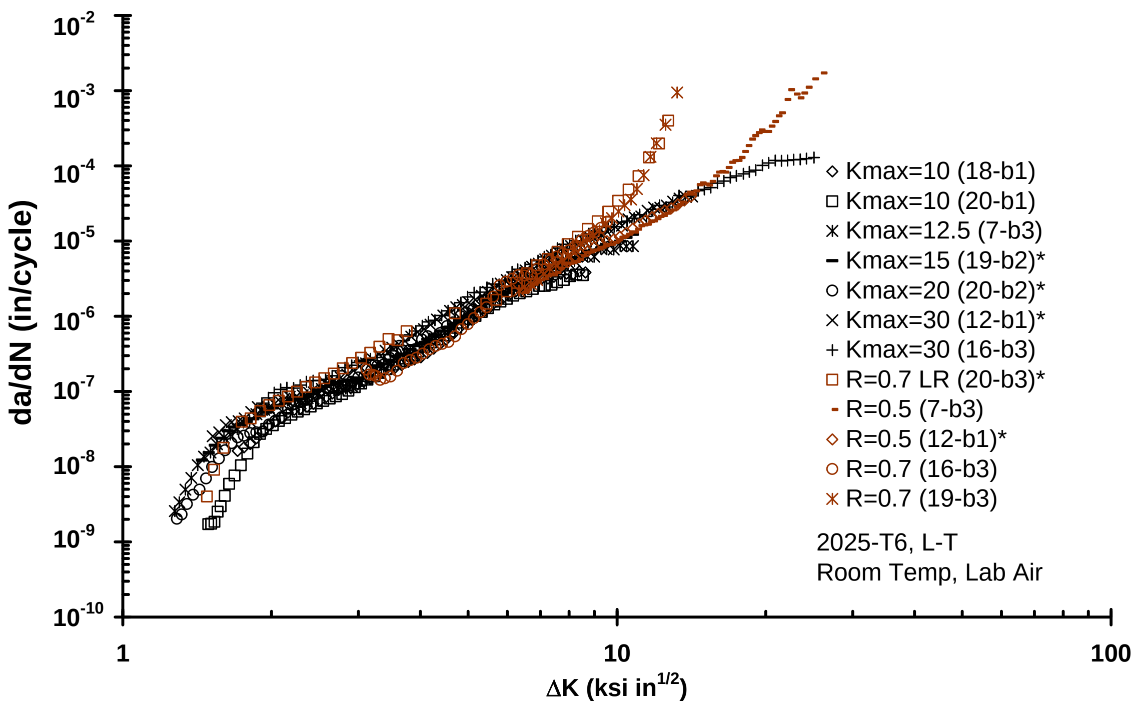


Figure 2-13. Fatigue Crack Growth Rate Data for Aluminum Alloy 2025-T6 (L-T)

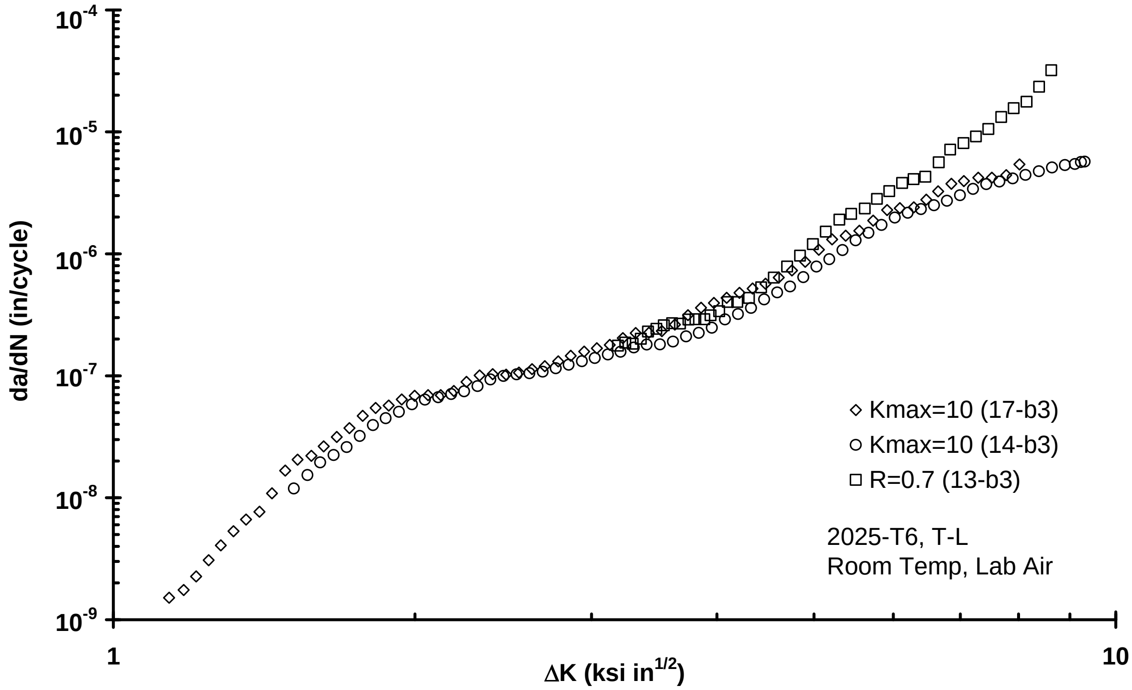


Figure 2-14. Fatigue Crack Growth Rate Data for Alloy 2025-T6 (T-L)

3. D6AC STEEL ALLOY.

3.1 D6AC STEEL MATERIAL DESCRIPTION.

D6AC steel is widely used in the aerospace industry. The chemical composition [7] of this alloy is listed in table 3-1.

Table 3-1. Chemical Composition of Steel Alloy D6AC [7]

Element	Symbol	D6AC Steel
Carbon	C	0.45-0.50%
Chromium	Cr	0.90-1.20%
Copper	Cu	<0.35%
Iron	Fe	Balance
Manganese	Mn	0.60-0.90%
Molybdenum	Mo	0.90-1.10%
Nickel	Ni	0.40-0.70%
Phosphorous	P	<0.015%
Silicon	Si	0.15-0.30%
Sulphur	S	<0.015%
Vanadium	V	0.08-0.15%

Test specimens were machined from hammer-forged steel alloy D6AC blocks (figure 3-1) that were provided by a propeller manufacturer. The details of the heat-treatment and material source are proprietary to the manufacturer. Material directions were defined with respect to the local block geometry (see figure 3-2). The longitudinal direction (L) coincided with the length of the block. The long-transverse (T) and short-transverse (S) directions coincided with the longest and shortest cross-sectional dimensions, respectively. These blocks where cut into compact tension (C(T)), middle-crack tension (M(T)), K_t = 1 S-N, and tensile specimens to measure specific mechanical properties. All fracture and tension specimens were machined from a single block, as shown in figure 3-2. Location and orientation of the S-N specimens, which were cut from a second block, is shown in figure 3-3. Fracture and tension specimens were numbered as shown in figure 3-4. Location and orientation were maintained in specimen numbering so possible variation of properties within the block could be noted.

Figure 3-1. Forging Made of Steel Alloy D6AC

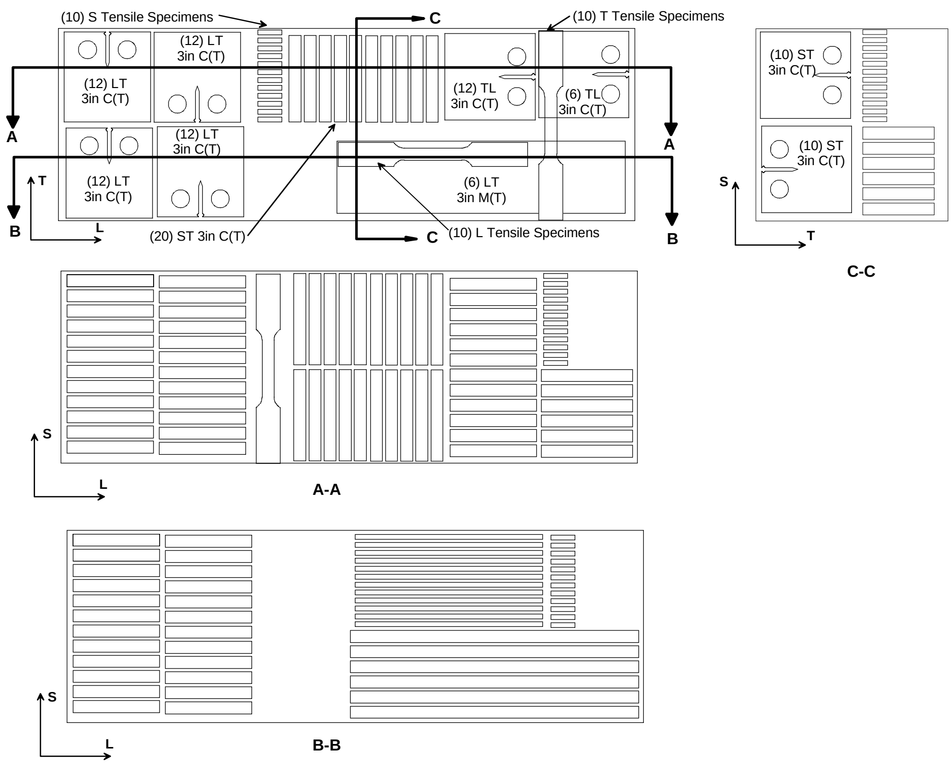
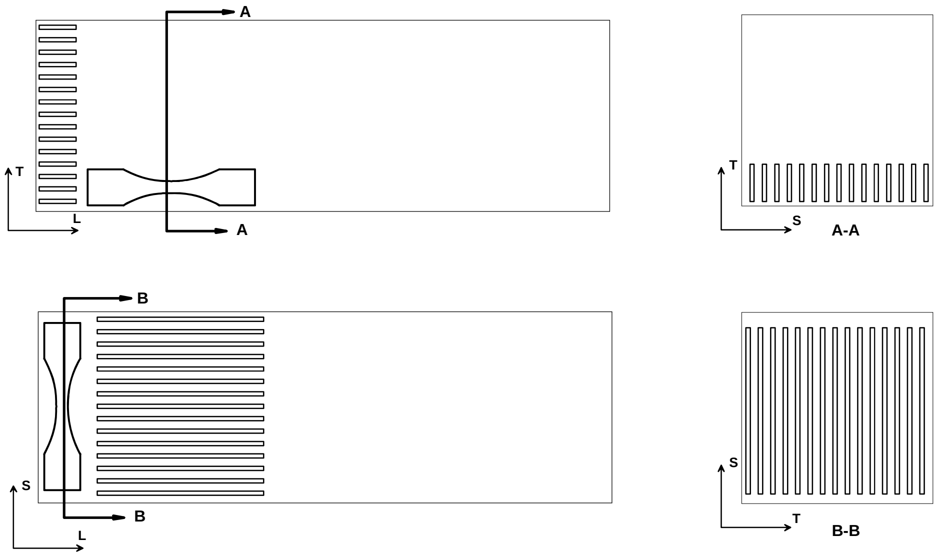


Figure 3-2. The Location and Orientation of Fracture and Tension Specimens, With Respect to the Forging



NOTE: Specimens numbered consecutively from one edge to the other with specimen 8 from the mid plane.

Figure 3-3. The Location, Numbering, and Orientation S-N Specimens, With Respect to the Forging

NOTE:Tensile specimens numbered starting with 1 at the centerline of the forging and 12 farthest from the centerline.

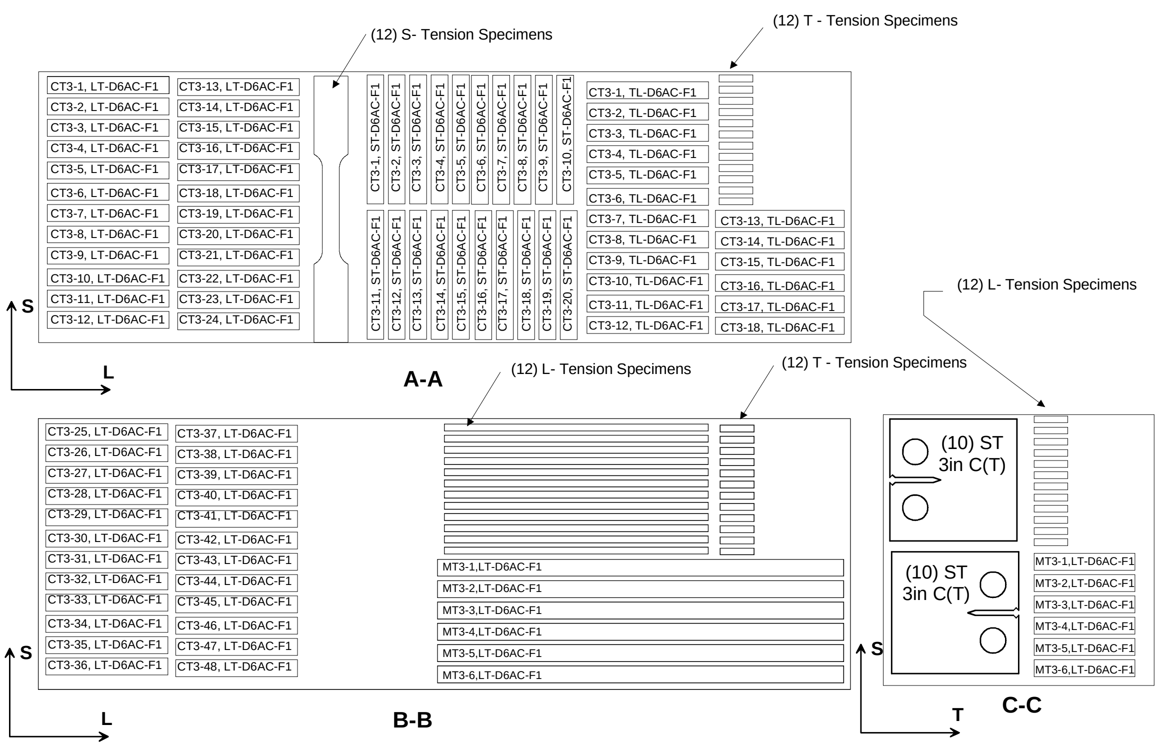


Figure 3-4. Numbering Layout for the Fracture and Tension Specimens

3.2 D6AC STEEL TENSILE TESTING.

Tensile tests were conducted according to ASTM E 8 using 0.5-inch-wide rectangular tension specimens, as shown in figure 2-5. The specimens were tested in the L, T, and S direction at three temperatures. Young's modulus, yield stress, and ultimate tensile stress were calculated from the test data. The results from the tensile tests are summarized in tables 3-2, 3-3, and 3-4 for each of the orientations. Figure 3-5 is a plot of all data showing average values and scatter for the properties measured. A trend of decreasing yield and ultimate strength with increasing test temperature can be seen in all orientation results. The Modulus data show very little variation with temperature. Figure 3-6 shows the variation of stress-strain results from the three tensile specimens tested with the L-orientation at room temperature. The variation of the yield point of specimen 12 is due to its location near the exterior of the forging. This trend in yield properties was evident for all orientations and temperatures tested, as demonstrated by figure 3-7, which shows a plot of the normalized yield stress as a function of location for the tensile specimens. The yield stress values were normalized by the specimen results closest to the center of the forging for each respective orientation and temperature.

Table 3-2. D6AC Tensile Data From the L-Orientation

Specimen ID	Temperature (^oF)	E (Msi)	$\sigma_{y0.2\%}$ (ksi)	σ_{ult} (ksi)
T-3-L-D6AC-F1	-60	33.9	168.8	190.0
T-7-L-D6AC-F1	-60	30.2	168.1	188.1
T-11-L-D6AC-F1	-60	31.3	177.7	191.6
T-1-L-D6AC-F1	75	30.5	160.5	178.1
T-6-L-D6AC-F1	75	30.2	160.6	179.7
T-12-L-D6AC-F1	75	30.7	166.7	179.7
T-2-L-D6AC-F1	250	30.9	151.7	174.5
T-5-L-D6AC-F1	250	30.1	150.2	173.9
T-10-L-D6AC-F1	250	30.7	155.8	176.9

Table 3-3. D6AC Tensile Data From the T-Orientation

Specimen ID	Temperature (^oF)	E (Msi)	$\sigma_{y0.2\%}$ (ksi)	σ_{ult} (ksi)
T-3-T-D6AC-F1	-60	30.8	170.7	190.9
T-7-T-D6AC-F1	-60	30.9	167.1	188.1
T-11-T-D6AC-F1	-60	31.1	175.6	191.8
T-1-T-D6AC-F1	75	30.9	164.3	182.5
T-6-T-D6AC-F1	75	30.4	164.0	181.8
T-12-T-D6AC-F1	75	31.5	170.6	184.4
T-2-T-D6AC-F1	250	30.1	152.6	177.0
T-5-T-D6AC-F1	250	30.5	154.2	176.5
T-10-T-D6AC-F1	250	31.0	156.9	177.8

Table 3-4. D6AC Tensile Data From the S-Orientation

Specimen ID	Temperature (^oF)	E (Msi)	$\sigma_{y0.2\%}$ (ksi)	σ_{ult} (ksi)
T-3-S-D6AC-F1	-60	30.5	167.4	187.5
T-7-S-D6AC-F1	-60	31.3	167.7	188.1
T-11-S-D6AC-F1	-60	30.4	173.8	189.6
T-1-S-D6AC-F1	75	31.1	160.2	178.9
T-6-S-D6AC-F1	75	30.7	159.9	179.2
T-12-S-D6AC-F1	75	31.1	171.5	183.0
T-2-S-D6AC-F1	250	30.9	152.3	176.7
T-5-S-D6AC-F1	250	30.9	148.6	171.4
T-10-S-D6AC-F1	250	30.9	152.9	174.7

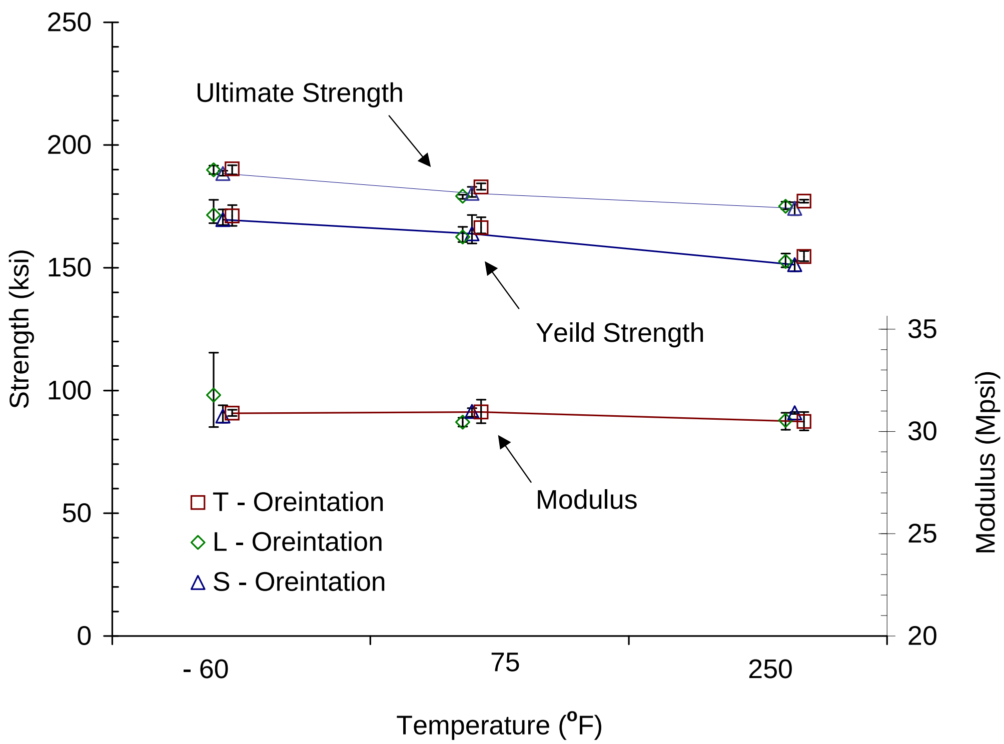


Figure 3-5. Average Measured Tensile Properties for Steel Alloy D6AC Tested, Strength vs Temperature

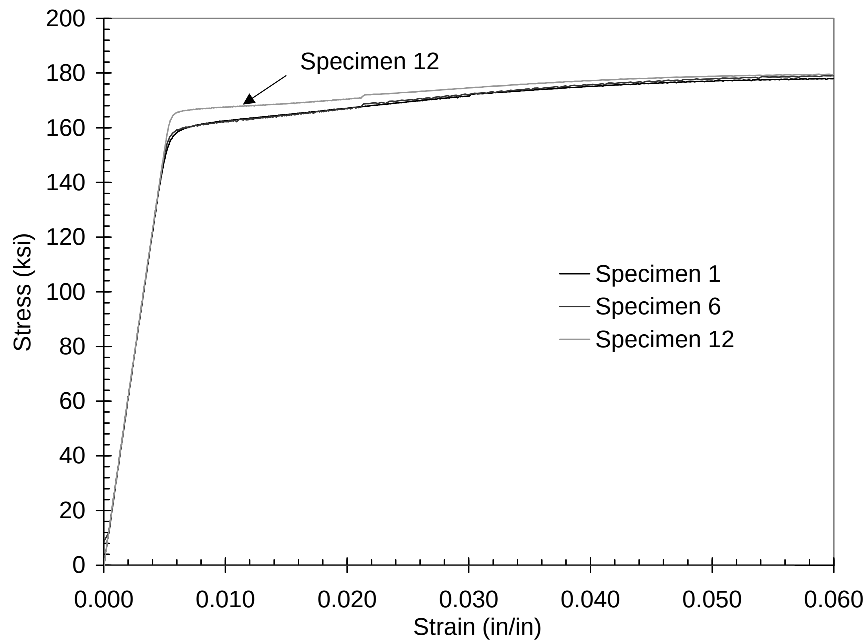


Figure 3-6. Average Measured Tensile Properties for Steel Alloy D6AC Tested, Stress vs Strain

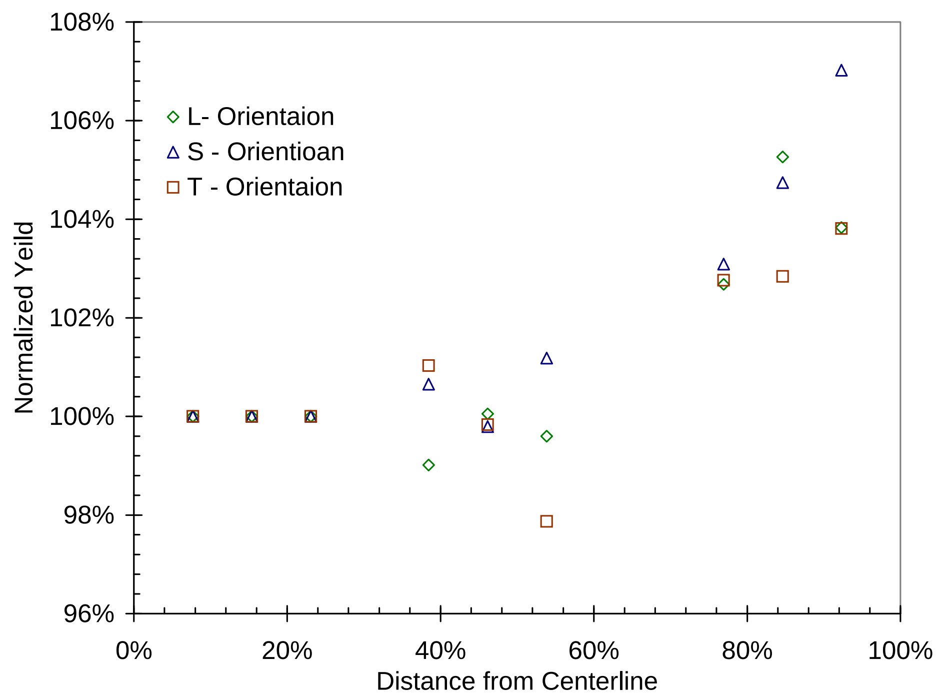


Figure 3-7. Stress-Strain Variation for the L-Orientation Tested at Room Temperature

3.3 D6AC STEEL FATIGUE (STRESS-LIFE) TESTING.

Stress-life data was generated using axially loaded K_t = 1 specimens shown in figure 2-9. The specimens were cycled at a fully reversed (R = -1) constant-amplitude load, and the data are summarized in table 3-5. Figure 3-8 shows specimen cycles to failure for each load level investigated. Vibratory stress is computed using the applied load and area of the gage section. Specimens that did not fail after 50,000,000 cycles are considered run-outs. The L and S orientations were tested and are denoted in the legend of figure 3-8, accordingly.

Table 3-5. D6AC Stress-Life Data (R = -1)

Specimen ID	Vibratory Stress (ksi)	Fatigue Life (cycles)
L-14	120.0	27,344
L-15	120.0	26,466
L-9	100.0	53,573
L-5	100.0	68,914
L-10	90.0	142,321
L-4	90.0	147,276
L-11	80.0	505,442
L-7	80.0	5,530,634
L-8	75.0	6,912,899
L-1	75.0	50,000,000
L-12	75.0	50,249,756
S-12	100.0	56,235
S-8	100.0	67,309
S-2	90.0	69,257
S-5	90.0	78,255
S-4	90.0	91,858
S-14	80.0	160,996
S-6	80.0	90,308
S-7	80.0	359,259
S-9	80.0	50,025,520
S-13	75.0	50,091,378

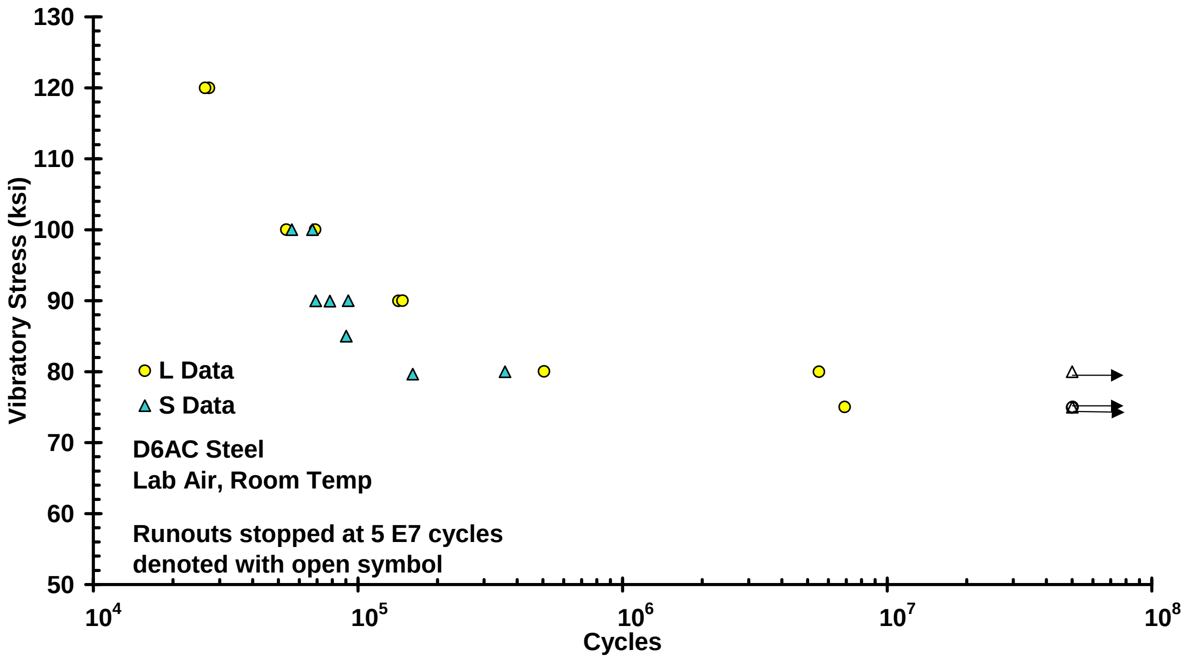


Figure 3-8. Fatigue (Stress-Life) Data for Steel Alloy D6AC

3.4 D6AC STEEL FATIGUE CRACK GROWTH RATE TESTING.

Development of the fatigue crack growth data presented herein was conducted in accordance to ASTM E 647 with the following exception, the compact tension specimen notch height exceeded the tolerances set by ASTM E 647 because the specimens were designed to meet ASTM E 399 (figure 2-11). It is believed that the impact of the out-of-tolerance notch height on the fatigue crack growth data is minimal because the specimens were precracked to a minimum *a/W* of 0.28 before load reduction testing was performed.

Compression precracking was also used to assess the effect of initial stress state on the fatigue crack growth threshold. The testing was conducted by first applying compressive loads at the top and bottom of the specimen via the clevises and loading blocks to initiate a crack at the notch root. Then, tensile loading was applied via pin loading and the specimen was cycled using either constant amplitude load or constant ΔK control. The results of these tests are presented after the baseline data.

3.4.1 Testing Procedure and Parameters.

ASTM E 647 defines two methods for generating fatigue crack growth rate data. The constant *R* load reduction test procedure [6] reduces the maximum and minimum load applied to a cracked specimen such that the load ratio, *R* ($R = K_{min}/K_{max} = P_{min}/P_{max}$) remains constant. The constant K_{max} test procedure imposes a constant K_{max} [4] while increasing K_{min}. For this study, the dimensions of the C(T) specimens were W = 3.0 inches, B = 0.5 inch, and an initial notch length of 0.75 inch, as shown in figure 2-12. The specimens were precracked at a constant ΔK that is equivalent to the first data point in the load reduction test. These loads were applied until the crack length was minimally an *a/W* of 0.28.

<u>3.4.2 Fatigue Crack Growth Rate Data</u>.

The fatigue crack growth rate data was generated using fixed stress ratios of 0.9, 0.8, 0.7, 0.3, and 0.1 and using constant K_{max} values of 15, 20, and 30 ksi-in$^{1/2}$. The specimen test data presented herein is grouped and plotted based on high and low stress ratios with distinctions being made for the L-T, T-L, and S-T orientations. All of the fatigue crack growth rate data is in tabular form in appendix B.

The fatigue crack growth rate data for the L-T, T-L, and S-T orientations at high stress ratios are plotted in figures 3-9, 3-10, and 3-11, respectively. Data presented in these plots were generated using the constant *R* and K_{max} test methods as indicated by the figure legends. The fatigue crack growth rate data for the L-T and S-T orientations at R = 0.3 are plotted in figures 3-12 and 3-13 respectively. The data presented in these plots were generated using the constant *R* test method. The fatigue crack growth rate data, generated using the constant R = 0.1 test method for the L-T and S-T orientations, are plotted in figures 3-14 and 3-15, respectively. Finally, all filled symbols are data that do not meet the ASTM E 647 plastic zone size requirements for remaining ligament. This data is italicized in appendix B.

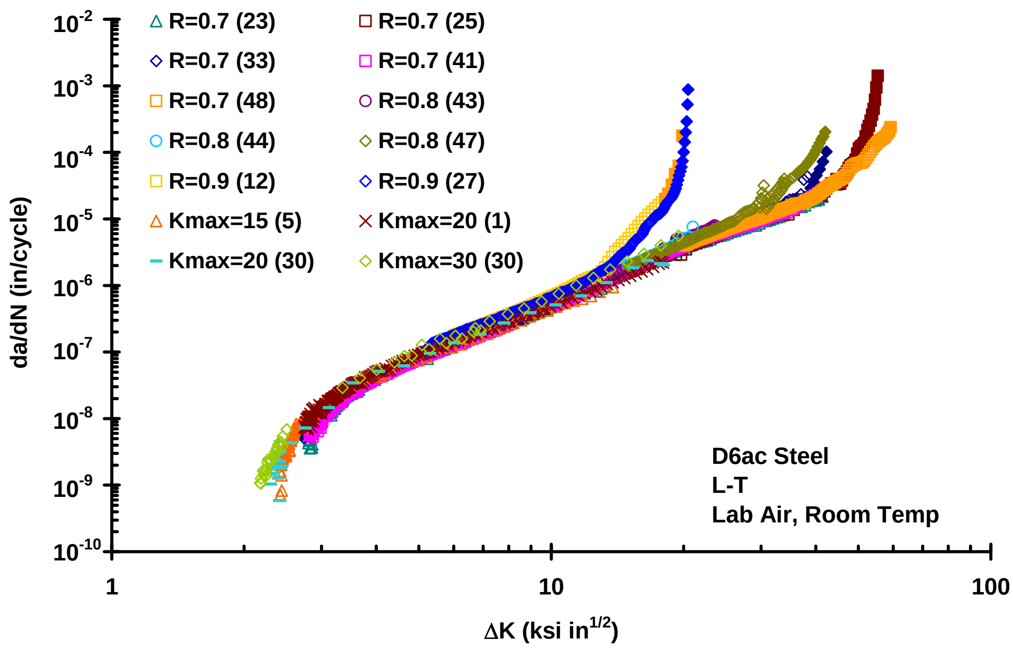


Figure 3-9. High Stress Ratio Fatigue Crack Growth Rate Data for Steel Alloy D6AC (L-T)
(Filled symbols do not meet ASTM E 647.)

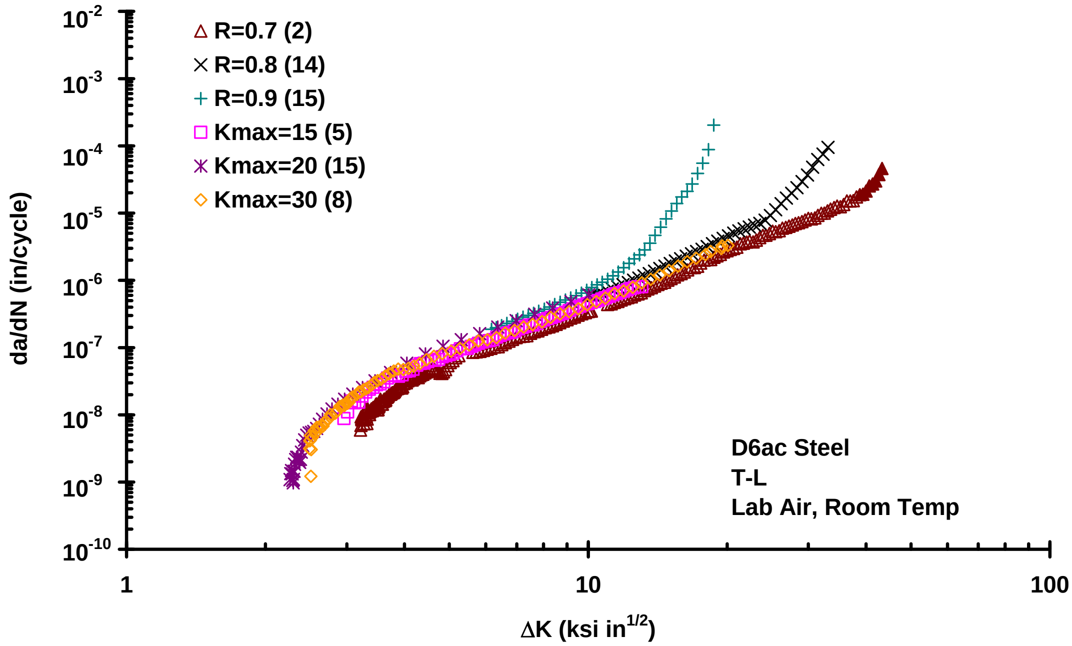


Figure 3-10. High Stress Ratio Fatigue Crack Growth Rate Data for Steel Alloy D6AC (T-L) (Filled symbols do not meet ASTM E 647.)

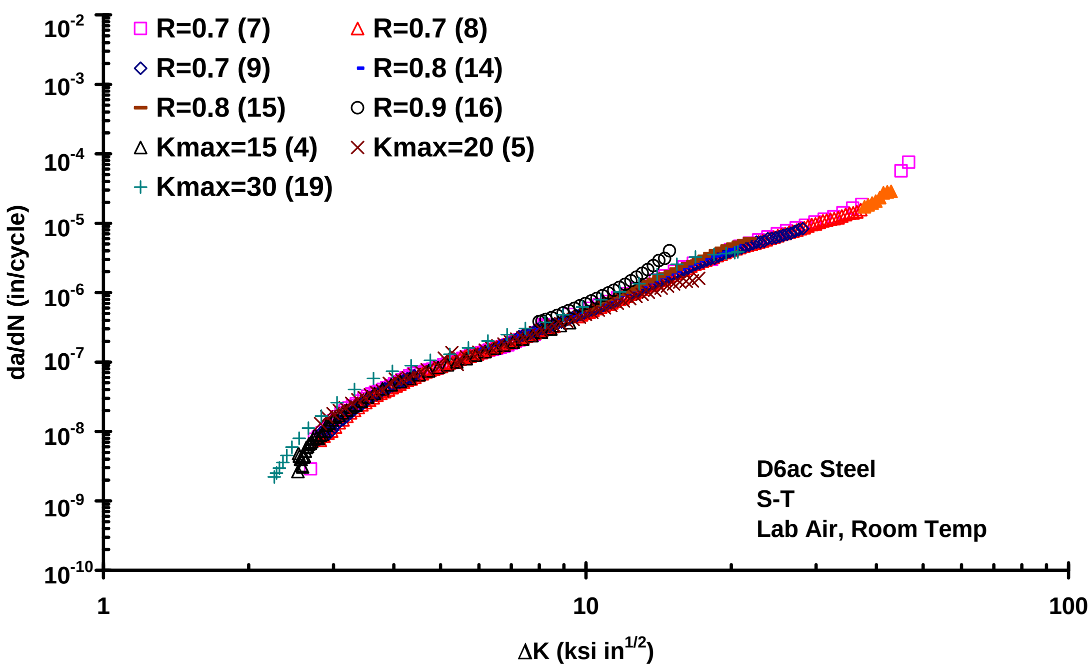


Figure 3-11. High Stress Ratio Fatigue Crack Growth Rate Data for Steel Alloy D6AC (S-T) (Filled symbols do not meet ASTM E 647.)

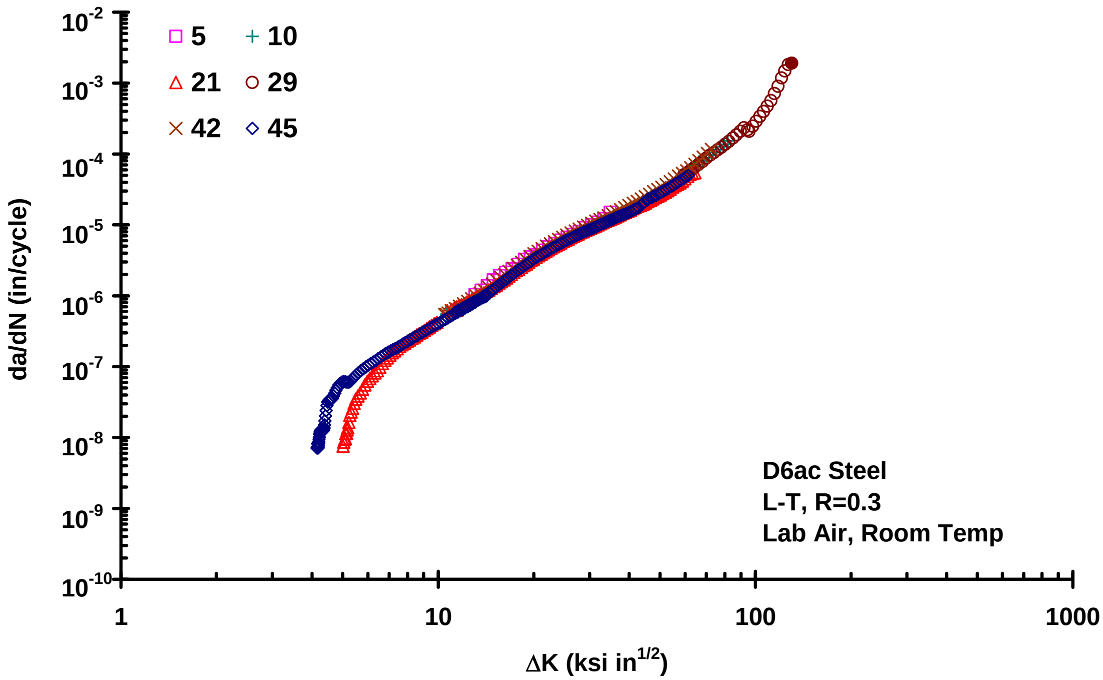


Figure 3-12. R = 0.3 Fatigue Crack Growth Rate Data for Steel Alloy D6AC (L-T) (Filled symbols do not meet ASTM E 647.)

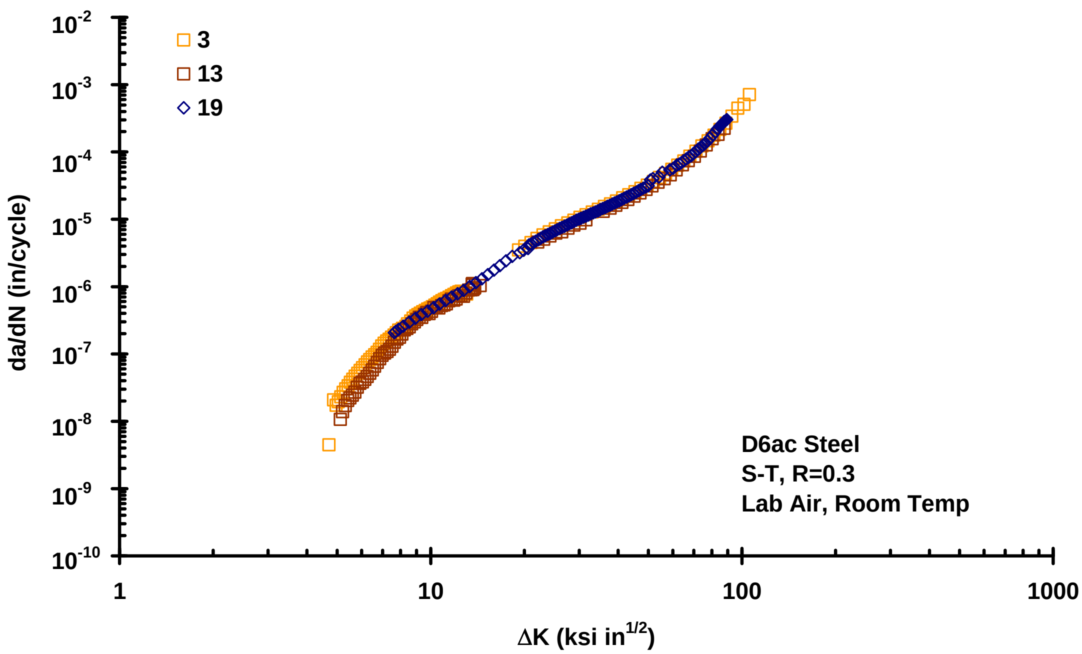


Figure 3-13. R = 0.3 Fatigue Crack Growth Rate Data for Steel Alloy D6AC (S-T) (Filled symbols do not meet ASTM E 647.)

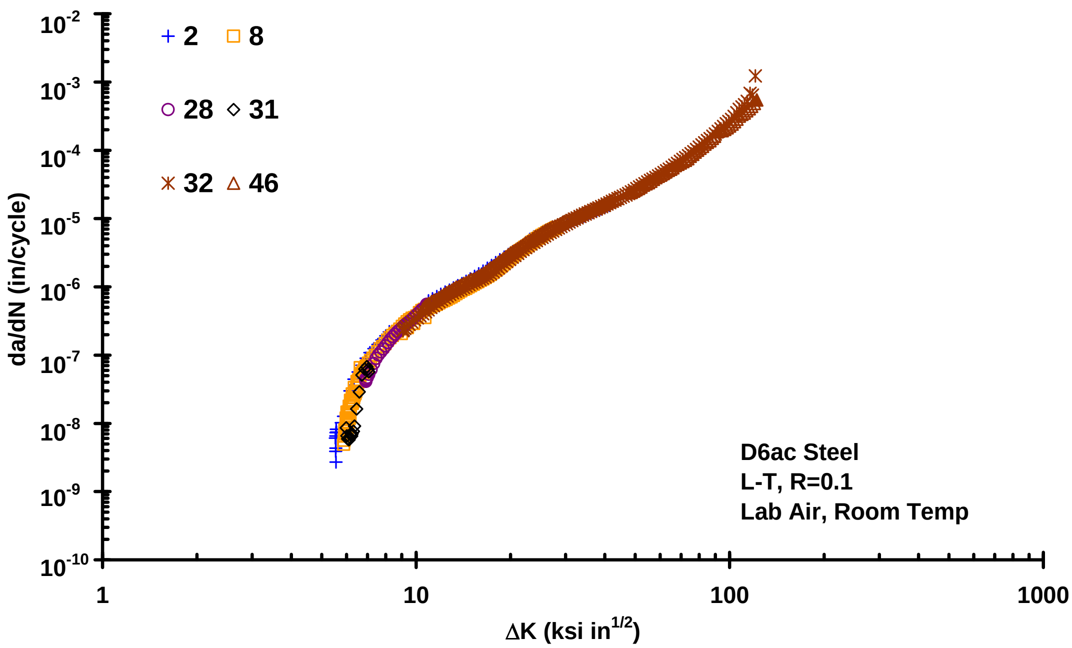


Figure 3-14. R = 0.1 Fatigue Crack Growth Rate vs ΔK Data for Steel Alloy D6AC (L-T)
(Filled symbols do not meet ASTM E 647.)

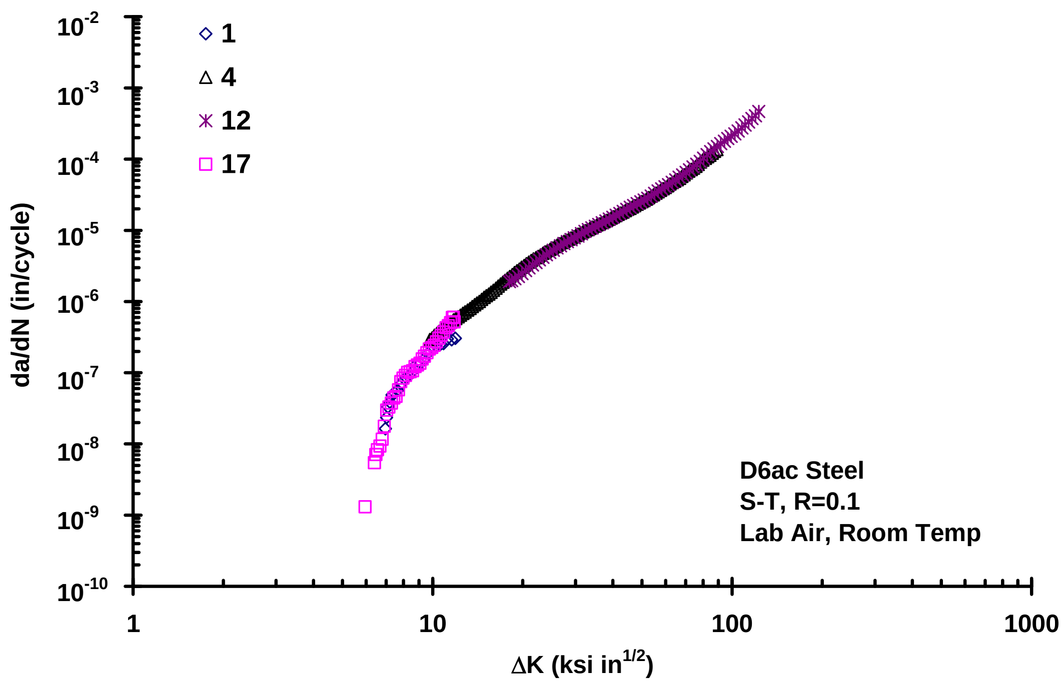


Figure 3-15. R = 0.1 Fatigue Crack Growth Rate Data for Steel Alloy D6AC (S-T)
(Filled symbols do not meet ASTM E 647.)

