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Volume 1

Damage Tolerant Design Handbook

A Compilation of Fracture and Crack-Growth Data for High-Strength Alloys

Metals and Ceramics Information Center
Battelle
Columbus Laboratories

Prepared by

University of Dayton Research Institute

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Air Force Wright Aeronautical Laboratories
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This edition entirely revamps the 1975 edition. This edition is arranged by alloy rather than by property as in the previous addition. The data are presented in eight chapters and four volumes. Plane-strain fracture toughness (K_{IC}), critical plane stress fracture toughness, apparent fracture toughness, R-curve, fatigue crack growth rates, sustained-load crack growth rate and threshold stress intensity (K_{ISCC}) data are presented for stainless steels, titanium alloys, nickel-base alloys, alloy steels, 2000-, 6000- and 7000-series aluminum alloys.

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DAMAGE TOLERANT DESIGN HANDBOOK
MCIC-HB-01R

ABOUT THIS HANDBOOK —

The **Damage Tolerant Design Handbook** was prepared by University of Dayton Research Institute under U.S. Air Force sponsorship and is being distributed by the Metals and Ceramics Information Center (MCIC). Its purpose is to provide a single comprehensive reference source on available fracture mechanics data for structural metal alloys of particular interest for aircraft and aerospace application.

SUPPLEMENTS —

It is intended that, as new data are generated on the fracture characteristics of structural alloys, supplements to this Handbook will be published by MCIC. Further updating and expansion of the current edition will result in supplements as significant data become available. Minor additions, errata, and inserts will be distributed as information becomes available.

KEEPING YOUR HANDBOOK UP TO DATE —

In order that we may keep all holders of the **Damage Tolerant Design Handbook** advised of supplements and new reference data, a registry of the location of all copies will be maintained. To assist us, we ask that you complete and return one of the self-addressed postcards (following this page) upon initial receipt of the Handbook. If responsibility for this copy is transferred to another party, please use one of the other postcards to advise us of the change. If there are no postcards, simply write to MCIC at the address below.

YOUR ASSISTANCE IS SOLICITED —

Although a substantial and continuing effort is made to include all available appropriate fracture mechanics data in this Handbook, we recognize that important sources may have been inadvertently overlooked and, of course, that new data are regularly being generated. Should you or your organization be able to provide additional pertinent data, MCIC — and other users of this reference Handbook — will be most appreciative. To be useful, data should include the supporting facts regarding material, condition, and test specimens and procedures. If you can assist us in this respect, please call or submit such data to MCIC at the address below. Many thanks ......

ADDITIONAL INFORMATION —

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Volume 1

Damage Tolerant Design Handbook

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This document was published by the Metals and Ceramics Information Center (MCIC), Battelle's Columbus Laboratories, 505 King Avenue, Columbus, Ohio 43201-2693. MCIC's objective is to provide a comprehensive current resource of technical information on the development and utilization of advanced metal- or ceramic-base metals.

MCIC is publishing this revised and expanded edition of the Damage Tolerant Design Handbook to increase the availability of information to the technical community. The loose leaf format was selected to facilitate updating the handbook as new information becomes available. This edition is a completely revised and expanded version of the original handbook first published by MCIC in 1972 and revised in 1973 and 1975.

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FOREWORD

This report has been prepared as AFWAL-TR-83-4144 to summarize the results of a damage-tolerant-material-property collection and reporting program conducted under USAF Contract No. F33615-80-C-5149, Damage Tolerant Design Handbook. The Materials Laboratory of Air Force Wright Aeronautical Laboratories (AFWAL/ML) was the sponsor; Mr. G. J. Petrak (AFWAL/MLSE) of the System Support Division was the Project Monitor. The University of Dayton was the contractor; the University of Dayton Research Institute (UDRI) conducted the work under the general supervision of Dr. J. P. Gallagher, program manager, and Mrs. Patricia L. Stumpff, principal investigator. Miss Elizabeth L. Johnson was responsible for the development of the software system that both stored the damage tolerant data and created the handbook graphical and tabular reports. Dr. P. W. Hovey developed the analytical french curve method used to describe the mean trend subcritical crack growth behavior. Other UDRI employees who provided extensive support for the creation of the handbook are: Dr. A. P. Berens, Mrs. Joanda D'Antuono, Mrs. JoAnn D. Jones, Miss Ellen M. Bornhorst, Miss Mary E. Stander, and Mr. Kevin Sullivan.

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CHAPTER 1

HANDBOOK ORGANIZATION AND CONTENT

1.0 OVERVIEW

This edition of the Damage Tolerant Design Data Handbook has been entirely revamped since the last update in 1975. The major organizational change is that data are now presented and sorted by material (aluminum, titanium, etc.) and by alloy (2024, 6Al-4V, etc.) rather than by property, i.e., K_{Ic}, K_{Iscc}, da/dN). The reorganization makes it possible to present all the pertinent damage tolerant data on a particular alloy within one chapter subsection. This new organization was suggested by aerospace engineers as being the format best suited for their use. Additionally, this format now conforms to other aerospace structural metals handbooks such as the Military Handbook-5 and Aerospace Structural Metals Handbook.

A survey was conducted at the beginning of this handbook program; over one-hundred aerospace design, materials, and structural engineers were canvassed for their comments relative to the proposed organization, formats, types of summaries and new data types. Many of the comments and suggestions received were incorporated into the final design of the handbook. The data types of greatest interest were found to be fracture toughness data, fatigue crack growth rate data and R-curves. Interest in specific materials were mainly for the nickel base and aluminum alloy materials.

Throughout the handbook, the data are presented in English units, i.e., ksi $\sqrt{\text{in}}$. was the unit for the fracture toughness and applied stress intensity factor levels, and inches/hr or inches/cycle were the unit values for the growth rates. Metric units have been incorporated along with the English units on the graphical presentation of the sustained load and fatigue crack growth rate data, but limited space forced the decision not to include metric units for the tabular data.

1.1 ORGANIZATION

The handbook is divided into eight chapters and consists of four volumes. Following the first chapter on handbook usage and the the second chapter on methods of calculations are the six material chapters. The order of the chapters are as designated in Table 1.1. This order was selected to keep the data for a particular chapter together as much as possible while keeping the size reasonable and the four volumes approximately equal.

Table 1.2 depicts the basic organization of each material chapter. Within each material chapter, the data are further divided into a section of material summaries, followed by sections that contain the data for individual alloys. The first number of any section, subsection, table or figure number refers to the chapter or material as designated in Table 1.1. The second number will run consecutively from zero on. A zero in the second position indicates that the data is a material summary; each succeeding second number indicates a new alloy, with the highest second number referring to the bibliography for that material chapter.

In a given material summary section, i.e., X.0, there are five possible material summary tables listed as subsections. Tables will be listed in the order defined by Table 1.2. If not enough data are available for a particular summary, this summary will not be printed and the next summary will pick up the sequence number. Section 1.3 describes the formats for the material summaries.

In each alloy section, e.g., Sections X.1, X.2, etc., the third number in the sequence will designate whether the data are (1) an alloy summary, (2) fracture toughness data, or (3) crack growth resistance data. Within each subsection, the data tables and graphs are ordered consecutively.

TABLE 1.1

ORDER OF CHAPTERS

VOLUME NUMBER	CHAPTER	TITLE
1	1	Handbook Organization, Content, and Formats
1	2	Methods of Calculations
1	3	Stainless Steel Alloys
1	4	Titanium Alloys
2	5	Nickel Base Alloys
2	6	Alloy Steel Allcys
3	7	2000 and 6000 Series Aluminum Alloys
3 and 4	8	7000 Series Aluminum Alloys

TABLE 1.2

ORGANIZATION OF THE XTH MATERIAL CHAPTER

SECTION X.0 - Material Summaries

- X.0.1 - Available Data Material Summary
- X.0.2 - Plane Strain Fracture Toughness Material Data Summary
- X.0.3 - Plane Stress and Transitional Fracture Toughness Data Summary
- X.0.4 - Fatigue Crack Growth Rate Comparison Material Data Summary
- X.0.5 - Stress Corrosion Cracking Threshold Material Data Summary

SECTION X.1 - First Material Alloy

- X.1.1 - Alloy Summaries
  - X.1.1.1 Plane Strain Fracture Toughness Summary
  - X.1.1.2 - Fatigue Crack Growth Rate Data Summary
- X.1.2 - Fracture Toughness Data
  - X.1.2.1 - Plane Strain Fracture Toughness Data for Alloy Number One
  - X.1.2.2 - Plane Stress and Transitional Fracture Toughness Data for Stainless Steel Alloy Number One
  - X.1.2.3 - R-Curves
- X.1.3 - Subcritical Crack Growth Data
  - X.1.3.1 - Fatigue Crack Growth Rate Data Data (Tables and Plots) for Alloy Number One
  - X.1.3.2 - Sustained Load Crack Growth Rate Data
  - X.1.3.3 - Stress Corrosion Cracking Threshold Data for Alloy Number One

SECTION X.2 - Second Material Alloy

SECTION X.N - Last Material Alloy

SECTION X.N+1 - Bibliography for the Chapter

There are three possible types of fracture toughness data: plane-strain fracture toughness data, plane stress and transitional fracture toughness data, and resistance curve data; Section 1.5 provides a detailed discussion of the data formats. There are three possible types of subcritical crack growth data: fatigue crack growth rate data, sustained load crack growth rate data, and stress corrosion cracking threshold data; Section 1.6 details the formats used to present these data.

To aid the handbook user locate data, examples of actual tables and figures follow. These examples are presented to familiarize the user with the formats presented in the handbook. Each table or figure is discussed as it is presented. The discussion follows the same order as that found in the handbook.

1.2 GENERAL COMMENTS ABOUT SORTING ORDER AND ABBREVIATIONS

1.2.1 Sorting Order

Table 1.3 describes the sorting order for all mechanical property data types. The left column lists the primary (material) data fields that have been sorted; the right column then lists the specific sorting order of each material data field. In all the following discussions, when a primary data field is noted as being sorted, the order of the sorting is as listed in Table 1.3. The primary data fields are also sorted; however, because the different data fields have different significance for individual mechanical property types, the sorting order is noted as each mechanical property data format is discussed. For all property data types, the property data are generally sorted in the order of first five primary data fields listed in Table 1.3.

1.2.2 Abbreviations

To ensure that all the necessary information is presented in the data tables and figures, specific abbreviations have been employed throughout the handbook. The abbreviations can be broken down into six categories that cover the following

TABLE 1.3

SORTING ORDER OF VARIOUS FIELDS

DATA FIELD	SORTING ORDER
1. Alloy	Blank Punctuation Marks (e.g., -) Alphabetic Characters (e.g., T) Numeric Characters (e.g., 6)
2. Condition/Heat Treatment	Blank Punctuation Marks Alphabetic Characters Numeric Characters
3. Product Forms	Sheet Plate Forging Extrusion Forged Bar Billet Casting Round Bar Welded and Stress Relieved Weldment Disk Extruded Bar Rolled Bar Bar
4. Test Temperatures	Negative Test Temp. (-423°F, -300°F) From 0°F to 65°F (0°F, 32°F etc.) From 65°F to 80°F (R.T.) Above 80°F (85°F, 200°F, etc.)
5. Specimen Orientation	L-S L-T T-S T-L S-T S-L L-C C-L L-R R-L R-C C-R
6. Yield Strength	Lowest to Highest
7. Buckling Constraints	Buckling of Crack Edges Not Restrained Buckling of Crack Edges Restrained Buckling of Crack Edges Unknown

data fields: (1) material, (2) condition/heat treatment, (3) product form, (4) environment, (5) specimen design, and (6) specimen/crack orientation. The abbreviations and associated descriptions for these six categories can be found in Tables 1.4 through 1.8 and Figure 1.1, respectively.

1.3 MATERIAL CHAPTER SUMMARIES

Material summaries are presented at the beginning of each chapter before any alloy summaries or detailed data. These summaries are meant to aid in the selection of materials for design and for basic comparisons of property data. There are five possible material summaries (see Table 1.2), each of which compare availability or properties of damage tolerant data for the given alloys, heat treatments, and product forms of a particular material. The five summaries immediately follow the text of introductory remarks that discuss the data for that material.

1.3.1 Available Data Summary

Figure 1.2 is the first page of the available data summary for the stainless steel chapter. As noted, the first number in the data summary table is a "3" which indicates that this is the third chapter; the second number is a "0" indicating that this is a material summary; the third number is a "1" which indicates that this is the first table in the material summary section. Note that the table numbers for subsequent data summaries only change in the third digit, except for the fatigue crack growth rate summary (see below).

The available data summary defines the property data that are available in the chapter by alloy, by condition/heat treatment, and by product form. The six different types of data are listed generally across the top of the table; an "x" is marked in the appropriate column to identify the particular property data that exists for the given alloy, condition/heat treatment, etc. The alloys are listed in the order that they appear in the handbook using the sorting order outlined in Table 1.3. This sorting order was created using a system

TABLE 1.4

ABBREVIATIONS FOR MATERIAL SYSTEMS

Abbreviation	Materials
ALUM	Aluminum Alloys
TITAN.	Titanium Alloys
NICKEL	Nickel-Base Alloys
STAIN. STEEL	Stainless Steel Alloys
ALLOY STEEL	Steel Alloys

TABLE 1.5

ABBREVIATIONS FOR ALLOY CONDITIONING AND HEAT TREATMENTS

Abbreviation	Condition/Heat Treatment
OQ	Oil Quenched
ABQ	Aus-Bay Quench
AC	Air Cool
WC	Water Quench
MA	Mill Anneal
BA	Beta Anneal
DA	Duplex Anneal
RA	Recrystallize Anneal
ST	Solution Treated
STA	Solution Treated And Aged

TABLE 1.6

ABBREVIATIONS FOR PRODUCT FORMS

Abbreviations	Product Form
S	Sheet
P	Plate
E	Extrusion
F	Forging
FB	Forged Bar
BT	Billet
BR	Round Bar
RB	Rolled Bar
C	Casting
W	Weldment
D	Disk
EB	Extruded Bar
B	Bar

TABLE 1.7

ABBREVIATIONS FOR ENVIRONMENTAL SYSTEMS

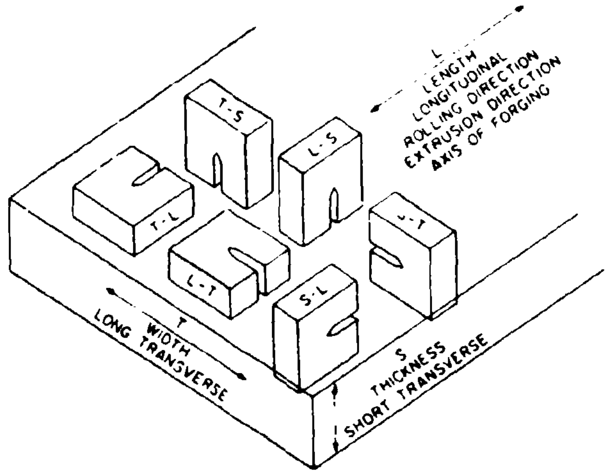
Abbreviations	Environmental System
R. T.	Room Temperature (65°F-80°F)
L. H. A.	Low Humidity Air (< 10% RH)
Dry Air	Low Humidity Air (< 10% RH)
H. H. A.	High Humidity Air (> 80% RH)
Lab. Air	Laboratory Air (% RH unspecified)
Dist. H_2O	Distilled Water
Dist. Water	Distilled Water
3.5 PCT Nacl	3.5% Salt Water Solution
JP.4	JP-4 Aircraft Fuel
JP.4 - Fuel	JP-4 Aircraft Fuel
S. T. W.	Sump Tank Water
S. S. W.	Simulated Sea Water
S. C. S.	Shop Cleaning Solvent
F. C. S.	Field Cleaning Solvent
Salt Fog	Salt Fog
Temp.	Temperature

TABLE 1.8

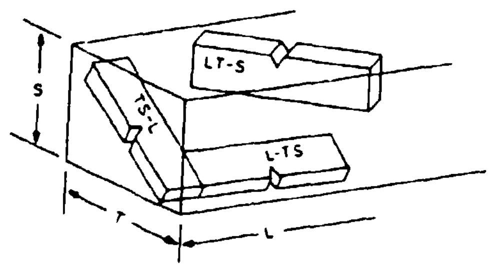
ABBREVIATIONS FOR SPECIMEN DESIGNS

Abbreviations	Specimen Design*
CT	Compact Tension
NB	3Pt. Notched Bend
WOL	Wedge Open Load
CCP	Center Cracked Panel
BWOL	Bolt Loaded-Wedge Open Load
CANT	Cantilever Beam
TDCB	Tapered Double Cantilever Beam
CHAR	Charpy
PTSC	Part Through Surface Crack
SENT	Single Edge Notch Tension
K_BBAR	K_B Bar
4-NB	4 Pt. Notched Bend
MCT	Modified Compact Tension
CNT	Center Notched Tension
DCB	Double Cantilever Beam
BDCB	Bolt Loaded Double Cantilever Beam

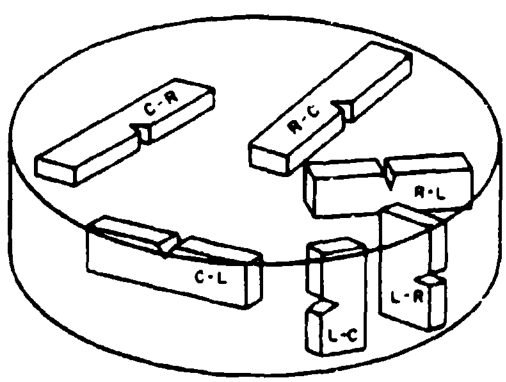
*Also note that when "SG" is used in conjunction with a specimen design, the specimen is side-grooved along the path of the crack.



(a) Crack Plane Orientation Code for Rectangular Sections



(b) Crack Plane Orientation Code for Rectangular Sections Where Specimens are Tilted with Respect to the Reference Directions



(c) Crack Plane Orientation Code for Bar and Hollow Cylinder

Figure 1.1. ASTM Abbreviations Used to Describe Specimen Orientations.

Table 3.0.1

AVAILABLE DATA FOR STAINLESS STEEL ALLOYS

ALLOY	CONDITION/HT	PRODUCT FORM	KIC	KC	R CURVES	DA/DN	DA/DT	KISCC
AFC 260	2200F 1HR 1900F 1HR OQ -100F 1HR -320F 1HR 800F 2+2 HR	PLATE						X
	2200F 1HR 1900F 1HR OQ -100F 1HR -320F 1HR 1050F 2+2HR	PLATE						X
	2200F 1HR 1900F 1HR OQ -100F 1HR -320F 1HR 900F 2+2 HR	PLATE						X
	2200F 1HR 1900F 1HR OQ -100F 1HR -320F 1HR 1000F 2+2 HR	PLATE						X
AFC 77	AUSTENIZED AT 2010F, QUENCHED& TEMPERED AT 810F	SHEET					X	
	1800F 1HR OQ, -100F 0.5HR, 500F 2+2 HR (COARSE GRAIN)	PLATE						X
	1800F 1HR OQ, -100F 0.5HR, 1000F 2+2 HR (COARSE GRAIN)	PLATE	X					X
	1800F 1HR OQ, -100F 0.5HR, 500F 2+2 HR (FINE GRAIN)	PLATE						X
	1800F 1HR OQ, -100F 0.5HR, 1000F 2+2 HR (FINE GRAIN)	PLATE	X					X
	1800F 1HR, OQ, -100F 0.5HR, 700F 2+2HR (COARSE GRAIN)	PLATE	X					
	1800F 1HR, OQ, -100F 0.5HR, 800F 2+2HR (COARSE GRAIN)	PLATE	X					
	1800F 1HR, OQ, -100F 0.5HR, 700F 2+2HR (FINE GRAIN)	PLATE	X					
	1800F 1HR, OQ, -100F 0.5HR, 800F 2+2HR (FINE GRAIN)	PLATE	X					

Figure 1.2. Sample Data Summary Table, Taken From Table 3.0.1 (Stainless Steel Alloys).

sort of the database and sorts the alloys with designations using blanks, punctuation marks and alphabetic characters first with numeric characters following. Heat treatments and conditions are also sorted in this same manner. Following the sort by alloy and by condition/heat treatment, the property data are then sorted according to product form. The particulars of the sorting by product form are also outlined in Table 1.3 with sheet data listed before plate, forging, extrusion, etc.

1.3.2 Plane Strain Fracture Toughness Material Data Summary

The first page of the stainless steel, plane-strain fracture-toughness-data summary is shown in Figure 1.3. This is the second possible material summary and the third table digit is "2". The data are again sorted and separated on the data fields of alloy, condition/heat treatment and product form. All data listed are for room temperature (65°F - 80°F) laboratory air only. Plane strain fracture toughness mean values and standard deviations are listed for the three major orientations; that is, L-T, T-L and S-L. Product thickness range and minimum specimen thicknesses are listed for general information. Dashes in a particular column indicate that no mean plane strain fracture toughness data exist for the stated conditions.

1.3.3 Plane Stress and Transitional Fracture Material Data Summary

The plane stress and transitional fracture toughness data summary is presented third in the series of summaries. Figure 1.4 illustrates that these tables are presented as a function of whether the data are collected using specimens with or without buckling constraints. Note that in Figure 1.4 (all available titanium data) and 1.4b (all available alloy steel data) that the data are sorted by alloy, condition/heat treatment, test temperature, specimen orientation and specimen width. Yield strength is not a sorting field but is given for general information. The mean K_c values are listed as a function of specimen thickness which is indicated across the top of the page.

TABLE 3.0.2

PLANE STRAIN FRACTURE TOUGHNESS VALUES OF STAINLESS STEEL ALLOYS AT ROOM TEMPERATURE

ALLOY	CONDITION/ (1)	PRODUCT FORM	RANGE OF PRODUCT THICKNESSES (IN)	KIC (KSI SQRT(IN)) L-T SPECIMEN THICK *	L-T MEAN	L-T STD DEV	T-L SPECIMEN THICK *	T-L MEAN	T-L STD DEV	S-L SPECIMEN THICK *	S-L MEAN	S-L STD DEV
AFC 77 (VAR)	1700F 1HR.OQ 2100F 1HR. MOVED TO FCE AT 1933F.HELD 1HR.OQ.-100F 24HR.900F.2+2HR	FORGING	6.00	0.50	48.6	3.1	0.50	50.8	1.3	----	----	----
	2100F 1HR. MOVED TO FCE AT 1900F.HELD 1HR.OQ.-100F 4HR.500F 2+2HR	FORGING	6.00	2.01	110.5	4.9	2.01	108.0	5.7	----	----	----
CUSTOM 455	1500F 1HR.OQ. 950F 4HR.AC	FORGING	4.00	0.48	72.1	7.8	----	----	----	----	----	----
	1500F 1HR.OQ. 900F 4HR.AC	FORGING	4.00	0.48	46.2	3.3	----	----	----	----	----	----
PH13-8MO	ANNEALED	FORGING	3.00	1.01	114.1	15.7	1.00	99.6	22.4	----	----	----
	AUSTENITE COND AND TRANSFORMED AT 38F.AGED 1015F	FORGED BAR	2.20	1.63	103.0	19.4	1.63	89.6	1.8	----	----	----
	H 950	SHEET	1.00-2.25	1.00	58.4	6.5	1.00	69.4	16.1	----	----	----
		FORGING	4.00-8.00	1.00	70.3	16.0	----	----	----	----	----	----
		ROLLED BAR	2.35	1.00	66.9	2.9	1.00	63.5	1.7	0.75	74.1	2.1
	H1000	SHEET	1.50-2.25	1.00	105.6	4.8	1.00	96.2	5.2	----	----	----
		PLATE	4.00	0.98	94.7	3.6	----	----	----	----	----	----
		FORGING	2.75-8.00	0.75	101.6	11.0	0.75	88.1	17.1	----	----	----
		EXTRUSION	1.50	1.00	68.5	5.5	1.00	66.2	2.1	----	----	----

* MINIMUM SPECIMEN THICKNESS (IN)

Figure 1.3. Summary of Plane Strain Fracture Toughness (K_{Ic}) Data, Taken from Table 3.0.2 (Stainless Steel Alloys).

TABLE 4.0.3

PLANE STRESS AND TRANSITIONAL FRACTURE TOUGHNESS OF TITANIUM ALLOYS (WITH BUCKLING CONSTRAINTS)

Alloy	Condition/Ht	Test Temp. (°F)	Specimen Orient	Specimen Width (in.)	Yield Strength (ksi)	K_c^* (ksi $\sqrt{in}$) Specimen Thickness (in.) = 0.020	0.040	0.050
Ti-5Al-2.5Sn	Annealed	-423	L-T	3.0	203	116.8/4.5 (5)		
				6.0	203	109.4/6.6 (9)		
				12.0	203	104.2/4.0 (8)		
				16.0	203	97.1/9.6 (2)		
			T-L	12.0	210	107.7/16.0 (2)	147.6/28.9 (2)	
Ti-6Al-4V	MA	R. T.	L-T	24.0	136			196.4/19.9 (6)
		-110	T-L	8.0	163			159.4/7.5 (3)
Ti-6Al-4V (ELI)	Annealed	R. T.	L-T	18.0	136	161.6/6.5 (5)		
Ti-8Al-1Mo-1V	D. A.	R. T.	L-T	12.0	136	111.7/15.0(3)		
				20.0	134			220.5/15.8(4)

*Mean/Standard Deviation (No. of Specimens)

Figure 1.4a. Format for Plane Stress and Transitional Fracture Toughness Data where Specimens were Constrained from Buckling. Example from Table 4.0.3, Titanium Alloys.

TABLE 6.0.3

PLANE STRESS AND TRANSITIONAL FRACTURE TOUGHNESS OF STEEL ALLOYS (WITHOUT BUCKLING CONSTRAINTS)

Alloy	Condition/Ht	Test Temp. (°F)	Specimen Orient	Specimen Width (in)	Yield Strength (Ksi)	Specimen Thickness (in) = 0.025 K_c^* (Ksi $\sqrt{in}$)
18 Ni(300) MAR	----	-423	L-T	4.0	386	86.4/7.3 (5)
		-320	L-T	2.0	336	142.6/7.4 (5)
				4.0	336	124.2/8.0 (5)
		R. T.	L-T	2.0	277	132.1/4.3 (5)
				4.0	277	128.5/3.8 (5)
				18.0	277	110.3/10.9 (3)

* Mean/Standard Deviation (No. of Specimens)

Figure 1.4b. Format for Plane Stress and Transitional Fracture Toughness Data Where Specimens Were Not Constrained from Buckling. Example from Table 6.0.3, Alloy Steels.

Individual K_c data values are listed only if useful in determining a trend in the data. Specimen thickness variations run along the top of the page and may vary from one table to another in order to prevent overcrowding the tables while still accommodating all of the data.

1.3.4 Fatigue Crack Growth Rate Material Data Summary

An example fatigue crack growth rate (FCGR) summary is presented in Figure 1.5 where the data are taken from the Stainless Steel Chapter. Note that the data are from Table 3.0.3.1, a four number sequenced designation. The first two numbers again indicate the chapter (3) and the summary section (0). The third number in the sequence (3) indicates that this is the third ordered table in the material summary (Note that insufficient plane stress and transitional fracture toughness data were available for this material so no summary table of the K_c type was generated). The fourth number in the sequence (1) indicates that this is the first ordered table in the fatigue crack growth rate summary. Readers will find one table for each specimen orientation for which there is enough data for the table to have meaning.

All data in a particular table were collected under conditions where the stress ratio (R) is between 0.0 and 0.1, and the environment is room temperature and laboratory air; the loading frequencies vary slightly depending on the individual tests. The range of test conditions are listed at the top of each table. Beneath the general description of test conditions are the data fields of alloy, condition/heat treatment and product form for which the FCGR data comparisons can be made. The ΔK (Delta K) levels are listed across the top of the table and are identical to some of the levels associated with the tabular format of the mean trend FCGR data, i.e., at levels of 2.5, 5.0, 10.0, 20.0, 50.0, 100.0 Ksi $\sqrt{in.}$ (see Section 1.6 for a listing of all mean trend ΔK levels). The fatigue crack growth rates in units of 10^{-6} inches/cycles, are listed in the appropriate columns and rows according to the alloy, condition/heat treatment, and product form for which they apply. With this format, it is easy to determine which materials, heat

Table 3.0.3.1

COMPARISON OF FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS OF THE STRESS INTENSITY FACTOR FOR STAINLESS STEEL ALLOYS

TEST CONDITIONS:

SPECIMEN ORIENTATION: Unknown

ENVIRONMENT: LAB AIR AT R.T.

STRESS RATIO: 0.05-0.10

FREQUENCY: 3.00-30.00HZ

ALLOY	CONDITION/HT	PRODUCT FORM	STRESS RATIO	FREQUENCY	FATIGUE CRACK GROWTH RATES (MICRO IN/CYCLE) FOR DELTA K LEVELS (KSI SQRT(IN)) = 2.5	5.0	10.0	20.0	50.0	100.0
304	ANNEALED	SHEET	0.05	10.00			.163	3.07		
	ANNEALED	SHEET	0.05	15.00			.133	2.83		
	ANNEALED	SHEET	0.10	1.67				2.86		
	ANNEALED	SHEET	0.10	6.00				2.56		
	ANNEALED & AGE	PLATE	0.05	3.00				1.38		
316	ANNEALED AT 1950F, 1HR, WQ	PLATE	0.05	10.00				2.39		
347	.050 IN. FROM CENTERLINE	WELDMENT	0.10	30.00					9.83	
	AT CENTERLINE	WELDMENT	0.10	30.00					13.1	
	AT HEAT AFFECTED ZONE	WELDMENT	0.10	30.00					17.9	

Figure 1.5. Summary of Fatigue Crack Growth Rate Data, Taken from Table 3.0.3 (Stainless Steel Alloys).

treatments, or product forms have the lowest growth rate at a particular ΔK level. For example, based on the data given in Figure 1.5, annealed and aged 304 stainless steel performs better than annealed 304 stainless steel.

1.3.5 Stress Corrosion Cracking Threshold Material Data Summary

Figure 1.6 illustrates, using Table 3.0.4, the format for the stress corrosion cracking threshold material data summary, the fifth possible material data summary. Because of the small number of specimens (typically one or two) that are used to generate these data, individual results are presented here rather than means and standard deviations. The data are sorted by alloy, condition/heat treatment, product form and specimen orientation. Possible environments for which K_{Iscc} data exist are listed across the top of the table; K_{Iscc} data values for each particular environment are listed in the appropriate row and column. This table summary allows for comparisons of K_{Iscc} values of various materials in a particular environment as well as a quick assessment of how various environments affect a particular material.

1.4 ALLOY SECTION SUMMARIES

Following the material summaries, the data were divided into sections by alloy. Each alloy section is further subdivided into three subsections: a summary subsection, a fracture toughness subsection, and a crack growth resistance subsection. The data content and format for these three subsections are described in this and the following two subsections, respectively.

There are two possible alloy summaries, a plane strain fracture toughness summary and fatigue crack growth rate data summary. Figure 1.7 presents the tabular format for the K_{Ic} alloy summary. It is similar to the K_{Ic} material summary in that the mean and standard deviation for a particular condition/heat treatment, product form and specimen orientation is given for each alloy. However, the number of specimens used to generate the data has been added. The data has also been sorted by product form first, then condition/heat treatment and specimen orientation.

TABLE 3.0.4

INDIVIDUAL STRESS CORROSION CRACKING THRESHOLD DATA FOR STAINLESS STEEL ALLOYS AT ROOM TEMPERATURE

ALLOY	CONDITION/ HT	PRODUCT FORM	SPECIMEN ORIENTATION	K_{ISCC} (Ksi√in) ENVIRONMENTS: SUMP TANK WATER	3.5% NaCl	20% NaCl	SEACOAST ATMOSPHERE	INDUST. ATMOSPHERE
AFC 77	1800F 1HR OQ, -100F 0.5 HR, 500F 2&2 HR, (Coarse G.S.)	P	---		15			
	2000F 1HR OQ, -100F 0.5 HR, 700F 2&2 HR	B	---		50			
	2000F 1HR OQ, -100F 0.5 HR, 800F 2&2 HR	B	---		40			
	2000F 1HR OQ, -100F 0.5 HR, 900F 2&2 HR	B	---		35			
	2000F 1HR OQ, -100F 0.5 HR, 1100F 2&2 HR	B	---		10			
	2000F 1HR OQ, -100F 0.5 HR, 500F 2&2 HR, & 10PCT CW, 1000F	B	---		30			
	2000F 1HR OQ, -100F 0.5 HR, 500 2&2 HR, & 10PCT CW, 700F	B	---		90			
	2000F 1HR OQ, -100F 0.5 HR, 500F 2&2 HR, & 20 PCT CW, 700F	B	---		48			
AFC 260	2200F 1HR, 1900F 1HR OQ, -100F 1HR, -300F 1HR, 900F, 2&2 HR	P	T-L		40			
	2200F 1HR, 1900F 1HR OQ, -100F 1HR, -300F 1HR 1000F 2&2 HR	P	T-L		45			
	2200F 1HR, 1900F 1HR OQ, -100F 1HR, -300F 1HR, 1050F 2&2 HR	P	T-L		37			
AM 355	SCT 850	P	T-L			8	24	45
		B	T-L			6	18	18
	SCT 1000	P	T-L			37	52	99
		B	T-L			28	35	66

Figure 1.6. Summary of Stress Corrosion Cracking Threshold Material Data, Taken from Table 3.0.4 (Stainless Steel Alloys).

Table 3.8.1.1

MEAN PLANE STRAIN FRACTURE TOUGHNESS DATA OF
STAINLESS STEEL ALLOY PH13-8MO AT ROOM TEMPERATURE

CONDITION/HT	MEAN KIC ± STANDARD (KSI SQRT(IN)) DEVIATION	(NUMBER OF SPECIMENS)	
	FORGED BAR		
CONDITION/HT	L-T	T-L	S-L
AUSTENITE COND AND TRANSFORMED AT 38F, AGED 1015F	103.0 ±19.4 (2)	89.6 ± 1.8 (2)	-----
H1000	114.2 ± 0.9 (2)	122.7 ± 3.0 (3)	-----
	ROLLED BAR		
CONDITION/HT	L-T	T-L	S-L
H 950	66.9 ± 2.9 (3)	63.5 ± 1.7 (6)	74.1 ± 2.1 (3)
H1000	90.0 ± 7.1 (2)	75.0 ± 4.2 (2)	-----
H1050	103.1 ± 4.6 (3)	94.8 ± 7.8 (6)	92.2 ± 4.2 (2)

Figure 1.7. Alloy Summary Format for Plane-Strain Fracture Toughness Data, Taken from Table 3.8.1.1, PH 13-8Mo Stainless Steel.

This summary basically puts all the K_{Ic} data for a particular condition and product form together for easy comparison. It also allows for a quick assessment of the effect that orientation has on the fracture toughness.

The FCGR alloy data summaries shown in Figure 1.8 are similar to the FCGR material data summaries described previously. Note that for a particular alloy, the data are separated by the test variables of specimen orientation and environment which are listed at the top of each page. Other test variables such as condition/heat treatment, product form, stress ratio and frequency are then listed for the data as noted. Typically, a number of FCGR data summaries are produced to describe the effects of specimen orientation and environments. Sorting on specimen orientation is as shown in Table 1.3 and sorting on environment is in the order described in Table 1.9. With these summary tables, it is possible to determine which condition/heat treatment and product form give the lowest FCGR in a given environment for a given specimen orientation. Discrepancies in data sets can also be noted as well as a quick determination of how stress ratio and frequency affect the data in a particular environment.

1.5 ALLOY FRACTURE TOUGHNESS SUBSECTION FORMATS

Within each alloy section following the alloy summaries is the fracture toughness type data. Fracture toughness data consists of plane strain data (K_{Ic}), plane stress and transitional fracture toughness data (K_c), and resistance curve data (R-curves). Each of these has a different and yet somewhat similar ordering scheme which is particularly suited to that type of data.

1.5.1 Plane Strain Fracture Toughness

The format for the plane-strain fracture toughness data is shown in Figure 1.9. This particular example is taken from the stainless steel chapter for alloy AFC 77. The data are sorted by condition/heat treatment, then product form, test temperature, orientation and yield strength using the sorting order identified in Table 1.3. All K_{Ic} data collected for these

Table 3.8.1.4

FATIGUE CRACK GROWTH RATE AT DEFINED LEVELS OF THE STRESS-INTENSITY FACTOR

STAINLESS STEEL PH13-8MO

TEST CONDITIONS

SPECIMEN ORIENTATION L-T

ENVIRONMENT: L.H.A. AT R.T.

CONDITION/HT	PRODUCT FORM	STRESS RATIO	FREQ (HZ)	DELTA K LEVELS (KSI SQRT(IN)) 2.5	5	10	20	50	100
	EXTRUDED BAR	0.08	6.00				2.22	20.8	
	EXTRUDED BAR	0.30	6.00				2.98		
H1000	FORGED BAR	0.08	6.00				5.82		
H1000	FORGED BAR	0.30	6.00				4.70		
H1000	FORGED BAR	0.50	6.00			0.51	4.70		
H1000	BILLET	0.00	6.00			0.34	4.02		
H1000	EXTRUDED BAR	0.08	6.00			0.33	3.73	34.4	
H1000	EXTRUDED BAR	0.50	6.00			0.85	5.59		
H1000	ROLLED BAR	0.08	1.00			0.29	3.57		
H1000	ROLLED BAR	0.00	6.00			0.29	3.40		
H1000	ROLLED BAR	0.30	6.00			0.62	4.39		
H1000	ROLLED BAR	0.50	6.00			0.79	5.09		

Figure 1.8. Format for Alloy Fatigue Crack Growth Rate Data Summary, Data Taken from Table 3.8.1.4, PH 13-8 Mo Stainless Steel.

TABLE 1.9

ORDERING SCHEME FOR ENVIRONMENT

Dry Air
Low Humidity Air
Negative Temperatures/Air
0°F to Room Temperature
Room Temperature/Laboratory Air
Above Room Temperature/Air
Argon
High Humidity Air
JP-4 Fuel
Water Saturated JP-4 Fuel
Alternating JP-4 Fuel
Distilled Water
Nitrogen
Solvent Cleaning Solution
3.5% Nacl
Sump Tank Water
Simulated Sea Water
Salt Fog
Field Cleaning Solvent

Table 3.2.2.1

STAINLESS STEEL AFC 77 K(IC)

CONDITION	--PRODUCT-- FORM	THICK (IN)	TEST TEMP (F)	SPECIMEN ORIENT	YIELD STRENGTH (KSI)	------SPECIMEN------ WIDTH (IN) W	THICK (IN) B	DESIGN	CRACK LENGTH (IN) A	2.5*(K(IC)/TYS)**2 (IN)	K(IC) (KSI*SQRT IN)	K(IC) MEAN	STAN DEV	DATE	REFER
1800F 1HR. OQ. -100F 0 5HR. 1000F 2+2HR (COARSE GRAIN)	P	0 56	R T	L-T	173 0	1 500	0 500	NB	----	0 05	25 00			1969	74720 (1)
1800F 1HR. OQ. -100F 0 5HR. 700F 2+2HR (COARSE GRAIN)	P	0 56	R T	L-T	183 0	1 500	0 500	NB	----	0 11	38 00			1969	74720 (1)
1800F 1HR. OQ. -100F 0 5HR. 800F 2+2HR (COARSE GRAIN)	P	0 56	R T	L-T	208 0	1 500	0 500	NB	----	0 05	28 00			1969	74720 (1)
1800F 1HR.OQ. -100F 0 5HR. 700F 2+2HR (FINE GRAIN)	P	0 56	R T	L-T	203 0	1 500	0 500	NB	----	0 15	49 00			1969	74720 (1)
1800F 1HR.OQ. -100F 0 5HR. 800F 2+2HR (FINE GRAIN)	P	0 56	R T	L-T	224 0	1 500	0 500	NB	----	0 05	31 00			1969	74720 (1)
1800F 1HR.OQ. -100F 0 5HR. 1000F 2+2HR (FINE GRAIN)	P	0 56	R T	L-T	232 0	1 500	0 500	NB	----	0 04	30 00			1969	74720 (1)
1800F 1HR.OQ. -100F 1HR. 700F 2+2HR	BR	3 00	R T	L-R	185 0	1 500	0 480	NB	----	0 14	44 00			1968	84302 (1)
1800F 1HR.OQ. -100F 1HR. 800F 2+2HR	BR	3 00	R T	L-R	213 0	1 500	0 480	NB	----	0 05	29 00			1968	84302 (1)
1900F 1HR.OQ. -100F 1HR. 800F 2+2HR	BR	3 00	R T	L-R	222 0	1 500	0 480	NB	----	0 28	74 00			1968	84302 (1)
2000F 1HR.OQ. -100F 1HR.900F 2+2HR	BR	3 00	- 65	L-R	----	1 500	0 480	NB	----	----	32 00			1968	84302 (1)
2000F 1HR.OQ. -100F 1HR.800F 2+2HR	BR	3 00	R T	L-R	207 0	1 500	0 480	NB	----	0 29	70 00			1969	76136 (1)
2000F 1HR.OQ. -100F 1HR.900F 2+2HR	BR	3 00	R T	L-R	214 0	1 500	0 480	NB	----	0 17	56 00			1969	76136 (1)

NOTES

(1) COMPOSITION(WT PERCENT)0 16C.0 10MN.0 015P.0 021S.0 13SI.0 21NI.14 0CR.5 02MO.13 4CO.0 [illegible]V.0 04N
THESE DATA ARE AVERAGE VALUES

Figure 1.9. Format for Plane Strain Fracture Toughness Data. Example Taken from AFC 77 Stainless Steel Alloys, Table 3.2.2.1.

same parameters are put together with the mean and standard deviation listed in a column near the right of the page. Product thickness is listed after product form, but is not a sorting parameter. Specimen dimensions including thickness, width and crack length are also listed, but are not listed in any particular order. The 2.5 $(K_{Ic}/\sigma_{ys})^2$ criterion value is included for information purposes only. Two additional columns list the date of the reference and the reference number so that an idea of when the data were collected can be assessed, and where additional information might be obtained should it be desired. Reference numbers from the earlier handbook have been retained and new data have been assigned a new reference number with the first two digits signifying the organization or journal from which the data was obtained. Table 1.10 lists the general format for new reference numbers. The final column at the right hand side of the page refers to the notes at the bottom and are used to indicate out-of-range compositions, average data values, and other identifying important features.

1.5.2 Plane Stress Fracture Toughness Data

The format for presenting plane stress fracture toughness (K_c) data is presented in Figure 1.10. The sorting format for the plane stress fracture toughness (K_c) data within a particular alloy section is by condition, then buckling of crack edges restrained, unrestrained, or unknown, and then by product form, test temperature, specimen orientation, specimen thickness and specimen width. Additionally, initial and final crack lengths are given as a function of the total crack length (2a) for center-cracked panel/specimens. Also, the onset and maximum gross stress values are listed when available. The fracture toughness parameters K_c and K_{app} are calculated as described in Chapter 2 and the individual as well as the mean and standard deviation values are listed for both K_c and K_{app}. The final two columns present the date of the reference and the reference number.

TABLE 1.10

REFERENCE NUMBERS FOR NEW DATA AND THE ORGANIZATIONS OR JOURNALS ASSOCIATED WITH THESE DATA

1. ALxxx - Alcoa Laboratories - Alcoa Center, PA.
2. AMxxx - Airesearch Manufacturing - Los Angeles, CA.
3. BLxxx - Battelle Columbus Laboratories, Columbus, OH
4. BWxxx - Boeing Military Airplane Co., Wichita, KA
5. DAxxx - Douglas Aircraft - Long Beach, CA
6. EFMxx - Journal of Engineering Fracture Mechanics
7. FRxxx - Fairchild Republic - Farmingdale, N.Y.
8. GDxxx - General Dynamics - Fort Worth, TX
9. GExxx - General Electric - Evendale, OH
10. HDxxx - Westinghouse Hanford Development Lab., Richland, Wash.
11. LGxxx - Lockheed Georgia - Marietta, GA.
12. MAxxx - McDonnell Aircraft Co. - St. Louis, MO
13. MDxxx - McDonnell Douglas Astronautics Corp, Huntington Beach, CA.
14. MRxxx - Materials Research Laboratory - Glenwood, IL
15. NCxxx - Northrop Corporation - Hawthorne, CA
16. NLxxx - NASA Langley Research Center - Hampton, VA.
17. NRxxx - Naval Research Laboratories - Washington, DC.
18. PWxxx - Pratt & Whitney Aircraft Group - Government Products Division - West Palm Beach Florida
19. RAxxx - Reynolds Metals Co. - Richmond, VA
20. RIxxx - Rockwell International - North American Division & Shuttle Orbiter Div. - Los Angeles, CA.
21. UCxxx - University of Cincinnati - Cincinnati, OH
22. UDxxx - University of Dayton Research Institute, Dayton, OH
23. UMxxx - University of Missouri - Rolle, Missouri
24. WAxxx - Wright Aeronautical Laboratories- WPAFB, OH

Table 3.9.2.1

STAINLESS STEEL PH14-8MO K(C)

CONDITION	--PRODUCT-- FORM	THICK (IN)	TEST TEMP (F)	SPEC OR	YIELD STR (KSI)	---SPECIMEN--- WIDTH (IN) W	THICK (IN) B	CRACK LENGTH INIT (IN) 2A(O)	FINAL (IN) 2A(F)	GROSS STRESS ONSET (KSI) S(O)	MAX (KSI) S(MAX)	K(APP) (KSI*SQRT IN)	K(APP) MEAN	STAN DEV	K(C) (KSI*SQRT IN)	K(C) MEAN	STAN DEV	DATE	REFER
BUCKLING OF CRACK EDGES RESTRAINED																			
SRH1050	S	0.03	63	L-T	174.5	24.040	0.025	5.990	----	---	72.60	231.63			----			1964	57573
SRH1050	S	0.03	R.T.	L-T	174.5	7.990	0.025	2.010	----	---	118.10	218.44*			----			1964	57573
SRH1050	S	0.03	R.T.	L-T	174.5	24.020	0.025	3.000	----	---	95.90	210.21			----			1964	57573
		0.03			174.5	24.030	0.025	6.000	----	---	72.40	231.22			----			1964	57573
		0.03			174.5	24.040	0.025	6.000	----	---	71.90	229.61	223.7/	11.7	----	----/	---	1964	57573
SRH1050	S	0.05	R.T.	L-T	196.6	24.010	0.050	6.000	----	---	92.10	294.15			----			1964	57573
SRH1050	S	0.09	R.T.	L-T	197.4	24.100	0.093	6.000	----	---	115.70	369.42			----			1964	57573

*NOTE- NET SECTION STRESS EXCEEDS 80% OF YIELD STRENGTH. VALUE NOT INCLUDED IN MEAN OR STD. DEV.

Figure 1.10. Format for Plane Stress Fracture Toughness Data; Example Taken from Table 3.9.2.1, PH14-8Mo Stainless Steel Alloy.

1.5.3 R-Curve Data

The format for resistance curve (R-Curve) data is shown in Figure 1.11. The information listed at the top of the page includes the material type, the alloy, the condition/heat treatment, the product form, and the thickness if known, the specimen type and orientation, the specimen dimensions, thickness and width, the K_c value, if known, and the reference number. Unless otherwise specified, the data were taken at room temperature in laboratory air environments. Only one specimen is illustrated per figure, and the figures are sorted by alloy, condition/heat treatment, test temperature and environment, orientation and specimen thickness and width.

The resistance curve data are plotted on linear scales; K_R, the applied stress intensity, as a function of Δa_{eff}, the change in effective crack length (see Chapter 2 for the details associated with the calculation). There are two possible scales for the data; (1) the vertical scale ranging from 0 to 120 Ksi $\sqrt{in.}$ and horizontal scale ranging between 0.0 to 1.1 inches, and (2) the vertical scale ranging from 0.0 to 240 Ksi $\sqrt{in.}$ and the horizontal scale ranging between 0.0 and 3.3 inches. These two scales were chosen to accommodate all the data.

1.6 ALLOY SUBCRITICAL CRACK GROWTH SUBSECTION FORMATS

The subcritical crack growth data follow the fracture toughness data within each alloy section. The subcritical crack growth data includes: fatigue crack growth rate data, sustained load crack growth rate data, and stress corrosion cracking threshold data.

1.6.1 Fatigue Crack Growth Rate Data

The fatigue crack growth rate data are presented in two complementary formats - a graphical format and a mean trend tabular format. Figure 1.12 represents the graphical format which was chosen to present fatigue crack growth rate data. Basic information common to all data on a particular page is listed at the top of the page in the header section. Below

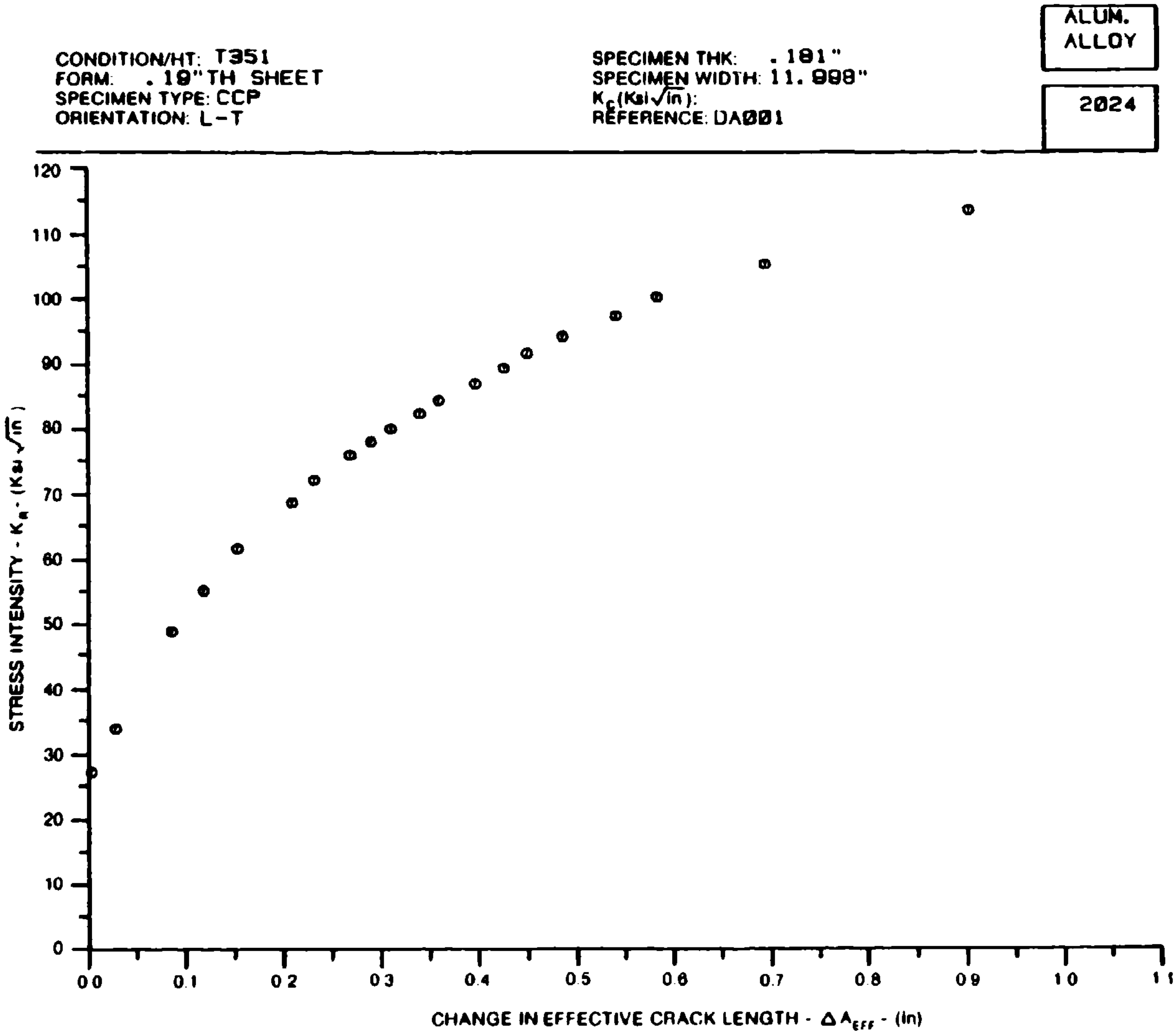


Figure 1.11. Format for Resistance Curve (R-Curve) Data. Example Taken from Figure 7.5.2.6, 2024 Aluminum Alloy.