3.4.3 Alternative Fatigue Crack Growth Data.

The procedure for the development of fatigue crack growth threshold data has been a topic for debate in recent years [8 and 9]. The authors have chosen to focus attention on the low stress level (R = 0.1) data generated in the L-T orientation to investigate any threshold phenomena. Compact tension specimens were precracked using a technique where both maximum and minimum loads are compressively applied [10]. This approach to precracking has been used successfully to generate a sharp fatigue crack from a notch. Recent finite element analyses have been used to develop guidelines for loading levels to avoid some of the shortcomings of this procedure [11], such as tensile residual stresses near the notch. The specimen is then cycled via pin loading in tension to propagate the crack either under constant-amplitude load or constant ΔK.

Standard fatigue crack growth threshold data is generated using constant stress ratio and constant maximum stress-intensity tests. These data are then used to formulate an effective stress-intensity solution. Using the effective solution as a predictive tool [12], as shown in figure 3-16, low stress-ratio testing was conducted using a compressive precracking scheme. The effective stress-intensity solution has previously proven accurate in predicting fatigue crack growth rates in several steel, aluminum, and titanium alloys [12 and 13]. In particular, for steel, constant R load reduction data using middle-through crack specimens agrees with AGARD [14] small crack data. However, recent compact tension data of 4340 steel (see section 4.4.3) from the constant R load reduction procedure shows elevated low R thresholds. The standard and alternative data both generated on D6AC steel using compact tension specimens resulted in a very high threshold at a low stress ratio in comparison to the predictions, as shown in figure 3-16. The baseline fatigue crack growth data used for discussion in this section is the constant R = 0.1 load reduction data generated using specimen 8 in the L-T orientation. The constant ΔK data in figure 3-16 was generated using compression precracking, followed by constant ΔK testing at 4, 5, and 7 ksi-in$^{1/2}$. The constant ΔK tests conducted at 4 and 5 ksi-in$^{1/2}$ initiated cracks that later arrested. Crack arrest was determined to occur when the crack growth rate fell below 10^{-9} inches/cycle. A plot of the crack growth versus cycle count for these two tests is shown in figure 3-17. The lines drawn through the data indicate where the growth rate was computed for each test. An additional result in figure 3-17 is for a test with compression precracking followed by constant load amplitude starting at ΔK = 3.6 ksi-in$^{1/2}$. The crack grew 0.0025 inch and arrested after approximately one million cycles. Specimen 32 was then used for a constant ΔK = 7 ksi-in$^{1/2}$ test as discussed later in this section.

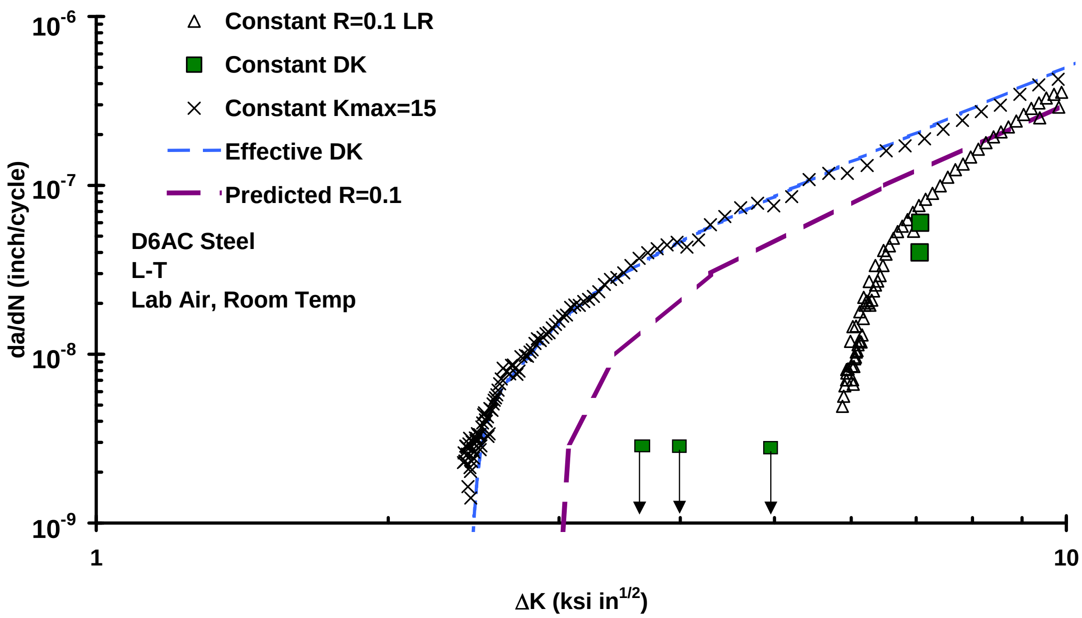


Figure 3-16. Effective Stress-Intensity Curves for Steel Alloy D6AC (L-T)

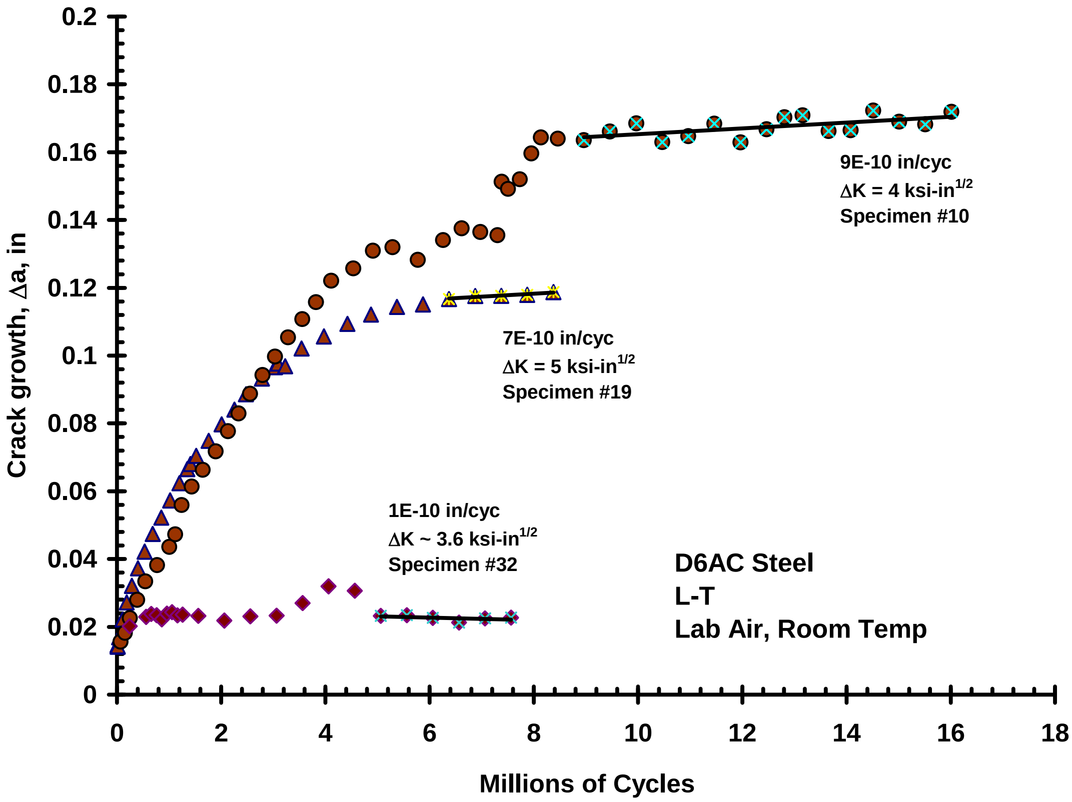


Figure 3-17. R = 0.1 Fatigue Crack Growth Rate vs Cycles Data for Steel Alloy D6AC (L-T)

Two tests were conducted with compression precracking followed by constant ΔK = 7 ksi-in$^{1/2}$. Specimen 31 was precracked, propagated at a constant ΔK = 7 ksi-in$^{1/2}$ for 0.0698 inch. A constant R = 0.1 load reduction test was performed for the next 0.8978 inch, and finally another constant ΔK = 7 ksi-in$^{1/2}$ was performed for 0.0985 inch. The data from these tests are plotted in figure 3-18 as crack growth versus cycles to highlight the computation of crack growth rate during the two constant ΔK regimes. The constant ΔK = 7 ksi-in$^{1/2}$ crack growth rate proceeding the load reduction test is nearly double the ΔK = 7 ksi-in$^{1/2}$ crack growth rate following load reduction. This reduction in crack growth rate for the second constant ΔK = 7 ksi-in$^{1/2}$ segment may be attributable to mechanisms retarding the crack [12]. First, the crack path was studied and crack tunneling was noted, which could retard the crack. Second, crack closure may have an influence on the crack growth rate. The closure measurements (2% offset) taken during the test are plotted in figure 3-19 versus crack length. There appears to be no closure detected in either test, indicating that something other than crack closure that is measurable with compliance is causing the variability in crack growth rate of this specimen. It has been postulated in the literature that intergranular crack growth dominates the threshold regime of D6AC steel [15]. It is entirely possible that this mechanism is being activated in this test; however, the authors have no evidence to either support or deny this hypothesis. Therefore, a second constant ΔK = 7 ksi-in$^{1/2}$ test was performed using specimen 32, as shown in figure 3-20. The fatigue crack growth rate determined from extensive crack growth (>0.50 inch) generated a fatigue crack growth rate similar to that of specimen 31 after the threshold test was conducted. Based on this test, it may be possible to imply that steady-state was not developed during the initial constant ΔK = 7 ksi-in$^{1/2}$ test on specimen 31.

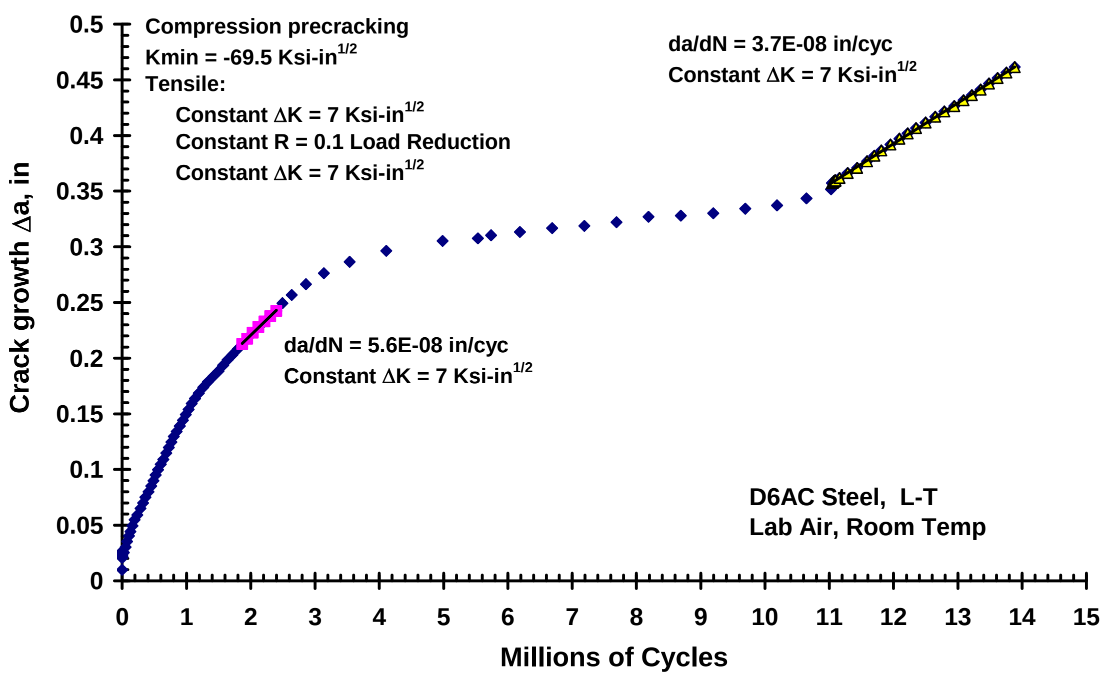


Figure 3-18. Fatigue Crack Growth Rate Data for Specimen 31 of Steel Alloy D6AC (L-T)

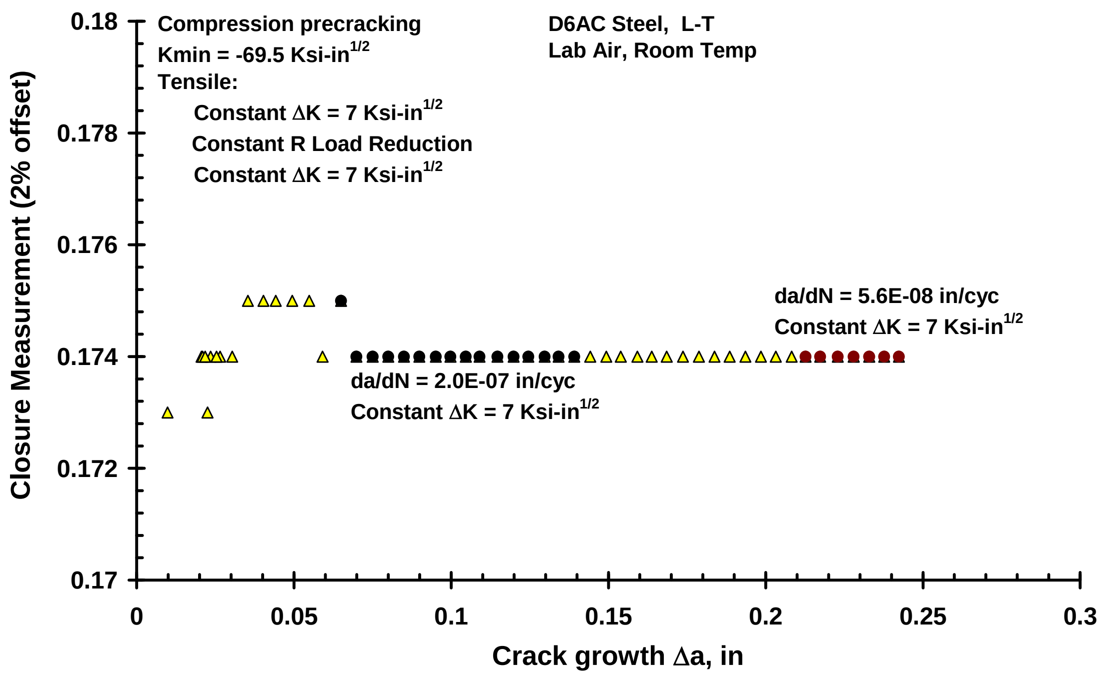


Figure 3-19. Crack Closure Measurements vs Crack Growth Data for Specimen 31 of Steel Alloy D6AC (L-T)

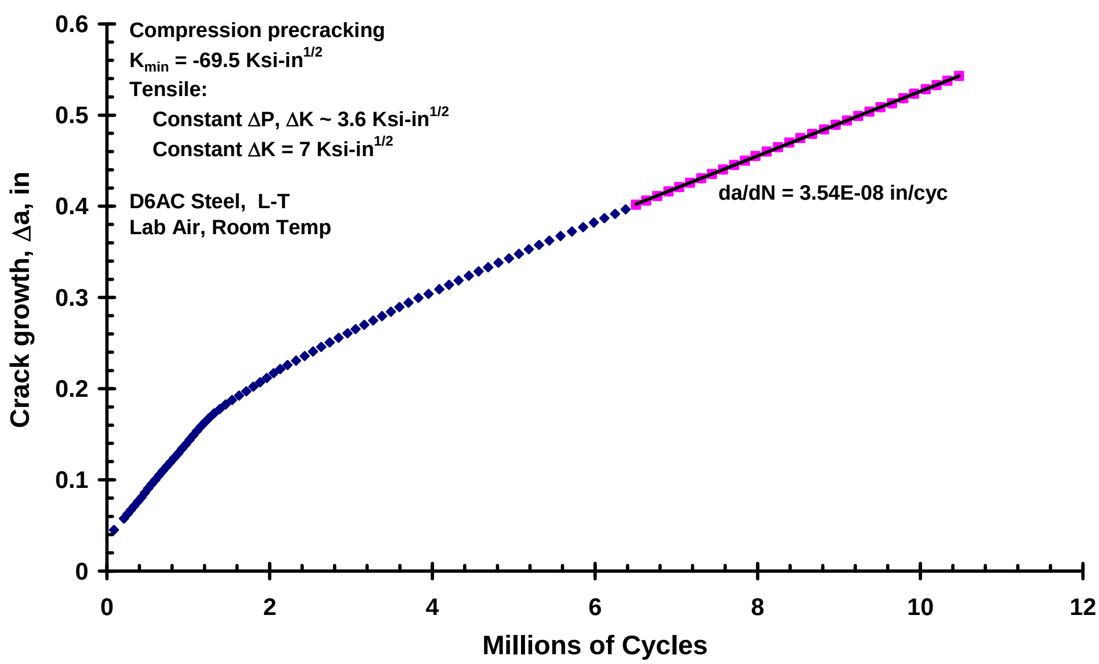


Figure 3-20. Fatigue Crack Growth Rate Data for Specimen 32 of Steel Alloy D6AC (L-T)

A more traditional test was conducted using specimen 28 to determine a baseline. The precracking was performed in tension at a constant ΔK = 10.8 ksi-in$^{1/2}$. Then a constant R = 0.1 load reduction test was performed to a ΔK of approximately 7.0 ksi-in$^{1/2}$ where a constant ΔK = 7.0 ksi-in$^{1/2}$ was performed. After the crack propagated approximately 0.14 inch, a constant ΔK = 7.6 ksi-in$^{1/2}$ test was performed for 0.074 inch. Subsequently, a constant ΔK = 8.7 ksi-in$^{1/2}$ and constant ΔK = 9.7 ksi-in$^{1/2}$ tests were performed consuming approximately 0.064 inch of the specimen each. A plot of these tests as crack length versus cycles is shown in figure 3-21.

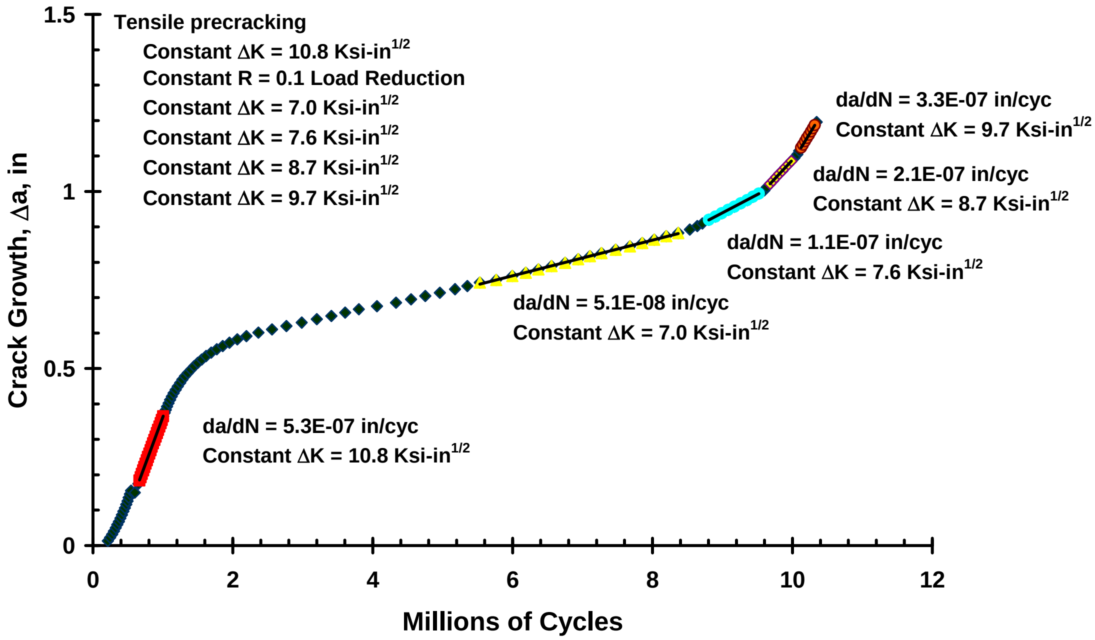


Figure 3-21. Fatigue Crack Growth Rate Data for Specimen 28 of Steel Alloy D6AC (L-T)

Finally, a comparison of the fatigue crack growth rate data for each test to the baseline data is presented in figure 3-22. There is little difference in crack growth rate between the experimental approaches presented herein. This would imply that the threshold value of 5.9 ksi-in$^{1/2}$ derived in this report is an accurate representation of the D6AC steel alloy. However, the authors believe that this threshold value is higher than should be expected for this material. Literature data suggests that the 3-inch compact tension specimen may be promoting higher threshold phenomena because of constraint [16], T-stress [17], and micromechanical issues [15]. The authors are continuing to evaluate this material with future testing of alternate specimen configurations and sizes. The fatigue crack growth data for specimens 28, 31, and 32 are in tabular form in appendix C.

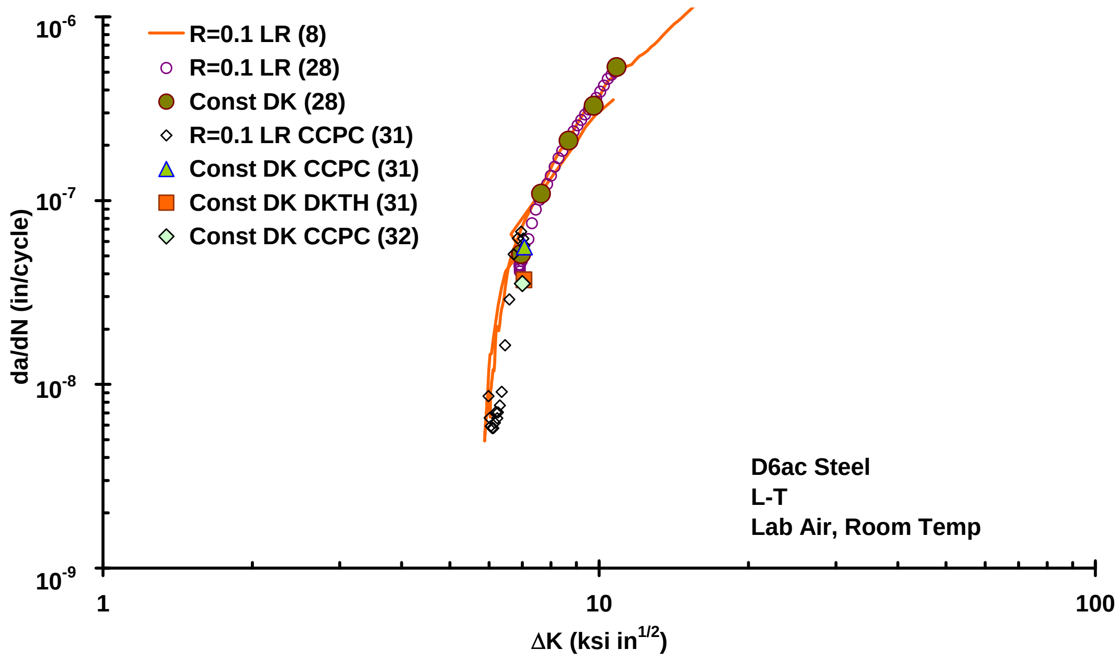


Figure 3-22. R = 0.1 Constant ΔK Fatigue Crack Growth Rate Data for Steel Alloy D6AC (L-T)

4. 4340 STEEL.

4.1 4340 STEEL MATERIAL DESCRIPTION.

4340 steel is widely used in the aerospace industry. The chemical composition [18] of this alloy is listed in table 4-1.

Table 4-1. Chemical Composition of Steel Alloy 4340 [18]

Element	Symbol	4340 Steel (%)
Carbon	C	0.38-0.43
Chromium	Cr	0.70-0.90
Iron	Fe	balance
Manganese	Mn	0.60-0.80
Molybdenum	Mo	0.20-0.30
Nickel	Ni	1.65-2.00
Phosphorous	P	<0.035
Silicon	Si	0.15-0.30
Sulphur	S	<0.040

Test specimens were machined from hammer-forged steel alloy 4340 blocks (figure 4-1) that were provided by a propeller manufacturer. The details of the heat-treatment and material source are proprietary to the manufacturer. Material directions were defined with respect to the local block geometry (see figure 4-2). The L direction coincided with the length of the block. The L-T and S-T directions coincided with the longest and shortest cross-sectional dimensions, respectively. These blocks where cut into C(T), M(T), K_t = 1 S-N and tensile specimens to measure specific mechanical properties. All fracture and tension specimens were machined from a single block as shown in figure 4-2. Location and orientation of the S-N specimens, which were cut from a second block, are shown in figure 4-3. Fracture and tension specimens were numbered as shown in figure 4-4. Location and orientation were maintained in the specimen numbering so possible variations of properties within the block could be noted.

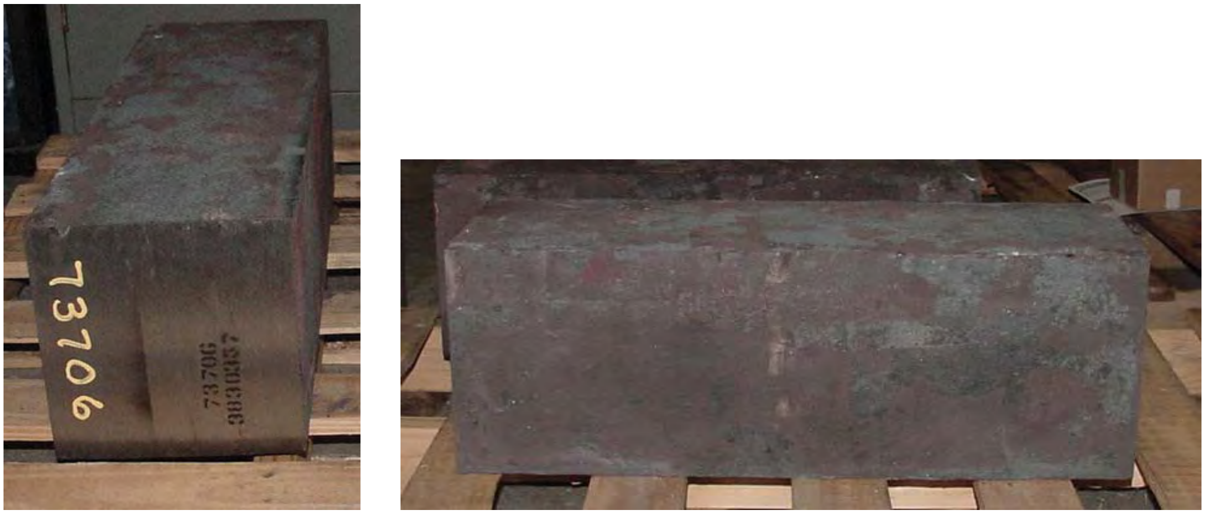


Figure 4-1. Forging Made of Steel Alloy 4340

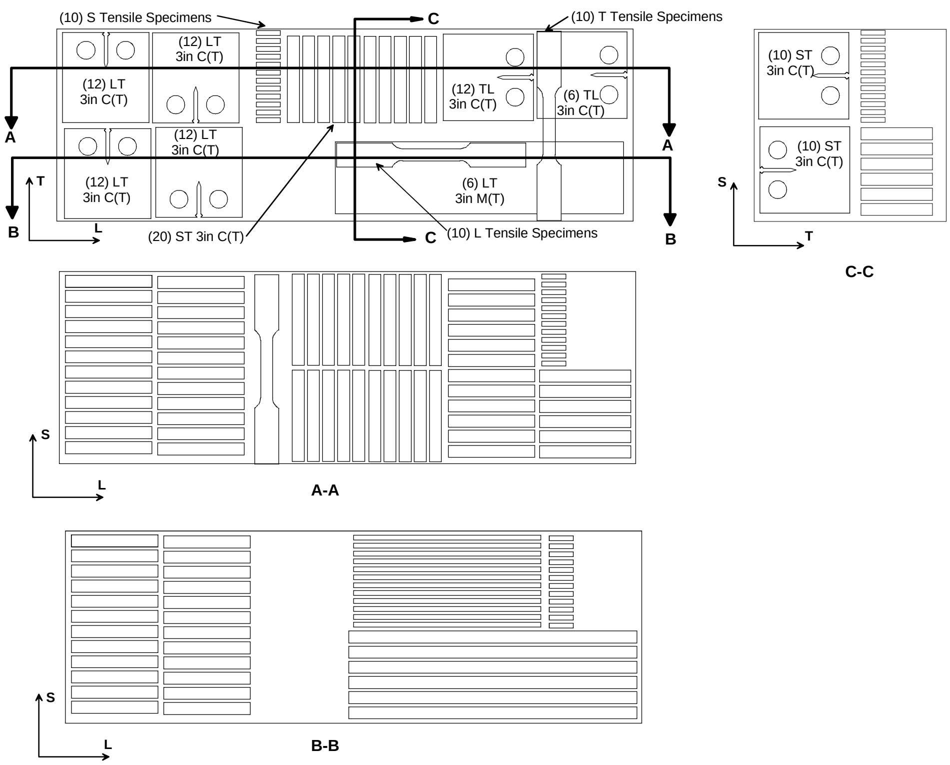
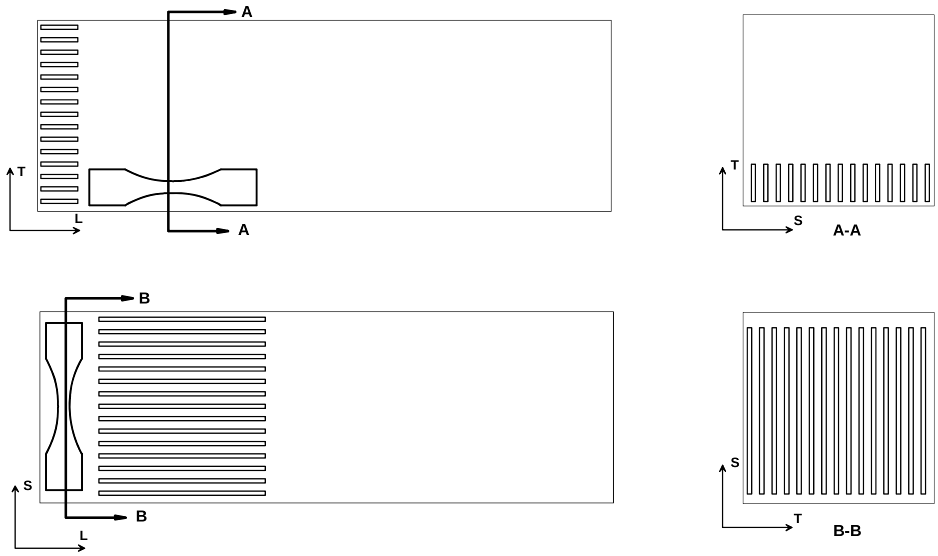


Figure 4-2. The Location and Orientation of Fracture and Tension Specimens, With Respect to the Forging



NOTE: Specimens numbered consecutively from one edge to the other with specimen 8 from the mid plane.

Figure 4-3. The Location, Numbering, and Orientation S-N Specimens, With Respect to the Forging

NOTE:Tensile specimens numbered starting with 1 at the centerline of the forging and 12 farthest from the centerline.

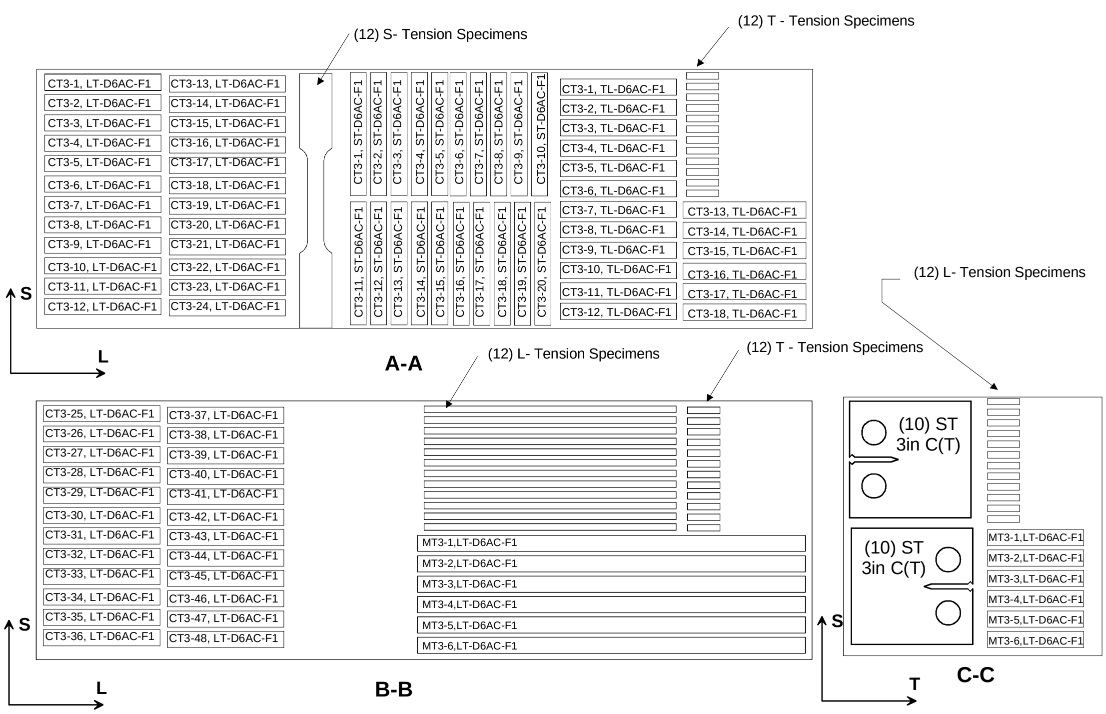


Figure 4-4. Numbering Layout for the Fracture and Tension Specimens

4.2 4340 STEEL TENSILE TESTING.

Tensile tests were conducted according to ASTM E 8 using 0.5-inch-wide rectangular tension specimens, as shown in figure 2-5. The specimens were tested in the L, T, and S directions at three temperatures. Young's modulus, yield stress, and ultimate tensile stress were calculated from the test data. Results from the tensile tests are summarized in tables 4-2, 4-3, and 4-4 for each of the orientations. Unfortunately, due to testing difficulties, three repeat tests were not conducted for all testing conditions. Figure 4-5 shows a plot of this data, showing average values and scatter for the properties measured. A trend of decreasing yield and ultimate strength with increasing test temperature is shown in all orientation results. The modulus data show very little variation with temperature.

Table 4-2. 4340 Tensile Data From the L-Orientation

Specimen ID	Temperature (^{o}F)	E (Msi)	$\sigma_{y0.2\%}$ (ksi)	σ_{ult} (ksi)
T-3-L-4340-F1	-60	30.9	78.6	116.3
T-7-L-4340-F1	-60	30.4	78.8	118.2
T-11-L-4340-F1	-60	29.8	77.4	116.0
T-1-L-4340-F1	75	30.6	71.8	105.1
T-6-L-4340-F1	75	30.2	72.8	106.0
T-12-L-4340-F1	75	30.5	73.2	106.8
T-2-L-4340-F1	250	30.0	69.6	101.0
T-5-L-4340-F1	250	30.4	69.2	100.8
T-10-L-4340-F1	250	29.6	67.5	99.4

Table 4-3. 4340 Tensile Data From the T-Orientation

Specimen ID	Temperature (^{o}F)	E (Msi)	$\sigma_{y0.2\%}$ (ksi)	σ_{ult} (ksi)
T-3-T-4340-F1	-60	33.5	78.4	115.9
T-7-T-4340-F1	-60	30.5	78.0	116.5
T-11-T-4340-F1	-60	30.0	77.8	116.5
T-1-T-4340-F1	75	30.6	75.0	108.5
T-6-T-4340-F1	75	30.5	-	-
T-2-T-4340-F1	250	30.3	69.5	101.0
T-5-T-4340-F1	250	29.8	69.6	101.0
T-10-T-4340-F1	250	30.6	69.2	100.9

Table 4-4. 4340 Tensile Data From the S-Orientation

Specimen ID	Temperature (°F)	E (Msi)	$\sigma_{y0.2\%}$ (ksi)	σ_{ult} (ksi)
T-3-S-4340-F1	-60	30.9	87.6	119.2
T-7-S-4340-F1	-60	30.4	78.7	116.3
T-11-S-4340-F1	-60	30.2	78.7	116.6
T-1-S-4340-F1	75	30.8	72.1	105.5
T-6-S-4340-F1	75	30.8	74.1	107.3
T-12-S-4340-F1	75	30.2	73.7	107.3
T-2-S-4340-F1	250	31.6	69.3	100.1
T-5-S-4340-F1	250	30.7	69.8	101.2

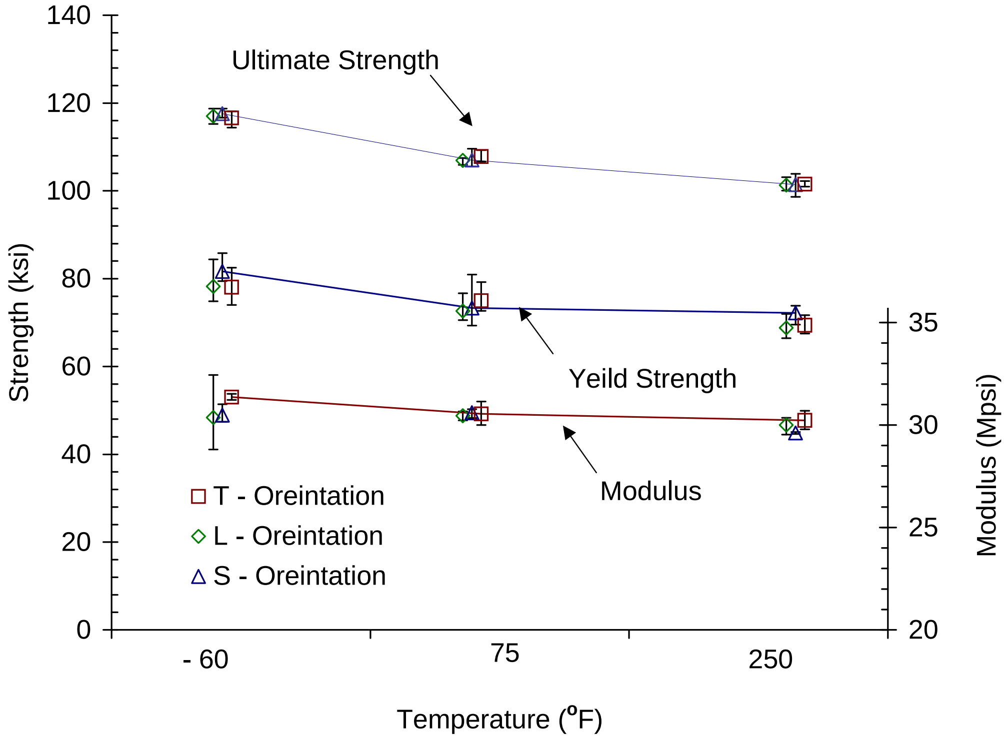


Figure 4-5. Average Measured Tensile Properties for Steel Alloy 4340 Tested

4.3 4340 STEEL FATIGUE (STRESS-LIFE) TESTING.

Stress-life data was generated using the axially loaded K_t = 1 specimens shown in figure 2-9. The specimens were cycled at a fully reversed (R = -1) constant-amplitude load, and the data are summarized in table 4-5. Figure 4-6 shows specimen cycles to failure for each of the load levels investigated. Vibratory stress was computed using the applied load and area of the gage section. Specimens that did not fail after 50,000,000 cycles are considered run-outs. The L and S orientations were tested and are denoted in the legend of figure 4-6 accordingly.

Table 4-5. 4340 Stress-Life Data (R=-1)

Specimen ID	Vibratory Stress (ksi)	Fatigue Life (cycles)
L-11	70.00	1,590
L-2	69.96	1,102
L-12	60.02	33,632
L-9	60.02	30,218
L-4	59.98	33,527
L-3	50.02	399,506
L-13	49.97	428,535
L-6	49.97	318,046
L-7	40.00	50,000,000
L-5	39.98	50,737,500
L-10	39.96	50,828,956
S-9	70.00	1,563
S-11	70.00	2,046
S-15	69.90	1,596
S-1	60.00	37,197
S-5	60.00	27,462
S-3	60.00	35,888
S-4	50.00	270,658
S-6	49.99	934,709
S-12	49.99	460,528
S-10	47.50	675,451
S-14	47.51	41,671,388
S-13	47.47	14,479,157
S-7	45.00	50,142,524
S-8	44.97	50,081,820
S-2	44.95	50,018,000

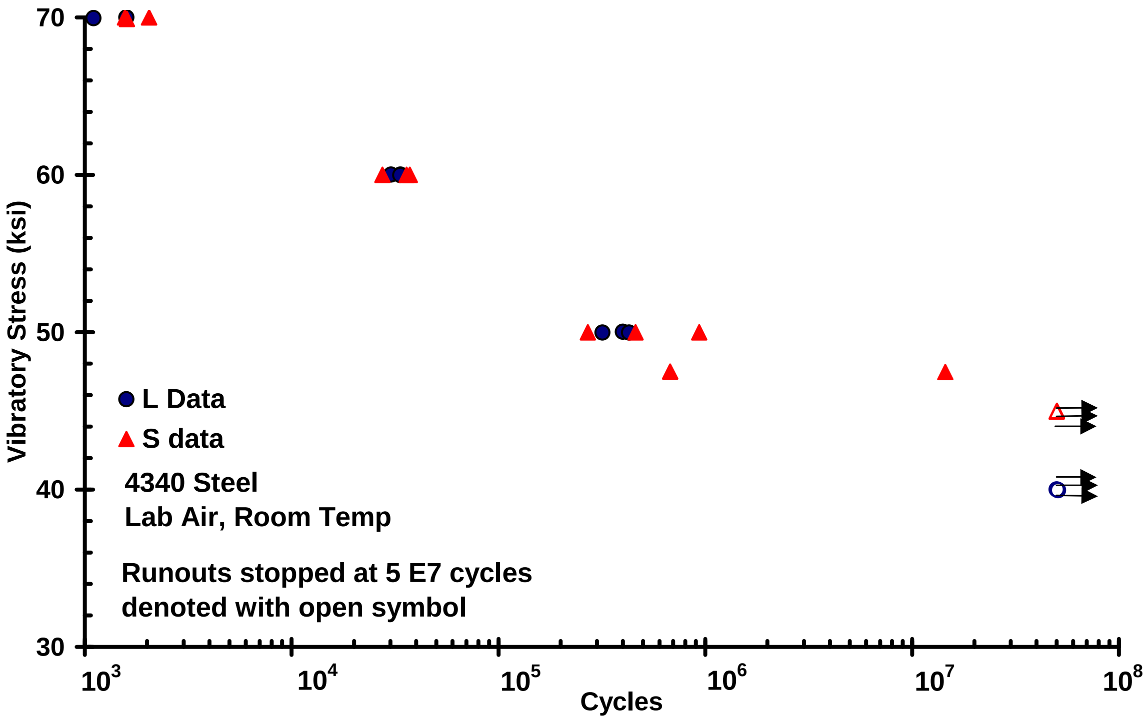


Figure 4-6. Fatigue (Stress-Life) Data for Steel Alloy 4340

4.4 4340 STEEL FATIGUE CRACK GROWTH RATE TESTING.

Development of the fatigue crack growth data presented herein was conducted in accordance to ASTM E 647 with the following exception, the compact tension specimen notch height exceeded the tolerances set by the ASTM E 647 because the specimens were designed to meet the ASTM E 399 (figure 2-11). It was believed that the impact of the out-of-tolerance notch height on the fatigue crack growth data is minimal because the specimens were precracked to a minimum *a/W* of 0.28 before load reduction testing was performed.

4.4.1 Testing Procedure and Parameters.

ASTM E 647 defines two methods for generating fatigue crack growth rate data. The constant *R* load reduction test procedure [6] reduces the maximum and minimum load applied to a cracked specimen such that the load ratio, *R* ($R = K_{min}/K_{max} = P_{min}/P_{max}$), remains constant. The constant K_{max} test procedure imposes a constant K_{max} [4] while increasing K_{min}. For this study, the dimensions of the C(T) specimens were W = 3.0 inches, B = 0.5 inch, and an initial notch length of 0.75 inch, as shown in figure 2-11. The specimens were precracked at a constant ΔK that is equivalent to the first data point in the load reduction test. These loads were applied until a minimum *a/W* of 0.28 was attained.

4.4.2 Fatigue Crack Growth Rate Data.

The fatigue crack growth rate data was generated using fixed stress ratios of 0.7, 0.3, and 0.1 and using constant K_{max} values of 11, 15, and 30 ksi-in$^{1/2}$. The specimen test data presented herein are grouped and plotted based on high and low stress ratios with distinctions being made for the L-T, T-L, and S-T orientations. All fatigue crack growth rate data is in tabular form in appendix C.

The fatigue crack growth rate data for the L-T, T-L, and S-T orientations at high stress ratios are plotted in figures 4-7, 4-8, and 4-9, respectively. Data presented in these plots were generated using the constant R and K_{max} test methods as indicated by the figure legends. The fatigue crack growth rate data for the L-T and S-T orientations at R = 0.3 are plotted in figures 4-10 and 4-11, respectively. Data presented in these plots were generated using the constant R test method. The fatigue crack growth rate data generated using the constant R = 0.1 test method for the L-T and S-T orientations are plotted in figures 4-12 and 4-13, respectively.

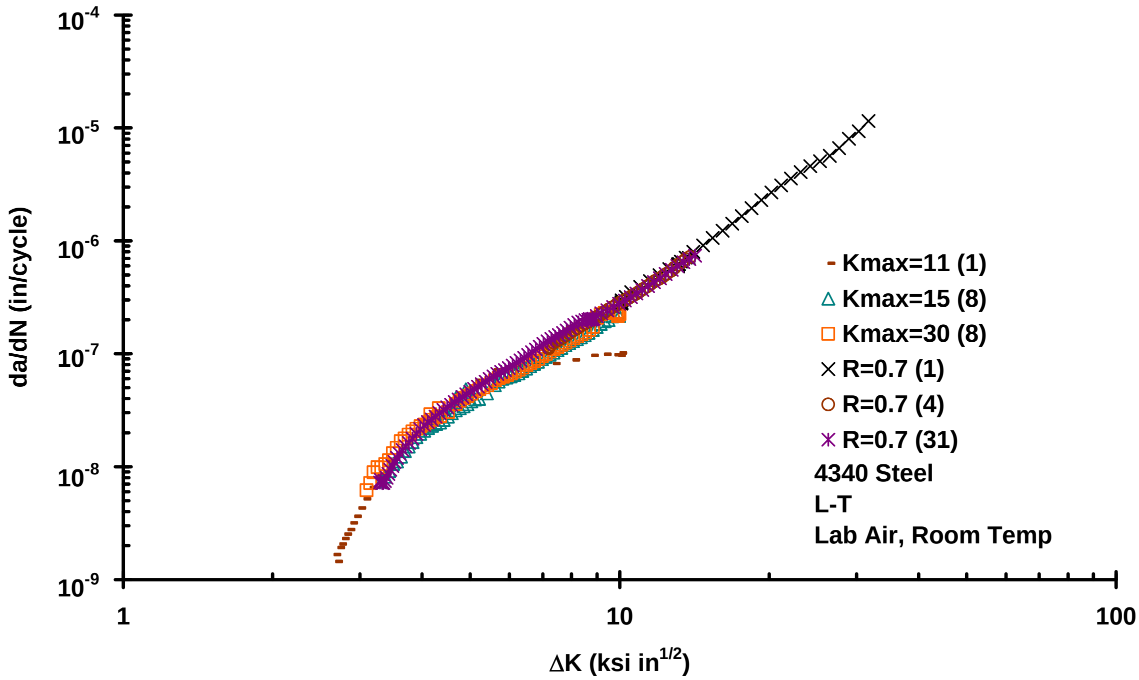


Figure 4-7. High Stress Ratio Fatigue Crack Growth Rate Data for Steel Alloy 4340 (L-T)

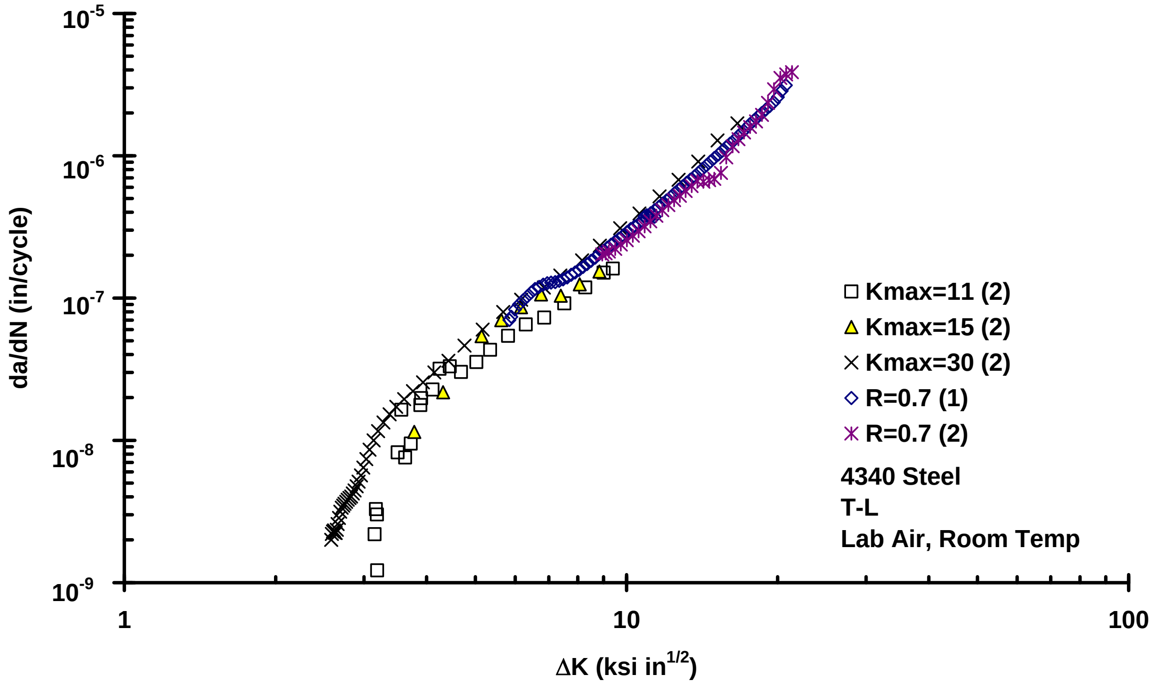


Figure 4-8. High Stress Ratio Fatigue Crack Growth Rate Data for Steel Alloy 4340 (T-L)

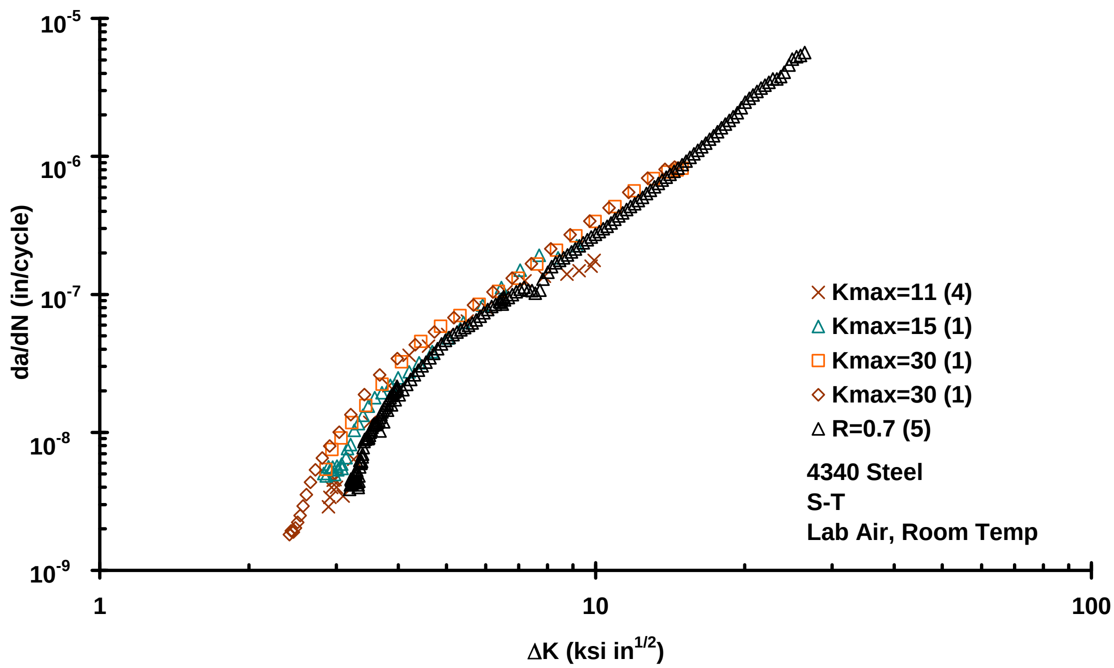


Figure 4-9. High Stress Ratio Fatigue Crack Growth Rate Data for Steel Alloy 4340 (S-T)

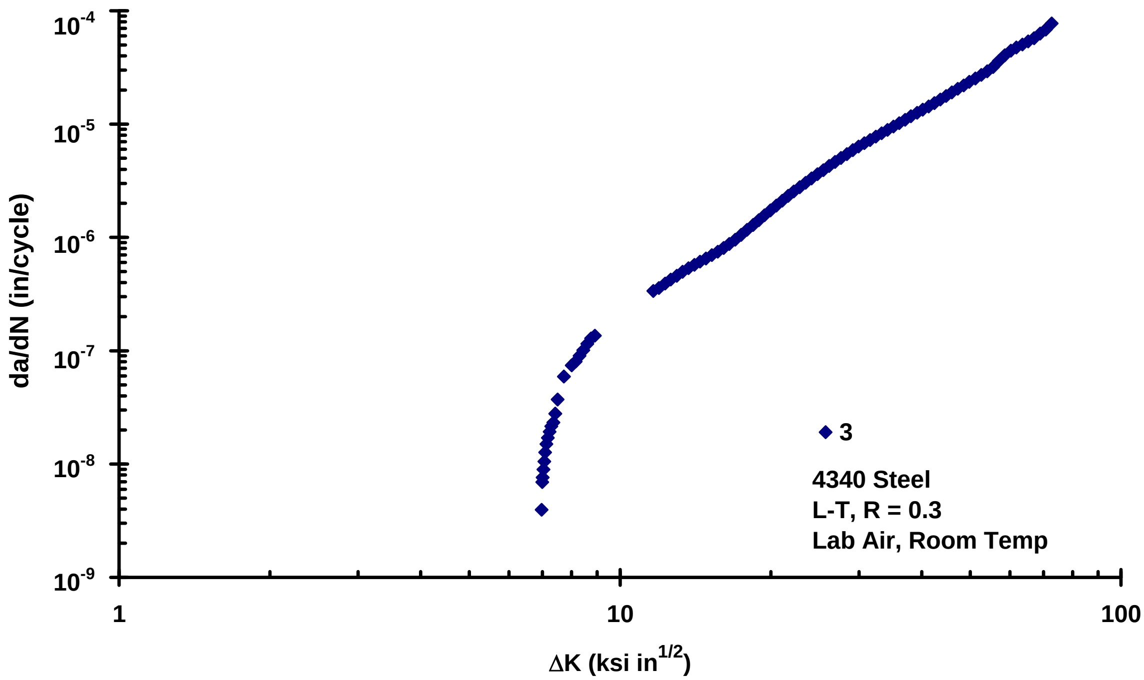


Figure 4-10. *R* = 0.3 Fatigue Crack Growth Rate Data for Steel Alloy 4340 (L-T)

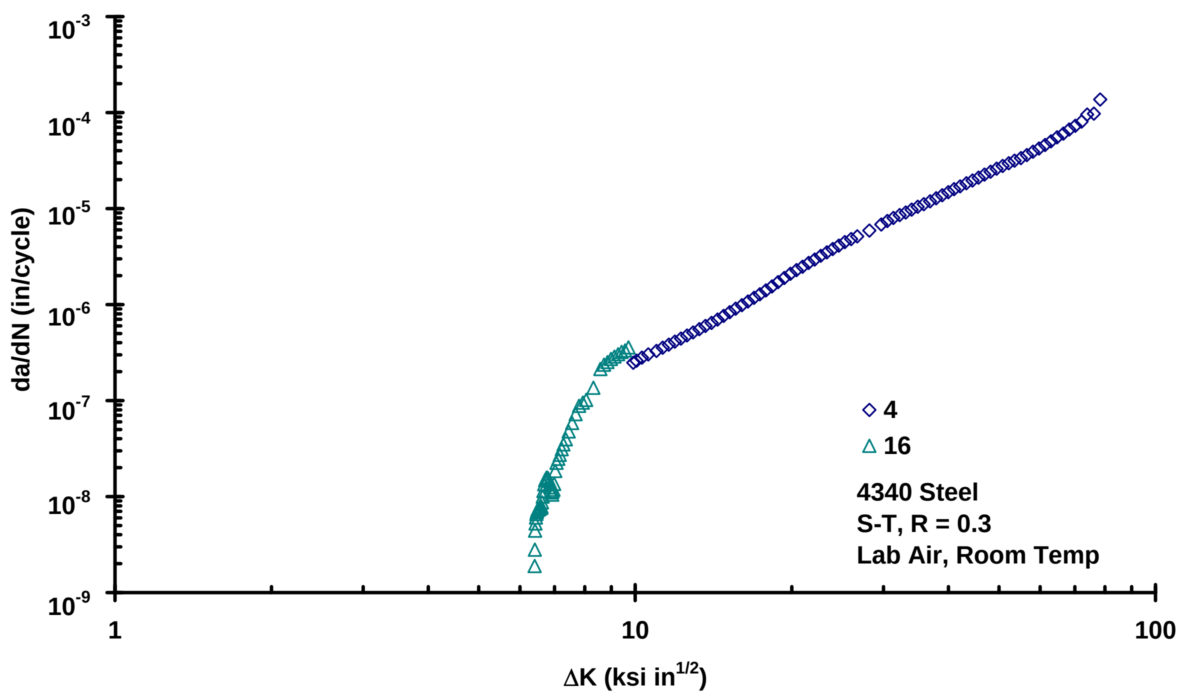


Figure 4-11. *R* = 0.3 Fatigue Crack Growth Rate Data for Steel Alloy 4340 (S-T)

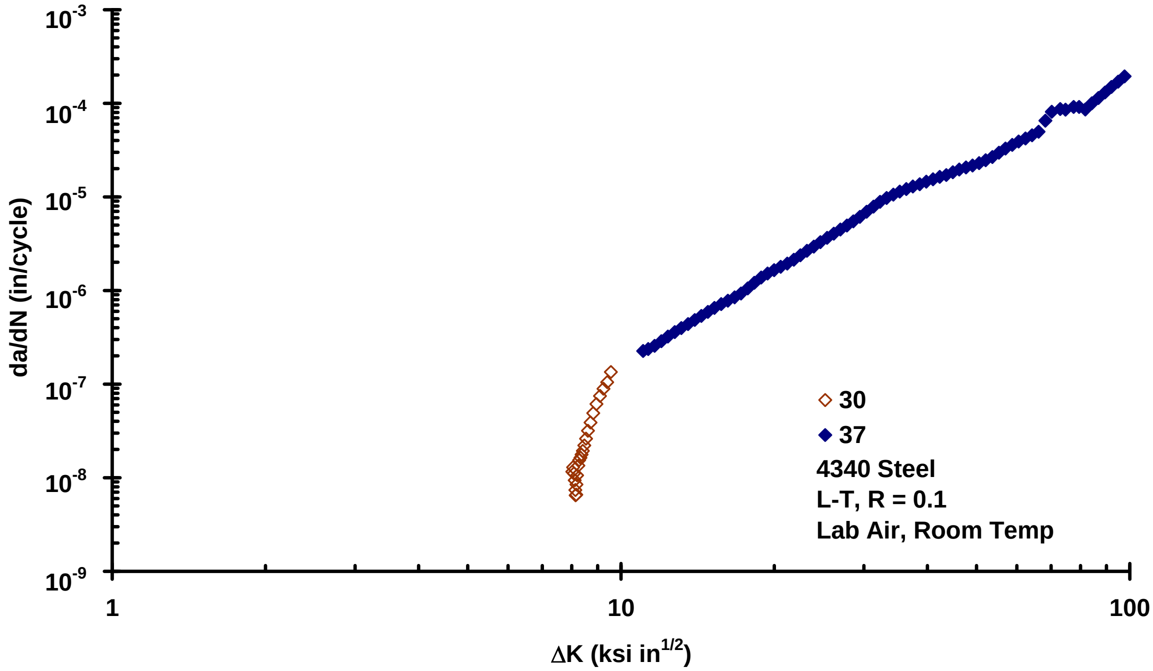


Figure 4-12. R = 0.1 Fatigue Crack Growth Rate Data for Steel Alloy 4340 (L-T)

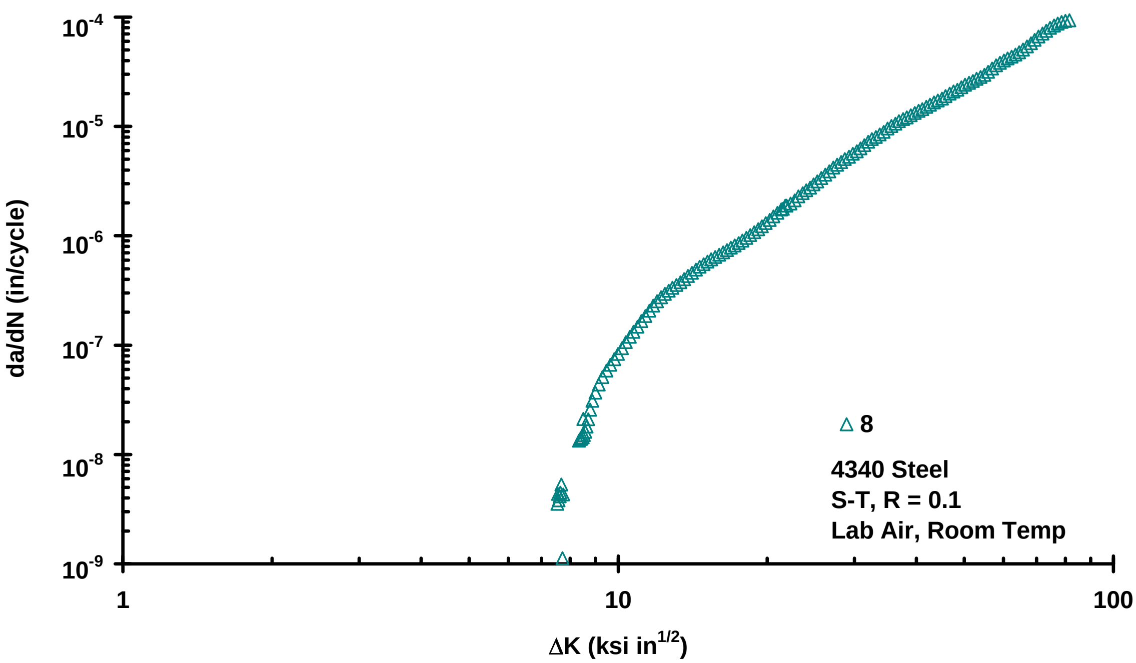


Figure 4-13. R = 0.1 Fatigue Crack Growth Rate Data for Steel Alloy 4340 (S-T)

4.4.3 Alternative Fatigue Crack Growth Data.

The procedure for the development of fatigue crack growth threshold data has been a topic for debate in recent years [9]. The authors have chosen to focus attention on the low stress level (R = 0.1) data generated in the L-T orientation to investigate any threshold phenomena. Compact tension specimens were precracked using a technique where both maximum and minimum loads are compressively applied [10]. This approach to precracking has been used successfully to generate a sharp fatigue crack from a notch. Recent finite element analyses have been used to develop guidelines for loading levels to avoid some of the shortcomings of this procedure [11], such as tensile residual stresses near the notch. The specimen is then cycled via pin loading in tension to propagate the crack either under constant-amplitude load or constant ΔK.

To evaluate the fatigue crack growth threshold data developed herein, 4340 steel data obtained in the literature [14] is used as a baseline. The data was generated using the constant R load reduction data with middle-through crack specimens. The standard data generated on 4340 steel using C(T) specimens resulted in a very high threshold at a low stress ratio in comparison to the literature data, as shown in figure 4-14. The baseline fatigue crack growth data used for discussion in this section is the constant R = 0.1 load reduction data generated using specimen 28 in the L-T orientation.

Using the literature data as a guide, specimen 9 was compression precracked then switched to tension where a constant ΔK of 6 ksi-in$^{1/2}$ test was applied for 0.26 inch. Unfortunately, the crack front grew out-of-straightness (side to side) and arrested. However, the data generated during the constant ΔK test agreed very well with the literature data, even though this ΔK level is below the threshold obtained from the load reduction test, as shown in figure 4-14. A constant ΔK of 9.8 ksi-in$^{1/2}$ test was then conducted in an attempt to straighten the crack front. The crack front returned to straightness within 0.05 inch then the constant ΔK of 9.8 ksi-in$^{1/2}$ data was recorded for 0.20 inch. A constant R = 0.1 load reduction test was then performed until the crack arrested at a ΔK of 7.34 ksi-in$^{1/2}$. Crack arrest was determined to occur when the crack growth rate fell below 10^{-9} inches/cycle. A plot of the crack growth versus cycle count for these tests is shown in figure 4-15. The lines drawn through the data indicate where the growth rate was computed for each test.

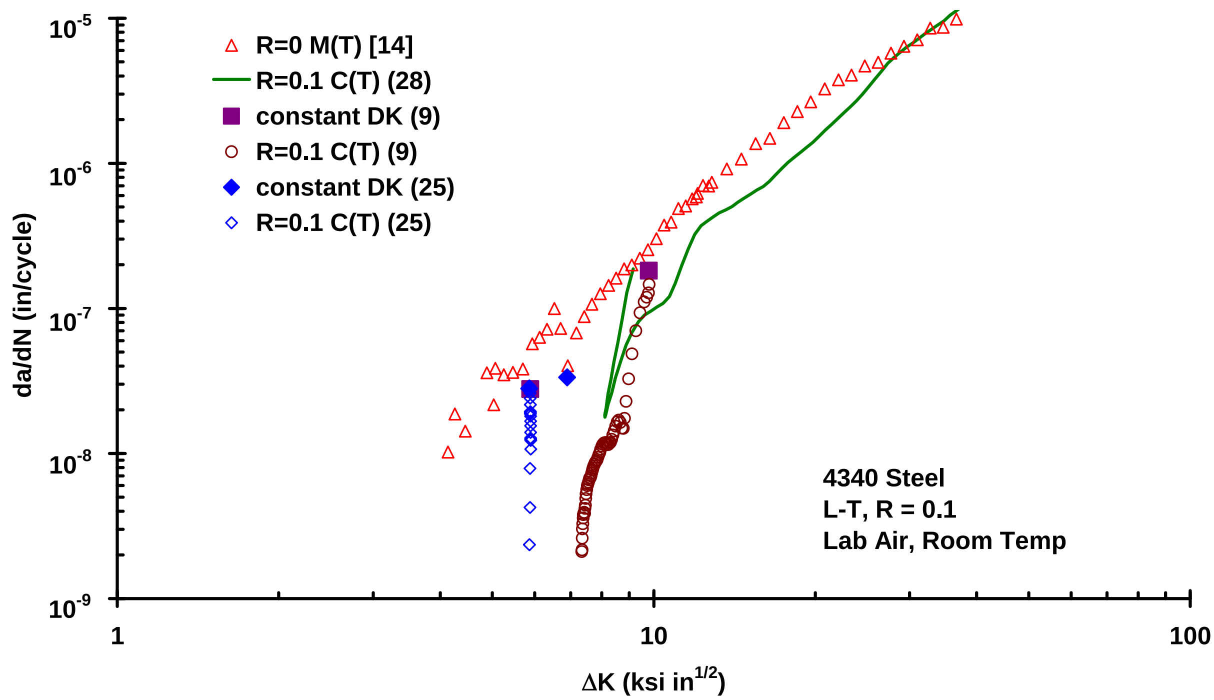


Figure 4-14. Comparison of Fatigue Crack Growth Rate Data for Steel Alloy 4340 (L-T)

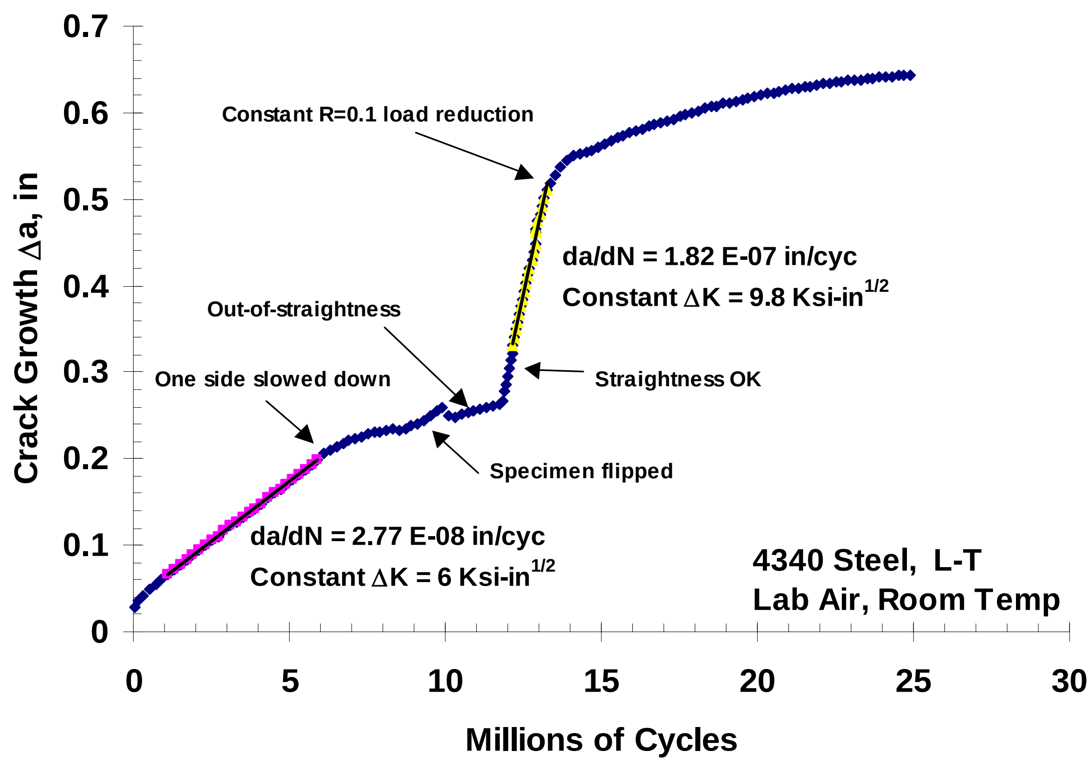


Figure 4-15. Fatigue Crack Growth Rate Data for Specimen 9 of Steel Alloy 4340 (L-T)

Specimen 25 was also compression precracked and subsequently tested at a constant ΔK of 6 ksi-in$^{1/2}$. The crack propagated for 0.20 inch under constant ΔK and was flipped in the test stand to pre-empt any crack front straightness issues similar to specimen 9. Fortunately, the crack propagated straight throughout the entire test. The crack growth rate computed from the constant ΔK of 6 ksi-in$^{1/2}$ test also matches the literature data well. A constant R = 0.1 load reduction test was then conducted, where the crack arrested at a ΔK of 5.85 ksi-in$^{1/2}$. A constant ΔK of 6.9 ksi-in$^{1/2}$ test was then conducted. The crack did not propagate for nearly 3 million cycles, then began to propagate at a rate of 3.35 x 10^{-8} inches/cycle. The reason for this delay is currently unknown.

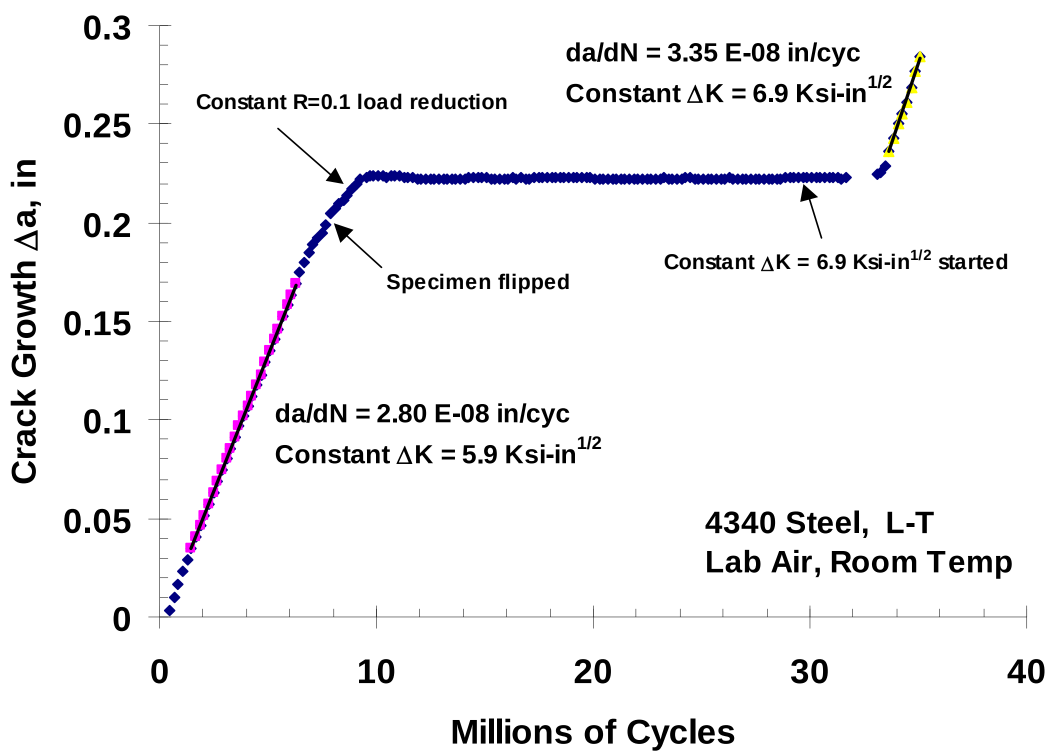


Figure 4-16. Fatigue Crack Growth Rate Data for Specimen 25 of Steel Alloy 4340 (L-T)

5. DISCUSSION.

The stress-life design of a propeller blade has always been mandated by the endurance limit, where failure does not occur (i.e., infinite life), because of the high-cycle fatigue loading seen in service. When transitioning to a DT design practice, the fatigue crack growth threshold, where crack initiation and arrest occurs, becomes the dominating factor in defining a service life. The stress-life endurance limit is simply defined by the number of cycles chosen to stop a stress-life test, in this case, 50 million cycles. There is only one experimental procedure that is widely accepted to determine the stress-life design curve. However, there have been numerous methods proposed to define the fatigue crack growth threshold. For instance, there are two widely accepted methods for experimentally determining threshold, constant R and constant K_{max} load reduction. Unfortunately, these two methods do not define the same threshold, requiring manipulation of the data to develop a threshold that could be used in a damage-tolerant design process.

The fatigue crack growth threshold testing of the propeller alloys 2025-T6 aluminum, D6AC steel, and the 4340 steel alloys led to several difficulties. The 2025-T6 generated mixed-mode cracking because of weak microstructural planes induced during the forging process. The out-of-plane cracking led to a significant portion of the test program being outside the ASTM guidelines for crack path straightness. A simple approach was devised using finite element analysis to adjust the data for mode-mixity with some success, found in Forth, et al. [3]. With the focus of the 2025-T6 being on mixed-mode crack growth, very little knowledge was gained about the fatigue crack growth threshold.

The fatigue crack growth threshold testing of the D6AC steel alloy led to a large fanning of threshold values based on stress ratio. It has been postulated in the literature [8, 9, and 12] that remote plasticity-induced crack closure is causing the constant R load reduction test method to produce artificially high threshold data. Compression precracking was used in combination with constant ΔK testing in an attempt to explain the variability at threshold using the plasticity-induced closure theory. The compression precracking method is positioned as an alternative means to generate near-threshold data without remote closure at low stress ratios. For the D6AC steel, several of the compression precracked specimens were tested at ΔK values below the threshold determined using the standard constant R load reduction method (R = 0.1). In each case, the crack propagated for nearly 0.1 inch then arrested. It is important to note that the compression precracking procedure imparts a tensile residual stress in the specimen [11] that can result in higher growth rates than anticipated. However, the effects of the residual stresses imparted in these tests should not have affected the crack for 0.1 inch. Furthermore, the plasticity theory would indicate that steady-state closure would have developed long before the crack arrested. Therefore, there must be another explanation for the crack arrest during the constant ΔK tests and the elevated thresholds obtained from the constant R load reduction tests. It has been postulated in the literature [15], and independently from a propeller manufacturer, that intergranular crack growth can occur near threshold in this alloy. The transition from transgranular crack growth to intergranular may explain the crack arrest witnessed in this test program, as intergranular cracking is typically at a much slower rate [15]. However, there were no measurements taken during this test program to confirm this theory. Other explanations for the arrest of the cracks are environmental effects such as crack face oxidation, and roughness-induced crack closure. In each test conducted at low stress ratios (*R* = 0.1 and 0.3), a visual examination of the fracture surface revealed a darkening near threshold, indicating oxide residue buildup. Measurements were not taken to quantify the level of oxide residue present. It is also plausible that roughness-induced closure caused the cracks to arrest. However, the fracture surfaces visually appeared smooth, since the grain size of D6AC steel is relatively small and large asperities were not clearly visible on the fracture surface. Therefore, roughness-induced closure may not be substantial. Separately, there has been evidence reported in the literature that specimen configuration and size can have a significant effect on the fatigue crack growth threshold [17]. A single test conducted on a smaller compact tension specimen (2 inches wide versus 3 inches used in this study) of the D6AC steel appears to confirm the hypothesis that specimen size affects threshold data. The 2-inch compact tension specimen resulted in a threshold of 4 ksi-in$^{1/2}$ compared to 6 ksi-in$^{1/2}$ for the 3-inch specimen, both tests were conducted at *R* = 0.1. There will be significant research needed to explain the fatigue crack growth threshold behavior of D6AC steel.

The fatigue crack growth threshold testing of the 4340 steel alloy led to an even larger fanning of the threshold than the D6AC. Once again, compression precracking was used to generate crack growth data near threshold for *R* = 0.1. In each load reduction test, the crack growth rate dropped dramatically, e.g., the slope of the *da*/*dN* versus ΔK curve was nearly infinite, indicating rapid crack arrest similar to the D6AC data. Constant ΔK = 6 ksi-in$^{1/2}$ testing, below the threshold of 7.34 ksi-in$^{1/2}$ determined from the constant *R* load reduction tests, was conducted on two compression precracked specimens, resulting in stable crack growth for more than 0.2 inch. In one case, a constant *R* load reduction test was conducted after the constant ΔK = 6 ksi-in$^{1/2}$ test resulting in the crack arresting at a ΔK of 5.85 ksi-in$^{1/2}$. The rapid arrest of the crack was similar to that of the standard constant *R* load reduction tests conducted using tensile precracking, indicating the crack arrest mechanisms are similar. Subsequent testing of this specimen at ΔK = 6.9 ksi-in$^{1/2}$ was conducted. The crack did not propagate for nearly 3 million cycles then began to propagate at a rate of 3.35 x 10^{-8} inches/cycle. The same hypotheses drawn for the arrest of the D6AC steel data (oxide- or roughness-induced crack closure, intergranular crack growth, specimen configuration) could be applicable to the 4340 steel. Once again, significant research will be needed to explain the fatigue crack growth threshold behavior of 4340 steel.

6. CONCLUSIONS.

The main conclusions from this study are as follows.

- The damage-tolerant design of a propeller system will require a complete understanding of the fatigue crack growth threshold.

- No experimental procedure exists to reliably develop the fatigue crack growth threshold data that is needed for damage-tolerant design methods.

- Significant research will be required to fully understand the fatigue crack growth threshold. The development of alternative precracking methods, evaluating the effect of specimen configuration, and attempting to identify micromechanical issues are simply the first steps to understanding the mechanics of the threshold.

7. REFERENCES.

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APPENDIX A—FATIGUE CRACK GROWTH RATE DATA (da/dN and ΔK) FOR 2025-T6 ALUMINUM ALLOY

The fatigue crack growth rate data (da/dN and ΔK) for 2025-T6 aluminum alloy are listed in tables A-1 through A-15.

Table A-1. Constant K_{max} FCG Data for Specimen 18-b1 of 2025-T6 Al

Specimen ID: 18-b1	Test: K_{max} = 10 ksi-in$^{1/2}$			Orientation: L-T	Out-of-Plane Angle: <5
ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)
8.63	3.82E-06	4.93	7.98E-07	2.81	1.15E-07
8.39	3.96E-06	4.79	6.88E-07	2.73	1.05E-07
8.16	3.63E-06	4.65	5.68E-07	2.65	9.43E-08
7.90	3.69E-06	4.51	4.90E-07	2.58	8.40E-08
7.70	3.67E-06	4.38	4.26E-07	2.50	7.50E-08
7.46	3.34E-06	4.25	3.71E-07	2.43	6.84E-08
7.25	3.17E-06	4.13	3.24E-07	2.36	6.25E-08
7.03	3.13E-06	4.01	2.85E-07	2.29	5.91E-08
6.83	2.91E-06	3.89	2.67E-07	2.22	5.70E-08
6.61	2.66E-06	3.78	2.47E-07	2.16	5.23E-08
6.43	2.54E-06	3.67	2.24E-07	2.10	4.48E-08
6.24	2.15E-06	3.56	2.09E-07	2.04	4.00E-08
6.06	1.91E-06	3.46	1.94E-07	1.98	3.59E-08
5.89	1.75E-06	3.36	1.79E-07	1.92	2.96E-08
5.72	1.56E-06	3.26	1.59E-07	1.86	2.38E-08
5.55	1.34E-06	3.17	1.45E-07	1.81	2.00E-08
5.39	1.17E-06	3.08	1.36E-07	1.76	1.81E-08
5.23	1.03E-06	2.98	1.24E-07	1.71	1.62E-08
5.07	8.98E-07	2.90	1.20E-07		

Table A-2. Constant K_{max} FCG Data for Specimen 20-b1 of 2025-T6 Al

Specimen ID: 20-b1 Test: K_{max} = 10 ksi-in$^{1/2}$			Orientation: L-T Out-of-Plane Angle: <5		
ΔK (ksi-in$^{1/2}$)	*da*/*dN* (inch/cycle)	ΔK (ksi-in$^{1/2}$)	*da*/*dN* (inch/cycle)	ΔK (ksi-in$^{1/2}$)	*da*/*dN* (inch/cycle)
8.53	3.51E-06	4.59	6.27E-07	2.47	6.92E-08
8.28	3.57E-06	4.46	5.57E-07	2.40	6.31E-08
8.04	3.42E-06	4.33	4.89E-07	2.33	5.77E-08
7.81	3.03E-06	4.20	4.48E-07	2.26	5.36E-08
7.57	2.83E-06	4.08	3.92E-07	2.19	4.90E-08
7.37	2.61E-06	3.96	3.38E-07	2.13	4.42E-08
7.15	2.52E-06	3.85	3.01E-07	2.07	4.04E-08
6.96	2.53E-06	3.74	2.74E-07	2.01	3.55E-08
6.76	2.31E-06	3.63	2.53E-07	1.95	3.17E-08
6.56	2.14E-06	3.52	2.27E-07	1.90	2.73E-08
6.36	2.01E-06	3.42	1.98E-07	1.84	2.10E-08
6.17	1.87E-06	3.32	1.75E-07	1.79	1.49E-08
5.98	1.70E-06	3.22	1.58E-07	1.73	1.04E-08
5.81	1.56E-06	3.13	1.43E-07	1.68	7.62E-09
5.65	1.43E-06	3.04	1.27E-07	1.64	5.92E-09
5.49	1.28E-06	2.95	1.13E-07	1.61	4.09E-09
5.33	1.14E-06	2.86	1.02E-07	1.58	2.97E-09
5.17	1.01E-06	2.78	9.19E-08	1.56	2.52E-09
5.02	9.09E-07	2.70	8.60E-08	1.53	1.85E-09
4.87	8.18E-07	2.62	8.03E-08	1.51	1.74E-09
4.73	7.01E-07	2.55	7.45E-08	1.49	1.71E-09

Table A-3. Constant K_{max} FCG Data for Specimen 7-b3 of 2025-T6 Al

Specimen ID: 7-b3			Orientation: L-T		
Test: K_{max} = 12.5 ksi-in$^{1/2}$			Out-of-Plane Angle: <5		
ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)
10.77	8.58E-06	5.12	1.07E-06	2.43	9.76E-08
10.45	8.52E-06	4.98	1.09E-06	2.37	8.21E-08
10.15	8.65E-06	4.82	9.29E-07	2.29	7.71E-08
9.85	7.72E-06	4.68	7.72E-07	2.23	8.02E-08
9.53	7.80E-06	4.55	6.06E-07	2.15	7.63E-08
9.28	7.92E-06	4.41	5.43E-07	2.09	7.12E-08
8.99	6.18E-06	4.28	5.01E-07	2.03	6.84E-08
8.72	6.21E-06	4.15	4.17E-07	1.97	6.12E-08
8.48	6.33E-06	4.03	3.79E-07	1.91	5.71E-08
8.21	5.48E-06	3.92	3.21E-07	1.86	4.99E-08
7.98	5.10E-06	3.80	2.97E-07	1.81	4.05E-08
7.75	4.88E-06	3.70	2.87E-07	1.75	3.86E-08
7.53	4.53E-06	3.58	2.57E-07	1.70	3.17E-08
7.32	4.03E-06	3.48	2.39E-07	1.65	2.67E-08
7.11	3.59E-06	3.37	2.15E-07	1.60	2.43E-08
6.89	3.21E-06	3.28	1.83E-07	1.55	1.99E-08
6.68	3.15E-06	3.18	1.59E-07	1.50	1.54E-08
6.50	2.69E-06	3.09	1.51E-07	1.46	1.36E-08
6.29	2.39E-06	3.00	1.32E-07	1.42	1.05E-08
6.13	2.43E-06	2.91	1.16E-07	1.38	7.10E-09
5.95	1.99E-06	2.83	1.10E-07	1.34	4.96E-09
5.77	1.84E-06	2.74	1.06E-07	1.30	3.38E-09
5.60	1.75E-06	2.64	1.31E-07	1.27	2.57E-09
5.43	1.60E-06	2.58	1.26E-07		
5.29	1.25E-06	2.49	9.38E-08		

Table A-4. Constant K_{max} FCG Data for Specimen 19-b2 of 2025-T6 Al

Specimen ID: 19-b2			Orientation: L-T		
Test: K_{max} = 15 ksi-in$^{1/2}$			Out-of-Plane Angle: 15		
ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)
12.86	1.29E-05	6.11	2.43E-06	2.88	1.42E-07
12.52	1.20E-05	5.92	2.08E-06	2.80	1.38E-07
12.13	1.18E-05	5.75	1.98E-06	2.71	1.28E-07
11.79	1.23E-05	5.58	1.81E-06	2.63	1.23E-07
11.44	1.16E-05	5.42	1.56E-06	2.55	1.16E-07
11.08	1.16E-05	5.25	1.34E-06	2.48	1.03E-07
10.77	1.22E-05	5.10	1.16E-06	2.41	9.26E-08
10.45	1.12E-05	4.95	1.00E-06	2.34	8.51E-08
10.14	9.90E-06	4.80	8.80E-07	2.27	8.00E-08
9.86	9.44E-06	4.66	7.92E-07	2.20	7.76E-08
9.56	8.74E-06	4.52	7.08E-07	2.14	7.13E-08
9.28	8.03E-06	4.39	6.29E-07	2.07	6.55E-08
9.00	7.46E-06	4.26	5.54E-07	2.01	6.00E-08
8.73	6.88E-06	4.13	4.94E-07	1.95	5.29E-08
8.48	6.31E-06	4.01	4.36E-07	1.89	4.73E-08
8.23	6.03E-06	3.88	4.07E-07	1.84	4.34E-08
8.00	5.63E-06	3.78	3.64E-07	1.78	4.01E-08
7.75	5.25E-06	3.66	3.12E-07	1.73	3.65E-08
7.53	4.80E-06	3.56	2.93E-07	1.68	3.35E-08
7.30	4.27E-06	3.45	2.59E-07	1.63	2.99E-08
7.09	3.88E-06	3.35	2.33E-07	1.58	2.38E-08
6.88	3.57E-06	3.25	2.19E-07	1.53	1.92E-08
6.69	3.14E-06	3.14	2.66E-07	1.49	1.54E-08
6.49	2.74E-06	3.06	2.46E-07	1.45	1.22E-08
6.29	2.72E-06	2.96	1.51E-07		

Table A-5. Constant K_{max} FCG Data for Specimen 20-b2 of 2025-T6 Al

Specimen ID: 20-b2	Test: K_{max} = 20.0 ksi-in$^{1/2}$		Orientation: L-T	Out-of-Plane Angle: 15	
ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)
9.47	1.13E-05	4.82	1.01E-06	2.43	8.75E-08
9.21	1.03E-05	4.66	8.25E-07	2.36	7.72E-08
8.92	9.09E-06	4.53	7.38E-07	2.29	7.21E-08
8.66	8.75E-06	4.39	6.00E-07	2.22	6.79E-08
8.40	7.99E-06	4.26	5.09E-07	2.16	5.87E-08
8.15	7.08E-06	4.14	5.42E-07	2.10	4.54E-08
7.91	6.82E-06	4.03	4.92E-07	2.03	4.07E-08
7.70	6.47E-06	3.91	3.65E-07	1.98	3.62E-08
7.47	5.40E-06	3.80	3.55E-07	1.92	2.93E-08
7.27	4.72E-06	3.69	3.52E-07	1.86	2.87E-08
7.06	4.44E-06	3.57	3.23E-07	1.81	2.80E-08
6.85	4.11E-06	3.47	2.78E-07	1.76	2.58E-08
6.65	3.66E-06	3.37	2.28E-07	1.71	2.45E-08
6.46	3.28E-06	3.27	2.19E-07	1.66	2.04E-08
6.28	2.76E-06	3.18	1.91E-07	1.61	1.65E-08
6.09	2.64E-06	3.08	1.60E-07	1.56	1.28E-08
5.92	2.58E-06	2.99	1.54E-07	1.52	9.88E-09
5.74	2.16E-06	2.90	1.35E-07	1.47	6.96E-09
5.57	1.82E-06	2.82	1.18E-07	1.43	4.95E-09
5.41	1.64E-06	2.74	1.13E-07	1.39	4.23E-09
5.26	1.49E-06	2.65	1.14E-07	1.35	3.18E-09
5.11	1.21E-06	2.58	1.12E-07	1.32	2.32E-09
4.96	1.13E-06	2.50	1.03E-07	1.29	2.03E-09

Table A-6. Constant K_{max} FCG Data for Specimen 12-b1 of 2025-T6 Al

Specimen ID: 12-b1			Orientation: L-T		
Test: K_{max} = 30.0 ksi-in$^{1/2}$			Out-of-Plane Angle: 10		
ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)
14.19	3.92E-05	6.54	4.08E-06	3.02	2.17E-07
13.79	3.85E-05	6.35	3.54E-06	2.93	1.90E-07
13.39	3.66E-05	6.17	3.22E-06	2.84	1.67E-07
12.99	3.34E-05	5.98	3.03E-06	2.76	1.54E-07
12.62	2.95E-05	5.81	2.72E-06	2.68	1.40E-07
12.25	2.78E-05	5.65	2.37E-06	2.61	1.21E-07
11.89	2.79E-05	5.48	2.11E-06	2.53	1.08E-07
11.54	2.53E-05	5.33	1.86E-06	2.45	1.02E-07
11.20	2.13E-05	5.17	1.66E-06	2.38	9.56E-08
10.86	2.06E-05	5.02	1.51E-06	2.31	8.88E-08
10.55	1.95E-05	4.87	1.41E-06	2.24	8.55E-08
10.24	1.61E-05	4.73	1.32E-06	2.18	8.52E-08
9.93	1.54E-05	4.59	1.18E-06	2.11	7.71E-08
9.66	1.42E-05	4.45	1.02E-06	2.05	6.35E-08
9.36	1.23E-05	4.32	9.05E-07	1.99	5.62E-08
9.09	1.17E-05	4.19	7.73E-07	1.93	5.72E-08
8.82	1.12E-05	4.07	6.75E-07	1.87	6.18E-08
8.56	1.02E-05	3.95	6.16E-07	1.82	5.35E-08
8.30	9.18E-06	3.84	5.35E-07	1.76	4.39E-08
8.07	8.56E-06	3.73	4.69E-07	1.71	4.02E-08
7.84	7.77E-06	3.61	4.25E-07	1.66	3.90E-08
7.60	7.08E-06	3.51	3.83E-07	1.62	3.57E-08
7.38	6.39E-06	3.40	3.47E-07	1.57	2.86E-08
7.16	5.70E-06	3.30	3.13E-07	1.52	2.54E-08
6.95	5.00E-06	3.20	2.67E-07		
6.74	4.56E-06	3.11	2.35E-07		

Table A-7. Constant K_{max} FCG Data for Specimen 16-b3 of 2025-T6 Al

Specimen ID: 16-b3			Orientation: L-T		
Test: K_{max} = 30.0 ksi-in$^{1/2}$			Out-of-Plane Angle: 7.5		
ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)
25.05	1.29E-04	9.31	1.33E-05	3.47	3.47E-07
24.19	1.25E-04	9.03	1.24E-05	3.37	3.08E-07
23.50	1.22E-04	8.78	1.25E-05	3.27	2.84E-07
22.79	1.20E-04	8.51	1.17E-05	3.17	2.71E-07
22.15	1.18E-04	8.26	1.01E-05	3.08	2.61E-07
21.53	1.17E-04	8.02	9.06E-06	2.99	2.42E-07
20.90	1.18E-04	7.79	9.07E-06	2.90	2.23E-07
20.28	1.10E-04	7.57	8.06E-06	2.82	2.08E-07
19.71	1.01E-04	7.35	6.56E-06	2.73	1.88E-07
19.11	8.79E-05	7.13	6.18E-06	2.65	1.62E-07
18.53	8.32E-05	6.92	5.48E-06	2.57	1.45E-07
18.02	7.83E-05	6.70	4.90E-06	2.50	1.40E-07
17.45	7.36E-05	6.52	4.41E-06	2.43	1.39E-07
16.97	6.98E-05	6.30	4.22E-06	2.35	1.34E-07
16.45	6.27E-05	6.13	3.89E-06	2.28	1.22E-07
15.97	5.88E-05	5.94	3.00E-06	2.22	1.11E-07
15.49	5.16E-05	5.77	2.67E-06	2.15	1.12E-07
15.03	4.85E-05	5.60	2.69E-06	2.09	1.06E-07
14.60	4.66E-05	5.45	2.41E-06	2.02	9.62E-08
14.17	3.97E-05	5.29	2.10E-06	1.97	8.20E-08
13.76	3.90E-05	5.14	2.06E-06	1.91	7.02E-08
13.36	4.03E-05	4.98	1.81E-06	1.86	7.15E-08
12.96	3.26E-05	4.83	1.52E-06	1.80	6.50E-08
12.58	2.83E-05	4.69	1.30E-06	1.75	5.24E-08
12.19	2.98E-05	4.55	1.18E-06	1.69	4.89E-08
11.82	2.65E-05	4.42	1.03E-06	1.65	4.14E-08
11.48	2.13E-05	4.28	8.87E-07	1.59	3.74E-08
11.12	2.24E-05	4.16	8.41E-07	1.55	3.56E-08
10.83	2.02E-05	4.04	7.45E-07	1.51	2.89E-08
10.48	1.84E-05	3.92	6.38E-07	1.46	3.42E-08
10.22	1.78E-05	3.80	5.67E-07	1.42	4.16E-08
9.87	1.56E-05	3.69	4.74E-07	1.38	3.67E-08
9.60	1.52E-05	3.58	3.99E-07	1.34	2.48E-08