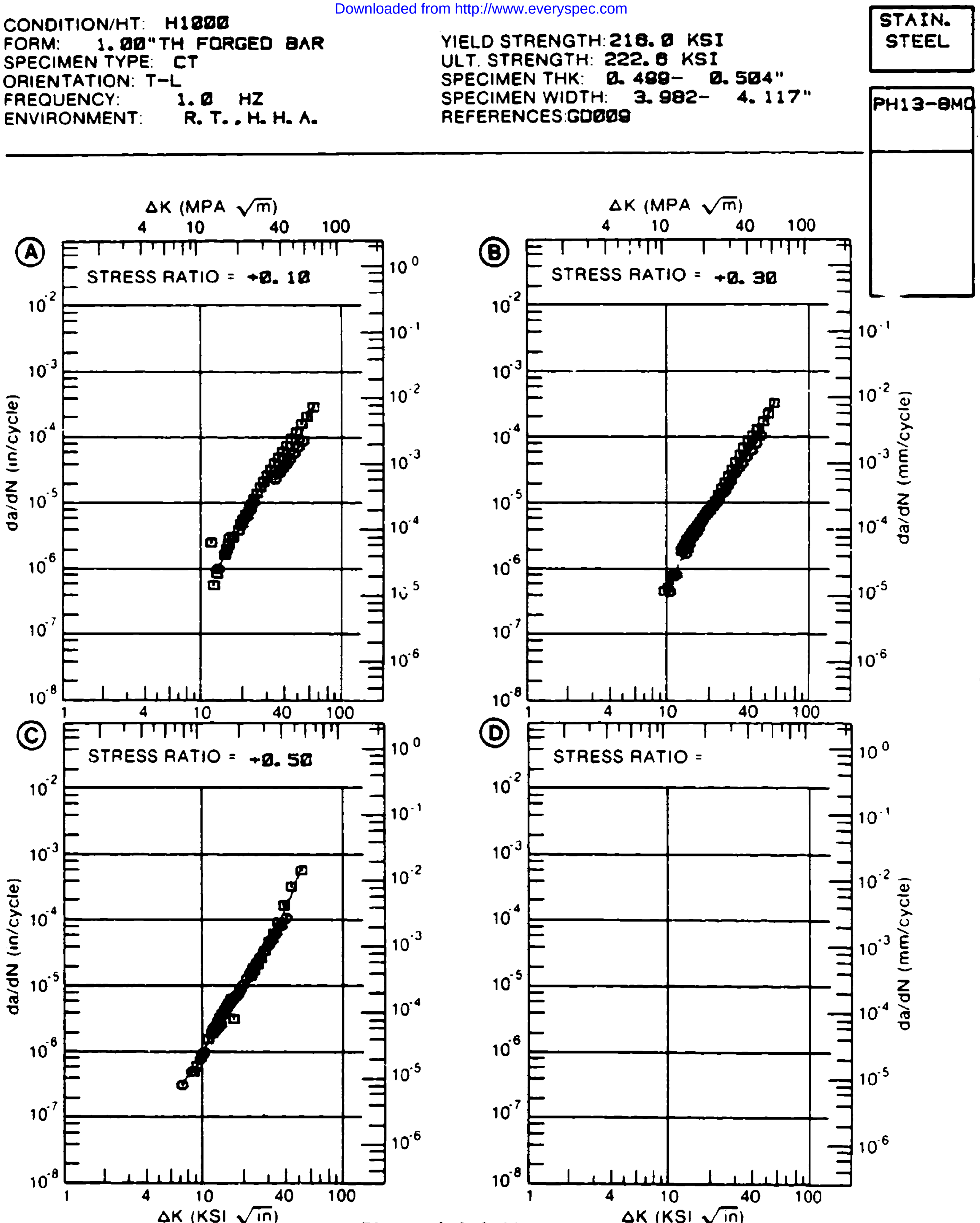


Figure 3.8.3.14

Figure 1.12. Graphical Format of the Fatigue Crack Growth Rate Data; Example Taken from Figure 3.8.3.14 Based on Stainless Steel Alloy PH13-8Mo Showing Effect of Stress Ratio.

the header section, there are four separate graphs on which the data are plotted. Each graph contains only data taken under identical conditions. Data are presented in each of the different graphs to show trends in behavior. The data on a page may describe the effects of one of three parameters: stress ratio, temperature/environment, and frequency. In order to accommodate these three variations, the header data at the top is slightly varied and the parameter being varied (e.g. stress ratio) is listed at the top of each of the active graphs as shown in Figure 1.12.

The header information at the top includes the material and alloy identifications listed in the small boxes in the upper right hand corner of each page for ease in locating the data. The condition/heat treatment is then listed at the top of the header. Below this, test and material parameters are listed in two columns; the first column listing the product form and product thickness, specimen type, specimen orientation and the two of the three parameters (i.e., stress ratio, test temperature/environment, frequency) not being varied on that partiuciar page. The second column lists the room temperature tensile yield and ultimate strengths, the specimen dimensions of thickness and width, and the reference numbers identifying the data source.

All data are plotted as fatigue crack growth rate (da/dN) as a function of the range in the stress intensity factor (ΔK). The graphs are equal sized log-log plots ranging from 10^{-8} to 10^{-1} inches/cycle for the growth rates (i.e., seven decades), and from 1 to 200 Ksi $\sqrt{in}$ for values of ΔK. The definition of ΔK according to ASTM Standard E647 was chosen for data presentation throughout the handbook, i.e., ΔK = the maximum stress-intensity factor if the stress ratio is negative ($R \leq 0$). For other details, see Chapter 2.

English units, i.e., inches/cycle for growth rates and Ksi $\sqrt{in}$. for ΔK, are listed to the left and the bottom of each page. Metric units, i.e., millimeters/cycle for growth rate values and megapascales $\sqrt{m}$ for ΔK, are listed at the top and right of each page.

By reviewing Figure 1.12, it can be noted that there are two different data symbols utilized in each graph. The two different symbols represent data from two different tests. Up to twenty different tests can be accommodated with the symbols defined in Table 1.11. Each graph, however, is restricted to a maximum of 300 da/dN-ΔK points; if the amount of data greatly exceeded these values, the data were separated onto two plots and the variable listed in each of the graphs is exactly the same. Mean trend curves have been established for each data set and can be seen going through the data on most of the graphs. The mean trend was developed using a cubic spline polynomial with the ability to control some aspects of the curve fit. The method is described in detail in Chapter 2. Fatigue crack growth rate data containing less than eight data points are plotted but mean trend curves were not established for these data.

Fatigue crack growth rate data are sorted slightly differently than fracture toughness data. Within a particular alloy, the data are sorted first by condition/heat treatment (using the order discussed in Table 1.3) then by product form and thickness with the order for product form defined as in Table 1.12. The product form order was altered to keep the data on forged and extruded bars near the data for forgings and extrusions, respectively. The sort on product thickness after product form is by increasing thickness. The next sort is by specimen orientation using the order defined by Table 1.3 and is followed by a sort by type of plot.

TABLE 1.11

LIST OF POSSIBLE SYMBOLS USED FOR EACH SPECIMEN IN THE GRAPHICAL PRESENTATION OF THE FATIGUE CRACK GROWTH RATE DATA

Test Order No.	Symbol	Test Order No.	Symbol
1	□	11	⌧
2	○	12	✳
3	△	13	⧗
4	+	14	|
5	×	15	*
6	◇	16	◆
7	↑	17	■
8	⌅	18	●
9	Z	19	★
10	Y	20	—

TABLE 1.12

ALTERNATE PRODUCT FORM SORTING ORDER FOR CRACK PROPAGATION DATA

Sheet
Plate
Bar
Billet
Disk
Extrusion
Extruded Bars
Forgings
Forged Bars
Rolled Bars
Round Bars
Castings
Weldments

In the final series of sorts, the data are ordered so that all the pages where the data varies on stress ratio are placed before the data that varies on test temperature/environment; these data are placed before any data which varies on frequency. When there are a number of stress ratio plots, within these data sets, the data are sorted by test temperature/environment using the order listed in Table 1.9. If there are a number of stress ratio plots which also have the same test temperature/environment, then the final sort is in order of decreasing frequency. Within the group of test temperature/environment plots that follow the stress ratio plots, these are also sorted additionally by increasing stress ratio then further by decreasing frequency if necessary. Within the group of frequency plots, which follow the temperature/environment plots, the data are further subdivided by increasing stress ratio and then by the test temperature/environment sort of Table 1.9 if necessary. The above organizational scheme was established for easy comparison of data and to define the effects that defined variables had on crack growth rate. For other types of comparisons, it may be necessary to search through a subsection to find all the data of interest.

As stated earlier, in addition to the graphical presentation there also exists a tabular format of the mean trend values. This format is presented in Figure 1.13. The tabular format and the graphical format will be presented side-by-side in the handbook with the tabular format on the left and the graphical format on the right. Figure 1.13 is the tabular format of the data presented in Figure 1.12. Note that the Table and Figure numbers are identical.

On examination of Figure 1.13, one can see that the Table can be broken up into six sections. These sections are identified as: (1) the header section, (2) the maximum ΔK-da/dN values section, (3) the mean trend fatigue crack growth rate values at the specified values of ΔK section, (4) the maximum ΔK - da/dN values section, (5) the root mean square percent error (RMSPE) section, and (6) the life prediction ratio section.

Section 1, the header section, does not include all the header information that is listed on the graphical format. Here only the material, alloy, condition/heat treatment and environment (if it is a stress ratio plot) are listed. Beneath the fatigue crack growth rate data header are the axes lables ΔK (Delta K) and da/dN. The letters A, B, C, and D, under the da/dN label, correspond to the same identifying letters on the four plots on the graphical format. Below these letters are the abbreviations of E for Environment, R for Stress Ratio, and F for Frequency which identifies the variable for this particular data set. Following these abbreviations are the values of the variables for this data.

Section 2 lists the minimum ΔK values to the left and the corresponding da/dN values in the appropriate column. These points present the slowest crack growth rate on the mean trend curves shown in Figure 1.12.

Section 3 lists the mean trend values. The ΔK values are listed to the left and the da/dN values are listed for each curve to the right in the appropriate column. However, the ΔK values are now fixed values and the growth rates in the columns correspond to these ΔK values for the individual graphs. There are 28 possible ΔK values ranging from 1 to 200 ksi $\sqrt{in}$; the specific values utilized are 1.0, 1.3, 1.6, 2.0, 2.5, 3.0, 4.0, 5.0, 6.0, 7.0, 8.0, 9.0, 10.0, 13.0, 16.0, 20.0, 25.0, 30.0, 40.0, 50.0, 60.0, 70.0, 80.0, 90.0, 100.0, 130.0, 160.0, and 200.0 Ksi $\sqrt{in}$.

Note that in Figure 1.13 all 28 ΔK values are not listed, only those in which there was a mean trend data available for at least one of the graphs. This means that in this case (Figure 1.12) all ΔK values less than 7.0 and greater than 60.0 Ksi $\sqrt{in}$. are not included since none of the curves had data outside this range.

Table 3.8.3.14

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 3.8.3.14 INDICATING EFFECT

OF STRESS RATIO

MATERIAL: STAINLESS STEEL PH13-8MO
CONDITION: H1000
ENVIRONMENT: R.T., H.H.A.

DELTA K (KSI*IN**1/2)		DA/DN (10**-6 IN./CYCLE) A R=+0.10	B R=+0.30	C R=+0.50	D
DELTA K MIN A:	11.42	.928			
DELTA K MIN B:	9.13		.466		
DELTA K MIN C:	6.87			.299	
DELTA K MIN D:					
	7.00			.342	
	8.00			.468	
	9.00			.625	
	10.00		.543	1.08	
	13.00	1.09	2.16	3.06	
	16.00	2.57	4.48	5.84	
	20.00	6.71	9.37	11.6	
	25.00	15.3	19.2	24.3	
	30.00	26.6	34.6	47.9	
	35.00	38.7	58.0	91.9	
	40.00	52.4	92.8	174.	
	50.00	108.	215.	607.	
	60.00	259.			
DELTA K MAX A:	62.14	303.			
DELTA K MAX B:	56.12		339.		
DELTA K MAX C:	50.46			643.	
DELTA K MAX D:					
ROOT MEAN SQUARE PERCENT ERROR		33.16	14.35	12.25	
LIFE PREDICTION RATIO SUMMARY (NP/NA)	0.0-0.5				
	0.5-0.8				
	0.8-1.25	2	1	2	
	1.25-2.0		1		
	>2.0				

Figure 1.13. Tabular Format for Fatigue Crack Growth Rate Data; Tabular Data Corresponds to Graphical Data Shown in Figure 1.12. Example Taken from Table 3.8.3.14, PH 13-8Mo Stainless Steel Alloy.

Section 4 identifies the maximum (highest) ΔK - da/dN point on the mean trend curve in a manner similar to Section 2 which identified the lowest point on the curve.

Section 5, entitled "The Root Mean Square Percent Error" (RMSPE), is basically a description of scatter about the mean trend line; that is, a smaller value indicates a smaller scatter than a larger one. The calculation of this value is described in Chapter 2.

Section 6 presents life prediction information in terms of life prediction ratios. The life prediction ratio (LPR) is the number of cycles predicted (using the mean trend curve) divided by the actual number of cycles taken from the experimental crack length versus cycle data for a predefined interval. The actual LPR values are not listed but the results are summarized. The data summary is divided into five ranges, that is LPR's from: (1) 0.0-0.5, (2) 0.5-0.8, (3) 0.8-1.25, (4) 1.25-2.0, and (5) above 2.0. The numeric values in the columns across from the LPR range represents the number of specimens that had LPR's in that particular range. Because some data were received in reduced form only, i.e., (ΔK, da/dN) only, not all of the test specimens shown on the graphs will have LPR's, i.e., raw crack length versus cycle count data was not available for comparison. The LPR's generally were found to be in the center range, indicating an adequate mean trend fit of the data. For threshold type tests and for tests in which the loads were varied frequently through the test, LPR's tended to be outside this range.

1.6.2 Sustained Load Crack Growth Rate

The sustained load crack growth rate data are presented subsequent to the fatigue crack growth rate data and are plotted on log-log plots in a manner similar to the FCGR data (See Figure 1.14). Tabular mean trend formats are also presented where sufficient data exists (See Figure 1.15). The data are

CONDITION/HT: AUSTENITIZED AT 2010F, QUENCHED & TEMPERED AT 810F
FORM: 0.08"TH SHEET
SPECIMEN TYPE:
ORIENTATION:
YIELD STRENGTH:
ULT. STRENGTH:
SPECIMEN THK:
SPECIMEN WIDTH:
CRACK LENGTH (A_O):
K_{ISCC}:
REFERENCES: 85544

STAIN. STEEL

AFC 77

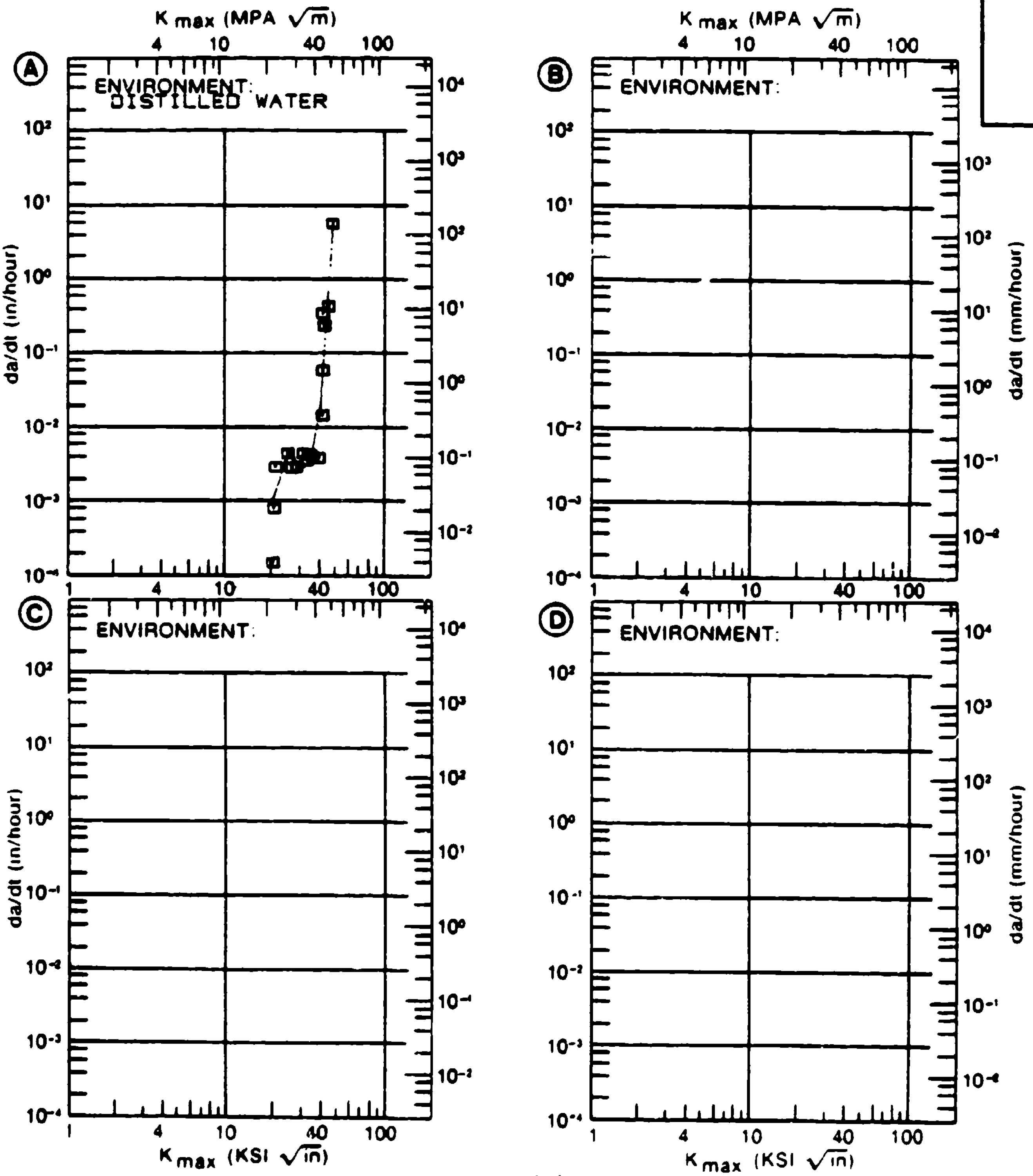


Figure 3.2.3.1

Figure 1.14. Graphical Format for Sustained Load Crack Growth Rate Data. Example Taken from Figure 3.2.3.1, AFC 77 Alloy Stainless Steel.

TABLE 3.2.3.1

SUSTAINED CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 3.2.3.1 INDICATING EFFECT

OF ENVIRONMENT

MATERIAL: STAINLESS STEEL AFC 77
CONDITION: AUSTENITIZED AT 2010F, QUENCHED & TEMPERED AT 810F

K MAX (KSI*IN**1/2)			DA/DT (10**-3 IN/HOUR) A	B	C	D
			E = DISTILLED WATER			
K MAX MIN	A:	20.00	1.01			
	B:					
	C:					
	D:					
		25.00	4.55			
		30.00	2.67			
		35.00	3.21			
		40.00	17.5			
K MAX MAX	A:	47.00	5213.			
	B:					
	C:					
	D:					
ROOT MEAN SQUARE PERCENT ERROR			62.42			

Figure 1.15. Tabular Format of Sustained Load Crack Growth Rate Data. Example Taken from Table 3.2.3.1, AFC 77 Stainless Steel Alloy.

plotted to present time based crack growth rate as a function of maximum stress-intensity factors on pages with header sections and four graphs of equal size with both English and Metric units lining the sides. Again, the header information includes the material and the alloy in the small boxes in the upper right hand corner of the pages. The condition/heat treatment is listed at the very top and the rest of the parameters are listed in two columns beneath the condition. The first column contains the parameters of form, form thickness, specimen type, specimen orientation, and test temperature/environment, while the second column contains the tensile yield strength, specimen thickness and width, initial crack length (a_o), stress corrosion cracking threshold values, K_{Iscc}, and the reference numbers. As before, there are also three variations on these plots, that is, variations on form and form thickness, tensile yield strength, and test temperature/environment. There are also some data sets in which condition/heat treatment for a given alloy is varied; these variations were manually designated on the plots. In addition to the three basic plot variations noted, the sustained load crack growth rate data have two possible growth rate axes. In order to accommodate the data, the two sets of axes chosen were 10^{-6} to 10^{0} inches/hr. and 10^{-4} to 10^{2} inches/hour (English units). Both have maximum stress-intensity values that range from 1 to 200 Ksi $\sqrt{in.}$

Some of these data also have mean trend curves and mean trend tables associated with them. The mean trend tables are again presented directly opposite to the graphical presentation of the data, similar to that done for the fatigue crack growth rate data. Figure 1.15 is the tabular format of the data in Figure 1.14. The format of this table is similar to the fatigue crack growth rate data, so little further explanation is warranted. All of these data were received in reduced form, and therefore, no LPR's are given; due to the nature of the data, the values of the RMSPE are usually larger than for the FCGR data. Additionally, mean trend curves representative of the data were not always created; for these cases, no mean trend curve or table is presented.

1.6.3 Stress Corrosion Cracking Threshold

Following the sustained load crack growth rate data is the tabular stress corrosion cracking threshold data. An example of this data format is presented in Figure 1.16, which is similar to the fracture toughness data format. The material, alloy and data type are listed at the top of the sheet. To the left, the condition/heat treatment is listed, then product form, product thickness, test temperature, specimen orientation, yield strength, and environment. Following these parameters are the specimen thickness, width and design as well as crack length, fracture toughness, K_{Iscc} individual values, mean values, standard deviations, test times, dates and reference numbers.

The data are sorted according to (material, alloy) condition/heat treatment, product form, test temperature, specimen orientation and environment. The order of the sorts are identified in Table 1.3 except for environment which is sorted by the utility sort, i.e., by a sort similar to that for alloy and condition/heat treatment.

The fracture toughness values presented, K(Q), only indicate the level of crack toughness of the material; these values were obtained from the threshold tests and are not valid plane-strain fracture toughness values. The K(Q) values, however, should provide an engineer with an indication of stress-corrosion cracking sensitivity relative to fracture.

In the K_{Iscc} tabular data, there are two columns in which asterisks (*) may appear; the column on specimen design and the column on K_{Iscc}. All asterisks that appear in the specimen design column indicate that the specimen has been side-grooved along the path of the crack; note (* = SG) at the top of the column. The asterisks that appear in the K_{Iscc} column behind the individual K_{Iscc} values indicate that the crack length and/or specimen thickness were not greater than 2.5 $(K_{Iscc}/\sigma_{ys})^2$, as noted at the bottom of the page.

Table 3.2.3.2

STAINLESS STEEL AFC 77 K(ISCC)

CONDITION	--PRODUCT-- FORM	THICK (IN)	TEST TEMP (F)	SPEC OR	YIELD STR (KSI)	ENVIRONMENT	------SPECIMEN-------- WIDTH (IN) W	THICK (IN) B	DESIGN (*=SG)	CRACK LENGTH (IN) A	K(Q) (KSI*SQRT IN)	K(ISCC)	MEAN	STAN DEV	TEST TIME (MIN)	DATE	REFER
1800F 1HR OQ. -100F 0.5HR.500F 2+2 HR (COARSE GRAINED STRUCTURE)	P	0.56	R.T.	---	154.0	3.5 PCT NACL	1.500	0.480	CANT*	----	119.00	92.00*			----	1969	74720
1800F 1HR OQ. -100F 0.5HR.1000F 2+2 HR (COARSE GRAINED STRUCTURE)	P	0.56	R.T.	---	173.0	3.5 PCT NACL	1.500	0.480	CANT*	----	25.00	15.00			----	1969	74720
1800F 1HR OQ. -100F 0.5HR.500F 2+2 HR (FINE GRAINED STRUCTURE)	P	0.56	R.T.	---	196.0	3.5 PCT NACL	1.500	0.480	CANT*	----	111.00	97.00*			----	1969	74720
1800F 1HR OQ. -100F 0.5HR.1000F 2+2 HR (FINE GRAINED STRUCTURE)	P	0.56	R.T.	---	232.0	3.5 PCT NACL	1.500	0.480	CANT*	----	30.00	20.00			----	1969	74720
2000F 1HR OQ -100F 0.5HR 1400F 2+2 HR	B	3.00	R.T.	---	150.0	3.5 PCT NACL	1.500	0.480	CANT*	----	116.00	80.00*			----	1969	76136
2000F 1HR OQ -100F 0.5HR 500F 2+2HR	B	3.00	R.T.	---	169.0	3.5 PCT NACL	1.500	0.480	CANT*	----	200.00	105.00*			----	1969	76136
2000F 1HR OQ -100F 0.5HR 700F 2+2 HR	B	3.00	R.T.	---	180.0	3.5 PCT NACL	1.500	0.480	CANT*	----	160.00	50.00			----	1969	76136
2000F 1HR OQ -100F 0.5HR 800F 2+2 HR	B	3.00	R.T.	---	207.0	3.5 PCT NACL	1.500	0.480	CANT*	----	70.00	40.00			----	1969	76136
2000F 1HR OQ -100F 0.5HR 900F 2+2 HR	B	3.00	R.T.	---	214.0	3.5 PCT NACL	1.500	0.480	CANT*	----	56.00	35.00			----	1969	76136
2000F 1HR OQ -100F 0.5HR 1100F 2+2 HR	B	3.00	R.T.	---	221.0	3.5 PCT NACL	1.500	0.480	CANT*	----	43.00	10.00			----	1969	76136

*Note - Data which do not meet minimum specimen thickness requirements of 2.5(KISCC/TYS) squared.

+Note - (*=SG) in design column implies that Asterisked specimens are side-grooved (SG).

Figure 1.16. Format for Stress Corrosion Cracking Threshold Data; Example Taken from Table 3.2.3.2, AFC 77 Stainless Steel Alloy.

Greater than (>) and less than (<) signs before the K_{Iscc} value indicates that the actual value is either greater than or less than the value stated, respectively. Data containing these signs were considered to be informative since little data exists and so were included; however, the data were not considered definitive and so were excluded from mean and standard deviation values.

CHAPTER 2

METHODS OF CALCULATIONS

CHAPTER 2

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METHODS OF CALCULATIONS

2.0 OVERVIEW

This chapter briefly describes the methods used to calculate the damage tolerant properties reported in the Handbook. The properties reported for characterizing fracture resistance include:

- K_{Ic}, the plane-strain fracture toughness
- K_C, the critical plane-stress (or transitional) fracture toughness
- K_{App}, the apparent plane-stress fracture toughness
- K_R, the tearing resistance

and, the properties reported for characterizing subcritical crack growth resistance include:

- $\frac{da}{dN}$, the constant amplitude fatigue crack growth rate
- $\frac{da}{dt}$, the sustained-load crack growth rate
- K_{Iscc}, the threshold for sustained load cracking

Sections 2.1 through 2.7 describe these properties and the specific methods of calculations utilized to convert laboratory (specimen) data into the properties reported.

2.0.1 Data Review and Acceptance Criteria

Newly acquired data and data available from previous revisions of the Handbook were systematically reviewed and analyzed. The principal data acceptance criteria were based on criteria established by the American Society for Testing and Materials (ASTM); these criteria are embedded within ASTM standards for test methods and practices. Table 2.1 lists those standards used to provide criteria for plane-strain fracture toughness (K_{Ic}) data, for R-curve data, and for fatigue crack growth rate (da/dN) data. ASTM literature

TABLE 2.1

APPLICABLE LIST OF STANDARDS FOUND IN PART 10, THE ASTM BOOK OF STANDARDS (1982)

ASTM STD	TITLE
E616-81	Standard Terminology Relating to Fracture Testing
E399-81	Test Method for Plane-Strain Fracture Toughness of Metallic Materials
E561-81	Practice for R-Curve Determination
E647-81	Test Method for Constant-Load-Amplitude Fatigue Crack Growth Rates Above 10^{-8} m/Cycle

was also reviewed to establish criteria based on typical engineering practice for the other types of data collected and reported.

Newly acquired data was substantially easier to process than the data available from previous revisions since the data suppliers screened their data according to ASTM criteria before it was released to the data processing organization (UDRI). Also, when questions concerning newly acquired data developed, the suppliers could be called and the questions resolved.

For the case of previously available Handbook data, it was necessary to systematically review the data employing a multi-step process. First, the computer compatible input data (computer cards) supplied to UDRI by MCIC were compared to the data reported in the 1975 revision of the Handbook. When discrepancies between variables (such as stress ratio, frequency, specimen direction, etc) were found, they were marked with an asterisk on the card image data so that the differences could be investigated further. One means of settling the discrepancy was through use of the second step in the process whereby the data were compared to the original reference. Since the data on the computer cards listed the specimen identification number, the original data was normally found with relative ease and comparisons made. Every attempt was made to consult the original references and verify the accuracy of these available data. As with newly acquired data, available data were also reviewed relative to applicable ASTM criteria prior to being identified as candidate data for the 1983 revision.

The final step in the review process was the determination of whether the data were a "true" representation of the behavior they described. This step was implemented for both newly acquired data as well as for the available Handbook data in order to eliminate suspect data through subjective criteria. Unfortunately, it is not possible to detail the subjective criteria that were employed to exclude questionable data. It can be stated that the principal mode of operation here was by way of comparison between behaviors that were expected to be somewhat similar.

2.0.2 Fracture Mechanics Basis

The damage tolerant data reported in this Handbook utilize the technology of linear elastic fracture mechanics. This technology is widely applied throughout the aerospace industry to relate structural calculations for cracked structures to material behavior in the presence of cracks. In essence, fracture mechanics provides a structural parameter, the stress-intensity factor (symbol K) which characterizes the magnitude of stresses and strains in the crack tip region of essentially elastic structures. It was postulated that the stress-intensity factor represents a similitude parameter that describes crack tip behavior under various loading conditions (monotonically increasing load, fatigue loading, etc.); the hypothesis has been verified for a wide number of materials, loading conditions, and failure type mechanisms. For a more thorough review of linear elastic fracture mechanics and its applications to the aerospace industry, see AFWAL-TR-82-3073, USAF Damage Tolerant Design Handbook: Guidelines for the Analysis and Design of Damage Tolerant Aircraft Structures.

Currently, there are developments that are extending the technology of fracture mechanics to aid in the solution of crack problems for which the assumptions of linear elastic fracture mechanics are invalid. This technology is referred to as nonlinear fracture mechanics and its similitude parameter is the J-integral (J), or alternately the crack tip opening displacement (δ). To date, nonlinear fracture mechanics has been successfully utilized to characterize tearing type fractures and fractures occurring in the presence of large-scale yielding. Some evidence has been presented suggesting that J may provide a similitude parameter for non-monotonically increasing type loadings, i.e., for fatigue loadings; but, questions still exist here. It is expected that subsequent revisions of this Handbook will include nonlinear fracture mechanics type data such as J_{IC}, a plane-strain fracture toughness property, and J_R-curves, (tearing resistance curves).

2.0.3 Test Specimen Geometries

As described above, the stress-intensity factor provides a parameter that can be used to establish similitude between two cracked structures. This means that if the stress-intensity factor in structure no. 1 equals the stress-intensity factor in structure no. 2 and if other conditions (loading, material, environment, etc) are the same, then the cracks in both structures will behave the same way. This concept provides the justification for conducting material behavior studies on small laboratory test specimens (coupons) which contain cracks. If the resistance to cracking in the laboratory can be optimized by a choice of material, then improved resistance can also be obtained for structural hardware (given that the material can be fabricated into the hardware without processing degradation taking place).

The types of test specimen geometries that have been employed to generate damage tolerance (fracture mechanics) type data for this Handbook are summarized in Table 2.2. Table 2.2 also guides the reader to individual figures (Figures 2.1 through 2.14) which describe the geometries associated with individual specimen names and symbols.

To relate the crack type data collected in a cracked test specimen to other cracked structures, it is necessary to have a description of the stress-intensity factor (K) as a function of crack length (a) for the test specimen geometry. Over the last fifteen years, a great deal of attention has been given to generating accurate stress-intensity factor equations for laboratory test specimen geometries, due to their importance to standard methods of test and to reporting data. The stress-intensity factor equations are typically presented in either of the following two forms:

$$K = \sigma\sqrt{\pi a}\cdot\beta$$

where σ = remote stress (load ÷ area) (2.1)

a = crack length measure

β = function of crack length and global geometry or

$$K = \frac{P}{BW^{1/2}} \quad Y \tag{2.2}$$

where P = load

B = thickness of specimen

W = width of specimen

Y = function of crack length (a) and global geometry

Equation 2.1 is used when the loading is applied remotely from the crack, whereas Equation 2.2 is more typically used for point loading or localized loading conditions. One should note that K is a linear function of loading (σ in Equation 2.1 and P in Equation 2.2) and that the loading and geometric components of the equations are independent of each other. Thus, if one wishes to describe a stress-intensity factor relationship for a given geometry, they might formulate the equations in the following forms:

$$\frac{K}{\sigma} = \sqrt{\pi a} \cdot \beta \tag{2.3}$$

or

$$\frac{K}{\dfrac{P}{BW^{1/2}}} = Y \tag{2.4}$$

Equations 2.3 and 2.4 are referred to as stress-intensity factor coefficients; the right hand side of these equations only describes the effect of the crack in the given geometry.

Table 2.3 provides a listing of stress-intensity factor coefficients which were used to generate data for this Handbook. Each equation is given a stress-intensity factor equation number, e.g. SIF.7 refers to the stress-intensity factor coefficient for the WOL (Wedge Opening Load) specimen geometry illustrated in Figure 2.6. Also note that Table 2.3 has a remarks section which describes the conditions under which individual equations were used.

TABLE 2.2

CORRELATION LISTING OF TEST SPECIMEN SYMBOL, TEST SPECIMEN GEOMETRY, AND REFERENCE FIGURE NUMBER

SYMBOL	TEST SPECIMEN	GEOMETRY DESCRIBED IN FIGURE NUMBER
CCP	Center Crack Panel	2.1
CT	Compact (Tension)	2.2
NB	Three Point Notched Bend	2.3
4-NB	Four Point Notched Bend	2.4
CANT	Cantilever Beam	2.5
WOL	Wedge Opening Load	2.6
BWOL	Bolt Loaded WOL	2.7
SENT	Single Edge Notch Tension	2.8
PTSC	Part-Through Surface Crack	2.9
KB-BAR	K_B BAR	2.10
DCB	Double Cantilever Beam	2.11
BDCB	Bolt Loaded DCB	2.12
TDCB	Tapered Double Cantilever Beam	2.13
CNT	Center Notch Tension	2.14

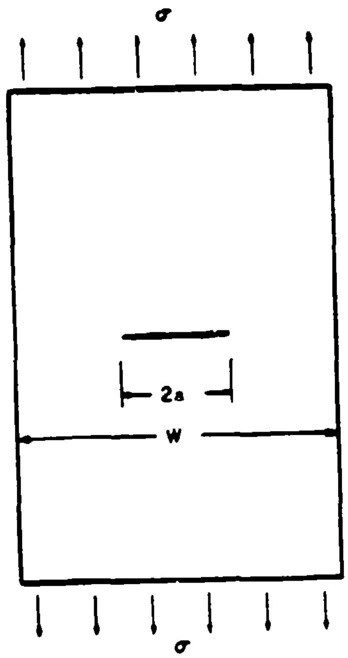


Figure 2.1. Center Cracked Panel (CCP) Specimen.

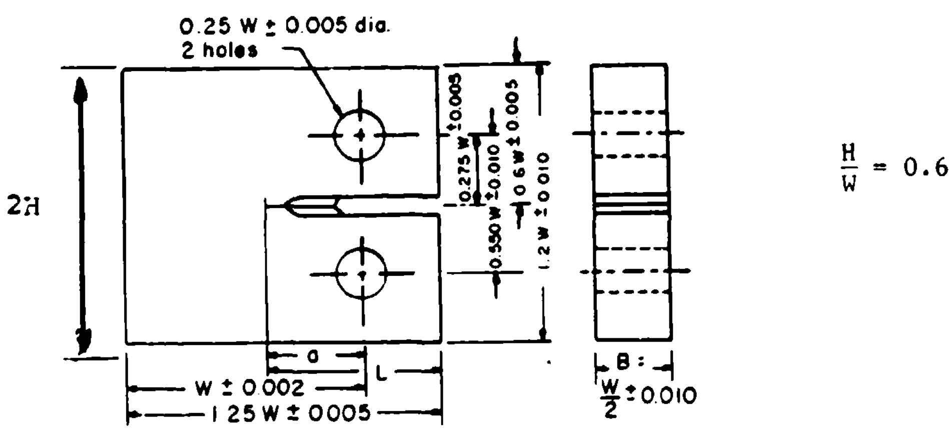


Figure 2.2. Compact Tension (CT) Specimen.

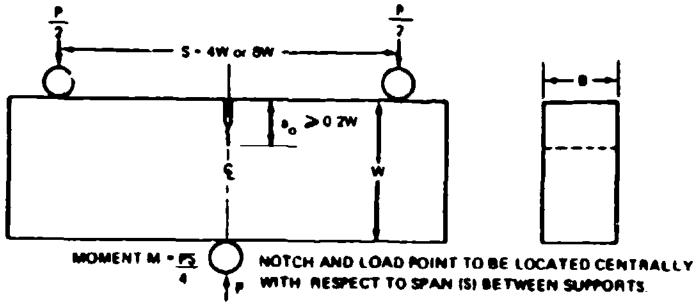


Figure 2.3. Three Point Notched Bend (NB) Specimen.

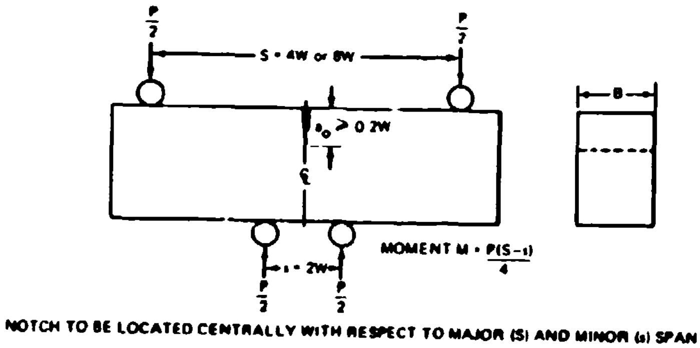


Figure 2.4. Four Point Notched Bend (4-NB) Specimen.

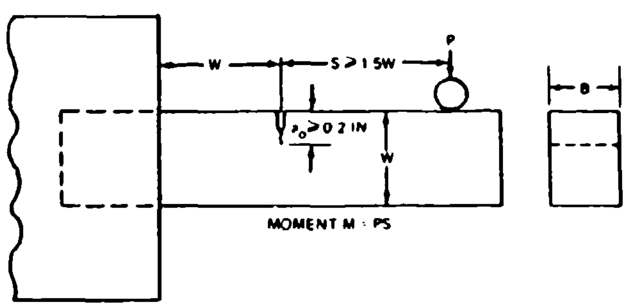


Figure 2.5. Cantilever Beam (CANT) Specimen.

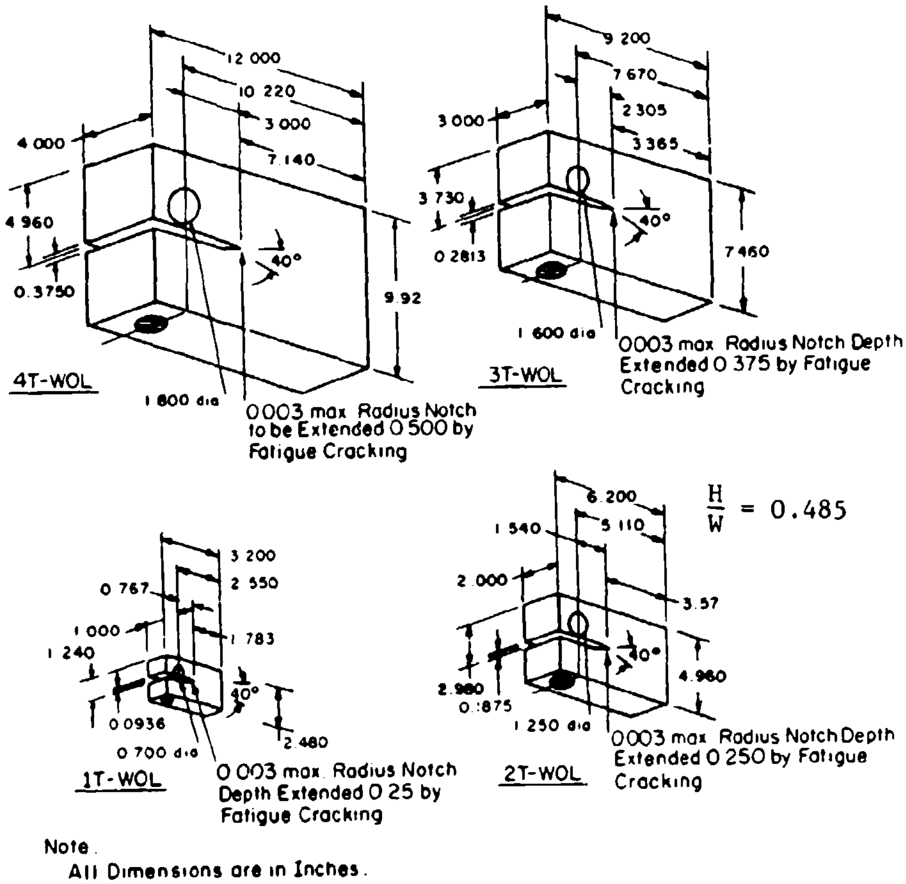


Figure 2.6. Dimensions of Several T Type Wedge Opening Load (WOL) Specimens.

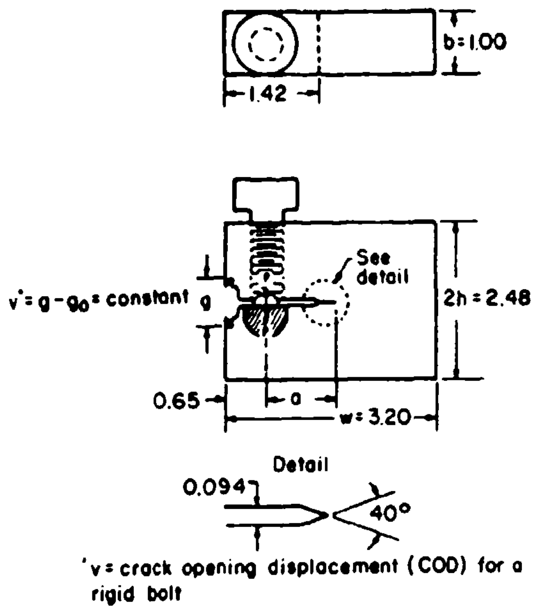


Figure 2.7 Modified 1-T WOL (BWOL) Specimen Used to Determine K_{Iscc} by Bolt Loading.

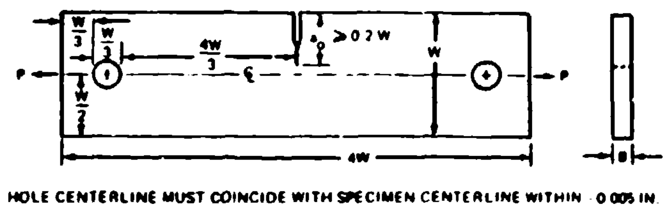


Figure 2.8. Single Edge Notch Tensile (SENT) Specimen.

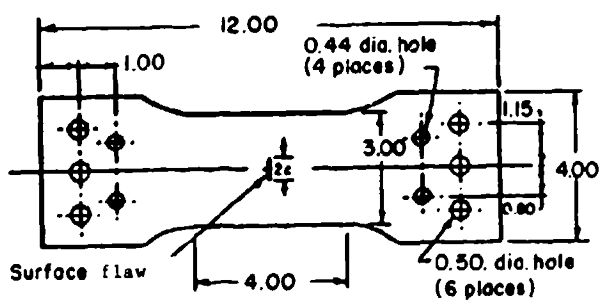


Figure 2.9. Typical Design for Part-Through-Surface-Crack (PTSC) Specimen.

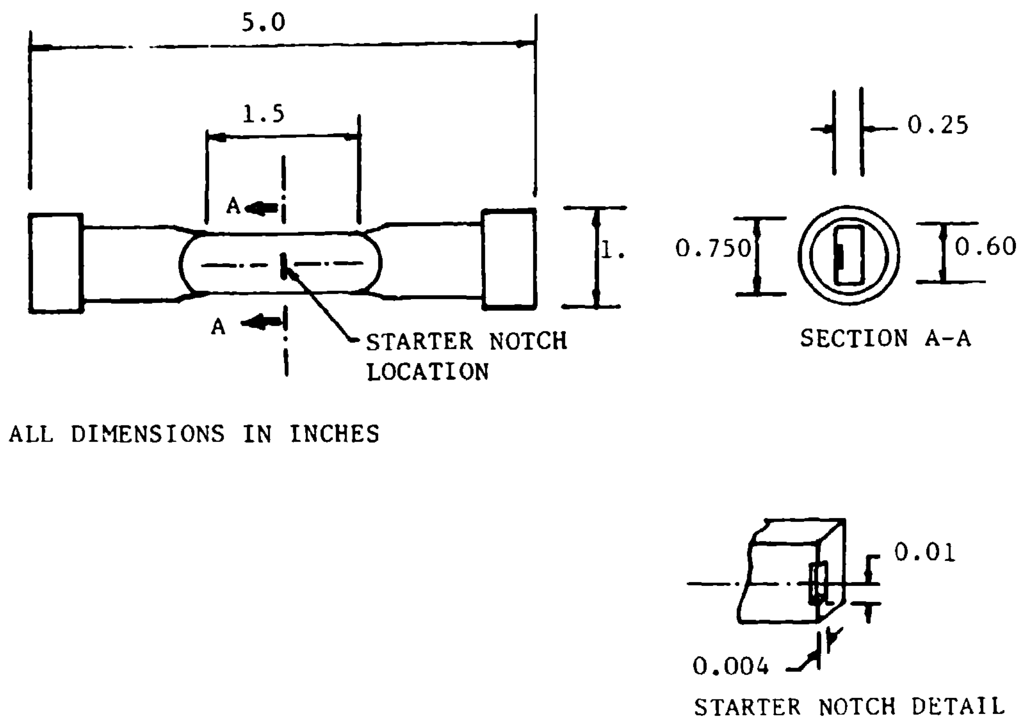


Figure 2.10. K_B Bar (KB-BAR) Specimen.

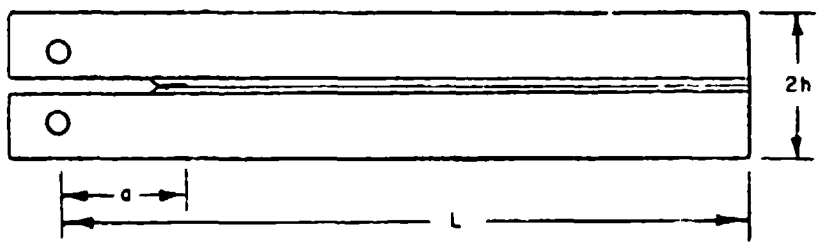


Figure 2.11. Double Cantilever Beam (DCB) Specimen with Side Grooves.

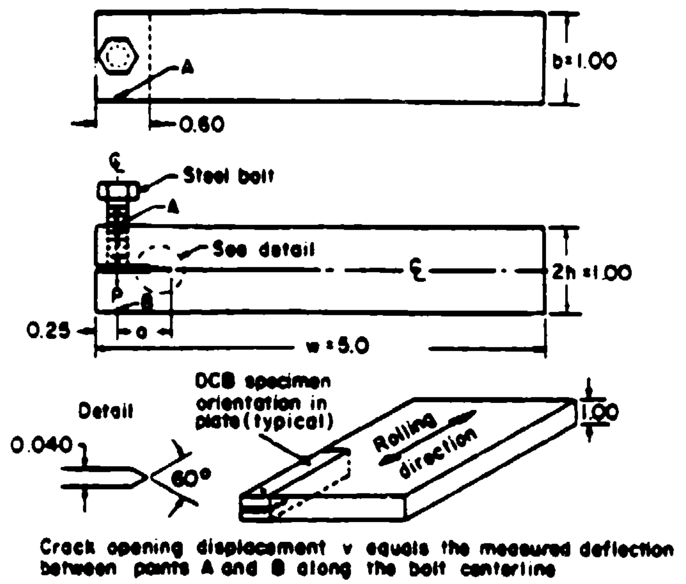
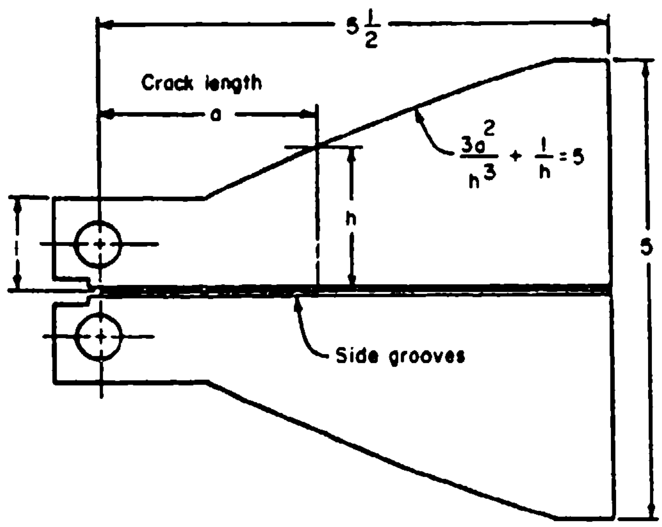


Figure 2.12. Bolt-Loaded Double Cantilever Beam (BDCB) Specimen.



$$\frac{3a^2}{h^3} + \frac{1}{h} = 5$$

Figure 2.13. Typical Tapered Double Cantilever Beam (TDCB) Specimen with Side Grooves.

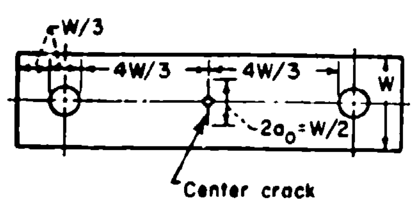


Figure 2.14. Center-Notch Tensile (CNT) Specimen.

TABLE 2.3

STRESS-INTENSITY FACTOR COEFFICIENTS FOR TEST SPECIMEN GEOMETRIES USED TO GENERATE DAMAGE TOLERANT DATA

TEST SPECIMEN GEOMETRY	STRESS-INTENSITY FACTOR COEFFICIENT	EQUATION NUMBER	REMARKS
CCP (See Figure 2.1)	$\frac{K}{\sigma} = \sqrt{\pi a} \cdot (\mathrm{Sec}\ \pi\alpha)^{1/2}$ $\alpha = a/W$	SIF.1	This equation was used whenever K was calculated for the CCP Specimen
CT (See Figure 2.2)	$\frac{K}{\frac{P}{BW^{1/2}}} = \frac{(2+\alpha)}{(1-\alpha)^{3/2}} \cdot [0.866 + 4.64\alpha - 13.32\alpha^2 + 14.72\alpha^3 - 5.6\alpha^4]$ $\alpha = a/W$ $\frac{H}{W} = 0.600$	SIF.2	This equation was used whenever K was calculated for data generated with the CT specimen, the equation is valid for a/W > 0.2
CT (See Figure 2.2)	$\frac{K}{\frac{P}{BW^{1/2}}} = \alpha^{1/2} [29.6 - 185.5\alpha + 655.7\alpha^2 - 1017\alpha^3 + 638.9\alpha^4]$ $\alpha = a/W$ $\frac{H}{W} = 0.600$	SIF.3	This equation was used to calculate K for data incorporated into pre-1983 revisions. Reprocessed a vs N data utilized equation SIF.2
NB (3 PT BEND) (See Figure 2.3)	$\frac{K}{\frac{P}{BW^{1/2}}} = S\alpha^{1/2} [2.9 - 4.6\alpha + 21.8\alpha^2 - 37.6\alpha^3 + 38.7\alpha^4]$ $\alpha = a/W$ S = span length	SIF.4	No new data were processed from NB specimens. Previous data incorporated into the handbook utilized this equation.

TABLE 2.3 (Continued)

STRESS-INTENSITY FACTOR COEFFICIENTS FOR TEST SPECIMEN GEOMETRIES USED TO GENERATE DAMAGE TOLERANT DATA

TEST SPECIMEN GEOMETRY	STRESS-INTENSITY FACTOR COEFFICIENT	EQUATION NUMBER	REMARKS
4-NB (4 PT BEND) (See Figure 2.4)	$\frac{K}{\frac{6M}{BW^{3/2}}} = \alpha^{1/2}[1.99 - 2.47\alpha + 12.97\alpha^2 - 23.17\alpha^3 + 24.80\alpha^4]$ $\alpha = a/W$ $M = P(S-s)/4$, moment S,s = major and minor span	SIF.5	No new data were processed from 4-NB specimens. Previous data incorporated into the handbook utilized this equation. s/W must be greater than 2.
CANT (See Figure 2.5)	$\frac{K}{\frac{M}{BW^{3/2}}} = 4.12\,[(1-\alpha)^{1/3}-(1-\alpha)^3]^{1/2}$ $\alpha = a/W$ $M = P{*}S$, moment	SIF.6	No new data were processed from CANT specimens. Previous data incorporated into the handbook utilized this equation.
WOL (See Figure 2.6)	$\frac{K}{\frac{P}{BW^{1/2}}} = \frac{(2+\alpha)}{(1-\alpha)^{3/2}}\,[0.8072 + 8.858\alpha - 30.23\alpha^2 + 41.088\alpha^3 - 24.15\alpha^4 + 4.951\alpha^5]$ $\alpha = a/W$ $\frac{H}{W} = 0.485$	SIF.7	All new a vs N data from WOL specimens with $\frac{H}{W} = 0.485$ were processed using this equation
BWOL (See Figure 2.7)	$\frac{K}{\frac{P}{BW^{1/2}}} = \alpha^{1/2}\,[30.96 - 195.8\alpha + 730.6\alpha^2 - 1186.3\alpha^3 + 754.6\alpha^4]$ $\alpha = a/W$ $B = \sqrt{B.B_N}$ B_N = Net Thickness at Side Groove	SIF.8	Equation was used to calculate stress-intensity factors for both WOL and BWOL in pre-1983 revisions. No new BWOL raw data were received for processing.

TABLE 2.3 (Continued)

[illegible]-INTENSITY FACTOR COEFFICIENTS FOR TEST SPECIMEN GEOMETRIES USED TO GENERATE DAMAGE TOLERANT DATA

[illegible]	STRESS-INTENSITY FACTOR COEFFICIENT	EQUATION NUMBER	REMARKS
SENT (See Figure 2.8)	$\frac{K}{\frac{P}{BW^{1/2}}} = \alpha^{1/2}\,[1.99 - 0.4124\alpha + 18.70\alpha^2 - 38.48\alpha^3 + 53.85\alpha^4]$ $\alpha = a/W$	SIF.9	New da/dN data processed from SENT specimens utilized this equation. Previous data incorporated into handbook also utilized this equation.
PTSC (See Figure 2.9)	$\frac{K}{\sigma} = 1.1\,[\frac{\pi a}{Q}]^{1/2}$ where for $(a/c) \leq 1$ $Q = 1.0 + 1.464\,(\frac{a}{c})^{1.65}$ a = depth $2c$ = surface length	SIF.10	Equation was used to reduce a vs N data for PTSC specimens. Previous data incorporated into handbook also used a similar version of this equation.
KB BAR (See Figure 2.10)	Equation Used by Aircraft Engine Group of General Electric Company. Closely Approximates Newman and Raju Solution Presented in AFWAL-TR-82-3073	SIF.11	Used for da/dN testing. Data received was directly incorporated into the 1983 revision for this geometry.
DCB (See Figure 2.11)	$\frac{K}{\frac{P}{BW^{1/2}}} = \alpha^{1/2}\,Y$ $\alpha = a/W$ $Y = Y\,(a/W,\ H/W)$ $B = \sqrt{B.B_N}$ B_N = Net Thickness at Side Groove	SIF.12	Specimen used for generating da/dN, da/dt, and K_{Iscc} data in pre-1983 revisions. The function Y was specified for given H/W. Data collected with DCB specimens were not reprocessed and no new data were received.

TABLE 2.3 (Concluded)

STRESS-INTENSITY FACTOR COEFFICIENTS FOR TEST SPECIMEN GEOMETRIES USED TO GENERATE DAMAGE TOLERANT DATA

TEST SPECIMEN GEOMETRY	STRESS-INTENSITY FACTOR COEFFICIENT	EQUATION NUMBER	REMARKS
B-DCB (See Figure 2.12)	$K = \frac{vEh\,[3h\,(a+0.6h)^2 + h^3]^{1/2}}{4\,[(a+0.6h)^3 + h^2 a]}$	SIF.13	Used for K_{Iscc} testing. [illegible] previously calculated using this equation were directly incorporated into the 1983 revision.
TDCB (See Figure 2.13)	$\frac{K}{P} = \left[\frac{E\,(\frac{dc}{da})}{2\,B_N\,(1-\nu^2)}\right]^{1/2}$ where $\frac{dc}{da} = [3.65 - 0.925\,(0.8 - \frac{B_N}{B})] \times 10^{-6}$/lb; B_N = Net Thickness at Side Groove; E = Elastic Modulus; ν = Poisson's Ratio	SIF.14	Equation used by McDonnell Aircraft Company to reduce data referenced in Ref. no. 84360 (Equation is based on Plane-Strain Assumptions). Data were incorporated without change.
TDCB (See Figure 2.13)	$\frac{K}{P} = \left[\frac{E}{2B}\,\frac{dc}{da}\right]^{1/2}$ where $\frac{dc}{da}$ = constant; E = Elastic Modulus; $B = \sqrt{B \cdot B_N}$; B_N = Net Thickness at Side Groove	SIF.15	No new data were processed from TDCB specimens. Previous data incorporated into the handbook utilized this equation.
CNT (See Figure 2.14)	$\frac{K}{\sigma\sqrt{\pi a}} = [1 - 0.2\alpha + 4\alpha^2]$; $\alpha = a/W$; SIF.16 is comparable to SIF.1 FOR $0 < \alpha < 0.3$	SIF.16	No new data were processed from CNT specimens. Previous data (K_{Iscc}) for sheet materials incorporated into the handbook utilized this equation.

2.1 PLANE-STRAIN FRACTURE TOUGHNESS (K_{Ic})

The plane-strain fracture toughness (K_{Ic}) property was initially established to characterize the fracture resistance of materials that exhibited rather abrupt fractures in the presence of cracks. Early observations showed that thickness had a pronounced effect on the critical levels of stress-intensity factor associated with fracture; a schematic illustrating this behavior is presented in Figure 2.15. As noted in the schematic, for thicknesses greater than the experimentally determined lower-bound, the critical stress-intensity factor level was found to be relatively constant.

The reasons for the independence of toughness with further increases in thickness were related to the amount and type of yielding which could occur at the crack tip under what has been referred to as plane-strain conditions. Because the thickness-independent toughness property was useful for comparing a large variety of metals for fracture resistance, ASTM (American Society for Testing and Materials) embarked on a standardization effort that eventually resulted in the ASTM Standard Test Method for plane-strain fracture toughness of metallic materials, i.e., in the ASTM Standard E399.

The ASTM Standard E399 is the current procedure for determining critical plane-strain stress intensity factors (K_{Ic} values) for high-strength alloys. From the method of test, "The property K_{Ic} determined by this method characterizes the resistance of a material to fracture in a neutral environment in the presence of a sharp crack under severe tensile constraint, such that the state of stress near the crack front approaches tritensile plane-strain, and the crack-tip plastic region is small compared with the crack size and specimen dimensions in the constraint direction."

Assuming that plane-strain conditions are approximated when unstable cracking occurs at the crack front during a K_{Ic} test, the critical stress intensity factor calculated from the

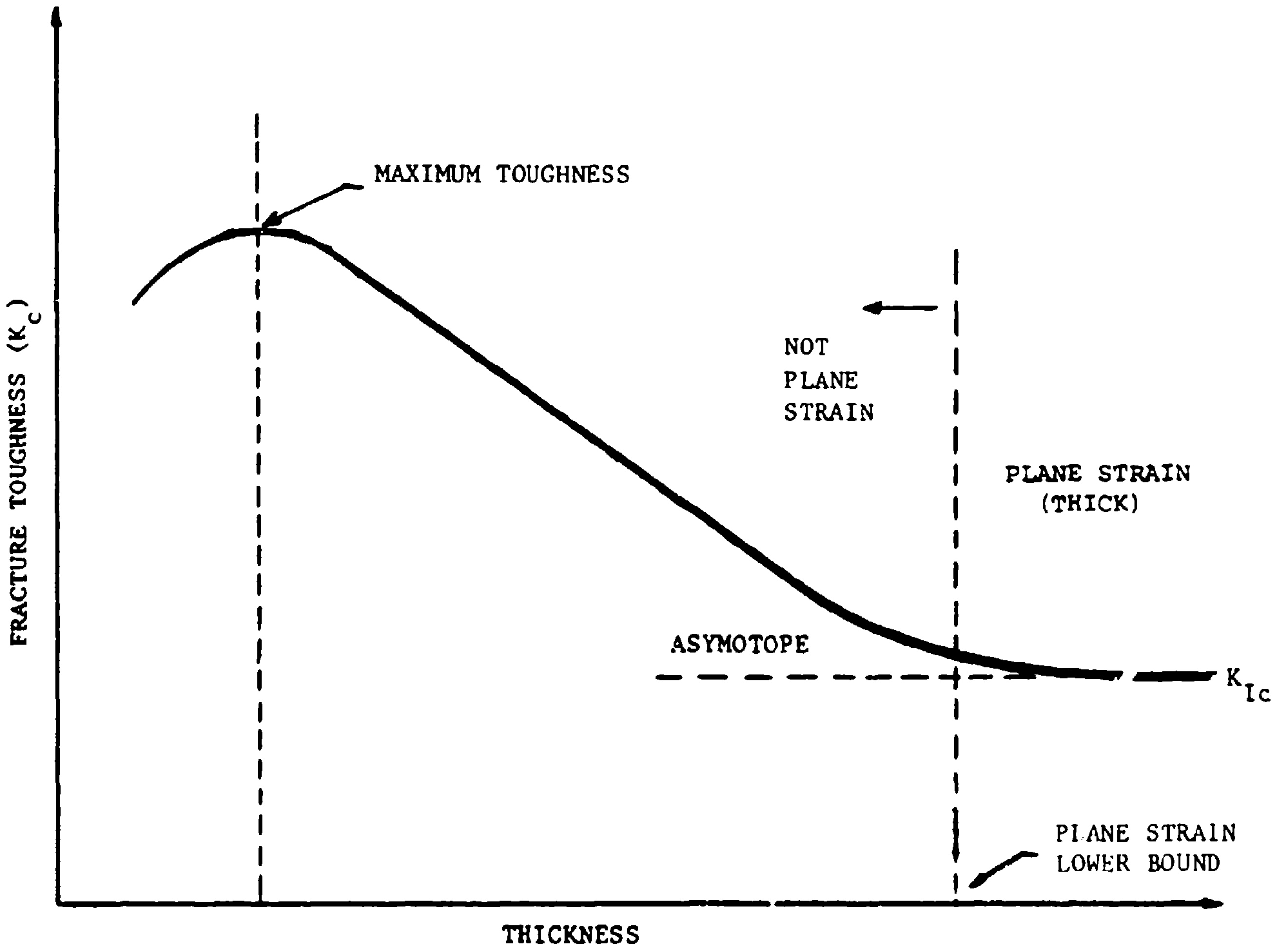


Figure 2.15. Fracture Toughness Behavior as a Function of Thickness.

test data is characteristic of the material of the specimen at the testing temperature and for the specific crack growth direction. Since the properties vary somewhat from specimen to specimen in one plate or in one heat, and from heat to heat of a given alloy type with the same heat treatment, the measured K_{Ic} values for several heats will show some degree of scattering in the data. Usually, the extent of scattering is greater than that for replicate tensile tests. For this reason, a relatively large number of data points would be required to establish minimum design values for any of the fracture mechanics parameters. To minimize the scatter in data, maximum effort is required in controlling the processing, preparation, and testing of each specimen. These precautions are discussed in the Method of Test (ASTM E399).

The ASTM E399 procedure indicates that calculated K values be designated K_Q, which is a provisional value. When the validity of the results is established by the procedures designated in the Method of Test, then the K_Q value can be identified as a valid K_{Ic} value. Some of the primary criteria for judging the validity of K_{Ic} values are based on crack length and specimen thickness conditions. The test data must demonstrate that sufficient constraint was available to justify the plane-strain assumptions. The other requirements for validity of the K_{Ic} values involve measurements of the length of the fatigue crack, contour of the crack front, out-of-plane deviation of the fatigue crack, maximum stress intensity resulting from the fatigue cracking load, and details of the load-deformation curves.

All newly acquired plane-strain fracture toughness (K_{Ic}) data incorporated in the 1983 Handbook revision were generated using the ASTM Standard E399. These newly acquired data were generated using the CT specimen geometry (See Figure 2.2). All suppliers of new K_{Ic} data provided only E399 validated K_{Ic} data in a reduced format which facilitated direct incorporation into the Handbook. Data incorporated in earlier revisions for the most part utilized ASTM Standard E399 or the predecessor tentative method for plane-strain fracture toughness testing; and after review, these data were also included into the 1983 revision. In some instances, nonstandard specimens were used for generating critical plane-strain stress-intensity factors in the earlier revisions. Some of these data were incorporated in the 1983 revision on the basis that a reasonable procedure was used and that corresponding data from other sources were limited for the alloys concerned. All data were checked against the criteria for specimen thickness (B) and crack length (a), i.e., B, a $\geq$ 2.5 $(K_{Ic}/\sigma_{ys})^2$ where σ_{ys} is the tensile yield strength.

2.2 CRITICAL PLANE STRESS FRACTURE TOUGHNESS

2.2.1 Plane Stress and Transitional Fracture Toughness

The critical level of the stress-intensity factor for non-plane-strain conditions is normally described with the symbol K_c, see Figure 2.15, and is referred to as the plane-stress or transitional fracture toughness. Generally, plane-stress fracture-toughness testing is representative only of through-the-thickness cracks in relatively thin section materials. For a given material thickness, this configuration has the least lateral restraint on the crack front and, hence, approaches most closely the ideal plane-stress stress state conditions at the crack tip. As the material thickness increases, transitional stress state behavior is introduced by the restraint of additional material along the crack front. In contrast to that in plane-strain fracture-toughness testing, the characterization of fracture toughness in the plane-stress and transitional-stress states is complicated by the degree to which crack tip plasticity and associated stable crack extension are manifested prior to fracture. Although an explicit test method for this mode of toughness has not been formulated, there are a number of useful experimental guidelines which have been developed.

As background information, the nature of plane-stress and transitional fracture toughness is described here in terms of its deviation from that of the plane-strain stress state. Current procedures for this mode of testing and the associated analytical formulations of toughness then are presented.

The difficulties that beset the characterization of plane stress and transitional fracture are not only of a theoretical nature, but also of a practical experimental nature. Basic questions on the nature of plasticity, crack extension, and crack instability, as well as the wide variation in experimental techniques among laboratories all contribute to variability in the resulting fracture toughness evaluations. However, in spite of these difficulties, surprisingly consistent charcterizations of fracture behavior can be obtained.

During the fracture test of a structural material in a plane-stress or transitional-stress state, stable extension of the initial fatigue precrack may occur as the load increases. This behavior is illustrated schematically in the crack growth curve of Figure 2.16. Depending on the material, stable crack extension may amount to 30 percent or more of the initial precrack length.

Once it is realized that fracture under these conditions is not an abrupt instability instantaneously associated with a small increment of crack extension, it must also be recognized that a single toughness parameter is not sufficient to characterize this complex behavior. In fact, the concept of crack growth resistance curves (see Section 2.4) is an outgrowth of these observations and best describes the material behavior. However, as a means of characterizing fracture behavior in plane-stress and transitional stress state, engineers have traditionally utilized abrupt fracture concepts, i.e., have used critical stress-intensity factor levels, to describe various events associated with the observed behavior.

2.2.2 Plane Stress and Transitional Fracture Toughness Testing

The procedures associated with testing thin-section center-cracked tension panels differ from those associated with plane-strain fracture toughness testing only in the additional emphasis and refinement that is directed to monitoring the slow, stable tear portion of the fracture process.

The general testing configuration is illustrated schematically in Figure 2.17. The specimen with an initial fatigue precrack, $2a_o$, is loaded slowly under load or stroke control. The onset and extension of crack growth under increasing load is usually monitored photographically, visually, or by means of compliance gage calibration until fracture occurs.

Although, as previously mentioned, more attention is currently being directed to monitoring the detail stress and crack length dimensions during the slow tear process, the preponderance

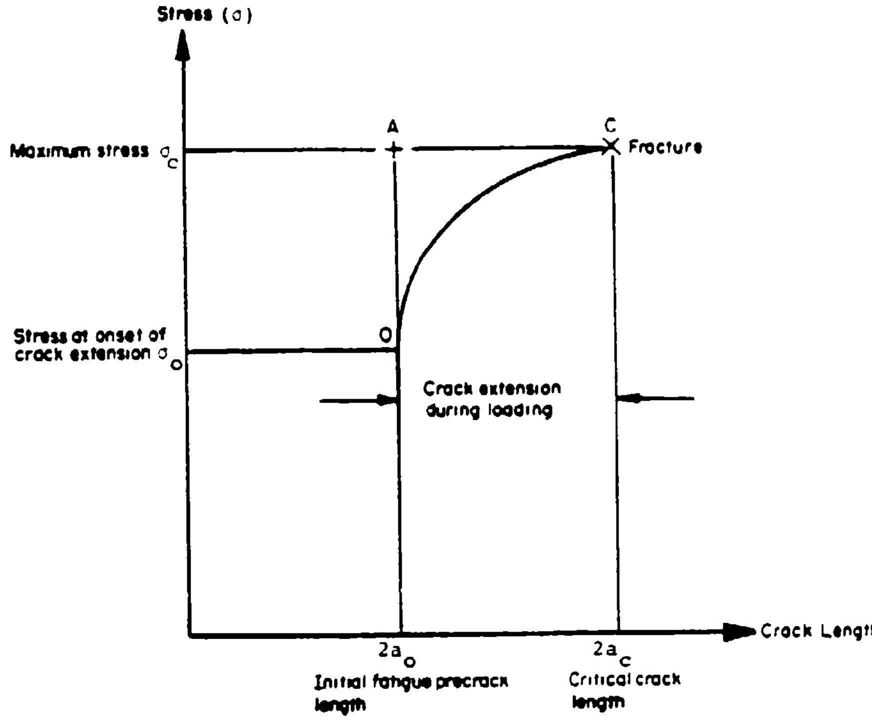


Figure 2.16. Typical Crack Growth Behavior in Plane Stress and Transitional Stress States.

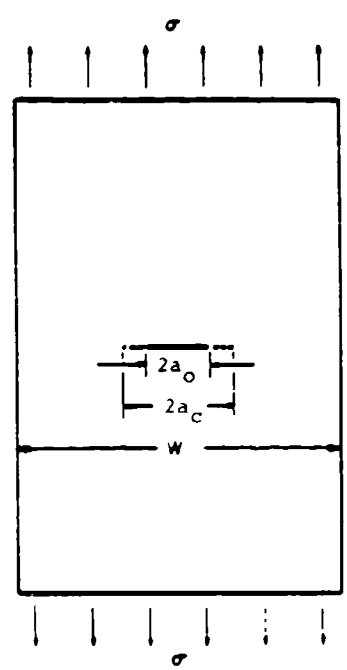


Figure 2.17. Thin-Section, Center-Cracked Tension Panel Configuration.

of available test data is limited to a record of σ_o, $2a_o$, σ_c, and $2a_c$, as indicated in Figure 2.16. It is this information which is compiled and analyzed in this Handbook.

2.2.3 Critical Stress-Intensity Factor (K_c)

There are two clearly identified points that can be noted on the crack growth resistance curve shown in Figure 2.16, i.e. points O and C which are associated with the onset of tearing and critical conditions, respectively. Using a linear elastic fracture mechanics analysis, these two structural conditions can be formulated as

$$K_{ONSET} = \sigma_o \sqrt{\pi a_o} \left(\text{Sec} \frac{\pi a_o}{W} \right)^{1/2} \quad (2.5)$$

and

$$K_c = \sigma_c \sqrt{\pi a_c} \left(\text{Sec} \frac{\pi a_c}{W} \right)^{1/2} \quad (2.6)$$

using the stress-intensity factor information given in Table 2.3, i.e. Equation SIF.1. As requested by industry engineers, available test information (σ_o, $2a_o$, σ_c, $2a_c$) were reported in the plane stress and transitional fracture toughness tables along with a calculation of the critical fracture toughness level based on Equation 2.6. While stress and crack length information was sometimes available for a calculation of the onset fracture toughness (Equation 2.5), insufficient space in the table precluded reporting this toughness.

Plane stress and transitional fracture behavior absorb much more energy than plane-strain behavior due to the lack of thickness constraint on crack tip plasticity is also insufficient, and the assumptions of linear elastic fracture mechanics are violated. The in-plane geometric constraint on crack tip plasticity is required to ensure that gross plasticity is not the controlling mechanisms of fracture. Extensive study has indicated that the condition for CCP specimen instability for ductile materials is given by a net section stress criteria and not by a fracture (crack) controlled instability criteria. While the fracture toughness values for all plane strain type tests are reported, those values calculated for stress conditions where the net section stress (σ_{net} = Load/(W-2a_c) exceeds 80 percent of the tensile yield strength are marked with an asterisk. Asterisked values are not utilized in any mean or standard deviation calculations summarizing plane-stress fracture critical properties.

2.3 THE APPARENT FRACTURE TOUGHNESS

The apparent fracture toughness (K_{App}) is a plane stress and transitional fracture toughness property that is sometimes utilized as a lower bound on the critical fracture toughness. Its initial purpose was to preclude measurements of the tearing process observed during fracture tests of CCP specimens. As noted in Figures 2.17, and 2.16, the initial crack length (2a_o) extends during the loading to the critical crack length (2a_c). The two simplest measurements to make in such a fracture test are those of the initial crack length (2a_o) and critical (maximum) stress at failure (σ_c). Thus, for simplicity, a K_{App} fracture toughness calculation was made using

$$K_{App} = \sigma_c \sqrt{\pi a_o} \cdot \left(\sec \frac{\pi a_o}{W}\right)^{\frac{1}{2}} \qquad (2.7)$$

Equation 2.7 represents the stress-intensity factor corresponding to the stress and crack length condition at point "A" in Figure 2.16. It can be noted by comparing Equations 2.6 and 2.7 that K_{App} will always be less than or equal to K_c since $a_o \leq a_c$. Also, K_{App} will always be greater than or equal to K_{ONSET} since $\sigma_o \leq \sigma_c$. A comparison of the apparent fracture toughness with the onset and critical fracture toughness is shown in Figure 2.18 for a wide ce: er cracked panel (CCP) specimen.

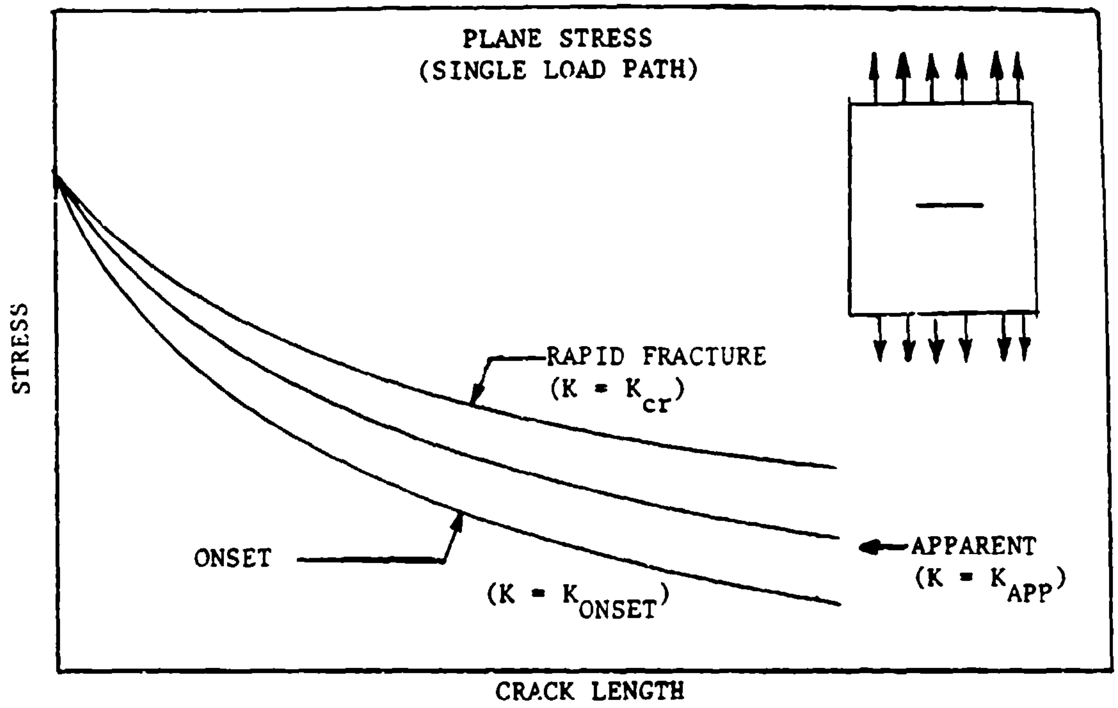


Figure 2.18. Description of the Three Fracture Toughness Criteria that are Utilized to Estimate Residual Strength Under Tearing Fracture Conditions.

When the net section stress (σ_{net} = Load/(W-2a_o)) exceeds 80 percent of the tensile yield strength, the K_{App} values are marked with an asterisk. The asterisked values are not utilized in any mean or standard deviation calculations summarizing plane-stress apparent fracture toughness properties.

2.4 R-CURVE (K_R VERSUS Δa_{eff})

The resistance curve (or R-curve) provides a complete description of the tearing fracture behavior illustrated in Figure 2.16. R-curves characterize the resistance to fracture of materials during incremental slow-stable crack extension and result from growth of the plastic zone as the crack extends. ASTM recently formalized the collection and reporting of such curves through a new standard, ASTM Standard E561, covering the standard practice for R-Curve Determination. As stated by ASTM E561: "An R-curve is a continuous record of toughness development in terms of K_R plotted against crack extension in the material as a crack is driven under continuously increased stress-intensity factor, K)."

The value of K_R (toughness) is calculated using standard stress-intensity factor equations evaluated with the instantaneous values of applied stress (σ) and crack length (a), as the crack extends. To account for the effects of plasticity, the measured crack length is enhanced with a plastic zone correction, and an effective crack length (a_{eff}) is actually used in the calculation of K_R. For example, when a CCP specimen is used to collect tearing resistance data, the K_R is calculated based on the standard stress-intensity factor equation (SIF.1) given in Table 2.3.

$$K_R = \sigma \sqrt{\pi a_{eff}} \cdot \left(\mathrm{Sec} \frac{\pi a_{eff}}{W}\right)^{\frac{1}{2}} \qquad (2.8)$$

where σ and a_{eff} are the current stress and effective crack length measurements in the test. The effective crack length for optical measurements is calculated from

$$a_{eff} = a + r_y \qquad (2.9)$$

where a is the optically measured crack length and

$$r_y = \frac{1}{2\pi} \left(\frac{K}{\sigma_{ys}} \right)^2 \qquad (2.10)$$

the plastic zone size for the current applied stress and crack length. If the crack length is automatically monitored by compliance techniques, then the effective crack length is automatically obtained using the two compliance equations presented in ASTM E561.

The K_R value calculated from Equation 2.8 can be described as a function of the increment of physical crack extension ($\Delta a = a - a_o$, a_o = initial crack length) or as suggested by ASTM 561 as a function of the increment of effective crack length ($\Delta a_{eff} = (a + r_y) - a_o$). The functions K_R versus Δa and K_R versus Δa_{eff} are referred to as R-curves (or resistance curves). Data presented in this handbook correspond to the use of the ASTM E561 definition of R-curves, i.e. K_R is presented as a function of Δa_{eff}.

One of the fundamental hypotheses behind the application of R-curves to the prediction of tearing type fractures in thin structures and in structures fabricated from ductile materials is that the R-curve (material tearing resistance) is independent of crack length for a given geometry and is independent of geometry and external loading. As long as the structure matches the monotonically increasing stress-intensity factor conditions given by the R-curve, the structure will exhibit the same tearing resistance experienced in the laboratory test specimen. The Damage Tolerant Guidelines Handbook (AFWAL-TR-82-3073) describes how the R-curve can be applied to the calculation of critical stress levels in structures.

2.5 FATIGUE CRACK GROWTH RATE

2.5.1 Fatigue Crack Growth Behavior

Under some loading conditions or environmental conditions, cracks can grow at load levels well below that required to cause fracture. As the crack continues to grow, conditions become more favorable for fracture, and eventually under the applied loading fracture does occur. This process whereby cracks are observed to grow at subcritical load levels is referred to as subcritical crack growth. Illustrated in Figure 2.19 is a fatigue crack growth curve, which shows the type of behavior typically observed during a specific subcritical crack growth process; in this case, damage is done to the material by cyclic (or fatigue) loading. This section addresses properties used to measure fatigue crack growth behavior and Sections 2.6 and 2.7 address properties used to characterize sustained load cracking in an environment.

The objective of fatigue crack growth testing is to determine the rates at which subcritical flaws propagate under cyclic loadings prior to reaching a size critical for fracture. These rates are determined from measurements of the crack extension occurring over an increment of cyclic loading. Typically, these measurements are made by monitoring crack extension optically on the specimen surface during the test. From the basic crack length and cycle count data, the fatigue-crack growth rate is determined as the quotient of the incremental crack growth divided by the incremental cycle count, i.e., $\Delta a / \Delta N$ or da/dN, the slope of the crack growth (life) curve.

The crack growth rate measures the resistance of the material to the applied loading conditions. The similitude parameter that allows data to be transferred from one cracked geometry to another is the range in stress-intensity factor (ΔK). The ΔK parameter is the difference between the maximum and minimum stress-intensity factors (K_{max} and K_{min}, respectively) for a cycle of loading. The property of fatigue crack growth rate is described throughout this Handbook as a function of ΔK.

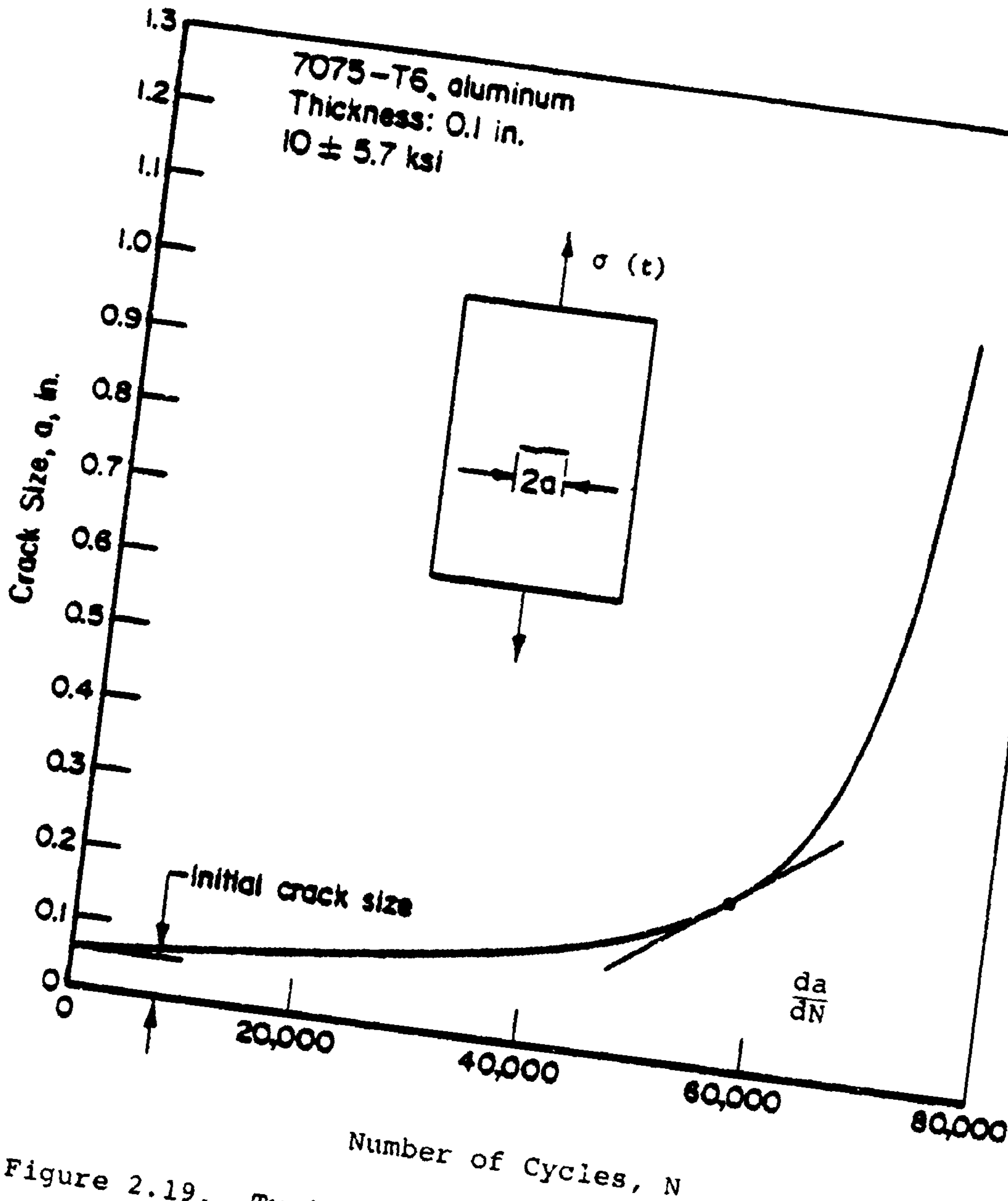


Figure 2.19. Typical Crack Growth-Life Curve.

2.5.2 Data Acceptance Criteria

In general, similar specimen configurations are used for fatigue-crack-growth testing as are used for other types of damage tolerant tests. The applied loads are reduced in magnitude and are cyclic in nature for studies of crack extension under fatigue loading conditions, and the experimental methods are extensions of the fracture testing procedures previously described. Instead of applying either a rising or sustained load to fracture the specimen, a constant amplitude cyclic load is applied to initiate and grow the crack over a significant portion of the specimen width. ASTM recently published a standard testing method, i.e., ASTM E647, which covers the collection and reporting of fatigue crack growth rate data. Most of fatigue crack growth rate data reported in the handbook were collected and reduced utilizing the guidelines and methods described by ASTM E647. For CCP and CT specimen geometries, the ASTM Standard describes 11 explicit criteria for validating the data; these criteria are summarized in Table 2.4. If data were noted to fail only one or two of the recommended criteria and provided a realistic representation of the growth rate behavior, they were incorporated into the handbook. Note is made in the handbook database of da/dN data that failed to meet the ASTM criteria listed in Table 2.4.

2.5.3 Data Reduction Procedures

Data reduction of crack growth rate from the crack length versus cycle count data was by one of two methods. The secant method was chosen when there were seven or less crack length versus cycle count measurements. A five point polynomial movable strip method was used for data with more than seven crack length versus cycle count measurements. This procedure was similar to the seven point method recommended in the ASTM standard; the five point method was chosen to provide additional data points at the extremes of growth rate range.

TABLE 2.4

CRITERIA CHECKS FOR FATIGUE CRACK GROWTH RATE DATA

Criteria No.	ASTM E647 Paragraph	Specimen Type	Criterion
1	7.1.3.1	CT	$\frac{W}{20} \leq B \leq W/4$
	7.1.3.2	CCP	$B \leq W/8$
2	Figure 1	CT	$W \geq 1.00''$
		CCP	None
3	8.6.3	CT and CCP	If $B/W \geq 0.15$ need front and back crack lengths.
4	7.1.1	CT	$a_N \geq 0.2W$
	7.1.2	CCP	None
5	8.3	CT and CCP	$a_1 \geq 0.1B$ or h, whichever is greater
6	8.6.4	CT and CCP	(Front Crack Length-Back Crack Length) $<$ 0.025 W or 0.25 B, whichever is less.
7	8.6.2.1	CT	if $0.25 \leq a/W \leq 0.60$ then $\Delta a \leq 0.02\ W$ $a/W > 0.60$ then $\Delta a \leq 0.01\ W$
	8.6.2.2	CCP	if $2a/W \leq 0.60$ then $\Delta a \leq 0.03\ W$ $2a/W > 0.60$ then $\Delta a \leq 0.02\ W$
8	8.6.2.3	CT and CCP	$\Delta a \geq 0.01''$
9	7.2.1	CT	$W - a \geq \frac{4}{\pi} (K_{max}/TYS)^2$
	7.2.2	CCP	$P_{max}/(BW)(1-2a/W) < TYS$
10	8.5.1	CT and CCP	In Test, Load Variation $0 \leq \left\lvert \frac{P_{max_{a+1}} - P_{max_a}}{P_{max_a}} \right\rvert \leq 0.10$
11	8.3.1	CT and CCP	(1) In Precracking. $\frac{P_{max_{a+1}} - P_{max_a}}{P_{max_a}} \leq 0.20$ (2) $\Delta a \geq (3/\pi)\ (K'_{max}/TYS)^2$

CT = Compact Tension
CCP = Center Cracked Panel
B = Specimen Thickness
W = Specimen Width
a = Crack Length
a_N = Notch Size
a_1 = Fatigue Precrack Length

h = Height of Specimen
Δa = Change in Crack Length
P_{max} = Maximum Load
K_{max} = Maximum Stress Intensity
TYS = Tensile Yield Strength
K'_{max} = Maximum Stress Intensity at Smaller Crack Length being Considered

It is important to note that the calculation of stress-intensity factor range (ΔK) is the difference between the maximum and minimum stress-intensity factors (K_{max} and K_{min}, respectively) as defined in ASTM Standard E647. These calculations are best expressed using equations specific to a given geometry; for illustration purposes, assume that the test specimen geometry is CCP. Then, the maximum and minimum stress-intensity factors are given by

$$K_{max} = \sigma_{max} \sqrt{\pi a} \left(\sec \frac{\pi a}{W}\right)^{1/2} \quad (2.11)$$

and

$$K_{min} = \sigma_{min} \sqrt{\pi a} \left(\sec \frac{a}{W}\right)^{1/2} \quad (2.12)$$

where σ_{max} and σ_{min} are the maximum and minimum stresses in the applied loading cycle. The range of stress-intensity factor is defined as

$$\Delta K = K_{max} - K_{min} \quad (2.13)$$

By ASTM convention, if K_{min} is compressive (negative), then $K_{min} \equiv 0$, and $\Delta K = K_{max}$.

2.5.4 Data Reporting Procedures

The presentation of fatigue-crack-propagation rate data is far more complex than the presentation of fracture toughness data (either K_{IC} or K_c) due to the large quantities of data which must be treated. Where a fracture test generally yields a single characteristic toughness value, a fatigue-crack-growth test specimen generally yields from 10 to 100 rate data points, da/dN, which must be evaluated in terms of the stress-intensity factor ΔK range.

The Damage Tolerant Design Data Handbook presents fatigue crack growth rate (da/dn) data in both graphical and tabular formats. A graphical format is used to present da/dN versus ΔK data and the mean trend of these data are tabulated. The least squares cubic spline approximation method has been selected from those available to provide a practical method for generating tables with fixed ΔK values. A least squares cubic spline approximation is an analytic method of fitting a "French" curve to a data set. The curve is constructed by fitting different cubic polynomials on non-overlapping, connecting subintervals over the range of the independent variable. In the Handbook, the independent variable will be ΔK. The boundary points of the intervals are referred to as knots and the cubic polynomials meet at the knots. The polynomials are also constrained so that the first and second derivatives are continuous at the knots. The result of this process is a smooth curve which passes through the center of the data.

Figure 2.20 is an example of a spline curve fit to a da/dN data set reported by Hudak et al. for 2219-T851 Aluminum alloy. The stress ratio used to establish the data shown was 0.3. The knots are marked in the figure by the large dots.

In general, da/dN data are well enough behaved so that a maximum of five knots was sufficient in generating the handbook tables. The actual number of knots used in fitting a curve to a set of data is a function of the number of da/dN data points and their pattern in da/dN-ΔK space.

The mean trend table for a set of da/dN data will be generated by selecting points from the spline curve that has been fit to the data. The ΔK values will be chosen such that they are approximately equally spaced in a logarithmic scale and cover the complete range of ΔK values expected. The da/dN values are obtained through the interpolation of the spline curve at the preselected ΔK values. The complete set of ΔK values are: 1.0, 1.3, 1.6, 2.0, 2.5, 3.0, 3.5, 4.0, 5.0, 6.0, 7.0, 8.0, and 9.9 as well as 10 times these values, and 130, 160, and 200.

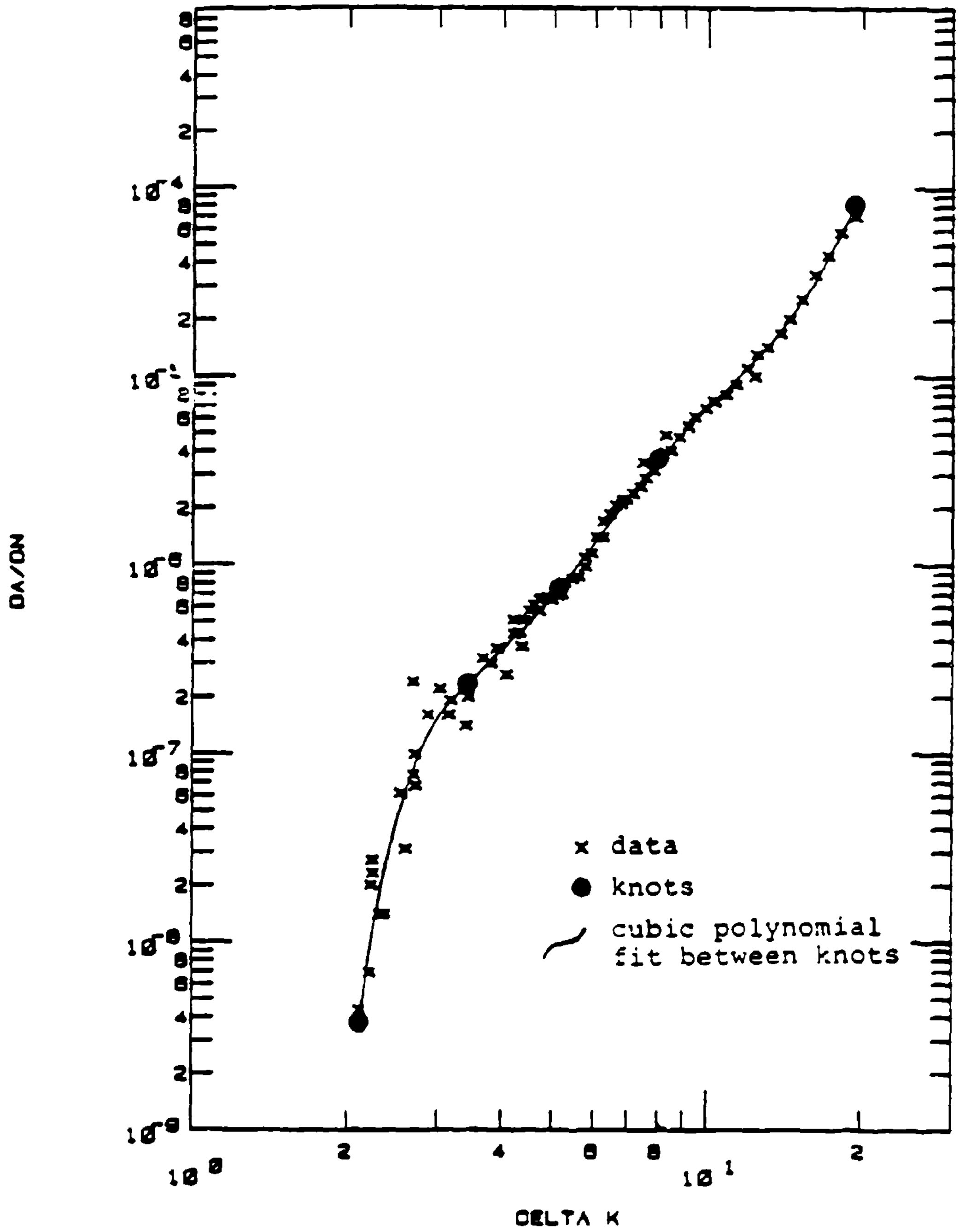


Figure 2.20. A Cubic Spline Curve Fit to FCGR Data for 2219-T851 Aluminum at a Stress Ratio of 0.3.

Because the da/dN data do not always span the complete ΔK range, the table also reports the minimum and maximum da/dN values corresponding to the recorded minimum and maximum ΔK values. The extreme pairs of (ΔK, da/dN) points correspond to the extremes of the spline curve.

Table 2.5 describes the type of table designed for the handbook. The minimum values of ΔK and da/dN as obtained from the spline curves are presented at the top of the table for each data set with a variable such as stress ratio. These tables will be directly opposite the graphical format of the da/dN data. The interpolated da/dN data are listed in the body of the table as a function of the selected ΔK values that span the data sets, and the maximum values of ΔK and da/dN as obtained from the spline curves are presented towards the bottom of the table.

The last two sections of Table 2.5 are utilized to summarize the statistics of the data fitting process. The room mean square percent error (RMSPE) is utilized to describe the statistical accuracy for the spline curve fit at each stress ratio. The RMSPE is given by:

$$\text{RMSPE} = 100 \times \sqrt{\frac{1}{n} \sum_{i=1}^{n} \left(\frac{y_i - \hat{y}_i}{\hat{y}_i}\right)^2} \tag{2.14}$$

where

y_i = observed $da/dN|_i$ at ΔK_i

$\hat{y}_i$ = da/dN interpolated from table at ΔK_i.

The RMSPE is a measure of how close the data lie to the mean trend table and has a similar interpretation to the coefficient of variation, i.e., the smaller the better. The coefficient of variation is used when all the data have the same mean and is calculated by dividing the standard deviation by the mean and multiplying by 100. For da/dN data, the mean da/dN is a function of

TABLE 2.5

EXAMPLE FATIGUE CRACK GROWTH RATE
TABLE (2219-T851 Aluminum)

ΔK (Ksi $\sqrt{in}$)		$da/dN \times 10^6$ inches/cycle				
		R1=-1.0	R2=0.1	R3=0.3	R4=0.5	R5=0.8
ΔK_{min} at: R1	1.09	0.00730				
R2	7.55		0.00336			
R3	2.11			0.00369		
R4	1.38				0.00351	
R5	1.17					0.00112
	1.3	0.0167				0.00429
	1.6	0.0351			0.0176	0.0251
	2.0	0.0676			0.0569	0.0689
	2.5	0.127		0.0451	0.0911	0.128
	3.0	0.216	0.0166	0.152	0.139	0.228
	3.5	0.336	0.0639	0.246	0.218	0.431
	4.0	0.488	0.171	0.355	0.339	0.809
	5.0	0.884	0.566	0.691	0.753	2.60
	6.0	1.37	1.14	1.30	1.46	7.83
	7.0	1.91	1.93	2.28	2.50	46.3
	8.0	2.47	3.09	3.60	3.95	
	9.0	3.08	4.78	5.14	6.07	
	10.0	3.80	7.04	6.86	9.38	
	13.0	7.16	17.0	14.4	38.4	
	16.0	13.2	36.2	30.9		
	20.0	28.3	126.0			
ΔK_{max} at: R1	20.7	32.0				
R2	24.7		887.0			
R3	19.3			81.3		
R4	15.8				146.0	
R5	7.01					47.4
root mean square percent error		2.2	80.4	8.6	6.4	6.1
life prediction ratio summary						
0.0 - 0.5						
0.5 - 0.8			1			
0.8 - 1.25		1	3	1	2	2
1.25 - 2.0						
> 2.0						

ΔK so this is taken into account when calculating the RMSPE. The RMSPE is an average percent error of the observed da/dN values from the curve established by the mean trend table.

When evaluating the mean trend da/dN description, engineers have come to rely on an evaluation of the ability of the mean trend curve to repredict the initial a versus N data and, in particular, to rely on life prediction ratio (N_p/N_A) which relates the predicted number of cycles (N_p) required to propagate a crack through a specified increment to the actual number of cycles (N_A) observed to propagate a crack through the same increment. Life prediction ratios between 0.8 and 1.25 are considered good and a life prediction ratio of 1.0 is ideal.

As a second measure of how well the mean trend curve fits the data, a summary of the life prediction ratios for the specimens used to generate the mean trend curve is included at the bottom of Table 2.5. This summary defines the number of specimens tested at each stress ratio presented whose life prediction ratios fall within the five intervals: 0.0 to 0.5, 0.5 to 0.8, 0.8 to 1.25, 1.25 to 2.0, and greater than 2.0.

The life prediction ratios summarized at the bottom of Table 2.5 are self predictions and as such will tend to be good. However, the summary is only valid for the data used to generate it and therefore should not be generalized to other situations. The life prediction ratio summary is not intended to predict how well the mean trend curve will predict crack growth for an arbitrary specimen; however, it does illustrate how well the mean trend in FCGR correlates with the lives of the cracks that were used in generating the mean trend.

In order to indicate how well the present method being used does in predicting life ratios, Table 2.6 gives a comparison on sixteen specimens of the Aluminum 2219-T851 at various stress ratios ranging from -1.0 to +0.8. The round-robin LPR resulted from an ASTM study conducted by eight organizations; the average results of the analysis are presented. From Table 2.6, it can be seen that the handbook mean trend method gives results comparable to other methods being used throughout the country.

TABLE 2.6

FULL INTERVAL COMPARISONS OF LIFE PREDICTION RATIOS

NO.	SPECIMEN	STRESS RATIO	ROUND-ROBIN LPR	DTD HB LPR
1.	CT 2219-3	.1	1.03	.9910
2.	CT 4*	.1	0.94	.9095
3.	CT 5	.1	0.91	.8876
4.	CT 6*	.1	0.91	1.0554
5.	CT 11*	.1	1.08	1.0475
6.	CT 20	.1	0.64	.6271
7.	CT 56*	.3	0.99	1.0221
8.	CT 58	.3	0.88	.8400
9.	CT 52	.5	1.07	1.0769
10.	CT 54*	.5	1.00	.9693
11.	CT 60*	.5	1.10	.8354
12.	CT 19	.8	1.71+	***
13.	CT 27*	.8	1.02	.8321
14.	CT 37*	.8	0.92	.9607
15.	CCP 9*	-1.0	0.87	.9856
16.	CCP 11	-1.0	1.14	1.1572
	Mean		0.97	0.95
	Std. Dev.		0.12	0.13

* Actual Data Were Available for Testing Life Prediction Analysis

*** Stress-Intensity Factor Out of Bounds

+ Not Included in Calculation of Mean or Std. Dev.

2.6 SUSTAINED-LOAD CRACK GROWTH RATES

2.6.1 Sustained-Load Crack Growth Rate Behavior

Sustained-load crack growth rate behavior is another type of subcritical crack growth behavior exhibited by materials which are sensitive to environmental attack. This type of subcritical crack growth behavior normally exhibits itself as a time-dependent crack growth rate process, whereby cracks are noted to extend under steady-state (sustained) static loading conditions in the presence of environments. Crack growth mechanisms controlling the sustained-load crack growth rate process include: stress-corrosion cracking, hydrogen embrittlement, liquid metal embrittlement, grain boundary separation, and creep. In practice, the time-dependent cracking process has been found to be driven by internal (residual) tensile stresses in the fabricated structure, even in the absence of externally applied loads; typically, however, the stressing condition which drives the crack is provided by external loads.

The objective of sustained-load crack growth testing is to determine the rates at which cracks propagate in pre-cracked specimens subjected to statically applied loads and prescribed environmental conditions. As with fatigue crack growth rate tests, most of the crack length measurements are made optically on the specimen surface during the test. Non-optical methods used to establish cracking include compliance and stress wave analysis techniques. From the basic crack length and time data, the sustained-load crack growth rate is determined as the quotient of the incremental crack growth divided by the incremental time, i.e., $\Delta a/\Delta t$ or da/dt, the slope of the crack growth (time to failure) curve.

The crack growth rate measures the resistance of the material to the applied loading for the specified environment. In this case, the similitude parameter that allows data to be transferred from one cracked geometry to another is the static stress-intensity factor (K_{max}). The K_{max} parameter is the stress-intensity factor evaluated for the applied loading and current crack length. The property of sustained-load crack growth rate (da/dt) is described throughout this Handbook as a function of K_{max}.

2.6.2 Data Acceptance Criteria

For the most part, the testing methodology for da/dt properties follows that utilized to obtain da/dN properties. There are, however, no current ASTM standards that specifically cover the collection of da/dt data. Sustained-load data have been obtained with a variety of specimens including double cantilever beams (DCB), tapered double cantilever beams (TDCB), compact tension (CT) specimens, cantilever beams (CANT), single-edge-notch tensile (SENT) specimens, part-through-surface-crack (PTSC) specimens, and center-cracked panel (CCP) specimens.

One validity criterion that is sometimes applied to da/dt data is that the thickness dimension and crack length must be greater than $2.5\,(K_{Ic}/\sigma_{ys})^2$. No da/dt data were excluded from the 1983 revision, however, based on this criteria due to the scarcity of da/dt data. The reader will find K_{Ic}, σ_{ys} and thickness reported with da/dt data whenever these were available.