Table A-8. Constant *R* (Decreasing Then Increasing Δ*K*) FCG Data for Specimen 20-b3 of 2025-T6 Al

Specimen ID: 20-b3	Test: $R = 0.7$		Orientation: L-T	Out-of-Plane Angle: 7	
Δ*K* (ksi-in$^{1/2}$)	*da*/*dN* (inch/cycle)	Δ*K* (ksi-in$^{1/2}$)	*da*/*dN* (inch/cycle)	Δ*K* (ksi-in$^{1/2}$)	*da*/*dN* (inch/cycle)
3.75	6.35E-07	2.07	7.51E-08	6.89	4.74E-06
3.60	4.80E-07	1.98	6.57E-08	7.25	5.76E-06
3.45	4.97E-07	1.90	5.48E-08	7.58	7.18E-06
3.31	3.93E-07	1.82	4.39E-08	7.95	9.07E-06
3.17	3.26E-07	1.74	3.95E-08	8.34	1.13E-05
3.04	2.79E-07	1.60	1.77E-08	8.73	1.44E-05
2.91	2.39E-07	1.53	9.12E-09	9.15	1.83E-05
2.79	2.02E-07	1.48	4.03E-09	9.60	2.47E-05
2.67	1.73E-07	4.70	1.09E-06	10.05	3.42E-05
2.56	1.50E-07	5.44	1.47E-06	10.57	4.84E-05
2.45	1.32E-07	5.70	1.65E-06	11.06	7.28E-05
2.35	1.15E-07	5.98	2.15E-06	11.60	1.29E-04
2.25	9.90E-08	6.27	2.77E-06	12.17	1.98E-04
2.16	8.53E-08	6.58	3.72E-06	12.71	3.99E-04

Table A-9. Constant *R* (Increasing Δ*K*) FCG Data for Specimen 12-b1 of 2025-T6 Al

Specimen ID: 12-b1	Test: $R = 0.5$		Orientation: L-T	Out-of-Plane Angle: 10	
Δ*K* (ksi-in$^{1/2}$)	*da*/*dN* (inch/cycle)	Δ*K* (ksi-in$^{1/2}$)	*da*/*dN* (inch/cycle)	Δ*K* (ksi-in$^{1/2}$)	*da*/*dN* (inch/cycle)
7.75	4.81E-06	9.55	1.00E-05	11.78	2.08E-05
7.96	5.26E-06	9.84	1.04E-05	12.14	2.31E-05
8.22	5.90E-06	10.14	1.14E-05	12.51	2.54E-05
8.47	6.69E-06	10.45	1.29E-05	12.89	2.73E-05
8.73	7.38E-06	10.77	1.46E-05	13.28	3.07E-05
9.00	8.27E-06	11.10	1.67E-05	13.69	3.45E-05
9.26	9.35E-06	11.43	1.89E-05	14.12	3.91E-05

Table A-10. Constant *R* (Increasing Δ*K*) FCG Data for Specimen 7-b3 of 2025-T6 Al

Specimen ID: 7-b3			Orientation: L-T		
Test: *R* = 0.5			Out-of-Plane Angle: <5		
Δ*K* (ksi-in$^{1/2}$)	*da*/*dN* (inch/cycle)	Δ*K* (ksi-in$^{1/2}$)	*da*/*dN* (inch/cycle)	Δ*K* (ksi-in$^{1/2}$)	*da*/*dN* (inch/cycle)
6.45	2.08E-06	10.16	1.11E-05	15.94	8.24E-05
6.55	2.24E-06	10.31	1.16E-05	16.16	8.38E-05
6.64	2.46E-06	10.47	1.23E-05	16.42	8.25E-05
6.75	2.66E-06	10.62	1.32E-05	16.67	9.46E-05
6.85	2.83E-06	10.77	1.31E-05	16.93	1.11E-04
6.96	3.06E-06	10.93	1.44E-05	17.19	1.17E-04
7.06	3.16E-06	11.09	1.60E-05	17.45	1.17E-04
7.17	3.43E-06	11.26	1.64E-05	17.71	1.29E-04
7.28	3.61E-06	11.43	1.67E-05	17.99	1.54E-04
7.39	3.55E-06	11.61	1.81E-05	18.28	1.86E-04
7.51	3.83E-06	11.77	1.86E-05	18.59	2.26E-04
7.62	4.35E-06	11.97	1.98E-05	18.86	2.52E-04
7.74	4.93E-06	12.14	2.13E-05	19.17	2.76E-04
7.85	5.08E-06	12.33	2.18E-05	19.44	3.01E-04
7.97	5.07E-06	12.52	2.33E-05	19.71	2.85E-04
8.09	5.13E-06	12.71	2.52E-05	20.04	2.85E-04
8.21	5.30E-06	12.89	2.59E-05	20.36	3.37E-04
8.34	5.70E-06	13.10	2.85E-05	20.68	3.88E-04
8.47	6.38E-06	13.29	3.05E-05	21.04	4.63E-04
8.60	6.98E-06	13.50	3.28E-05	21.36	5.06E-04
8.73	7.09E-06	13.70	4.19E-05	21.92	7.61E-04
8.86	7.43E-06	13.91	4.45E-05	22.30	1.03E-03
8.99	7.62E-06	14.12	4.19E-05	22.88	8.96E-04
9.13	7.88E-06	14.34	4.65E-05	23.29	8.01E-04
9.26	8.24E-06	14.56	5.59E-05	23.70	9.27E-04
9.40	8.68E-06	14.78	5.93E-05	24.20	1.11E-03
9.54	9.00E-06	15.00	5.72E-05	24.94	1.43E-03
9.69	9.08E-06	15.23	5.52E-05	25.94	1.71E-03
9.85	9.61E-06	15.46	6.18E-05		
10.00	1.04E-05	15.70	7.34E-05		

Table A-11. Constant R (Increasing ΔK) FCG Data for Specimen 16-b3 of 2025-T6 Al

Specimen ID: 16-b3			Orientation: L-T		
Test: $R = 0.7$			Out-of-Plane Angle: 7.5		
ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)
3.11	1.96E-07	4.43	4.29E-07	6.70	3.59E-06
3.16	1.68E-07	4.56	4.56E-07	6.90	4.25E-06
3.21	1.66E-07	4.71	5.39E-07	7.11	4.88E-06
3.25	1.60E-07	4.85	6.72E-07	7.33	5.53E-06
3.32	1.42E-07	4.99	7.87E-07	7.55	6.19E-06
3.39	1.50E-07	5.14	9.42E-07	7.77	6.84E-06
3.48	1.58E-07	5.29	1.13E-06	8.00	7.52E-06
3.59	1.88E-07	5.45	1.32E-06	8.25	8.70E-06
3.70	2.38E-07	5.62	1.82E-06	8.48	1.02E-05
3.81	2.60E-07	5.79	2.57E-06	8.74	1.16E-05
3.93	2.80E-07	5.96	2.87E-06	9.00	1.31E-05
4.05	3.18E-07	6.15	3.16E-06	9.28	1.49E-05
4.17	3.63E-07	6.32	3.53E-06	9.56	1.81E-05
4.30	4.02E-07	6.50	3.48E-06		

Table A-12. Constant R (Increasing ΔK) FCG Data for Specimen 19-b3 of 2025-T6 Al

Specimen ID: 19-b3			Orientation: L-T		
Test: $R = 0.7$			Out-of-Plane Angle: <5		
ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)
6.33	2.19E-06	8.21	7.75E-06	10.68	3.56E-05
6.50	2.45E-06	8.45	9.15E-06	10.97	4.91E-05
6.69	2.69E-06	8.71	1.06E-05	11.32	7.51E-05
6.89	3.03E-06	8.96	1.20E-05	11.69	1.32E-04
7.10	3.64E-06	9.22	1.38E-05	12.03	2.00E-04
7.31	4.31E-06	9.50	1.72E-05	12.54	3.52E-04
7.52	4.78E-06	9.78	2.02E-05	13.24	9.46E-04
7.75	5.44E-06	10.07	2.48E-05		
7.98	6.51E-06	10.36	2.99E-05		

Table A-13. Constant K_{max} FCG Data for Specimen 17-b3 of 2025-T6 Al

Specimen ID:	17-b3			Orientation:	T-L
Test:	K_{max} = 10 ksi-in$^{1/2}$			Out-of-Plane Angle:	<5
ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)
8.64	8.03E-06	4.34	5.19E-07	2.19	7.51E-08
8.46	5.79E-06	4.21	4.79E-07	2.12	6.94E-08
8.16	3.96E-06	4.09	4.36E-07	2.06	6.93E-08
8.02	5.41E-06	3.97	3.96E-07	2.00	6.85E-08
7.78	4.42E-06	3.86	3.61E-07	1.94	6.39E-08
7.52	4.20E-06	3.74	3.14E-07	1.88	5.69E-08
7.29	4.21E-06	3.63	2.62E-07	1.83	5.45E-08
7.05	3.96E-06	3.52	2.32E-07	1.77	4.69E-08
6.85	3.75E-06	3.42	2.26E-07	1.72	3.73E-08
6.65	3.25E-06	3.32	2.24E-07	1.67	3.15E-08
6.47	2.78E-06	3.22	2.04E-07	1.62	2.64E-08
6.29	2.41E-06	3.13	1.79E-07	1.58	2.21E-08
6.09	2.37E-06	3.04	1.68E-07	1.53	2.05E-08
5.91	2.29E-06	2.95	1.58E-07	1.48	1.67E-08
5.73	1.87E-06	2.86	1.46E-07	1.44	1.09E-08
5.55	1.55E-06	2.78	1.31E-07	1.40	7.67E-09
5.38	1.41E-06	2.69	1.20E-07	1.36	6.62E-09
5.21	1.31E-06	2.62	1.13E-07	1.32	5.32E-09
5.06	1.08E-06	2.54	1.06E-07	1.28	4.06E-09
4.90	8.61E-07	2.47	1.02E-07	1.24	3.08E-09
4.75	7.31E-07	2.39	1.03E-07	1.21	2.26E-09
4.61	6.39E-07	2.32	1.01E-07	1.18	1.75E-09
4.47	5.68E-07	2.25	8.92E-08	1.14	1.51E-09

Table A-14. Constant K_{max} FCG Data for Specimen 14-b3 of 2025-T6 Al

Specimen ID: 14-b3			Orientation: T-L		
Test: K_{max} = 10 ksi-in$^{1/2}$			Out-of-Plane Angle: <5		
ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)
9.31	5.71E-06	5.03	7.86E-07	2.60	1.05E-07
9.23	5.66E-06	4.88	6.44E-07	2.53	1.03E-07
9.11	5.46E-06	4.73	5.39E-07	2.45	9.95E-08
8.90	5.33E-06	4.60	4.83E-07	2.38	9.33E-08
8.64	5.09E-06	4.46	4.22E-07	2.31	8.22E-08
8.38	4.75E-06	4.33	3.59E-07	2.24	7.46E-08
8.13	4.44E-06	4.20	3.21E-07	2.17	7.07E-08
7.89	4.16E-06	4.08	2.90E-07	2.11	6.66E-08
7.65	3.91E-06	3.96	2.48E-07	2.05	6.39E-08
7.43	3.72E-06	3.84	2.25E-07	1.99	5.85E-08
7.21	3.40E-06	3.73	2.10E-07	1.93	5.07E-08
6.99	3.02E-06	3.62	1.91E-07	1.87	4.49E-08
6.79	2.72E-06	3.51	1.81E-07	1.82	3.95E-08
6.59	2.50E-06	3.41	1.80E-07	1.76	3.21E-08
6.39	2.32E-06	3.31	1.71E-07	1.71	2.61E-08
6.20	2.17E-06	3.21	1.57E-07	1.66	2.24E-08
6.02	1.98E-06	3.11	1.49E-07	1.61	1.95E-08
5.84	1.72E-06	3.02	1.40E-07	1.56	1.54E-08
5.67	1.49E-06	2.93	1.32E-07	1.51	1.19E-08
5.50	1.29E-06	2.85	1.23E-07	1.44	7.07E-09
5.34	1.07E-06	2.76	1.15E-07		
5.18	9.04E-07	2.68	1.08E-07		

Table A-15. Constant R (Increasing ΔK) FCG Data for Specimen 13-b3 of 2025-T6 Al

Specimen ID: 13-b3			Orientation: T-L		
Test: R = 0.7			Out-of-Plane Angle: <5		
ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)
3.19	1.77E-07	4.10	4.02E-07	6.12	3.80E-06
3.24	1.87E-07	4.19	4.03E-07	6.29	4.09E-06
3.30	1.83E-07	4.31	4.35E-07	6.46	4.28E-06
3.36	2.01E-07	4.43	5.30E-07	6.66	5.62E-06
3.42	2.30E-07	4.56	6.38E-07	6.84	7.15E-06
3.48	2.43E-07	4.70	7.87E-07	7.05	8.10E-06
3.54	2.59E-07	4.84	9.66E-07	7.26	9.15E-06
3.61	2.70E-07	4.99	1.20E-06	7.46	1.05E-05
3.68	2.68E-07	5.14	1.52E-06	7.69	1.32E-05
3.75	2.88E-07	5.30	1.91E-06	7.91	1.57E-05
3.81	2.91E-07	5.45	2.12E-06	8.15	1.76E-05
3.89	2.91E-07	5.62	2.35E-06	8.39	2.34E-05
3.94	3.13E-07	5.78	2.82E-06	8.62	3.19E-05
4.02	3.38E-07	5.95	3.27E-06		

APPENDIX B—FATIGUE CRACK GROWTH RATE DATA (*da*/*dN* AND Δ*K*) FOR D6AC STEEL ALLOY

The fatigue crack growth rate data (*da*/*dN* and Δ*K*) for D6AC steel alloy are listed in tables B-1 through B-48 sequentially by specimen orientation and number. Italicized data does not meet the ASTM E 647 requirement for remaining ligament length.

Table B-1. Constant K_{max} FCG Data for Specimen 1 L-T of D6AC Steel

Specimen ID: 1			Orientation: L-T		
Test: K_{max} = 20 ksi-in$^{1/2}$					
Δ*K* (ksi-in$^{1/2}$)	*da*/*dN* (inch/cycle)	Δ*K* (ksi-in$^{1/2}$)	*da*/*dN* (inch/cycle)	Δ*K* (ksi-in$^{1/2}$)	*da*/*dN* (inch/cycle)
17.96	2.22E-06	4.52	7.07E-08	3.11	1.86E-08
17.70	2.27E-06	4.46	6.69E-08	3.10	1.82E-08
17.56	2.12E-06	4.40	6.39E-08	3.09	1.64E-08
17.04	1.91E-06	4.34	6.19E-08	3.08	1.64E-08
16.54	1.76E-06	4.29	5.48E-08	3.07	1.66E-08
16.05	1.64E-06	4.24	5.35E-08	3.06	1.64E-08
15.57	1.51E-06	4.20	5.65E-08	3.05	1.55E-08
15.11	1.40E-06	4.15	5.34E-08	3.04	1.48E-08
14.66	1.30E-06	4.10	5.25E-08	3.03	1.50E-08
14.23	1.20E-06	4.06	5.19E-08	3.02	1.50E-08
13.81	1.12E-06	4.02	5.13E-08	3.01	1.47E-08
13.40	1.04E-06	3.98	4.96E-08	3.00	1.38E-08
13.00	9.61E-07	3.94	4.68E-08	3.00	1.21E-08
12.62	8.85E-07	3.90	4.47E-08	2.99	1.30E-08
12.25	8.17E-07	3.87	4.34E-08	2.98	1.54E-08
11.89	7.57E-07	3.83	4.21E-08	2.97	1.59E-08
11.53	7.02E-07	3.80	4.06E-08	2.96	1.36E-08
11.19	6.52E-07	3.77	4.21E-08	2.95	1.23E-08
10.86	6.04E-07	3.74	3.71E-08	2.95	1.28E-08
10.54	5.57E-07	3.71	3.36E-08	2.94	1.23E-08
10.23	5.20E-07	3.69	3.58E-08	2.93	1.21E-08
9.93	4.87E-07	3.66	3.52E-08	2.92	1.23E-08
9.63	4.45E-07	3.63	3.49E-08	2.92	1.25E-08
9.35	4.14E-07	3.61	3.50E-08	2.91	1.20E-08
9.08	3.91E-07	3.58	3.47E-08	2.90	1.40E-08
8.81	3.65E-07	3.56	3.36E-08	2.89	1.45E-08
8.55	3.35E-07	3.53	3.36E-08	2.89	1.06E-08
8.30	3.10E-07	3.51	3.21E-08	2.88	9.17E-09
8.05	2.92E-07	3.49	2.96E-08	2.87	1.08E-08
7.81	2.71E-07	3.47	2.92E-08	2.87	1.38E-08
7.58	2.50E-07	3.45	2.92E-08	2.86	1.35E-08
7.36	2.30E-07	3.43	2.84E-08	2.85	1.09E-08
7.14	2.14E-07	3.41	2.76E-08	2.85	8.94E-09
6.92	2.01E-07	3.39	2.64E-08	2.84	7.52E-09
6.72	1.86E-07	3.37	2.54E-08	2.84	9.66E-09

Table B-1. Constant K_{max} FCG Data for Specimen 1 L-T of D6AC Steel (Continued)

Specimen ID: 1 Test: K_{max} = 20 ksi-in$^{1/2}$			Orientation: L-T		
ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)
6.52	1.73E-07	3.35	2.56E-08	2.83	1.18E-08
6.33	1.61E-07	3.34	2.55E-08	2.82	1.08E-08
6.15	1.51E-07	3.32	2.48E-08	2.82	9.44E-09
5.97	1.41E-07	3.30	2.43E-08	2.81	9.22E-09
5.81	1.31E-07	3.29	2.39E-08	2.81	9.08E-09
5.66	1.21E-07	3.27	2.28E-08	2.80	1.06E-08
5.52	1.15E-07	3.26	2.19E-08	2.80	9.98E-09
5.40	1.09E-07	3.24	2.14E-08	2.79	6.90E-09
5.28	1.02E-07	3.23	2.14E-08	2.79	7.42E-09
5.18	9.81E-08	3.21	2.13E-08	2.78	9.94E-09
5.08	9.48E-08	3.20	2.04E-08	2.78	9.76E-09
4.98	9.06E-08	3.19	2.00E-08	2.77	8.83E-09
4.89	8.77E-08	3.17	2.00E-08	2.77	8.66E-09
4.81	8.22E-08	3.16	1.95E-08	2.76	7.38E-09
4.73	7.67E-08	3.15	1.88E-08	2.76	7.19E-09
4.66	7.42E-08	3.14	1.82E-08	2.75	7.64E-09
4.59	7.29E-08	3.12	1.76E-08	2.75	7.50E-09

Table B-2. Constant R (Decreasing Then Increasing ΔK) FCG Data for Specimen 2 L-T of D6AC Steel

Specimen ID: 2 Test: R = 0.1			Orientation: L-T		
ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)
8.22	2.19E-07	11.28	6.70E-07	22.28	4.18E-06
8.01	1.92E-07	11.63	7.22E-07	23.03	4.95E-06
7.78	1.66E-07	12.00	7.79E-07	23.69	5.42E-06
7.56	1.43E-07	12.38	8.38E-07	24.47	5.26E-06
7.34	1.25E-07	12.77	8.98E-07	25.18	5.62E-06
7.12	1.08E-07	13.17	9.65E-07	25.96	6.05E-06
6.92	8.98E-08	13.58	1.04E-06	26.79	6.48E-06
6.72	7.13E-08	14.00	1.12E-06	27.63	6.96E-06
6.53	5.68E-08	14.44	1.21E-06	28.51	7.49E-06
6.34	4.43E-08	14.89	1.31E-06	29.41	8.00E-06
6.15	3.00E-08	15.35	1.42E-06	30.33	8.53E-06
5.87	1.27E-08	15.85	1.56E-06	31.29	9.11E-06
5.77	1.02E-08	16.35	1.71E-06	32.27	9.68E-06
5.57	7.44E-09	16.86	1.87E-06	33.28	1.02E-05
5.56	8.19E-09	17.40	2.06E-06	34.33	1.09E-05
5.56	7.30E-09	17.94	2.26E-06	35.42	1.16E-05

Table B-2. Constant R (Decreasing Then Increasing ΔK) FCG Data for Specimen 2 L-T of D6AC Steel (Continued)

Specimen ID: 2 Test: $R = 0.1$			Orientation: L-T		
ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)
5.55	2.72E-09	18.50	2.49E-06	36.52	1.24E-05
5.54	4.35E-09	19.09	2.72E-06	37.67	1.31E-05
5.54	6.51E-09	19.69	2.99E-06	38.83	1.39E-05
5.54	3.89E-09	20.30	3.26E-06	40.04	1.47E-05
5.53	6.08E-09	20.94	3.55E-06	41.28	1.56E-05
10.94	6.24E-07	21.60	3.87E-06		

Table B-3. Constant K_{max} FCG Data for Specimen 5 L-T of D6AC Steel

Specimen ID: 5 Test: K_{max} = 15 ksi-in$^{1/2}$			Orientation: L-T		
ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)
13.80	9.50E-07	3.22	2.11E-08	2.53	4.25E-09
12.88	8.04E-07	3.18	2.05E-08	2.52	4.02E-09
12.31	6.94E-07	3.15	1.95E-08	2.52	4.08E-09
11.76	6.32E-07	3.11	1.96E-08	2.51	4.49E-09
11.24	5.91E-07	3.08	1.89E-08	2.51	4.38E-09
10.74	5.46E-07	3.05	1.71E-08	2.50	3.91E-09
10.26	4.84E-07	3.02	1.68E-08	2.50	3.71E-09
9.81	4.25E-07	3.00	1.57E-08	2.49	2.86E-09
9.36	3.94E-07	2.97	1.50E-08	2.49	2.72E-09
8.95	3.46E-07	2.95	1.43E-08	2.48	3.34E-09
8.55	2.99E-07	2.93	1.34E-08	2.48	3.30E-09
8.17	2.73E-07	2.91	1.32E-08	2.48	3.32E-09
7.81	2.42E-07	2.89	1.26E-08	2.47	3.39E-09
7.47	2.15E-07	2.87	1.20E-08	2.47	3.17E-09
7.14	1.89E-07	2.85	1.23E-08	2.46	3.07E-09
6.82	1.72E-07	2.83	1.16E-08	2.46	3.19E-09
6.52	1.60E-07	2.81	1.06E-08	2.45	2.95E-09
6.23	1.31E-07	2.80	1.03E-08	2.45	2.63E-09
5.94	1.18E-07	2.78	9.72E-09	2.45	2.43E-09
5.69	1.18E-07	2.77	9.84E-09	2.44	2.72E-09
5.43	1.08E-07	2.74	9.67E-09	2.44	3.03E-09
5.21	8.58E-08	2.73	7.94E-09	2.44	2.32E-09
4.99	7.57E-08	2.71	7.59E-09	2.44	8.31E-10
4.80	7.83E-08	2.70	8.29E-09	2.43	1.41E-09
4.62	7.37E-08	2.69	8.63E-09	2.43	2.02E-09
4.45	6.54E-08	2.68	8.60E-09	2.43	2.13E-09
4.30	5.84E-08	2.67	7.64E-09	2.42	3.18E-09
4.18	4.76E-08	2.65	7.87E-09	2.42	2.95E-09
4.06	4.31E-08	2.63	8.25E-09	2.42	7.08E-10

Table B-3. Constant K_{max} FCG Data for Specimen 5 L-T of D6AC Steel (Continued)

Specimen ID: 5	Test: K_{max} = 15 ksi-in$^{1/2}$		Orientation: L-T		
ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)
3.97	4.61E-08	2.61	7.14E-09	2.42	5.74E-12
3.88	4.44E-08	2.60	6.68E-09	2.42	1.64E-09
3.79	4.21E-08	2.60	6.13E-09	2.41	2.56E-09
3.70	3.99E-08	2.59	5.76E-09	2.41	2.80E-09
3.63	3.70E-08	2.58	5.51E-09	2.41	2.85E-09
3.56	3.35E-08	2.57	5.34E-09	2.40	2.86E-09
3.50	3.04E-08	2.56	5.08E-09	2.40	2.33E-09
3.44	2.85E-08	2.56	4.65E-09	2.40	2.32E-09
3.39	2.77E-08	2.55	4.71E-09	2.39	2.60E-09
3.34	2.59E-08	2.55	4.77E-09	2.39	2.28E-09
3.30	2.35E-08	2.54	3.38E-09		
3.25	2.20E-08	2.53	3.26E-09		

Table B-4. Constant R (Increasing ΔK) FCG Data for Specimen 5 L-T of D6AC Steel

Specimen ID: 5	Test: R = 0.3		Orientation: L-T		
ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)
13.06	1.05E-06	19.53	3.52E-06	29.13	9.19E-06
13.66	1.19E-06	20.42	3.80E-06	30.46	1.01E-05
14.29	1.39E-06	21.33	4.39E-06	31.85	1.09E-05
14.93	1.67E-06	22.29	4.90E-06	33.30	1.23E-05
15.62	1.92E-06	23.33	5.46E-06	34.82	1.50E-05
16.32	2.14E-06	24.39	6.06E-06	36.43	2.06E-05
17.09	2.40E-06	25.51	6.69E-06	39.90	5.16E-05
17.86	2.78E-06	26.67	7.33E-06		
18.70	3.25E-06	27.87	8.09E-06		

Table B-5. Constant R (Decreasing Then Increasing ΔK) FCG Data for Specimen 8 L-T of D6AC Steel

Specimen ID: 8	Test: R = 0.1		Orientation: L-T		
ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)
10.68	3.53E-07	6.63	4.86E-08	14.95	1.03E-06
9.82	2.91E-07	6.70	5.33E-08	15.23	1.09E-06
9.39	2.51E-07	6.77	5.74E-08	15.50	1.14E-06
8.99	2.06E-07	6.86	6.27E-08	15.78	1.19E-06
6.64	6.56E-08	6.95	6.92E-08	16.07	1.25E-06
6.95	5.35E-08	7.05	7.60E-08	16.35	1.30E-06

Table B-5. Constant R (Decreasing Then Increasing ΔK) FCG Data for Specimen 8 L-T of D6AC Steel (Continued)

Specimen ID: 8 Test: R = 0.1			Orientation: L-T		
ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)
6.48	4.12E-08	7.16	8.28E-08	16.65	1.36E-06
6.36	3.35E-08	7.28	8.97E-08	16.96	1.43E-06
6.26	2.70E-08	7.41	9.94E-08	17.27	1.52E-06
6.18	2.17E-08	7.54	1.12E-07	17.58	1.61E-06
6.12	1.78E-08	7.68	1.24E-07	17.90	1.72E-06
6.07	1.47E-08	7.82	1.34E-07	18.22	1.84E-06
6.02	1.46E-08	7.97	1.47E-07	18.54	1.96E-06
5.99	1.19E-08	8.11	1.64E-07	18.88	2.10E-06
5.95	8.19E-09	8.26	1.79E-07	19.22	2.26E-06
5.93	7.04E-09	8.41	1.94E-07	19.58	2.43E-06
5.91	6.50E-09	8.56	2.07E-07	19.95	2.60E-06
5.89	5.64E-09	8.71	2.22E-07	20.31	2.77E-06
5.88	4.92E-09	8.88	2.40E-07	20.67	2.96E-06
5.94	7.72E-09	9.04	2.63E-07	21.04	3.17E-06
5.94	8.12E-09	9.20	2.85E-07	21.42	3.38E-06
6.01	8.51E-09	9.37	3.08E-07	21.81	3.58E-06
6.02	7.06E-09	9.54	3.29E-07	22.21	3.77E-06
6.03	6.64E-09	9.71	3.47E-07	22.61	3.97E-06
6.04	8.46E-09	9.89	3.55E-07	23.02	4.23E-06
6.05	9.38E-09	10.06	3.75E-07	23.44	4.52E-06
6.06	9.60E-09	10.25	4.17E-07	23.87	4.79E-06
6.07	1.03E-08	10.43	4.49E-07	24.30	5.08E-06
6.09	1.05E-08	10.62	4.66E-07	24.74	5.38E-06
6.10	1.14E-08	10.82	4.81E-07	25.19	5.67E-06
6.11	1.20E-08	11.01	4.99E-07	25.64	5.94E-06
6.13	1.19E-08	11.21	5.26E-07	26.11	6.21E-06
6.14	1.18E-08	11.42	5.40E-07	26.58	6.49E-06
6.16	1.30E-08	11.63	5.50E-07	27.06	6.79E-06
6.18	1.63E-08	11.84	5.80E-07	27.56	7.08E-06
6.20	1.95E-08	12.05	6.09E-07	28.05	7.38E-06
6.22	2.07E-08	12.27	6.28E-07	28.56	7.70E-06
6.25	2.01E-08	12.49	6.51E-07	29.08	8.02E-06
6.27	1.95E-08	12.72	6.85E-07	29.61	8.34E-06
6.30	2.09E-08	12.95	7.11E-07	30.15	8.66E-06
6.33	2.37E-08	13.19	7.46E-07	30.70	8.98E-06
6.36	2.57E-08	13.42	7.89E-07	31.26	9.29E-06
6.39	2.71E-08	13.67	8.28E-07	31.82	9.65E-06
6.43	2.92E-08	13.91	8.73E-07	32.40	1.01E-05
6.47	3.35E-08	14.16	9.12E-07	32.98	1.06E-05
6.52	3.92E-08	14.42	9.48E-07	33.57	1.10E-05
6.57	4.38E-08	14.69	9.90E-07	34.17	1.10E-05

Table B-6. Constant R (Increasing ΔK) FCG Data for Specimen 10 L-T of D6AC Steel

Specimen ID: 10 Test: R = 0.3			Orientation: L-T		
ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)
10.64	5.60E-07	18.87	2.74E-06	39.86	1.65E-05
10.64	5.45E-07	19.38	2.98E-06	40.94	1.76E-05
10.64	5.41E-07	19.91	3.24E-06	42.03	1.88E-05
10.64	5.24E-07	20.45	3.51E-06	43.17	2.00E-05
10.63	5.16E-07	21.01	3.78E-06	44.35	2.14E-05
10.63	5.12E-07	21.56	4.07E-06	45.55	2.30E-05
10.70	5.15E-07	22.15	4.37E-06	46.79	2.46E-05
10.84	5.26E-07	22.76	4.69E-06	48.03	2.65E-05
11.06	5.48E-07	23.38	5.03E-06	49.32	2.85E-05
11.36	5.83E-07	24.02	5.38E-06	50.64	3.08E-05
11.68	6.27E-07	24.68	5.75E-06	51.99	3.33E-05
11.99	6.76E-07	25.34	6.14E-06	53.41	3.59E-05
12.32	7.30E-07	26.02	6.52E-06	54.87	3.88E-05
12.66	7.88E-07	26.72	6.92E-06	56.36	4.22E-05
13.00	8.50E-07	27.43	7.36E-06	57.90	4.58E-05
13.35	9.18E-07	28.18	7.79E-06	59.45	5.01E-05
13.71	9.94E-07	28.94	8.24E-06	61.06	5.61E-05
14.08	1.08E-06	29.71	8.75E-06	62.69	6.32E-05
14.46	1.16E-06	30.52	9.26E-06	64.59	7.00E-05
14.85	1.26E-06	31.35	9.78E-06	66.15	7.70E-05
15.25	1.37E-06	32.20	1.03E-05	68.12	8.17E-05
15.67	1.49E-06	33.08	1.10E-05	69.73	8.91E-05
16.09	1.63E-06	33.98	1.16E-05	71.58	9.67E-05
16.53	1.78E-06	34.89	1.23E-05	73.51	1.06E-04
16.97	1.94E-06	35.81	1.30E-05	75.49	1.16E-04
17.43	2.12E-06	36.80	1.38E-05	77.57	1.27E-04
17.90	2.31E-06	37.78	1.46E-05	79.63	1.36E-04
18.37	2.52E-06	38.82	1.55E-05	81.82	1.53E-04

Table B-7. Constant R (Increasing ΔK) FCG Data for Specimen 12 L-T of D6AC Steel

Specimen ID: 12 Test: R = 0.9			Orientation: L-T		
ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)
6.00	1.75E-07	9.04	5.07E-07	13.76	2.67E-06
6.06	1.79E-07	9.20	5.32E-07	13.99	3.19E-06
6.15	1.86E-07	9.36	5.60E-07	14.25	3.54E-06
6.26	1.94E-07	9.52	5.88E-07	14.48	4.02E-06
6.37	2.02E-07	9.69	6.16E-07	14.73	4.50E-06
6.48	2.11E-07	9.86	6.49E-07	14.99	5.09E-06
6.60	2.21E-07	10.03	6.84E-07	15.25	5.88E-06

Table B-7. Constant R (Increasing ΔK) FCG Data for Specimen 12 L-T of D6AC Steel (Continued)

Specimen ID: 12 Test: R = 0.9			Orientation: L-T		
da/dN (inch/cycle)	ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi-in$^{1/2}$)
6.71	2.31E-07	10.21	7.20E-07	15.53	6.84E-06
6.83	2.42E-07	10.39	7.59E-07	15.81	7.82E-06
6.95	2.53E-07	10.57	8.01E-07	16.09	8.96E-06
7.08	2.65E-07	10.76	8.49E-07	16.37	1.02E-05
7.20	2.77E-07	10.96	9.00E-07	16.66	1.15E-05
7.33	2.90E-07	11.16	9.55E-07	16.95	1.28E-05
7.46	3.04E-07	11.35	1.02E-06	17.25	1.43E-05
7.59	3.18E-07	11.55	1.09E-06	17.55	1.60E-05
7.72	3.32E-07	11.75	1.16E-06	17.85	1.77E-05
7.86	3.47E-07	11.95	1.22E-06	18.17	2.00E-05
8.00	3.62E-07	12.16	1.27E-06	18.48	2.38E-05
8.14	3.79E-07	12.37	1.33E-06	18.81	3.26E-05
8.28	3.98E-07	12.60	1.38E-06	19.15	4.71E-05
8.43	4.17E-07	12.82	1.47E-06	19.52	6.29E-05
8.58	4.37E-07	13.05	1.63E-06	19.89	1.78E-04
8.73	4.58E-07	13.28	1.88E-06		
8.88	4.81E-07	13.51	2.24E-06		

Table B-8. Constant R (Decreasing Then Increasing ΔK) FCG Data for Specimen 21 L-T of D6AC Steel

Specimen ID: 21 Test: R = 0.3			Orientation: L-T		
ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)
11.44	6.24E-07	11.22	6.70E-07	27.63	7.47E-06
9.90	4.23E-07	11.43	6.97E-07	28.13	7.76E-06
9.72	4.04E-07	11.63	7.21E-07	28.64	8.06E-06
9.55	3.82E-07	11.85	7.45E-07	29.17	8.37E-06
9.38	3.62E-07	12.06	7.74E-07	29.70	8.68E-06
9.21	3.44E-07	12.28	8.10E-07	30.25	9.01E-06
9.04	3.25E-07	12.51	8.46E-07	30.80	9.35E-06
8.88	3.08E-07	12.73	8.78E-07	31.36	9.65E-06
8.72	2.94E-07	12.97	9.16E-07	31.93	1.00E-05
8.57	2.80E-07	13.21	9.58E-07	32.50	1.04E-05
8.42	2.64E-07	13.45	1.00E-06	33.09	1.08E-05
8.27	2.51E-07	13.69	1.05E-06	33.70	1.12E-05
8.12	2.39E-07	13.94	1.10E-06	34.30	1.16E-05
7.97	2.26E-07	14.19	1.15E-06	34.93	1.20E-05
7.83	2.15E-07	14.45	1.21E-06	35.56	1.25E-05
7.69	2.04E-07	14.71	1.27E-06	36.20	1.29E-05

Table B-8. Constant *R* (Decreasing Then Increasing ΔK) FCG Data for Specimen 21 L-T of D6AC Steel (Continued)

Specimen ID: 21	Test: $R = 0.3$		Orientation: L-T		
ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)
7.55	1.93E-07	14.98	1.34E-06	36.85	1.34E-05
7.42	1.80E-07	15.25	1.42E-06	37.52	1.40E-05
7.29	1.68E-07	15.53	1.50E-06	38.20	1.45E-05
7.16	1.57E-07	15.81	1.58E-06	38.90	1.50E-05
7.03	1.45E-07	16.10	1.68E-06	39.61	1.56E-05
6.91	1.33E-07	16.40	1.79E-06	40.33	1.62E-05
6.78	1.22E-07	16.69	1.89E-06	41.07	1.69E-05
6.66	1.11E-07	16.99	2.01E-06	41.81	1.76E-05
6.54	9.77E-08	17.29	2.15E-06	42.58	1.83E-05
6.42	8.80E-08	17.61	2.27E-06	43.35	1.89E-05
6.31	8.18E-08	17.93	2.37E-06	44.14	1.95E-05
6.20	7.45E-08	18.26	2.51E-06	44.95	2.04E-05
6.09	6.80E-08	18.60	2.66E-06	45.77	2.13E-05
5.98	6.25E-08	18.94	2.81E-06	46.61	2.23E-05
5.87	5.54E-08	19.29	2.98E-06	47.44	2.33E-05
5.77	4.80E-08	19.63	3.14E-06	48.30	2.42E-05
5.67	4.27E-08	19.98	3.31E-06	49.16	2.52E-05
5.58	3.87E-08	20.34	3.48E-06	50.06	2.63E-05
5.50	3.47E-08	20.71	3.67E-06	50.98	2.76E-05
5.43	3.04E-08	21.09	3.86E-06	51.93	2.89E-05
5.36	2.58E-08	21.47	4.05E-06	52.88	3.04E-05
5.31	2.30E-08	21.87	4.26E-06	53.84	3.20E-05
5.26	2.05E-08	22.26	4.46E-06	54.79	3.41E-05
5.22	1.64E-08	22.66	4.67E-06	55.78	3.59E-05
5.19	1.38E-08	23.07	4.90E-06	56.77	3.73E-05
5.16	1.28E-08	23.49	5.12E-06	57.82	3.92E-05
5.14	1.14E-08	23.92	5.35E-06	58.87	4.18E-05
5.11	1.14E-08	24.36	5.58E-06	59.93	4.49E-05
5.09	9.75E-09	24.80	5.83E-06	61.02	4.83E-05
5.07	9.42E-09	25.24	6.07E-06	62.12	5.13E-05
5.03	8.66E-09	25.70	6.33E-06	63.26	5.36E-05
5.01	7.51E-09	26.17	6.62E-06	64.41	5.47E-05
10.67	6.19E-07	26.65	6.88E-06		
11.02	6.44E-07	27.14	7.17E-06		

Table B-9. Constant *R* (Decreasing Then Increasing Δ*K*) FCG Data for Specimen 23 L-T of D6AC Steel

Specimen ID: 23 Test: *R* = 0.7			Orientation: L-T		
Δ*K* (ksi-in$^{1/2}$)	*da*/*dN* (inch/cycle)	Δ*K* (ksi-in$^{1/2}$)	*da*/*dN* (inch/cycle)	Δ*K* (ksi-in$^{1/2}$)	*da*/*dN* (inch/cycle)
11.11	6.34E-07	3.70	3.13E-08	2.82	3.59E-09
10.91	5.93E-07	3.67	3.06E-08	2.82	5.54E-09
10.72	5.61E-07	3.65	2.74E-08	2.82	5.64E-09
10.53	5.46E-07	3.63	2.69E-08	2.82	7.94E-09
10.34	5.20E-07	3.61	3.06E-08	2.81	7.57E-09
10.16	4.89E-07	3.59	3.11E-08	2.81	4.68E-09
9.97	4.70E-07	3.57	2.62E-08	2.80	4.27E-09
9.79	4.49E-07	3.55	2.50E-08	2.80	5.68E-09
9.62	4.28E-07	3.53	2.46E-08	2.80	6.92E-09
9.45	4.11E-07	3.52	2.39E-08	2.80	6.21E-09
9.28	3.90E-07	3.50	2.54E-08	12.69	8.35E-07
9.12	3.72E-07	3.48	2.48E-08	13.01	9.00E-07
8.96	3.57E-07	3.47	2.32E-08	13.26	9.75E-07
8.80	3.40E-07	3.45	2.30E-08	13.48	1.20E-06
8.65	3.20E-07	3.43	2.23E-08	13.74	1.32E-06
8.49	3.15E-07	3.42	2.18E-08	14.00	1.44E-06
8.33	3.02E-07	3.40	2.28E-08	14.27	1.48E-06
8.18	2.77E-07	3.39	2.32E-08	14.55	1.51E-06
8.04	2.67E-07	3.37	2.04E-08	14.82	1.64E-06
7.90	2.56E-07	3.36	1.92E-08	15.10	1.74E-06
7.76	2.48E-07	3.35	1.86E-08	15.36	1.78E-06
7.62	2.40E-07	3.34	1.78E-08	15.64	1.84E-06
7.48	2.26E-07	3.32	1.97E-08	15.92	1.98E-06
7.35	2.16E-07	3.31	1.89E-08	16.22	2.09E-06
7.22	2.08E-07	3.30	1.92E-08	16.53	2.23E-06
7.09	1.98E-07	3.29	1.80E-08	16.83	2.29E-06
6.96	1.89E-07	3.27	1.75E-08	17.17	2.47E-06
6.84	1.79E-07	3.26	1.83E-08	17.47	2.62E-06
6.72	1.71E-07	3.25	1.56E-08	17.81	2.63E-06
6.60	1.62E-07	3.24	1.63E-08	18.13	2.78E-06
6.48	1.54E-07	3.23	1.65E-08	18.47	2.98E-06
6.37	1.44E-07	3.22	1.44E-08	18.80	3.17E-06
6.25	1.41E-07	3.21	1.40E-08	19.13	3.28E-06
6.14	1.51E-07	3.20	1.42E-08	19.49	3.42E-06
6.03	1.36E-07	3.19	1.52E-08	19.85	3.62E-06
5.92	1.20E-07	3.18	1.53E-08	20.21	3.78E-06
5.82	1.17E-07	3.17	1.30E-08	20.60	3.98E-06
5.72	1.11E-07	3.17	1.28E-08	20.98	4.14E-06
5.61	1.08E-07	3.16	1.12E-08	21.38	4.30E-06
5.52	1.05E-07	3.15	1.26E-08	21.78	4.48E-06
5.41	1.01E-07	3.14	1.47E-08	22.19	4.63E-06

Table B-9. Constant R (Decreasing Then Increasing ΔK) FCG Data for Specimen 23 L-T of D6AC Steel (Continued)

Specimen ID: 23			Orientation: L-T		
Test: R = 0.7					
da/*dN* (inch/cycle)	ΔK (ksi-in$^{1/2}$)	*da*/*dN* (inch/cycle)	ΔK (ksi-in$^{1/2}$)	*da*/*dN* (inch/cycle)	ΔK (ksi-in$^{1/2}$)
5.23	7.92E-08	3.13	1.29E-08	22.59	4.73E-06
5.06	8.51E-08	3.13	1.22E-08	23.01	4.95E-06
4.98	8.15E-08	3.12	1.22E-08	23.43	5.35E-06
4.90	7.67E-08	3.11	1.35E-08	23.86	5.54E-06
4.82	7.55E-08	3.10	1.33E-08	24.29	5.66E-06
4.75	7.29E-08	3.10	1.16E-08	24.73	5.85E-06
4.69	6.73E-08	3.09	1.22E-08	25.20	6.15E-06
4.62	6.54E-08	3.08	1.26E-08	25.67	6.46E-06
4.57	6.27E-08	3.07	1.24E-08	26.17	6.65E-06
4.51	6.08E-08	3.06	1.14E-08	26.65	6.95E-06
4.46	5.94E-08	3.06	1.11E-08	27.14	7.19E-06
4.40	5.82E-08	3.05	1.20E-08	27.63	7.41E-06
4.36	5.61E-08	3.04	1.27E-08	28.15	7.81E-06
4.31	5.25E-08	3.04	1.21E-08	28.68	7.96E-06
4.26	5.20E-08	3.03	1.15E-08	29.22	8.00E-06
4.22	4.99E-08	3.02	1.16E-08	29.77	8.62E-06
4.18	4.73E-08	3.02	1.13E-08	30.31	9.29E-06
4.14	4.51E-08	2.99	1.09E-08	30.85	9.43E-06
4.10	4.46E-08	2.91	8.10E-09	31.40	9.80E-06
4.07	4.37E-08	2.88	8.04E-09	31.98	1.02E-05
4.03	4.28E-08	2.86	7.91E-09	32.59	1.06E-05
4.00	4.13E-08	2.86	6.37E-09	33.20	1.10E-05
3.97	3.84E-08	2.86	4.13E-09	33.83	1.15E-05
3.94	3.95E-08	2.85	3.67E-09	37.11	1.52E-05
3.91	3.89E-08	2.85	6.43E-09	37.80	1.61E-05
3.88	3.68E-08	2.85	7.80E-09	38.49	1.80E-05
3.85	3.62E-08	2.84	6.17E-09	39.19	1.89E-05
3.82	3.58E-08	2.84	6.02E-09	39.91	1.89E-05
3.79	3.47E-08	2.84	4.88E-09	40.65	1.97E-05
3.77	3.31E-08	2.83	3.63E-09	41.40	2.16E-05
3.74	3.29E-08	2.83	8.11E-09		
3.72	3.16E-08	2.83	6.40E-09		

Table B-10. Constant R (Increasing ΔK) FCG Data for Specimen 25 L-T of D6AC Steel