Readers should note that sustained load crack growth rate data in aluminum alloys in planes other than those parallel to the surface of rolled plates are questionable because of the localized corrosion that occurs on the planes even though the initial notch and crack orientation are normal to these planes.

2.6.3 Data Reduction Procedures

Data reduction of sustained-load crack growth rates was accomplished using the secant method applied to crack length (a) measurements recorded as a function of time (t). These calculations and those of static stress-intensity factor were provided to the data processing organization for reformatting.

2.6.4 Data Reporting Procedures

The data reporting procedures for sustained-load cracking data are similar to those discussed in subsection 2.5.4 for fatigue crack growth rates. The major difference between the two subcritical cracking rate reporting procedures is that da/dt vs K_{max} describes the sustained-load behavior whereas da/dN vs ΔK describes the fatigue behavior. The reader might also note that no a vs t were available to compare with the integrated crack growth mean trend data and therefore no life prediction ratios were presented.

2.7 THRESHOLD STRESS INTENSITY (K_{ISCC})

2.7.1 The Threshold

In many environments, materials exhibit a condition whereby cracks are not observed to grow if the static stress intensity factor is below a critical level, designated K_{Iscc}. This property is specific for a given material in a given environment within a specified time period. In high-strength materials, K_{Iscc} may be only a small fraction of the plane-strain fracture-toughness value (K_{Ic}) of the material. In lower strength tougher materials where plane-strain conditions still prevail, K_{Iscc} may approach or equal K_{Ic}, if the environment has little or no effect on the stress intensity required to propagate a crack.

K_{Iscc} data have been obtained with a variety of specimens including: Cantilever beam (CANT), 3-point loaded bend beam (ND), 4-point loaded bend beam (4-NB), Single-edge-notch tensile (SENT), Center-cracked tensile (CNT), Part-through surface-crack (PTSC), Compact tension (CT), Bolt-loaded WOL (BWOL), Double cantilever beam (DCB), and Tapered or contoured double cantilever beam (TDCB). All specimens are notched and precracked by fatigue, and many specimens are side grooved (SG) to ensure that the crack propagates in one plane perpendicular to the applied tensile loading and also to minimize the contribution of shear lips at the edges of the crack.

The types of specimens for determining K_{Iscc} fall into two broad categories: those that are loaded by weights or tensile machines (see Figure 2.21) and those that are self-loaded as by bolts. The former require bulky setups to accommodate lever arms, weights, and tensile machines while the latter are compact and portable. Thus the environment is applied to the externally loaded specimens usually in the form of a small container sealed onto the specimen, while the self-loaded specimen may be completely immersed in the environment.

Under dead-weight loading conditions, the usual practice is to run a number of specimens at various stress intensities less than K_{Ic} for a finite length of time (more than 24 hours and usually about 500 hours) to establish K_{Iscc}. Another method is to step load a single specimen until the crack starts to propagate. This method requires holding after each load increment for a sufficient time to establish that crack propagation does not occur.

Under bolt self-loading conditions, sufficient load is first applied to the bolt to cause the crack to extend beyond its precracked position. The specimen is then exposed to the environment. As the crack propagates in the environment, the stress-intensity factor decreases at the tip of the advancing crack until the crack arrests at K_{Iscc}. Specimen length must be sufficient to ensure that the crack arrests before completely penetrating the specimen, thus assuring that a value is obtained for K_{Iscc}.

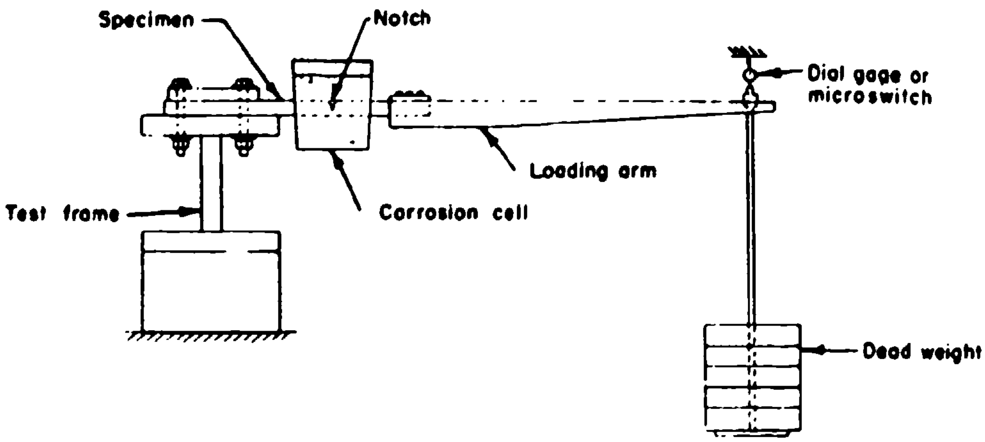


Figure 2.21. Schematic Drawing of Fatigue Cracked Cantilever Beam Test Specimen and Fixtures.

2.7.2 Conditions for Validity of Data

There are no ASTM standards that specifically cover the collection of K_{Iscc} data. The criterion typically used to validate K_{Iscc} data is that the thickness dimension (B) and crack length (a) are greater than the ASTM E399 requirement for plane-strain fracture toughness, i.e., that B and a $\geq$ 2.5 $(K_{Ic}/\sigma_{ys})^2$. Data which did not meet this criterion are identified in the K_{Iscc} tables with an asterisk. Many tests reveal a drastic reduction in the stress intensity required to propagate a crack even though the 2.5 $(K_{Ic}/\sigma_{ys})^2$ criterion is not met. Although these data are not recommended for material selection and design purposes, they do indicate a qualitative effect.

CHAPTER 3

STAINLESS STEEL ALLOY SECTION

Table 3.0.1

AVAILABLE DATA FOR STAINLESS STEEL ALLOYS

ALLOY	CONDITION/HT	PRODUCT FORM	KIC	KC	R CURVES	DA/DN	DA/DT	KISCC
AFC 260	2200F 1HR 1900F 1HR OQ -100F 1HR -320F 1HR 800F 2+2 HR	PLATE						X
	2200F 1HR 1900F 1HR OQ -100F 1HR -320F 1HR 1050F 2+2HR	PLATE						X
	2200F 1HR 1900F 1HR OQ -100F 1HR -320F 1HR 900F 2+2 HR	PLATE						X
	2200F 1HR 1900F 1HR OQ -100F 1HR -320F 1HR 1000F 2+2 HR	PLATE						X
AFC 77	AUSTENIZED AT 2010F,QUENCHED& TEMPERED AT 810F	SHEET					X	
	1800F 1HR OQ. -100F 0.5HR. 500F 2+2 HR (COARSE GRAIN)	PLATE						X
	1800F 1HR OQ. -100F 0.5HR. 1000F 2+2 HR (COARSE GRAIN)	PLATE	X					X
	1800F 1HR OQ. -100F 0.5HR. 500F 2+2 HR (FINE GRAIN)	PLATE						X
	1800F 1HR OQ. -100F 0.5HR. 1000F 2+2 HR (FINE GRAIN)	PLATE	X					X
	1800F 1HR. OQ.-100F 0.5HR. 700F 2+2HR (COARSE GRAIN)	PLATE	X					
	1800F 1HR. OQ.-100F 0.5HR. 800F 2+2HR (COARSE GRAIN)	PLATE	X					
	1800F 1HR.OQ. -100F 0.5HR. 700F 2+2HR (FINE GRAIN)	PLATE	X					
	1800F 1HR.OQ. -100F 0.5HR. 800F 2+2HR (FINE GRAIN)	PLATE	X					

Table 3.0.1 (Con't)

AVAILABLE DATA FOR STAINLESS STEEL ALLOYS

ALLOY	CONDITION/HT	PRODUCT FORM	KIC	KC	R CURVES	DA/DN	DA/DT	KISCC
AFC 77	1800F 1HR.OQ. -100F 1HR. 700F 2+2HR	ROUND BAR	X					
	1800F 1HR.OQ. -100F 1HR. 800F 2+2HR	ROUND BAR	X					
	1900F 1HR.OQ. -100F 1HR. 800F 2+2HR	ROUND BAR	X					
	2000F 1HR OQ. -100F 0.5HR 1400F 2+2 HR	BAR						X
	2000F 1HR OQ. -100F 0.5HR 500F 2+2HR	BAR						X
	2000F 1HR OQ. -100F 0.5HR 700F 2+2 HR	BAR						X
	2000F 1HR OQ. -100F 0.5HR 800F 2+2 HR	BAR						X
	2000F 1HR OQ. -100F 0.5HR 900F 2+2 HR	BAR						X
	2000F 1HR OQ. -100F 0.5HR 1100F 2+2 HR	BAR						X
	2000F 1HR OQ. -100F 0.5HR 500F 2+2HR + 10 PCT CW.1000F	BAR						X
	2000F 1HR OQ. -100F 0.5HR 500F 2+2HR + 10 PCT CW.700F	BAR						X
	2000F 1HR OQ. -100F 0.5HR 500F 2+2HR + 20 PCT CW.700F	BAR						X
	2000F 1HR.OQ. -100F 1HR.900F 2+2HR	ROUND BAR	X					
	2020F 1HR.OQ. -100F 1HR.800F 2+2HR	ROUND BAR	X					
	2100F 1HR.FC TO 1700F HOLD 1HR.OQ.-100F 4HR.500F 2+2 HR	FORGING						X

Table 3.0.1 (Con't)

AVAILABLE DATA FOR STAINLESS STEEL ALLOYS

ALLOY	CONDITION/HT	PRODUCT FORM	KIC	KC	R CURVES	DA/DN	DA/DT	KISCC
AFC 77 (VAR)	1700F 1HR.OQ 2100F 1HR. MOVED TO FCE AT 1933F.HELD 1HR.OQ.-100F 24HR.900F. 2+2HR	FORGING	X					
	2100F 1HR. MOVED TO FCE AT 1900F.HELD 1HR.OQ.-100F 4HR.300F 2+2HR	FORGING	X					
AM 355	MOD SCT1000	BAR						X
	SCT 850	PLATE						X
		BAR						X
	SCT1000	PLATE						X
		BAR						X
AM 362	H 900	BAR						X
	H1000	BAR						X
AM 364	H 850	FORGING						X
	H 950	FORGING						X
CUSTOM 455	H 900	FORGING						X
	H 950	FORGING						X
	H1000	FORGING				X		
	1500F 1HR.OQ. 950F 4HR.AC	FORGING	X					
	1500F 1HR.OQ. 900F 4HR.AC	FORGING	X					

Table 3.0.1 (Con't)

AVAILABLE DATA FOR STAINLESS STEEL ALLOYS

ALLOY	CONDITION/HT	PRODUCT FORM	KIC	KC	R CURVES	DA/DN	DA/DT	KIBCC
PH13-8MO		EXTRUDED BAR				X		
	ANNEALED	FORGING	X					
	AUSTENITE COND AND TRANSFORMED AT 38F, AGED 1015F	FORGED BAR	X					
	H 950	SHEET	X					
		FORGING	X					X
		ROLLED BAR	X					
		FORGED BAR						X
		BAR						X
	H1000	SHEET	X					
		PLATE	X					
		FORGING	X			X		
		EXTRUSION	X					X
		FORGED BAR	X			X		X
		ROLLED BAR	X			X		X
		BAR				X		
		BILLET				X		
		EXTRUDED BAR				X		
	H1025	SHEET	X					
	H1050	ROLLED BAR	X					
		BAR						X
	MILL 1700F, LAB 1050F 4HR	FORGING	X					
	MILL 1700F, LAB 1600F, 1000F 4HR	FORGING	X					
	MILL 1700F, LAB 1500F, 1000F 4HR	FORGING	X					
	RH 950	ROLLED BAR	X					
		ROUND BAR						X
	RH 975	ROLLED BAR	X					
		ROUND BAR						X

Table 3.0.1 (Con't)

AVAILABLE DATA FOR STAINLESS STEEL ALLOYS

ALLOY	CONDITION/HT	PRODUCT FORM	KIC	KC	R CURVES	DA/DN	DA/DT	KISCC
PH13-8MO	RH1000	ROLLED BAR	X					
		ROUND BAR						X
	TYS=140KSI	PLATE						X
	TYS=180KSI	PLATE						X
	TYS=190KSI	PLATE						X
	TYS=200KSI	PLATE						X
	TYS=210KSI	PLATE						X
PH14-8MO	SRH1050	SHEET		X				
PH15-7MO	RH 950	ROLLED BAR	X					
		BAR						X
	RH1050	ROLLED BAR	X					
	TH1050	BAR						X
15-5PH	H 900	ROLLED BAR	X					
		BAR						X
	H1025	BAR				X		
	H1150M	BAR						X
	TUS=150-165KSI	BILLET				X		
	TYS=150-165KSI	FORGING	X					
15-5PH(AM)	H 900	FORGING						X
	H1000	FORGING						X

Table 3.0.1 (Con't)

AVAILABLE DATA FOR STAINLESS STEEL ALLOYS

ALLOY	CONDITION/HT	PRODUCT FORM	KIC	KC	R CURVES	DA/DN	DA/DT	KISCC
15-5PH(VM)	H 900	FORGING						X
	H1000	FORGING						X
17-4PH	H 900	PLATE				X		
		BAR						X
	H 975	ROLLED BAR	X					
	H1000	BAR						X
	H1025	ROUND BAR	X			X		
		CASTING				X		
17-7PH	RH 950	BAR						X
	RH1050	ROLLED BAR	X					
		BAR						X
	TH1050	PLATE				X		
		BAR						X
304	ANNEALED	SHEET				X		
		PLATE				X		
	ANNEALED & AGED	PLATE				X		
316	ANNEALED	PLATE				X		
	ANNEALED AT 1950F, 1HR. WQ	PLATE				X		
347	.050 IN. FROM CENTERLINE	WELDMENT				X		
	AT CENTERLINE	WELDMENT				X		
	AT HEAT AFFECTED ZONE	WELDMENT				X		

Table 3.0.2

PLANE STRAIN FRACTURE TOUGHNESS VALUES OF STAINLESS STEEL ALLOYS AT ROOM TEMPERATURE

ALLOY	CONDITION/ HT	PRODUCT FORM	RANGE OF PRODUCT THICKNESSES (IN)	KIC (KSI SQRT(IN)) L-T SPECIMEN THICK *	L-T MEAN	L-T STD. DEV.	T-L SPECIMEN THICK *	T-L MEAN	T-L STD. DEV.	S-L SPECIMEN THICK *	S-L MEAN	S-L STD. DEV.
AFC 77 (VAR)	1700F 1HR. OQ 2100F 1HR. MOVED TO FCE AT 1933F. HELD 1HR. OQ. -100F 24HR. 900F. 2+2HR	FORGING	6.00	0.50	48.6	3.1	0.50	50.8	1.3	----	----	----
	2100F 1HR. MOVED TO FCE AT 1900F. HELD 1HR. OQ. -100F 4HR. 500F 2+2HR	FORGING	6.00	2.01	110.5	4.9	2.01	108.0	5.7	----	----	----
CUSTOM 455	1500F 1HR. OQ. 950F 4HR. AC	FORGING	4.00	0.48	72.1	7.8	----	----	----	----	----	----
	1500F 1HR. OQ. 900F 4HR. AC	FORGING	4.00	0.48	46.2	3.3	----	----	----	----	----	----
PH13-8MO	ANNEALED	FORGING	3.00	1.01	114.1	15.7	1.00	99.6	22.4	----	----	----
	AUSTENITE COND AND TRANSFORMED AT 38F. AGED 1015F	FORGED BAR	2.20	1.63	103.0	19.4	1.63	89.6	1.8	----	----	----
	H 950	SHEET	1.00-2.25	1.00	58.4	6.5	1.00	69.4	16.1	----	----	----
		FORGING	4.00-8.00	1.00	70.3	16.0	----	----	----	----	----	----
		ROLLED BAR	2.25	1.00	66.9	2.9	1.00	63.5	1.7	0.75	74.1	2.1
	H1000	SHEET	1.50-2.25	1.00	105.6	4.8	1.00	96.2	5.2	----	----	----
		PLATE	4.00	0.98	94.7	3.6	----	----	----	----	----	----
		FORGING	2.75-8.00	0.75	101.6	11.0	0.75	88.1	17.1	----	----	----
		EXTRUSION	1.50	1.00	68.5	5.5	1.00	66.2	2.1	----	----	----

* MINIMUM SPECIMEN THICKNESS (IN.)

Table 3.0.2 (Con't)

PLANE STRAIN FRACTURE TOUGHNESS VALUES OF STAINLESS STEEL ALLOYS AT ROOM TEMPERATURE

ALLOY	CONDITION/ HT	PRODUCT FORM	RANGE OF PRODUCT THICKNESSES (IN)	KIC (KSI SQRT(IN))								
				L-T			T-L			S-L		
				SPECIMEN THICK *	MEAN	STD. DEV.	SPECIMEN THICK *	MEAN	STD. DEV.	SPECIMEN THICK *	MEAN	STD. DEV.
PH13-8MO	H1000	FORGED BAR	1.00	1.00	114.2	0.9	1.00	122.7	3.0	----	----	----
		ROLLED BAR	1.50	1.00	90.0	7.1	1.00	75.0	4.2	----	----	----
	H1050	ROLLED BAR	2.25	1.00	103.1	4.6	1.00	94.8	7.8	0.75	92.2	4.2
PH15-7MO	RH 950	ROLLED BAR	1.25	----	----	----	1.00	30.6	0.1	----	----	----
	RH1050	ROLLED BAR	1.25	----	----	----	1.00	40.2	1.5	----	----	----
15-5PH	H 900	ROLLED BAR	2.25	----	----	----	1.00	72.7	4.5	----	----	----
	TYS=150-165KSI	FORGING	-----	----	----	----	1.50	94.8	6.9	----	----	----
17-7PH	RH1050	ROLLED BAR	1.25	----	----	----	1.00	47.0	0.7	----	----	----

* MINIMUM SPECIMEN THICKNESS (IN.).

Table 3.0.3.1

COMPARISON OF FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS OF THE STRESS INTENSITY FACTOR FOR STAINLESS STEEL ALLOYS

TEST CONDITIONS:

SPECIMEN ORIENTATION: Unknown

ENVIRONMENT: LAB AIR AT R.T.

STRESS RATIO: 0.05-0.10

FREQUENCY: 3.00-30.00HZ

ALLOY	CONDITION/HT	PRODUCT FORM	STRESS RATIO	FREQUENCY	FATIGUE CRACK GROWTH RATES (MICRO IN/CYCLE) FOR DELTA K LEVELS (KSI SQRT(IN)) = 2.5	5.0	10.0	20.0	50.0	100.0
304	ANNEALED	SHEET	0.05	10.00			.163	3.07		
	ANNEALED	SHEET	0.05	15.00			.133	2.83		
	ANNEALED	SHEET	0.10	1.67				2.86		
	ANNEALED	SHEET	0.10	6.00				2.56		
	ANNEALED & AGE	PLATE	0.05	3.00				1.38		
316	ANNEALED AT 1950F. 1HR. WQ	PLATE	0.05	10.00				2.39		
347	.050 IN FROM CENTERLINE	WELDMENT	0.10	30.00					9.83	
	AT CENTERLINE	WELDMENT	0.10	30.00					13.1	
	AT HEAT AFFECTED ZONE	WELDMENT	0.10	30.00					17.5	

Table 3.0.3.2

COMPARISON OF FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS OF THE STRESS INTENSITY FACTOR FOR STAINLESS STEEL ALLOYS

TEST CONDITIONS:

SPECIMEN ORIENTATION L-T — ENVIRONMENT: LAB AIR AT R. T.

STRESS RATIO 0 00-0 10 — FREQUENCY: 0. 03-30. 00HZ

ALLOY	CONDITION/HT	PRODUCT FORM	STRESS RATIO	FREQUENCY	FATIGUE CRACK GROWTH RATES (MICRO IN/CYCLE) FOR DELTA K LEVELS (KSI SQRT(IN)) = 2. 5	5. 0	10. 0	20. 0	50. 0	100 0
CUSTOM 455	H1000	FORGING	0. 10	10. 00- 30. 00				2. 78		
PH13-8MO	H1000	FORGING	0. 10	1. 00- 10. 00				5. 44	31. 9	127.
	H1000	BAR	0. 02	1. 00					31. 6	
17-4PH	H 900	PLATE	0. 08	20. 00			. 305	3. 38	53. 1	
17-7PH	TH1050	PLATE	0. 10	20. 00		. 0252	. 433			
304	ANNEALED	PLATE	0. 00	. 03					56. 0	
	ANNEALED	'LATE	0. 00	6. 67				1. 92	28. 5	

Table 3.0.3.3

COMPARISON OF FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS OF THE STRESS INTENSITY FACTOR FOR STAINLESS STEEL ALLOYS

TEST CONDITIONS:

SPECIMEN ORIENTATION T-L

ENVIRONMENT: LAB AIR AT R.T.

STRESS RATIO 0.00-0.10

FREQUENCY: 1.00-30.00HZ

ALLOY	CONDITION/HT	PRODUCT FORM	STRESS RATIO	FREQUENCY	FATIGUE CRACK GROWTH RATES (MICRO IN/CYCLE) FOR DELTA K LEVELS (KSI SQRT(IN)) = 2.5	5.0	10.0	20.0	50.0	100.0
CUSTOM 455	H1000	FORGING	0.10	10.00					25.0	
	H1000	FORGING	0.10	20.00				3.00		
	H1000	FORGING	0.10	20.00- 30.00				2.58		
PH13-8MO	H1000	FORGING	0.10	1.00- 10.00				5.57	32.1	145.
15-5PH	H1025	BAR	0.05	10.00					15.3	155.
17-4PH	H1025	ROUND BAR	0.10	30.00			.0607	2.00		
17-7PH	TH1050	PLATE	0.10	20.00		.0265	.388	4.44		
304	ANNEALED	PLATE	0.00	6.60				1.86	32.5	

TABLE 3.0.4

INDIVIDUAL STRESS CORROSION CRACKING THRESHOLD DATA FOR STAINLESS STEEL ALLOYS AT ROOM TEMPERATURE

ALLOY	CONDITION/ HT	PRODUCT FORM	SPECIMEN ORIENTATION	K_{ISCC} (Ksi$\sqrt{in}$) ENVIRONMENTS: SUMP TANK WATER	3.5% NaCl	20% NaCl	SEACOAST ATMOSPHERE	INDUST. ATMOSPHERE
AFC 77	1800F 1HR OQ, -100F 0.5 HR, 500F 2&2 HR, (Coarse G.S.)	P	---		15			
	2000F 1HR OQ, -100F 0.5 HR, 700F 2&2 HR	B	---		50			
	2000F 1HR OQ, -100F 0.5 HR, 800F 2&2 HR	B	---		40			
	2000F 1HR OQ, -100F 0.5 HR, 900F 2&2 HR	B	---		15			
	2000F 1HR OQ, -100F 0.5 HR, 1100F 2&2 HR	B	---		10			
	2000F 1HR OQ, -100F 0.5 HR, 500F 2&2 HR, & 10PCT CW, 1000F	B	---		30			
	2000F 1HR OQ, -100F 0.5 HR, 500 2&2 HR, & 10PCT CW, 700F	B	---		90			
	2000F 1HR OQ, -100F 0.5 HR, 500F 2&2 HR, & 20 PCT CW, 700F	B	---		48			
AFC 260	2200F 1HR, 1900F 1HR OQ, -100F 1HR, -100F 1HR, 900F, 2&2 HR	P	T-L		40			
	2200F 1HR, 1900F 1HR OQ, -100F 1HR, -100F 1HR 1000F 2&2 HR	P	T-L		45			
	2200F 1HR, 1900F 1HR OQ, -100F 1HR, -100F 1HR, 1050F 2&2 HR	P	T-L		37			
AM 355	SCT 850	P	T-L			8	24	45
		B	T-L			6	18	18
	SCT 1000	P	T-L			37	52	99
		B	T-L			28	35	66

Table 3.0.4 (Continued)

INDIVIDUAL STRESS CORROSION CRACKING THRESHOLD DATA FOR STAINLESS STEEL ALLOYS AT ROOM TEMPERATURE

ALLOY	CONDITION/ HT	PRODUCT FORM	SPECIMEN ORIENTATION	K_{ISCC} (Ksi$\sqrt{in}$) ENVIRONMENTS: SUMP TANK WATER	3.5% NaCl	20% NaCl	SEACOAST ATMOSPHERE	INDUST. ATMOSPHERE
AM 362	H900	B	---		12			
	H1000	B	---		31			
CUSTOM 455	H900	F	---		60			
	H950	F	---		72			
PH13-8Mo	H950	F	T-L		74			
		FB	L-T	48				
		B	[illegible]			46	31	59
	H1000	E	L-T	55				
		FB	L-T	88				
		FB	T-L	100				
		RB	L-T	70				
	H1050	B	T-L			65	44	83
	TYS=210 KSI	P	T-L		120			
PH15-7Mo	RH950	B	---		14			
	RH1050	B	---		18			
15-5 PH	H900	B				33	36	68
15-5 PH(VM)	H900	F	---		56			
17-4 PH	H900	B	---		52			
17-7 PH	RH1050	B	T-L			65	12	24
	TH1050	B	---		16			

Table 3.1.3.1

STAINLESS STEEL AFC 260 K(ISCC)

CONDITION	--PRODUCT-- FORM	THICK (IN)	TEST TEMP (F)	SPEC OR	YIELD STR (KSI)	ENVIRONMENT	------SPECIMEN-------- WIDTH (IN) W	THICK (IN) B	DESIGN (*=SQ)	CRACK LENGTH (IN) A	K(Q) (KSI*SQRT IN)	K(ISCC)	MEAN	STAN DEV	TEST TIME (MIN)	DATE	REFER
2200F 1HR 1900F 1HR OQ -100F 1HR -320F 1HR 800F 2+2 HR	P	0.56	R.T.	T-L	----	3.5 PCT NACL	1.500	0.480	CANT*	----	64.00	59.00*			----	1971	80685
2200F 1HR 1900F 1HR OQ -100F 1HR -320F 1HR 1050F 2+2HR	P	0.56	R.T.	T-L	185.0	3.5 PCT NACL	1.500	0.480	CANT*	----	------	37.00			----	1971	80685
2200F 1HR 1900F 1HR OQ -100F 1HR -320F 1HR 900F 2+2 HR	P	0.56	R.T.	T-L	196.0	3.5 PCT NACL	1.500	0.480	CANT*	----	47.00	40.00			----	1971	80685
2200F 1HR 1900F 1HR OQ -100F 1HR -32CF 1HR 1000F 2+2HR	P	0.56	R.T.	T-L	206.0	3.5 PCT NACL	1.500	0.480	CANT*	----	------	45.00			----	1971	80685

*NOTE-DATA WHICH DO NOT MEET MINIMUM SPECIMEN THICKNESS REQUIREMENTS OF 2.5(KISCC/TYS)SQUARED

Table 3.2.2.1

STAINLESS STEEL AFC 77 K(IC)

CONDITION	--PRODUCT-- FORM	THICK (IN)	TEST TEMP (F)	SPECIMEN ORIENT	YIELD STRENGTH (KSI)	------SPECIMEN------ WIDTH (IN) W	THICK (IN) B	DESIGN	CRACK LENGTH (IN) A	2.5*(K(IC)/TYS)**2 (IN)	K(IC) (KSI*SQRT IN)	K(IC) MEAN	STAN DEV	DATE	REFER
1800F 1HR. OQ. -100F 0.5HR. 1000F 2+2HR (COARSE GRAIN)	P	0.56	R.T.	L-T	173.0	1.500	0.500	NB	----	0.05	23.00			1969	74720 (1)
1800F 1HR. OQ. -100F 0.5HR. 700F 2+2HR (COARSE GRAIN)	P	0.56	R.T.	L-T	183.0	1.500	0.500	NB	----	0.11	38.00			1969	74720 (1)
1800F 1HR. OQ. -100F 0.5HR. 800F 2+2HR (COARSE GRAIN)	P	0.56	R.T.	L-T	208.0	1.500	0.500	NB	----	0.05	28.00			1969	74720 (1)
1800F 1HR.OQ. -100F 0.5HR. 700F 2+2HR (FINE GRAIN)	P	0.56	R.T.	L-T	203.0	1.500	0.500	NB	----	0.15	49.00			1969	74720 (1)
1800F 1HR.OQ. -100F 0.5HR. 800F 2+2HR (FINE GRAIN)	P	0.56	R.T.	L-T	224.0	1.500	0.500	NB	----	0.05	31.00			1969	74720 (1)
1800F 1HR.OQ. -100F 0.5HR. 1000F 2+2HR (FINE GRAIN)	P	0.56	R.T.	L-T	232.0	1.500	0.500	NB	----	0.04	30.00			1969	74720 (1)
1800F 1HR.OQ. -100F 1HR. 700F 2+2HR	BR	3.00	R.T.	L-R	185.0	1.500	0.480	NB	----	0.14	44.00			1968	84302 (1)
1800F 1HR.OQ. -100F 1HR. 800F 2+2HR	BR	3.00	R.T.	L-R	213.0	1.500	0.480	NB	----	0.05	29.00			1968	84302 (1)
1900F 1HR.OQ. -100F 1HR. 800F 2+2HR	BR	3.00	R.T.	L-R	222.0	1.500	0.480	NB	----	0.28	74.00			1968	84302 (1)
2000F 1HR.OQ. -100F 1HR.900F 2+2HR	BR	3.00	- 65	L-R	----	1.500	0.480	NB	----	----	32.00			1968	84302 (1)
2000F 1HR.OQ. -100F 1HR.800F 2+2HR	BR	3.00	R.T.	L-R	207.0	1.500	0.480	NB	----	0.29	70.00			1969	76136 (1)
2000F 1HR.OQ. -100F 1HR.900F 2+2HR	BR	3.00	R.T.	L-R	214.0	1.500	0.480	NB	----	0.17	56.00			1969	76136 (1)

NOTES:
(1) COMPOSITION(WT PERCENT)0.16C,0.18MN,0.015P,0.021S,0.13SI,0.21NI,14.0CR,5.02MO,13.4CO,0.23V,0.04N
THESE DATA ARE AVERAGE VALUES

TABLE 3.2.3.1

SUSTAINED CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 3.2.3.1 INDICATING EFFECT

OF ENVIRONMENT

MATERIAL: STAINLESS STEEL AFC 77
CONDITION: AUSTENITIZED AT 2010F, QUENCHED & TEMPERED AT 810F

K MAX (KSI*IN**1/2)			DA/DT (10**-3 IN/HOUR) A	B	C	D
			E= DISTILLED WATER			
K MAX MIN	A:	20.00	1.01			
	B:					
	C:					
	D:					
		25.00	4.55			
		30.00	2.67			
		35.00	3.21			
		40.00	17.5			
K MAX MAX	A:	47.00	5213.			
	B:					
	C:					
	D:					
ROOT MEAN SQUARE PERCENT ERROR			62.42			

CONDITION/HT: AUSTENITIZED AT 2010F, QUENCHED & TEMPERED AT 810F
FORM: 0.08"TH SHEET
SPECIMEN TYPE:
ORIENTATION:
YIELD STRENGTH:
ULT. STRENGTH:
SPECIMEN THK:
SPECIMEN WIDTH:
CRACK LENGTH (A_0):
K_{ISCC}:
REFERENCES:85544

STAIN. STEEL

AFC 77

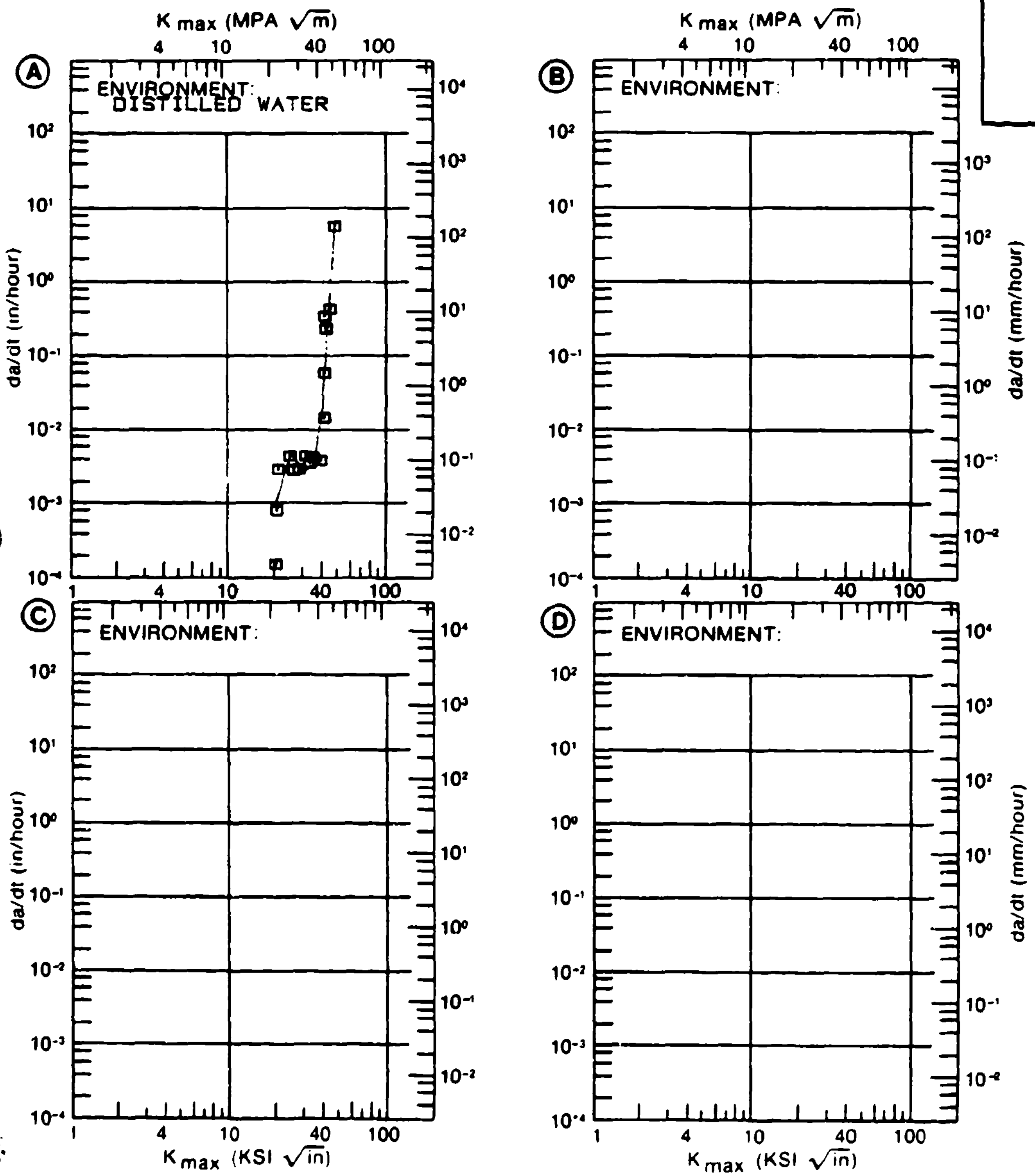


Figure 3.2.3.1

Table 3.2.3.2

STAINLESS STEEL AFC 77 K(ISCC)

CONDITION	PRODUCT FORM	PRODUCT THICK (IN)	TEST TEMP (F)	SPEC OR	YIELD STR (KSI)	ENVIRONMENT	SPECIMEN WIDTH (IN) W	SPECIMEN THICK (IN) B	SPECIMEN DESIGN (*=SG)	CRACK LENGTH (IN) A	K(Q) (KSI*SQRT IN)	K(ISCC) (KSI*SQRT IN)	MEAN	STAN DEV	TEST TIME (MIN)	DATE	REFER
1800F 1HR OQ. -100F 0.5HR, 500F 2+2 HR (COARSE GRAINED STRUCTURE)	P	0.56	R.T.	---	154.0	3.5 PCT NACL	1.500	0.480	CANT*	----	119.00	82.00*			----	1969	74720
1800F 1HR OQ. -100F 0.5HR, 1000F 2+2 HR (COARSE GRAINED STRUCTURE)	P	0.56	R.T.	---	173.0	3.5 PCT NACL	1.500	0.480	CANT*	----	25.00	15.00			----	1969	74720
1800F 1HR OQ. -100F 0.5HR, 500F 2+2 HR (FINE GRAINED STRUCTURE)	P	0.56	R.T.	---	196.0	3.5 PCT NACL	1.500	0.480	CANT*	----	111.00	97.00*			----	1969	74720
1800F 1HR OQ. -100F 0.5HR, 1000F 2+2 HR (FINE GRAINED STRUCTURE)	P	0.56	R.T.	---	232.0	3.5 PCT NACL	1.500	0.480	CANT*	----	30.00	20.00			----	1969	74720
2000F 1HR OQ -100F 0.5HR 1400F 2+2 HR	B	3.00	R.T.	---	150.0	3.5 PCT NACL	1.500	0.480	CANT*	----	116.00	80.00*			----	1969	76136
2000F 1HR OQ -100F 0.5HR 500F 2+2HR	B	3.00	R.T.	---	169.0	3.5 PCT NACL	1.500	0.480	CANT*	----	200.00	105.00*			----	1969	76136
2000F 1HR OQ -100F 0.5HR 700F 2+2 HR	B	3.00	R.T.	---	180.0	3.5 PCT NACL	1.500	0.480	CANT*	----	160.00	50.00			----	1969	76136
2000F 1HR OQ -100F 0.5HR 800F 2+2 HR	B	3.00	R.T.	---	207.0	3.5 PCT NACL	1.500	0.480	CANT*	----	70.00	40.00			----	1969	76136
2000F 1HR OQ -100F 0.5HR 900F 2+2 HR	B	3.00	R.T.	---	214.0	3.5 PCT NACL	1.500	0.480	CANT*	----	56.00	35.00			----	1969	76136
2000F 1HR OQ -100F 0.5HR 1100F 2+2 HR	B	3.00	R.T.	---	221.0	3.5 PCT NACL	1.500	0.480	CANT*	----	43.00	10.00			----	1969	76136

*NOTE-DATA WHICH DO NOT MEET MINIMUM SPECIMEN THICKNESS REQUIREMENTS OF 2.5(KISCC/TYS)SQUARED

Table 3.2.3.2 (Continued)

STAINLESS STEEL AFC 77 K(ISCC)

CONDITION	PRODUCT FORM	PRODUCT THICK (IN)	TEST TEMP (F)	SPEC OR	YIELD STR (KSI)	ENVIRONMENT	SPECIMEN WIDTH (IN) W	SPECIMEN THICK (IN) B	SPECIMEN DESIGN (*=SG)	CRACK LENGTH (IN) A	K(Q) (KSI*SQRT IN)	K(ISCC) (KSI*SQRT IN)	MEAN	STAN DEV	TEST TIME (MIN)	DATE	REFER
2000F 1HR OQ. -100F 0.5HR 500F 2+2HR + 10 PCT CW. 1000F	B	3.00	R.T.	---	252.0	3.5 PCT NACL	1.500	0.480	CANT*	----	80.00	30.00			----	1969	76136
2000F 1HR OQ. -100F 0.5HR 500F 2+2HR + 10 PCT CW. 700F	B	3.00	R.T.	---	277.0	3.5 PCT NACL	1.500	0.480	CANT*	----	106.00	90.00			----	1969	76136
2000F 1HR OQ. -100F 0.5HR 500F 2+2HR + 20 PCT CW. 700F	B	3.00	R.T.	---	297.0	3.5 PCT NACL	1.500	0.480	CANT*	----	107.00	48.00			----	1969	76136
2100F 1HR. FC TO 1900F HOLD 1HR. OQ. -100F 4HR. 500F 2+2 HR	F	10.00	R.T.	L-T	165.8	3.5 PCT NACL	20.000	0.500	NB *	0.400	108.00	> 10.00			----	1973	87360
2100F 1HR. FC TO 1900F HOLD 1HR. OQ. -100F 4HR. 500F 2+2 HR	F	10.00	R.T.	T-L	164.6	3.5 PCT NACL	13.000	0.500	NB *	0.400	110.00	> 10.00			----	1973	87360

Table 3.3.1.1

MEAN PLANE STRAIN FRACTURE TOUGHNESS DATA OF
STAINLESS STEEL ALLOY AFC 77 (VAR) AT ROOM TEMPERATURE

CONDITION/HT — MEAN KIC ± STANDARD DEVIATION (KSI SQRT(IN)) (NUMBER OF SPECIMENS)

FORGING

CONDITION/HT	L-T	T-L	S-L
1700F 1HR.OQ 2100F 1HR. MOVED TO FCE AT 1933F.HELD 1HR.OQ.-100F 24HR.900F. 2+2HR	48.6 ± 3.1 (7)	50.8 ± 1.3 (7)	-----
2100F 1HR. MOVED TO FCE AT 1900F.HELD 1HR.OQ.-100F 4HR.500F 2+2HR	110.5 ± 4.9 (2)	108.0 ± 5.7 (2)	-----

Table 3.3.2.1

STAINLESS STEEL AFC 77 (VAR) (K IC)

CONDITION	PRODUCT FORM	PRODUCT THICK (IN)	TEST TEMP (F)	SPECIMEN ORIENT	YIELD STRENGTH (KSI)	SPECIMEN WIDTH (IN) W	SPECIMEN THICK (IN) B	SPECIMEN DESIGN	CRACK LENGTH (IN) A	2.5*(K(IC)/TYS)**2 (IN)	K(IC) (KSI*SQRT IN)	K(IC) MEAN	STAN DEV	DATE	REFER
1700F 1HR. OQ	F	6.00	-65	L-T	210.0	1.002	0.501	NB	0.510	0.10	41.30			1973	87360 (1)
2100F 1HR.		6.00			210.0	1.002	0.501	NB	0.513	0.10	42.40			1973	87360 (1)
MOVED TO FCE AT 1933F, HELD 1HR. OQ. -100F 24HR. 900F, 2+2HR												41.9/	0.8		
1700F 1HR. OQ	F	6.00	R.T.	L-T	192.0	1.002	0.501	NB	0.523	0.19	53.40			1973	87360 (1)
2100F 1HR.		6.00			192.0	1.002	0.501	NB	0.527	0.14	45.60			1973	87360 (1)
MOVED TO FCE		6.00			192.0	1.002	0.500	NB	0.533	0.16	48.80			1973	87360 (1)
AT 1933F, HELD		6.00			192.0	1.002	0.501	NB	0.505	0.18	50.80			1973	87360 (1)
1HR. OQ. -100F		6.00			192.0	1.002	0.500	NB	0.507	0.13	44.40			1973	87360 (1)
24HR. 900F,		6.00			192.0	1.002	0.500	NB	0.520	0.16	47.90			1973	87360 (1)
2+2HR		6.00			192.0	1.002	0.501	NB	0.510	0.17	49.60			1973	87360 (1)
												48.6/	3.1		
1700F 1HR. OQ	F	6.00	-65	T-L	210.0	1.002	0.501	NB	0.523	0.11	43.30			1973	87360 (1)
2100F 1HR.		5.00			210.0	1.002	0.501	NB	0.520	0.16	52.40			1973	87360 (1)
MOVED TO FCE AT 1933F, HELD 1HR. OQ. -100F 24HR. 900F, 2+2HR												47.9/	6.4		
1700F 1HR. OQ	F	6.00	R.T.	T-L	194.0	1.002	0.501	NB	0.520	0.18	52.60			1973	87360 (1)
2100F 1HR.		6.00			194.0	1.002	0.501	NB	0.510	0.17	50.70			1973	87360 (1)
MOVED TO FCE		6.00			194.0	1.002	0.501	NB	0.513	0.18	52.00			1973	87360 (1)
AT 1933F, HELD		6.00			194.0	1.002	0.501	NB	0.513	0.16	48.80			1973	87360 (1)
1HR. OQ. -100F		6.00			194.0	1.002	0.501	NB	0.525	0.17	49.90			1973	87360 (1)
24HR. 900F,		6.00			194.0	1.002	0.501	NB	0.500	0.17	51.00			1973	87360 (1)
2+2HR		6.00			194.0	1.002	0.501	NB	0.515	0.17	50.40			1973	87360 (1)
												50.8/	1.3		
2100F 1HR.	F	6.00	-65	L-T	180.0	0.995	0.495	NB	0.477	0.46	77.70			1973	87360
MOVED TO FCE AT 1900F, HELD 1HR. OQ. -100F 4HR, 500F 2+2HR															
2100F 1HR.	F	6.00	R.T.	L-T	165.0	4.000	2.007	CT	2.090	1.19	114.00			1973	87360
MOVED TO FCE		6.00			165.0	4.000	2.006	CT	2.110	1.05	107.00			1973	87360
AT 1900F, HELD 1HR. OQ. -100F 4HR, 500F 2+2HR												110.5/	4.9		
2100F 1HR.	F	6.00	-65	T-L	180.0	0.995	0.497	NB	0.490	0.35	67.10			1973	87360
MOVED TO FCE		6.00			180.0	0.994	0.497	NB	0.533	0.42	73.90			1973	87360
AT 1900F, HELD 1HR. OQ. -100F 4HR, 500F 2+2HR												70.5/	4.8		
2100F 1HR.	F	6.00	R.T.	T-L	166.0	4.000	2.006	CT	2.070	0.98	104.00			1973	87360
MOVED TO FCE		6.00			166.0	4.000	2.007	CT	2.110	1.14	112.00			1973	87360
AT 1900F, HELD 1HR. OQ. -100F 4HR, 500F 2+2HR												108.0/	5.7		

NOTES
(1) COMPOSITION(WT PERCENT)0.15C, 0.08MN, 0.012P, 0.004S, 0.20SI, 1.17NI, 13.7CR, 5.02MO, 13.5CO, 0.30V, 0.18CB, 0.020N

Table 3.4.3.1

STAINLESS STEEL AM 355 K(ISCC)

CONDITION	--PRODUCT-- FORM	--PRODUCT-- THICK (IN)	TEST TEMP (F)	SPEC OR	YIELD STR (KSI)	ENVIRONMENT	------SPECIMEN-------- WIDTH (IN) W	THICK (IN) B	DESIGN (*=SG)	CRACK LENGTH (IN) A	K(Q) (KSI*SQRT IN)	K(ISCC) (KSI*SQRT IN)	MEAN	STAN DEV	TEST TIME (MIN)	DATE	REFER
MOD SCT1000	B	2.25	R.T.	---	163.2	3.5 PCT NACL	1.500	0.480	CANT	----	117.00	117.00*			> 30000	1971	84333
SCT 850	P	1.13	R.T	T-L	152.5	INDUSTRIAL ATM	2.000	1.000	CT	----	48.00	45.00			----	1973	86688
SCT 850	P	1.13	R.T	T-L	152.5	SEACOAST ATM	2.000	1.000	CT	----	48.00	24.00			----	1973	86688
SCT 850	P	1.13	R.T	T-L	152.5	20PCT NACL	2.000	1.000	CT	----	48.00	8.00			----	1973	86688
SCT 850	B	2.25	R.T	---	180.0	3.5 PCT NACL	1.500	0.480	CANT	----	59.20	32.50			> 30000	1971	84333
SCT 850	B	2.00	R.T.	T-L	190.3	INDUSTRIAL ATM	2.000	1.000	CT	----	36.60	18.00			----	1973	86688
SCT 850	B	2.00	R.T.	T-L	190.3	SEACOAST ATM	2.000	1.000	CT	----	36.60	18.00			----	1973	86688
SCT 850	B	2.00	R.T.	T-L	190.3	20 PCT NACL	2.000	1.000	CT	----	36.60	6.00			----	1973	86688
SCT1000	P	1.13	R.T.	T-L	169.7	INDUSTRIAL ATM	2.000	1.000	CT	----	104.70	99.00			----	1973	86688
SCT1000	P	1.13	R.T.	T-L	169.7	SEACOAST ATM	2.000	1.000	CT	----	104.70	52.00			----	1973	86688
SCT1000	P	1.13	R.T	T-L	169.7	20 PCT NACL	2.000	1.000	CT	----	104.70	37.00			----	1973	86688
SCT1000	B	2.25	R.T.	---	171.2	3.5 PCT NACL	1.500	0.480	CANT	----	88.40	88.40*			> 30000	1971	84333
SCT1000	B	2.00	R.T	T-L	172.4	INDUSTRIAL ATM	2.000	1.000	CT	----	70.00	66.00			----	1973	86688
SCT1000	B	2.00	R.T	T-L	172.4	SEACOAST ATM	2.000	1.000	CT	----	70.00	35.00			----	1973	86688
SCT1000	B	2.00	R.T	T-L	172.4	20 PCT NACL	2.000	1.000	CT	----	70.00	28.00			----	1973	86688

*NOTE-DATA WHICH DO NOT MEET MINIMUM SPECIMEN THICKNESS REQUIREMENTS OF 2.5(KISCC/TYS)SQUARED

Table 3.5.3.1

STAINLESS STEEL AM 362 K(ISCC)

CONDITION	--PRODUCT-- FORM	--PRODUCT-- THICK (IN)	TEST TEMP (F)	SPEC OR	YIELD STR (KSI)	ENVIRONMENT	------SPECIMEN-------- WIDTH (IN) W	THICK (IN) B	DESIGN (*=SO)	CRACK LENGTH (IN) A	K(Q) (KSI*SQRT IN)	K(ISCC)	MEAN	STAN DEV	TEST TIME (MIN)	DATE	REFER
H 900	B	2.25	R.T.	---	200.5	3.5 PCT NACL	1.500	0.480	CANT	----	30.20	12.50			> 42000	1971	84333
H1000	B	2.25	R.T.	---	178.9	3.5 PCT NACL	1.500	0.480	CANT	----	40.10	31.00			> 36000	1971	84333

Table 3.6.3.1

STAINLESS STEEL AM 364 K(ISCC)

CONDITION	PRODUCT FORM	PRODUCT THICK (IN)	TEST TEMP (F)	SPEC OR	YIELD STR (KSI)	ENVIRONMENT	SPECIMEN WIDTH (IN) W	SPECIMEN THICK (IN) B	SPECIMEN DESIGN (*=80)	CRACK LENGTH (IN) A	K(Q) (KSI*SQRT IN)	K(ISCC) (KSI*SQRT IN)	MEAN	STAN DEV	TEST TIME (MIN)	DATE	REFER
H 850	F	3.00	R.T.	T-L	183.3	3.5 PCT NACL	1.500	0.480	CANT	----	131.00	93.00*			> 60000	1971	84333
H 950	F	3.00	R.T.	T-L	186.7	3.5 PCT NACL	1.500	0.480	CANT	----	128.00	128.00*			> 60000	1971	84333

*NOTE-DATA WHICH DO NOT MEET MINIMUM SPECIMEN THICKNESS REQUIREMENTS OF 2.5(KISCC/TYS)SQUARED

Table 3.7.1.1

MEAN PLANE STRAIN FRACTURE TOUGHNESS DATA OF
STAINLESS STEEL ALLOY CUSTOM 455 AT ROOM TEMPERATURE

CONDITION/HT	MEAN KIC ± STANDARD (KSI SQRT(IN)) DEVIATION	(NUMBER OF SPECIMENS)	
	FORGING		
CONDITION/HT	L-T	T-L	S-L
1500F 1HR.OQ. 950F 4HR.AC	72.1 ± 7.8 (2)	-----	-----
1500F 1HR.OQ. 900F 4HR.AC	46.2 ± 3.3 (3)	-----	-----

Table 3.7.1.2

FATIGUE CRACK GROWTH RATE AT DEFINED LEVELS OF THE STRESS-INTENSITY FACTOR

STAINLESS STEEL CUSTOM 455

TEST CONDITIONS

SPECIMEN ORIENTATION: L-T

ENVIRONMENT: LAB AIR AT R.T.

CONDITION/HT	PRODUCT FORM	STRESS RATIO	FREQ. (HZ)	DELTA K LEVELS (KSI SQRT(IN))	2.5	5	10	20	50	100
					FATIGUE CRACK GROWTH RATES (MICRO IN/CYCLE)					
H1000	FORGING	0.10	10.00-30.00					2.78		
H1000	FORGING	0.30	10.00-30.00					3.72		

Table 3.7.1.3

FATIGUE CRACK GROWTH RATE AT DE[illegible] LEVELS OF THE STRESS-INTENSITY FACTOR

STAINLESS STEEL CUSTOM 455

TEST CONDITIONS

SPECIMEN ORIENTATION 1-1

ENVIRONMENT: LAB AIR AT R.T.

CONDITION/HT	PRODUCT FORM	STRESS RATIO	FREQ. (HZ)	DELTA K LEVELS (KSI SQRT(IN))	2.5	5	10	20	50	100
					FATIGUE CRACK GROWTH RATES (MICRO IN/CYCLE)					
H1000	FORGING	0.10	10.00						25.0	
H1000	FORGING	0.10	20.00					3.00		
H1000	FORGING	0.10	20.00-30.00					2.58		

Table 3.7.2.1

STAINLESS STEEL CUSTOM 455 K(IC)

CONDITION	--PRODUCT-- FORM	THICK (IN)	TEST TEMP (F)	SPECIMEN ORIENT	YIELD STRENGTH (KSI)	------SPECIMEN------ WIDTH (IN) W	THICK (IN) B	DESIGN	CRACK LENGTH (IN) A	2.5*(K(IC)/TYS)**2 (IN)	K(IC) (KSI*SQRT IN)	K(IC) MEAN	STAN DEV	DATE	REFER
1500F 1HR.OQ.	F	4.00	R.T	L-T	246.0	1.500	0.480	NB	0.310	0.25	77.60			----	77934
950F 4HR.AC		4.00			246.0	1.500	0.480	NB	0.310	0.18	66.60	72.1/	7.8	----	77934
1500F 1HR.OQ.	F	4.00	R.T.	L-T	255.0	1.500	0.480	NB	0.310	0.09	47.70			----	77934
900F 4HR.AC		4.00			255.0	1.500	0.480	NB	0.320	0.07	42.40			----	77934
		4.00			255.0	1.500	0.480	NB	0.330	0.09	48.40	46.2/	3.3	----	77934

TABLE 3.7.3.1

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 3.7.3.1 INDICATING EFFECT

OF STRESS RATIO

MATERIAL: STAINLESS STEEL CUSTOM 455
CONDITION: H1000
ENVIRONMENT: R.T., LAB AIR

DELTA K (KSI*IN**1/2)			DA/DN (10**-6 IN./CYCLE) A	B	C	D
			R=+0.10	R=+0.30		
	A:	10.07	.281			
DELTA K MIN	B:	12.71		1.04		
	C:					
	D:					
		13.00	.699	1.10		
		16.00	1.39	1.99		
		20.00	2.78	3.72		
		25.00	4.91			
		30.00	6.90			
	A:	32.83	8.14			
DELTA K MAX	B:	23.86		5.31		
	C:					
	D:					
ROOT MEAN SQUARE PERCENT ERROR			11.51	2.74		
LIFE PREDICTION RATIO SUMMARY (NP/NA)		0.0-0.5				
		0.5-0.8				
		0.8-1.25	3	1		
		1.25-2.0				
		>2.0				

CONDITION/HT: H1000
FORM: 2.50"TH FORGING
SPECIMEN TYPE: CT
ORIENTATION: L-T
FREQUENCY: 10.0 - 30.0 HZ
ENVIRONMENT: R.T., LAB AIR

YIELD STRENGTH: 195.0 KSI
ULT. STRENGTH: 204.4 KSI
SPECIMEN THK: 0.750"
SPECIMEN WIDTH: 2.100"
REFERENCES: RI004

STAIN. STEEL

CUSTOM 455

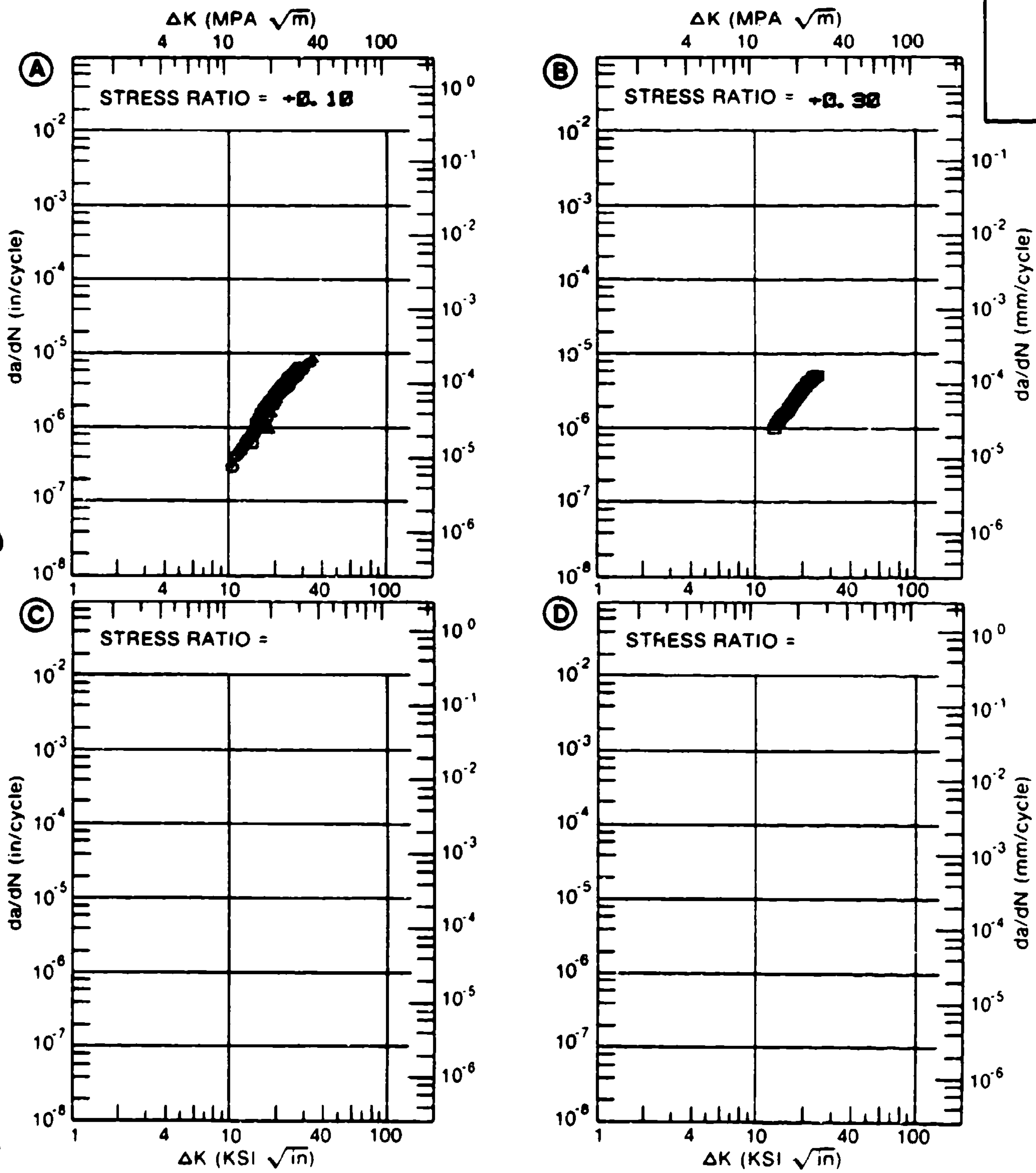


Figure 3.7.3.1

TABLE 3.7.3.2

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 3.7.3.2 INDICATING EFFECT

OF FREQUENCY

MATERIAL: STAINLESS STEEL CUSTOM 455
CONDITION: H1000
ENVIRONMENT: R.T., LAB AIR

DELTA K (KSI*IN**1/2)		DA/DN (10**-6 IN./CYCLE) A F(HZ)= 5.0	B F(HZ)= 10.0	C F(HZ)= 20.0	D
DELTA K MIN	A: 62.02	39.7			
	B: 25.12		4.98		
	C: 12.70			.739	
	D:				
	13.00			.703	
	16.00			1.04	
	20.00			3.00	
	25.00			3.70	
	30.00		7.09		
	35.00		10.0		
	40.00		13.9		
	50.00		25.0		
	60.00				
	70.00	68.9			
DELTA K MAX	A: 76.71	82.1			
	B: 56.40		35.0		
	C: 25.96			3.16	
	D:				
ROOT MEAN SQUARE PERCENT ERROR		9.70	9.22	22.29	
LIFE PREDICTION RATIO SUMMARY (NP/NA)	0.0-0.5				
	0.5-0.8			1	
	0.8-1.25	1	1	1	
	1.25-2.0				
	>2.0				

CONDITION/HT: H1000
FORM: 2.50"TH FORGING
SPECIMEN TYPE: CT
ORIENTATION: T-L
STRESS RATIO: +0.10
ENVIRONMENT: R.T., LAB AIR

YIELD STRENGTH: 185.0 KSI
ULT. STRENGTH: 204.4 KSI
SPECIMEN THK: 0.750"
SPECIMEN WIDTH: 2.100"
REFERENCES: RI004

STAIN. STEEL

CUSTOM 455

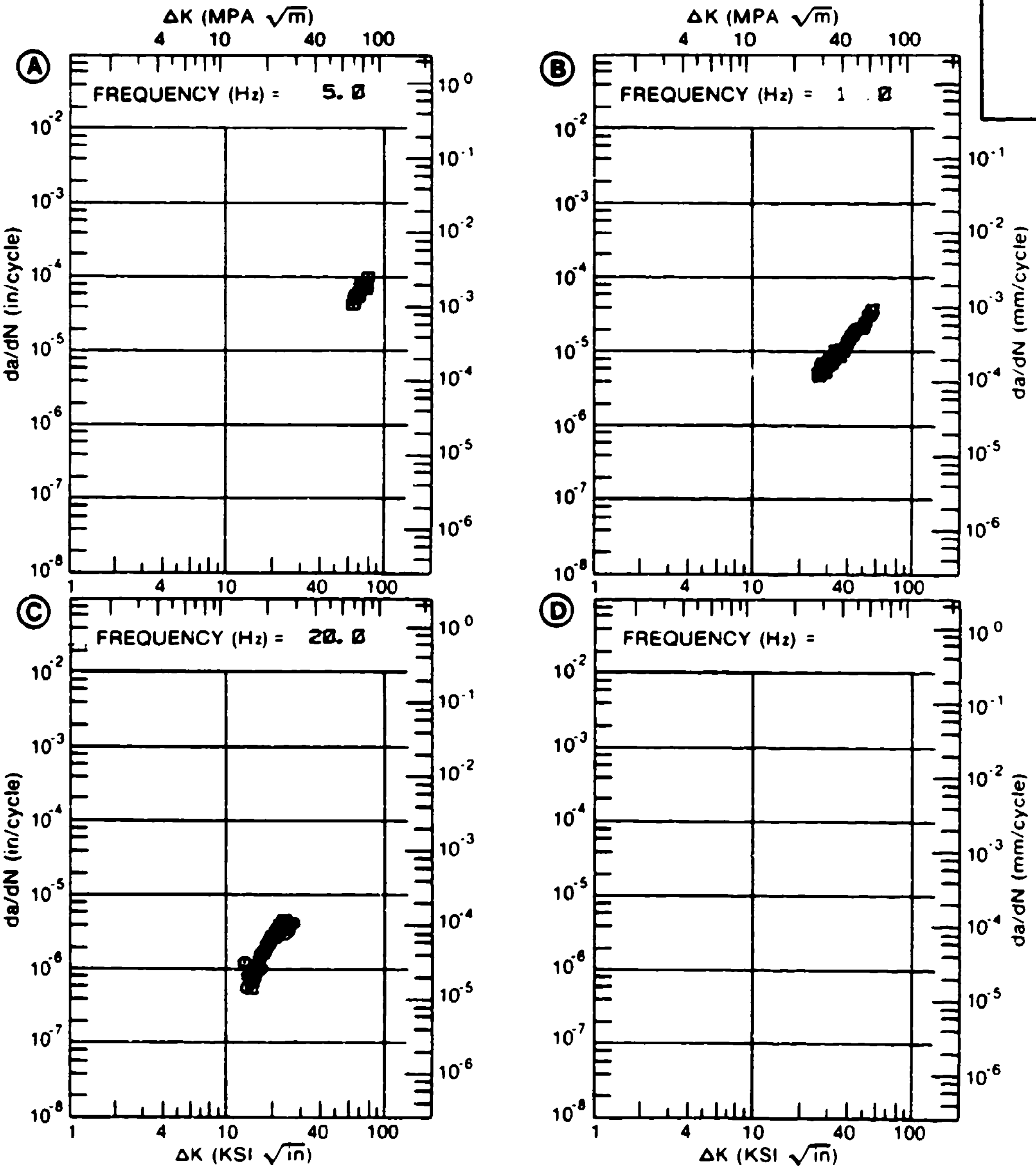


Figure 3.7.3.2

TABLE 3.7.3.3

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 3.7.3.3 INDICATING EFFECT
OF ENVIRONMENT

MATERIAL: STAINLESS STEEL CUSTOM 455
CONDITION: H1000

DELTA K (KSI*IN**1/2)			DA/DN (10**-6 IN./CYCLE) A	B	C	D
			E= R.T. LAB AIR	E=- 100F AIR		
	A:	10.09	.256			
DELTA K MIN	B:					
	C:					
	D:					
		13.00	.828			
		16.00	1.43			
		20.00	2.58			
		25.00	4.75			
	A:	27.10	6.32			
DELTA K MAX	B:					
	C:					
	D:					
ROOT MEAN SQUARE PERCENT ERROR			13.93	0.00		
LIFE PREDICTION RATIO SUMMARY (NP/NA)		0.0-0.5				
		0.5-0.8				
		0.8-1.25	3			
		1.25-2.0				
		>2.0				

CONDITION/HT: H1000
FORM: 2.50"TH FORGING
SPECIMEN TYPE: CT
ORIENTATION: T-L
STRESS RATIO: +0.10
FREQUENCY: 20.0 - 30.0 HZ

YIELD STRENGTH: 195.0- 205.0 KSI
ULT. STRENGTH: 204.4 KSI
SPECIMEN THK: 0.750"
SPECIMEN WIDTH: 2.100"
REFERENCES: RI004

STAIN. STEEL

CUSTOM 455

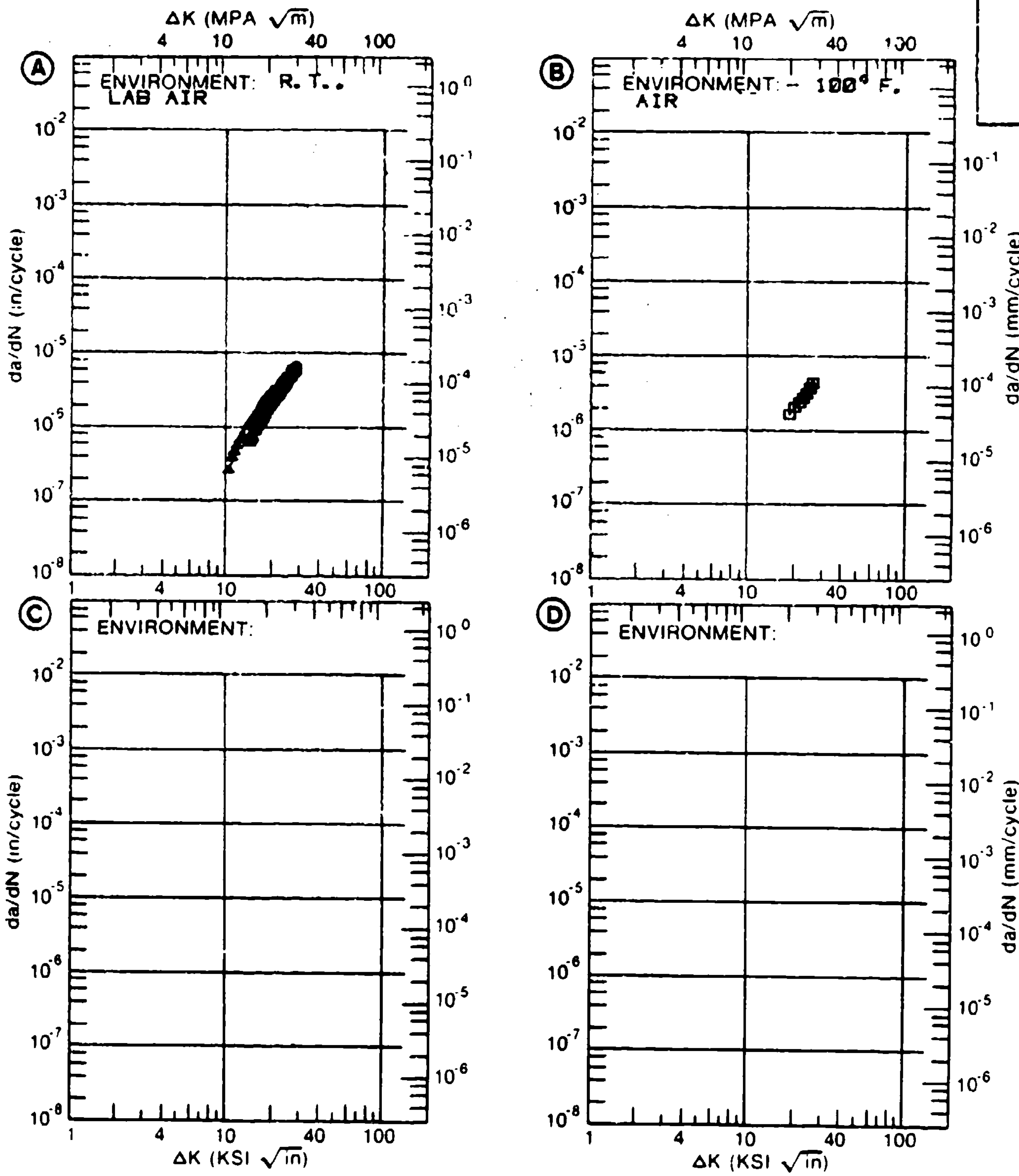


Figure 3.7.3.3

Table 3.7.3.4

STAINLESS STEEL CUSTOM 455 K(ISCC)

CONDITION	PRODUCT FORM	PRODUCT THICK (IN)	TEST TEMP (F)	SPEC OR	YIELD STR (KSI)	ENVIRONMENT	SPECIMEN WIDTH (IN) W	SPECIMEN THICK (IN) B	SPECIMEN DESIGN (*=SG)	CRACK LENGTH (IN) A	K(0) (KSI*SQRT IN)	K(ISCC) (KSI*SQRT IN)	MEAN	STAN DEV	TEST TIME (MIN)	DATE	REFER
H 900	F	4.00	R.T.	---	255.0	3.5 PCT NACL	1.500	0.500	CANT	----	62.00	60.00			> 60000	1969	77934
H 550	F	4.00	R.T.	---	246.0	3.5 PCT NACL	1.500	0.480	CANT	----	72.10	72.10			> 60000	1971	84333

Table 3.8.1.1

MEAN PLANE STRAIN FRACTURE TOUGHNESS DATA OF
STAINLESS STEEL ALLOY PH13-8MO AT ROOM TEMPERATURE

CONDITION/HT	MEAN KIC ± STANDARD (KSI SQRT(IN)) DEVIATION	(NUMBER OF SPECIMENS)	
	SHEET		
CONDITION/HT	L-T	T-L	S-L
H 950	58.4 ± 6.5 (2)	69.4 ±16.[illegible] (4)	-----
H1000	105.6 ± 4.8 (6)	96.2 ± 5.2 (4)	-----
	PLATE		
CONDITION/HT	L-T	T-L	S-L
H1000	94.7 ± 3.6 (3)	-----	-----
	FORGING		
CONDITION/HT	L-T	T-L	S-L
ANNEALED	114.1 ±15.7 (5)	99.6 ±22.4 (6)	-----
H 950	70.3 ±16.0 (9)	-----	-----
H1000	101.6 ±11.0 (12)	88.1 ±17.1 (7)	-----
	EXTRUSION		
CONDITION/HT	L-T	T-L	S-L
H1000	68.5 ± 5.5 (8)	66.2 ± 2.1 (6)	-----

Table 3.8.1.1 (Continued)

MEAN PLANE STRAIN FRACTURE TOUGHNESS DATA OF
STAINLESS STEEL ALLOY PH13-8MO AT ROOM TEMPERATURE

CONDITION/HT	MEAN KIC ± STANDARD (KSI SQRT(IN)) DEVIATION	(NUMBER OF SPECIMENS)	
		FORGED BAR	
CONDITION/HT	L-T	T-L	S-L
AUSTENITE COND AND TRANSFORMED AT 38F. AGED 1015F	103.0 ±19.4 (2)	89.6 ± 1.8 (2)	-----
H1000	114.2 ± 0.9 (2)	122.7 ± 3.0 (3)	-----
		ROLLED BAR	
CONDITION/HT	L-T	T-L	S-L
H 950	66.9 ± 2.9 (3)	63.5 ± 1.7 (6)	74.1 ± 2.1 (3)
H1000	90.0 ± 7.1 (2)	75.0 ± 4.2 (2)	-----
H1050	103.1 ± 4.6 (3)	94.8 ± 7.8 (6)	92.2 ± 4.2 (2)

Table 3.8.1.2

FATIGUE CRACK GROWTH RATE AT DEFINED LEVELS OF THE STRESS-INTENSITY FACTOR

STAINLESS STEEL PH13-8MO

TEST CONDITIONS

SPECIMEN ORIENTATION L-T

ENVIRONMENT: DRY AIR AT R. T.

CONDITION/HT	PRODUCT FORM	STRESS RATIO	FREQ. (HZ)	DELTA K LEVELS (KSI SQRT(IN))	FATIGUE CRACK GROWTH RATES (MICRO IN/CYCLE)					
					2.5	5	10	20	50	100
H1000	FORGED BAR	0.10	6.00				0.23	3.07	29.6	
H1000	FORGED BAR	0.30	6.00				0.58	4.17		
H1000	FORGED BAR	0.50	6.00				0.64	4.79		

Table 3.8.1.3

FATIGUE CRACK GROWTH RATE AT DEFINED LEVELS OF THE STRESS-INTENSITY FACTOR

STAINLESS STEEL PH13-8MO

TEST CONDITIONS

SPECIMEN ORIENTATION: L-T

ENVIRONMENT: L.H.A. AT - 65 F

CONDITION/HT	PRODUCT FORM	STRESS RATIO	FREQ. (HZ)	DELTA K LEVELS (KSI SQRT(IN)) 2.5	5	10	20	50	100
				FATIGUE CRACK GROWTH RATES (MICRO IN/CYCLE)					
	EXTRUDED BAR	0.08	6.00				1.32	21.6	
H1000	EXTRUDED BAR	0.08	6.00			0.23	2.87		
H1000	ROLLED BAR	0.00	6.00				1.67		

Table 3.8.1.4

FATIGUE CRACK GROWTH RATE AT DEFINED LEVELS OF THE STRESS-INTENSITY FACTOR

STAINLESS STEEL PH13-8MO

TEST CONDITIONS

SPECIMEN ORIENTATION: L-T

ENVIRONMENT: L.H.A. AT R.T.

CONDITION/HT	PRODUCT FORM	STRESS RATIO	FREQ. (HZ)	DELTA K LEVELS (KSI SQRT(IN))	2.5	5	10	20	50	100
				FATIGUE CRACK GROWTH RATES (MICRO IN/CYCLE)						
	EXTRUDED BAR	0.00	6.00					2.22	20.8	
	EXTRUDED BAR	0.30	6.00					2.98		
H1000	FORGED BAR	0.08	6.00					5.82		
H1000	FORGED BAR	0.30	6.00					4.70		
H1000	FORGED BAR	0.50	6.00				0.51	4.70		
H1000	BILLET	0.00	6.00				0.34	4.02		
H1000	EXTRUDED BAR	0.08	6.00				0.33	3.73	34.4	
H1000	EXTRUDED BAR	0.50	6.00				0.85	5.59		
H1000	ROLLED BAR	0.08	1.00				0.29	3.37		
H1000	ROLLED BAR	0.00	6.00				0.29	3.40		
H1000	ROLLED BAR	0.30	6.00				0.62	4.39		
H1000	ROLLED BAR	0.50	6.00				0.79	5.09		

Table 3.8.1.5

FATIGUE CRACK GROWTH RATE AT DEFINED LEVELS OF THE STRESS-INTENSITY FACTOR

STAINLESS STEEL PH13-8MO

TEST CONDITIONS

SPECIMEN ORIENTATION: L-T

ENVIRONMENT: LAB AIR AT R.T.

CONDITION/HT	PRODUCT FORM	STRESS RATIO	FREQ (HZ)	DELTA K LEVELS (KSI SQRT(IN)) 2.5	5	10	20	50	100
				FATIGUE CRACK GROWTH RATES (MICRO IN/CYCLE)					
H1000	FORGING	0.10	1.00-10.00				5.44	31.9	127
H1000	BAR	0.02	1.00					31.6	

Table 3.8.1.6

FATIGUE CRACK GROWTH RATE AT DEFINED LEVELS OF THE STRESS-INTENSITY FACTOR

STAINLESS STEEL PH13-8MO

TEST CONDITIONS

SPECIMEN ORIENTATION: L-T

ENVIRONMENT: H.H.A. AT R.T.

CONDITION/HT	PRODUCT FORM	STRESS RATIO	FREQ. (HZ)	DELTA K LEVELS (KSI SQRT(IN))						
				FATIGUE CRACK GROWTH RATES (MICRO IN/CYCLE)						
				2.5	5	10	20	50	100
H1000	FORGED BAR	0.10	1.00			0.29	7.56	105	
H1000	FORGED BAR	0.30	1.00			0.81	11.3	129	
H1000	FORGED BAR	0.50	1.00			0.94	12.5		

Table 3.8.1.7

FATIGUE CRACK GROWTH RATE AT DEFINED LEVELS OF THE STRESS-INTENSITY FACTOR

STAINLESS STEEL PH13-8MO

TEST CONDITIONS

SPECIMEN ORIENTATION: L-T

ENVIRONMENT: S.T.W. AT R.T.

CONDITION/HT	PRODUCT FORM	STRESS RATIO	FREQ. (HZ)	DELTA K LEVELS (KSI SQRT(IN))	FATIGUE CRACK GROWTH RATES (MICRO IN/CYCLE) 2.5	5	10	20	50	100
	EXTRUDED BAR	0.08	1.00					2.85		
H1000	EXTRUDED BAR	0.08	1.00				0.64	7.11		
H1000	ROLLED BAR	0.08	1.00					4.15		
H1000	ROLLED BAR	0.30	1.00				0.64	12.2		
H1000	ROLLED BAR	0.08	0.10					6.44		

Table 3.8.1.8

FATIGUE CRACK GROWTH RATE AT DEFINED LEVELS OF THE STRESS-INTENSITY FACTOR

STAINLESS STEEL PH13-8MO

TEST CONDITIONS

SPECIMEN ORIENTATION. T-L

ENVIRONMENT: DRY AIR AT R.T.

CONDITION/HT	PRODUCT FORM	STRESS RATIO	FREQ. (HZ)	DELTA K LEVELS (KSI SQRT(IN))	FATIGUE CRACK GROWTH RATES (MICRO IN/CYCLE)					
					2.5	5	10	20	50	100
H1000	FORGED BAR	0.10	6.00				0.26	3.14	24.3	
H1000	FORGED BAR	0.30	6.00				0.42	4.17	37.1	
H1000	FORGED BAR	0.50	6.00				0.51	4.60		

Table 3.8.1.9

FATIGUE CRACK GROWTH RATE AT DEFINED LEVELS OF THE STRESS-INTENSITY FACTOR

STAINLESS STEEL PH13-8MO

TEST CONDITIONS

SPECIMEN
ORIENTATION: T-L

ENVIRONMENT: L.H.A.
AT R.T.

CONDITION/HT	PRODUCT FORM	STRESS RATIO	FREQ. (HZ)	DELTA K LEVELS (KSI SQRT(IN))	FATIGUE CRACK GROWTH RATES (MICRO IN/CYCLE)					
					2.5	5	10	20	50	100
H1000	BILLET	0.08	6.00				0.34	3.47	31.3	
H1000	ROLLED BAR	0.08	6.00					4.01		

Table 3.8.1.10

FATIGUE CRACK GROWTH RATE AT DEFINED LEVELS OF THE STRESS-INTENSITY FACTOR

STAINLESS STEEL PH13-8MO

TEST CONDITIONS

SPECIMEN ORIENTATION T-L

ENVIRONMENT: H.H.A. AT R.T.

CONDITION/HT	PRODUCT FORM	STRESS RATIO	FREQ. (HZ)	DELTA K LEVELS (KSI SQRT(IN))					
				FATIGUE CRACK GROWTH RATES (MICRO IN/CYCLE)					
				2.5	5	10	20	50	100
H1000	FORGED BAR	0.10	1.00				6.71	108	
H1000	FORGED BAR	0.30	1.00			0.54	9.37	215	
H1000	FORGED BAR	0.50	1.00			1.08	11.6	607	

Table 3.8.1.11

FATIGUE CRACK GROWTH RATE AT DEFINED LEVELS OF THE STRESS-INTENSITY FACTOR

STAINLESS STEEL PH13-8MO

TEST CONDITIONS

SPECIMEN ORIENTATION T-L

ENVIRONMENT: S.T.W. AT R.T.

CONDITION/HT	PRODUCT FORM	STRESS RATIO	FREQ. (HZ)	DELTA K LEVELS (KSI SQRT(IN))	2.5	5	10	20	50	100
					FATIGUE CRACK GROWTH RATES (MICRO IN/CYCLE)					
H1000	FORGED BAR	0.08	1.00					18.5		
H1000	ROLLED BAR	0.08	1.00				0.28	6.43		

Table 3.8.2.1

STAINLESS STEEL PH13-8MO K(IC)

CONDITION	PRODUCT FORM	PRODUCT THICK (IN)	TEST TEMP (F)	SPECIMEN ORIENT	YIELD STRENGTH (KSI)	SPECIMEN WIDTH (IN) W	SPECIMEN THICK (IN) B	SPECIMEN DESIGN	CRACK LENGTH (IN) A	2.5*(K(IC)/TYS)**2 (IN)	K(IC) (KSI*SQRT IN)	K(IC) MEAN/ STAN DEV	DATE	REFER
ANNEALED	F	3.00	R.T.	L-T	200.7	3.978	2.003	CT	2.073	0.66	103.80		1976	NC001
		3.00			200.7	4.000	2.003	CT	2.043	0.52	92.12		1976	NC001
		3.00			200.7	3.997	1.996	CT	2.058	1.02	128.41		1976	NC001
		3.00			206.0	2.000	1.007	CT	1.026	0.94	126.90		1976	NC001
		3.00			206.0	4.000	1.999	CT	2.057	0.83	119.40	114.1/ 15.7	1976	NC001
ANNEALED	F	3.00	R.T.	T-L	202.0	3.999	1.996	CT	2.060	0.43	83.91		1976	NC001
		3.00			202.0	4.000	2.003	CT	2.035	1.08	132.91		1976	NC001
		3.00			202.0	3.999	1.998	CT	2.061	0.73	109.27		1976	NC001
		3.00			205.0	2.000	1.007	CT	1.025	0.76	113.50		1976	NC001
		3.00			207.0	3.938	2.002	CT	2.008	0.36	79.44		1976	NC001
		3.00			214.0	2.000	1.004	CT	1.005	0.33	78.36	99.6/ 22.4	1976	NC001
AUSTENITE COND	FB	2.20	R.T.	L-T	212.0	2.999	1.635	CT	1.577	0.76	116.70		1973	85836
AND		2.20			212.0	3.001	1.626	CT	1.597	0.44	89.20		1973	85836
TRANSFORMED AT 38F, AGED 1015F												103.0/ 19.4		
AUSTENITE COND	FB	2.20	R.T.	T-L	212.0	3.001	1.628	CT	1.604	0.46	90.80		1973	85836
AND		2.20			212.0	3.001	1.634	CT	1.587	0.43	88.30		1973	85836
TRANSFORMED AT 38F, AGED 1015F												89.6/ 1.8		
H 950	S	1.50	R.T.	L-T	210.0	2.000	1.000	CT	1.000	0.22	63.00		1972	84365
		1.50			210.0	2.000	1.000	CT	1.000	0.16	53.80	58.4/ 6.5	1972	84365
H 950	S	1.00	R.T.	T-L	210.0	-----	-----	NB	-----	0.38	81.60		1972	84365
		1.50			210.0	2.000	1.000	CT	1.000	0.17	54.30		1972	84365
		2.25			210.0	-----	-----	NB	-----	0.41	85.00		1972	84365
		1.50			210.0	2.000	1.000	CT	1.000	0.18	56.70	69.4/ 16.1	1972	84365
H 950	F	8.00	R.T.	L-T	210.0	2.000	1.000	CT	1.000	0.13	47.00		1972	84365
		4.00			210.0	-----	-----	NB	-----	0.40	83.90		1972	84365
		4.00			210.0	-----	-----	NB	-----	0.40	84.50		1972	84365
		8.00			210.0	2.000	1.000	CT	1.000	0.19	57.80		1972	84365
		4.00			210.0	-----	-----	NB	-----	0.39	83.60		1972	84365
		4.00			210.0	2.000	1.000	CT	1.000	0.47	91.30		1972	84365
		4.00			210.0	-----	-----	NB	-----	0.28	70.50		1972	84365
		8.00			210.0	2.000	1.000	CT	1.000	0.19	58.20		1972	84365
		4.00			210.0	-----	-----	NB	-----	0.18	55.90	70.3/ 16.0	1972	84365

Table 3.8.2.1 (Continued)

STAINLESS STEEL PH13-8MO K(IC)

CONDITION	--PRODUCT-- FORM	THICK (IN)	TEST TEMP (F)	SPECIMEN ORIENT	YIELD STRENGTH (KSI)	------SPECIMEN------ WIDTH (IN) W	THICK (IN) B	DESIGN	CRACK LENGTH (IN) A	2.5*(K(IC)/TYS)**2 (IN)	K(IC) (KSI*SQRT IN)	K(IC) MEAN	STAN DEV	DATE	REFER
H 950	RB	2.25	R.T	L-T	202.0	2.000	1.000	CT	1.077	0.25	64.20			1973	86688
		2.25			202.0	2.000	1.000	CT	1.069	0.30	70.00			1973	86688
		2.25			202.0	2.000	1.000	CT	1.040	0.27	66.40	66.9/	2.9	1973	86688
H 950	RB	2.25	R.T	T-L	197.0	2.000	1.000	CT	1.060	0.24	60.90			1973	86688
		2.25			197.0	2.000	1.000	CT	1.049	0.25	62.80			1973	86688
		2.25			197.0	4.000	2.000	CT	2.071	0.26	63.60			1973	86688
		2.25			197.0	4.000	2.000	CT	2.028	0.28	66.20			1973	86688
		2.25			197.0	2.000	1.000	CT	1.030	0.26	64.00			1973	86688
		2.25			197.0	4.000	2.000	CT	1.996	0.26	63.40	63.5/	1.7	1973	86688
H 950	RB	2.25	R.T	S-L	203.0	1.500	0.750	CT	0.780	0.33	73.80			1973	86688
		2.25			203.0	1.500	0.750	CT	0.738	0.35	76.40			1973	86688
		2.25			203.0	1.500	0.750	CT	0.797	0.32	72.20	74.1/	2.1	1973	86688
H1000	S	1.50	R.T	L-T	205.0	2.000	1.000	CT	1.000	0.71	109.00			1972	84365
		1.50			205.0	2.000	1.000	CT	1.000	0.58	98.50			1972	84365
		2.25			211.0	-----	-----	NB	----	0.68	110.00			1972	84365
		2.25			211.0	-----	-----	NB	----	0.59	103.00			1972	84365
		2.25			211.0	2.000	1.000	CT	1.000	0.60	103.00			1972	84365
		1.75			219.0	-----	-----	CT	----	.63	110.00	105.6/	4.8	1972	84365
H1000	S	1.50	R.T	T-L	205.0	2.000	1.000	CT	1.000	0.61	101.00			1972	84365
		1.50			205.0	2.000	1.000	CT	1.000	0.59	99.70			1972	84365
		2.25			213.0	2.000	1.000	CT	1.000	0.49	94.30			1972	84365
		2.25			214.0	2.000	1.000	CT	1.000	0.44	89.60	96.2/	5.2	1972	84365
H1000	P	4.00	R.T	L-T	201.0	3.501	0.990	CT	1.761	0.59	98.10			----	84306
		4.00			201.0	3.501	0.978	CT	1.768	0.55	94.90			----	84306
		4.00			201.0	3.501	0.994	CT	1.782	0.51	91.00	94.7/	3.6	----	84306
H1000	P	4.00	R.T	T-L	198.0	3.500	0.990	CT	1.796	0.54	93.40			----	84306
H1000	F	4.00	-65	L-T	185.0	3.994	1.381	CT	1.941	0.21	53.80			1973	85836
		5.00			195.0	2.000	1.000	CT	1.030	0.14	46.90	50.4/	4.9	1973	85836
H1000	F	8.00	R.T	L-T	205.0	1.000	2.000	CT	1.000	0.43	85.10			1973	85034
		8.00			205.0	2.495	1.258	CT	1.232	0.65	104.60			1974	88136
		8.00			205.0	1.000	2.000	CT	1.000	0.56	97.30			1973	85034
		8.00			205.0	2.493	1.261	CT	1.188	0.58	98.60			1974	88136

Table 3.8.2.1 (Continued)

STAINLESS STEEL PH13-8MO K(IC)

CONDITION	--PRODUCT-- FORM	THICK (IN)	TEST TEMP (F)	SPECIMEN ORIENT	YIELD STRENGTH (KSI)	------SPECIMEN------ WIDTH (IN) W	THICK (IN) B	DESIGN	CRACK LENGTH (IN) A	2.5*(K(IC)/TYS)**2 (IN)	K(IC) (KSI*SQRT IN)	K(IC) MEAN	STAN DEV	DATE	REFER
H1000	F	4.00	R.T.	L-T	205.0	1.000	2.000	NB	1.000	1.00	131.00			1972	84365
		8.00			205.0	2.477	1.259	CT	1.226	0.59	99.50			1974	88136
		4.00			205.0	1.000	2.000	NB	1.000	0.69	106.00			1972	84365
		6.00			209.0	1.998	0.753	CT	0.986	0.57	100.00			1973	85034
		6.00			210.0	1.997	0.751	CT	0.988	0.56	99.40			1973	85034
		4.00			211.0	1.000	2.000	CT	1.000	0.56	99.80			1973	85836
		4.00			212.0	1.000	2.000	CT	1.000	0.47	91.70			1973	85836
		4.00			212.0	1.000	2.000	CT	1.000	0.60	104.00	101.6/	11.0	1973	85836
H1000	F	4.00	-65	T-L	215.0	3.000	1.630	CT	----	0.17	56.00			1974	90011
		2.25			215.0	3.000	1.630	CT	----	0.15	53.00	54.5/	2.1	1974	90011
H1000	F	2.75	R.T.	T-L	196.0	2.002	0.752	CT	1.008	0.43	79.50			1973	85857
		2.75			196.0	2.003	0.751	CT	0.990	0.34	73.00			1973	85857
		2.75			196.0	2.004	0.750	CT	1.013	0.37	75.60			1973	85857
		2.75			196.0	2.003	0.750	CT	1.002	0.39	78.20			1973	85857
		6.00			199.0	2.001	0.752	CT	0.986	0.61	98.50			1973	85034
		6.00			201.0	1.999	0.752	CT	0.982	0.51	90.70			1973	85034
		8.00			205.0	1.000	2.000	CT	1.000	0.87	121.00	88.1/	17.1	1973	85034
H1000	F	4.00	R.T.	S-T	202.0	3.002	1.368	CT	1.499	0.46	86.40			1973	85836
H1000	E	1.50	-65	L-T	215.0	3.000	1.000	CT	----	0.15	52.00			1974	90011
		1.50			215.0	3.000	1.000	CT	----	0.13	50.00			1974	90011
		1.50			215.0	3.000	1.000	CT	----	0.12	48.00	50.0/	2.0	1974	90011
H1000	E	1.50	R.T.	L-T	208.0	3.000	1.000	CT	----	0.21	61.00			1974	90011
		1.50			208.0	3.000	1.000	CT	----	0.25	66.00			1974	90011
		1.50			208.0	3.000	1.000	CT	----	0.28	70.00			1974	90011
		1.50			208.0	3.000	1.000	CT	----	0.21	61.00			1974	90011
		1.50			208.0	3.999	1.413	CT	1.973	0.30	72.20			1973	85836
		1.50			208.0	3.999	1.417	CT	2.018	0.34	76.70			1973	85836
		1.50			208.0	3.000	1.000	CT	----	0.29	71.00			1974	90011
		1.50			208.0	3.000	1.000	CT	----	0.28	70.00	68.5/	5.5	1974	90011
H1000	E	1.50	-65	T-L	215.0	3.000	1.000	CT	----	0.12	48.00			1974	90011
		1.50			215.0	3.000	1.000	CT	----	0.12	48.00			1974	90011
		1.50			215.0	3.000	1.000	CT	----	0.13	50.00	48.7/	1.2	1974	90011
H1000	E	1.50	R.T.	T-L	208.0	3.000	1.000	CT	----	0.26	67.00			1974	90011
		1.50			208.0	3.000	1.000	CT	----	0.26	67.00			1974	90011
		1.50			208.0	3.000	1.000	CT	----	0.26	67.00			1974	90011

Table 3.8.2.1 (Continued)

STAINLESS STEEL PH13-8MO K(IC)

CONDITION	PRODUCT FORM	PRODUCT THICK (IN)	TEST TEMP (F)	SPECIMEN ORIENT	YIELD STRENGTH (KSI)	SPECIMEN WIDTH (IN) W	SPECIMEN THICK (IN) B	SPECIMEN DESIGN	CRACK LENGTH (IN) A	2.5*(K(IC)/TYS)**2 (IN)	K(IC) (KSI*SQRT IN)	K(IC) MEAN	STAN DEV	DATE	REFER
H1000	E	1.50	R.T.	T-L	208.0	3.000	1.000	CT	----	0.22	62.00			1974	90011
		1.50			208.0	3.000	1.000	CT	----	0.27	68.00			1974	90011
		1.50			208.0	3.000	1.000	CT	----	0.25	66.00	66.2/	2.1	1974	90011
H1000	FB	4.00	-65	L-T	210.0	2.006	0.998	CT	1.028	0.14	48.90			1973	85836
H1000	FB	1.00	R.T.	L-T	215.0	2.006	1.000	CT	1.052	0.69	113.50			1978	GD009
		1.00			215.0	2.004	1.000	CT	1.051	0.71	114.80	114.2/	0.9	1978	GD009
H1000	FB	1.00	R.T.	T-L	216.0	2.003	1.001	CT	1.034	0.83	124.80			1978	GD009
		1.00			216.0	2.004	1.005	CT	1.048	0.76	119.30			1978	GD009
		1.00			216.0	2.005	1.001	CT	1.058	0.82	124.00	122.7/	3.0	1978	GD009
H1000	RB	1.50	R.T.	L-T	205.0	3.000	1.000	CT	----	0.54	95.00			1974	90011
		1.50			205.0	3.000	1.000	CT	----	0.43	85.00	90.0/	7.1	1974	90011
H1000	RB	1.50	R.T.	T-L	205.0	3.000	1.000	CT	----	0.36	78.00			1974	90011
		1.50			205.0	3.000	1.000	CT	----	0.31	72.00	75.0/	4.2	1974	90011
H1025	S	5.00	R.T.	L-T	200.0	----	----	NB	----	0.44	84.30			1972	84365
H1050	RB	2.25	R.T.	L-T	172.0	2.000	1.000	CT	1.019	0.91	103.90			1973	86688
		2.25			172.0	2.000	1.000	CT	1.018	0.81	98.20			1973	86688
		2.25			172.0	2.000	1.000	CT	1.034	0.97	107.30	103.1/	4.6	1973	86688
H1050	RB	2.25	R.T.	T-L	178.0	2.000	1.000	CT	1.030	0.61	88.10			1973	86688
		2.25			178.0	4.000	2.000	CT	2.104	0.82	102.10			1973	86688
		2.25			178.0	4.000	2.000	CT	2.091	0.81	101.40			1973	86688
		2.25			178.0	2.000	1.000	CT	1.032	0.59	86.30			1973	86688
		2.25			178.0	4.000	2.000	CT	2.105	0.82	102.30			1973	86688
		2.25			178.0	2.000	1.000	CT	1.028	0.62	88.90	94.9/	7.8	1973	86688
H1050	RB	2.25	R.T.	S-L	176.0	1.500	0.750	CT	0.762	0.64	89.20			1973	86688
		2.25			176.0	1.500	0.750	CT	0.781	0.73	95.20	92.2/	4.2	1973	86688
MILL 1700F, LAB 1050F 4HR	F	5.00	-65	L-T	195.0	2.996	1.500	CT	1.546	0.41	78.80			1973	85836

Table 3.8.2.1 (Continued)

STAINLESS STEEL PH13-8MO K(IC)

CONDITION	PRODUCT FORM	PRODUCT THICK (IN)	TEST TEMP (F)	SPECIMEN ORIENT	YIELD STRENGTH (KSI)	SPECIMEN WIDTH (IN) W	SPECIMEN THICK (IN) B	SPECIMEN DESIGN	CRACK LENGTH (IN) A	2.5*(K(IC)/TYS)**2 (IN)	K(IC) (KSI*SQRT IN)	K(IC) MEAN	STAN DEV	DATE	REFER
MILL 17?0F,LAB 1600F,1?00F 4HR	F	5.00	- 65	L-T	195.0	2.008	1.000	CT	1.060	0.30	67.60			1973	85836
MILL 1?00F,LAB 1500F,1?00F 4HR	F	5.00	- 65	L-T	195.0	2.006	0.999	CT	1.052	0.34	72.50			1973	85836
RH 950	RB	1.50	R.T.	L-R	210.0	1.000	0.500	CT	----	0.18	57.00			1974	90011
		1.50			210.0	1.000	0.500	CT	----	0.22	62.00			1974	90011
		1.50			210.0	1.000	0.500	CT	----	0.21	61.00			1974	90011
		1.50			210.0	1.000	0.500	CT	----	0.20	59.00	59.8/	2.2	1974	90011
RH 975	RB	1.50	R.T.	L-R	207.0	1.000	0.500	CT	----	0.25	66.00			1974	90011
		1.50			207.0	1.000	0.500	CT	----	0.34	76.00			1974	90011
		1.50			207.0	1.000	0.500	CT	----	0.30	68.00	70.0/	5.3	1974	90011
RH1000	RB	1.50	R.T.	L-R	205.0	1.000	0.500	CT	----	0.54	95.00			1974	90011

TABLE 3.8.3.1

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 3.8.3.1 INDICATING EFFECT

OF STRESS RATIO

MATERIAL: STAINLESS STEEL PH13-8MO
CONDITION:
ENVIRONMENT: R.T., L.H.A.

DELTA K (KSI*IN**1/2)		DA/DN (10**-6 IN./CYCLE) A	B	C	D
		R=+0.08	R=+0.30		
DELTA K MIN	A: 13.43	.370			
	B: 10.60		.114		
	C:				
	D:				
	13.00		.463		
	16.00	.936	1.32		
	20.00	2.22	2.98		
	25.00	4.12	5.56		
	30.00	6.17	8.77		
	35.00	8.51	13.1		
	40.00	11.4	19.6		
	50.00	20.8			
	60.00	40.2			
DELTA K MAX	A: 61.76	45.5			
	B: 48.07		38.4		
	C:				
	D:				
ROOT MEAN SQUARE PERCENT ERROR		8.38	7.23		
LIFE PREDICTION RATIO SUMMARY (NP/NA)	0.0-0.5				
	0.5-0.8				
	0.8-1.25	1			
	1.25-2.0		1		
	>2.0				

CONDITION/HT:
FORM: EXTRUDED BAR
SPECIMEN TYPE: CT
ORIENTATION: L-T
FREQUENCY: 6.0 HZ
ENVIRONMENT: R.T., L.H.A.