Specimen ID: 25 Test: R = 0.7			Orientation: L-T		
ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)
4.58	6.53E-08	12.49	9.29E-07	35.61	1.37E-05
4.60	6.72E-08	12.84	1.00E-06	36.55	1.75E-05
4.66	7.01E-08	13.19	1.09E-06	37.52	1.97E-05
4.75	7.43E-08	13.55	1.19E-06	38.55	2.13E-05
4.88	7.99E-08	13.92	1.29E-06	39.61	2.21E-05
5.01	8.70E-08	14.30	1.40E-06	40.69	2.33E-05
5.15	9.49E-08	14.69	1.51E-06	41.81	2.59E-05
5.29	1.02E-07	15.08	1.63E-06	41.59	2.92E-05
5.44	1.09E-07	15.49	1.76E-06	41.21	2.22E-05
5.58	1.17E-07	15.90	1.90E-06	42.23	2.88E-05
5.74	1.24E-07	16.34	2.06E-06	43.40	3.42E-05
5.89	1.33E-07	16.78	2.24E-06	44.58	3.94E-05
6.05	1.43E-07	17.25	2.41E-06	44.67	3.30E-05
6.22	1.53E-07	17.72	2.60E-06	45.06	3.38E-05
6.39	1.64E-07	18.20	2.80E-06	45.46	3.38E-05
6.56	1.76E-07	18.70	3.03E-06	*45.87*	*3.77E-05*
6.74	1.90E-07	19.21	2.90E-06	*46.27*	*4.39E-05*
6.93	2.06E-07	19.74	2.89E-06	*46.68*	*4.68E-05*
7.12	2.27E-07	20.27	3.47E-06	*47.10*	*5.14E-05*
7.31	2.41E-07	20.82	4.06E-06	*47.52*	*5.83E-05*
7.51	2.53E-07	21.39	4.32E-06	*47.96*	*6.35E-05*
7.71	2.68E-07	21.96	4.60E-06	*48.39*	*6.67E-05*
7.92	2.80E-07	22.57	4.91E-06	*48.82*	*6.92E-05*
8.14	2.95E-07	23.18	5.25E-06	*49.26*	*7.72E-05*
8.36	3.15E-07	23.81	5.59E-06	*49.70*	*9.55E-05*
8.59	3.36E-07	24.45	6.06E-06	*50.13*	*1.14E-04*
8.82	3.62E-07	25.12	6.65E-06	*50.59*	*1.23E-04*
9.05	3.86E-07	25.79	7.14E-06	*51.03*	*1.28E-04*
9.30	4.12E-07	26.49	7.64E-06	*51.49*	*1.38E-04*
9.55	4.46E-07	27.20	8.01E-06	*51.94*	*1.74E-04*
9.81	4.81E-07	27.94	8.26E-06	*52.39*	*2.18E-04*
10.08	5.19E-07	28.70	8.73E-06	*52.85*	*2.49E-04*
10.36	5.59E-07	29.48	9.20E-06	*53.28*	*3.00E-04*
10.64	6.02E-07	30.29	9.64E-06	*53.74*	*3.69E-04*
10.94	6.43E-07	31.11	1.02E-05	*54.16*	*4.51E-04*
11.24	6.89E-07	31.96	1.08E-05	*54.58*	*6.18E-04*
11.54	7.40E-07	32.84	1.15E-05	*54.96*	*9.43E-04*
11.85	7.95E-07	33.77	1.18E-05	*55.32*	*1.41E-03*
12.17	8.64E-07	34.66	1.17E-05		

Table B-11. Constant R (Increasing ΔK) FCG Data for Specimen 27 L-T of D6AC Steel

Specimen ID: 27 Test: R = 0.9			Orientation: L-T		
ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)
5.25	1.13E-07	8.32	4.10E-07	13.15	1.71E-06
5.27	1.21E-07	8.37	4.15E-07	13.23	1.75E-06
5.31	1.28E-07	8.42	4.21E-07	13.31	1.80E-06
5.34	1.35E-07	8.47	4.27E-07	13.39	1.85E-06
5.37	1.37E-07	8.52	4.34E-07	13.47	1.91E-06
5.41	1.39E-07	8.57	4.42E-07	13.55	1.98E-06
5.44	1.41E-07	8.63	4.50E-07	13.64	2.05E-06
5.47	1.44E-07	8.68	4.58E-07	13.72	2.12E-06
5.51	1.47E-07	8.73	4.64E-07	13.80	2.19E-06
5.54	1.50E-07	8.78	4.69E-07	13.88	2.27E-06
5.57	1.53E-07	8.84	4.73E-07	13.97	2.36E-06
5.61	1.54E-07	8.89	4.76E-07	14.05	2.46E-06
5.64	1.56E-07	8.94	4.81E-07	14.14	2.58E-06
5.68	1.57E-07	9.00	4.89E-07	14.22	2.70E-06
5.71	1.59E-07	9.05	4.99E-07	14.31	2.80E-06
5.75	1.60E-07	9.11	5.10E-07	14.39	2.89E-06
5.78	1.62E-07	9.16	5.22E-07	14.48	2.99E-06
5.82	1.65E-07	9.22	5.32E-07	14.57	3.08E-06
5.85	1.68E-07	9.28	5.36E-07	14.66	3.15E-06
5.89	1.71E-07	9.33	5.41E-07	14.74	3.25E-06
5.92	1.74E-07	9.39	5.47E-07	14.83	3.32E-06
5.96	1.77E-07	9.45	5.55E-07	14.92	3.37E-06
5.99	1.79E-07	9.50	5.66E-07	15.01	3.45E-06
6.03	1.81E-07	9.56	5.83E-07	15.10	3.68E-06
6.07	1.85E-07	9.62	6.00E-07	15.19	3.97E-06
6.10	1.89E-07	9.68	6.15E-07	15.28	4.21E-06
6.14	1.93E-07	9.74	6.26E-07	15.37	4.45E-06
6.18	1.96E-07	9.80	6.34E-07	15.47	4.67E-06
6.22	1.98E-07	9.86	6.39E-07	15.56	4.84E-06
6.26	2.01E-07	9.92	6.46E-07	15.65	4.97E-06
6.29	2.05E-07	9.98	6.57E-07	15.75	5.15E-06
6.33	2.09E-07	10.04	6.69E-07	15.84	5.34E-06
6.37	2.14E-07	10.10	6.83E-07	15.94	5.49E-06
6.41	2.17E-07	10.16	6.98E-07	16.03	5.70E-06
6.45	2.19E-07	10.22	7.14E-07	16.13	6.02E-06
6.49	2.21E-07	10.28	7.26E-07	16.23	6.54E-06
6.53	2.25E-07	10.34	7.41E-07	16.33	7.13E-06
6.57	2.28E-07	10.41	7.56E-07	16.42	7.62E-06
6.61	2.31E-07	10.47	7.73E-07	16.52	8.12E-06
6.65	2.34E-07	10.53	7.87E-07	16.62	8.50E-06
6.69	2.36E-07	10.60	7.95E-07	16.72	8.70E-06
6.73	2.40E-07	10.66	8.01E-07	16.82	8.91E-06
6.77	2.44E-07	10.73	8.07E-07	16.93	9.27E-06

Table B-11. Constant *R* (Increasing Δ*K*) FCG Data for Specimen 27 L-T of D6AC Steel (Continued)

Specimen ID: 27			Orientation: L-T		
Test: *R* = 0.9					
Δ*K* (ksi-in$^{1/2}$)	*da*/*dN* (inch/cycle)	Δ*K* (ksi-in$^{1/2}$)	*da*/*dN* (inch/cycle)	Δ*K* (ksi-in$^{1/2}$)	*da*/*dN* (inch/cycle)
6.81	2.49E-07	10.79	8.15E-07	17.03	9.84E-06
6.85	2.54E-07	10.86	8.25E-07	17.13	1.04E-05
6.89	2.57E-07	10.92	8.45E-07	17.23	1.09E-05
6.93	2.59E-07	10.99	8.67E-07	*17.33*	*1.13E-05*
6.98	2.61E-07	11.05	8.85E-07	*17.44*	*1.16E-05*
7.02	2.64E-07	11.12	9.04E-07	*17.54*	*1.17E-05*
7.06	2.67E-07	11.19	9.22E-07	*17.65*	*1.19E-05*
7.10	2.70E-07	11.25	9.48E-07	*17.75*	*1.23E-05*
7.15	2.74E-07	11.32	9.72E-07	*17.86*	*1.28E-05*
7.19	2.80E-07	11.39	9.92E-07	*17.97*	*1.37E-05*
7.23	2.86E-07	11.46	1.01E-06	*18.07*	*1.46E-05*
7.28	2.91E-07	11.53	1.03E-06	*18.18*	*1.58E-05*
7.32	2.95E-07	11.59	1.05E-06	*18.29*	*1.71E-05*
7.37	2.98E-07	11.66	1.06E-06	*18.40*	*1.81E-05*
7.41	3.00E-07	11.73	1.08E-06	*18.52*	*1.88E-05*
7.46	3.04E-07	11.81	1.10E-06	*18.63*	*1.96E-05*
7.50	3.09E-07	11.88	1.12E-06	*18.74*	*2.06E-05*
7.55	3.16E-07	11.95	1.14E-06	*18.85*	*2.19E-05*
7.59	3.24E-07	12.02	1.17E-06	*18.96*	*2.37E-05*
7.64	3.31E-07	12.09	1.20E-06	*19.08*	*2.58E-05*
7.69	3.36E-07	12.17	1.23E-06	*19.19*	*2.86E-05*
7.73	3.39E-07	12.24	1.28E-06	*19.31*	*3.26E-05*
7.78	3.42E-07	12.31	1.32E-06	*19.43*	*3.83E-05*
7.83	3.45E-07	12.39	1.35E-06	*19.54*	*4.49E-05*
7.88	3.48E-07	12.46	1.39E-06	*19.66*	*5.17E-05*
7.92	3.53E-07	12.54	1.42E-06	*19.77*	*6.04E-05*
7.97	3.63E-07	12.61	1.45E-06	*19.89*	*7.44E-05*
8.02	3.74E-07	12.69	1.49E-06	*20.01*	*1.01E-04*
8.07	3.82E-07	12.77	1.53E-06	*20.12*	*1.43E-04*
8.12	3.89E-07	12.84	1.58E-06	*20.23*	*2.00E-04*
8.17	3.94E-07	12.92	1.61E-06	*20.34*	*2.92E-04*
8.22	4.00E-07	13.00	1.65E-06	*20.41*	*5.24E-04*
8.27	4.05E-07	13.08	1.68E-06	*20.48*	*8.77E-04*

Table B-12. Constant *R* (Decreasing Δ*K*) FCG Data for Specimen 28 L-T of D6AC Steel

Specimen ID: 28			Orientation: L-T		
Test: *R* = 0.1					
Δ*K* (ksi-in$^{1/2}$)	*da*/*dN* (inch/cycle)	Δ*K* (ksi-in$^{1/2}$)	*da*/*dN* (inch/cycle)	Δ*K* (ksi-in$^{1/2}$)	*da*/*dN* (inch/cycle)
10.81	5.54E-07	10.89	5.20E-07	8.28	1.70E-07
10.81	5.50E-07	10.84	5.12E-07	8.14	1.53E-07
10.82	5.44E-07	10.75	5.01E-07	8.00	1.36E-07
10.82	5.40E-07	10.60	4.83E-07	7.86	1.23E-07
10.83	5.37E-07	10.41	4.60E-07	7.72	1.10E-07
10.83	5.34E-07	10.23	4.22E-07	7.59	1.01E-07
10.84	5.33E-07	10.05	3.91E-07	7.46	8.92E-08
10.84	5.32E-07	9.88	3.61E-07	7.32	7.52E-08
10.85	5.30E-07	9.71	3.35E-07	7.20	6.17E-08
10.86	5.30E-07	9.54	3.13E-07	7.07	5.22E-08
10.86	5.29E-07	9.37	2.93E-07	6.99	4.69E-08
10.87	5.28E-07	9.21	2.75E-07	6.93	4.47E-08
10.87	5.26E-07	9.04	2.56E-07	6.91	4.49E-08
10.88	5.24E-07	8.89	2.38E-07	6.92	4.39E-08
10.88	5.24E-07	8.73	2.20E-07	6.92	4.34E-08
10.88	5.25E-07	8.58	2.03E-07	6.92	4.23E-08
10.89	5.22E-07	8.43	1.86E-07	6.92	4.11E-08

Table B-13. Constant *R* (Increasing Δ*K*) FCG Data for Specimen 29 L-T of D6AC Steel

Specimen ID: 29			Orientation: L-T		
Test: *R* = 0.3					
Δ*K* (ksi-in$^{1/2}$)	*da*/*dN* (inch/cycle)	Δ*K* (ksi-in$^{1/2}$)	*da*/*dN* (inch/cycle)	Δ*K* (ksi-in$^{1/2}$)	*da*/*dN* (inch/cycle)
59.49	5.08E-05	78.07	1.25E-04	103.33	3.40E-04
60.19	5.09E-05	80.24	1.37E-04	106.07	3.97E-04
61.11	5.49E-05	82.47	1.51E-04	108.93	4.75E-04
62.72	5.97E-05	84.75	1.68E-04	111.89	5.65E-04
64.43	6.53E-05	87.08	1.87E-04	114.76	7.14E-04
66.22	7.17E-05	89.53	2.08E-04	117.87	9.04E-04
68.09	7.87E-05	91.95	2.33E-04	120.73	1.19E-03
69.95	8.73E-05	94.50	2.20E-04	123.73	1.48E-03
71.91	9.63E-05	95.46	2.09E-04	126.78	1.82E-03
73.93	1.05E-04	98.01	2.47E-04	*130.03*	*1.91E-03*
75.96	1.14E-04	100.60	2.90E-04		

Table B-14. Constant K_{max} FCG Data for Specimen 30 L-T of D6AC Steel

Specimen ID: 30	Test: K_{max} = 20 ksi-in$^{1/2}$		Orientation: L-T		
ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)
18.02	2.04E-06	5.30	9.53E-08	2.41	2.25E-09
17.74	2.14E-06	4.62	6.18E-08	2.41	5.89E-10
16.55	2.36E-06	4.05	5.13E-08	2.39	1.27E-09
15.35	1.85E-06	3.54	3.44E-08	2.38	2.95E-09
13.36	1.10E-06	3.12	1.46E-08	2.36	2.40E-09
11.70	6.96E-07	2.76	7.21E-09	2.34	1.50E-09
10.23	5.10E-07	2.57	4.33E-09	2.32	1.96E-09
8.96	3.88E-07	2.44	1.92E-09	2.31	1.74E-09
7.81	2.73E-07	2.42	1.80E-09	2.30	1.04E-09
6.89	1.85E-07	2.42	3.17E-09	2.29	1.45E-09
6.02	1.37E-07	2.42	4.54E-09		

Table B-15. Constant K_{max} FCG Data for Specimen 30 L-T of D6AC Steel

Specimen ID: 30	Test: K_{max} = 30 ksi-in$^{1/2}$		Orientation: L-T		
ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)
19.47	5.58E-06	6.92	2.10E-07	2.36	3.19E-09
17.75	4.00E-06	6.66	2.02E-07	2.34	2.80E-09
16.26	2.98E-06	6.26	1.59E-07	2.33	2.61E-09
14.87	2.29E-06	5.77	1.36E-07	2.31	2.31E-09
13.62	1.73E-06	5.28	1.10E-07	2.27	2.41E-09
12.46	1.30E-06	4.82	8.84E-08	2.26	2.20E-09
11.39	1.00E-06	4.40	7.03E-08	2.25	1.68E-09
10.40	7.54E-07	4.01	5.46E-08	2.24	1.39E-09
9.51	5.74E-07	3.67	4.08E-08	2.24	1.37E-09
8.68	4.49E-07	3.35	2.91E-08	2.22	1.69E-09
7.96	3.71E-07	2.50	6.87E-09	2.22	1.43E-09
7.24	2.90E-07	2.45	5.41E-09	2.21	1.65E-09
6.71	2.29E-07	2.44	3.87E-09	2.19	1.26E-09
6.05	1.75E-07	2.43	4.39E-09	2.18	1.06E-09
5.58	1.57E-07	2.41	4.48E-09	2.18	1.08E-09
5.08	1.28E-07	2.39	4.03E-09		
4.63	8.71E-08	2.37	3.56E-09		

Table B-16. Constant R (Decreasing ΔK) FCG Data for Specimen 31 L-T of D6AC Steel

Specimen ID: 31 Test: R = 0.1			Orientation: L-T		
ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)
7.07	5.69E-08	6.46	1.63E-08	6.16	6.18E-09
7.03	6.21E-08	6.36	9.12E-09	6.12	5.78E-09
6.96	6.77E-08	6.31	7.68E-09	6.09	5.79E-09
6.86	6.23E-08	6.26	7.05E-09	6.05	5.92E-09
6.72	5.10E-08	6.23	6.54E-09	6.02	6.57E-09
6.59	2.90E-08	6.20	7.08E-09	5.98	8.63E-09

Table B-17. Constant-R (Increasing ΔK) FCG Data for Specimen 32 L-T of D6AC Steel

Specimen ID: 32 Test: R = 0.1			Orientation: L-T		
ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)
9.08	2.27E-07	21.49	3.30E-06	52.61	3.08E-05
9.11	2.34E-07	21.92	3.52E-06	53.65	3.25E-05
9.19	2.46E-07	22.36	3.74E-06	54.73	3.43E-05
9.32	2.62E-07	22.80	3.99E-06	55.81	3.62E-05
9.50	2.81E-07	23.26	4.24E-06	56.96	3.79E-05
9.69	3.03E-07	23.73	4.49E-06	58.09	4.01E-05
9.89	3.28E-07	24.22	4.76E-06	59.27	4.23E-05
10.09	3.51E-07	24.71	5.03E-06	60.48	4.46E-05
10.29	3.76E-07	25.20	5.32E-06	61.68	4.73E-05
10.50	4.03E-07	25.71	5.61E-06	62.94	5.01E-05
10.72	4.31E-07	26.22	5.92E-06	64.21	5.33E-05
10.93	4.62E-07	26.75	6.26E-06	65.51	5.66E-05
11.15	4.96E-07	27.30	6.59E-06	66.83	6.04E-05
11.37	5.29E-07	27.85	6.94E-06	68.16	6.46E-05
11.60	5.66E-07	28.41	7.29E-06	69.55	6.88E-05
11.83	6.06E-07	28.97	7.66E-06	70.94	7.35E-05
12.07	6.46E-07	29.55	8.06E-06	72.38	7.82E-05
12.31	6.87E-07	30.15	8.44E-06	73.86	8.32E-05
12.56	7.30E-07	30.75	8.88E-06	75.30	8.94E-05
12.81	7.75E-07	31.37	9.34E-06	76.81	9.56E-05
13.07	8.17E-07	32.00	9.78E-06	78.33	1.03E-04
13.33	8.58E-07	32.63	1.02E-05	79.91	1.11E-04
13.61	8.95E-07	33.28	1.07E-05	81.54	1.20E-04
13.88	9.33E-07	33.95	1.12E-05	83.19	1.28E-04
14.16	9.77E-07	34.64	1.17E-05	84.85	1.39E-04
14.44	1.03E-06	35.35	1.22E-05	86.52	1.49E-04
14.74	1.08E-06	36.06	1.27E-05	88.24	1.61E-04
15.03	1.13E-06	36.79	1.32E-05	90.02	1.74E-04
15.33	1.18E-06	37.52	1.37E-05	91.86	1.89E-04

Table B-17. Constant-R (Increasing ΔK) FCG Data for Specimen 32 L-T of D6AC Steel (Continued)

Specimen ID: 32 Test: R = 0.1			Orientation: L-T		
ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)
15.64	1.23E-06	38.28	1.43E-05	93.69	2.06E-04
15.95	1.29E-06	39.05	1.49E-05	95.58	2.24E-04
16.28	1.35E-06	39.83	1.56E-05	97.44	2.44E-04
16.60	1.41E-06	40.63	1.63E-05	99.36	2.65E-04
16.93	1.48E-06	41.43	1.71E-05	101.34	2.83E-04
17.27	1.56E-06	42.27	1.79E-05	103.33	3.14E-04
17.62	1.65E-06	43.10	1.87E-05	105.37	3.55E-04
17.97	1.76E-06	43.97	1.96E-05	107.26	3.98E-04
18.33	1.89E-06	44.86	2.04E-05	109.41	4.32E-04
18.69	2.02E-06	45.76	2.13E-05	111.49	4.68E-04
19.07	2.18E-06	46.68	2.23E-05	113.76	5.20E-04
19.46	2.34E-06	47.63	2.33E-05	116.06	6.84E-04
19.86	2.52E-06	48.59	2.45E-05	118.23	6.46E-04
20.26	2.70E-06	49.57	2.59E-05	120.75	1.23E-03
20.66	2.89E-06	50.57	2.75E-05		
21.08	3.08E-06	51.58	2.91E-05		

Table B-18. Constant R (Decreasing Then Increasing ΔK) FCG Data for Specimen 33 L-T of D6AC Steel

Specimen ID: 33 Test: R = 0.7			Orientation: L-T		
ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)
8.75	3.46E-07	3.13	1.66E-08	14.84	1.86E-06
8.60	3.16E-07	3.11	1.66E-08	15.10	1.97E-06
8.45	3.06E-07	3.09	1.61E-08	15.37	2.11E-06
8.29	2.92E-07	3.07	1.49E-08	15.64	2.26E-06
8.14	2.73E-07	3.05	1.42E-08	15.91	2.36E-06
7.99	2.67E-07	3.03	1.34E-08	16.20	2.44E-06
7.85	2.52E-07	3.01	1.28E-08	16.48	2.66E-06
7.70	2.37E-07	3.00	1.21E-08	16.78	2.81E-06
7.56	2.28E-07	2.98	1.23E-08	17.08	2.92E-06
7.42	2.17E-07	2.96	1.29E-08	17.39	3.12E-06
7.28	2.08E-07	2.95	1.13E-08	17.70	3.34E-06
7.15	1.99E-07	2.93	1.01E-08	18.00	3.46E-06
7.02	1.90E-07	2.92	1.08E-08	18.32	3.58E-06
6.89	1.80E-07	2.91	1.13E-08	18.62	3.77E-06
6.76	1.72E-07	2.89	9.64E-09	18.95	3.88E-06
6.64	1.65E-07	2.88	7.51E-09	19.28	4.19E-06
6.52	1.55E-07	2.87	8.40E-09	19.61	4.33E-06

Table B-18. Constant R (Decreasing Then Increasing ΔK) FCG Data for Specimen 33 L-T of D6AC Steel (Continued)

Specimen ID: 33			Orientation: L-T		
Test: R = 0.7					
ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)
6.40	1.46E-07	2.86	9.62E-09	19.96	4.50E-06
6.28	1.40E-07	2.85	9.08E-09	20.30	4.84E-06
6.16	1.36E-07	2.84	8.55E-09	20.66	4.97E-06
6.05	1.32E-07	2.83	9.27E-09	21.03	5.13E-06
5.94	1.29E-07	2.82	9.03E-09	21.41	5.42E-06
5.83	1.23E-07	2.81	8.90E-09	21.78	5.78E-06
5.73	1.15E-07	2.80	9.12E-09	22.17	5.97E-06
5.62	1.13E-07	2.79	6.50E-09	22.55	6.24E-06
5.52	1.10E-07	2.78	5.66E-09	22.94	6.57E-06
5.41	1.03E-07	2.77	7.20E-09	23.34	6.69E-06
5.32	9.82E-08	2.76	7.29E-09	23.75	6.91E-06
5.22	9.35E-08	2.75	7.58E-09	24.18	7.30E-06
5.13	8.84E-08	2.75	6.49E-09	24.61	7.46E-06
5.03	8.52E-08	2.74	5.10E-09	25.04	7.74E-06
4.94	8.09E-08	2.73	6.39E-09	25.47	8.12E-06
4.85	7.65E-08	2.72	7.01E-09	25.93	8.23E-06
4.76	7.19E-08	2.72	6.80E-09	26.38	8.68E-06
4.67	7.00E-08	2.71	6.19E-09	26.85	9.29E-06
4.59	6.76E-08	2.70	5.73E-09	27.33	9.35E-06
4.50	6.39E-08	2.70	6.00E-09	27.79	9.66E-06
4.42	6.08E-08	9.42	4.81E-07	28.28	1.02E-05
4.34	5.69E-08	9.60	4.86E-07	28.78	1.02E-05
4.26	5.30E-08	9.76	5.15E-07	29.29	1.08E-05
4.18	5.07E-08	9.94	5.57E-07	29.82	1.22E-05
4.11	4.85E-08	10.11	5.71E-07	30.33	1.26E-05
4.03	4.61E-08	10.29	5.81E-07	30.88	1.29E-05
3.96	4.33E-08	10.47	6.19E-07	31.40	1.38E-05
3.89	4.07E-08	10.66	6.44E-07	31.96	1.45E-05
3.82	3.88E-08	10.85	6.75E-07	32.51	1.47E-05
3.76	3.63E-08	11.04	7.15E-07	33.08	1.49E-05
3.70	3.41E-08	11.23	7.46E-07	*33.65*	*1.60E-05*
3.65	3.21E-08	11.43	7.83E-07	*34.25*	*1.81E-05*
3.60	3.00E-08	11.63	8.17E-07	*34.85*	*1.95E-05*
3.55	2.94E-08	11.84	8.61E-07	*35.48*	*1.98E-05*
3.51	2.83E-08	12.05	9.22E-07	*36.08*	*2.03E-05*
3.47	2.65E-08	12.26	9.79E-07	*36.96*	*2.34E-05*
3.43	2.53E-08	12.48	1.03E-06	*37.53*	*3.88E-05*
3.39	2.44E-08	12.70	1.09E-06	*38.26*	*4.36E-05*
3.36	2.36E-08	12.93	1.18E-06	*38.91*	*2.90E-05*
3.32	2.28E-08	13.15	1.23E-06	*39.42*	*3.68E-05*

Table B-18. Constant *R* (Decreasing Then Increasing Δ*K*) FCG Data for Specimen 33 L-T of D6AC Steel (Continued)

Specimen ID: 33	Test: R = 0.7		Orientation: L-T		
Δ*K* (ksi-in$^{1/2}$)	*da*/*dN* (inch/cycle)	Δ*K* (ksi-in$^{1/2}$)	*da*/*dN* (inch/cycle)	Δ*K* (ksi-in$^{1/2}$)	*da*/*dN* (inch/cycle)
3.29	2.16E-08	13.38	1.27E-06	*40.10*	*4.52E-05*
3.26	2.08E-08	13.61	1.35E-06	*40.83*	*5.61E-05*
3.23	2.04E-08	13.84	1.47E-06	*41.52*	*7.28E-05*
3.20	1.99E-08	14.07	1.57E-06	*42.27*	*1.02E-04*
3.18	1.90E-08	14.33	1.65E-06		
3.15	1.74E-08	14.58	1.77E-06		

Table B-19. Constant *R* (Decreasing Then Increasing Δ*K*) FCG Data for Specimen 41 L-T of D6AC Steel

Specimen ID: 41	Test: R = 0.7		Orientation: L-T		
Δ*K* (ksi-in$^{1/2}$)	*da*/*dN* (inch/cycle)	Δ*K* (ksi-in$^{1/2}$)	*da*/*dN* (inch/cycle)	Δ*K* (ksi-in$^{1/2}$)	*da*/*dN* (inch/cycle)
8.07	2.68E-07	3.32	1.86E-08	10.74	5.76E-07
7.93	2.53E-07	3.31	1.85E-08	10.93	6.05E-07
7.79	2.42E-07	3.29	1.70E-08	11.13	6.35E-07
7.65	2.29E-07	3.28	1.65E-08	11.33	6.73E-07
7.51	2.18E-07	3.27	1.67E-08	11.54	7.15E-07
7.38	2.08E-07	3.26	1.70E-08	11.75	7.52E-07
7.25	2.00E-07	3.25	1.74E-08	11.97	8.00E-07
7.12	1.92E-07	3.24	1.71E-08	12.18	8.41E-07
7.00	1.85E-07	3.23	1.67E-08	12.41	8.80E-07
6.87	1.75E-07	3.21	1.72E-08	12.63	9.42E-07
6.75	1.66E-07	3.20	1.58E-08	12.86	1.00E-06
6.63	1.60E-07	3.19	1.52E-08	13.09	1.07E-06
6.51	1.54E-07	3.18	1.56E-08	13.33	1.14E-06
6.39	1.47E-07	3.17	1.39E-08	13.57	1.20E-06
6.28	1.37E-07	3.16	1.28E-08	13.81	1.27E-06
6.17	1.32E-07	3.16	1.33E-08	14.06	1.35E-06
6.06	1.29E-07	3.15	1.40E-08	14.32	1.43E-06
5.95	1.24E-07	3.14	1.38E-08	14.58	1.52E-06
5.84	1.18E-07	3.13	1.31E-08	14.84	1.63E-06
5.74	1.13E-07	3.12	1.43E-08	15.10	1.74E-06
5.64	1.08E-07	3.11	1.46E-08	15.37	1.84E-06
5.53	1.01E-07	3.10	1.26E-08	15.65	1.94E-06
5.44	9.82E-08	3.09	1.15E-08	15.94	2.07E-06
5.34	9.34E-08	3.09	1.17E-08	16.23	2.18E-06
5.25	8.88E-08	3.08	1.12E-08	16.53	2.31E-06
5.15	8.57E-08	3.07	1.10E-08	16.83	2.47E-06
5.07	8.14E-08	3.06	1.21E-08	17.13	2.57E-06

Table B-19. Constant *R* (Decreasing Then Increasing Δ*K*) FCG Data for Specimen 41 L-T of D6AC Steel (Continued)

Specimen ID: 41 Test: *R* = 0.7			Orientation: L-T		
Δ*K* (ksi-in$^{1/2}$)	*da*/*dN* (inch/cycle)	Δ*K* (ksi-in$^{1/2}$)	*da*/*dN* (inch/cycle)	Δ*K* (ksi-in$^{1/2}$)	*da*/*dN* (inch/cycle)
4.98	7.73E-08	3.06	1.18E-08	17.44	2.70E-06
4.90	7.45E-08	3.05	1.12E-08	17.75	2.88E-06
4.83	7.15E-08	3.04	1.12E-08	18.07	3.01E-06
4.76	6.83E-08	3.04	1.16E-08	18.41	3.12E-06
4.69	6.59E-08	3.03	1.30E-08	18.74	3.33E-06
4.63	6.40E-08	3.02	1.18E-08	19.09	3.50E-06
4.57	6.22E-08	3.01	9.41E-09	19.43	3.62E-06
4.51	5.94E-08	3.01	8.91E-09	19.77	3.82E-06
4.46	5.72E-08	3.00	9.92E-09	20.13	4.05E-06
4.41	5.54E-08	3.00	1.03E-08	20.49	4.25E-06
4.36	5.30E-08	2.99	8.50E-09	20.87	4.42E-06
4.31	5.18E-08	2.99	7.31E-09	21.25	4.63E-06
4.27	4.95E-08	2.98	8.88E-09	21.63	4.86E-06
4.22	4.67E-08	2.97	9.40E-09	22.02	4.98E-06
4.18	4.70E-08	2.97	8.55E-09	22.42	5.14E-06
4.14	4.64E-08	2.96	8.14E-09	22.82	5.37E-06
4.10	4.32E-08	2.96	7.96E-09	23.24	5.57E-06
4.07	4.32E-08	2.95	8.91E-09	23.65	5.81E-06
4.03	4.41E-08	2.95	8.15E-09	24.09	6.02E-06
3.99	4.14E-08	2.94	6.48E-09	24.52	6.20E-06
3.96	3.92E-08	2.94	7.84E-09	24.96	6.43E-06
3.93	3.86E-08	2.94	8.74E-09	25.42	6.80E-06
3.90	3.75E-08	2.93	8.61E-09	25.87	7.06E-06
3.87	3.55E-08	2.92	9.08E-09	26.35	7.22E-06
3.84	3.49E-08	2.92	7.29E-09	26.82	7.56E-06
3.81	3.42E-08	2.91	7.63E-09	27.31	7.88E-06
3.79	3.29E-08	2.91	8.51E-09	27.80	8.03E-06
3.76	3.37E-08	2.90	7.63E-09	28.31	8.34E-06
3.73	3.31E-08	2.90	8.39E-09	28.82	8.78E-06
3.71	3.19E-08	2.89	9.48E-09	29.34	9.15E-06
3.68	3.15E-08	2.89	9.01E-09	29.88	9.45E-06
3.66	3.18E-08	2.88	6.64E-09	30.43	9.76E-06
3.64	2.88E-08	2.88	6.45E-09	30.99	1.04E-05
3.62	2.56E-08	2.88	8.01E-09	31.55	1.09E-05
3.60	2.52E-08	2.87	7.34E-09	32.12	1.12E-05
3.58	2.54E-08	2.87	5.90E-09	32.68	1.16E-05
3.56	2.67E-08	2.86	5.31E-09	33.28	1.21E-05
3.54	2.65E-08	2.86	6.64E-09	33.87	1.23E-05
3.52	2.60E-08	2.86	6.20E-09	34.49	1.27E-05
3.50	2.50E-08	2.85	6.12E-09	35.11	1.38E-05

Table B-19. Constant *R* (Decreasing Then Increasing Δ*K*) FCG Data for Specimen 41 L-T of D6AC Steel (Continued)

Specimen ID: 41			Orientation: L-T		
Test: *R* = 0.7					
Δ*K* (ksi-in$^{1/2}$)	*da*/*dN* (inch/cycle)	Δ*K* (ksi-in$^{1/2}$)	*da*/*dN* (inch/cycle)	Δ*K* (ksi-in$^{1/2}$)	*da*/*dN* (inch/cycle)
3.48	2.35E-08	2.85	7.92E-09	35.75	1.48E-05
3.47	2.33E-08	2.84	7.75E-09	36.41	1.59E-05
3.45	2.33E-08	2.84	6.82E-09	37.07	1.71E-05
3.43	2.32E-08	2.84	6.15E-09	37.75	1.82E-05
3.42	2.27E-08	2.83	6.02E-09	38.42	1.96E-05
3.40	2.18E-08	2.83	6.39E-09	*39.12*	*2.12E-05*
3.39	2.08E-08	2.83	5.66E-09	*39.82*	*2.26E-05*
3.37	2.03E-08	2.82	6.31E-09	*40.56*	*2.42E-05*
3.36	2.03E-08	10.17	4.96E-07	*41.29*	*2.64E-05*
3.34	1.94E-08	10.36	5.18E-07	*42.05*	*2.92E-05*
3.33	1.80E-08	10.54	5.47E-07		

Table B-20. Constant *R* (Decreasing Then Increasing Δ*K*) FCG Data for Specimen 42 L-T of D6AC Steel

Specimen ID: 42			Orientation: L-T		
Test: *R* = 0.3					
Δ*K* (ksi-in$^{1/2}$)	*da*/*dN* (inch/cycle)	Δ*K* (ksi-in$^{1/2}$)	*da*/*dN* (inch/cycle)	Δ*K* (ksi-in$^{1/2}$)	*da*/*dN* (inch/cycle)
10.50	5.39E-07	18.86	3.27E-06	38.71	1.76E-05
10.50	5.44E-07	19.43	3.59E-06	39.88	1.89E-05
10.50	5.39E-07	20.02	3.92E-06	41.10	2.02E-05
10.50	5.40E-07	20.64	4.25E-06	42.35	2.15E-05
10.58	5.47E-07	21.26	4.61E-06	43.64	2.31E-05
10.74	5.71E-07	21.91	5.00E-06	44.96	2.50E-05
10.98	6.15E-07	22.57	5.40E-06	46.32	2.72E-05
11.31	6.64E-07	23.25	5.78E-06	47.75	2.93E-05
11.66	7.13E-07	23.95	6.20E-06	49.20	3.15E-05
12.02	7.70E-07	24.67	6.68E-06	50.70	3.40E-05
12.38	8.34E-07	25.42	7.16E-06	52.26	3.72E-05
12.76	9.09E-07	26.21	7.68E-06	53.84	4.06E-05
13.14	9.97E-07	27.00	8.18E-06	55.46	4.44E-05
13.55	1.09E-06	27.83	8.70E-06	57.16	4.89E-05
13.96	1.19E-06	28.69	9.31E-06	58.86	5.32E-05
14.40	1.32E-06	29.56	9.90E-06	60.67	5.80E-05
14.84	1.46E-06	30.44	1.06E-05	62.48	6.39E-05
15.30	1.63E-06	31.37	1.13E-05	64.39	7.18E-05
15.76	1.80E-06	32.32	1.19E-05	66.32	8.08E-05
16.24	1.99E-06	33.29	1.26E-05	68.37	9.02E-05

Table B-20. Constant *R* (Decreasing Then Increasing Δ*K*) FCG Data for Specimen 42 L-T of D6AC Steel (Continued)

Specimen ID: 42	Test: R = 0.3		Orientation: L-T		
Δ*K* (ksi-in$^{1/2}$)	*da*/*dN* (inch/cycle)	Δ*K* (ksi-in$^{1/2}$)	*da*/*dN* (inch/cycle)	Δ*K* (ksi-in$^{1/2}$)	*da*/*dN* (inch/cycle)
16.73	2.21E-06	34.31	1.35E-05	70.44	1.02E-04
17.23	2.45E-06	35.35	1.43E-05	72.57	1.16E-04
17.75	2.70E-06	36.43	1.53E-05		
18.29	2.97E-06	37.56	1.64E-05		

Table B-21. Constant *R* (Increasing Δ*K*) FCG Data for Specimen 43 L-T of D6AC Steel

Specimen ID: 43	Test: R = 0.8		Orientation: L-T		
Δ*K* (ksi-in$^{1/2}$)	*da*/*dN* (inch/cycle)	Δ*K* (ksi-in$^{1/2}$)	*da*/*dN* (inch/cycle)	Δ*K* (ksi-in$^{1/2}$)	*da*/*dN* (inch/cycle)
5.02	9.31E-08	9.31	4.42E-07	16.22	2.38E-06
5.04	8.95E-08	9.47	4.63E-07	16.51	2.51E-06
5.04	9.27E-08	9.64	4.94E-07	16.80	2.67E-06
5.04	9.42E-08	9.82	5.31E-07	17.11	2.84E-06
5.04	9.32E-08	9.99	5.57E-07	17.42	3.02E-06
5.03	9.53E-08	8.11	2.94E-07	17.73	3.16E-06
5.03	9.40E-08	8.24	3.20E-07	18.03	3.58E-06
5.03	9.22E-08	8.39	3.44E-07	19.26	4.92E-06
5.03	9.38E-08	8.54	3.66E-07	19.30	4.94E-06
5.06	9.96E-08	8.69	3.74E-07	19.33	4.95E-06
5.10	9.95E-08	8.85	3.82E-07	19.39	4.57E-06
5.17	9.53E-08	9.01	4.08E-07	19.47	4.71E-06
5.26	9.64E-08	9.17	4.28E-07	19.56	4.86E-06
5.36	9.93E-08	9.34	4.41E-07	19.68	4.78E-06
5.45	1.09E-07	9.51	4.76E-07	19.80	4.88E-06
5.55	1.18E-07	9.68	5.18E-07	19.92	5.00E-06
5.65	1.22E-07	9.85	5.37E-07	20.04	4.84E-06
5.75	1.27E-07	10.03	5.49E-07	20.16	5.02E-06
5.86	1.36E-07	10.21	5.78E-07	20.27	5.09E-06
5.96	1.41E-07	10.39	6.15E-07	20.40	4.96E-06
6.07	1.48E-07	10.58	6.47E-07	20.52	5.03E-06
6.18	1.53E-07	10.77	6.80E-07	20.64	5.06E-06
6.29	1.58E-07	10.97	7.25E-07	20.77	5.23E-06
6.40	1.65E-07	11.16	7.63E-07	20.89	5.50E-06
6.52	1.70E-07	11.36	7.87E-07	21.02	5.67E-06
6.64	1.78E-07	11.57	8.34E-07	21.14	5.70E-06
6.76	1.92E-07	11.77	8.89E-07	21.27	5.73E-06
6.88	2.01E-07	11.98	9.32E-07	21.40	5.65E-06
7.00	2.07E-07	12.20	9.76E-07	21.53	5.66E-06
7.13	2.21E-07	12.42	1.05E-06	21.66	5.97E-06

Table B-21. Constant *R* (Increasing Δ*K*) FCG Data for Specimen 43 L-T of D6AC Steel (Continued)

Specimen ID: 43 Test: *R* = 0.8			Orientation: L-T		
Δ*K* (ksi-in$^{1/2}$)	*da*/*dN* (inch/cycle)	Δ*K* (ksi-in$^{1/2}$)	*da*/*dN* (inch/cycle)	Δ*K* (ksi-in$^{1/2}$)	*da*/*dN* (inch/cycle)
7.26	2.32E-07	12.65	1.12E-06	21.79	6.16E-06
7.39	2.38E-07	12.88	1.16E-06	21.92	6.08E-06
7.52	2.50E-07	13.10	1.22E-06	22.05	6.26E-06
7.65	2.58E-07	13.34	1.30E-06	22.19	6.53E-06
7.79	2.64E-07	13.57	1.37E-06	22.32	6.54E-06
7.93	2.82E-07	13.82	1.43E-06	22.45	6.56E-06
8.07	3.00E-07	14.06	1.53E-06	22.58	6.59E-06
8.21	3.18E-07	14.31	1.66E-06	22.72	6.80E-06
8.36	3.34E-07	14.57	1.75E-06	22.86	7.04E-06
8.51	3.51E-07	14.83	1.82E-06	22.99	6.97E-06
8.66	3.69E-07	15.10	1.92E-06	23.14	7.33E-06
8.82	3.84E-07	15.37	2.04E-06	23.27	7.59E-06
8.98	4.03E-07	15.65	2.19E-06	23.41	7.59E-06
9.15	4.22E-07	15.93	2.31E-06	23.55	7.95E-06

Table B-22. Constant *R* (Increasing Δ*K*) FCG Data for Specimen 44 L-T of D6AC Steel

Specimen ID:44 Test: *R* = 0.8			Orientation: L-T		
Δ*K* (ksi-in$^{1/2}$)	*da*/*dN* (inch/cycle)	Δ*K* (ksi-in$^{1/2}$)	*da*/*dN* (inch/cycle)	Δ*K* (ksi-in$^{1/2}$)	*da*/*dN* (inch/cycle)
14.95	2.02E-06	16.45	2.57E-06	18.83	3.87E-06
15.07	2.05E-06	16.90	2.79E-06	19.34	4.28E-06
15.27	2.10E-06	17.36	3.02E-06	19.87	5.17E-06
15.59	2.21E-06	17.84	3.26E-06	20.42	5.24E-06
16.01	2.38E-06	18.32	3.54E-06	21.00	7.60E-06

Table B-23. Constant *R* (Decreasing Then Increasing Δ*K*) FCG Data for Specimen 45 L-T of D6AC Steel

Specimen ID: 45 Test: *R* = 0.3			Orientation: L-T		
Δ*K* (ksi-in$^{1/2}$)	*da*/*dN* (inch/cycle)	Δ*K* (ksi-in$^{1/2}$)	*da*/*dN* (inch/cycle)	Δ*K* (ksi-in$^{1/2}$)	*da*/*dN* (inch/cycle)
14.21	9.99E-07	4.72	4.21E-08	19.28	2.93E-06
14.13	9.87E-07	4.68	3.85E-08	19.63	3.09E-06
14.00	9.67E-07	4.64	3.59E-08	19.98	3.27E-06
13.79	9.36E-07	4.61	3.48E-08	20.35	3.44E-06
13.54	8.96E-07	4.58	3.45E-08	20.73	3.62E-06
13.30	8.54E-07	4.55	3.44E-08	21.11	3.80E-06
13.06	8.06E-07	4.52	3.34E-08	21.51	4.01E-06

Table B-23. Constant R (Decreasing Then Increasing ΔK) FCG Data for Specimen 45 L-T of D6AC Steel (Continued)

Specimen ID: 45 Test: R = 0.3			Orientation: L-T		
ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)
12.83	7.68E-07	4.48	3.17E-08	21.89	4.21E-06
12.60	7.34E-07	4.46	2.83E-08	22.29	4.38E-06
12.38	7.01E-07	4.43	2.41E-08	22.69	4.59E-06
12.16	6.72E-07	4.41	2.01E-08	23.09	4.82E-06
11.94	6.40E-07	4.40	1.71E-08	23.53	5.05E-06
11.73	6.13E-07	4.38	1.50E-08	23.95	5.25E-06
11.52	5.87E-07	4.37	1.37E-08	24.40	5.49E-06
11.31	5.61E-07	4.36	1.33E-08	24.84	5.76E-06
11.11	5.37E-07	4.35	1.27E-08	25.29	6.00E-06
10.91	5.11E-07	4.34	1.26E-08	25.76	6.25E-06
10.72	4.87E-07	4.33	1.25E-08	26.23	6.51E-06
10.52	4.64E-07	4.31	1.27E-08	26.72	6.79E-06
10.34	4.43E-07	4.30	1.29E-08	27.20	7.07E-06
10.15	4.23E-07	4.29	1.29E-08	27.70	7.32E-06
9.97	4.06E-07	4.28	1.29E-08	28.21	7.64E-06
9.79	3.88E-07	4.27	1.28E-08	28.72	7.91E-06
9.62	3.70E-07	4.26	1.26E-08	29.25	8.22E-06
9.45	3.53E-07	4.25	1.23E-08	29.78	8.50E-06
9.28	3.38E-07	4.24	1.16E-08	30.34	8.75E-06
9.11	3.22E-07	4.23	1.11E-08	30.89	9.05E-06
8.95	3.07E-07	4.22	1.01E-08	31.46	9.34E-06
8.79	2.93E-07	4.21	9.42E-09	32.03	9.81E-06
8.63	2.79E-07	4.20	8.73E-09	32.61	1.02E-05
8.48	2.65E-07	4.20	8.20E-09	33.21	1.06E-05
8.33	2.53E-07	4.19	7.69E-09	33.80	1.10E-05
8.18	2.41E-07	4.18	7.18E-09	34.41	1.14E-05
8.03	2.30E-07	4.18	7.13E-09	35.05	1.17E-05
7.89	2.19E-07	4.17	7.29E-09	35.67	1.21E-05
7.75	2.09E-07	4.16	8.20E-09	36.33	1.26E-05
7.61	1.99E-07	4.16	7.30E-09	36.98	1.31E-05
7.47	1.90E-07	4.15	7.14E-09	37.67	1.35E-05
7.34	1.81E-07	11.38	6.02E-07	38.36	1.39E-05
7.21	1.74E-07	11.59	6.25E-07	39.06	1.44E-05
7.08	1.67E-07	11.80	6.51E-07	39.77	1.49E-05
6.95	1.60E-07	12.03	6.82E-07	40.50	1.56E-05
6.83	1.53E-07	12.24	7.13E-07	41.24	1.62E-05
6.71	1.45E-07	12.47	7.47E-07	42.01	1.69E-05
6.59	1.38E-07	12.69	7.83E-07	42.77	1.75E-05
6.47	1.30E-07	12.93	8.16E-07	43.54	1.90E-05
6.36	1.23E-07	13.17	8.51E-07	44.33	2.05E-05
6.24	1.17E-07	13.41	8.87E-07	45.49	2.20E-05
6.13	1.11E-07	13.66	9.36E-07	45.97	2.33E-05

Table B-23. Constant R (Decreasing Then Increasing ΔK) FCG Data for Specimen 45 L-T of D6AC Steel (Continued)

Specimen ID: 45 Test: R = 0.3			Orientation: L-T		
ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)
6.02	1.05E-07	13.91	9.89E-07	47.17	2.44E-05
5.91	9.91E-08	14.17	1.05E-06	47.68	2.55E-05
5.81	9.36E-08	14.43	1.11E-06	48.55	2.61E-05
5.71	8.81E-08	14.70	1.18E-06	49.43	2.73E-05
5.61	8.27E-08	14.97	1.24E-06	50.35	2.86E-05
5.52	7.70E-08	15.23	1.32E-06	51.28	3.00E-05
5.43	7.17E-08	15.51	1.41E-06	52.22	3.15E-05
5.36	6.66E-08	15.80	1.51E-06	53.17	3.30E-05
5.29	6.22E-08	16.08	1.61E-06	54.14	3.46E-05
5.22	6.02E-08	16.37	1.70E-06	55.13	3.64E-05
5.17	6.04E-08	16.66	1.81E-06	56.13	3.83E-05
5.10	6.12E-08	16.97	1.93E-06	57.15	4.03E-05
5.04	6.17E-08	17.29	2.05E-06	58.16	4.25E-05
4.98	6.08E-08	17.61	2.19E-06	59.22	4.48E-05
4.91	5.84E-08	17.94	2.33E-06	60.31	4.77E-05
4.86	5.47E-08	18.28	2.47E-06	61.42	4.98E-05
4.81	5.04E-08	18.61	2.61E-06		
4.76	4.63E-08	18.95	2.78E-06		