YIELD STRENGTH: 201.0 KSI
ULT. STRENGTH: 212.0 KSI
SPECIMEN THK: 0.280"
SPECIMEN WIDTH: 6.000"
REFERENCES: 88579

STAIN. STEEL

PH13-8MO

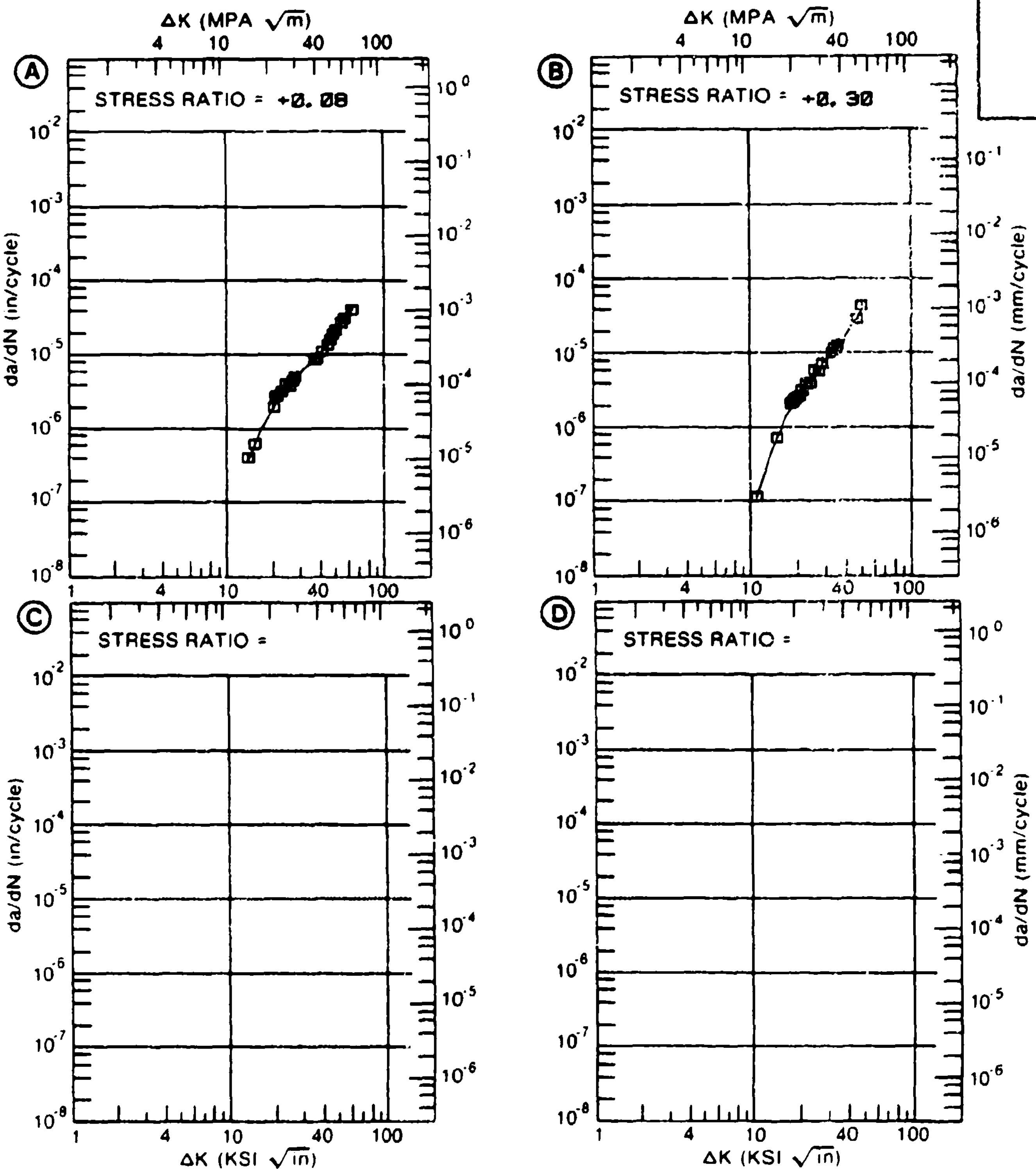


Figure 3.8.3.1

TABLE 3.8.3.2

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 3.8.3.2 INDICATING EFFECT

OF ENVIRONMENT

MATERIAL: STAINLESS STEEL PH13-8MO
CONDITION:

DELTA K (KSI*IN**1/2)			DA/DN (10**-6 IN./CYCLE)			
			A	B	C	D
			E= R.T. L.H.A.-6.0HZ	E=- 65 F L.H.A.-6.0HZ	E= R.T. S.T.W.-1.0HZ	
	A:	13.43	.370			
DELTA K	B:	13.84		.259		
MIN	C:	12.50			.148	
	D:					
		13.00			.211	
		16.00	.936	.531	.962	
		20.00	2.22	1.32	2.85	
		25.00	4.12	2.79	6.10	
		30.00	6.17	4.78	10.6	
		35.00	8.51	7.39	17.9	
		40.00	11.4	10.8	31.5	
		50.00	20.8	21.6		
		60.00	40.2	41.8		
	A:	61.76	45.5			
DELTA K	B:	62.88		50.5		
MAX	C:	42.46			42.5	
	D:					
ROOT MEAN SQUARE PERCENT ERROR			8.38	7.09	6.15	
LIFE PREDICTION RATIO SUMMARY (NP/NA)		0.0-0.5				
		0.5-0.8				
		0.8-1.25	1	1	1	
		1.25-2.0				
		>2.0				

CONDITION/HT:
FORM: EXTRUDED BAR
SPECIMEN TYPE: CT
ORIENTATION: L-T
STRESS RATIO: +0.08
FREQUENCY:

YIELD STRENGTH: 201.0 KSI
ULT. STRENGTH: 212.0 KSI
SPECIMEN THK: 0.250- 0.280"
SPECIMEN WIDTH: 6.000"
REFERENCES: 88579

STAIN. STEEL

PH13-8MO

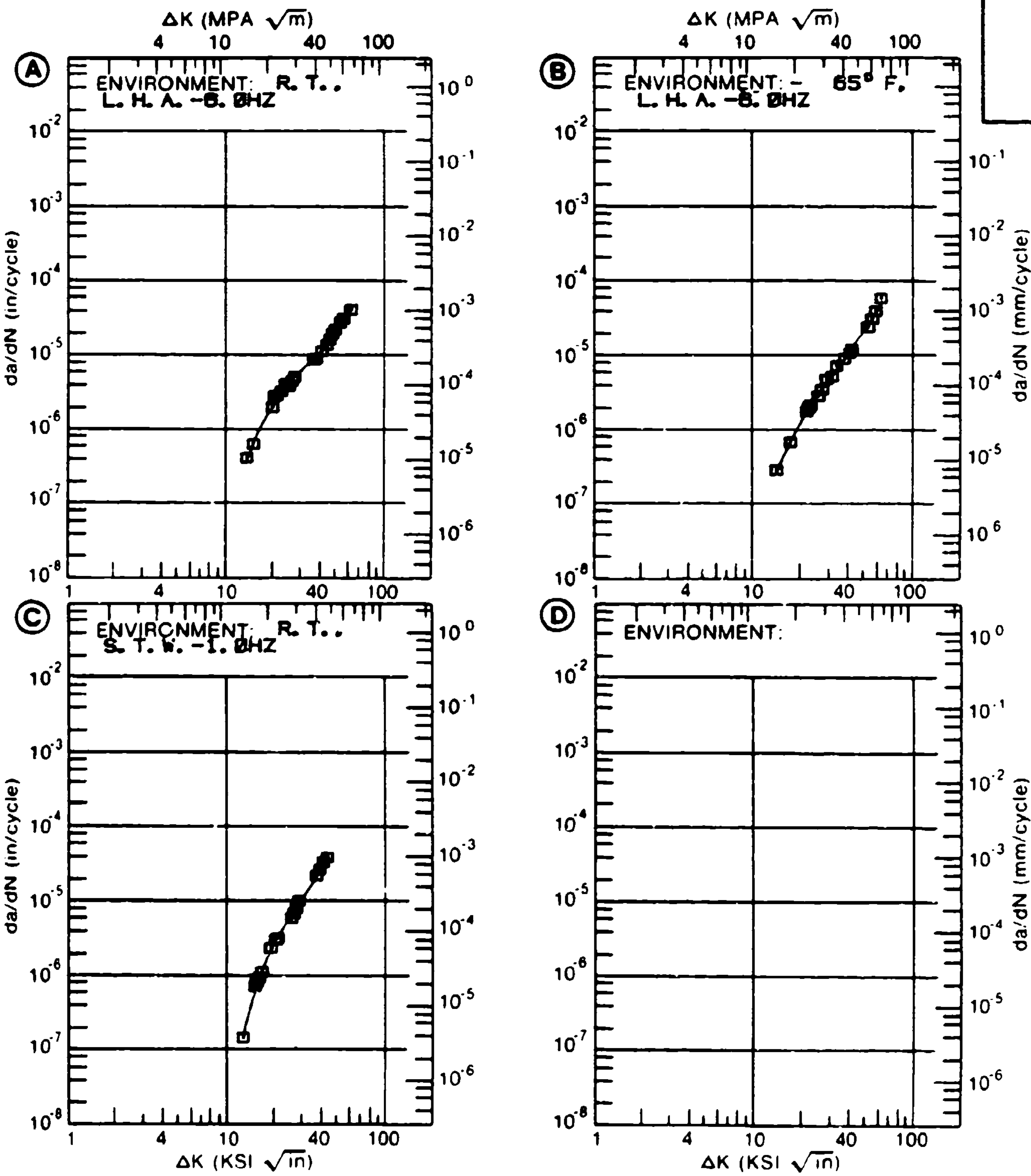


Figure 3.8.3.2

TABLE 3.8.3.3

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 3.8.3.3 INDICATING EFFECT

OF FREQUENCY

MATERIAL: STAINLESS STEEL PH13-8MO
CONDITION: H1000
ENVIRONMENT: R. T., LAB AIR

DELTA K (KSI*IN**1/2)			DA/DN (10**-6 IN./CYCLE) A	B	C	D
			F(HZ)= 1.00			
	A:	22.06	5.28			
DELTA K	B:					
MIN	C:					
	D:					
		25.00	6.49			
		30.00	9.06			
		35.00	12.5			
		40.00	17.1			
		50.00	31.6			
	A:	56.54	46.7			
DELTA K	B:					
MAX	C:					
	D:					
ROOT MEAN SQUARE PERCENT ERROR			1.97			
LIFE		0.0-0.5				
PREDICTION		0.5-0.8				
RATIO		0.8-1.25	1			
SUMMARY		1.25-2.0				
(NP/NA)		>2.0				

CONDITION/HT: H1000
FORM: 2.50"TH BAR
SPECIMEN TYPE: CT
ORIENTATION: L-T
STRESS RATIO: +0.02
ENVIRONMENT: R.T., LAB AIR

YIELD STRENGTH: 205.0 KSI
ULT. STRENGTH: 211.5 KSI
SPECIMEN THK: 1.250"
SPECIMEN WIDTH: 5.000"
REFERENCES: 88136

STAIN. STEEL

PH13-8MO

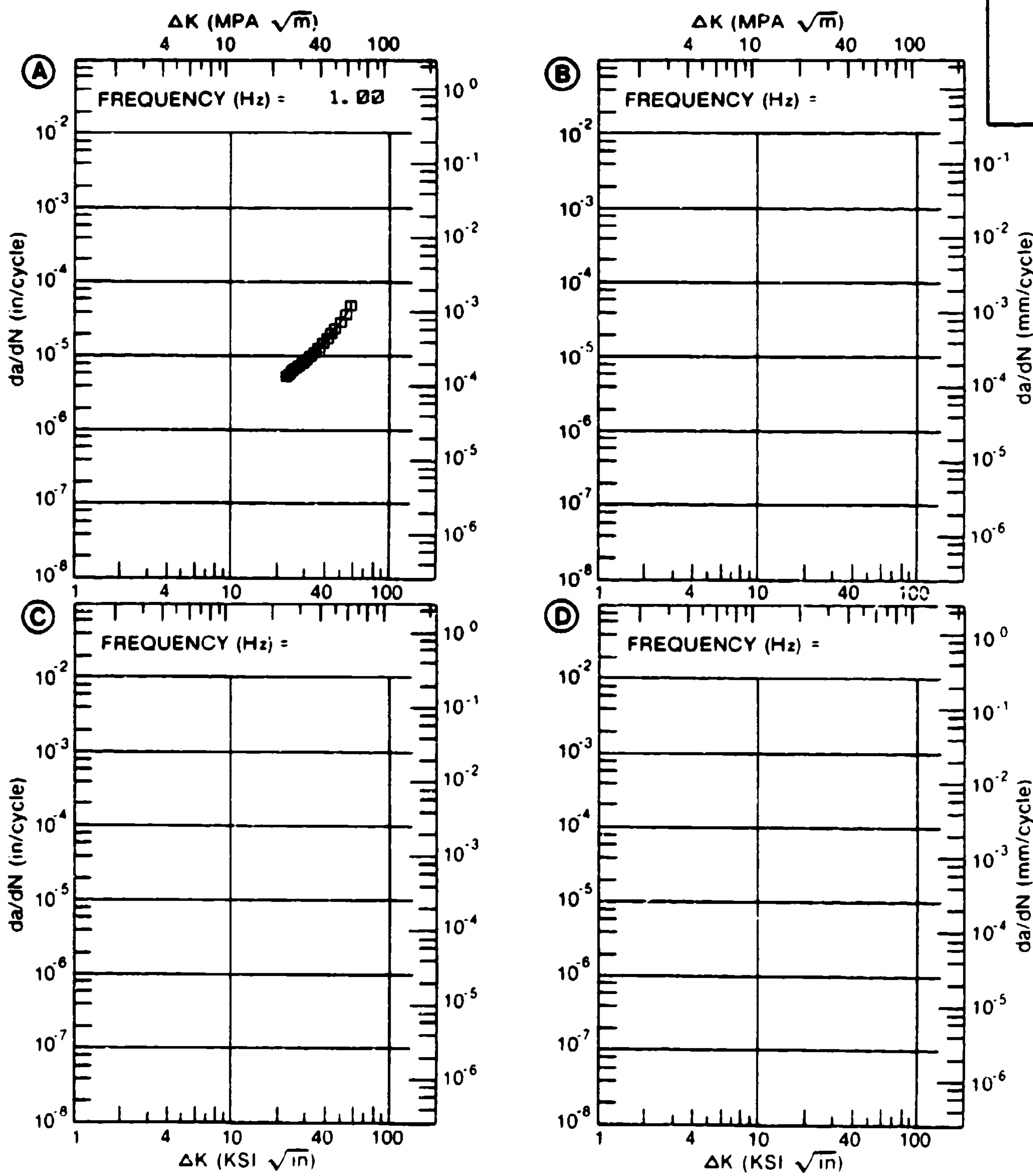


Figure 3.8.3.3

TABLE 3.8.3.4

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 3.8.3.4 INDICATING EFFECT

OF ENVIRONMENT

MATERIAL: STAINLESS STEEL PH13-8MO
CONDITION: H1000

DELTA K (KSI*IN**1/2)			DA/DN (10**-6 IN./CYCLE) A	B	C	D
			E= R.T. L.H.A.			
DELTA K MIN	A:	8.54	.20			
	B:					
	C:					
	D:					
		9.00	.236			
		10.00	.341			
		13.00	.986			
		16.00	2.11			
		20.00	4.02			
		25.00	6.85			
		30.00	10.3			
		35.00	14.6			
DELTA K MAX	A:	35.80	15.4			
	B:					
	C:					
	D:					

ROOT MEAN SQUARE PERCENT ERROR 17.07

LIFE PREDICTION RATIO SUMMARY (NP/NA)		
	0.0-0.5	
	0.5-0.8	
	0.8-1.25	1
	1.25-2.0	
	>2.0	

CONDITION/HT: H1000
FORM: 6.00"TH BILLET
SPECIMEN TYPE: CT
ORIENTATION: L-T
STRESS RATIO: +0.08
FREQUENCY: 6.00 HZ

YIELD STRENGTH: 191.0 KSI
ULT. STRENGTH: 208.0 KSI
SPECIMEN THK: 0.987"
SPECIMEN WIDTH: 6.191"
REFERENCES: 85837

STAIN. STEEL

PH13-8MO

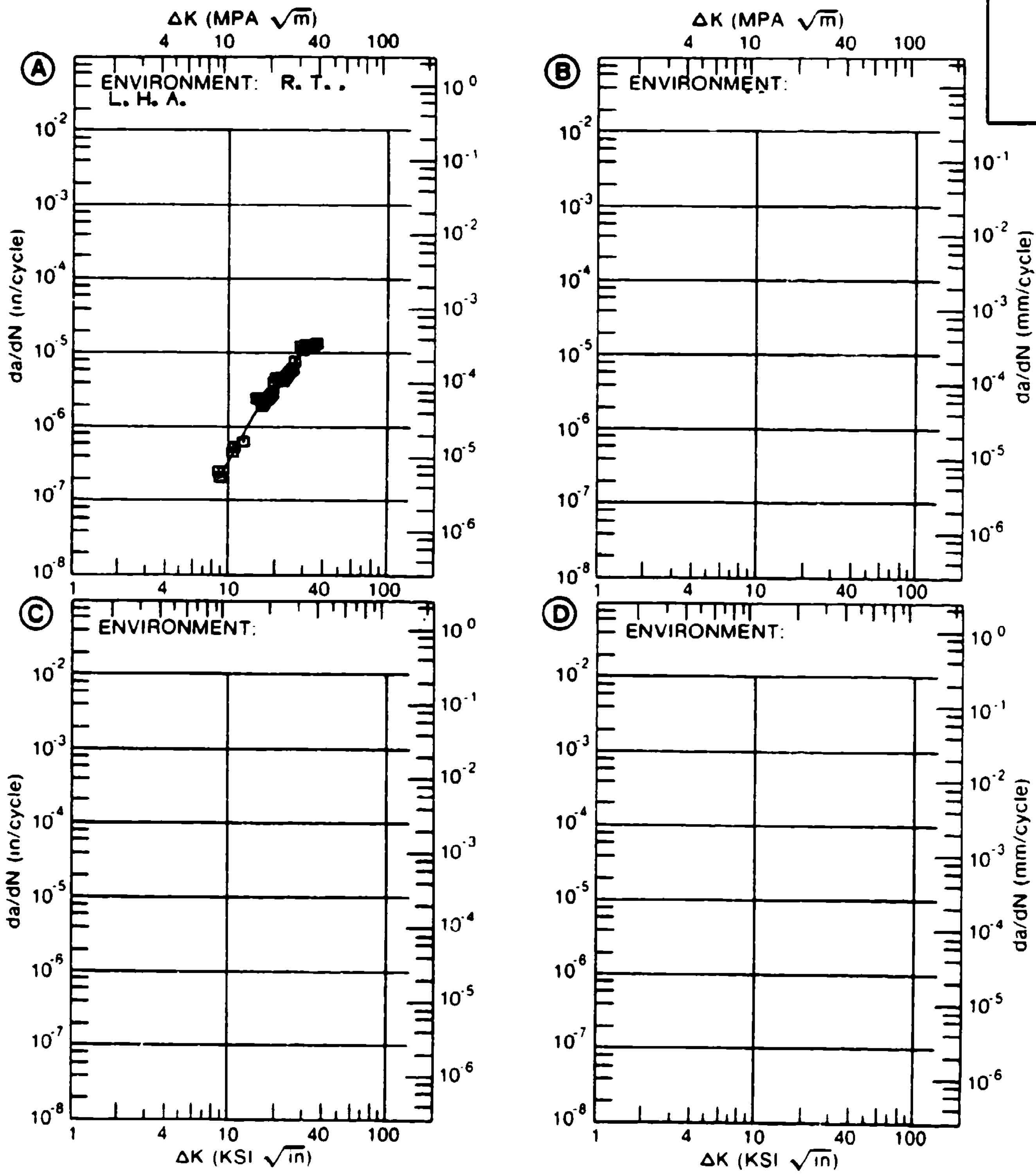


Figure 3.8.3.4

TABLE 3.8.3.5

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 3.8.3.5 INDICATING EFFECT

OF ENVIRONMENT

MATERIAL: STAINLESS STEEL PH13-8MO
CONDITION: H1000

DELTA K (KSI*IN**1/2)		DA/DN (10**-6 IN./CYCLE) A	B	C	D
		E=- 65F L. H. A.			
DELTA K MIN	A: 8.14	.129			
	B:				
	C:				
	D:				
	9.00	.172			
	10.00	.238			
	13.00	.552			
	16.00	1.05			
	20.00	2.02			
	25.00	3.92			
	30.00	7.14			
	35.00	12.7			
DELTA K MAX	A: 35.96	14.2			
	B:				
	C:				
	D:				

ROOT MEAN SQUARE PERCENT ERROR	6.53

LIFE PREDICTION RATIO SUMMARY (NP/NA)		
	0.0-0.5	
	0.5-0.8	
	0.8-1.25	
	1.25-2.0	1
	>2.0	

CONDITION/HT: H1000
FORM: 6.00"TH BILLET
SPECIMEN TYPE: CT
ORIENTATION: S-T
STRESS RATIO: +0.08
FREQUENCY: 6.00 HZ

YIELD STRENGTH: 190.0 KSI
ULT. STRENGTH: 207.0 KSI
SPECIMEN THK: 1.000"
SPECIMEN WIDTH: 4.940"
REFERENCES: 88579

STAIN. STEEL

PH13-8MO

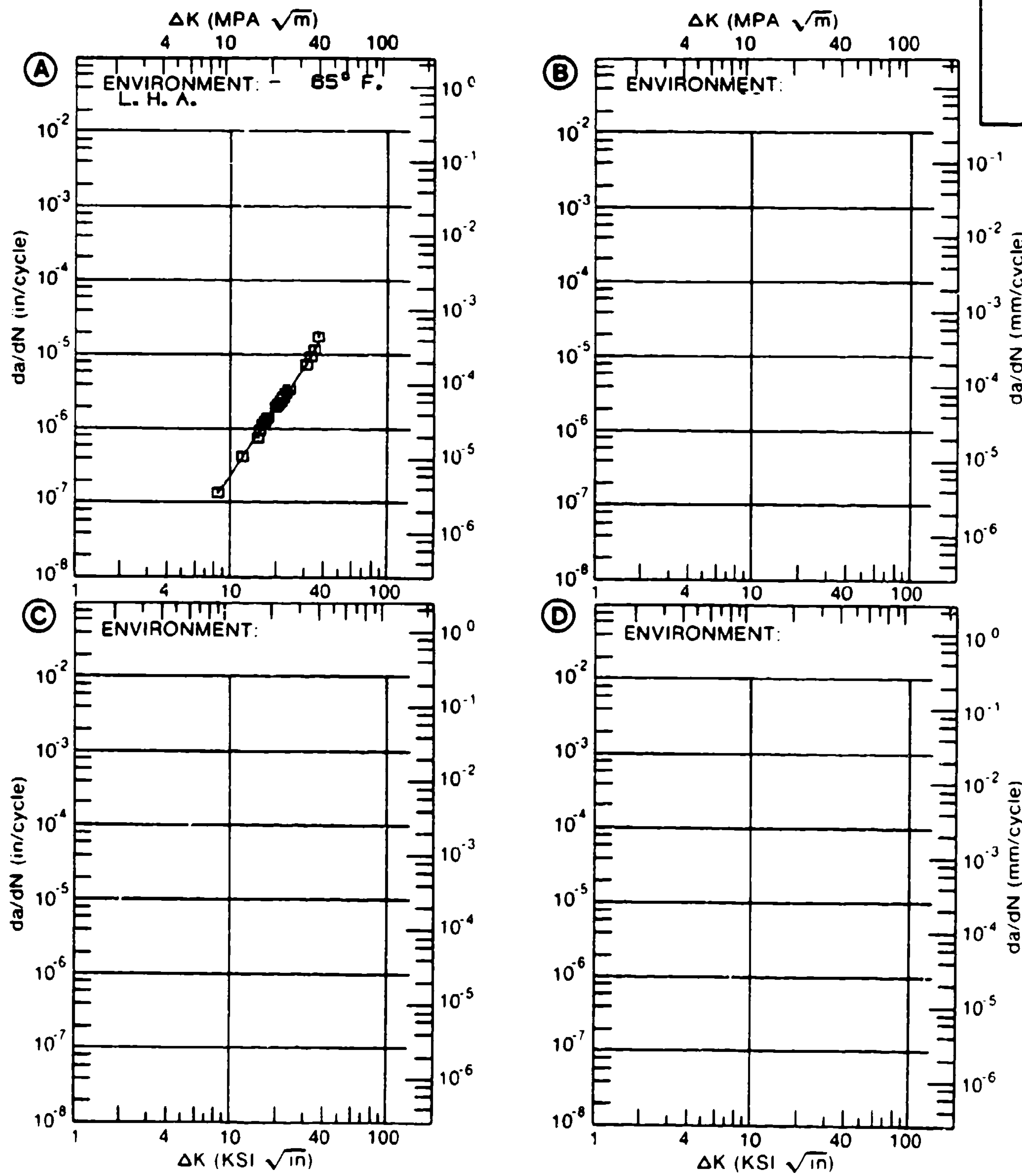


Figure 3.8.3.5

TABLE 3.8.3.6

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 3.8.3.6 INDICATING EFFECT

OF ENVIRONMENT

MATERIAL: STAINLESS STEEL PH13-8MO
CONDITION: H1000

DELTA K (KSI*IN**1/2)		DA/DN (10**-6 IN./CYCLE) A	B	C	D
		E= R.T. L.H.A.			
DELTA K MIN A:	8.63	.241			
B:					
C:					
D:					
	9.00	.256			
	10.00	.340			
	13.00	1.01			
	16.00	2.00			
	20.00	3.47			
	25.00	5.60			
	30.00	8.38			
	35.00	11.9			
	40.00	16.1			
	50.00	31.3			
DELTA K MAX A:	55.15	54.3			
B:					
C:					
D:					
ROOT MEAN SQUARE PERCENT ERROR		5.25			
LIFE PREDICTION RATIO SUMMARY (NP/NA)	0.0-0.5				
	0.5-0.8				
	0.8-1.25	1			
	1.25-2.0				
	>2.0				

CONDITION/HT: H1000
FORM: 22.00"TH BILLET
SPECIMEN TYPE: CT
ORIENTATION: T-L
STRESS RATIO: +0.08
FREQUENCY: 6.00 HZ

YIELD STRENGTH: 190.0 KSI
ULT. STRENGTH: 207.0 KSI
SPECIMEN THK: 1.000"
SPECIMEN WIDTH: 4.940"
REFERENCES: 88579

STAIN. STEEL

PH13-8MO

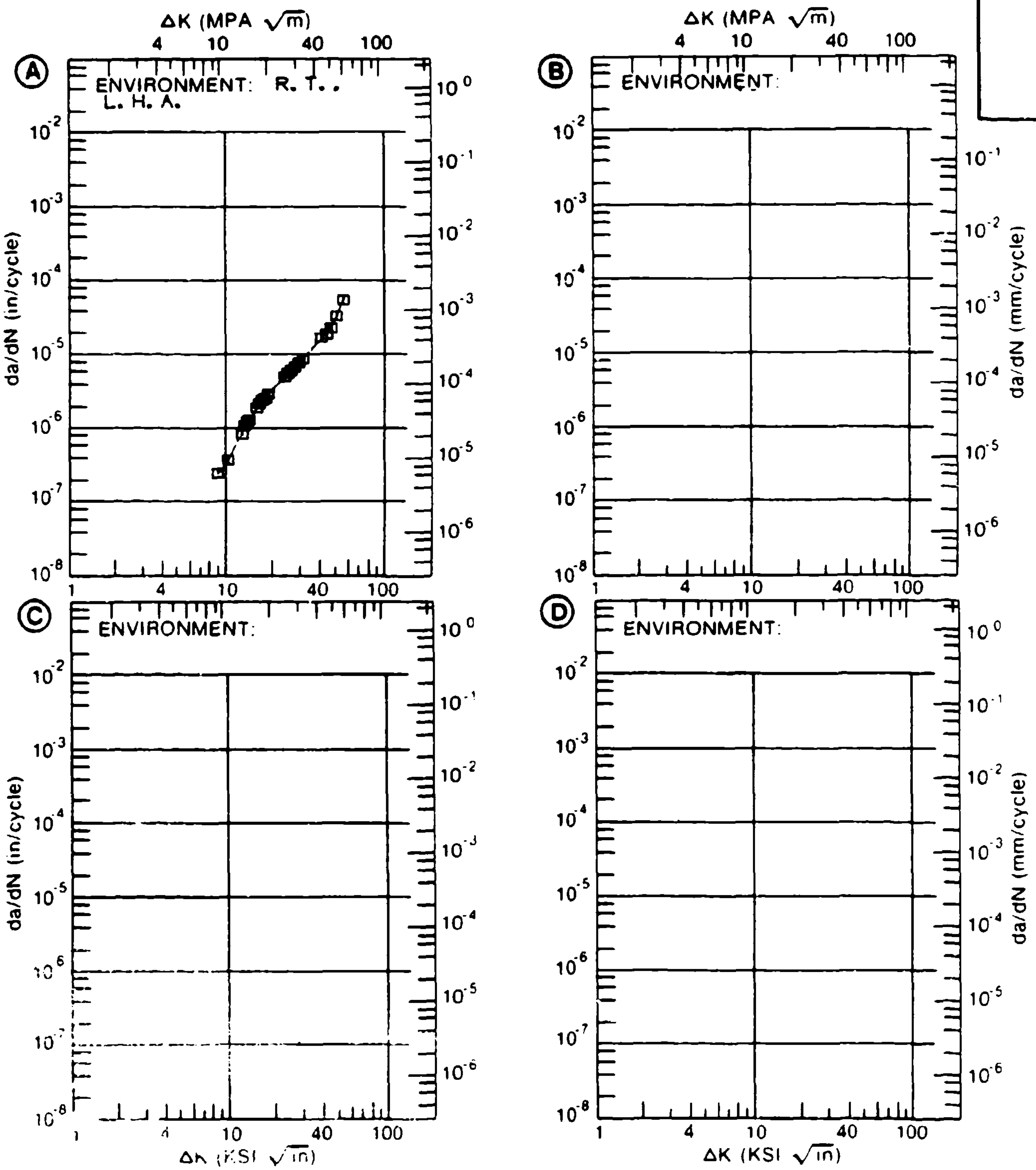


Figure 3.8.3.6

TABLE 3.8.3.7

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 3.8.3.7 INDICATING EFFECT
OF STRESS RATIO

MATERIAL: STAINLESS STEEL PH13-8MO
CONDITION: H1000
ENVIRONMENT: R.T., L.H.A.

DELTA K (KSI*IN**1/2)			DA/DN (10**-6 IN./CYCLE) A	B	C	D
			R=+0.08	R=+0.50		
	A:	7.96	.154			
DELTA K MIN	B:	7.25		.252		
	C:					
	D:					
		8.00	.156	.383		
		9.00	.219	.598		
		10.00	.335	.852		
		13.00	1.12	1.82		
		16.00	2.31	3.10		
		20.00	3.83	5.59		
		25.00	5.93	11.0		
		30.00	9.36	21.3		
		35.00	15.7			
		40.00	24.2			
		50.00	34.1			
	A:	59.52	48.3			
DELTA K MAX	B:	33.12		32.5		
	C:					
	D:					
[illegible] SQUARE [illegible] ERROR			15.95	11.43		
[illegible]		[illegible]				
[illegible]REDICT[illegible]ON		[illegible]				
[illegible]		[illegible]-1.25	2	2		
SUMMARY		[illegible]5-2.0	1			
NP/NA		[illegible]2.0				

CONDITION/HT: H1000
FORM: 1.50"TH EXTRUDED BAR
SPECIMEN TYPE: CT
ORIENTATION: L-T
FREQUENCY: 6.0 HZ
ENVIRONMENT: R.T., L.H.A.

YIELD STRENGTH: 214.0 KSI
ULT. STRENGTH: 221.0 KSI
SPECIMEN THK: 1.000"
SPECIMEN WIDTH: 6.170- 6.180"
REFERENCES: 88579

STAIN. STEEL

PH13-8MO

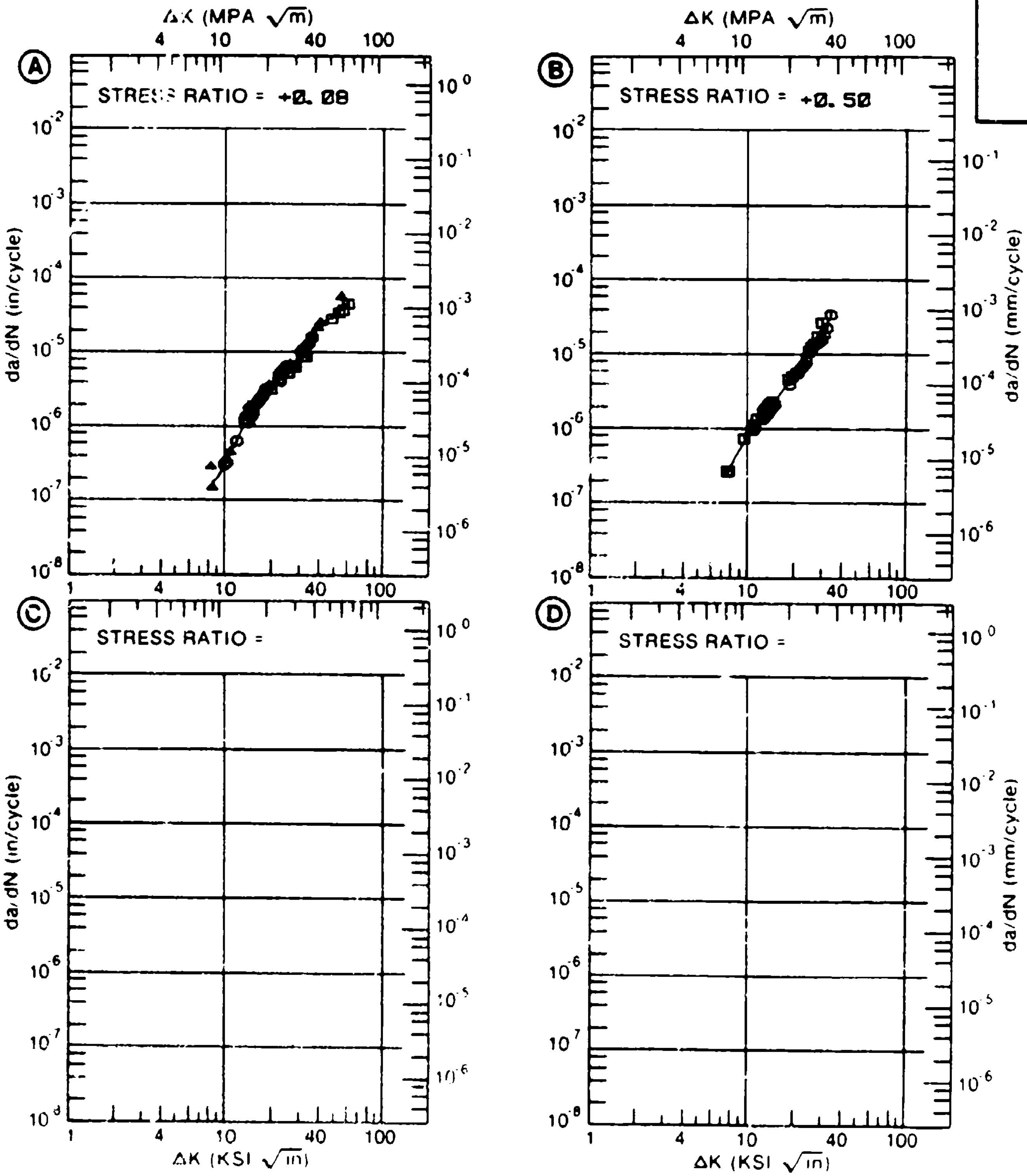


Figure 3.8.3.7

TABLE 3.8.3.8

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 3.8.3.8 INDICATING EFFECT

OF ENVIRONMENT

MATERIAL: STAINLESS STEEL PH13-8MO
CONDITION: H1000

DELTA K (KSI*IN**1/2)			DA/DN (10**-6 IN./CYCLE) A	B	C	D
			E= R.T. L.H.A.-6.0HZ	E=- 65 F L.H.A.-6.0HZ	E= R.T. S.T.W.-1.0HZ	
DELTA K MIN	A:	7.96	.156			
	B:	7.62		.112		
	C:	8.27			.388	
	D:					
		8.00	.157	.123		
		9.00	.216	.167	.479	
		10.00	.331	.236	.643	
		13.00	1.14	.635	1.49	
		16.00	2.33	1.31	3.13	
		20.00	3.73	2.87	7.11	
		25.00	5.82	4.64	15.8	
		30.00	9.82		29.0	
		35.00	16.2			
		40.00	23.2			
		50.00	34.4			
DELTA K MAX	A:	59.52	46.5			
	B:	29.92		12.3		
	C:	34.43			43.7	
	D:					
ROOT MEAN SQUARE PERCENT ERROR			16.24	16.25	8.27	
LIFE PREDICTION RATIO SUMMARY (NP/NA)		0.0-0.5				
		0.5-0.8				
		0.8-1.25	2	1	1	
		1.25-2.0	1			
		>2.0				

CONDITION/HT: H1000
FORM: 1.50"TH EXTRUDED BAR
SPECIMEN TYPE: CT
ORIENTATION: L-T
STRESS RATIO: +0.08
FREQUENCY:

YIELD STRENGTH: 208.0- 214.0 KSI
ULT. STRENGTH: 216.0- 221.0 KSI
SPECIMEN THK: 0.999- 1.000"
SPECIMEN WIDTH: 6.170- 6.180"
REFERENCES: 88579, 85837

STAIN. STEEL

PH13-8MO

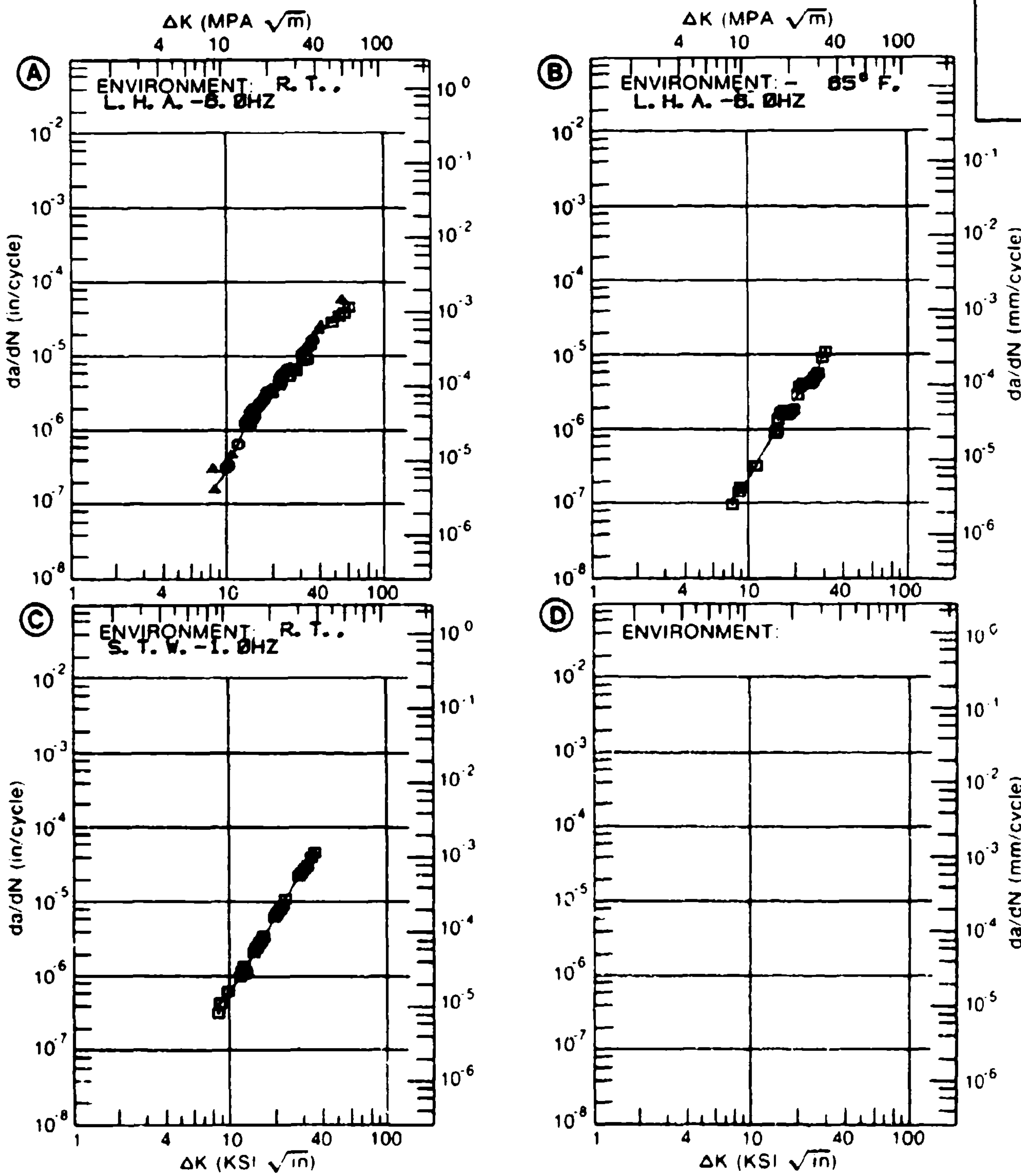


Figure 3.8.3.8

TABLE 3.8.3.9

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 3.8.3.9 INDICATING EFFECT

OF ENVIRONMENT

MATERIAL: STAINLESS STEEL PH13-8MO
CONDITION: H1000

DELTA K (KSI*IN**1/2)		DA/DN (10**-6 IN./CYCLE) A	B	C	D
		E= R.T. LAB AIR	E= R.T. SIM. SEA WATER		
DELTA K MIN A:	12.29	1.26			
DELTA K MIN B:	12.13		1.30		
DELTA K MIN C:					
DELTA K MIN D:					
	13.00	1.53	1.82		
	16.00	2.97	4.36		
	20.00	5.44	9.07		
	25.00	9.04	16.1		
	30.00	13.0	23.9		
	35.00	17.3	32.3		
	40.00	21.8	41.8		
	50.00	31.9	65.5		
	60.00	44.0	99.7		
	70.00	58.6			
	80.00	76.7			
	90.00	99.1			
	100.00	127.			
	130.00	259.			
DELTA K MAX A:	154.80	457.			
DELTA K MAX B:	69.01		145.		
DELTA K MAX C:					
DELTA K MAX D:					
ROOT MEAN SQUARE PERCENT ERROR		6.23	11.04		
LIFE PREDICTION RATIO SUMMARY (NP/NA)	0.0-0.5				
	0.5-0.8				
	0.8-1.25	2	2		
	1.25-2.0				
	>2.0				

CONDITION/HT: H1000
FORM: 3.00"TH FORGING
SPECIMEN TYPE: CT
ORIENTATION: L-T
STRESS RATIO: +0.10
FREQUENCY: 1.00- 10.00 HZ

YIELD STRENGTH: 206.0 KSI
ULT. STRENGTH: 210.6 KSI
SPECIMEN THK: 1.003- 1.005"
SPECIMEN WIDTH: 4.500- 7.400"
REFERENCES: NC002

STAIN. STEEL

PH13-8MO

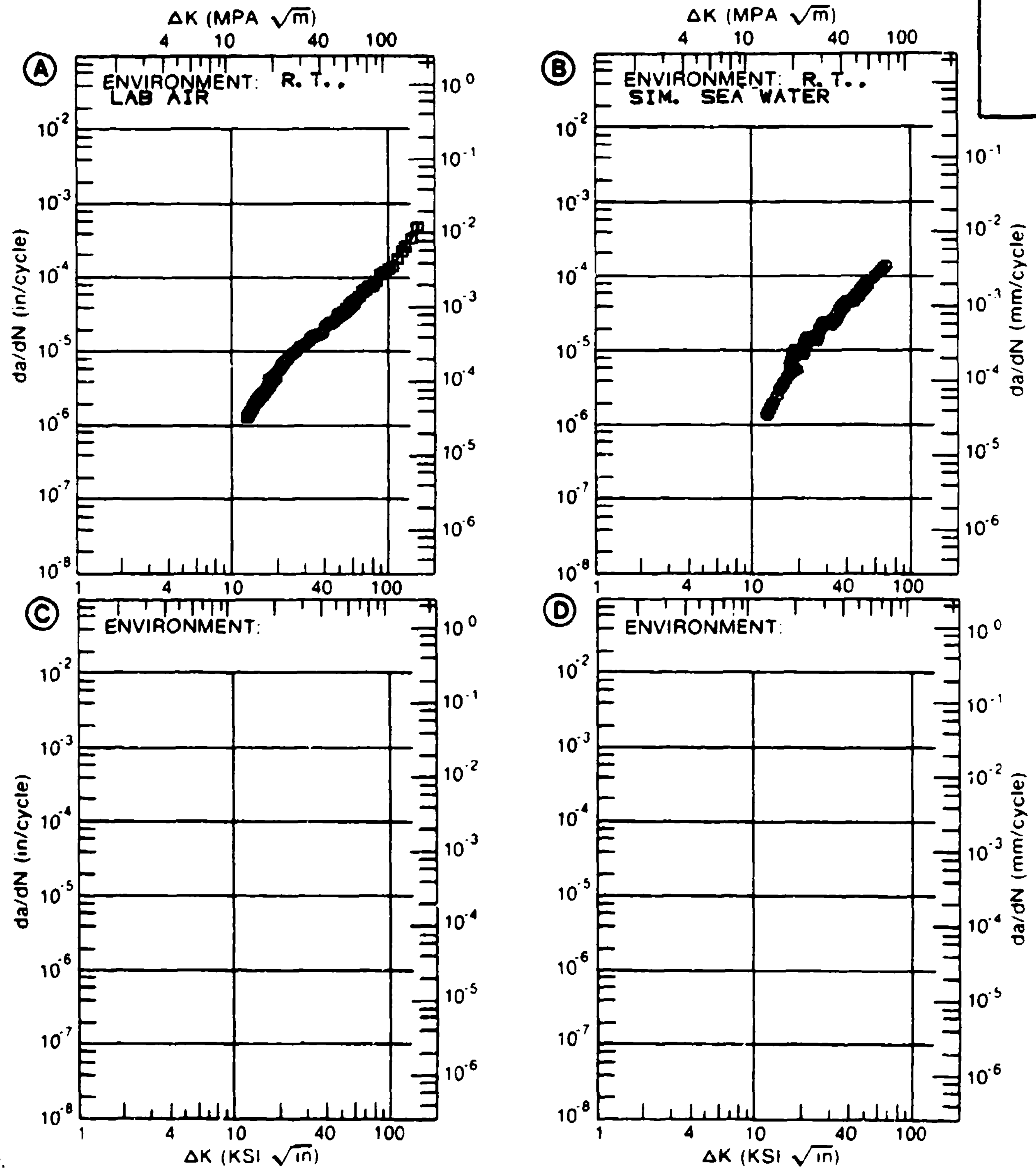


Figure 3.8.3.9

TABLE 3.8.3.10

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 3.8.3.10 INDICATING EFFECT

OF ENVIRONMENT

MATERIAL: STAINLESS STEEL PH13-8MO
CONDITION: H1000

DELTA K (KSI*IN**1/2)			DA/DN (10**-6 IN./CYCLE) A: E= R.T. LAB AIR	B: E= R.T. SIM. SEA WATER	C	D
DELTA K MIN	A:	12.18	1.37			
	B:	12.34		1.57		
	C:					
	D:					
		13.00	1.70	1.93		
		16.00	3.16	4.42		
		20.00	5.57	8.95		
		25.00	9.04	15.5		
		30.00	12.9	22.8		
		35.00	17.0	31.2		
		40.00	21.6	40.9		
		50.00	32.1	65.4		
		60.00	45.2	99.7		
		70.00	61.7	148.		
		80.00	82.8	212.		
		90.00	110.	296.		
		100.00	145.	404.		
		130.00		896.		
DELTA K MAX	A:	116.68	226.			
	B:	137.87		1074.		
	C:					
	D:					
ROOT MEAN SQUARE PERCENT ERROR			6.87	12.77		
LIFE PREDICTION RATIO SUMMARY (NP/NA)		0.0-0.5				
		0.5-0.8				
		0.8-1.25	2	2		
		1.25-2.0				
		>2.0				

CONDITION/HT: H1000
FORM: 3.00"TH FORGING
SPECIMEN TYPE: CT
ORIENTATION: T-L
STRESS RATIO: +0.10
FREQUENCY: 1.00- 10.00 HZ

YIELD STRENGTH: 205.4 KSI
ULT. STRENGTH: 210.8 KSI
SPECIMEN THK: 1.003- 1.005"
SPECIMEN WIDTH: 4.500- 7.400"
REFERENCES: NC002

STAIN. STEEL

PH13-8MO

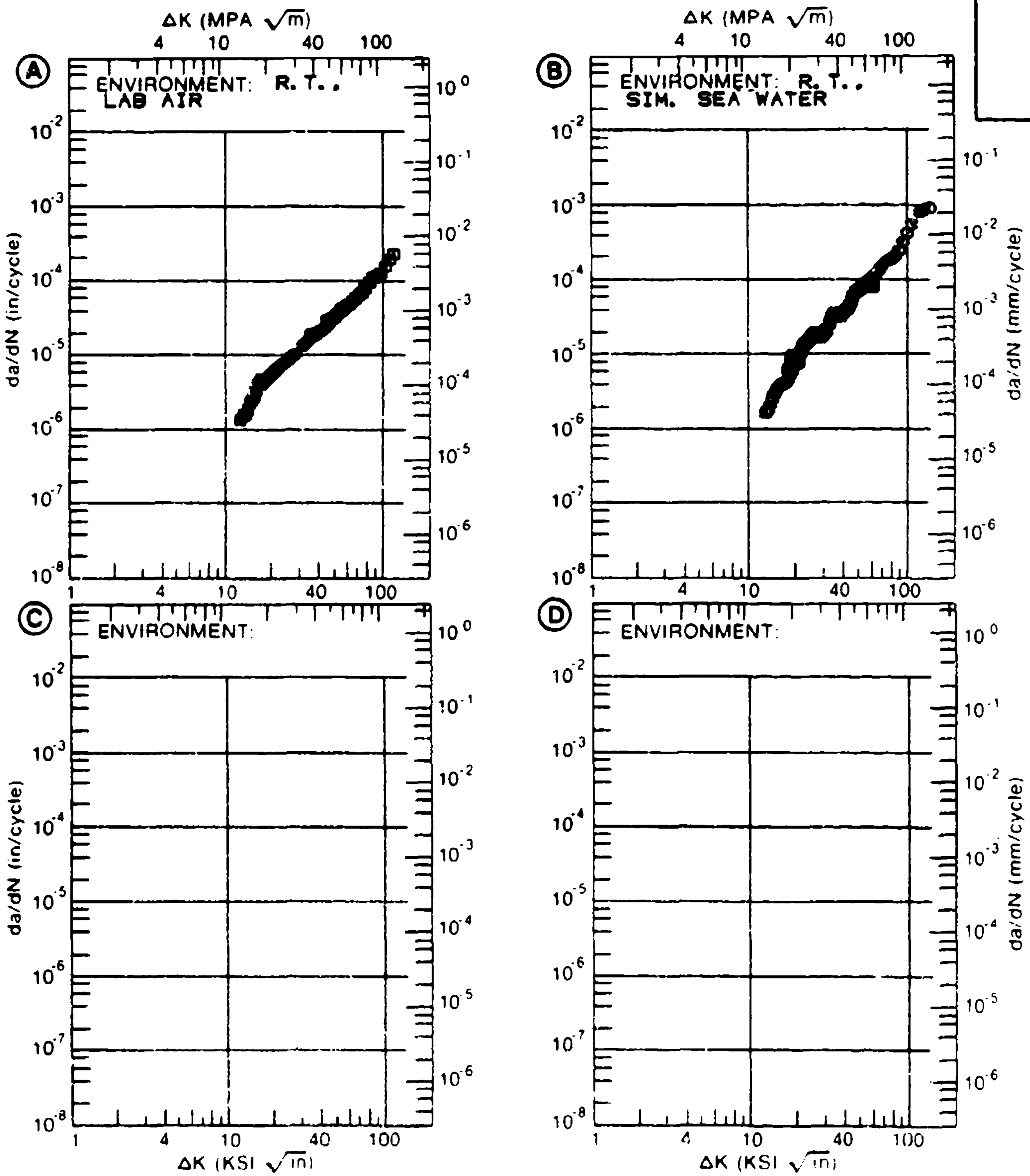


Figure 3.8.3.10

TABLE 3.8.3.11

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 3.8.3.11 INDICATING EFFECT
OF STRESS RATIO

MATERIAL: STAINLESS STEEL PH13-8MO
CONDITION: H1000
ENVIRONMENT: R. T., DRY AIR

DELTA K (KSI*IN**1/2)		DA/DN (10**-6 IN./CYCLE) A R=+0.10	B R=+0.30	C R=+0.50	D
DELTA K MIN A:	8.91	.137			
DELTA K MIN B:	7.44		.177		
DELTA K MIN C:	6.27			.0264	
DELTA K MIN D:					
	7.00			.120	
	8.00		.244	.243	
	9.00	.144	.393	.413	
	10.00	.239	.582	.641	
	13.00	.724	1.36	1.58	
	16.00	1.53	2.41	2.80	
	20.00	3.07	4.17	4.79	
	25.00	5.69	6.96	8.03	
	30.00	9.00	10.5	12.6	
	35.00	13.0	15.1	19.5	
	40.00	17.7	21.1		
	50.00	29.6			
	60.00	45.7			
	70.00	67.2			
	80.00	95.9			
DELTA K MAX A:	85.01	114.			
DELTA K MAX B:	40.86		22.2		
DELTA K MAX C:	37.95			25.1	
DELTA K MAX D:					
ROOT MEAN SQUARE PERCENT ERROR		5.19	5.60	6.49	
LIFE PREDICTION RATIO SUMMARY (NP/NA)	0.0-0.5				
	0.5-0.8				
	0.8-1.25	1	1	1	
	1.25-2.0				
	>2.0				

STAIN. STEEL

PH13-8MO

CONDITION/HT: H1000
FORM: 1.00"TH FORGED BAR
SPECIMEN TYPE: CT
ORIENTATION: L-T
FREQUENCY: 8.0 HZ
ENVIRONMENT: R.T., DRY AIR

YIELD STRENGTH: 215.0 KSI
ULT. STRENGTH: 221.0 KSI
SPECIMEN THK: 0.500- 0.502"
SPECIMEN WIDTH: 3.987- 3.992"
REFERENCES: CD009

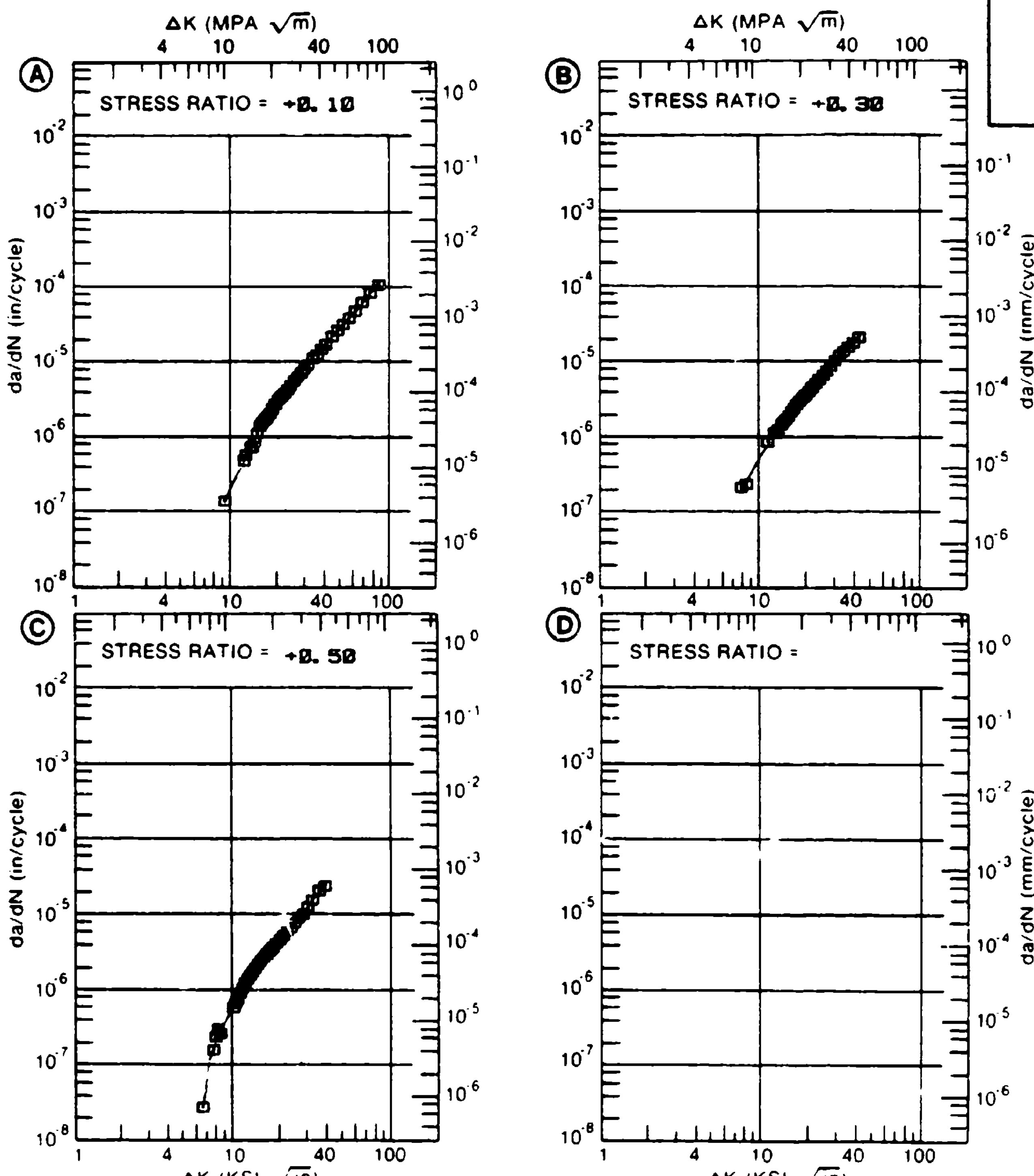


Figure 3.8.3.11

TABLE 3.8.3.12

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 3.8.3.12 INDICATING EFFECT

OF STRESS RATIO

MATERIAL: STAINLESS STEEL PH13-8MO
CONDITION: H1000
ENVIRONMENT: R.T., H.H.A.