Table B-24. Constant R (Increasing ΔK) FCG Data for Specimen 46 L-T of D6AC Steel

Specimen ID: 46 Test: R = 0.1			Orientation: L-T		
ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)
10.58	4.82E-07	23.14	4.77E-06	56.05	3.54E-05
10.58	4.90E-07	23.55	5.09E-06	57.07	3.76E-05
10.66	5.15E-07	23.97	5.45E-06	58.11	3.99E-05
10.79	5.43E-07	24.42	5.59E-06	59.17	4.16E-05
10.97	5.72E-07	24.87	5.91E-06	60.27	4.33E-05
11.21	6.14E-07	25.33	6.32E-06	61.38	4.57E-05
11.40	6.32E-07	25.80	6.65E-06	62.51	4.82E-05
11.62	6.51E-07	26.26	6.90E-06	63.67	5.11E-05
11.83	6.90E-07	26.74	7.21E-06	64.79	5.27E-05
12.05	7.35E-07	27.22	7.54E-06	65.96	5.53E-05
12.27	7.73E-07	27.72	7.77E-06	67.13	5.95E-05
12.49	8.13E-07	28.23	8.11E-06	68.34	6.23E-05
12.72	8.52E-07	28.74	8.31E-06	69.60	6.51E-05
12.96	8.81E-07	29.27	8.72E-06	70.89	6.85E-05
13.19	9.37E-07	29.78	9.06E-06	72.18	7.15E-05
13.44	9.97E-07	30.32	9.36E-06	73.52	7.58E-05

Table B-24. Constant *R* (Increasing Δ*K*) FCG Data for Specimen 46 L-T of D6AC Steel (Continued)

Specimen ID: 46	Test: $R = 0.1$		Orientation: L-T		
Δ*K* (ksi-in$^{1/2}$)	*da*/*dN* (inch/cycle)	Δ*K* (ksi-in$^{1/2}$)	*da*/*dN* (inch/cycle)	Δ*K* (ksi-in$^{1/2}$)	*da*/*dN* (inch/cycle)
13.68	1.02E-06	30.87	9.76E-06	74.86	8.17E-05
13.94	1.07E-06	31.44	1.00E-05	76.20	8.77E-05
14.20	1.13E-06	32.02	1.05E-05	77.62	9.41E-05
14.47	1.15E-06	32.62	1.08E-05	79.02	1.00E-04
14.73	1.22E-06	33.22	1.11E-05	80.46	1.07E-04
14.99	1.29E-06	33.82	1.16E-05	81.94	1.15E-04
15.26	1.29E-06	34.44	1.21E-05	83.43	1.23E-04
15.54	1.34E-06	35.06	1.25E-05	84.92	1.30E-04
15.82	1.43E-06	35.70	1.30E-05	86.46	1.38E-04
16.11	1.49E-06	36.34	1.37E-05	88.03	1.50E-04
16.40	1.58E-06	36.99	1.39E-05	89.48	1.60E-04
16.70	1.67E-06	37.66	1.44E-05	91.27	1.88E-04
17.02	1.78E-06	38.35	1.51E-05	92.81	1.99E-04
17.33	1.90E-06	39.05	1.56E-05	94.63	1.93E-04
17.65	1.99E-06	39.77	1.61E-05	96.39	2.02E-04
17.98	2.14E-06	40.49	1.68E-05	98.17	2.14E-04
18.30	2.29E-06	41.23	1.74E-05	99.92	2.27E-04
18.64	2.41E-06	41.99	1.82E-05	101.76	2.42E-04
18.97	2.57E-06	42.76	1.90E-05	103.59	2.62E-04
19.31	2.74E-06	43.54	1.98E-05	105.49	2.86E-04
19.66	2.94E-06	47.66	2.38E-05	107.38	3.16E-04
20.02	3.12E-06	48.50	2.41E-05	109.35	3.37E-04
20.39	3.29E-06	49.37	2.52E-05	111.31	3.51E-04
20.76	3.45E-06	50.28	2.65E-05	113.33	3.80E-04
21.14	3.66E-06	51.20	2.78E-05	115.41	4.07E-04
21.53	3.89E-06	52.14	2.91E-05	117.53	4.42E-04
21.92	4.11E-06	53.10	3.09E-05	119.74	4.85E-04
22.33	4.40E-06	54.06	3.23E-05	*122.07*	*5.45E-04*
22.74	4.63E-06	55.05	3.36E-05		

Table B-25. Constant *R* (Increasing Δ*K*) FCG Data for Specimen 47 L-T of D6AC Steel

Specimen ID: 47 Test: *R* = 0.8			Orientation: L-T		
Δ*K* (ksi-in$^{1/2}$)	*da*/*dN* (inch/cycle)	Δ*K* (ksi-in$^{1/2}$)	*da*/*dN* (inch/cycle)	Δ*K* (ksi-in$^{1/2}$)	*da*/*dN* (inch/cycle)
15.00	1.92E-06	22.31	6.14E-06	32.60	2.76E-05
15.08	1.94E-06	22.54	6.26E-06	32.93	2.98E-05
15.19	2.05E-06	22.77	6.35E-06	33.25	3.23E-05
15.35	2.07E-06	23.00	6.49E-06	33.58	3.53E-05
15.51	2.12E-06	23.23	6.68E-06	33.91	3.97E-05
15.66	2.20E-06	23.47	6.91E-06	34.00	3.51E-05
15.82	2.26E-06	23.70	7.13E-06	30.85	1.43E-05
15.98	2.33E-06	23.94	7.36E-06	31.16	1.54E-05
16.13	2.41E-06	24.18	7.54E-06	31.47	1.66E-05
16.30	2.48E-06	24.43	7.66E-06	31.79	1.80E-05
16.47	2.57E-06	24.68	7.92E-06	32.11	1.96E-05
16.64	2.66E-06	24.93	8.27E-06	32.44	2.12E-05
16.81	2.74E-06	25.19	8.55E-06	32.76	2.30E-05
16.99	2.80E-06	25.44	8.78E-06	33.09	2.48E-05
17.15	2.88E-06	25.70	9.01E-06	33.42	2.72E-05
17.33	2.94E-06	25.95	9.25E-06	33.75	3.02E-05
17.50	3.01E-06	26.21	9.56E-06	34.09	3.33E-05
17.68	3.09E-06	26.48	1.01E-05	34.43	3.58E-05
17.86	3.18E-06	26.74	1.09E-05	34.78	3.78E-05
18.04	3.29E-06	27.01	1.16E-05	35.12	4.00E-05
18.22	3.39E-06	27.29	1.21E-05	35.48	4.21E-05
18.41	3.47E-06	27.55	1.26E-05	35.84	4.46E-05
18.60	3.56E-06	27.83	1.30E-05	*36.21*	*4.78E-05*
18.79	3.66E-06	28.11	1.32E-05	*36.58*	*5.10E-05*
18.98	3.74E-06	28.38	1.35E-05	*36.94*	*5.39E-05*
19.17	3.84E-06	28.68	1.39E-05	*37.31*	*5.69E-05*
19.36	3.96E-06	28.97	1.45E-05	*37.67*	*6.06E-05*
19.56	4.10E-06	29.26	1.58E-05	*38.05*	*6.58E-05*
19.76	4.24E-06	29.55	1.71E-05	*38.43*	*7.13E-05*
19.96	4.39E-06	29.83	1.48E-05	*38.82*	*7.69E-05*
20.17	4.52E-06	29.99	2.03E-05	*39.21*	*8.41E-05*
20.37	4.63E-06	30.15	1.90E-05	*39.61*	*9.36E-05*
20.58	4.75E-06	30.26	2.47E-05	*40.00*	*1.06E-04*
20.79	4.88E-06	30.44	3.18E-05	*40.39*	*1.21E-04*
20.99	5.03E-06	30.68	2.18E-05	*40.79*	*1.38E-04*
21.20	5.19E-06	30.99	2.02E-05	*41.21*	*1.59E-04*
21.42	5.39E-06	31.30	2.11E-05	*41.62*	*1.73E-04*
21.63	5.59E-06	31.61	2.23E-05	*42.04*	*2.04E-04*
21.86	5.78E-06	31.94	2.37E-05		
22.08	5.97E-06	32.26	2.56E-05		

Table B-26. Constant R (Increasing ΔK) FCG Data for Specimen 48 L-T of D6AC Steel

Specimen ID: 48 Test: R = 0.7			Orientation: L-T		
ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)
19.94	3.97E-06	28.64	9.49E-06	41.44	2.63E-05
20.04	4.01E-06	28.93	9.70E-06	41.86	2.78E-05
20.19	4.09E-06	29.21	9.90E-06	42.29	2.94E-05
20.39	4.20E-06	29.51	1.01E-05	42.71	3.08E-05
20.59	4.35E-06	29.81	1.03E-05	43.14	3.22E-05
20.80	4.47E-06	30.11	1.06E-05	43.56	3.36E-05
21.00	4.59E-06	30.41	1.08E-05	44.00	3.50E-05
21.21	4.71E-06	30.71	1.11E-05	44.43	3.63E-05
21.43	4.84E-06	31.02	1.14E-05	44.88	3.77E-05
21.64	4.97E-06	31.33	1.18E-05	45.33	3.88E-05
21.86	5.10E-06	31.65	1.21E-05	45.80	4.03E-05
22.08	5.24E-06	31.96	1.23E-05	46.26	4.22E-05
22.31	5.36E-06	32.28	1.26E-05	46.73	4.50E-05
22.53	5.48E-06	32.61	1.29E-05	47.19	4.90E-05
22.76	5.63E-06	32.93	1.32E-05	47.67	5.42E-05
22.99	5.78E-06	33.26	1.35E-05	48.15	5.97E-05
23.22	5.91E-06	33.60	1.39E-05	48.64	6.33E-05
23.45	6.05E-06	33.93	1.42E-05	49.13	6.56E-05
23.69	6.19E-06	34.28	1.45E-05	49.62	6.79E-05
23.92	6.33E-06	34.62	1.48E-05	50.10	6.89E-05
24.16	6.47E-06	34.97	1.52E-05	50.60	6.93E-05
24.41	6.62E-06	35.32	1.57E-05	51.11	7.15E-05
24.65	6.78E-06	35.67	1.63E-05	51.63	7.56E-05
24.90	6.96E-06	36.03	1.67E-05	52.15	8.23E-05
25.15	7.12E-06	36.39	1.69E-05	52.68	9.16E-05
25.40	7.28E-06	36.76	1.70E-05	53.21	1.02E-04
25.66	7.45E-06	37.13	1.72E-05	53.73	1.12E-04
25.91	7.63E-06	37.50	1.75E-05	54.27	1.23E-04
26.17	7.82E-06	37.88	1.81E-05	54.81	1.33E-04
26.44	8.00E-06	38.25	1.88E-05	*55.35*	*1.43E-04*
26.71	8.20E-06	38.65	1.95E-05	*55.90*	*1.51E-04*
26.97	8.39E-06	39.03	2.00E-05	*56.47*	*1.57E-04*
27.24	8.55E-06	39.43	2.06E-05	*57.03*	*1.64E-04*
27.51	8.77E-06	39.81	2.14E-05	*57.61*	*1.75E-04*
27.79	8.97E-06	40.22	2.23E-05	*58.18*	*1.91E-04*
28.07	9.12E-06	40.61	2.36E-05	*58.75*	*2.09E-04*
28.35	9.29E-06	41.03	2.50E-05	*59.22*	*2.38E-04*

Table B-27. Constant R (Decreasing Then Increasing ΔK) FCG Data for Specimen 2 T-L of D6AC Steel

Specimen ID: 2 Test: R = 0.7			Orientation: T-L		
ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)
10.15	3.50E-07	3.82	2.34E-08	13.25	7.05E-07
10.15	3.53E-07	3.80	2.21E-08	13.47	7.45E-07
10.10	3.52E-07	3.78	2.13E-08	13.70	7.77E-07
10.00	3.45E-07	3.77	2.14E-08	13.92	8.24E-07
9.86	3.32E-07	3.75	2.09E-08	14.15	8.72E-07
9.68	3.19E-07	3.73	2.03E-08	14.39	9.05E-07
9.51	3.04E-07	3.72	2.06E-08	14.63	9.37E-07
9.34	2.86E-07	3.70	2.01E-08	14.88	1.00E-06
9.17	2.76E-07	3.69	1.91E-08	15.12	1.06E-06
9.00	2.61E-07	3.67	1.85E-08	15.38	1.13E-06
8.84	2.48E-07	3.66	1.82E-08	15.63	1.21E-06
8.68	2.35E-07	3.64	1.68E-08	15.89	1.26E-06
8.52	2.22E-07	3.63	1.63E-08	16.15	1.33E-06
8.37	2.12E-07	3.62	1.72E-08	16.42	1.43E-06
8.22	2.04E-07	3.61	1.67E-08	16.70	1.55E-06
8.07	1.99E-07	3.59	1.58E-08	16.97	1.56E-06
7.93	1.88E-07	3.58	1.44E-08	17.26	1.62E-06
7.78	1.78E-07	3.57	1.45E-08	17.53	1.82E-06
7.64	1.73E-07	3.56	1.57E-08	17.83	1.99E-06
7.50	1.63E-07	3.55	1.71E-08	18.12	2.05E-06
7.37	1.51E-07	3.54	1.56E-08	18.42	2.04E-06
7.24	1.47E-07	3.52	1.36E-08	18.72	2.20E-06
7.11	1.47E-07	3.51	1.31E-08	19.01	2.32E-06
6.98	1.41E-07	3.50	1.19E-08	19.32	2.44E-06
6.85	1.33E-07	3.50	1.19E-08	19.64	2.65E-06
6.74	1.25E-07	3.49	1.34E-08	19.98	2.76E-06
6.61	1.18E-07	3.48	1.46E-08	20.32	2.88E-06
6.50	1.11E-07	3.47	1.43E-08	20.65	2.99E-06
6.38	1.03E-07	3.46	1.29E-08	20.99	3.10E-06
6.27	1.02E-07	3.45	1.24E-08	21.34	3.50E-06
6.15	9.80E-08	3.44	1.27E-08	21.67	3.58E-06
6.04	9.45E-08	3.43	1.28E-08	22.05	3.72E-06
5.93	9.14E-08	3.42	1.28E-08	22.38	3.87E-06
5.83	8.80E-08	3.41	1.16E-08	22.76	3.74E-06
5.72	8.69E-08	3.40	1.15E-08	23.13	3.97E-06
5.63	8.48E-08	3.39	1.23E-08	23.51	4.31E-06
5.25	7.58E-08	3.38	1.21E-08	23.90	4.67E-06
5.17	7.10E-08	3.38	1.16E-08	24.28	4.72E-06
5.09	6.44E-08	3.37	1.12E-08	24.68	4.96E-06
5.02	5.98E-08	3.36	1.01E-08	25.09	5.38E-06
4.96	5.38E-08	3.35	1.08E-08	25.49	5.28E-06

Table B-27. Constant *R* (Decreasing Then Increasing ΔK) FCG Data for Specimen 2 T-L of D6AC Steel (Continued)

Specimen ID: 2 Test: $R = 0.7$			Orientation: T-L		
ΔK (ksi-in$^{1/2}$)	*da*/*dN* (inch/cycle)	ΔK (ksi-in$^{1/2}$)	*da*/*dN* (inch/cycle)	ΔK (ksi-in$^{1/2}$)	*da*/*dN* (inch/cycle)
4.91	4.73E-08	3.35	1.08E-08	25.93	5.50E-06
4.86	4.36E-08	3.34	1.14E-08	26.34	5.96E-06
4.82	4.12E-08	3.33	1.23E-08	26.79	6.14E-06
4.77	4.15E-08	3.32	8.66E-09	27.22	6.39E-06
4.73	4.45E-08	3.32	7.40E-09	27.66	6.68E-06
4.69	4.53E-08	3.31	9.48E-09	28.10	7.01E-06
4.64	4.75E-08	3.30	1.16E-08	28.56	7.22E-06
4.60	4.90E-08	3.30	1.21E-08	29.01	7.47E-06
4.55	4.70E-08	3.29	8.74E-09	29.50	7.91E-06
4.51	4.46E-08	3.28	8.69E-09	29.98	8.34E-06
4.46	4.38E-08	3.28	8.58E-09	30.46	8.26E-06
4.43	4.18E-08	3.27	7.39E-09	30.97	8.44E-06
4.39	4.03E-08	3.26	8.86E-09	31.45	9.26E-06
4.35	3.95E-08	3.26	8.43E-09	31.97	9.98E-06
4.31	3.80E-08	3.25	8.42E-09	32.48	1.00E-05
4.28	3.59E-08	3.25	9.16E-09	33.00	1.08E-05
4.25	3.61E-08	3.24	9.03E-09	33.51	1.14E-05
4.22	3.73E-08	3.23	8.42E-09	34.08	1.21E-05
4.18	3.45E-08	3.23	8.70E-09	34.60	1.28E-05
4.15	3.30E-08	3.22	9.35E-09	35.19	1.24E-05
4.12	3.41E-08	3.22	6.96E-09	35.77	1.34E-05
4.10	3.43E-08	3.21	5.94E-09	36.34	1.51E-05
4.07	3.20E-08	11.03	4.38E-07	36.93	1.52E-05
4.04	3.02E-08	11.21	4.46E-07	37.52	1.54E-05
4.01	3.02E-08	11.40	4.71E-07	38.11	1.74E-05
3.99	2.94E-08	11.59	4.85E-07	*38.74*	*1.88E-05*
3.97	2.62E-08	11.79	5.11E-07	*39.35*	*1.91E-05*
3.94	2.51E-08	11.99	5.34E-07	*40.00*	*2.14E-05*
3.92	2.63E-08	12.19	5.54E-07	*40.63*	*2.54E-05*
3.90	2.60E-08	12.40	5.72E-07	*41.30*	*2.71E-05*
3.88	2.49E-08	12.61	6.03E-07	*41.96*	*3.01E-05*
3.86	2.46E-08	12.82	6.30E-07	*42.64*	*3.73E-05*
3.84	2.46E-08	13.03	6.53E-07	*43.30*	*4.60E-05*

Table B-28. Constant K_{max} FCG Data for Specimen 5 T-L of D6AC Steel

Specimen ID: 5	Test: K_{max} = 15 ksi-in$^{1/2}$		Orientation: T-L		
ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)
13.08	8.07E-07	7.88	2.44E-07	4.74	6.69E-08
12.84	8.05E-07	7.73	2.26E-07	4.66	6.46E-08
12.61	7.80E-07	7.59	2.17E-07	4.58	6.51E-08
12.38	7.56E-07	7.46	2.15E-07	4.49	6.21E-08
12.16	7.25E-07	7.32	2.07E-07	4.41	5.85E-08
11.94	6.91E-07	7.19	1.98E-07	4.33	5.77E-08
11.73	6.59E-07	7.07	1.88E-07	4.25	5.46E-08
11.52	6.33E-07	6.94	1.76E-07	4.18	4.76E-08
11.31	6.07E-07	6.82	1.68E-07	4.10	4.49E-08
11.11	5.78E-07	6.69	1.66E-07	4.03	4.43E-08
10.91	5.52E-07	6.57	1.59E-07	3.96	3.94E-08
10.71	5.27E-07	6.45	1.51E-07	3.88	3.74E-08
10.52	5.02E-07	6.34	1.42E-07	3.82	3.88E-08
10.33	4.83E-07	6.22	1.32E-07	3.74	3.82E-08
10.15	4.67E-07	6.11	1.27E-07	3.68	3.52E-08
9.97	4.49E-07	6.00	1.25E-07	3.61	3.08E-08
9.79	4.30E-07	5.89	1.20E-07	3.54	2.87E-08
9.61	4.12E-07	5.79	1.15E-07	3.48	2.80E-08
9.44	3.94E-07	5.68	1.09E-07	3.42	2.57E-08
9.27	3.74E-07	5.58	1.04E-07	3.36	2.40E-08
9.10	3.54E-07	5.48	9.80E-08	3.30	2.17E-08
8.94	3.35E-07	5.38	9.65E-08	3.24	1.90E-08
8.78	3.20E-07	5.29	9.59E-08	3.18	1.54E-08
8.62	3.07E-07	5.19	8.91E-08	3.12	1.51E-08
8.47	2.91E-07	5.10	8.20E-08	3.07	1.61E-08
8.32	2.79E-07	5.01	7.83E-08	3.01	1.10E-08
8.17	2.69E-07	4.92	7.61E-08	2.96	8.79E-09
8.02	2.56E-07	4.83	7.27E-08		

Table B-29. Constant K_{max} FCG Data for Specimen 8 T-L of D6AC Steel

Specimen ID: 8	Test: K_{max} = 30 ksi-in$^{1/2}$		Orientation: T-L		
ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)
20.08	3.32E-06	6.05	1.31E-07	3.03	1.55E-08
19.50	3.25E-06	5.78	1.26E-07	3.01	1.49E-08
19.43	2.98E-06	5.52	1.09E-07	2.98	1.48E-08
18.42	2.68E-06	5.27	9.67E-08	2.96	1.38E-08
17.95	2.41E-06	5.04	8.86E-08	2.94	1.39E-08
17.14	2.13E-06	4.83	8.16E-08	2.90	1.33E-08
16.39	1.89E-06	4.63	7.44E-08	2.86	1.16E-08
15.65	1.63E-06	4.47	6.58E-08	2.85	1.09E-08

Table B-29. Constant K_{max} FCG Data for Specimen 8 T-L of D6AC Steel (Continued)

Specimen ID: 8	Test: K_{max} = 30 ksi-in$^{1/2}$		Orientation: T-L		
ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)
14.96	1.40E-06	4.32	5.77E-08	2.83	1.05E-08
14.30	1.20E-06	4.19	5.31E-08	2.77	1.01E-08
13.66	1.04E-06	4.08	4.92E-08	2.74	8.71E-09
13.06	9.19E-07	3.98	4.71E-08	2.71	8.01E-09
12.49	7.86E-07	3.88	4.78E-08	2.68	7.58E-09
11.93	6.93E-07	3.79	4.49E-08	2.67	7.61E-09
11.41	6.34E-07	3.70	4.09E-08	2.66	6.84E-09
10.90	5.45E-07	3.63	3.73E-08	2.65	6.75E-09
10.41	4.83E-07	3.56	3.36E-08	2.61	6.53E-09
9.96	4.36E-07	3.50	3.23E-08	2.58	6.51E-09
9.52	3.77E-07	3.44	3.04E-08	2.57	5.43E-09
9.10	3.43E-07	3.39	2.77E-08	2.55	5.86E-09
8.69	3.17E-07	3.35	2.57E-08	2.53	4.71E-09
8.30	2.82E-07	3.30	2.45E-08	2.51	3.04E-09
7.94	2.43E-07	3.26	2.37E-08	2.51	1.22E-09
7.58	2.21E-07	3.22	2.20E-08	2.50	4.24E-09
7.25	2.02E-07	3.18	2.18E-08	2.50	4.90E-09
6.92	1.80E-07	3.15	2.00E-08	2.49	4.13E-09
6.62	1.64E-07	3.09	1.84E-08	2.49	3.14E-09
6.33	1.41E-07	3.06	1.77E-08		

Table B-30. Constant R (Increasing ΔK) FCG Data for Specimen 14 T-L of D6AC Steel

Specimen ID: 14	Test: R = 0.8		Orientation: T-L		
ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)
10.11	5.91E-07	14.67	1.63E-06	22.33	6.22E-06
10.14	5.90E-07	15.06	1.78E-06	22.93	6.61E-06
10.27	5.95E-07	15.45	1.94E-06	23.54	7.06E-06
10.44	6.13E-07	15.86	2.10E-06	24.18	7.81E-06
10.71	6.44E-07	16.30	2.28E-06	24.81	9.18E-06
11.00	6.89E-07	16.73	2.48E-06	25.49	1.12E-05
11.29	7.43E-07	17.18	2.68E-06	26.17	1.38E-05
11.59	8.01E-07	17.64	2.91E-06	26.86	1.67E-05
11.89	8.62E-07	18.11	3.18E-06	27.59	1.98E-05
12.21	9.29E-07	18.59	3.50E-06	28.32	2.39E-05
12.54	1.00E-06	19.09	3.84E-06	29.06	2.94E-05
12.87	1.08E-06	19.59	4.21E-06	29.86	3.68E-05
13.21	1.16E-06	20.12	4.60E-06	30.63	4.81E-05
13.56	1.26E-06	20.65	5.03E-06	31.42	6.29E-05
13.92	1.37E-06	21.19	5.45E-06	32.25	7.54E-05
14.29	1.50E-06	21.76	5.84E-06	33.07	9.49E-05

Table B-31. Constant R (Increasing ΔK) FCG Data for Specimen 15 T-L of D6AC Steel

Specimen ID: 15			Orientation: T-L		
Test: R = 0.9					
ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)
6.17	1.87E-07	9.17	5.49E-07	13.60	3.57E-06
6.32	1.99E-07	9.41	5.93E-07	13.96	4.67E-06
6.49	2.13E-07	9.67	6.47E-07	14.36	6.19E-06
6.67	2.29E-07	9.92	7.14E-07	14.73	8.24E-06
6.85	2.46E-07	10.18	7.82E-07	15.15	1.07E-05
7.03	2.64E-07	10.45	8.54E-07	15.55	1.39E-05
7.22	2.83E-07	10.72	9.41E-07	15.94	1.74E-05
7.42	3.03E-07	11.02	1.05E-06	16.39	2.11E-05
7.62	3.23E-07	11.32	1.17E-06	16.80	2.71E-05
7.82	3.48E-07	11.62	1.34E-06	17.25	3.89E-05
8.03	3.74E-07	11.94	1.55E-06	17.70	5.52E-05
8.24	4.03E-07	12.26	1.79E-06	18.22	8.81E-05
8.46	4.36E-07	12.58	2.08E-06	18.70	2.04E-04
8.69	4.71E-07	12.91	2.41E-06		
8.92	5.09E-07	13.25	2.84E-06		

Table B-32. Constant K_{max} FCG Data for Specimen 15 T-L of D6AC Steel

Specimen ID: 15			Orientation: T-L		
Test: K_{max} = 20 ksi-in$^{1/2}$					
ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)
10.03	6.06E-07	2.97	1.71E-08	2.37	1.97E-09
9.17	4.84E-07	2.87	1.45E-08	2.36	2.13E-09
8.38	3.89E-07	2.78	1.22E-08	2.35	2.34E-09
7.65	3.14E-07	2.72	1.03E-08	2.34	2.34E-09
6.98	2.52E-07	2.66	8.57E-09	2.32	2.16E-09
6.37	2.03E-07	2.61	7.26E-09	2.31	1.84E-09
5.82	1.62E-07	2.58	6.28E-09	2.30	1.46E-09
5.31	1.32E-07	2.55	5.70E-09	2.30	1.10E-09
4.85	1.05E-07	2.52	5.50E-09	2.29	9.77E-10
4.44	8.04E-08	2.49	5.38E-09	2.29	1.06E-09
4.05	5.88E-08	2.45	4.97E-09	2.28	1.33E-09
3.73	4.28E-08	2.43	4.23E-09	2.28	1.48E-09
3.45	3.22E-08	2.41	3.48E-09	2.27	1.33E-09
3.24	2.54E-08	2.39	2.78E-09	2.26	1.09E-09
3.09	2.04E-08	2.38	2.18E-09		

Table B-33. Constant R (Decreasing ΔK) FCG Data for Specimen 1 S-T of D6AC Steel

Specimen ID: 1 Test: R = 0.1			Orientation: S-T		
ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)
11.92	3.04E-07	9.36	1.56E-07	7.47	5.19E-08
11.58	2.91E-07	9.09	1.35E-07	7.32	4.88E-08
11.20	2.99E-07	8.82	1.30E-07	7.20	3.87E-08
10.87	2.56E-07	8.56	1.03E-07	7.09	3.32E-08
10.56	2.45E-07	8.31	8.94E-08	7.01	2.35E-08
10.25	2.40E-07	8.06	8.12E-08	6.96	1.63E-08
9.94	2.37E-07	7.83	6.93E-08		
9.64	1.86E-07	7.63	5.66E-08		

Table B-34. Constant R (Decreasing Then Increasing ΔK) FCG Data for Specimen 3 S-T of D6AC Steel

Specimen ID: 3 Test: R = 0.3			Orientation: S-T		
ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)
13.06	7.72E-07	7.35	1.65E-07	26.32	8.01E-06
12.75	7.92E-07	7.22	1.55E-07	27.56	8.84E-06
12.53	8.52E-07	7.09	1.44E-07	28.83	9.70E-06
12.31	8.37E-07	6.96	1.31E-07	30.17	1.07E-05
12.09	7.99E-07	6.84	1.17E-07	31.55	1.17E-05
11.88	7.65E-07	6.72	1.06E-07	33.04	1.28E-05
11.67	7.32E-07	6.60	9.69E-08	34.55	1.41E-05
11.46	6.97E-07	6.49	8.97E-08	36.16	1.55E-05
11.25	6.67E-07	6.37	8.27E-08	37.82	1.70E-05
11.06	6.44E-07	6.26	7.57E-08	39.55	1.87E-05
10.87	6.17E-07	6.15	6.89E-08	41.39	2.08E-05
10.68	5.88E-07	6.04	6.24E-08	43.29	2.30E-05
10.49	5.58E-07	5.93	5.68E-08	45.32	2.57E-05
10.30	5.29E-07	5.83	5.15E-08	47.40	2.87E-05
10.13	5.02E-07	5.72	4.67E-08	49.64	3.22E-05
9.95	4.80E-07	5.62	4.21E-08	51.94	3.65E-05
9.77	4.62E-07	5.52	3.77E-08	54.39	4.18E-05
9.60	4.42E-07	5.43	3.37E-08	56.85	4.81E-05
9.43	4.22E-07	5.33	3.02E-08	59.52	5.51E-05
9.26	4.03E-07	5.24	2.68E-08	62.20	6.34E-05
9.10	3.83E-07	5.14	2.30E-08	65.07	7.38E-05
8.94	3.64E-07	5.05	1.94E-08	68.07	8.64E-05
8.78	3.41E-07	4.96	1.73E-08	71.26	1.02E-04
8.62	3.09E-07	4.88	2.08E-08	74.40	1.23E-04

Table B-34. Constant R (Decreasing Then Increasing ΔK) FCG Data for Specimen 3 S-T of D6AC Steel (Continued)

Specimen ID: 3	Test: R = 0.3	Orientation: S-T			
ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)
8.42	2.81E-07	4.71	4.47E-09	77.86	1.46E-04
8.32	2.56E-07	19.16	3.50E-06	81.31	1.77E-04
8.12	2.40E-07	20.05	3.97E-06	84.97	2.15E-04
8.03	2.28E-07	21.00	4.52E-06	88.89	2.67E-04
7.89	2.24E-07	21.96	5.19E-06	92.85	3.39E-04
7.75	2.07E-07	22.97	5.83E-06	97.05	4.47E-04
7.62	1.91E-07	24.04	6.49E-06	101.45	5.10E-04
7.48	1.77E-07	25.15	7.21E-06	105.76	7.10E-04

Table B-35. Constant R (Increasing ΔK) FCG Data for Specimen 4 S-T of D6AC Steel

Specimen ID: 4	Test: R = 0.1	Orientation: S-T			
ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)
10.15	3.36E-07	21.33	3.76E-06	44.78	1.97E-05
10.34	3.57E-07	21.73	3.96E-06	45.61	2.04E-05
10.53	3.81E-07	22.12	4.14E-06	46.45	2.13E-05
10.72	4.08E-07	22.51	4.30E-06	47.30	2.22E-05
10.91	4.32E-07	22.92	4.51E-06	48.18	2.32E-05
11.11	4.59E-07	23.33	4.74E-06	49.05	2.43E-05
11.32	4.90E-07	23.76	4.97E-06	49.95	2.54E-05
11.52	5.22E-07	24.20	5.20E-06	50.85	2.63E-05
11.74	5.53E-07	24.64	5.43E-06	51.79	2.74E-05
11.95	5.81E-07	25.10	5.66E-06	52.72	2.89E-05
12.17	6.09E-07	25.57	5.93E-06	53.68	3.03E-05
12.39	6.45E-07	26.03	6.19E-06	54.63	3.16E-05
12.62	6.82E-07	26.50	6.48E-06	55.65	3.32E-05
12.85	7.16E-07	26.99	6.77E-06	56.66	3.49E-05
13.09	7.60E-07	27.48	7.01E-06	57.71	3.66E-05
13.33	8.03E-07	27.99	7.27E-06	58.77	3.85E-05
13.57	8.50E-07	28.50	7.56E-06	59.82	4.01E-05
13.82	9.04E-07	29.01	7.83E-06	60.92	4.23E-05
14.07	9.51E-07	29.53	8.13E-06	62.02	4.48E-05
14.32	1.01E-06	30.07	8.48E-06	63.18	4.70E-05
14.58	1.07E-06	30.63	8.85E-06	64.35	4.91E-05
14.85	1.14E-06	31.19	9.19E-06	65.54	5.14E-05
15.12	1.21E-06	31.75	9.53E-06	66.74	5.41E-05
15.40	1.27E-06	32.33	9.90E-06	67.94	5.71E-05
15.68	1.35E-06	32.92	1.03E-05	69.17	6.04E-05
15.97	1.45E-06	33.52	1.06E-05	70.43	6.40E-05

Table B-35. Constant R (Increasing ΔK) FCG Data for Specimen 4 S-T of D6AC Steel (Continued)

Specimen ID: 4 Test: R = 0.1			Orientation: S-T		
ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)
16.26	1.55E-06	34.14	1.11E-05	71.70	6.78E-05
16.55	1.65E-06	34.77	1.15E-05	73.00	7.15E-05
16.86	1.76E-06	35.40	1.19E-05	74.35	7.51E-05
17.16	1.87E-06	36.04	1.24E-05	75.68	7.90E-05
17.48	1.99E-06	36.70	1.28E-05	77.06	8.46E-05
17.80	2.12E-06	37.37	1.33E-05	78.44	9.12E-05
18.11	2.25E-06	38.07	1.38E-05	79.85	9.70E-05
18.44	2.39E-06	38.77	1.44E-05	81.32	1.03E-04
18.78	2.56E-06	39.47	1.49E-05	82.81	1.08E-04
19.13	2.71E-06	40.20	1.55E-05	84.30	1.14E-04
19.48	2.85E-06	40.92	1.62E-05	85.87	1.21E-04
19.84	3.03E-06	41.68	1.68E-05	87.39	1.29E-04
20.20	3.22E-06	42.43	1.75E-05	88.98	1.36E-04
20.57	3.38E-06	43.21	1.81E-05		
20.95	3.57E-06	44.00	1.89E-05		

Table B-36. Constant K_{max} FCG Data for Specimen 4 S-T of D6AC Steel

Specimen ID: 4 Test: K_{max} = 15 ksi-in$^{1/2}$			Orientation: S-T		
ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)
9.26	3.71E-07	3.95	4.71E-08	2.75	9.03E-09
8.85	3.36E-07	3.79	4.11E-08	2.72	7.78E-09
8.46	3.02E-07	3.65	3.54E-08	2.70	7.15E-09
8.09	2.70E-07	3.53	3.14E-08	2.69	6.82E-09
7.73	2.40E-07	3.42	2.75E-08	2.67	6.56E-09
7.40	2.15E-07	3.34	2.41E-08	2.65	6.10E-09
7.07	1.94E-07	3.26	2.25E-08	2.63	5.84E-09
6.76	1.75E-07	3.19	2.03E-08	2.62	5.22E-09
6.46	1.58E-07	3.13	1.85E-08	2.61	4.42E-09
6.18	1.41E-07	3.08	1.71E-08	2.60	4.27E-09
5.91	1.25E-07	3.02	1.62E-08	2.59	3.09E-09
5.65	1.12E-07	2.98	1.47E-08	2.58	3.25E-09
5.40	1.00E-07	2.94	1.32E-08	2.57	3.96E-09
5.17	9.09E-08	2.90	1.24E-08	2.56	4.02E-09
4.94	8.32E-08	2.87	1.01E-08	2.55	4.43E-09
4.72	7.48E-08	2.84	9.10E-09	2.54	4.84E-09
4.51	6.57E-08	2.82	8.79E-09	2.53	2.65E-09
4.31	5.78E-08	2.79	7.91E-09		
4.13	5.23E-08	2.77	8.23E-09		

Table B-37. Constant K_{max} FCG Data for Specimen 5 S-T of D6AC Steel

Specimen ID: 5 Test: K_{max} = 20 ksi-in$^{1/2}$			Orientation: S-T		
ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)
17.12	1.60E-06	9.13	3.87E-07	4.97	8.55E-08
16.62	1.48E-06	8.86	3.58E-07	4.69	7.73E-08
16.13	1.46E-06	8.60	3.32E-07	4.55	7.27E-08
15.65	1.42E-06	8.34	3.11E-07	4.41	6.65E-08
15.19	1.33E-06	8.10	2.87E-07	4.28	5.93E-08
14.75	1.24E-06	7.86	2.63E-07	4.16	5.43E-08
14.31	1.16E-06	7.63	2.45E-07	4.03	5.67E-08
13.89	1.09E-06	7.41	2.27E-07	3.91	4.95E-08
13.47	1.01E-06	7.19	2.13E-07	3.79	3.83E-08
13.08	9.49E-07	6.97	1.97E-07	3.69	3.60E-08
12.70	8.84E-07	6.77	1.81E-07	3.58	3.36E-08
12.33	8.19E-07	6.56	1.71E-07	3.47	3.08E-08
11.96	7.61E-07	6.37	1.60E-07	3.37	2.86E-08
11.61	7.05E-07	6.18	1.48E-07	3.27	2.54E-08
11.26	6.53E-07	6.00	1.38E-07	3.17	2.18E-08
10.93	6.06E-07	5.82	1.29E-07	3.08	2.00E-08
10.60	5.60E-07	5.65	1.19E-07	2.99	1.80E-08
10.29	5.22E-07	5.48	1.11E-07	2.90	1.63E-08
9.99	4.83E-07	5.41	9.26E-08	2.82	1.30E-08
9.69	4.44E-07	5.28	1.36E-07		
9.41	4.14E-07	5.09	1.14E-07		

Table B-38. Constant R (Decreasing Then Increasing ΔK) FCG Data for Specimen 7 S-T of D6AC Steel

Specimen ID: 7 Test: R = 0.7			Orientation: S-T		
ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)
8.27	2.95E-07	4.81	7.88E-08	2.69	2.88E-09
8.26	3.24E-07	4.72	7.63E-08	9.23	4.83E-07
8.19	3.43E-07	4.64	7.34E-08	10.17	5.93E-07
8.10	3.00E-07	4.56	7.05E-08	10.65	6.61E-07
7.96	2.68E-07	4.47	7.03E-08	11.13	7.44E-07
7.82	2.51E-07	4.39	6.84E-08	11.64	8.42E-07
7.68	2.41E-07	4.31	6.35E-08	12.17	9.67E-07
7.55	2.33E-07	4.24	5.94E-08	12.73	1.13E-06
7.41	2.20E-07	4.16	5.52E-08	13.32	1.30E-06
7.28	2.07E-07	4.09	5.14E-08	13.94	1.51E-06
7.15	1.98E-07	4.01	4.85E-08	14.58	1.75E-06
7.02	1.88E-07	3.94	4.57E-08	15.26	2.03E-06
6.90	1.77E-07	3.87	4.29E-08	15.96	2.34E-06

Table B-38. Constant R (Decreasing Then Increasing ΔK) FCG Data for Specimen 7 S-T of D6AC Steel (Continued)

Specimen ID: 7 Test: R = 0.7			Orientation: S-T		
ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)
6.77	1.70E-07	3.80	4.02E-08	16.70	2.64E-06
6.65	1.64E-07	3.73	3.79E-08	18.23	3.01E-06
6.53	1.58E-07	3.66	3.66E-08	19.92	4.17E-06
6.42	1.52E-07	3.60	3.47E-08	20.83	4.65E-06
6.30	1.49E-07	3.53	3.21E-08	21.81	5.16E-06
6.19	1.43E-07	3.47	2.97E-08	22.79	5.73E-06
6.08	1.36E-07	3.41	2.73E-08	23.84	6.34E-06
5.97	1.31E-07	3.35	2.51E-08	24.93	7.04E-06
5.87	1.26E-07	3.28	2.34E-08	26.07	7.78E-06
5.76	1.22E-07	3.23	2.17E-08	27.28	8.58E-06
5.66	1.18E-07	3.17	2.00E-08	28.53	9.33E-06
5.56	1.13E-07	3.11	1.84E-08	29.85	1.04E-05
5.46	1.09E-07	3.05	1.64E-08	31.20	1.15E-05
5.36	1.04E-07	3.00	1.43E-08	32.64	1.23E-05
5.26	9.80E-08	2.95	1.22E-08	34.12	1.41E-05
5.17	9.39E-08	2.89	1.09E-08	35.71	1.65E-05
5.08	9.10E-08	2.84	9.59E-09	37.28	1.86E-05
4.98	8.60E-08	2.79	8.32E-09	45.01	5.68E-05
4.90	8.15E-08	2.74	7.72E-09	46.68	7.52E-05

Table B-39. Constant R (Decreasing Then Increasing ΔK) FCG Data for Specimen 8 S-T of D6AC Steel

Specimen ID: 8 Test: R = 0.7			Orientation: S-T		
ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)
8.54	3.24E-07	3.56	2.83E-08	18.38	3.25E-06
8.39	3.12E-07	3.50	2.61E-08	18.72	3.41E-06
8.24	2.99E-07	3.44	2.42E-08	19.06	3.58E-06
8.09	2.84E-07	3.37	2.21E-08	19.42	3.79E-06
7.95	2.70E-07	3.31	2.02E-08	19.77	4.00E-06
7.80	2.61E-07	3.25	1.86E-08	20.13	4.14E-06
7.67	2.50E-07	3.20	1.65E-08	20.49	4.28E-06
7.53	2.38E-07	3.14	1.47E-08	20.86	4.47E-06
7.39	2.27E-07	3.08	1.34E-08	21.24	4.68E-06
7.26	2.17E-07	3.03	1.16E-08	21.62	4.85E-06
7.13	2.07E-07	2.97	1.01E-08	22.01	4.94E-06
7.01	1.98E-07	2.92	9.48E-09	22.40	5.10E-06
6.88	1.89E-07	2.87	8.52E-09	22.81	5.37E-06
6.76	1.80E-07	2.82	7.45E-09	23.23	5.57E-06

Table B-39. Constant *R* (Decreasing Then Increasing Δ*K*) FCG Data for Specimen 8 S-T of D6AC Steel (Continued)

Specimen ID: 8 Test: *R* = 0.7			Orientation: S-T		
Δ*K* (ksi-in$^{1/2}$)	*da*/*dN* (inch/cycle)	Δ*K* (ksi-in$^{1/2}$)	*da*/*dN* (inch/cycle)	Δ*K* (ksi-in$^{1/2}$)	*da*/*dN* (inch/cycle)
6.64	1.72E-07	9.62	4.51E-07	23.66	5.78E-06
6.52	1.64E-07	9.80	4.80E-07	24.09	6.06E-06
6.41	1.57E-07	9.98	5.05E-07	24.53	6.30E-06
6.30	1.52E-07	10.16	5.28E-07	24.97	6.59E-06
6.18	1.43E-07	10.34	5.57E-07	25.42	6.88E-06
6.07	1.36E-07	10.53	5.88E-07	25.88	7.13E-06
5.97	1.31E-07	10.72	6.16E-07	26.36	7.40E-06
5.86	1.27E-07	10.92	6.47E-07	26.84	7.62E-06
5.76	1.22E-07	11.12	6.80E-07	27.34	7.96E-06
5.65	1.18E-07	11.32	7.15E-07	27.83	8.33E-06
5.62	1.18E-07	11.52	7.51E-07	28.34	8.62E-06
5.59	1.14E-07	11.73	7.97E-07	28.84	9.12E-06
5.49	1.10E-07	11.94	8.45E-07	29.37	9.57E-06
5.39	1.05E-07	12.16	8.99E-07	29.89	9.76E-06
5.29	9.88E-08	12.38	9.56E-07	30.43	1.03E-05
5.20	9.58E-08	12.60	9.95E-07	30.98	1.08E-05
5.11	9.18E-08	12.84	1.05E-06	31.54	1.11E-05
5.02	8.64E-08	13.07	1.12E-06	32.13	1.15E-05
4.93	8.28E-08	13.31	1.19E-06	32.71	1.17E-05
4.84	7.95E-08	13.55	1.26E-06	33.30	1.20E-05
4.75	7.59E-08	13.79	1.33E-06	33.91	1.27E-05
4.67	7.22E-08	14.04	1.41E-06	34.52	1.33E-05
4.58	6.80E-08	14.29	1.49E-06	35.15	1.38E-05
4.50	6.43E-08	14.55	1.57E-06	35.79	1.41E-05
4.42	6.05E-08	14.82	1.67E-06	36.45	1.45E-05
4.34	5.74E-08	15.08	1.78E-06	37.11	1.57E-05
4.26	5.47E-08	15.36	1.89E-06	*37.78*	*1.72E-05*
4.19	5.13E-08	15.64	2.02E-06	*38.46*	*1.84E-05*
4.11	4.80E-08	15.93	2.12E-06	*39.16*	*1.95E-05*
4.04	4.54E-08	16.22	2.25E-06	*39.87*	*2.08E-05*
3.97	4.28E-08	16.51	2.42E-06	*40.64*	*2.33E-05*
3.90	3.98E-08	16.81	2.55E-06	*41.36*	*2.73E-05*
3.83	3.73E-08	17.12	2.67E-06	*42.12*	*2.84E-05*
3.76	3.52E-08	17.43	2.81E-06	*42.88*	*2.86E-05*
3.69	3.32E-08	17.74	2.97E-06		
3.63	3.06E-08	18.06	3.12E-06		

Table B-40. Constant *R* (Decreasing Then Increasing ΔK) FCG Data for Specimen 9 S-T of D6AC Steel

Specimen ID: 9 Test: $R = 0.7$			Orientation: S-T		
ΔK (ksi-in$^{1/2}$)	*da*/*dN* (inch/cycle)	ΔK (ksi-in$^{1/2}$)	*da*/*dN* (inch/cycle)	ΔK (ksi-in$^{1/2}$)	*da*/*dN* (inch/cycle)
4.41	6.35E-08	8.26	3.15E-07	15.97	2.12E-06
4.34	6.02E-08	8.42	3.29E-07	16.26	2.25E-06
4.26	5.75E-08	8.57	3.43E-07	16.55	2.40E-06
4.19	5.40E-08	8.73	3.57E-07	16.86	2.54E-06
4.11	5.09E-08	8.90	3.76E-07	17.17	2.66E-06
4.04	4.91E-08	9.06	3.97E-07	17.49	2.78E-06
3.97	4.56E-08	9.23	4.18E-07	17.81	2.93E-06
3.90	4.27E-08	9.39	4.40E-07	18.14	3.07E-06
3.83	4.11E-08	9.56	4.63E-07	18.47	3.14E-06
3.76	3.77E-08	9.74	4.86E-07	18.82	3.34E-06
3.69	3.47E-08	9.92	5.11E-07	19.16	3.57E-06
3.62	3.27E-08	10.10	5.36E-07	19.52	3.73E-06
3.56	3.04E-08	10.29	5.64E-07	19.88	3.88E-06
3.50	2.74E-08	10.49	5.91E-07	20.24	4.04E-06
3.44	2.49E-08	10.68	6.18E-07	20.61	4.23E-06
3.38	2.30E-08	10.88	6.53E-07	20.99	4.42E-06
3.32	2.09E-08	11.07	6.88E-07	21.37	4.58E-06
3.26	1.86E-08	11.28	7.18E-07	21.78	4.81E-06
3.20	1.67E-08	11.49	7.63E-07	22.18	5.06E-06
3.14	1.50E-08	12.36	9.65E-07	22.59	5.32E-06
3.09	1.37E-08	12.59	1.02E-06	22.99	5.34E-06
3.04	1.24E-08	12.82	1.08E-06	23.42	5.51E-06
2.98	1.05E-08	13.05	1.14E-06	23.84	5.97E-06
2.93	9.37E-09	13.29	1.21E-06	24.29	6.09E-06
2.88	9.92E-09	13.53	1.28E-06	24.73	6.19E-06
2.83	9.69E-09	13.79	1.34E-06	25.19	6.43E-06
7.27	2.32E-07	14.05	1.44E-06	25.66	6.67E-06
7.40	2.41E-07	14.31	1.52E-06	26.13	6.99E-06
7.54	2.51E-07	14.57	1.59E-06	26.60	7.19E-06
7.68	2.62E-07	14.84	1.68E-06	27.10	7.60E-06
7.82	2.76E-07	15.11	1.79E-06	27.59	8.08E-06
7.97	2.90E-07	15.39	1.92E-06	28.12	8.36E-06
8.12	3.03E-07	15.68	2.04E-06		

Table B-41. Constant R (Increasing ΔK) FCG Data for Specimen 12 S-T of D6AC Steel

Specimen ID: 12			Orientation: S-T		
Test: R = 0.1					
ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)
18.05	1.91E-06	34.94	1.14E-05	68.33	6.01E-05
18.35	1.98E-06	35.90	1.21E-05	70.22	6.50E-05
18.82	2.09E-06	36.88	1.27E-05	72.14	7.08E-05
19.34	2.25E-06	37.91	1.35E-05	74.10	7.76E-05
19.87	2.47E-06	38.91	1.43E-05	76.14	8.48E-05
20.42	2.72E-06	40.00	1.53E-05	78.19	9.31E-05
20.99	2.98E-06	41.02	1.63E-05	80.34	1.03E-04
21.56	3.25E-06	42.16	1.73E-05	82.54	1.15E-04
22.14	3.54E-06	43.31	1.85E-05	84.73	1.27E-04
22.73	3.84E-06	44.48	1.97E-05	87.00	1.39E-04
23.33	4.18E-06	45.72	2.11E-05	89.31	1.51E-04
23.96	4.53E-06	46.95	2.24E-05	91.70	1.65E-04
24.62	4.88E-06	48.22	2.37E-05	94.24	1.79E-04
25.29	5.25E-06	49.56	2.52E-05	96.76	1.95E-04
26.00	5.66E-06	50.90	2.66E-05	99.37	2.10E-04
26.71	6.06E-06	52.30	2.83E-05	102.11	2.27E-04
27.45	6.54E-06	53.70	3.04E-05	104.83	2.50E-04
28.18	6.94E-06	55.15	3.30E-05	107.69	2.74E-04
28.99	7.41E-06	56.63	3.59E-05	110.56	3.01E-04
29.74	7.87E-06	58.16	3.83E-05	113.49	3.33E-04
30.58	8.34E-06	59.75	4.08E-05	116.51	3.73E-04
31.39	8.97E-06	61.37	4.37E-05	119.65	4.05E-04
32.24	9.62E-06	63.07	4.72E-05	122.82	4.66E-04
33.12	1.02E-05	64.78	5.13E-05		
34.01	1.08E-05	66.54	5.56E-05		

Table B-42. Constant R (Decreasing Then Increasing ΔK) FCG Data for Specimen 13 S-T of D6AC Steel

Specimen ID: 13			Orientation: S-T		
Test: R = 0.3					
ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)
13.85	9.62E-07	8.08	1.96E-07	14.43	1.03E-06
13.80	9.41E-07	7.93	1.77E-07	22.07	4.56E-06
13.67	9.03E-07	7.79	1.66E-07	23.08	5.04E-06
13.49	8.99E-07	7.65	1.49E-07	24.16	5.65E-06
13.24	8.87E-07	7.51	1.30E-07	25.24	6.24E-06
12.99	7.99E-07	7.37	1.17E-07	26.40	6.49E-06
12.75	7.18E-07	7.24	1.09E-07	27.61	7.36E-06
12.53	7.30E-07	7.11	1.02E-07	28.83	8.17E-06
12.30	7.25E-07	6.98	9.50E-08	30.17	8.74E-06

Table B-42. Constant R (Decreasing Then Increasing ΔK) FCG Data for Specimen 13 S-T of D6AC Steel (Continued)

Specimen ID: 13 Test: R = 0.3			Orientation: S-T		
ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)
12.08	6.52E-07	6.85	8.50E-08	31.51	9.84E-06
11.85	6.26E-07	6.73	7.50E-08	35.86	1.31E-05
11.64	6.52E-07	6.61	6.53E-08	37.72	1.47E-05
11.44	6.16E-07	6.49	5.78E-08	39.36	1.61E-05
11.23	5.52E-07	6.37	5.17E-08	41.17	1.78E-05
11.03	5.33E-07	6.26	4.59E-08	43.05	1.97E-05
10.83	5.24E-07	6.14	4.17E-08	45.03	2.20E-05
10.63	4.79E-07	6.03	3.84E-08	47.06	2.47E-05
10.43	4.86E-07	5.92	3.65E-08	49.19	2.78E-05
10.24	4.87E-07	5.81	3.21E-08	51.41	3.13E-05
10.06	4.28E-07	5.70	2.70E-08	53.80	3.55E-05
9.88	3.96E-07	5.61	2.43E-08	56.26	4.00E-05
9.70	4.10E-07	5.51	2.23E-08	58.84	4.58E-05
9.54	3.85E-07	5.41	2.02E-08	61.50	5.41E-05
9.36	3.49E-07	5.31	1.70E-08	64.34	6.42E-05
9.20	3.49E-07	5.21	1.38E-08	67.26	7.41E-05
9.03	3.24E-07	5.12	1.06E-08	70.32	8.59E-05
8.86	2.99E-07	13.61	1.11E-06	73.48	1.03E-04
8.70	2.79E-07	13.61	1.06E-06	76.78	1.27E-04
8.54	2.52E-07	13.61	1.08E-06	80.21	1.57E-04
8.38	2.39E-07	13.60	1.06E-06	83.79	1.83E-04
8.23	2.26E-07	13.60	1.05E-06	87.63	2.25E-04

Table B-43. Constant R (Increasing ΔK) FCG Data for Specimen 14 S-T of D6AC Steel

Specimen ID: 14 Test: R = 0.8			Orientation: S-T		
ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)
6.00	1.51E-07	9.08	4.46E-07	13.96	1.56E-06
6.05	1.54E-07	9.24	4.69E-07	14.22	1.65E-06
6.12	1.58E-07	9.41	4.93E-07	14.48	1.75E-06
6.22	1.64E-07	9.58	5.17E-07	14.74	1.84E-06
6.34	1.72E-07	9.76	5.42E-07	15.01	1.94E-06
6.45	1.82E-07	9.93	5.68E-07	15.28	2.04E-06
6.57	1.92E-07	10.11	5.97E-07	15.55	2.16E-06
6.69	2.02E-07	10.29	6.27E-07	15.83	2.29E-06
6.81	2.11E-07	10.48	6.59E-07	16.11	2.43E-06
6.94	2.20E-07	10.67	6.92E-07	16.40	2.58E-06
7.06	2.28E-07	10.86	7.27E-07	16.70	2.73E-06
7.19	2.38E-07	11.06	7.66E-07	17.00	2.88E-06

Table B-43. Constant R (Increasing ΔK) FCG Data for Specimen 14 S-T of D6AC Steel (Continued)

Specimen ID: 14	Test: R = 0.8	Orientation: S-T			
ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)
7.32	2.49E-07	11.26	8.07E-07	17.31	3.03E-06
7.46	2.61E-07	11.46	8.52E-07	17.63	3.17E-06
7.59	2.74E-07	11.67	9.03E-07	17.95	3.32E-06
7.73	2.88E-07	11.88	9.57E-07	18.27	3.36E-06
7.86	3.02E-07	12.09	1.01E-06	18.60	3.47E-06
8.00	3.17E-07	12.31	1.07E-06	18.91	3.60E-06
8.15	3.32E-07	12.53	1.13E-06	19.28	3.79E-06
8.30	3.48E-07	12.76	1.19E-06	19.61	4.08E-06
8.45	3.65E-07	12.99	1.25E-06	19.99	4.42E-06
8.60	3.83E-07	13.23	1.32E-06	20.35	4.76E-06
8.76	4.03E-07	13.47	1.39E-06		
8.91	4.25E-07	13.71	1.48E-06		

Table B-44. Constant R (Increasing ΔK) FCG Data for Specimen 15 S-T of D6AC Steel

Specimen ID: 15	Test: R = 0.8	Orientation: S-T			
ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)
10.01	5.59E-07	12.73	1.19E-06	17.12	3.05E-06
10.01	5.53E-07	13.08	1.31E-06	17.58	3.32E-06
10.12	5.65E-07	13.44	1.43E-06	18.06	3.63E-06
10.27	6.03E-07	13.80	1.55E-06	18.56	3.99E-06
10.53	6.61E-07	14.17	1.70E-06	19.07	4.34E-06
10.82	7.33E-07	14.56	1.84E-06	19.60	4.68E-06
11.12	8.01E-07	14.96	2.00E-06	20.14	4.98E-06
11.43	8.68E-07	15.37	2.18E-06	20.68	5.31E-06
11.74	9.39E-07	15.79	2.38E-06	21.25	5.59E-06
12.06	1.01E-06	16.23	2.59E-06	21.84	5.99E-06
12.39	1.10E-06	16.67	2.81E-06		

Table B-45. Constant *R* (Increasing Δ*K*) FCG Data for Specimen 16 S-T of D6AC Steel

Specimen ID: 16	Test: *R* = 0.9	Orientation: S-T			
Δ*K* (ksi-in$^{1/2}$)	*da*/*dN* (inch/cycle)	Δ*K* (ksi-in$^{1/2}$)	*da*/*dN* (inch/cycle)	Δ*K* (ksi-in$^{1/2}$)	*da*/*dN* (inch/cycle)
8.00	3.81E-07	9.98	6.96E-07	12.74	1.68E-06
8.11	3.90E-07	10.26	7.56E-07	13.08	1.89E-06
8.26	4.09E-07	10.54	8.26E-07	13.43	2.14E-06
8.49	4.35E-07	10.83	9.03E-07	13.80	2.44E-06
8.73	4.69E-07	11.13	9.83E-07	14.18	2.91E-06
8.97	5.07E-07	11.43	1.07E-06	14.57	3.11E-06
9.22	5.50E-07	11.74	1.19E-06	14.91	4.01E-06
9.46	5.95E-07	12.07	1.32E-06		
9.72	6.44E-07	12.40	1.48E-06		

Table B-46. Constant *R* (Decreasing Δ*K*) FCG Data for Specimen 17 S-T of D6AC Steel

Specimen ID: 17	Test: *R* = 0.1	Orientation: S-T			
Δ*K* (ksi-in$^{1/2}$)	*da*/*dN* (inch/cycle)	Δ*K* (ksi-in$^{1/2}$)	*da*/*dN* (inch/cycle)	Δ*K* (ksi-in$^{1/2}$)	*da*/*dN* (inch/cycle)
11.81	5.19E-07	9.57	1.90E-07	7.55	4.64E-08
11.74	6.01E-07	9.40	1.70E-07	7.42	4.41E-08
11.65	5.96E-07	9.23	1.56E-07	7.29	3.75E-08
11.49	5.03E-07	9.08	1.36E-07	7.15	3.30E-08
11.29	4.57E-07	8.91	1.28E-07	7.03	2.99E-08
11.10	4.27E-07	8.75	1.22E-07	6.90	1.77E-08
10.89	3.73E-07	8.58	1.06E-07	6.79	1.17E-08
10.68	3.34E-07	8.42	1.03E-07	6.68	9.30E-09
10.50	3.06E-07	8.26	1.01E-07	6.56	8.26E-09
10.31	2.70E-07	8.12	9.13E-08	6.47	7.10E-09
10.14	2.42E-07	7.97	8.39E-08	6.40	5.43E-09
9.93	2.26E-07	7.83	7.48E-08	5.95	1.31E-09
9.75	2.14E-07	7.70	5.75E-08		

Table B-47. Constant R (Increasing ΔK) FCG Data for Specimen 19 S-T of D6AC Steel

Specimen ID: 19 Test: R = 0.3			Orientation: S-T		
ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)
7.63	2.07E-07	24.61	6.46E-06	45.68	2.54E-05
7.71	2.15E-07	25.05	6.71E-06	46.50	2.66E-05
7.88	2.31E-07	25.50	7.01E-06	47.32	2.77E-05
8.16	2.59E-07	25.95	7.31E-06	48.18	2.89E-05
8.53	2.95E-07	26.42	7.60E-06	49.04	3.02E-05
8.92	3.39E-07	26.90	7.91E-06	49.94	3.16E-05
9.33	3.84E-07	27.38	8.26E-06	50.81	3.86E-05
9.76	4.33E-07	27.87	8.59E-06	51.72	4.02E-05
10.21	4.88E-07	28.36	8.91E-06	54.12	4.25E-05
10.68	5.52E-07	28.85	9.28E-06	55.45	5.00E-05
11.16	6.24E-07	29.36	9.67E-06	58.59	5.44E-05
11.67	6.99E-07	29.89	1.00E-05	60.08	5.71E-05
12.20	7.85E-07	30.43	1.04E-05	61.72	6.34E-05
12.76	8.81E-07	30.97	1.07E-05	62.81	6.63E-05
13.35	1.00E-06	31.53	1.11E-05	63.96	6.98E-05
13.96	1.15E-06	32.09	1.15E-05	65.10	7.38E-05
14.60	1.31E-06	32.66	1.20E-05	66.27	7.87E-05
15.26	1.51E-06	33.24	1.25E-05	67.45	8.35E-05
15.96	1.76E-06	33.84	1.29E-05	68.64	8.85E-05
16.68	2.06E-06	34.44	1.34E-05	69.83	9.45E-05
17.45	2.42E-06	35.06	1.39E-05	71.07	1.02E-04
18.25	2.82E-06	35.69	1.44E-05	72.32	1.09E-04
19.32	3.20E-06	36.32	1.50E-05	73.65	1.17E-04
19.88	3.47E-06	36.95	1.56E-05	74.93	1.26E-04
20.55	3.68E-06	37.62	1.62E-05	76.28	1.35E-04
20.70	4.16E-06	38.28	1.68E-05	77.63	1.47E-04
20.99	4.33E-06	38.96	1.74E-05	79.00	1.61E-04
21.38	4.53E-06	39.66	1.82E-05	80.42	1.79E-04
21.76	4.74E-06	40.36	1.89E-05	81.85	1.98E-04
22.15	4.98E-06	41.09	1.97E-05	83.29	2.19E-04
22.54	5.23E-06	41.82	2.05E-05	*84.76*	*2.40E-04*
22.94	5.47E-06	42.58	2.14E-05	*86.24*	*2.61E-04*
23.35	5.71E-06	43.33	2.23E-05	*87.74*	*2.82E-04*
23.76	5.95E-06	44.12	2.32E-05	*89.29*	*3.05E-04*
24.18	6.20E-06	44.89	2.43E-05		

Table B-48. Constant K_{max} FCG Data for Specimen 19 S-T of D6AC Steel

Specimen ID: 19			Orientation: S-T		
Test: K_{max} = 30 ksi-in$^{1/2}$					
ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)
20.64	3.86E-06	8.96	4.78E-07	3.32	4.04E-08
20.34	3.77E-06	8.22	3.73E-07	3.05	2.59E-08
19.53	3.67E-06	7.49	3.05E-07	2.83	1.66E-08
18.42	3.53E-06	6.87	2.49E-07	2.66	1.12E-08
16.87	3.26E-06	6.27	2.00E-07	2.54	8.00E-09
15.44	2.56E-06	5.70	1.60E-07	2.46	5.92E-09
14.05	1.82E-06	5.23	1.29E-07	2.40	4.50E-09
12.89	1.34E-06	4.76	1.06E-07	2.36	3.58E-09
11.75	1.03E-06	4.34	8.90E-08	2.32	2.97E-09
10.73	7.90E-07	3.97	7.36E-08	2.28	2.52E-09
9.83	6.17E-07	3.63	5.80E-08	2.26	2.21E-09

APPENDIX C—FATIGUE CRACK GROWTH RATE DATA (a, N, da/dN, AND ΔK) OF D6AC STEEL ALLOY

The fatigue crack growth rate data (a, N, da/dN, and ΔK) of D6AC steel alloy are listed in tables C-1 through C-3 sequentially by specimen orientation and number.

Table C-1. Crack Growth Data for Specimen 28 L-T of D6AC Steel

Specimen ID:	28		Orientation:	L-T
Test:	Constant ΔK = 10.8 ksi-in$^{1/2}$ Constant R = 0.1 Load Reduction Constant ΔK = 7.0 ksi-in$^{1/2}$ Constant ΔK = 7.6 ksi-in$^{1/2}$ Constant ΔK = 8.7 ksi-in$^{1/2}$ Constant ΔK = 9.7 ksi-in$^{1/2}$			
a (inch)	N (cycles)	ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)	Test Condition
0.711	98,454	0.00	0.00E+00	Precrack
0.724	213,024	10.71	1.55E-07	
0.734	245,747	10.71	3.11E-07	
0.743	273,703	10.72	3.28E-07	
0.752	299,483	10.72	3.55E-07	
0.761	324,600	10.72	3.76E-07	
0.771	348,149	10.72	3.92E-07	
0.779	369,825	10.72	4.08E-07	
0.789	391,890	10.73	4.25E-07	
0.798	414,915	10.73	4.47E-07	
0.808	436,166	10.74	4.71E-07	
0.818	455,442	10.74	4.94E-07	
0.827	474,193	10.75	5.19E-07	
0.837	492,573	10.76	5.36E-07	
0.847	510,379	10.77	4.99E-07	
0.857	527,616	10.77	4.66E-07	
0.866	544,852	10.20	2.97E-07	
0.861	596,593	10.79	2.90E-07	
0.886	648,665	10.21	4.80E-07	
0.895	665,716	10.80	5.40E-07	Constant ΔK = 10.8 ksi-in$^{1/2}$
0.905	682,412	10.80	5.37E-07	
0.914	699,648	10.81	5.54E-07	
0.924	716,884	10.81	5.50E-07	
0.933	734,121	10.82	5.44E-07	
0.943	752,075	10.82	5.40E-07	
0.952	770,030	10.83	5.37E-07	
0.961	787,266	10.83	5.34E-07	
0.971	805,221	10.84	5.33E-07	
0.981	823,893	10.84	5.32E-07	
0.990	841,848	10.85	5.30E-07	
1.000	859,803	10.86	5.30E-07	

Table C-1. Crack Growth Data for Specimen 28 L-T of D6AC Steel (Continued)

a (inch)	*N* (cycles)	ΔK (ksi-in$^{1/2}$)	*da*/*dN* (inch/cycle)	Test Condition
1.009	877,757	10.86	5.29E-07	Constant ΔK = 10.8 ksi-in$^{1/2}$ (Continued)
1.019	895,712	10.87	5.28E-07	
1.029	914,384	10.87	5.26E-07	
1.038	932,339	10.88	5.24E-07	
1.048	950,293	10.88	5.24E-07	
1.057	968,248	10.88	5.25E-07	
1.066	986,203	10.89	5.22E-07	
1.076	1,004,875	10.89	5.20E-07	Constant *R* = 0.1 Load Reduction
1.086	1,023,712	10.84	5.12E-07	
1.094	1,039,611	10.75	5.01E-07	
1.104	1,059,332	10.60	4.83E-07	
1.113	1,080,342	10.41	4.60E-07	
1.123	1,102,756	10.23	4.22E-07	
1.133	1,127,234	10.05	3.91E-07	
1.142	1,153,940	9.88	3.61E-07	
1.152	1,182,415	9.71	3.35E-07	
1.161	1,212,673	9.54	3.13E-07	
1.170	1,245,127	9.37	2.93E-07	
1.180	1,279,786	9.21	2.75E-07	
1.189	1,316,746	9.04	2.56E-07	
1.199	1,357,010	8.89	2.38E-07	
1.209	1,401,006	8.73	2.20E-07	
1.218	1,447,700	8.58	2.03E-07	
1.227	1,498,589	8.43	1.86E-07	
1.237	1,555,745	8.28	1.70E-07	
1.247	1,618,218	8.14	1.53E-07	
1.256	1,689,787	8.00	1.36E-07	
1.265	1,769,706	7.86	1.23E-07	
1.275	1,855,930	7.72	1.10E-07	
1.284	1,951,875	7.59	1.01E-07	
1.294	2,062,498	7.46	8.92E-08	
1.303	2,194,620	7.32	7.52E-08	
1.313	2,364,898	7.20	6.17E-08	
1.322	2,559,258	7.07	5.22E-08	
1.332	2,766,332	6.99	4.69E-08	
1.341	2,983,507	6.93	4.47E-08	
1.350	3,200,678	6.91	4.49E-08	
1.359	3,407,749	6.92	4.39E-08	
1.369	3,604,719	6.92	4.34E-08	
1.379	3,801,689	6.92	4.23E-08	
1.387	4,059,264	6.92	4.11E-08	
1.397	4,331,991	6.93	4.12E-08	
1.407	4,549,166	6.93	4.21E-08	
1.416	4,751,187	6.93	4.45E-08	

Table C-1. Crack Growth Data for Specimen 28 L-T of D6AC Steel (Continued)

a (inch)	*N* (cycles)	ΔK (ksi-in$^{1/2}$)	*da*/*dN* (inch/cycle)	Test Condition
1.425	4,958,258	6.94	4.67E-08	Constant *R* = 0.1 Load Reduction (Continued)
1.435	5,175,432	6.94	4.62E-08	
1.444	5,352,199	6.94	4.59E-08	
1.454	5,528,967	6.94	4.58E-08	Constant ΔK = 7.0 ksi-in$^{1/2}$
1.462	5,766,341	6.95	4.57E-08	
1.472	5,993,614	6.95	4.62E-08	
1.482	6,185,533	6.95	4.70E-08	
1.491	6,367,353	6.96	4.96E-08	
1.500	6,554,224	6.96	5.04E-08	
1.510	6,751,194	6.96	5.11E-08	
1.520	6,938,062	6.96	5.07E-08	
1.529	7,104,729	6.97	5.04E-08	
1.537	7,271,395	6.97	5.06E-08	
1.546	7,473,416	6.97	5.02E-08	
1.556	7,675,436	6.98	5.11E-08	
1.566	7,852,204	6.98	5.21E-08	
1.575	8,023,921	6.98	5.36E-08	
1.585	8,195,641	6.98	5.77E-08	
1.594	8,367,358	6.99	6.55E-08	
1.603	8,533,729	7.28	7.97E-08	Transition
1.614	8,638,694	7.29	8.93E-08	
1.621	8,712,943	7.59	9.40E-08	
1.631	8,805,751	7.61	1.02E-07	Constant ΔK = 7.6 ksi-in$^{1/2}$
1.640	8,897,499	7.61	1.04E-07	
1.650	8,989,246	7.62	1.03E-07	
1.659	9,080,993	7.62	1.02E-07	
1.668	9,169,781	7.62	1.03E-07	
1.678	9,262,268	7.63	1.04E-07	
1.687	9,351,056	7.63	1.06E-07	
1.696	9,436,145	7.63	1.17E-07	
1.705	9,521,233	7.77	1.39E-07	
1.714	9,596,584	8.14	1.70E-07	Transition
1.723	9,634,114	8.29	1.84E-07	
1.733	9,679,383	8.66	1.99E-07	Constant ΔK = 8.7 ksi-in$^{1/2}$
1.742	9,723,322	8.67	2.15E-07	
1.751	9,767,261	8.67	2.11E-07	
1.761	9,811,201	8.68	2.11E-07	
1.770	9,853,625	8.68	2.11E-07	
1.779	9,897,565	8.68	2.11E-07	
1.788	9,941,504	8.69	2.14E-07	
1.797	9,983,928	8.69	2.24E-07	
1.806	10,026,352	8.87	2.46E-07	Transition
1.816	10,069,187	9.21	2.78E-07	
1.826	10,097,447	9.39	2.98E-07	

Table C-1. Crack Growth Data for Specimen 28 L-T of D6AC Steel (Continued)

a (inch)	*N* (cycles)	ΔK (ksi-in$^{1/2}$)	*da*/*dN* (inch/cycle)	Test Condition
1.835	10,124,341	9.74	3.13E-07	Constant ΔK = 9.7 ksi-in$^{1/2}$
1.843	10,151,311	9.74	3.29E-07	
1.853	10,179,190	9.74	3.29E-07	
1.862	10,207,068	9.75	3.28E-07	
1.871	10,234,947	9.75	3.28E-07	
1.880	10,264,038	9.75	3.29E-07	
1.889	10,291,917	9.76	3.35E-07	
1.898	10,318,584	9.76	3.35E-07	
1.907	10,345,250	0.00	0.00E+00	

Table C-2. Crack Growth Data for Specimen 31 L-T of D6AC Steel

Specimen ID: 31 Orientation: L-T
Test: Constant ΔK = 7.0 ksi-in$^{1/2}$
Constant R = 0.1 Load Reduction
Constant ΔK = 7.0 ksi-in$^{1/2}$

a (inch)	*N* (cycles)	ΔK (ksi-in$^{1/2}$)	*da*/*dN* (inch/cycle)	Test Condition
0.750	114	0.00	0.00E+00	Precrack
0.745	253	6.94	-2.49E-05	
0.745	303	6.89	-1.07E-04	
0.734	353	6.95	1.62E-05	
0.746	404	6.91	-4.34E-07	
0.751	456	6.96	-1.57E-08	
0.748	507	7.03	-6.28E-08	
0.746	3,148	7.02	-7.49E-08	
0.749	24,504	7.08	2.98E-07	
0.754	53,232	7.08	1.92E-07	
0.759	77,795	7.08	1.81E-07	
0.764	105,732	7.08	1.79E-07	
0.768	129,423	7.08	1.76E-07	
0.773	159,243	7.08	1.64E-07	
0.779	193,168	7.08	1.48E-07	
0.783	235,987	7.08	1.31E-07	
0.789	284,818	7.08	1.23E-07	
0.794	323,954	7.08	1.18E-07	
0.799	362,176	7.07	1.20E-07	
0.804	409,055	7.07	1.24E-07	
0.809	453,492	7.07	1.27E-07	
0.814	487,321	7.07	1.28E-07	
0.819	520,661	7.07	1.29E-07	
0.824	558,912	7.07	1.31E-07	
0.829	599,729	7.07	1.25E-07	
0.833	641,444	7.07	1.20E-07	
0.839	685,128	7.07	1.22E-07	

Table C-2. Crack Growth Data for Specimen 31 L-T of D6AC Steel (Continued)

a (inch)	*N* (cycles)	Δ*K* (ksi-in$^{1/2}$)	*da*/*dN* (inch/cycle)	Test Condition
0.844	725,641	7.07	1.22E-07	Precrack (Continued)
0.849	764,392	7.07	1.21E-07	
0.854	803,143	7.07	1.18E-07	
0.858	847,182	7.07	1.13E-07	
0.863	894,740	7.07	1.08E-07	
0.868	944,060	7.07	1.07E-07	
0.873	989,857	7.07	1.06E-07	
0.878	1,032,131	7.07	1.03E-07	
0.883	1,081,451	7.06	1.01E-07	
0.888	1,132,532	7.06	9.40E-08	
0.893	1,190,659	7.06	8.49E-08	
0.898	1,261,551	7.06	7.51E-08	
0.903	1,334,757	7.06	6.83E-08	
0.908	1,417,326	7.06	6.53E-08	
0.913	1,498,516	7.06	6.47E-08	
0.918	1,570,758	7.06	6.46E-08	
0.922	1,639,560	7.06	6.50E-08	
0.927	1,714,557	7.06	6.47E-08	
0.932	1,796,435	7.06	6.37E-08	
0.937	1,868,678	7.06	6.24E-08	Constant Δ*K* = 7.0 ksi-in$^{1/2}$
0.941	1,944,362	7.06	6.14E-08	
0.947	2,030,365	7.06	6.00E-08	
0.952	2,119,807	7.06	5.71E-08	
0.957	2,212,690	7.06	5.25E-08	
0.962	2,305,573	7.05	5.09E-08	
0.966	2,398,456	0.00	0.00E+00	
0.973	2,491,291	7.03	6.21E-08	Constant *R* = 0.1 Load Reduction
0.981	2,637,396	6.96	6.77E-08	
0.991	2,859,985	6.86	6.23E-08	
1.000	3,138,430	6.72	5.10E-08	
1.010	3,539,327	6.59	2.90E-08	
1.020	4,108,350	6.46	1.63E-08	
1.029	4,982,794	6.36	9.12E-09	
1.032	5,533,165	6.31	7.68E-09	
1.034	5,736,502	6.26	7.05E-09	
1.037	6,187,246	6.23	6.54E-09	
1.041	6,687,739	6.20	7.08E-09	
1.043	7,188,515	6.16	6.18E-09	
1.046	7,688,722	6.12	5.78E-09	
1.051	8,188,032	6.09	5.79E-09	
1.052	8,690,572	6.05	5.92E-09	
1.054	9,193,112	6.02	6.57E-09	
1.058	9,690,574	5.98	8.63E-09	
1.061	10,188,036	6.36	1.39E-08	

Table C-2. Crack Growth Data for Specimen 31 L-T of D6AC Steel (Continued)

a (inch)	*N* (cycles)	ΔK (ksi-in$^{1/2}$)	*da*/*dN* (inch/cycle)	Test Condition
1.067	10,644,080	6.50	1.26E-08	Constant R = 0.1 Load Reduction (Continued)
1.076	11,026,100	6.90	3.11E-09	
1.081	11,040,381	7.06	3.82E-10	Constant ΔK = 7.0 ksi-in$^{1/2}$
1.081	11,055,655	7.06	3.09E-11	
1.082	11,057,639	7.06	-2.04E-08	
1.082	11,059,621	7.06	8.65E-08	
1.082	11,061,605	7.06	1.04E-07	
1.082	11,063,591	7.06	7.81E-08	
1.083	11,065,575	7.06	8.35E-08	
1.083	11,067,559	7.06	7.23E-08	
1.083	11,069,544	7.06	6.28E-08	
1.083	11,071,530	7.06	5.12E-08	
1.083	11,073,514	7.06	2.13E-08	
1.083	11,075,498	7.06	4.09E-09	
1.083	11,077,482	7.06	5.24E-10	
1.083	11,079,466	7.06	3.12E-08	
1.083	11,081,450	7.06	3.47E-08	
1.083	11,083,434	7.06	5.71E-08	
1.084	11,085,417	7.06	8.05E-08	
1.083	11,087,399	7.06	4.62E-08	
1.084	11,089,383	7.06	2.53E-08	
1.084	11,091,367	7.06	-1.01E-09	
1.083	11,093,351	7.06	1.46E-10	
1.084	11,095,335	7.06	-7.49E-09	
1.083	11,097,319	7.06	-2.62E-08	
1.086	11,159,807	7.06	-1.01E-06	
1.090	11,285,763	7.06	4.79E-08	
1.095	11,432,331	7.06	3.81E-08	
1.101	11,586,093	7.06	3.87E-08	
1.106	11,698,899	7.06	3.91E-08	
1.111	11,809,648	7.06	3.98E-08	
1.116	11,951,106	7.06	3.95E-08	
1.121	12,089,160	7.06	3.78E-08	
1.126	12,216,816	7.06	3.64E-08	
1.131	12,349,198	7.06	3.57E-08	
1.136	12,495,764	7.06	3.48E-08	
1.141	12,647,552	7.06	3.41E-08	
1.146	12,789,684	7.06	3.37E-08	
1.150	12,941,969	7.06	3.43E-08	
1.156	13,089,177	7.06	3.54E-08	
1.160	13,216,080	7.06	3.64E-08	

Table C-2. Crack Growth Data for Specimen 31 L-T of D6AC Steel (Continued)

a (inch)	*N* (cycles)	Δ*K* (ksi-in$^{1/2}$)	*da*/*dN* (inch/cycle)	Test Condition
1.165	13,353,136	7.06	3.72E-08	Constant Δ*K* = 7.0 ksi-in$^{1/2}$ (Continued)
1.171	13,485,116	7.06	3.76E-08	
1.176	13,617,096	7.06	3.66E-08	
1.180	13,754,151	7.06	3.69E-08	
1.186	13,886,131	0.00	0.00E+00	

Table C-3. Crack Growth Data for Specimen 32 L-T of D6AC Steel

Specimen ID:	32		Orientation:	L-T
Test:	Constant Δ*P*, Δ*K* ~ 3.6 ksi-in$^{1/2}$ Constant Δ*K* = 7.0 ksi-in$^{1/2}$			
a (inch)	*N* (cycles)	Δ*K* (ksi-in$^{1/2}$)	*da*/*dN* (inch/cycle)	Test condition
0.768	86,983	0.00	0.00E+00	Constant Δ*K* = 7.0 ksi-in$^{1/2}$
0.781	207,751	7.06	1.05E-07	
0.786	253,215	7.15	1.09E-07	
0.790	292,819	7.15	1.05E-07	
0.794	335,494	7.14	1.07E-07	
0.800	383,601	7.14	1.09E-07	
0.804	427,052	7.14	1.10E-07	
0.809	465,539	7.14	1.11E-07	
0.814	506,923	7.14	1.13E-07	
0.818	549,963	7.14	1.12E-07	
0.823	594,659	7.13	1.09E-07	
0.828	641,010	7.13	1.06E-07	
0.833	687,360	7.13	1.04E-07	
0.838	733,711	7.13	1.03E-07	
0.842	781,717	7.13	1.02E-07	
0.847	829,724	7.13	1.02E-07	
0.852	877,730	7.13	1.03E-07	
0.857	924,081	7.13	1.05E-07	
0.862	968,776	7.13	1.06E-07	
0.867	1,015,127	7.12	1.06E-07	
0.872	1,061,478	7.12	1.06E-07	
0.877	1,106,173	7.12	1.03E-07	
0.881	1,152,526	7.12	1.00E-07	
0.886	1,202,193	7.12	9.60E-08	
0.891	1,256,827	7.12	8.89E-08	
0.896	1,317,667	7.12	8.09E-08	
0.901	1,385,954	7.12	7.33E-08	
0.906	1,459,415	7.12	6.69E-08	
0.910	1,539,601	7.12	6.20E-08	
0.915	1,625,607	7.11	5.89E-08	
0.920	1,712,902	7.11	5.73E-08	

Table C-3. Crack Growth Data for Specimen 32 L-T of D6AC Steel (Continued)

a (inch)	*N* (cycles)	ΔK (ksi-in$^{1/2}$)	*da*/*dN* (inch/cycle)	Test condition
0.925	1,800,192	7.11	5.74E-08	Constant ΔK = 7.0 ksi-in$^{1/2}$ (Continued)
0.930	1,881,017	7.11	5.76E-08	
0.935	1,965,074	7.11	5.74E-08	
0.940	2,049,132	7.11	5.65E-08	
0.944	2,129,956	7.11	5.48E-08	
0.949	2,220,480	7.11	5.22E-08	
0.954	2,323,935	7.11	4.95E-08	
0.959	2,431,432	7.11	4.83E-08	
0.964	2,532,462	7.10	4.78E-08	
0.969	2,633,493	7.10	4.77E-08	
0.974	2,738,566	7.10	4.73E-08	
0.979	2,847,681	7.10	4.64E-08	
0.984	2,956,794	7.10	4.53E-08	
0.988	3,057,825	7.10	4.47E-08	
0.993	3,162,896	7.10	4.44E-08	
0.998	3,272,009	7.10	4.46E-08	
1.002	3,381,122	7.10	4.48E-08	
1.007	3,490,235	7.10	4.48E-08	
1.012	3,595,307	7.10	4.42E-08	
1.017	3,708,462	7.09	4.31E-08	
1.022	3,829,699	7.09	4.13E-08	
1.027	3,954,976	7.09	3.96E-08	
1.032	4,085,306	7.09	3.94E-08	
1.037	4,206,543	7.09	3.96E-08	
1.042	4,322,728	7.09	4.00E-08	
1.047	4,449,021	7.09	4.01E-08	
1.052	4,570,270	7.09	3.98E-08	
1.056	4,686,467	7.09	3.92E-08	
1.061	4,812,770	7.09	3.92E-08	
1.066	4,944,123	7.09	3.91E-08	
1.071	5,065,371	7.09	3.88E-08	
1.076	5,186,620	7.09	3.87E-08	
1.081	5,312,921	7.08	3.86E-08	
1.085	5,439,221	7.08	3.75E-08	
1.090	5,575,626	7.08	3.66E-08	
1.095	5,717,084	7.08	3.63E-08	
1.100	5,853,490	7.08	3.61E-08	
1.105	5,984,843	7.08	3.63E-08	
1.110	6,116,196	7.08	3.69E-08	
1.115	6,247,544	7.08	3.73E-08	
1.120	6,378,884	7.08	3.73E-08	
1.125	6,505,171	7.08	3.73E-08	
1.129	6,631,460	7.08	3.72E-08	
1.134	6,767,852	7.08	3.68E-08	

Table C-3. Crack Growth Data for Specimen 32 L-T of D6AC Steel (Continued)

a (inch)	*N* (cycles)	ΔK (ksi-in$^{1/2}$)	*da*/*dN* (inch/cycle)	Test condition
1.139	6,904,244	7.08	3.64E-08	Constant ΔK = 7.0 ksi-in$^{1/2}$ (Continued)
1.144	7,035,583	7.07	3.62E-08	
1.149	7,171,974	7.07	3.61E-08	
1.154	7,308,365	7.07	3.61E-08	
1.158	7,439,705	7.07	3.60E-08	
1.163	7,576,096	7.07	3.63E-08	
1.168	7,712,488	7.07	3.65E-08	
1.173	7,843,829	7.07	3.65E-08	
1.178	7,975,168	7.07	3.63E-08	
1.183	8,111,559	7.07	3.62E-08	
1.188	8,253,001	7.07	3.55E-08	
1.193	8,389,393	7.07	3.48E-08	
1.198	8,525,784	7.07	3.45E-08	
1.202	8,672,280	7.07	3.43E-08	
1.207	8,818,774	7.07	3.42E-08	
1.212	8,960,217	7.07	3.43E-08	
1.217	9,101,669	7.06	3.48E-08	
1.222	9,238,074	7.06	3.46E-08	
1.227	9,374,477	7.06	3.49E-08	
1.232	9,510,871	7.06	3.52E-08	
1.236	9,652,315	7.06	3.54E-08	
1.241	9,793,758	7.06	3.54E-08	
1.246	9,925,097	7.06	3.54E-08	
1.251	10,066,540	7.06	3.58E-08	
1.256	10,202,931	7.06	3.47E-08	
1.261	10,334,270	7.06	3.63E-08	
1.266	10,475,713	0.00	0.00E+00	

APPENDIX D—FATIGUE CRACK GROWTH RATE DATA (*da*/*dN* AND ΔK) FOR 4340 STEEL

The fatigue crack growth rate data (*da*/*dN* and ΔK) for 4340 steel are listed in tables D-1 through D-24 sequentially by specimen orientation and number.

Table D-1. Constant K_{max} FCG Data for Specimen 1 L-T of 4340 Steel

Specimen ID:	1			Orientation:	L-T
Test:	K_{max} = 11 ksi-in$^{1/2}$				
ΔK (ksi-in$^{1/2}$)	*da*/*dN* (inch/cycle)	ΔK (ksi-in$^{1/2}$)	*da*/*dN* (inch/cycle)	ΔK (ksi-in$^{1/2}$)	*da*/*dN* (inch/cycle)
10.02	1.02E-07	5.60	7.20E-08	2.99	4.30E-09
10.02	1.02E-07	5.14	5.81E-08	2.93	3.64E-09
9.96	9.65E-08	4.68	4.34E-08	2.88	3.17E-09
9.79	9.77E-08	4.28	3.08E-08	2.84	2.78E-09
9.33	9.86E-08	3.93	2.12E-08	2.80	2.53E-09
8.79	9.66E-08	3.64	1.50E-08	2.77	2.31E-09
8.06	8.80E-08	3.42	1.10E-08	2.73	2.07E-09
7.37	8.19E-08	3.26	8.36E-09	2.71	1.92E-09
6.73	7.96E-08	3.15	6.54E-09	2.68	1.45E-09
6.16	7.85E-08	3.06	5.19E-09	2.66	1.66E-09

Table D-2. Constant *R* (Increasing ΔK) FCG Data for Specimen 1 L-T of 4340 Steel

Specimen ID:	1			Orientation:	L-T
Test:	*R* = 0.7				
ΔK (ksi-in$^{1/2}$)	*da*/*dN* (inch/cycle)	ΔK (ksi-in$^{1/2}$)	*da*/*dN* (inch/cycle)	ΔK (ksi-in$^{1/2}$)	*da*/*dN* (inch/cycle)
10.08	2.78E-07	13.10	6.05E-07	19.29	2.30E-06
10.08	2.80E-07	13.10	5.95E-07	20.20	2.69E-06
10.08	2.81E-07	13.10	5.96E-07	21.14	3.11E-06
10.08	2.86E-07	13.10	6.02E-07	22.12	3.56E-06
10.10	2.98E-07	13.10	6.19E-07	23.15	4.07E-06
10.29	3.19E-07	13.28	6.55E-07	24.21	4.59E-06
10.55	3.51E-07	13.58	7.12E-07	25.31	5.07E-06
11.00	3.91E-07	14.07	7.99E-07	26.51	5.66E-06
11.50	4.40E-07	14.72	9.14E-07	27.67	6.61E-06
12.03	4.96E-07	15.40	1.06E-06	28.97	8.02E-06
12.59	5.63E-07	16.12	1.23E-06	30.31	9.34E-06
13.17	6.25E-07	16.86	1.42E-06	31.70	1.15E-05
13.78	7.07E-07	17.62	1.66E-06		
13.10	6.01E-07	18.44	1.94E-06		

Table D-3. Constant R (Decreasing Then Increasing ΔK) FCG Data for Specimen 2 L-T of 4340 Steel

Specimen ID:	2			Orientation:	L-T
Test:	$R = 0.3$				
ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)
10.54	2.81E-07	10.82	3.17E-07	26.97	5.11E-06
10.53	2.80E-07	11.02	3.27E-07	27.46	5.36E-06
10.44	2.78E-07	11.22	3.37E-07	27.95	5.62E-06
10.33	2.70E-07	11.43	3.54E-07	28.46	5.89E-06
10.16	2.61E-07	11.63	3.73E-07	28.97	6.18E-06
9.98	2.50E-07	11.84	3.94E-07	29.49	6.46E-06
9.80	2.36E-07	12.04	4.14E-07	30.03	6.74E-06
9.62	2.23E-07	12.26	4.37E-07	30.57	7.03E-06
9.45	2.08E-07	12.48	4.63E-07	31.13	7.36E-06
9.28	1.93E-07	12.71	4.87E-07	31.68	7.72E-06
9.12	1.77E-07	12.94	5.15E-07	32.25	8.09E-06
8.96	1.60E-07	13.18	5.36E-07	32.84	8.47E-06
8.80	1.44E-07	13.43	5.52E-07	33.42	8.87E-06
8.65	1.28E-07	13.66	5.73E-07	34.03	9.27E-06
8.49	1.15E-07	13.91	5.96E-07	34.65	1.02E-05
8.34	1.04E-07	14.15	6.26E-07	35.28	1.18E-05
8.19	9.45E-08	14.39	6.66E-07	36.49	1.25E-05
8.04	8.56E-08	14.66	7.07E-07	36.59	1.26E-05
7.90	7.60E-08	14.92	7.42E-07	37.81	1.32E-05
7.76	6.58E-08	15.20	7.83E-07	37.92	1.34E-05
7.62	5.66E-08	15.48	8.31E-07	38.60	1.27E-05
7.49	4.93E-08	15.77	8.96E-07	39.30	1.31E-05
7.36	4.39E-08	16.04	9.54E-07	40.02	1.40E-05
7.23	3.96E-08	16.33	1.02E-06	40.74	1.48E-05
7.12	3.65E-08	16.62	1.10E-06	41.48	1.56E-05
7.02	3.40E-08	16.93	1.17E-06	42.20	1.64E-05
6.93	3.16E-08	17.24	1.25E-06	42.96	1.71E-05
6.85	2.93E-08	17.54	1.33E-06	43.74	1.79E-05
6.77	2.70E-08	17.85	1.42E-06	44.52	1.88E-05
6.70	2.43E-08	18.16	1.52E-06	45.34	1.97E-05
6.63	2.15E-08	18.49	1.61E-06	46.17	2.08E-05
6.58	1.92E-08	18.83	1.72E-06	46.99	2.19E-05
6.53	1.72E-08	19.17	1.84E-06	47.86	2.30E-05
6.49	1.61E-08	19.53	1.95E-06	48.71	2.41E-05
6.45	1.54E-08	19.88	2.06E-06	49.58	2.52E-05
6.41	1.50E-08	20.24	2.18E-06	50.49	2.62E-05
6.37	1.48E-08	20.61	2.31E-06	51.40	2.73E-05
6.34	1.47E-08	20.99	2.43E-06	52.33	2.86E-05
6.30	1.41E-08	21.36	2.56E-06	53.27	3.00E-05
6.26	1.31E-08	21.76	2.70E-06	54.25	3.16E-05
6.23	1.24E-08	22.15	2.87E-06	55.22	3.36E-05

Table D-3. Constant *R* (Decreasing Then Increasing Δ*K*) FCG Data for Specimen 2 L-T of 4340 Steel (Continued)

Δ*K* (ksi-in$^{1/2}$)	*da*/*dN* (inch/cycle)	Δ*K* (ksi-in$^{1/2}$)	*da*/*dN* (inch/cycle)	Δ*K* (ksi-in$^{1/2}$)	*da*/*dN* (inch/cycle)
6.20	1.17E-08	22.56	3.04E-06	56.24	3.57E-05
6.17	1.13E-08	22.96	3.21E-06	57.25	3.77E-05
6.15	1.09E-08	23.38	3.39E-06	58.26	3.97E-05
6.12	1.04E-08	23.80	3.58E-06	59.31	4.17E-05
6.09	9.77E-09	24.23	3.80E-06	60.36	4.40E-05
6.07	9.36E-09	24.67	3.99E-06	61.47	4.64E-05
6.05	8.95E-09	25.11	4.21E-06	62.58	4.90E-05
10.53	3.09E-07	25.57	4.45E-06	63.70	5.24E-05
10.58	3.09E-07	26.04	4.66E-06	64.86	5.47E-05
10.68	3.11E-07	26.50	4.87E-06		

Table D-4. Constant *R* (Increasing Δ*K*) FCG Data for Specimen 3 L-T of 4340 Steel