DELTA K (KSI*IN**1/2)		DA/DN (10**-6 IN./CYCLE) A R=+0.10	B R=+0.30	C R=+0.50	D
DELTA K MIN A:	9.78	.219			
B:	9.28		.576		
C:	6.78			.393	
D:					
	7.00			.299	
	8.00			.375	
	9.00			.592	
	10.00	.294	.818	.942	
	13.00	1.52	2.50	2.89	
	16.00	3.61	5.41	6.11	
	20.00	7.56	11.3	12.5	
	25.00	16.0	21.9	24.6	
	30.00	28.7	36.0	43.1	
	35.00	45.4	53.6	71.2	
	40.00	64.9	74.8	114.	
	50.00	105.	129.		
DELTA K MAX A:	59.32	133.			
B:	50.68		134.		
C:	47.33			221.	
D:					
ROOT MEAN SQUARE PERCENT ERROR		13.22	7.15	11.69	
LIFE PREDICTION RATIO SUMMARY (NP/NA)	0.0-0.5				
	0.5-0.8				
	0.8-1.25	2	2	2	
	1.25-2.0				
	>2.0				

CONDITION/HT: H1000
FORM: 1.00"TH FORGED BAR
SPECIMEN TYPE: CT
ORIENTATION: L-T
FREQUENCY: 1.0 HZ
ENVIRONMENT: R.T., H.H.A.

YIELD STRENGTH: 215.0 KSI
ULT. STRENGTH: 221.0 KSI
SPECIMEN THK: 0.501- 0.504"
SPECIMEN WIDTH: 3.986- 4.006"
REFERENCES: CD009

STAIN. STEEL

PH13-8MO

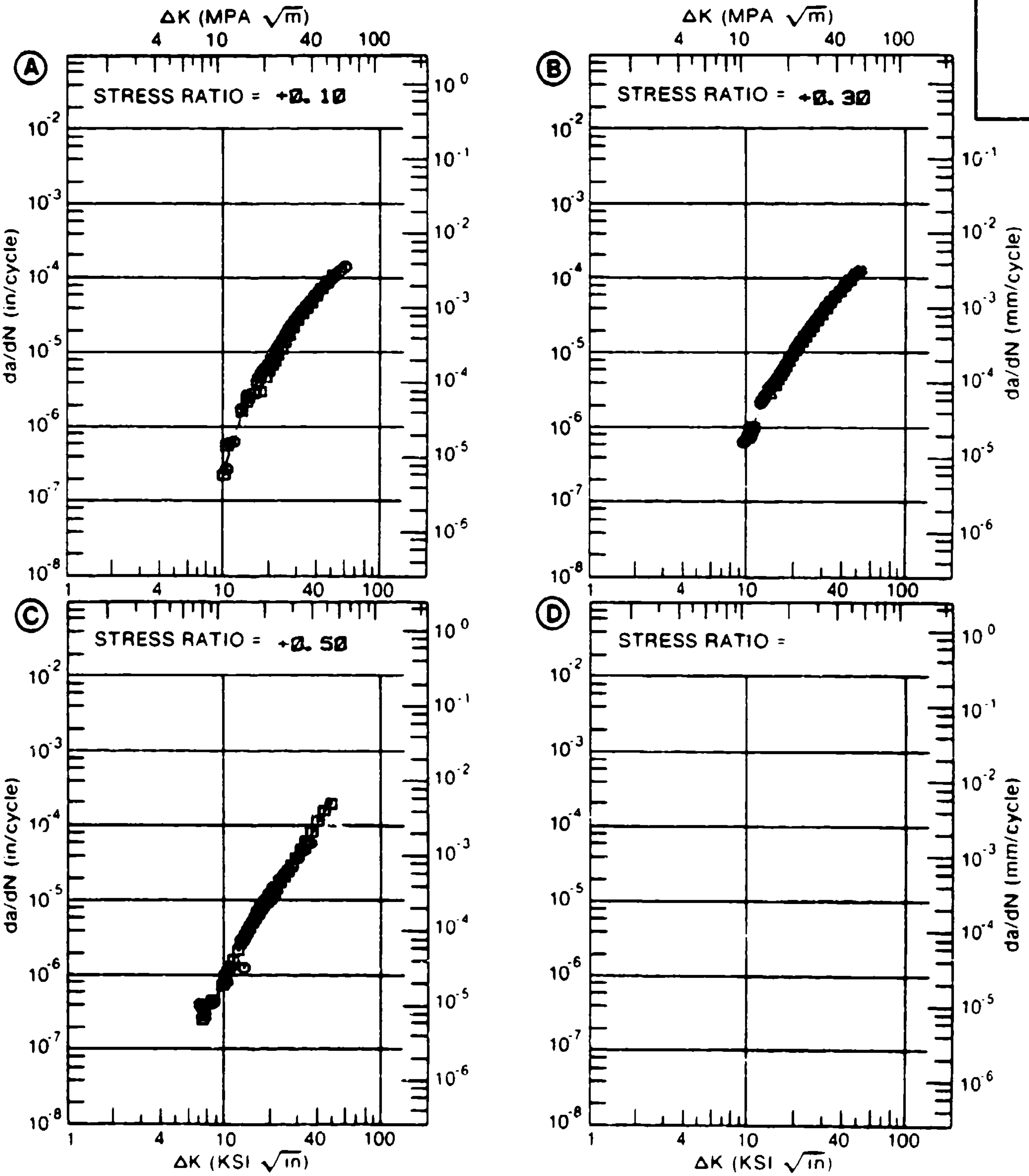


Figure 3.8.3.12

TABLE 3.8.3.13

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 3.8.3.13 INDICATING EFFECT
OF STRESS RATIO

MATERIAL: STAINLESS STEEL PH13-8MO
CONDITION: H1000
ENVIRONMENT: R.T., DRY AIR

DELTA K (KSI*IN**1/2)			DA/DN (10**-6 IN./CYCLE)			
			A	B	C	D
			R=+0.10	R=+0.30	R=+0.50	
DELTA K MIN	A:	9.25	.147			
	B:	7.78		.176		
	C:	6.00			.121	
	D:					
		7.00			.153	
		8.00		.193	.220	
		9.00		.289	.335	
		10.00	.265	.426	.511	
		13.00	.737	1.15	1.40	
		16.00	1.59	2.29	2.62	
		20.00	3.14	4.17	4.60	
		25.00	5.52	6.93	7.62	
		30.00	8.27	10.2	11.5	
		35.00	11.4	14.4	16.8	
		40.00	15.0	19.8	24.1	
		50.00	24.3	37.1		
		60.00	37.7	69.9		
		70.00	57.6	134.		
		80.00	87.4			
DELTA K MAX	A:	86.80	116.			
	B:	73.72		171.		
	C:	48.04			42.9	
	D:					
ROOT MEAN SQUARE PERCENT ERROR			8.22	7.37	6.14	
LIFE PREDICTION RATIO SUMMARY (NF/NA)		0.0-0.5				
		0.5-0.8				
		0.8-1.25		1	1	
		1.25-2.0	1			
		>2.0				

CONDITION/HT: H1000
FORM: 1.00"TH FORGED BAR
SPECIMEN TYPE: CT
ORIENTATION: T-L
FREQUENCY: 6.0 HZ
ENVIRONMENT: R.T., DRY AIR

YIELD STRENGTH: 216.0 KSI
ULT. STRENGTH: 222.6 KSI
SPECIMEN THK: 0.502- 0.503"
SPECIMEN WIDTH: 3.991- 3.993"
REFERENCES: GD009

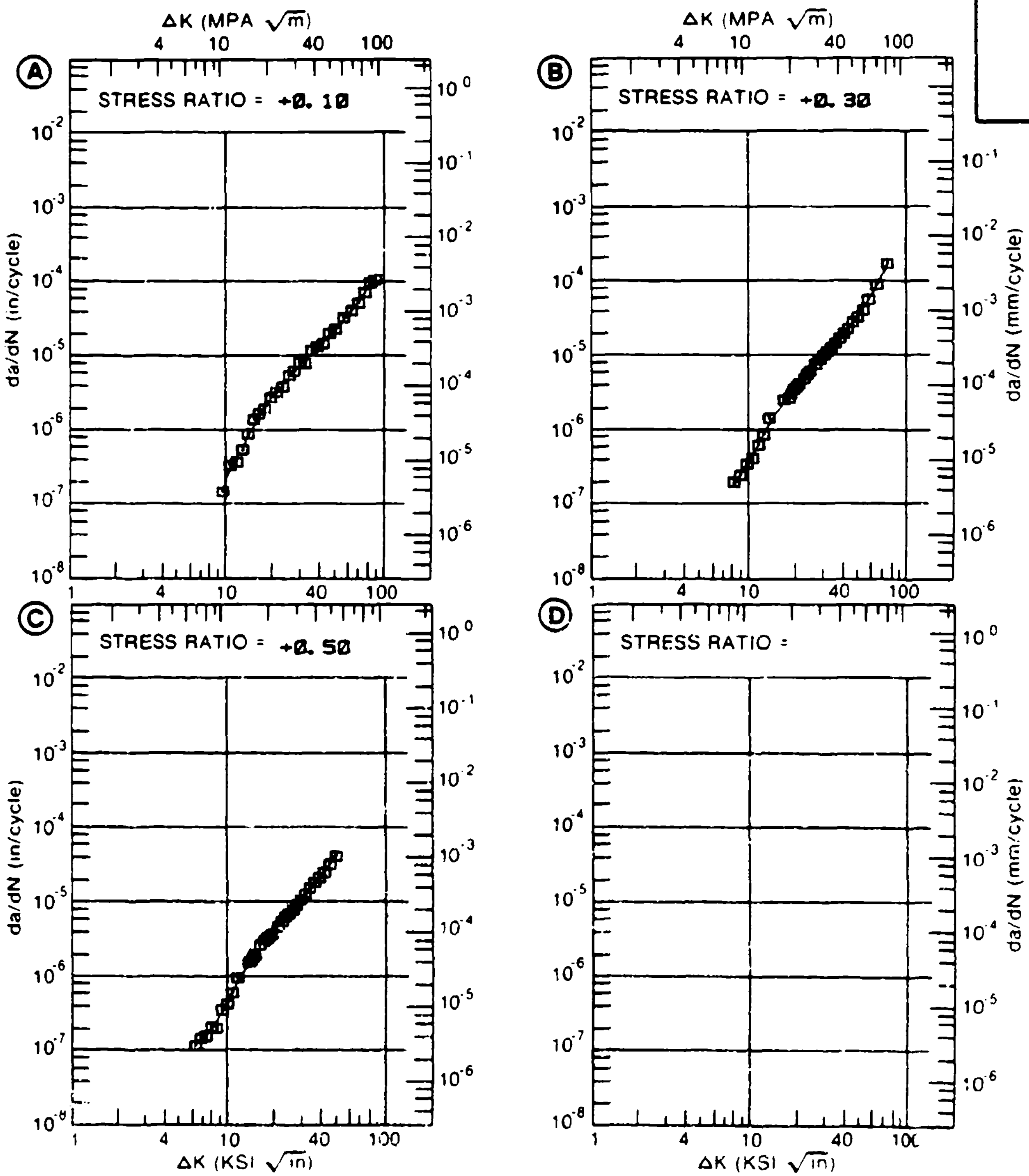


Figure 3.8.3.13

TABLE 3.8.3.14

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 3.8.3.14 INDICATING EFFECT

OF STRESS RATIO

MATERIAL: STAINLESS STEEL PH13-8MO
CONDITION: H1000
ENVIRONMENT: R.T., H.H.A.

DELTA K (KSI*IN**1/2)		DA/DN (10**-6 IN./CYCLE) A	B	C	D
		R=+0.10	R=+0.30	R=+0.50	
DELTA K MIN	A: 11.42	.928			
	B: 9.13		.466		
	C: 6.87			.299	
	D:				
	7.00			.342	
	8.00			.468	
	9.00			.625	
	10.00		.543	1.08	
	13.00	1.09	2.16	3.06	
	16.00	2.57	4.48	5.84	
	20.00	6.71	9.37	11.6	
	25.00	15.3	19.2	24.3	
	30.00	26.6	34.6	47.9	
	35.00	38.7	58.0	91.9	
	40.00	52.4	92.8	174.	
	50.00	108.	215.	607.	
	60.00	259.			
DELTA K MAX	A: 62.14	303.			
	B: 56.12		339.		
	C: 50.46			643.	
	D:				
ROOT MEAN SQUARE PERCENT ERROR		33.16	14.35	12.25	

LIFE PREDICTION RATIO SUMMARY (NP/NA)		A	B	C	D
	0.0-0.5				
	0.5-0.8				
	0.8-1.25	2	1	2	
	1.25-2.0		1		
	>2.0				

CONDITION/HT: H1000
FORM: 1.00"TH FORGED BAR
SPECIMEN TYPE: CT
ORIENTATION: T-L
FREQUENCY: 1.0 HZ
ENVIRONMENT: R.T., H.H.A.

YIELD STRENGTH: 216.0 KSI
ULT STRENGTH: 222.6 KSI
SPECIMEN THK: 0.499- 0.504"
SPECIMEN WIDTH: 3.982- 4.117"
REFERENCES: GD009

STAIN. STEEL

PH13-8MO

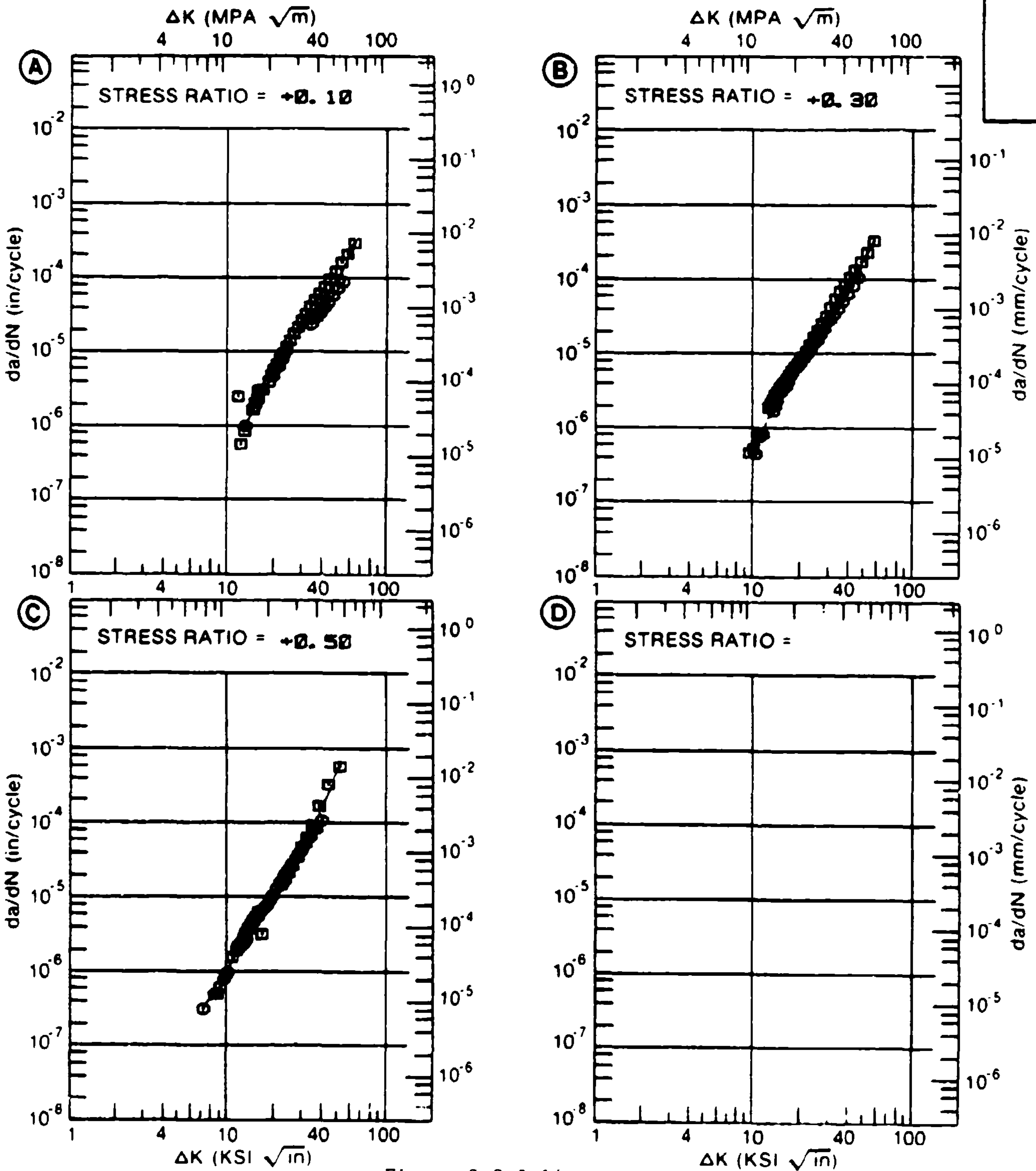


Figure 3.8.3.14

TABLE 3.8.3.15

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 3.8.3.15 INDICATING EFFECT

OF STRESS RATIO

MATERIAL: STAINLESS STEEL PH13-8MO
CONDITION: H1000
ENVIRONMENT: R. T., L. H. A.

DELTA K (KSI*IN**1/2)		DA/DN (10**-6 IN./CYCLE) A R=+0.08	B R=+0.30	C R=+0.50	D
DELTA K MIN A:	10.78	.447			
B:	10.25		.571		
C:	6.81			.119	
D:					
	7.00			.132	
	8.00			.220	
	9.00			.345	
	10.00			.515	
	13.00	1.52	1.29	1.33	
	16.00	3.49	2.52	2.60	
	20.00	5.82	4.70	4.70	
	25.00	8.52	8.11	7.10	
	30.00	12.7	13.4		
DELTA K MAX A:	34.32	19.9			
B:	34.71		18.7		
C:	29.25			8.31	
D:					
ROOT MEAN SQUARE PERCENT ERROR		10.57	17.34	9.04	
LIFE PREDICTION RATIO SUMMARY (NP/NA)	0.0-0.5				
	0.5-0.8				
	0.8-1.25	1	1	1	
	1.25-2.0				
	>2.0				

CONDITION/HT: H1000
FORM: 4.00"TH FORGED BAR
SPECIMEN TYPE: CT
ORIENTATION: L-T
FREQUENCY: 6.0 HZ
ENVIRONMENT: R.T., L.H.A.

YIELD STRENGTH: 201.0 KSI
ULT. STRENGTH: 212.0 KSI
SPECIMEN THK: 0.990- 0.998"
SPECIMEN WIDTH: 6.000"
REFERENCES: 85837, 88578

STAIN. STEEL

PH13-8MO

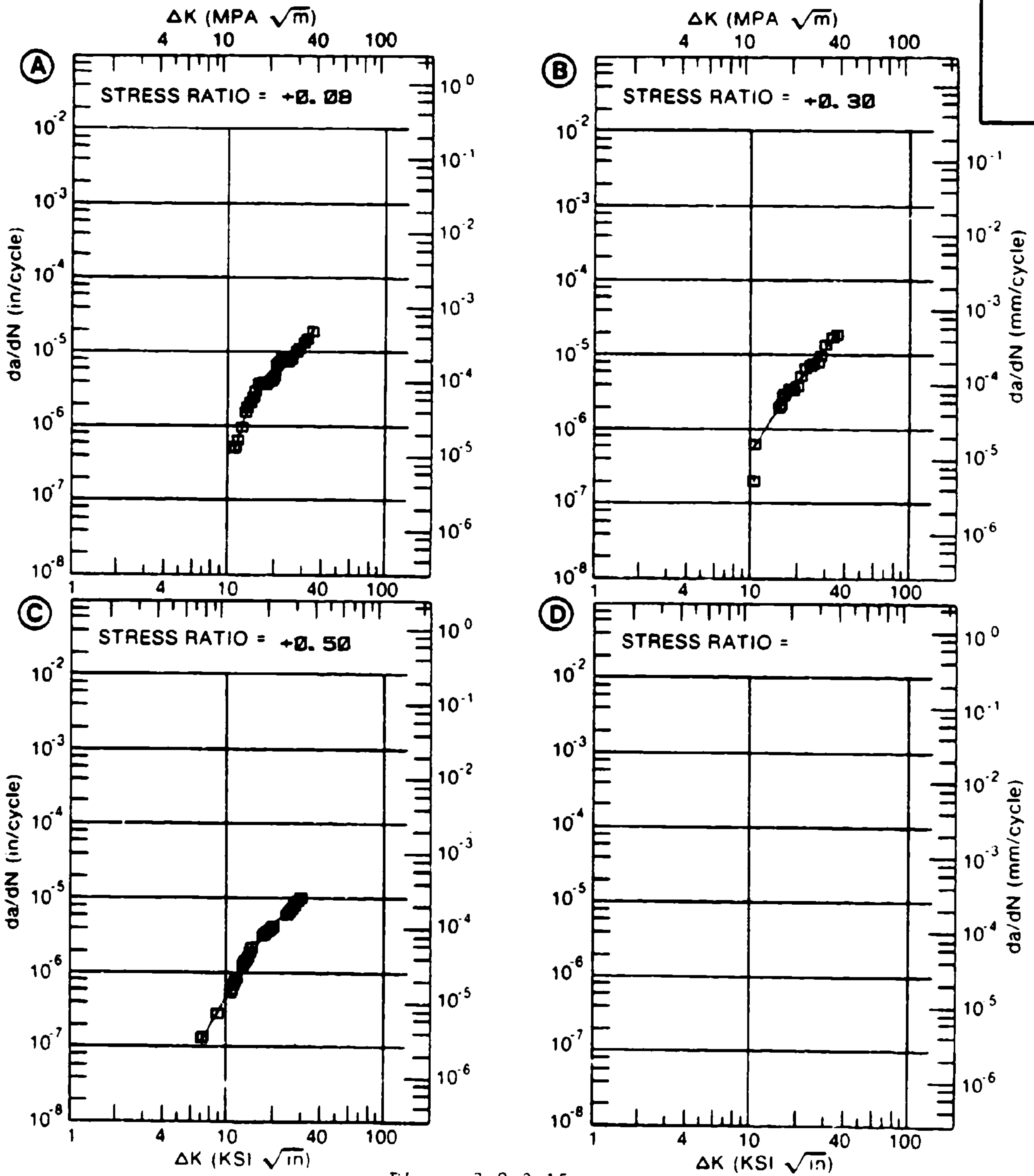


Figure 3.8.3.15

TABLE 3.8.3.16

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 3.8.3.16 INDICATING EFFECT

OF ENVIRONMENT

MATERIAL: STAINLESS STEEL PH13-8MO
CONDITION: H1000

DELTA K (KSI*IN**1/2)			DA/DN (10**-6 IN./CYCLE) A	B	C	D
			E= R.T. S.T.W.			
	A:	10.68	1.11			
DELTA K	B:					
MIN	C:					
	D:					
		13.00	2.92			
		16.00	7.61			
		20.00	18.5			
		25.00	36.1			
		30.00	50.1			
	A:	33.64	54.6			
DELTA K	B:					
MAX	C:					
	D:					
ROOT MEAN SQUARE PERCENT ERROR			8.98			
LIFE		0.0-0.5				
PREDICTION		0.5-0.8				
RATIO		0.8-1.25	1			
SUMMARY		1.25-2.0				
(NP/NA)		>2.0				

CONDITION/HT: H1000
FORM: 4.00"TH FORGED BAR
SPECIMEN TYPE: CT
ORIENTATION: T-L
STRESS RATIO: +0.08
FREQUENCY: 1.0 HZ

YIELD STRENGTH: 198.0 KSI
ULT. STRENGTH: 206.0 KSI
SPECIMEN THK: 0.991"
SPECIMEN WIDTH: 6.000"
REFERENCES: 85837

STAIN. STEEL

PH13-8MO

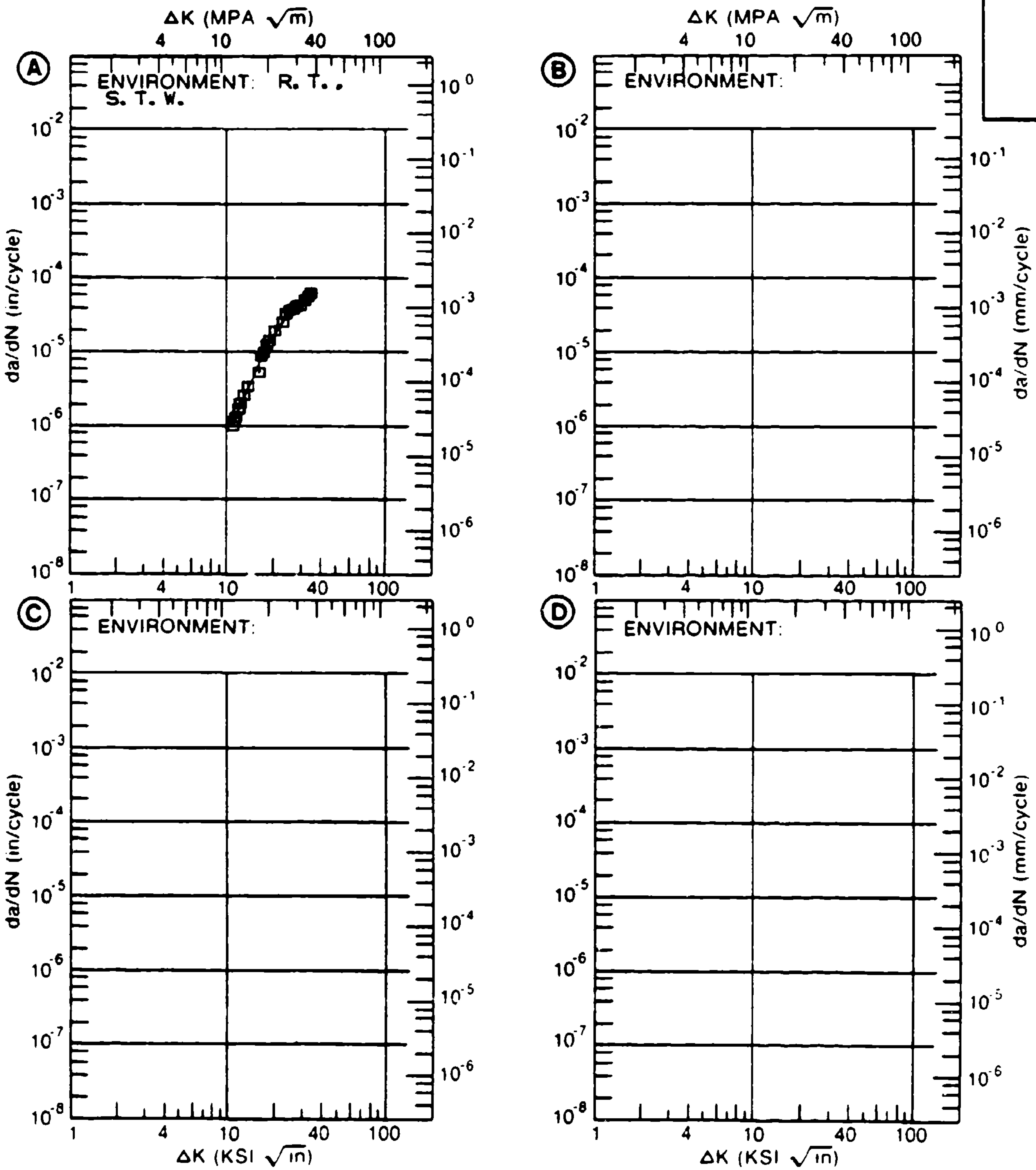


Figure 3.8.3.16

TABLE 3.8.3.17

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 3.8.3.17 INDICATING EFFECT

OF STRESS RATIO

MATERIAL: STAINLESS STEEL PH13-8MO
CONDITION: H1000
ENVIRONMENT: R.T., L.H.A.

DELTA K (KSI*IN**1/2)			DA/DN (10**-6 IN./CYCLE)			
			A	B	C	D
			R=+0.00	R=+0.30	R=+0.50	
	A:	8.33	.155			
DELTA K	B:	9.50		.514		
MIN	C:	9.52			.593	
	D:					
		9.00	.194			
		10.00	.290	.624	.792	
		13.00	.931	1.49	2.02	
		16.00	1.92	2.61	3.20	
		20.00	3.40	4.39	5.09	
		25.00	5.43	7.05	7.70	
		30.00	7.97	10.3	11.7	
		35.00	12.1	14.4	19.4	
		40.00	19.4	19.7	38.0	
	A:	42.46	15.5			
DELTA K	B:	42.47		22.8		
MAX	C:	41.04			44.6	
	D:					
ROOT MEAN SQUARE PERCENT ERROR			12.32	5.40	7.95	
LIFE		0.0-0.5				
PREDICTION		0.5-0.8				
RATIO		0.8-1.25	2	1	1	
SUMMARY		1.25-2.0				
(NP/NA)		>2.0				

CONDITION/HT: H1000
FORM: 1.50"TH ROLLED BAR
SPECIMEN TYPE: CT
ORIENTATION: L-T
FREQUENCY: 6.0 HZ
ENVIRONMENT: R.T., L.H.A.

YIELD STRENGTH: 208.0 KSI
ULT. STRENGTH: 218.0 KSI
SPECIMEN THK: 0.251- 0.990"
SPECIMEN WIDTH: 7.390- 7.400"
REFERENCES: 88579, 85837

STAIN. STEEL

PH13-8MO

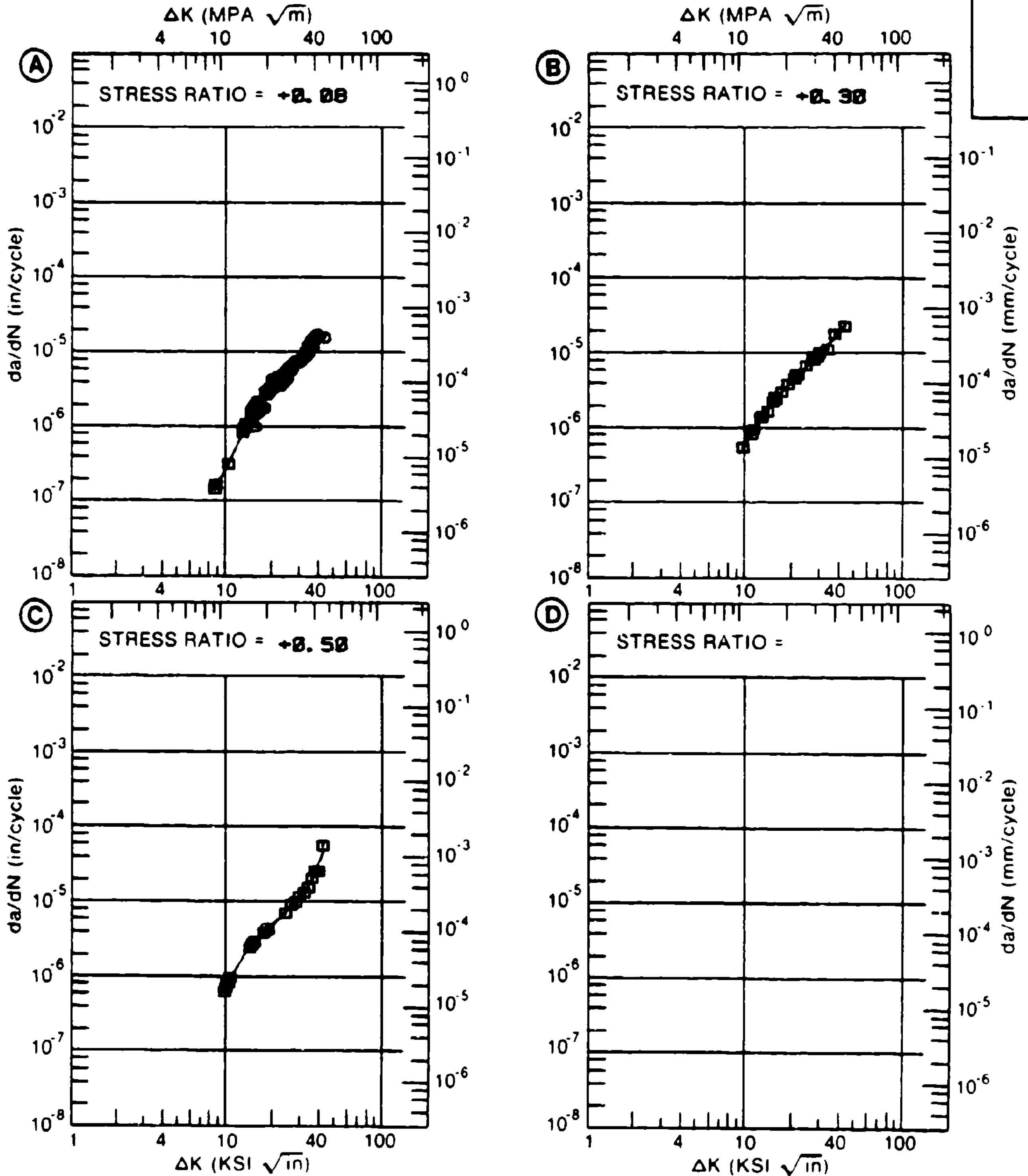


Figure 3.8.3.17

TABLE 3.8.3.18

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 3.8.3.18 INDICATING EFFECT

OF ENVIRONMENT

MATERIAL: STAINLESS STEEL PH13-8MO
CONDITION: H1000

DELTA K (KSI*IN**1/2)		DA/DN (10**-6 IN./CYCLE) A E= R.T. L.H.A.-1.0HZ	B E=- 65 F L.H.A.-6.0HZ	C E= R.T. S.C.S.-1.0HZ	D
DELTA K MIN	A: 8.72	.151			
	B: 15.07		.404		
	C: 12.88			.517	
	D:				
	9.00	.177			
	10.00	.290			
	13.00	.863		.544	
	16.00	1.80	.594	1.68	
	20.00	3.57	1.67	5.24	
	25.00	6.47	3.68	13.6	
	30.00	10.0		24.5	
	35.00	14.1		35.8	
	40.00			45.9	
	50.00			60.7	
DELTA K MAX	A: 36.40	15.3			
	B: 29.64		7.95		
	C: 56.24			66.5	
	D:				
ROOT MEAN SQUARE PERCENT ERROR		16.46	12.41	14.12	
LIFE PREDICTION RATIO SUMMARY (NP/NA)	0.0-0.5				
	0.5-0.8				
	0.8-1.25	1	1	1	
	1.25-2.0				
	>2.0				

CONDITION/HT: H1000
FORM: 1.50"TH ROLLED BAR
SPECIMEN TYPE: CT
ORIENTATION: L-T
STRESS RATIO: +0.08
FREQUENCY:

YIELD STRENGTH: 208.0 KSI
ULT. STRENGTH: 218.0 KSI
SPECIMEN THK: 0.990- 0.993"
SPECIMEN WIDTH: 7.400"
REFERENCES: 85837, 88579

STAIN. STEEL

PH13-8MO

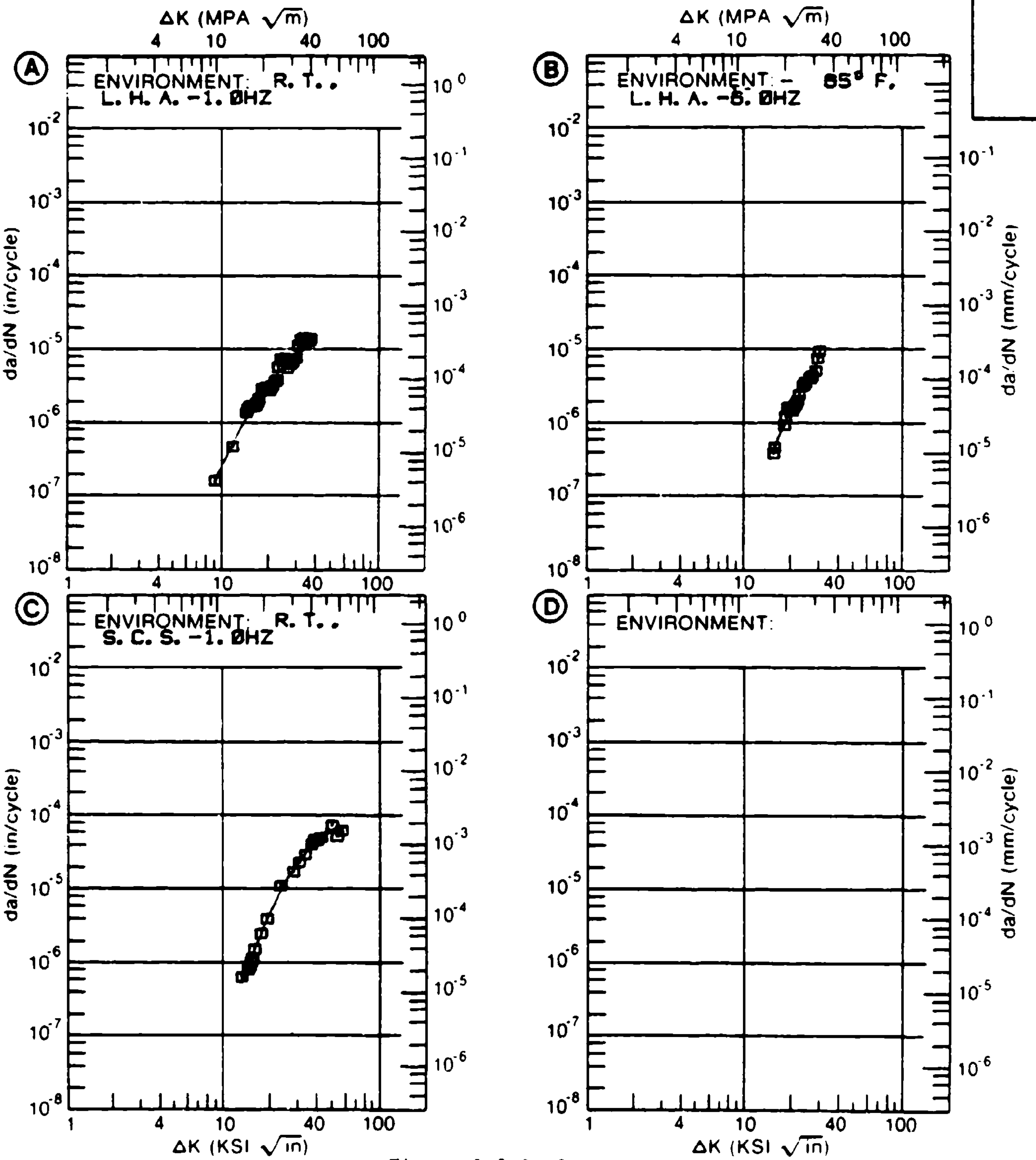


Figure 3.8.3.18

TABLE 3.8.3.19

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 3.8.3.19 INDICATING EFFECT

OF STRESS RATIO

MATERIAL: STAINLESS STEEL PH13-8MO
CONDITION: H1000
ENVIRONMENT: R.T., S.T.W.

DELTA K (KSI*IN**1/2)			DA/DN (10**-6 IN./CYCLE) A	B	C	D
			R=+0.08	R=+0.30		
DELTA K MIN	A:	11.05	.260			
	B:	8.60		.276		
	C:					
	D:					
		9.00		.372		
		10.00		.640		
		13.00	1.07	2.10		
		16.00	2.32	6.04		
		20.00	4.15	12.2		
		25.00	13.7	25.5		
		30.00	41.7	70.5		
		35.00	63.4	183.		
DELTA K MAX	A:	38.49	65.6			
	B:	36.46		225.		
	C:					
	D:					
ROOT MEAN SQUARE PERCENT ERROR			24.63	15.20		
LIFE PREDICTION RATIO SUMMARY (NP/NA)		0.0-0.5				
		0.5-0.8	1			
		0.8-1.25		2		
		1.25-2.0				
		>2.0				

STAIN. STEEL

PH13-8MO

CONDITION/HT: H1000
FORM: 1.50"TH ROLLED BAR
SPECIMEN TYPE: CT
ORIENTATION: L-T
FREQUENCY: 1.0 HZ
ENVIRONMENT: R.T., S.T.W.

YIELD STRENGTH: 208.0 KSI
ULT. STRENGTH: 216.0 KSI
SPECIMEN THK: 0.990- 1.002"
SPECIMEN WIDTH: 7.390- 7.400"
REFERENCES: 85837, 88579

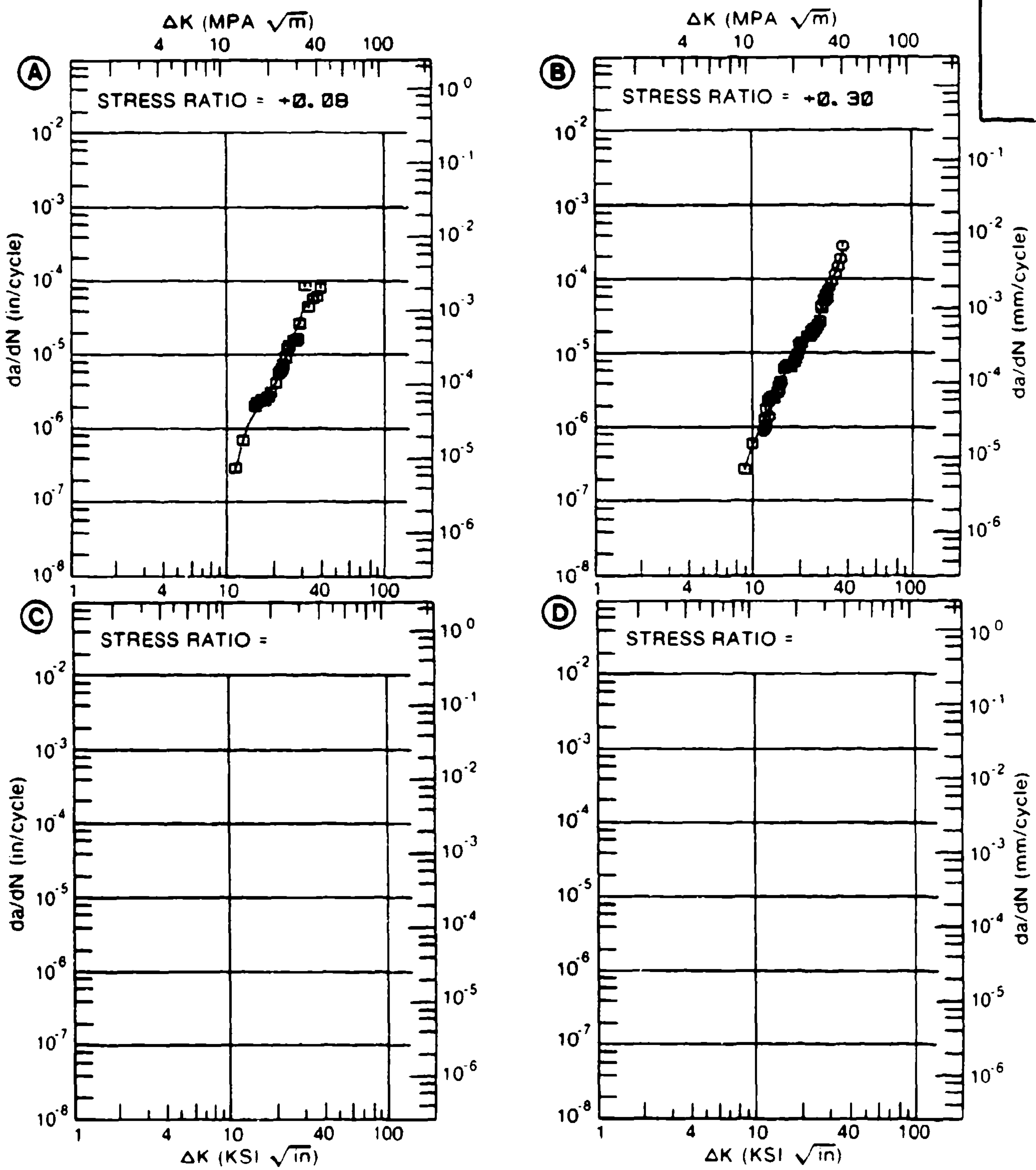


Figure 3.8.3.19

TABLE 3.8.3.20

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 3.8.3.20 INDICATING EFFECT

OF FREQUENCY

MATERIAL: STAINLESS STEEL PH13-8MO
CONDITION: H1000
ENVIRONMENT: R. T., S. T. W.

DELTA K (KSI*IN**1/2)		DA/DN (10**-6 IN./CYCLE) A	B	C	D
		F(HZ)= 0.1			
DELTA K MIN A:	14.76	2.15			
DELTA K MIN B:					
DELTA K MIN C:					
DELTA K MIN D:					
	16.00	2.75			
	20.00	6.44			
	25.00	12.9			
	30.00	22.1			
DELTA K MAX A:	31.99	26.7			
DELTA K MAX B:					
DELTA K MAX C:					
DELTA K MAX D:					
ROOT MEAN SQUARE PERCENT ERROR		3.35			

LIFE PREDICTION RATIO SUMMARY (NP/NA)		
	0.0-0.5	
	0.5-0.8	
	0.8-1.25	1
	1.25-2.0	
	>2.0	

CONDITION/HT: H1000
FORM: 1.50"TH ROLLED BAR
SPECIMEN TYPE: CT
ORIENTATION: L-T
STRESS RATIO: +0.08
ENVIRONMENT: R.T., S.T.W.