Specimen ID:	3			Orientation:	L-T
Test:	*R* = 0.3				
Δ*K* (ksi-in$^{1/2}$)	*da*/*dN* (inch/cycle)	Δ*K* (ksi-in$^{1/2}$)	*da*/*dN* (inch/cycle)	Δ*K* (ksi-in$^{1/2}$)	*da*/*dN* (inch/cycle)
8.91	1.36E-07	14.84	6.52E-07	33.29	8.29E-06
8.75	1.29E-07	15.24	6.98E-07	34.19	8.89E-06
8.60	1.15E-07	15.66	7.48E-07	35.13	9.51E-06
8.45	1.01E-07	16.09	8.06E-07	36.08	1.02E-05
8.30	9.01E-08	16.53	8.75E-07	37.07	1.09E-05
8.15	8.02E-08	16.99	9.56E-07	38.09	1.17E-05
8.01	7.43E-08	17.45	1.05E-06	39.15	1.26E-05
7.72	5.92E-08	17.92	1.17E-06	40.22	1.34E-05
7.50	3.72E-08	18.43	1.29E-06	41.30	1.43E-05
7.42	2.79E-08	18.92	1.42E-06	42.41	1.53E-05
7.36	2.33E-08	19.43	1.57E-06	43.54	1.65E-05
7.29	2.16E-08	19.96	1.73E-06	44.74	1.77E-05
7.23	1.93E-08	20.50	1.91E-06	45.96	1.90E-05
7.18	1.70E-08	21.07	2.11E-06	47.20	2.05E-05
7.13	1.51E-08	21.64	2.32E-06	48.49	2.20E-05
7.09	1.27E-08	22.23	2.55E-06	49.82	2.36E-05
7.06	1.05E-08	22.83	2.78E-06	51.19	2.53E-05
7.03	8.95E-09	23.46	3.03E-06	52.60	2.72E-05
7.01	7.61E-09	24.10	3.32E-06	54.06	2.93E-05
6.99	6.92E-09	24.76	3.61E-06	55.52	3.19E-05
6.97	3.95E-09	25.45	3.93E-06	57.02	3.62E-05
11.64	3.37E-07	26.14	4.27E-06	58.59	4.06E-05
11.96	3.58E-07	26.86	4.64E-06	60.24	4.45E-05
12.29	3.92E-07	27.60	5.03E-06	61.81	4.76E-05

Table D-4. Constant R (Increasing ΔK) FCG Data for Specimen 3 L-T of 4340 Steel (Continued)

ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)
12.63	4.25E-07	28.36	5.44E-06	63.58	5.05E-05
12.98	4.60E-07	29.13	5.89E-06	65.25	5.37E-05
13.33	4.97E-07	29.91	6.34E-06	67.03	5.73E-05
13.70	5.35E-07	30.73	6.79E-06	68.91	6.31E-05
14.07	5.74E-07	31.55	7.25E-06	70.77	6.83E-05
14.45	6.11E-07	32.41	7.77E-06	72.70	7.72E-05

Table D-5. Constant R (Increasing ΔK) FCG Data for Specimen 4 L-T of 4340 Steel

Specimen ID: Test:	4 $R = 0.7$			Orientation:	L-T
ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)
7.19	1.11E-07	8.67	1.93E-07	11.16	3.73E-07
7.19	1.15E-07	8.83	2.02E-07	11.36	3.95E-07
7.19	1.14E-07	8.99	2.12E-07	11.57	4.17E-07
7.21	1.16E-07	9.16	2.23E-07	11.78	4.40E-07
7.28	1.21E-07	9.33	2.34E-07	11.99	4.60E-07
7.37	1.25E-07	9.50	2.46E-07	12.21	4.82E-07
7.50	1.31E-07	9.67	2.58E-07	12.43	5.09E-07
7.64	1.37E-07	9.85	2.70E-07	12.66	5.40E-07
7.78	1.44E-07	10.02	2.84E-07	12.89	5.76E-07
7.92	1.52E-07	10.20	2.96E-07	13.12	6.13E-07
8.07	1.60E-07	10.39	3.10E-07	13.36	6.50E-07
8.21	1.68E-07	10.57	3.24E-07	13.60	6.88E-07
8.36	1.77E-07	10.76	3.38E-07	13.85	7.19E-07
8.52	1.85E-07	10.96	3.54E-07		

Table D-6. Constant K_{max} FCG Data for Specimen 8 L-T of 4340 Steel

Specimen ID: Test:	8 K_{max} = 15 ksi-in$^{1/2}$			Orientation:	L-T
ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)
9.98	2.17E-07	6.84	8.53E-08	4.67	3.15E-08
9.82	2.17E-07	6.72	8.15E-08	4.59	2.99E-08
9.67	2.14E-07	6.60	7.77E-08	4.50	2.78E-08
9.50	2.00E-07	6.48	7.42E-08	4.42	2.61E-08
9.32	1.94E-07	6.36	7.05E-08	4.35	2.46E-08
9.15	1.85E-07	6.25	6.72E-08	4.27	2.39E-08
8.99	1.73E-07	6.14	6.49E-08	4.19	2.31E-08
8.82	1.63E-07	6.03	6.31E-08	4.11	2.20E-08
8.66	1.54E-07	5.92	6.17E-08	4.04	2.09E-08
8.51	1.46E-07	5.81	6.04E-08	3.96	1.96E-08

Table D-6. Constant K_{max} FCG Data for Specimen 8 L-T of 4340 Steel (Continued)

ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)
8.35	1.40E-07	5.70	5.67E-08	3.89	1.83E-08
8.20	1.35E-07	5.60	5.27E-08	3.83	1.65E-08
8.06	1.29E-07	4.90	4.84E-08	3.76	1.51E-08
7.91	1.25E-07	5.40	4.46E-08	3.69	1.38E-08
7.77	1.19E-07	4.69	4.17E-08	3.63	1.23E-08
7.63	1.13E-07	5.21	3.99E-08	3.56	1.11E-08
7.49	1.08E-07	5.12	3.93E-08	3.50	1.06E-08
7.36	1.03E-07	5.02	3.79E-08	3.43	9.13E-09
7.23	9.84E-08	4.93	3.59E-08	3.37	8.16E-09
7.10	9.41E-08	4.85	3.43E-08	3.31	7.40E-09
6.97	8.96E-08	4.76	3.29E-08		

Table D-7. Constant K_{max} FCG Data for Specimen 8 L-T of 4340 Steel

Specimen ID: Test:	8 K_{max} = 30 ksi-in$^{1/2}$			Orientation:	L-T
ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)
10.00	2.25E-07	6.73	8.60E-08	4.16	2.90E-08
9.93	2.16E-07	6.61	8.24E-08	4.35	2.80E-08
9.84	2.34E-07	6.49	7.90E-08	4.27	2.73E-08
9.68	2.35E-07	6.37	7.54E-08	4.19	2.61E-08
9.51	2.32E-07	6.26	7.22E-08	4.12	2.47E-08
9.33	2.30E-07	6.15	6.95E-08	4.04	2.36E-08
9.16	2.23E-07	6.04	6.67E-08	3.97	2.28E-08
9.00	2.08E-07	5.93	6.45E-08	3.90	2.16E-08
8.84	1.73E-07	5.82	6.26E-08	3.83	2.05E-08
8.68	1.63E-07	5.71	6.09E-08	3.76	1.92E-08
8.52	1.54E-07	5.61	5.82E-08	3.69	1.77E-08
8.37	1.48E-07	5.51	5.51E-08	3.62	1.68E-08
8.22	1.42E-07	5.41	5.26E-08	3.56	1.47E-08
8.07	1.37E-07	5.31	5.03E-08	3.49	1.31E-08
7.92	1.31E-07	5.22	4.85E-08	3.43	1.14E-08
7.78	1.26E-07	5.13	4.65E-08	3.37	1.05E-08
7.64	1.20E-07	5.03	4.43E-08	3.31	9.82E-09
7.50	1.14E-07	4.94	4.22E-08	3.25	9.89E-09
7.36	1.10E-07	4.85	4.05E-08	3.19	8.92E-09
7.23	1.04E-07	4.76	3.83E-08	3.14	7.15E-09
7.10	9.94E-08	4.68	3.58E-08	3.09	6.18E-09
6.97	9.48E-08	4.32	3.29E-08		
6.85	9.00E-08	4.51	3.05E-08		

Table D-8. Constant *R* (Increasing ΔK) FCG Data for Specimen 28 L-T of 4340 Steel

Specimen ID:	28			Orientation:	L-T
Test:	$R = 0.1$				
ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)
9.16	1.87E-07	15.57	6.55E-07	40.75	1.43E-05
8.91	1.29E-07	15.99	6.92E-07	41.84	1.51E-05
8.73	8.46E-08	16.42	7.50E-07	43.00	1.62E-05
8.57	5.82E-08	16.85	8.31E-07	44.15	1.74E-05
8.43	4.26E-08	17.33	9.23E-07	45.35	1.86E-05
8.32	3.26E-08	17.78	1.01E-06	46.55	2.00E-05
8.22	2.56E-08	18.27	1.10E-06	47.79	2.14E-05
8.16	2.08E-08	18.77	1.19E-06	49.10	2.30E-05
8.10	1.84E-08	19.27	1.29E-06	50.45	2.47E-05
8.11	1.78E-08	19.80	1.40E-06	51.86	2.66E-05
8.14	1.87E-08	20.34	1.54E-06	53.26	2.85E-05
8.22	2.17E-08	20.89	1.70E-06	54.70	3.08E-05
8.35	2.63E-08	21.46	1.86E-06	56.14	3.34E-05
8.48	3.31E-08	22.03	2.04E-06	57.67	3.62E-05
8.67	4.30E-08	22.63	2.23E-06	59.21	3.95E-05
8.88	5.57E-08	23.24	2.44E-06	60.80	4.27E-05
9.11	6.84E-08	23.87	2.70E-06	62.43	4.59E-05
9.36	8.11E-08	24.51	3.01E-06	64.11	4.93E-05
9.61	9.01E-08	25.19	3.38E-06	65.86	5.33E-05
9.88	9.61E-08	25.88	3.83E-06	67.68	5.72E-05
10.13	1.02E-07	26.60	4.34E-06	69.57	6.16E-05
10.41	1.08E-07	27.31	4.89E-06	71.40	6.77E-05
10.69	1.21E-07	28.06	5.36E-06	73.29	7.58E-05
10.97	1.49E-07	28.80	5.81E-06	75.50	8.36E-05
11.28	1.97E-07	29.56	6.29E-06	77.24	9.02E-05
11.59	2.57E-07	30.38	6.73E-06	79.62	9.81E-05
11.92	3.24E-07	31.19	7.26E-06	81.55	1.06E-04
12.25	3.72E-07	32.04	7.80E-06	83.79	1.16E-04
12.58	3.99E-07	32.93	8.38E-06	86.02	1.33E-04
12.91	4.28E-07	33.83	8.98E-06	88.44	1.52E-04
13.24	4.55E-07	34.73	9.57E-06	90.75	1.70E-04
13.61	4.77E-07	35.67	1.05E-05	93.18	1.90E-04
13.99	5.04E-07	36.63	1.13E-05	95.62	2.15E-04
14.37	5.41E-07	37.66	1.21E-05	98.14	2.30E-04
14.76	5.77E-07	38.64	1.29E-05	100.75	2.69E-04
15.16	6.14E-07	39.74	1.35E-05		

Table D-9. Constant *R* (Decreasing Δ*K*) FCG Data for Specimen 30 L-T of 4340 Steel

Specimen ID:	30			Orientation:	L-T
Test:	*R* = 0.7				
Δ*K* (ksi-in$^{1/2}$)	*da*/*dN* (inch/cycle)	Δ*K* (ksi-in$^{1/2}$)	*da*/*dN* (inch/cycle)	Δ*K* (ksi-in$^{1/2}$)	*da*/*dN* (inch/cycle)
9.55	1.35E-07	8.61	3.18E-08	8.24	1.35E-08
9.39	1.05E-07	8.53	2.62E-08	8.20	1.06E-08
9.24	8.91E-08	8.47	2.21E-08	8.18	8.46E-09
9.09	7.47E-08	8.41	1.93E-08	8.16	6.59E-09
8.95	6.13E-08	8.37	1.77E-08	8.14	6.47E-09
8.82	4.89E-08	8.32	1.64E-08		
8.71	3.90E-08	8.27	1.55E-08		

Table D-10. Constant *R* (Decreasing Then Increasing Δ*K*) FCG Data for Specimen 31 L-T of 4340 Steel

Specimen ID:	31			Orientation:	L-T
Test:	*R* = 0.7				
Δ*K* (ksi-in$^{1/2}$)	*da*/*dN* (inch/cycle)	Δ*K* (ksi-in$^{1/2}$)	*da*/*dN* (inch/cycle)	Δ*K* (ksi-in$^{1/2}$)	*da*/*dN* (inch/cycle)
8.71	2.03E-07	5.37	5.66E-08	3.42	8.65E-09
8.64	2.00E-07	5.28	5.37E-08	3.39	8.01E-09
8.54	1.98E-07	5.18	5.12E-08	3.37	7.49E-09
8.40	1.94E-07	5.09	4.87E-08	3.34	7.21E-09
8.25	1.89E-07	5.00	4.61E-08	3.32	7.15E-09
8.11	1.79E-07	4.91	4.38E-08	3.30	7.63E-09
7.96	1.70E-07	4.83	4.15E-08	3.29	7.23E-09
7.82	1.61E-07	4.74	3.94E-08	8.77	2.01E-07
7.69	1.53E-07	4.66	3.73E-08	8.80	2.02E-07
7.55	1.46E-07	4.57	3.53E-08	8.86	2.04E-07
7.41	1.41E-07	4.49	3.35E-08	8.99	2.15E-07
7.28	1.35E-07	4.41	3.18E-08	9.18	2.28E-07
7.15	1.29E-07	4.33	2.99E-08	9.45	2.43E-07
7.03	1.22E-07	4.26	2.78E-08	9.71	2.59E-07
6.90	1.16E-07	4.18	2.62E-08	9.98	2.77E-07
6.78	1.09E-07	4.11	2.48E-08	10.25	2.97E-07
6.66	1.03E-07	4.04	2.33E-08	10.53	3.17E-07
6.54	9.74E-08	3.96	2.15E-08	10.81	3.42E-07
6.42	9.23E-08	3.89	1.95E-08	11.11	3.68E-07
6.31	8.75E-08	3.83	1.77E-08	11.41	3.99E-07
6.20	8.31E-08	3.76	1.63E-08	11.72	4.31E-07
6.09	7.88E-08	3.71	1.51E-08	12.05	4.67E-07
5.98	7.47E-08	3.65	1.40E-08	12.38	5.08E-07

Table D-10. Constant *R* (Decreasing Then Increasing Δ*K*) FCG Data for Specimen 31 L-T of 4340 Steel (Continued)

Δ*K* (ksi-in$^{1/2}$)	*da*/*dN* (inch/cycle)	Δ*K* (ksi-in$^{1/2}$)	*da*/*dN* (inch/cycle)	Δ*K* (ksi-in$^{1/2}$)	*da*/*dN* (inch/cycle)
5.87	7.15E-08	3.60	1.30E-08	12.72	5.54E-07
5.77	6.91E-08	3.56	1.20E-08	13.07	5.99E-07
5.67	6.64E-08	3.52	1.10E-08	13.44	6.45E-07
5.57	6.32E-08	3.48	1.02E-08	13.81	6.89E-07
5.47	5.99E-08	3.45	9.40E-09	14.19	7.41E-07

Table D-11. Constant *R* (Increasing Δ*K*) FCG Data for Specimen 37 L-T of 4340 Steel

Specimen ID: Test:	37 *R* = 0.1			Orientation:	L-T
Δ*K* (ksi-in$^{1/2}$)	*da*/*dN* (inch/cycle)	Δ*K* (ksi-in$^{1/2}$)	*da*/*dN* (inch/cycle)	Δ*K* (ksi-in$^{1/2}$)	*da*/*dN* (inch/cycle)
11.05	2.26E-07	23.20	2.65E-06	49.06	2.17E-05
11.31	2.36E-07	23.91	2.95E-06	50.57	2.30E-05
11.64	2.57E-07	24.64	3.29E-06	52.08	2.47E-05
12.00	2.87E-07	25.41	3.65E-06	53.68	2.67E-05
12.37	3.21E-07	26.18	4.04E-06	55.31	2.96E-05
12.76	3.59E-07	26.97	4.48E-06	56.97	3.28E-05
13.14	3.97E-07	27.78	4.95E-06	58.72	3.59E-05
13.55	4.38E-07	28.61	5.48E-06	60.47	3.90E-05
13.95	4.84E-07	29.48	6.12E-06	62.32	4.21E-05
14.37	5.36E-07	30.39	6.93E-06	64.21	4.54E-05
14.81	5.90E-07	31.32	7.85E-06	66.19	4.97E-05
15.27	6.52E-07	32.29	8.86E-06	68.20	6.50E-05
15.74	7.16E-07	33.26	9.76E-06	70.20	8.10E-05
16.22	7.79E-07	34.28	1.06E-05	72.98	8.70E-05
16.71	8.48E-07	35.29	1.14E-05	74.71	8.56E-05
17.22	9.30E-07	36.37	1.21E-05	77.50	9.16E-05
17.74	1.05E-06	37.46	1.29E-05	79.47	9.16E-05
18.28	1.21E-06	38.62	1.37E-05	81.70	8.59E-05
18.84	1.37E-06	39.81	1.46E-05	84.21	9.98E-05
19.40	1.52E-06	41.04	1.54E-05	86.71	1.14E-04
19.99	1.65E-06	42.28	1.63E-05	89.37	1.31E-04
20.59	1.79E-06	43.55	1.72E-05	91.99	1.50E-04
21.21	1.94E-06	44.89	1.83E-05	94.83	1.70E-04
21.85	2.13E-06	46.21	1.96E-05	97.67	1.94E-04
22.52	2.38E-06	47.64	2.06E-05	100.48	2.11E-04

Table D-12. Constant K_{max} FCG Data for Specimen 1 S-T of 4340 Steel

Specimen ID:	1			Orientation:	S-T
Test:	K_{max} = 15 ksi-in$^{1/2}$				
ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)
9.16	2.26E-07	4.00	2.49E-08	3.07	5.89E-09
8.40	1.84E-07	3.85	2.20E-08	3.08	5.48E-09
7.70	1.92E-07	3.71	1.94E-08	3.02	5.35E-09
7.05	1.50E-07	3.59	1.78E-08	3.01	5.69E-09
6.45	1.12E-07	3.48	1.55E-08	2.98	4.95E-09
5.92	8.36E-08	3.40	1.33E-08	2.95	5.59E-09
5.41	6.27E-08	3.33	1.16E-08	2.92	5.42E-09
5.04	4.83E-08	3.26	1.03E-08	2.89	5.63E-09
4.68	3.85E-08	3.21	8.15E-09	2.86	4.84E-09
4.41	3.20E-08	3.16	7.63E-09	2.83	5.03E-09
4.21	2.75E-08	3.14	6.55E-09		

Table D-13. Constant K_{max} FCG Data for Specimen 1 S-T of 4340 Steel

Specimen ID:	1			Orientation:	S-T
Test:	K_{max} = 30 ksi-in$^{1/2}$				
ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)
14.94	8.20E-07	8.34	2.09E-07	4.06	3.24E-08
14.60	7.98E-07	7.61	1.66E-07	3.71	2.23E-08
14.00	7.69E-07	6.98	1.31E-07	3.44	1.57E-08
13.10	6.90E-07	6.37	1.05E-07	3.23	1.17E-08
11.96	5.63E-07	5.83	8.46E-08	3.07	9.09E-09
10.94	4.33E-07	5.33	7.02E-08	2.94	7.51E-09
9.98	3.38E-07	4.87	5.87E-08	2.86	5.39E-09
9.13	2.65E-07	4.44	4.56E-08		

Table D-14. Constant K_{max} FCG Data for Specimen 1 S-T of 4340 Steel

Specimen ID:	1			Orientation:	S-T
Test:	K_{max} = 45 ksi-in$^{1/2}$				
Δ*K* (ksi-in$^{1/2}$)	*da*/*dN* (inch/cycle)	Δ*K* (ksi-in$^{1/2}$)	*da*/*dN* (inch/cycle)	Δ*K* (ksi-in$^{1/2}$)	*da*/*dN* (inch/cycle)
14.42	8.37E-07	5.67	8.36E-08	2.72	5.35E-09
13.81	8.06E-07	5.18	6.79E-08	2.66	4.35E-09
12.74	6.96E-07	4.73	5.34E-08	2.61	3.54E-09
11.66	5.49E-07	4.33	4.31E-08	2.57	2.92E-09
10.65	4.24E-07	3.98	3.43E-08	2.53	2.50E-09
9.73	3.40E-07	3.67	2.60E-08	2.51	2.22E-09
8.88	2.70E-07	3.42	1.88E-08	2.48	2.03E-09
8.12	2.14E-07	3.21	1.34E-08	2.46	1.90E-09
7.42	1.67E-07	3.04	1.00E-08	2.43	1.93E-09
6.79	1.31E-07	2.91	7.96E-09	2.41	1.81E-09
6.20	1.04E-07	2.81	6.51E-09		

Table D-15. Constant K_{max} FCG Data for Specimen 4 S-T of 4340 Steel

Specimen ID:	4			Orientation:	S-T
Test:	K_{max} = 11 ksi-in$^{1/2}$				
Δ*K* (ksi-in$^{1/2}$)	*da*/*dN* (inch/cycle)	Δ*K* (ksi-in$^{1/2}$)	*da*/*dN* (inch/cycle)	Δ*K* (ksi-in$^{1/2}$)	*da*/*dN* (inch/cycle)
9.94	1.62E-07	5.52	4.65E-08	3.00	5.73E-09
9.80	1.45E-07	5.04	3.58E-08	2.98	5.04E-09
9.27	1.47E-07	4.60	2.73E-08	2.96	4.09E-09
8.76	1.50E-07	4.21	2.04E-08	2.94	3.45E-09
7.89	1.26E-07	3.84	1.45E-08	2.92	3.23E-09
7.21	9.52E-08	3.51	9.17E-09	2.90	3.29E-09
6.60	7.44E-08	3.26	6.57E-09		
6.02	5.90E-08	3.10	5.64E-09		

Table D-16. Constant *R* (Increasing Δ*K*) FCG Data for Specimen 4 S-T of 4340 Steel

Specimen ID:	4			Orientation:	S-T
Test:	*R* = 0.3				
Δ*K* (ksi-in$^{1/2}$)	*da*/*dN* (inch/cycle)	Δ*K* (ksi-in$^{1/2}$)	*da*/*dN* (inch/cycle)	Δ*K* (ksi-in$^{1/2}$)	*da*/*dN* (inch/cycle)
9.92	2.45E-07	19.92	2.07E-06	42.27	1.70E-05
10.07	2.50E-07	20.46	2.29E-06	43.45	1.81E-05
10.32	2.71E-07	21.02	2.49E-06	44.62	1.97E-05
10.60	3.05E-07	21.59	2.70E-06	45.84	2.10E-05
11.00	3.32E-07	22.19	2.94E-06	47.07	2.24E-05
11.31	3.56E-07	22.79	3.19E-06	48.33	2.40E-05
11.62	3.84E-07	23.41	3.47E-06	49.66	2.62E-05
11.94	4.13E-07	24.03	3.80E-06	51.00	2.81E-05
12.26	4.33E-07	24.68	4.12E-06	52.40	2.97E-05

Table D-16. Constant R (Increasing ΔK) FCG Data for Specimen 4 S-T of 4340 Steel (Continued)

ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)
12.59	4.73E-07	25.36	4.39E-06	53.79	3.15E-05
12.94	5.22E-07	26.06	4.84E-06	55.28	3.31E-05
13.30	5.54E-07	26.79	5.33E-06	56.80	3.60E-05
13.67	5.92E-07	28.25	5.65E-06	58.34	3.88E-05
14.05	6.41E-07	29.78	6.96E-06	59.94	4.15E-05
14.43	6.99E-07	30.62	7.44E-06	61.56	4.54E-05
14.81	7.52E-07	31.45	7.95E-06	63.21	4.97E-05
15.22	8.14E-07	32.31	8.56E-06	64.95	5.48E-05
15.63	9.11E-07	33.19	9.23E-06	66.73	5.99E-05
16.06	9.91E-07	34.08	9.73E-06	68.54	6.55E-05
16.50	1.06E-06	35.00	1.04E-05	70.36	7.14E-05
16.95	1.15E-06	35.97	1.11E-05	72.35	7.93E-05
17.40	1.26E-06	36.97	1.19E-05	74.20	8.67E-05
17.87	1.40E-06	37.97	1.27E-05	76.46	9.73E-05
18.36	1.53E-06	39.03	1.36E-05	78.58	1.37E-04
18.87	1.68E-06	40.07	1.48E-05		
19.39	1.86E-06	41.14	1.61E-05		

Table D-17. Constant R (Decreasing Then Increasing ΔK) FCG Data for Specimen 5 S-T of 4340 Steel

Specimen ID: Test:	5 R = 0.7			Orientation:	S-T
ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)
6.52	9.62E-08	3.54	1.09E-08	8.78	1.93E-07
6.51	9.46E-08	3.52	1.05E-08	8.94	2.03E-07
6.46	9.26E-08	3.51	1.00E-08	9.10	2.14E-07
6.39	8.87E-08	3.50	9.52E-09	9.27	2.25E-07
6.28	8.46E-08	3.48	9.14E-09	9.44	2.37E-07
6.17	8.17E-08	3.47	9.01E-09	9.62	2.49E-07
6.06	7.77E-08	3.46	9.02E-09	9.80	2.61E-07
5.95	7.36E-08	3.45	9.09E-09	9.99	2.72E-07
5.85	6.94E-08	3.44	8.96E-09	10.17	2.85E-07
5.74	6.53E-08	3.42	8.90E-09	10.36	2.99E-07
5.64	6.21E-08	3.41	8.59E-09	10.55	3.12E-07
5.54	5.97E-08	3.40	7.78E-09	10.74	3.30E-07
5.44	5.74E-08	3.39	6.96E-09	10.93	3.50E-07
5.35	5.53E-08	3.38	6.65E-09	11.13	3.71E-07
5.25	5.33E-08	3.37	6.17E-09	11.34	3.90E-07
5.16	5.11E-08	3.36	6.02E-09	11.55	4.12E-07
5.07	4.86E-08	3.36	5.95E-09	11.76	4.34E-07
4.98	4.63E-08	3.35	6.26E-09	11.98	4.54E-07

Table D-17. Constant *R* (Decreasing Then Increasing Δ*K*) FCG Data for Specimen 5 S-T of 4340 Steel (Continued)

Δ*K* (ksi-in$^{1/2}$)	*da*/*dN* (inch/cycle)	Δ*K* (ksi-in$^{1/2}$)	*da*/*dN* (inch/cycle)	Δ*K* (ksi-in$^{1/2}$)	*da*/*dN* (inch/cycle)
4.89	4.37E-08	3.34	5.61E-09	12.20	4.78E-07
4.80	4.04E-08	3.33	4.83E-09	12.43	5.05E-07
4.72	3.73E-08	3.33	4.43E-09	12.66	5.37E-07
4.63	3.47E-08	3.32	3.99E-09	12.90	5.69E-07
4.55	3.24E-08	3.32	4.16E-09	13.14	6.02E-07
4.47	3.03E-08	3.31	4.34E-09	13.38	6.37E-07
4.39	2.83E-08	3.31	5.10E-09	13.62	6.72E-07
4.31	2.61E-08	3.30	5.29E-09	13.88	7.05E-07
4.24	2.42E-08	3.29	5.35E-09	14.13	7.40E-07
4.16	2.22E-08	3.29	5.20E-09	14.40	7.80E-07
4.09	2.04E-08	3.28	4.98E-09	14.67	8.24E-07
4.02	1.87E-08	3.27	4.73E-09	14.94	8.71E-07
3.94	1.72E-08	3.27	4.46E-09	15.22	9.24E-07
3.87	1.58E-08	3.26	4.34E-09	15.50	9.83E-07
3.80	1.45E-08	3.26	4.37E-09	15.79	1.04E-06
3.74	1.19E-08	3.25	4.43E-09	16.07	1.11E-06
3.67	1.02E-08	3.24	4.50E-09	16.38	1.17E-06
3.98	2.16E-08	3.24	4.64E-09	16.68	1.25E-06
3.98	2.07E-08	3.23	4.55E-09	16.98	1.33E-06
3.98	2.06E-08	3.23	4.24E-09	17.30	1.42E-06
3.98	2.05E-08	3.22	4.26E-09	17.61	1.51E-06
3.98	2.04E-08	3.22	4.51E-09	17.93	1.61E-06
3.97	2.03E-08	3.21	4.57E-09	18.27	1.72E-06
3.96	2.01E-08	3.20	4.16E-09	18.61	1.83E-06
3.94	1.97E-08	3.19	3.87E-09	18.95	1.94E-06
3.91	1.92E-08	6.43	8.77E-08	19.31	2.07E-06
3.88	1.85E-08	6.48	8.52E-08	19.67	2.25E-06
3.85	1.78E-08	6.55	9.12E-08	20.02	2.47E-06
3.82	1.70E-08	6.67	9.48E-08	20.41	2.64E-06
3.80	1.63E-08	6.79	9.95E-08	20.77	2.79E-06
3.77	1.57E-08	6.92	1.05E-07	21.16	2.95E-06
3.75	1.51E-08	7.05	1.09E-07	21.56	3.12E-06
3.73	1.46E-08	7.18	1.13E-07	21.96	3.28E-06
3.71	1.40E-08	7.31	1.07E-07	22.37	3.45E-06
3.69	1.35E-08	7.44	1.06E-07	22.79	3.64E-06
3.67	1.28E-08	7.55	1.02E-07	23.20	3.64E-06
3.65	1.22E-08	7.72	1.07E-07	23.63	3.79E-06
3.64	1.18E-08	7.83	1.29E-07	24.01	4.07E-06
3.62	1.15E-08	8.01	1.45E-07	24.54	4.60E-06
3.60	1.14E-08	8.16	1.59E-07	24.92	5.06E-06
3.59	1.15E-08	8.31	1.69E-07	25.44	5.29E-06
3.57	1.15E-08	8.46	1.77E-07	25.91	5.39E-06
3.55	1.12E-08	8.62	1.84E-07	26.39	5.66E-06

Table D-18. Constant *R* (Decreasing Then Increasing Δ*K*) FCG Data for Specimen 8 S-T of 4340 Steel

Specimen ID:	8			Orientation:	S-T
Test:	*R* = 0.1				
Δ*K* (ksi-in$^{1/2}$)	*da*/*dN* (inch/cycle)	Δ*K* (ksi-in$^{1/2}$)	*da*/*dN* (inch/cycle)	Δ*K* (ksi-in$^{1/2}$)	*da*/*dN* (inch/cycle)
8.50	2.12E-08	15.15	5.81E-07	35.01	9.56E-06
7.75	4.31E-09	15.42	6.10E-07	35.64	1.01E-05
7.72	1.13E-09	15.70	6.40E-07	36.31	1.06E-05
7.68	5.33E-09	16.00	6.72E-07	36.91	1.12E-05
7.64	4.49E-09	16.29	7.06E-07	37.62	1.17E-05
7.62	4.15E-09	16.59	7.39E-07	38.26	1.21E-05
7.58	3.82E-09	16.89	7.76E-07	38.99	1.27E-05
7.56	4.36E-09	17.19	8.16E-07	39.69	1.33E-05
7.54	3.54E-09	17.51	8.59E-07	40.44	1.39E-05
8.34	1.34E-08	17.83	9.05E-07	41.11	1.44E-05
8.39	1.39E-08	18.15	9.58E-07	41.89	1.51E-05
8.43	1.39E-08	18.48	1.02E-06	42.63	1.58E-05
8.48	1.44E-08	18.82	1.08E-06	43.44	1.66E-05
8.53	1.51E-08	19.17	1.15E-06	44.21	1.73E-05
8.58	1.61E-08	19.51	1.22E-06	45.07	1.79E-05
8.64	1.81E-08	19.87	1.31E-06	45.83	1.90E-05
8.70	2.11E-08	20.23	1.40E-06	46.71	2.00E-05
8.78	2.57E-08	20.60	1.50E-06	47.56	2.09E-05
8.87	3.09E-08	20.98	1.62E-06	48.41	2.16E-05
9.00	3.68E-08	21.36	1.74E-06	49.30	2.28E-05
9.14	4.37E-08	21.74	1.89E-06	50.18	2.40E-05
9.30	5.10E-08	21.51	1.77E-06	51.09	2.51E-05
9.47	5.87E-08	21.88	1.89E-06	52.00	2.61E-05
9.64	6.62E-08	22.30	1.97E-06	52.95	2.73E-05
9.82	7.44E-08	22.72	2.11E-06	53.91	2.84E-05
9.99	8.32E-08	23.12	2.30E-06	54.88	2.97E-05
10.18	9.40E-08	23.58	2.46E-06	55.88	3.16E-05
10.36	1.07E-07	23.97	2.61E-06	56.92	3.39E-05
10.56	1.19E-07	24.40	2.75E-06	57.96	3.62E-05
10.75	1.33E-07	24.82	2.96E-06	59.02	3.82E-05
10.94	1.48E-07	25.25	3.14E-06	60.10	4.00E-05
11.14	1.66E-07	25.73	3.38E-06	61.18	4.19E-05
11.35	1.85E-07	26.20	3.63E-06	62.30	4.34E-05
11.56	2.06E-07	26.70	3.89E-06	63.40	4.54E-05
11.77	2.30E-07	27.18	4.21E-06	64.54	4.77E-05
11.99	2.52E-07	27.69	4.46E-06	65.70	5.05E-05
12.21	2.74E-07	28.18	4.73E-06	66.89	5.39E-05
12.42	2.95E-07	28.70	5.03E-06	68.13	5.77E-05
12.65	3.15E-07	29.26	5.28E-06	69.38	6.20E-05
12.87	3.35E-07	29.78	5.62E-06	70.62	6.65E-05
13.11	3.54E-07	30.32	5.93E-06	71.90	7.07E-05

Table D-18. Constant R (Decreasing Then Increasing ΔK) FCG Data for Specimen 8 S-T of 4340 Steel (Continued)

ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)
13.35	3.77E-07	30.87	6.32E-06	73.18	7.50E-05
13.59	4.02E-07	31.40	6.75E-06	74.50	7.96E-05
13.84	4.30E-07	31.98	7.23E-06	75.87	8.39E-05
14.09	4.59E-07	32.55	7.69E-06	77.22	8.73E-05
14.35	4.90E-07	33.14	8.00E-06	78.62	9.02E-05
14.61	5.22E-07	33.75	8.47E-06	80.02	9.25E-05
14.88	5.52E-07	34.36	8.90E-06	81.47	9.36E-05

Table D-19. Constant R (Increasing ΔK) FCG Data for Specimen 12 S-T of 4340 Steel

Specimen ID:	12			Orientation:	S-T
Test:	R = 0.3				
ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)
10.36	2.69E-07	21.05	2.63E-06	43.73	1.85E-05
10.50	2.78E-07	21.63	2.89E-06	44.92	1.98E-05
10.68	2.97E-07	22.22	3.15E-06	46.16	2.11E-05
10.96	3.22E-07	22.84	3.42E-06	47.41	2.26E-05
11.27	3.52E-07	23.44	3.69E-06	48.72	2.43E-05
11.58	3.85E-07	24.08	3.99E-06	50.06	2.61E-05
11.90	4.20E-07	24.74	4.31E-06	51.43	2.80E-05
12.23	4.55E-07	25.43	4.66E-06	52.84	3.02E-05
12.56	4.93E-07	26.14	5.06E-06	54.25	3.24E-05
12.91	5.34E-07	26.87	5.50E-06	55.78	3.48E-05
13.27	5.81E-07	27.61	5.96E-06	57.28	3.76E-05
13.64	6.31E-07	28.37	6.42E-06	58.90	4.06E-05
14.02	6.85E-07	29.14	6.86E-06	60.49	4.41E-05
14.41	7.46E-07	29.93	7.31E-06	62.23	4.78E-05
14.79	8.16E-07	30.75	7.77E-06	63.86	5.18E-05
15.20	8.89E-07	31.60	8.30E-06	65.67	5.61E-05
15.60	9.64E-07	32.45	8.90E-06	67.39	6.13E-05
16.03	1.06E-06	33.34	9.50E-06	69.24	6.67E-05
16.49	1.16E-06	34.25	1.01E-05	71.14	7.28E-05
16.94	1.27E-06	35.19	1.08E-05	73.10	7.91E-05
17.40	1.40E-06	36.16	1.16E-05	75.14	8.51E-05
17.88	1.53E-06	37.17	1.24E-05	83.71	1.28E-04
18.37	1.68E-06	38.20	1.33E-05	85.98	1.48E-04
18.88	1.84E-06	39.25	1.43E-05	88.32	1.66E-04
19.41	2.01E-06	40.34	1.52E-05	90.70	1.88E-04
19.94	2.20E-06	41.43	1.61E-05		
20.49	2.41E-06	42.56	1.72E-05		

Table D-20. Constant R (Decreasing ΔK) FCG Data for Specimen 16 S-T of 4340 Steel

Specimen ID:	16			Orientation:	S-T
Test:	R = 0.3				
ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)
9.70	3.58E-07	7.16	2.73E-08	6.62	8.73E-09
9.56	3.33E-07	7.11	2.49E-08	6.60	7.82E-09
9.41	3.22E-07	7.06	2.25E-08	6.59	7.60E-09
9.27	3.03E-07	7.02	1.85E-08	6.58	7.63E-09
9.12	2.87E-07	6.99	1.35E-08	6.56	7.60E-09
8.98	2.71E-07	6.97	1.18E-08	6.55	7.49E-09
8.84	2.51E-07	6.94	1.13E-08	6.54	7.39E-09
8.71	2.37E-07	6.93	1.05E-08	6.52	7.38E-09
8.57	2.13E-07	6.90	1.10E-08	6.51	7.36E-09
8.31	1.36E-07	6.88	1.25E-08	6.49	7.30E-09
8.05	1.01E-07	6.86	1.34E-08	6.48	7.15E-09
7.93	9.53E-08	6.83	1.46E-08	6.47	6.92E-09
7.80	8.83E-08	6.80	1.55E-08	6.46	6.59E-09
7.68	7.23E-08	6.77	1.58E-08	6.44	6.04E-09
7.56	5.83E-08	6.74	1.56E-08	6.43	5.27E-09
7.45	4.77E-08	6.71	1.48E-08	6.42	4.44E-09
7.36	3.94E-08	6.68	1.35E-08	6.42	2.79E-09
7.28	3.50E-08	6.66	1.14E-08	6.41	1.89E-09
7.23	3.12E-08	6.64	1.00E-08		

Table D-21. Constant R (Increasing ΔK) FCG Data for Specimen 1 T-L of 4340 Steel

Specimen ID:	1			Orientation:	T-L
Test:	R = 0.7				
ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)
5.85	7.01E-08	9.32	2.37E-07	13.41	6.79E-07
5.89	7.40E-08	9.49	2.49E-07	13.65	7.16E-07
6.00	8.32E-08	9.66	2.62E-07	13.90	7.58E-07
6.11	9.00E-08	9.84	2.75E-07	14.16	8.05E-07
6.22	9.62E-08	10.02	2.90E-07	14.42	8.56E-07
6.34	1.03E-07	10.20	3.05E-07	14.69	9.09E-07
6.46	1.09E-07	10.39	3.19E-07	14.96	9.63E-07
6.58	1.16E-07	10.58	3.33E-07	15.24	1.02E-06
6.70	1.20E-07	10.77	3.46E-07	15.51	1.08E-06
6.82	1.24E-07	10.97	3.58E-07	15.79	1.15E-06
6.95	1.27E-07	11.17	3.69E-07	16.08	1.22E-06
7.08	1.28E-07	11.38	3.72E-07	16.38	1.29E-06
7.21	1.29E-07	11.07	3.74E-07	16.68	1.37E-06
7.34	1.32E-07	11.19	3.74E-07	16.99	1.46E-06
7.48	1.35E-07	10.86	3.75E-07	17.29	1.56E-06
7.62	1.40E-07	10.97	3.81E-07	17.61	1.66E-06

Table D-21. Constant R (Increasing ΔK) FCG Data for Specimen 1 T-L of 4340 Steel (Continued)

ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)
7.76	1.45E-07	11.18	3.95E-07	17.93	1.77E-06
7.90	1.51E-07	11.38	4.15E-07	18.26	1.88E-06
8.05	1.58E-07	11.59	4.36E-07	18.59	1.99E-06
8.19	1.65E-07	11.80	4.60E-07	18.94	2.11E-06
8.35	1.74E-07	12.02	4.85E-07	19.28	2.23E-06
8.50	1.83E-07	12.24	5.13E-07	19.64	2.38E-06
8.66	1.92E-07	12.47	5.45E-07	20.01	2.59E-06
8.82	2.03E-07	12.70	5.77E-07	20.38	2.86E-06
8.98	2.14E-07	12.93	6.10E-07	20.76	3.13E-06
9.15	2.25E-07	13.17	6.44E-07		

Table D-22. Constant K_{max} FCG Data for Specimen 2 T-L of 4340 Steel

Specimen ID: Test:	2 K_{max} = 11 ksi-in$^{1/2}$			Orientation:	T-L
ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)
9.40	1.61E-07	5.02	3.54E-08	3.63	7.57E-09
9.01	1.51E-07	4.68	3.02E-08	3.56	1.64E-08
8.28	1.19E-07	4.45	3.31E-08	3.50	8.23E-09
7.52	9.17E-08	4.25	3.19E-08	3.19	1.22E-09
6.86	7.29E-08	4.11	2.27E-08	3.18	3.02E-09
6.31	6.52E-08	3.90	1.98E-08	3.15	2.18E-09
5.81	5.43E-08	3.88	1.77E-08		
5.35	4.33E-08	3.72	9.50E-09		

Table D-23. Constant K_{max} FCG Data for Specimen 2 T-L of 4340 Steel

Specimen ID: Test:	2 K_{max} = 15 ksi-in$^{1/2}$			Orientation:	T-L
ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)	ΔK (ksi-in$^{1/2}$)	da/dN (inch/cycle)
8.83	1.53E-07	6.76	1.06E-07	5.14	5.40E-08
8.07	1.25E-07	6.16	8.62E-08	4.31	2.18E-08
7.39	1.04E-07	5.63	6.98E-08	3.78	1.14E-08

Table D-24. Constant *R* (Decreasing Then Increasing Δ*K*) FCG Data for Specimen 6 T-L of 4340 Steel

Specimen ID: 6				Orientation: T-L	
Test: $R = 0.7$					
Δ*K* (ksi-in$^{1/2}$)	*da*/*dN* (inch/cycle)	Δ*K* (ksi-in$^{1/2}$)	*da*/*dN* (inch/cycle)	Δ*K* (ksi-in$^{1/2}$)	*da*/*dN* (inch/cycle)
7.25	1.21E-07	3.52	1.12E-08	9.57	2.13E-07
7.18	1.20E-07	3.50	1.06E-08	9.75	2.24E-07
7.06	1.17E-07	3.49	1.02E-08	9.93	2.36E-07
6.94	1.13E-07	3.48	9.82E-09	10.11	2.48E-07
6.82	1.08E-07	3.46	9.45E-09	10.30	2.61E-07
6.70	1.03E-07	3.45	9.11E-09	10.49	2.75E-07
6.59	9.82E-08	3.44	9.02E-09	10.68	2.90E-07
6.47	9.45E-08	3.43	8.73E-09	10.88	3.07E-07
6.36	9.10E-08	3.42	8.36E-09	11.08	3.24E-07
6.25	8.74E-08	3.41	8.08E-09	11.29	3.42E-07
6.14	8.35E-08	3.40	7.83E-09	11.50	3.61E-07
6.03	7.96E-08	3.39	7.54E-09	11.71	3.81E-07
5.93	7.57E-08	3.38	7.14E-09	11.93	4.03E-07
5.83	7.22E-08	3.37	6.96E-09	12.15	4.24E-07
5.73	6.90E-08	3.36	6.74E-09	12.37	4.45E-07
5.63	6.57E-08	3.35	6.53E-09	12.60	4.71E-07
5.53	6.23E-08	3.34	6.23E-09	12.83	4.96E-07
5.44	5.90E-08	3.34	5.99E-09	13.07	5.23E-07
5.34	5.62E-08	3.33	5.74E-09	13.31	5.53E-07
5.25	5.35E-08	3.32	5.61E-09	13.56	5.85E-07
5.16	5.09E-08	3.32	5.56E-09	13.81	6.18E-07
5.07	4.83E-08	3.31	5.53E-09	14.07	6.54E-07
4.98	4.56E-08	3.30	5.48E-09	14.32	6.92E-07
4.90	4.31E-08	3.29	5.33E-09	14.59	7.34E-07
4.82	4.08E-08	3.29	5.22E-09	14.86	7.83E-07
4.75	3.87E-08	3.28	5.13E-09	15.13	8.34E-07
4.69	3.69E-08	3.28	5.11E-09	15.41	8.70E-07
4.63	3.54E-08	3.27	5.11E-09	15.70	9.07E-07
4.57	3.42E-08	3.26	5.08E-09	15.99	9.69E-07
4.51	3.31E-08	3.26	4.94E-09	16.28	1.08E-06
4.46	3.20E-08	3.25	4.77E-09	16.59	1.24E-06
4.40	3.10E-08	3.25	4.50E-09	16.90	1.35E-06
4.35	3.00E-08	3.24	4.31E-09	17.21	1.45E-06
4.31	2.90E-08	3.24	4.23E-09	17.53	1.54E-06
4.26	2.82E-08	3.23	4.27E-09	17.85	1.58E-06
4.22	2.73E-08	3.23	4.24E-09	18.18	1.63E-06
4.18	2.64E-08	3.22	4.21E-09	18.52	1.70E-06
4.14	2.52E-08	3.21	4.26E-09	18.86	1.80E-06
4.10	2.40E-08	3.21	4.27E-09	19.20	1.91E-06
4.06	2.28E-08	3.20	4.32E-09	19.56	2.03E-06
4.03	2.19E-08	3.20	4.38E-09	19.92	2.16E-06

Table D-24. Constant *R* (Decreasing Then Increasing ΔK) FCG Data for Specimen 6 T-L of 4340 Steel (Continued)

ΔK (ksi-in$^{1/2}$)	*da*/*dN* (inch/cycle)	ΔK (ksi-in$^{1/2}$)	*da*/*dN* (inch/cycle)	ΔK (ksi-in$^{1/2}$)	*da*/*dN* (inch/cycle)
4.00	2.11E-08	3.19	4.31E-09	20.29	2.30E-06
3.97	2.02E-08	3.19	4.32E-09	20.67	2.45E-06
3.94	1.94E-08	3.18	4.44E-09	21.04	2.61E-06
3.91	1.87E-08	3.18	4.35E-09	21.44	2.75E-06
3.88	1.79E-08	3.17	4.28E-09	21.83	2.89E-06
3.86	1.73E-08	3.17	4.23E-09	22.24	3.04E-06
3.83	1.69E-08	3.16	4.08E-09	22.65	3.19E-06
3.81	1.67E-08	3.16	3.66E-09	23.06	3.37E-06
3.79	1.65E-08	3.15	3.27E-09	23.49	3.57E-06
3.76	1.62E-08	3.15	3.22E-09	23.92	3.98E-06
3.74	1.57E-08	3.15	3.06E-09	24.37	4.37E-06
3.72	1.50E-08	7.68	1.23E-07	24.15	4.40E-06
3.70	1.42E-08	7.82	1.27E-07	24.60	4.16E-06
3.68	1.34E-08	7.97	1.33E-07	25.06	4.27E-06
3.66	1.28E-08	8.12	1.39E-07	25.53	4.52E-06
3.64	1.24E-08	8.27	1.45E-07	26.01	4.82E-06
3.63	1.22E-08	8.42	1.52E-07	26.50	4.63E-06
3.61	1.21E-08	8.57	1.59E-07	27.00	4.93E-06
3.60	1.21E-08	8.73	1.66E-07	27.37	5.45E-06
3.58	1.21E-08	8.89	1.74E-07	28.02	6.39E-06
3.56	1.22E-08	9.06	1.82E-07	28.42	7.23E-06
3.55	1.21E-08	9.22	1.92E-07	29.07	8.82E-06
3.53	1.17E-08	9.40	2.01E-07		