YIELD STRENGTH: 208.0 KSI
ULT. STRENGTH: 216.0 KSI
SPECIMEN THK: 0.990"
SPECIMEN WIDTH: 7.400"
REFERENCES: 88579, 85837

STAIN. STEEL

PH13-8MO

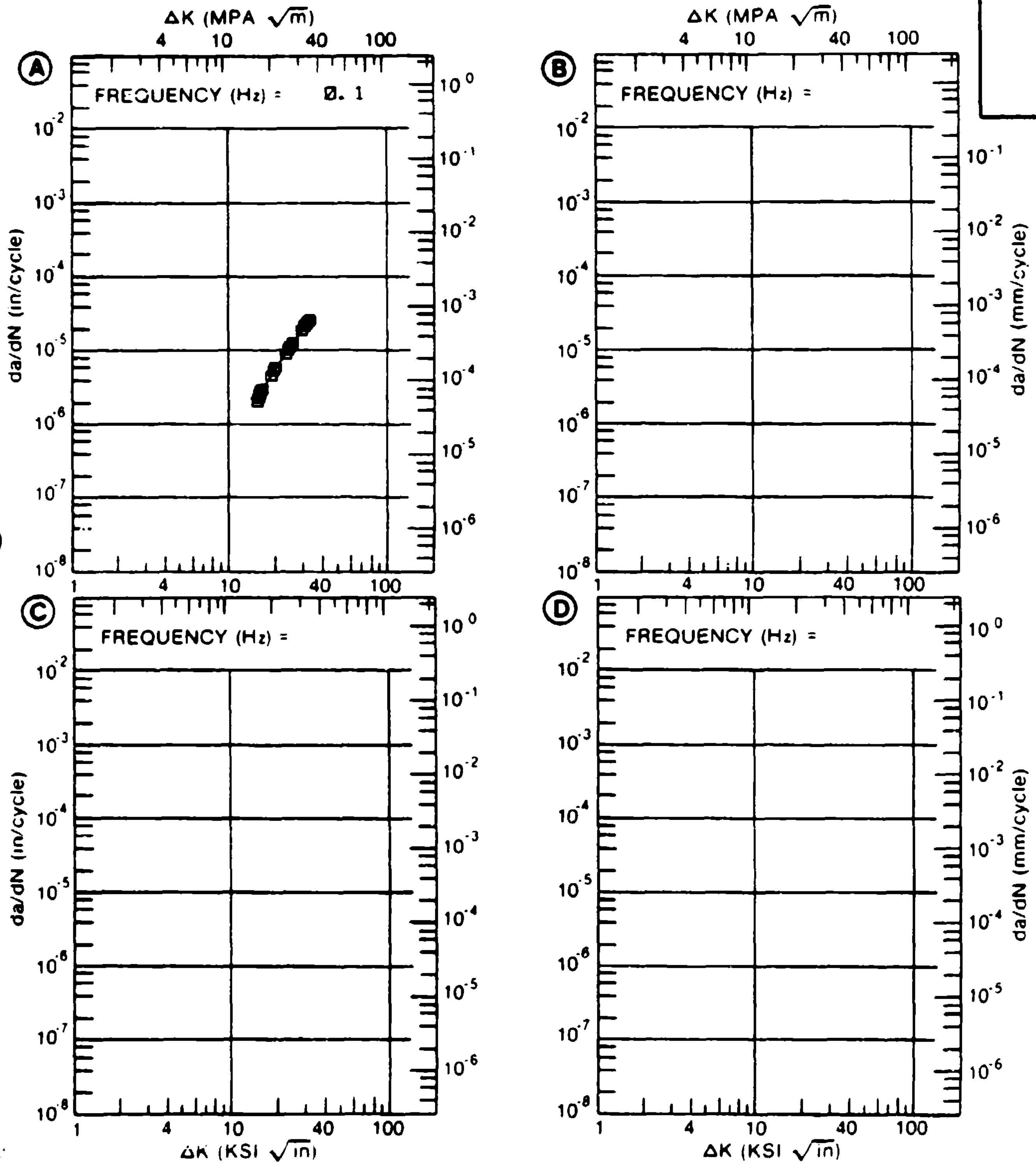


Figure 3.8.3.20

TABLE 3.8.3.21

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 3.8.3.21 INDICATING EFFECT OF ENVIRONMENT

MATERIAL: STAINLESS STEEL PH13-8MO
CONDITION: H1000

DELTA K (KSI*IN**1/2)			DA/DN (10**-6 IN./CYCLE) A	B	C	D
			E= R.T. L.H.A.-6.0HZ	E=- 65 F L.H.A.-6.0HZ	E= R.T. S.T.W.-1.0HZ	
	A:	10.66	.158			
DELTA K MIN	B:	11.98		.360		
	C:	7.82			.101	
	D:					
		8.00			.106	
		9.00			.162	
		10.00			.286	
		13.00	.658	.622	1.47	
		16.00	1.88	1.52	3.55	
		20.00	4.01	3.15	6.43	
		25.00	6.78	5.47	17.3	
		30.00	9.74	8.16	27.6	
		35.00	13.5		62.8	
		40.00	18.8			
	A:	42.91	23.2			
DELTA K MAX	B:	30.75		9.87		
	C:	36.71			102.	
	D:					
ROOT MEAN SQUARE PERCENT ERROR			3.59	10.72	13.75	
LIFE PREDICTION RATIO SUMMARY (NP/NA)		0.0-0.5				
		0.5-0.8				
		0.8-1.25		1	1	
		1.25-2.0	1			
		>2.0				

CONDITION/HT: H1000
FORM: 1.50"TH ROLLED BAR
SPECIMEN TYPE: CT
ORIENTATION: T-L
STRESS RATIO: +0.08
FREQUENCY:

YIELD STRENGTH: 210.0- 215.0 KSI
ULT. STRENGTH: 219.0 KSI
SPECIMEN THK: 0.989- 0.993"
SPECIMEN WIDTH: 7.400"
REFERENCES: 88579, 85837

STAIN. STEEL

PH13-8MO

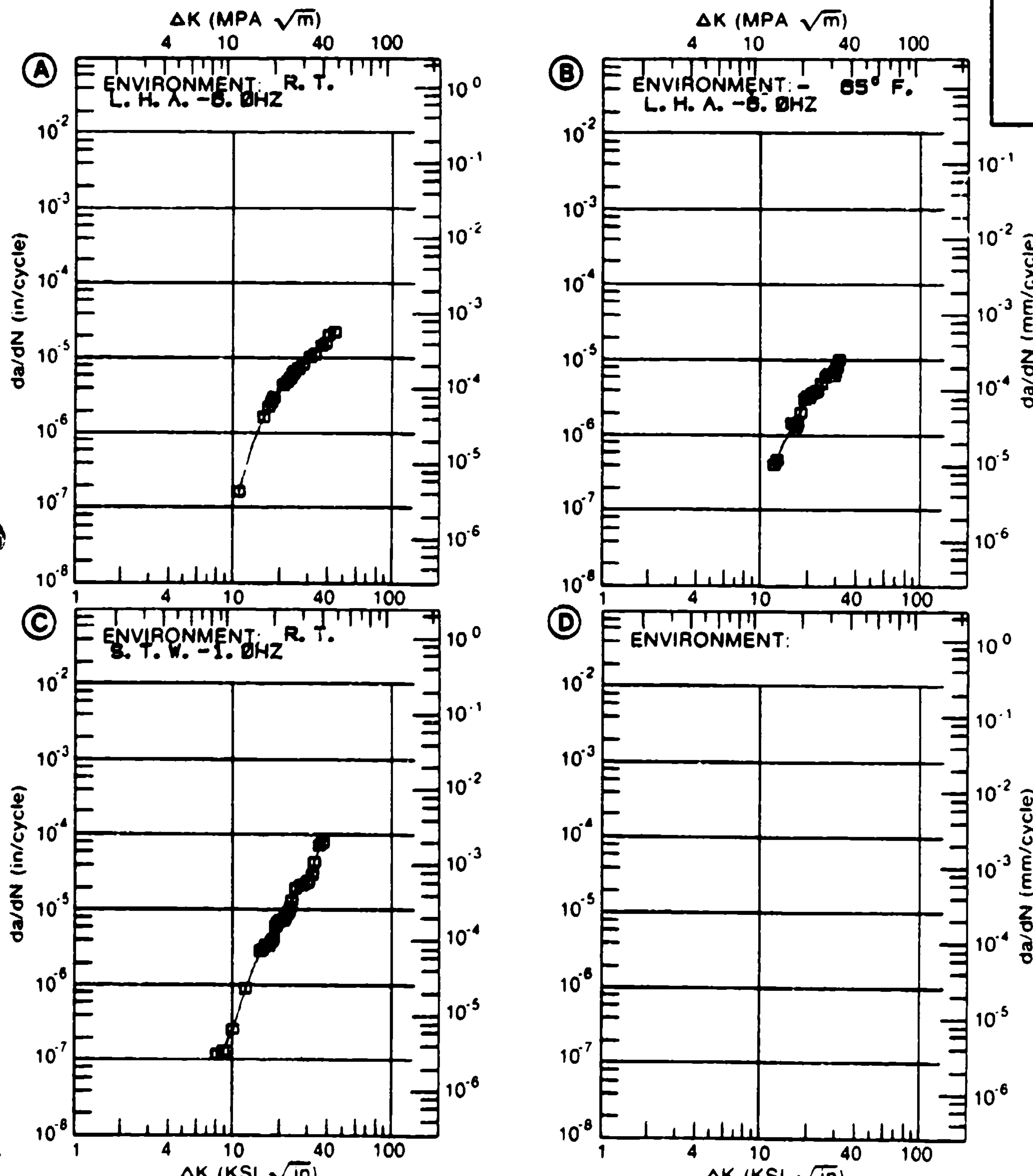


Figure 3.8.3.21

Table 3.8.3.22

STAINLESS STEEL PH13-8MO K(ISCC)

CONDITION	PRODUCT FORM	PRODUCT THICK (IN)	TEST TEMP (F)	SPEC OR	YIELD STR (KSI)	ENVIRONMENT	SPECIMEN WIDTH (IN) W	SPECIMEN THICK (IN) B	SPECIMEN DESIGN (*=SC)	CRACK LENGTH (IN) A	K(Q) (KSI*SQRT IN)	K(ISCC) (KSI*SQRT IN)	MEAN	STAN DEV	TEST TIME (MIN)	DATE	REFER
H 950	L	4.00	R.T.	T-L	207.5	3.5 PCT NACL	1.500	0.480	C.NT	----	73.90	73.90			> 60000	1971	84333
H 950	FB	4.00	R.T.	L-T	204.0	S.T.W.	5.500	1.000	DCB	----	131.00	> 48.00			83580	1976	R1006
		4.00			204.0		5.500	1.000	DCB	----	130.00	50.00			83520	1976	R1006
		4.00			204.0		5.500	1.000	DCB	----	131.00	> 46.30			51720	1976	R1006
		4.00			204.0		5.500	1.000	DCB	----	131.00	> 46.00			51720	1976	R1006
		4.00			204.0		5.500	1.000	DCB	----	130.0	> 49.00			48780	1976	R1006
		4.00			204.0		5.500	1.000	DCB	----	130.00	> 48.00			51720	1976	R1006
		4.00			204.0		5.500	1.000	DCB	----	131.00	> 40.00			86280	1976	R1006
		4.00			204.0		5.500	1.000	DCB	----	130.00	46.00			83520	1976	R1006
		4.00			204.0		5.500	1.000	DCB	----	131.00	> 50.00			86280	1976	R1006
		4.00			204.0		5.500	1.000	DCB	----	130.00	> 48.00			48780	1976	R1006
													48.0/	2.8			
H 950	B	2.25	R.T.	T-L	196.7	INDUSTRIAL ATM	2.000	1.000	CT	----	62.60	59.00			----	1973	86688
H 950	B	2.25	R.T.	T-L	196.7	SEACOAST ATM	2.000	1.000	CT	----	62.60	31.00			----	1973	86688
H 950	B	2.25	R.T.	T-L	196.7	20 PCT NACL	2.000	1.000	CT	----	62.60	46.00			----	1973	86688
H1000	E	1.50	R.T.	L-T	214.0	S.T.W.	5.500	1.000	DCB	----	132.00	> 53.00			116820	1976	R1006
		1.50			214.0		5.500	1.000	DCB	----	132.00	< 53.00			116820	1976	R1006
		1.50			214.0		5.500	1.000	DCB	----	132.00	55.00			120840	1976	R1006
		1.50			214.0		5.500	1.000	DCB	----	132.00	> 52.00			120840	1976	R1006
		1.50			214.0		5.500	1.000	DCB	----	132.00	< 54.00			86280	1976	R1006
H1000	E	1.50	R.T.	T-L	213.0	S.T.W.	5.500	1.000	DCB	----	132.00	> 54.00			116820	1976	R1006
		1.50			213.0		5.500	1.000	DCB	----	132.00	> 53.00			116820	1976	R1006
		1.50			213.0		5.500	1.000	DCB	----	132.00	< 53.00			116820	1976	R1006
H1000	FB	1.00	R.T.	L-T	215.0	S.T.W.	2.544	0.998	WOL	1.207	------	88.10			> 60420	1978	GD009
		4.00			201.0		5.500	1.000	DCB	----	127.00	> 74.00			51720	1976	R1006
		4.00			201.0		5.500	1.000	DCB	----	127.00	> 80.00			83520	1976	R1006
H1000	FB	1.00	R.T.	L-T	215.0	3.5% NACL	2.548	0.998	WOL	1.250	------	82.30			> 60420	1978	GD009
		1.00			215.0		2.549	0.998	WOL	1.110	------	94.80			> 60420	1978	GD009
													88.6/	8.8			
H1000	FB	1.00	R.T.	T-L	216.0	S.T.W.	2.544	0.999	WOL	1.048	------	99.50			> 60420	1978	GD009
		1.00			216.0		2.549	0.999	WOL	1.048	------	99.60			> 60420	1978	GD009
		4.00			198.0		5.500	1.000	DCB	----	125.00	> 49.00			83520	1976	R1006
		4.00			198.0		5.500	1.000	DCB	----	125.00	> 49.00			83520	1976	R1006

Table 3.8.3.22 (Continued)

STAINLESS STEEL PH13-8MO K(ISCC)

CONDITION	PRODUCT FORM	PRODUCT THICK (IN)	TEST TEMP (F)	SPEC OR	YIELD STR (KSI)	ENVIRONMENT	SPECIMEN WIDTH (IN) W	SPECIMEN THICK (IN) B	SPECIMEN DESIGN (*=SG)	CRACK LENGTH (IN) A	K(0) (KSI*SQRT IN)	K(ISCC) (KSI*SQRT IN)	MEAN	STAN DEV	TEST TIME (MIN)	DATE	REFER
H1000	FB	4.00	R.T.	T-L	198.0	S.T.W.	5.500	1.000	DCB	----	125.00	> 46.00			83520	1976	R1006
		4.00			198.0		5.500	1.000	DCB	----	125.00	> 71.00			51720	1976	R1006
		4.00			198.0		5.500	1.000	DCB	----	125.00	> 68.00			51720	1976	R1006
													99.6/	0.1			
H1000	FB	1.00	R.T.	T-L	216.0	3.5% NACL	2.545	0.998	WOL	1.880	------	63.20			> 60420	1978	GD009
		1.00			216.0		2.547	0.999	WOL	1.250	------	85.50			> 60420	1978	GD009
													74.4/	15.8			
H1000	RB	1.50	R.T.	L-T	208.0	F.C.S.	5.500	1.000	DCB	----	132.00	> 75.00			75180	1976	R1006
H1000	RB	1.50	R.T.	L-T	208.0	S.C.B.	5.500	1.000	DCB	----	132.00	> 87.00			60180	1976	R1006
		1.50			208.0		5.500	1.000	DCB	----	132.00	> 70.00			75240	1976	R1006
H1000	RB	1.50	R.T.	L-T	208.0	S.T.W.	5.500	1.000	DCB	----	132.00	> 73.00			86280	1976	R1006
		1.50			208.0		5.500	1.000	DCB	----	132.00	> 73.00			116820	1976	R1006
		1.50			208.0		5.500	1.000	DCB	----	132.00	70.00			116820	1976	R1006
		1.50			208.0		5.500	1.000	DCB	----	132.00	> 73.00			116820	1976	R1006
H1000	RB	1.50	R.T.	T-L	215.0	S.T.W.	5.500	1.000	DCB	----	133.00	> 63.00			86280	1976	R1006
		1.50			215.0		5.500	1.000	DCB	----	133.00	> 63.00			116820	1976	R1006
		1.50			215.0		5.500	1.000	DCB	----	133.00	> 63.00			116820	1976	R1006
		1.50			215.0		5.500	1.000	DCB	----	133.00	> 63.00			116820	1976	R1006
H1050	B	2.25	R.T.	T-L	178.5	INDUSTRIAL ATM	2.000	1.000	CT	----	87.80	83.00			----	1973	86688
H1050	B	2.25	R.T.	T-L	178.5	SEACOAST ATM	2.000	1.000	CT	----	87.80	44.00			----	1973	86688
H1050	B	2.25	R.T.	T-L	178.5	20 PCT NACL	2.000	1.000	CT	----	87.80	65.00			----	1973	86688
RH 950	BR	1.50	R.T.	L-S	219.0	S.T.W.	5.500	1.000	CT	----	98.00	> 50.00			120960	1976	R1006
		1.50			217.0		5.500	1.000	CT	----	97.00	> 54.00			120960	1976	R1006
		1.50			219.0		5.500	1.000	CT	----	98.00	> 51.00			120960	1976	R1006
		1.50			217.0		5.500	1.000	CT	----	97.00	> 56.00			120960	1976	R1006
RH 975	BR	1.50	R.T.	L-S	216.0	S.T.W.	5.500	1.000	CT	----	97.00	> 67.00			120960	1976	R1006
		1.50			219.0		5.500	1.000	CT	----	98.00	> 58.00			120960	1976	R1006
		1.50			216.0		5.500	1.000	CT	----	97.00	> 67.00			120960	1976	R1006

Table 3.8.3.22 (Continued)

STAINLESS STEEL PH13-8MO K(ISCC)

CONDITION	PRODUCT FORM	PRODUCT THICK (IN)	TEST TEMP (F)	SPEC OR	YIELD STR (KSI)	ENVIRONMENT	SPECIMEN WIDTH (IN) W	SPECIMEN THICK (IN) B	SPECIMEN DESIGN (*=SQ)	CRACK LENGTH (IN) A	K(Q) (KSI*SQRT IN)	K(ISCC) (KSI*SQRT IN)	MEAN	STAN DEV	TEST TIME (MIN)	DATE	REFER
RH1000	BR	1.50	R.T.	L-S	215.0	S.T.W	5.500	1.000	CT	----	96.00	101.00			120960	1976	R1006
		1.50			215.0		5.500	1.000	CT	----	96.00	92.00			120960	1976	R1006
		1.50			218.0		5.500	1.000	CT	----	97.00	85.00			120960	1976	R1006
TYS=140KSI	P	1.00	R.T.	T-L	140.0	3.5 PCT NACL	----	1.000	CANT*	----	180.00	170.00*			----	1972	83613
TYS=180KSI	P	1.00	R.T.	T-L	180.0	3.5 PCT NACL	----	1.000	CANT*	----	190.00	160.00*			----	1972	83613
TYS=190KSI	P	1.00	R.T.	T-L	190.0	3.5 PCT NACL	----	1.000	CANT*	----	180.00	130.00*			----	1972	83613
TYS=200KSI	P	1.00	R.T.	T-L	200.0	3.5 PCT NACL	----	1.000	CANT*	----	190.00	155.00*			----	1972	83613
TYS=210KSI	P	1.00	R.T.	T-L	210.0	3.5 PCT NACL	----	1.000	CANT*	----	135.00	120.00			----	1972	83613

*NOTE-DATA WHICH DO NOT MEET MINIMUM SPECIMEN THICKNESS REQUIREMENTS OF 2.5(KISCC/TYS)SQUARED

Table 3.9.2.1

STAINLESS STEEL PH14-8MO K(C)

CONDITION	--PRODUCT-- FORM	THICK (IN)	TEST TEMP (F)	SPEC OR	YIELD STR (KSI)	---SPECIMEN--- WIDTH (IN) W	THICK (IN) B	CRACK LENGTH INIT (IN) 2A(O)	FINAL (IN) 2A(F)	GROSS STRESS ONSET (KSI) S(O)	MAX (KSI) S(MAX)	K(APP) (KSI*SQRT IN)	K(APP) MEAN	STAN DEV	K(C) (KSI*SQRT IN)	K(C) MEAN	STAN DEV	DATE	REFER
BUCKLING OF CRACK EDGES RESTRAINED																			
SRH1050	S	0.03	63	L-T	174.5	24.040	0.025	5.990	----	---	72.60	231.63			----			1964	57573
SRH1050	S	0.03	R.T.	L-T	174.5	7.990	0.025	2.010	----	---	118.10	218.44*			----			1964	57573
SRH1050	S	0.03	R.T.	L-T	174.5	24.020	0.025	3.000	----	---	95.90	210.21			----			1964	57573
		0.03			174.5	24.030	0.025	6.000	----	---	72.40	231.22			----			1964	57573
		0.03			174.5	24.040	0.025	6.000	----	---	71.90	229.61	223.7/	11.7	----	----/	---	1964	57573
SRH1050	S	0.05	R.T.	L-T	196.6	24.010	0.050	6.000	----	---	92.10	294.15			----			1964	57573
SRH1050	S	0.09	R.T.	L-T	197.4	24.100	0.093	6.000	----	---	115.70	369.42			----			1964	57573

*NOTE- NET SECTION STRESS EXCEEDS 80% OF YIELD STRENGTH. VALUE NOT INCLUDED IN MEAN OR STD. DEV

Table 3.10.1.1

MEAN PLANE STRAIN FRACTURE TOUGHNESS DATA OF
STAINLESS STEEL ALLOY PH15-7MO AT ROOM TEMPERATURE

CONDITION/HT — MEAN KIC ± STANDARD DEVIATION (KSI SQRT(IN)) (NUMBER OF SPECIMENS)

ROLLED BAR

CONDITION/HT	L-T	T-L	S-L
RH 950	-----	30.6 ± 0.1 (2)	-----
RH1050	-----	40.2 ± 1.5 (3)	-----

Table 3.10.2.1

STAINLESS STEEL PH15-7MO K(IC)

CONDITION	--PRODUCT-- FORM	THICK (IN)	TEST TEMP (F)	SPECIMEN ORIENT	YIELD STRENGTH (KSI)	------SPECIMEN------ WIDTH (IN) W	THICK (IN) B	DESIGN	CRACK LENGTH (IN) A	2.5*(K(IC)/TYS)**2 (IN)	K(IC) (KSI*SQRT IN)	K(IC) MEAN	STAN DEV	DATE	REFER
RH 950	RB	1.25	R T	T-L	204.0	2.000	1.000	CT	1.025	0.06	30.50			1973	86688
		1.25			204.0	2.000	1.000	CT	1.007	0.06	30.70	30.6/	0.1	1973	86688
RH1050	RB	1.25	R T	T-L	195.0	2.000	1.000	CT	1.019	0.10	38.50			1973	86688
		1.25			195.0	2.000	1.000	CT	1.010	0.11	40.70			1973	86688
		1.25			195.0	2.000	1.000	CT	1.006	0.11	41.30	40.2/	1.5	1973	86688

Table 3.10.3.1

STAINLESS STEEL PH15-7MO K(ISCC)

CONDITION	--PRODUCT-- FORM	THICK (IN)	TEST TEMP (F)	SPEC OR	YIELD STR (KSI)	ENVIRONMENT	------SPECIMEN------ WIDTH (IN) W	THICK (IN) B	DESIGN (*=SG)	CRACK LENGTH (IN) A	K(Q) (KSI*SQRT IN)	K(ISCC) MEAN	STAN DEV	TEST TIME (MIN)	DATE	REFER
RH 950	B	1.75	R.T.	---	196.5	3.5 PCT NACL	1.500	0.480	CANT	----	31.50	14.00		> 30000	1971	84333
TH1050	B	1.75	R.T.	---	167.8	3.5 PCT NACL	1.500	0.480	CANT	----	33.60	18.50		> 60000	1971	84333

Table 3.11.1.1

MEAN PLANE STRAIN FRACTURE TOUGHNESS DATA OF
STAINLESS STEEL ALLOY 15-5PH AT ROOM TEMPERATURE

CONDITION/HT	MEAN KIC ± STANDARD (KSI SQRT(IN)) DEVIATION	(NUMBER OF SPECIMENS)	
		FORGING	
CONDITION/HT	L-T	T-L	S-L
TYS=150-165KSI	-----	94.8 ± 6.9 (3)	-----
		ROLLED BAR	
CONDITION/HT	L-T	T-L	S-L
H 900	-----	72.7 ± 4.9 (6)	-----

Table 3.11.1.2

FATIGUE CRACK GROWTH RATE AT DEFINED LEVELS OF THE STRESS-INTENSITY FACTOR

STAINLESS STEEL 15-5PH

TEST CONDITIONS

SPECIMEN ORIENTATION: T-L

ENVIRONMENT: H.H.A. AT R.T.

CONDITION/HT	PRODUCT FORM	STRESS RATIO	FREQ. (HZ)	DELTA K LEVELS (KSI SQRT(IN))	2.5	5	10	20	50	100
					FATIGUE CRACK GROWTH RATES (MICRO IN/CYCLE)					
TUS=150-165KSI	BILLET	-1.00						3.93	45.6	
TUS=150-165KSI	BILLET	-0.20						3.05	33.6	
TUS=150-165KSI	BILLET	0.04						2.92	33.6	
TUS=150-165KSI	BILLET	0.40					0.73	5.18		

Table 3.11.1.3

FATIGUE CRACK GROWTH RATE AT DEFINED LEVELS OF THE STRESS-INTENSITY FACTOR

STAINLESS STEEL 15-5PH

TEST CONDITIONS

SPECIMEN ORIENTATION S-L

ENVIRONMENT: H.H.A. AT R.T.

CONDITION/HT	PRODUCT FORM	STRESS RATIO	FREQ. (HZ)	DELTA K LEVELS (KSI SQRT(IN))	FATIGUE CRACK GROWTH RATES (MICRO IN/CYCLE) 2.5	5	10	20	50	100
TUS=150-165KSI	BILLET	-1.00						4.78	51.6	
TUS=150-165KSI	BILLET	-0.20						3.46	39.8	
TUS=150-165KSI	BILLET	0.04						3.16	37.9	
TUS=150-165KSI	BILLET	0.40						6.02		

Table 3.11.2.1

STAINLESS STEEL 15-5PH K(IC)

CONDITION	--PRODUCT-- FORM	THICK (IN)	TEST TEMP (F)	SPECIMEN ORIENT	YIELD STRENGTH (KSI)	------SPECIMEN------ WIDTH (IN) W	THICK (IN) B	DESIGN	CRACK LENGTH (IN) A	2.5*(K(IC)/TYS)**2 (IN)	K(IC) (KSI*SQRT IN)	K(IC) MEAN	STAN DEV	DATE	REFER
H 900	RB	2.25	R.T	T-L	171.0	4.000	2.000	CT	2.057	0.43	70.90			1973	B6688
		2.25			171.0	4.000	2.000	CT	2.064	0.42	70.50			1973	B6688
		2.25			171.0	2.000	1.000	CT	1.040	0.38	66.50			1973	B6688
		2.25			171.0	2.000	1.000	CT	1.049	0.46	73.10			1973	B6688
		2.25			171.0	4.000	2.000	CT	2.068	0.54	79.40			1973	B6688
		2.25			171.0	2.000	1.000	CT	1.051	0.49	75.80	72.7/	4.5	1973	B6688
H 900	RB	4.00	R.T.	L-R	185.0	2.000	1.000	NB	1.000	0.55	86.90			1972	B4212
TYS=150-165KSI	F	----	R.T.	T-L	155.0	3.000	1.500	CT	----	1.09	102.50			1978	BW007
		----			155.0	3.000	1.500	CT	----	0.89	92.70			1978	BW007
		----			155.0	3.000	1.500	CT	----	0.83	89.20	94.8/	6.9	1978	BW007

TABLE 3.11.3.1

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 3.11.3.1 INDICATING EFFECT
OF ENVIRONMENT

MATERIAL: STAINLESS STEEL 15-5PH
CONDITION: H1025

DELTA K (KSI*IN**1/2)			DA/DN (10**-6 IN./CYCLE) A: E= R.T. LAB AIR-10.0HZ	B: E= R.T. 3.5%NACL-1.0HZ	C	D
DELTA K MIN	A:	30.17	8.27			
	B:	17.18		5.06		
	C:					
	D:					
		20.00		9.97		
		25.00		15.7		
		30.00		20.3		
		35.00	15.0			
		40.00	18.0			
		50.00	22.0			
		60.00	29.7			
		70.00	41.2			
		80.00	56.1			
		90.00	74.1			
		100.00	94.2			
DELTA K MAX	A:	124.79	146.			
	B:	30.88		21.5		
	C:					
	D:					
ROOT MEAN SQUARE PERCENT ERROR			8.12	19.17		
LIFE PREDICTION RATIO SUMMARY (NP/NA)		0.0-0.5				
		0.5-0.8				
		0.8-1.25	2	1		
		1.25-2.0				
		>2.0				

CONDITION/HT: H1025
FORM: 1.50"TH BAR
SPECIMEN TYPE: CT
ORIENTATION L-T
STRESS RATIO: +0.50
FREQUENCY:

YIELD STRENGTH: 150.7 KSI
ULT. STRENGTH: 156.2 KSI
SPECIMEN THK: 1.500"
SPECIMEN WIDTH: 3.000"
REFERENCES: 82270

STAIN. STEEL

15-5PH

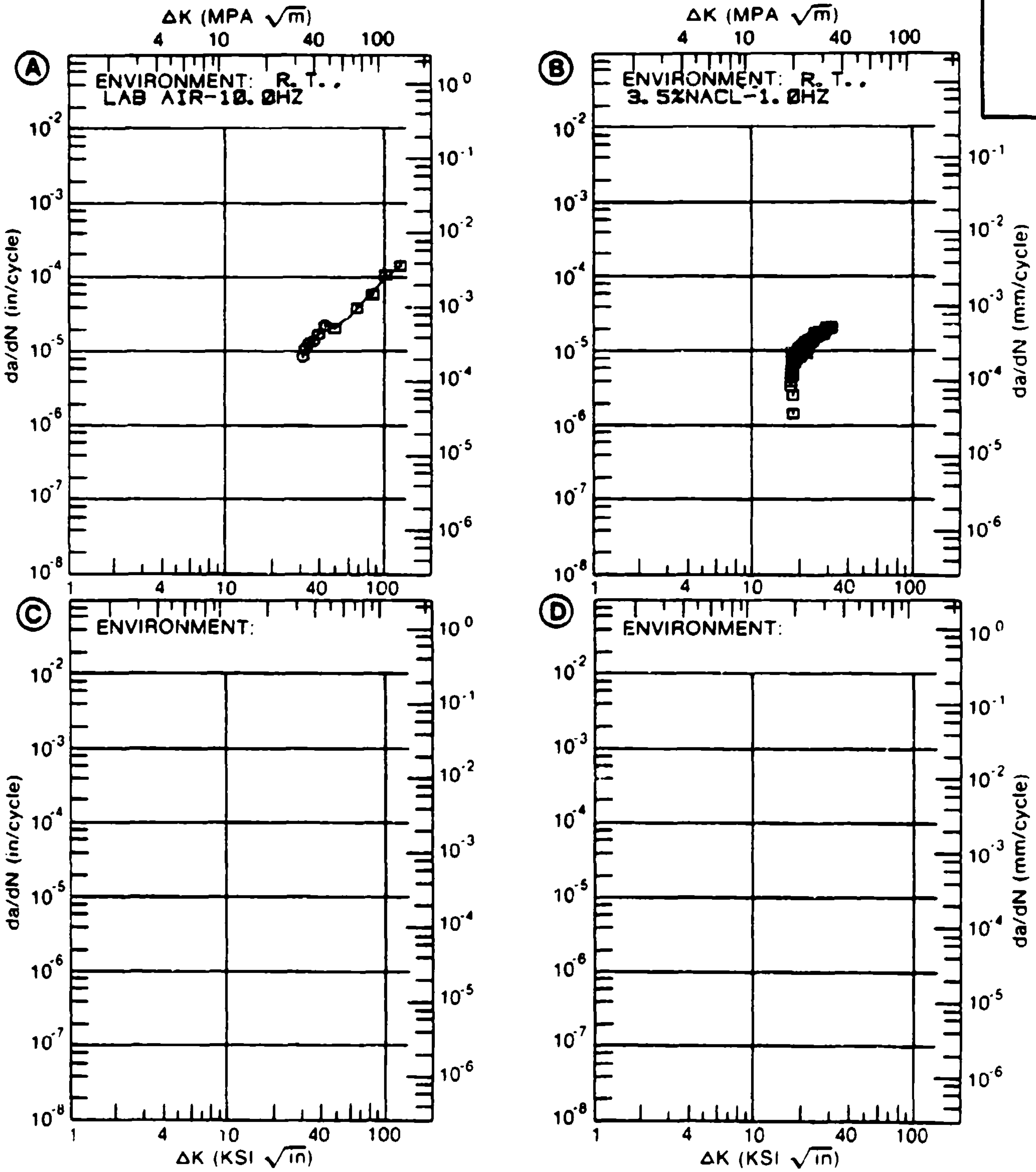


Figure 3.11.3.1

TABLE 3.11.3.2

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 3.11.3.2 INDICATING EFFECT

OF ENVIRONMENT

MATERIAL: STAINLESS STEEL 15-5PH
CONDITION: H1025

DELTA K (KSI*IN**1/2)		DA/DN (10**-6 IN./CYCLE) A	B	C	D
		E= R.T. LAB AIR			
DELTA K MIN	A: 28.88	1.50			
	B:				
	C:				
	D:				
	30.00	1.73			
	35.00	3.08			
	40.00	5.37			
	50.00	15.3			
	60.00	31.1			
	70.00	48.6			
	80.00	70.0			
	90.00	102.			
	100.00	155.			
DELTA K MAX	A: 107.17	219.			
	B:				
	C:				
	D:				
ROOT MEAN SQUARE PERCENT ERROR		42.67			
LIFE PREDICTION RATIO SUMMARY (NP/NA)	0.0-0.5				
	0.5-0.8				
	0.8-1.25	2			
	1.25-2.0				
	>2.0				

CONDITION/HT: H1025
FORM: 1.50"TH BAR
SPECIMEN TYPE: CT
ORIENTATION: T-L
STRESS RATIO: +0.05
FREQUENCY: 10.00 HZ

YIELD STRENGTH: 151.2 KSI
ULT. STRENGTH: 156.1 KSI
SPECIMEN THK: 1.500"
SPECIMEN WIDTH: 3.000"
REFERENCES: 82270

STAIN. STEEL

15-5PH

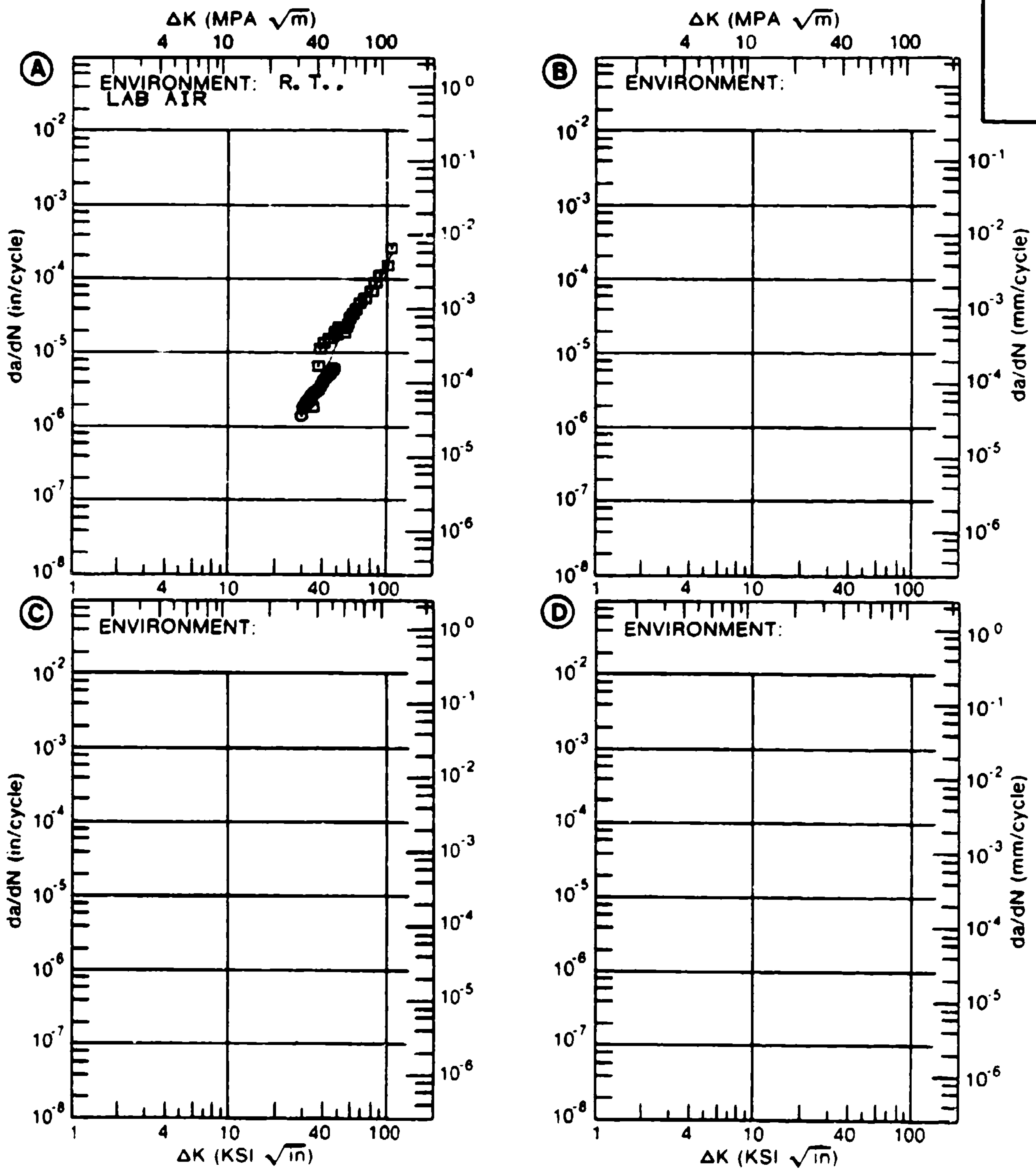


Figure 3.11.3.2

TABLE 3.11.3.3

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 3.11.3.3 INDICATING EFFECT

OF STRESS RATIO

MATERIAL: STAINLESS STEEL 15-5PH
CONDITION: H1025
ENVIRONMENT: R.T., 3.5% NACL

DELTA K (KSI*IN**1/2)			DA/DN (10**-6 IN./CYCLE) A	B	C	D
			R=+0.05	R=+0.50		
	A:	33.23	17.9			
DELTA K MIN	B:	24.76		13.2		
	C:					
	D:					
		25.00		13.4		
		30.00		18.6		
		35.00	19.9	26.7		
		40.00	25.6	36.7		
		50.00	39.4			
		60.00	60.4			
	A:	63.17	69.7			
DELTA K MAX	B:	43.53		44.1		
	C:					
	D:					
ROOT MEAN SQUARE PERCENT ERROR			2.30	4.38		
LIFE PREDICTION RATIO SUMMARY (NP/NA)		0.0-0.5				
		0.5-0.8				
		0.8-1.25	1	1		
		1.25-2.0				
		>2.0				

CONDITION/HT: H1025
FORM: 1.50"TH BAR
SPECIMEN TYPE: CT
ORIENTATION: T-L
FREQUENCY: 1.00 HZ
ENVIRONMENT: R.T., 3.5% NACL

YIELD STRENGTH: 151.2 KSI
ULT. STRENGTH: 158.1 KSI
SPECIMEN THK: 1.500"
SPECIMEN WIDTH: 3.000"
REFERENCES: 82270

STAIN. STEEL

15-5PH

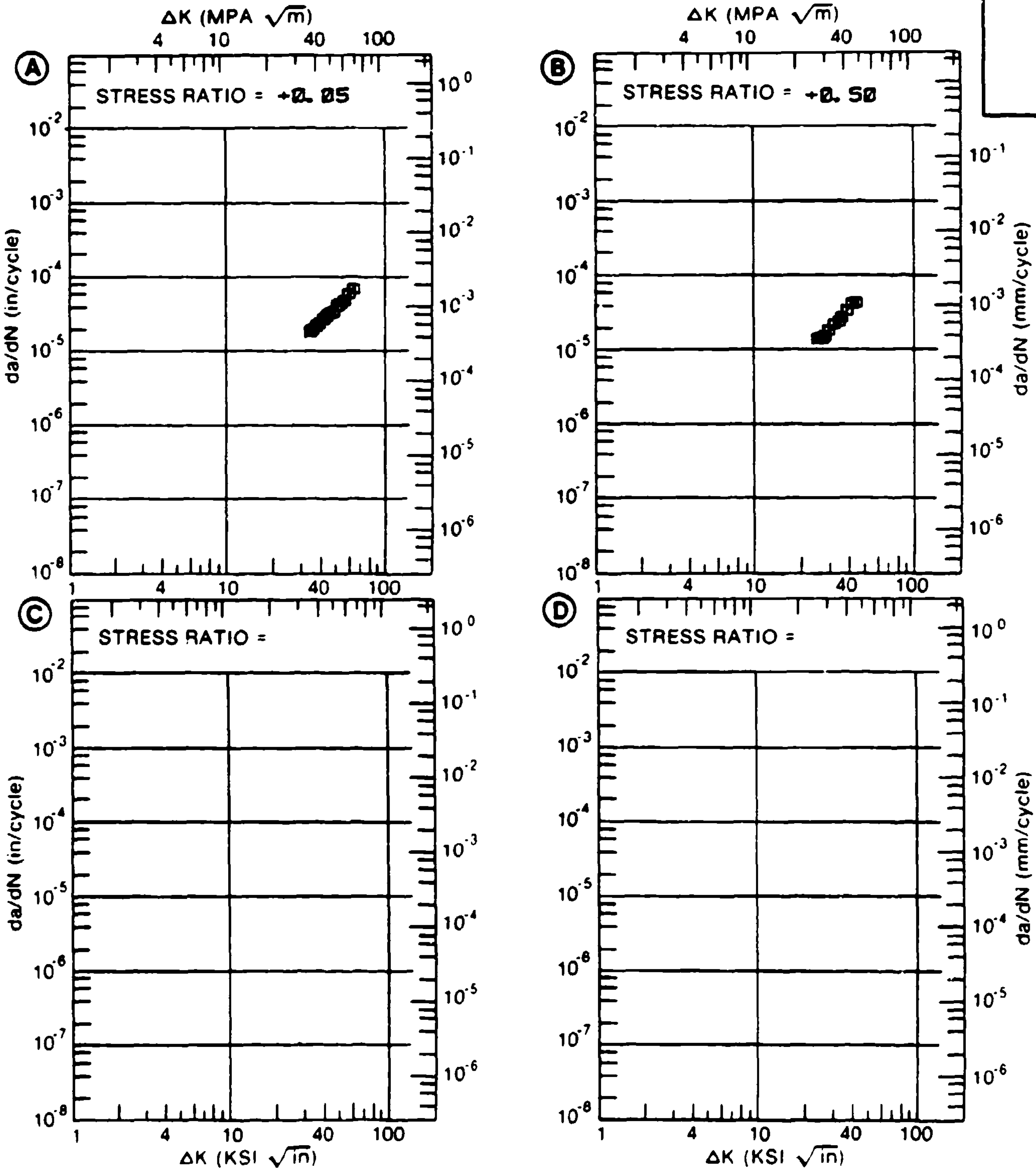


Figure 3.11.3.3

TABLE 3.11.3.4

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 3.11.3.4 INDICATING EFFECT

OF STRESS RATIO

MATERIAL: STAINLESS STEEL 15-5PH
CONDITION: TUS=150-165KSI
ENVIRONMENT: R.T., H.H.A.

DELTA K (KSI*IN**1/2)		DA/DN (10**-6 IN./CYCLE) A R=-1.00	B R=-0.20	C R=+0.04	D R=+0.40
DELTA K MIN	A: 12.00	.706			
	B: 14.00		.915		
	C: 13.44			.738	
	D: 9.60				.629
	10.00				.739
	13.00	.985			1.76
	16.00	2.07	1.52	1.45	3.05
	20.00	3.93	3.05	2.92	5.18
	25.00	6.82	5.43	5.22	8.94
	30.00	10.5	8.38	8.09	14.9
	35.00	15.5	12.2	11.8	24.9
	40.00	22.3	17.2	16.8	42.2
	50.00	45.6	33.6	33.6	
	60.00	94.6	66.2	67.8	
	70.00		133.	140.	
DELTA K MAX	A: 70.00	200.			
	B: 80.00		272.		
	C: 76.80			231.	
	D: 48.00				101.
ROOT MEAN SQUARE PERCENT ERROR		1.30	.62	2.28	2.82

LIFE PREDICTION RATIO SUMMARY (NP/NA)	
	0.0-0.5
	0.5-0.8
	0.8-1.25
	1.25-2.0
	>2.0

CONDITION/HT: TUS=150-185KSI
FORM: 0.50"TH BILLET
SPECIMEN TYPE: CCP
ORIENTATION: T-L
FREQUENCY:
ENVIRONMENT: R. T., H. H. A.

YIELD STRENGTH:
ULT. STRENGTH:
SPECIMEN THK:
SPECIMEN WIDTH:
REFERENCES: BW005

STAIN. STEEL

15-5PH

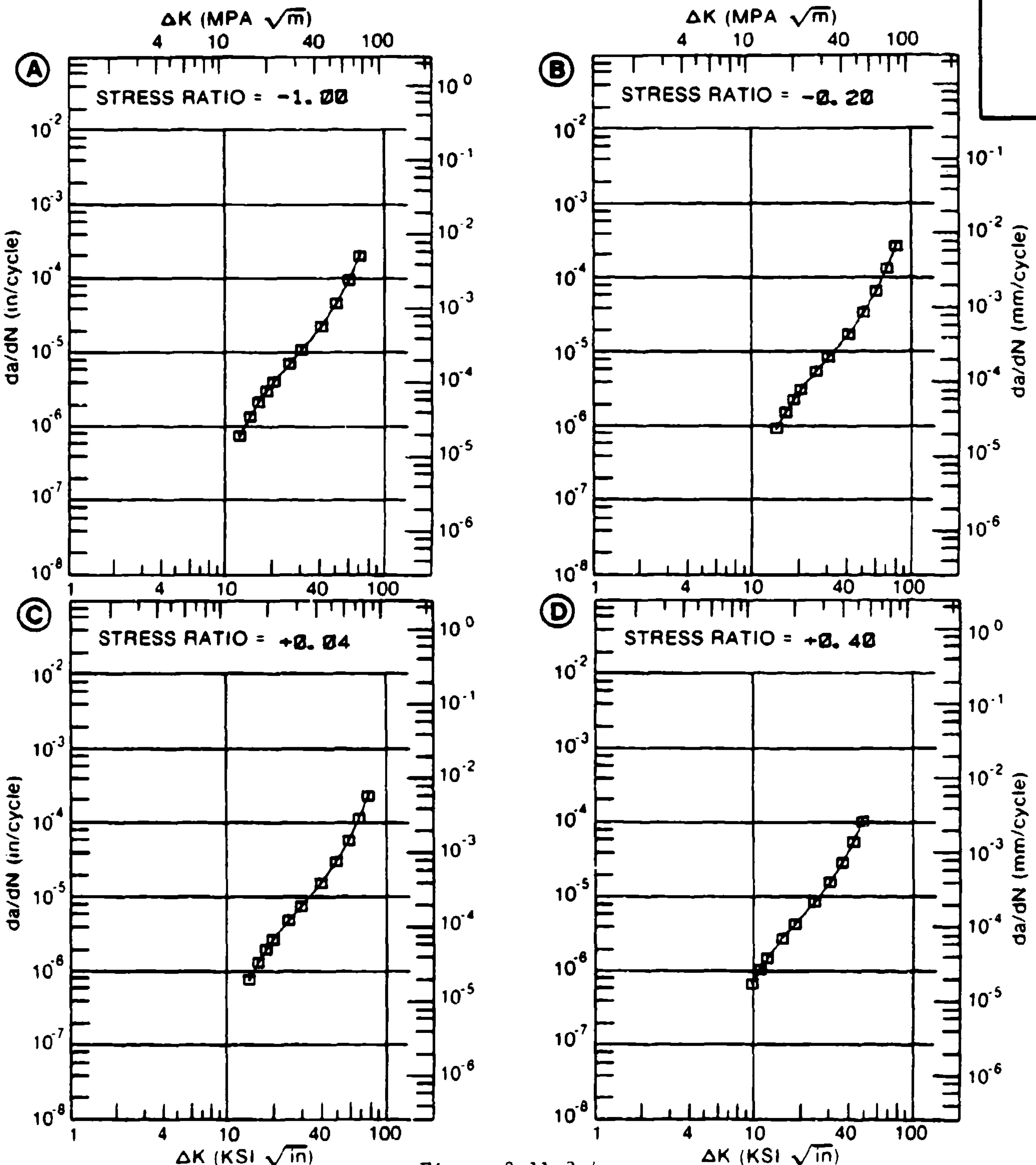


Figure 3.11.3.4

TABLE 3.11.3.5

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 3.11.3.5 INDICATING EFFECT

OF STRESS RATIO

MATERIAL: STAINLESS STEEL 15-5PH
CONDITION: TUS=150-165KSI
ENVIRONMENT: R.T., H.H.A.

DELTA K (KSI*IN**1/2)		DA/DN (10**-6 IN./CYCLE) A R=-1.00	B R=-0.20	C R=+0.04	D R=+0.40
DELTA K MIN A:	14.00	1.67			
DELTA K MIN B:	14.00		1.31		
DELTA K MIN C:	15.36			1.56	
DELTA K MIN D:	10.80				1.24
	13.00				2.09
	16.00	2.61	1.92	1.75	3.51
	20.00	4.78	3.46	3.16	6.02
	25.00	8.05	5.99	5.45	10.8
	30.00	12.2	9.38	8.51	18.9
	35.00	17.7	13.9	12.7	33.0
	40.00	25.3	20.1	18.5	58.0
	50.00	51.6	39.8	37.9	
	60.00			76.5	
DELTA K MAX A:	60.00	108.			
DELTA K MAX B:	60.00		76.0		
DELTA K MAX C:	67.20			126.	
DELTA K MAX D:	48.00				146.
ROOT MEAN SQUARE PERCENT ERROR		7.16	1.94	2.77	4.04

LIFE PREDICTION RATIO SUMMARY (NP/NA)	
	0.0-0.5
	0.5-0.8
	0.8-1.25
	1.25-2.0
	>2.0

CONDITION/HT: TUS=150-165KSI
FORM: 0.50"TH BILLET
SPECIMEN TYPE: CCP
ORIENTATION: S-L
FREQUENCY:
ENVIRONMENT: R. T., H. H. A.

YIELD STRENGTH:
ULT. STRENGTH:
SPECIMEN THK:
SPECIMEN WIDTH:
REFERENCES: BW004

STAIN. STEEL

15-5PH

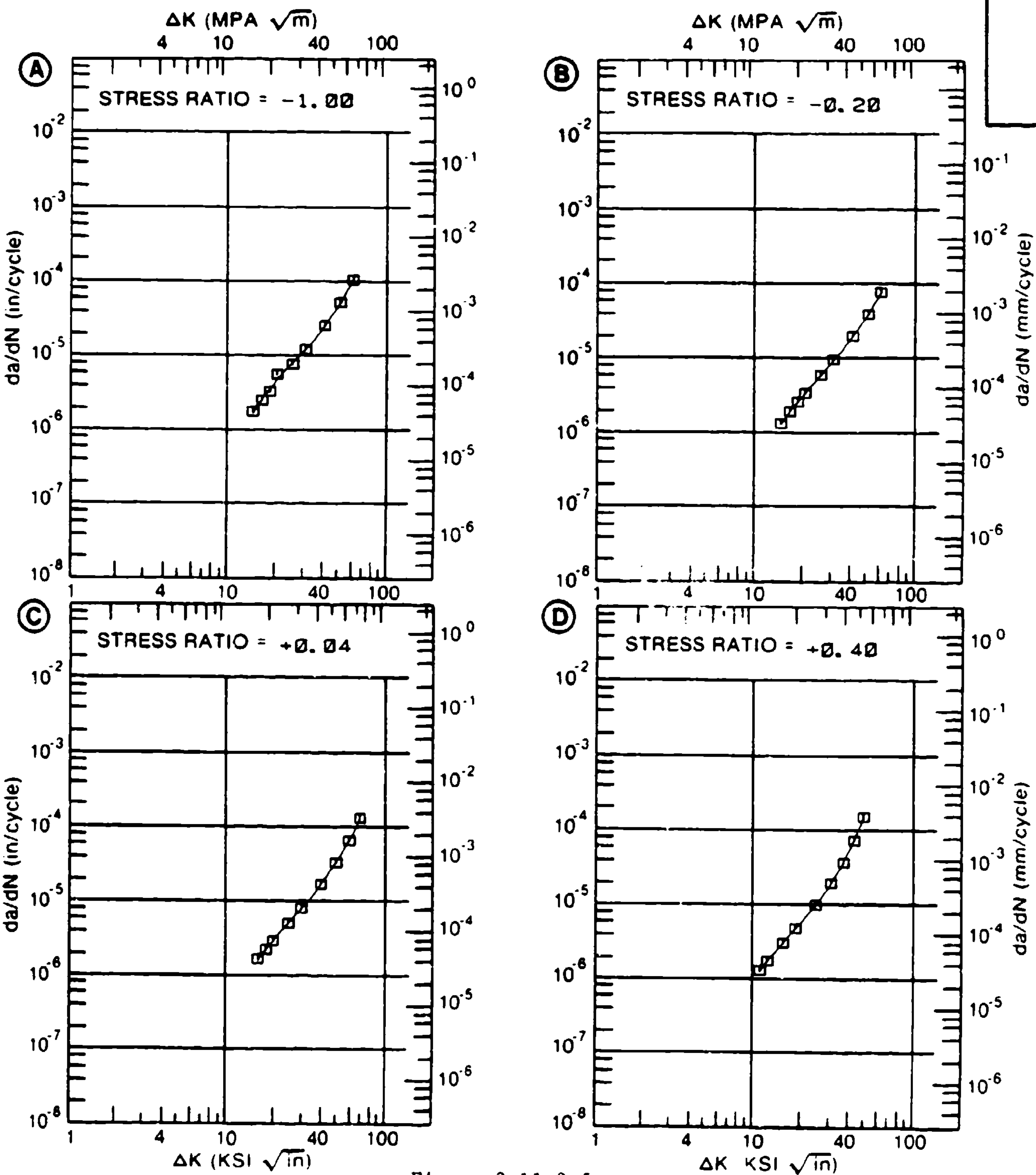


Figure 3.11.3.5

Table 3.11.3.6

STAINLESS STEEL 15-5PH K(ISCC)

CONDITION	--PRODUCT-- FORM	THICK (IN)	TEST TEMP (F)	SPEC OR	YIELD STR (KSI)	ENVIRONMENT	------SPECIMEN------ WIDTH (IN) W	THICK (IN) B	DESIGN (*=SG)	CRACK LENGTH (IN) A	K(Q) (KSI*SQRT IN)	K(ISCC)	MEAN	STAN DEV	TEST TIME (MIN)	DATE	REFER
H 900	B	2.25	R.T.	T-L	171.2	INDUSTRIAL ATM	2.000	1.000	CT	----	71.80	68.00			----	1973	86688
H 900	B	2.25	R.T.	T-L	171.2	SEACOAST ATM	2.000	1.000	CT	----	71.80	36.00			----	1973	86688
H 900	B	2.25	R.T.	T-L	171.2	20 PCT NACL	2.000	1.000	CT	----	71.80	33.00			----	1973	86688
H1150M	B	2.25	R.T.	T-L	93.1	INDUSTRIAL ATM	2.000	1.000	CT	----	75.70	72.00*			----	1973	86688
H1150M	B	2.25	R.T.	T-L	93.1	SEACOAST ATM	2.000	1.000	CT	----	75.70	72.00*			----	1973	86688
H1150M	B	2.25	R.T.	T-L	93.1	20 PCT NACL	2.000	1.000	CT	----	75.70	72.00*			----	1973	86688

*NOTE-DATA WHICH DO NOT MEET MINIMUM SPECIMEN THICKNESS REQUIREMENTS OF 2.5(KISCC/TYS)SQUARED

Table 3.12.3.1

STAINLESS STEEL 15-5PH(AM) K(ISCC)

CONDITION	PRODUCT FORM	PRODUCT THICK (IN)	TEST TEMP (F)	SPEC OR	YIELD STR (KSI)	ENVIRONMENT	SPECIMEN WIDTH (IN) W	SPECIMEN THICK (IN) B	SPECIMEN DESIGN (*=SG)	CRACK LENGTH (IN) A	K(0) (KSI*SQRT IN)	K(ISCC) (KSI*SQRT IN)	MEAN	STAN DEV	TEST TIME (MIN)	DATE	REFER
H 900	F	3.00	R T	---	175.0	3.5 PCT NACL	1.500	0.480	CANT	----	96.80	80.00*			> 60000	1971	84333
H1000	F	3.00	R T	---	157.9	3.5 PCT NACL	1.500	0.480	CANT	----	114.00	114.00*			> 60000	1971	84333

*NOTE-DATA WHICH DO NOT MEET MINIMUM SPECIMEN THICKNESS REQUIREMENTS OF 2.5(KISCC/TYS)SQUARED

Table 3.13.3.1

STAINLESS STEEL 15-5PH(VM) K(ISCC)

CONDITION	--PRODUCT-- FORM	THICK (IN)	TEST TEMP (F)	SPEC OR	YIELD STR (KSI)	ENVIRONMENT	------SPECIMEN------ WIDTH (IN) W	THICK (IN) B	DESIGN (*=SG)	CRACK LENGTH (IN) A	K(Q) (KSI*SQRT IN)	K(ISCC)	MEAN	STAN DEV	TEST TIME (MIN)	DATE	REFER
H 900	F	4.50	R.T.	---	174.9	3.5 PCT NACL	1.500	0.480	CANT	----	74.50	55.80			> 48000	1971	84333
H1000	F	4.50	R.T.	---	157.6	3.5 PCT NACL	1.500	0.480	CANT	----	120.00	120.00*			> 60000	1971	84333

*NOTE-DATA WHICH DO NOT MEET MINIMUM SPECIMEN THICKNESS REQUIREMENTS OF 2.5(KISCC/TYS)SQUARED

Table 3.14.1.1

FATIGUE CRACK GROWTH RATE AT DEFINED LEVELS OF THE STRESS-INTENSITY FACTOR

STAINLESS STEEL 17-4PH

TEST CONDITIONS

SPECIMEN ORIENTATION T-:

ENVIRONMENT: LAB AIR AT R.T.

CONDITION/HT	PRODUCT FORM	STRESS RATIO	FREQ. (HZ)	DELTA K LEVELS (KSI SQRT(IN)) 2.5	5	10	20	50	100
H1025	ROUND BAR	0.10	30.00			0.06	2.00		
H1025	ROUND BAR	0.50	10.00				5.77		
H1025	ROUND BAR	0.50	30.00		0.03	0.51			

Table 3.14.2.1

STAINLESS STEEL 17-4PH K(IC)

CONDITION	--PRODUCT-- FORM	THICK (IN)	TEST TEMP (F)	SPECIMEN ORIENT	YIELD STRENGTH (KSI)	------SPECIMEN------ WIDTH (IN) W	THICK (IN) B	DESIGN	CRACK LENGTH (IN) A	2.5*(K(IC)/TYS)**2 (IN)	K(IC) (KSI*SQRT IN)	K(IC) MEAN	STAN DEV	DATE	REFER
H 975	RR	3.25	R.T.	L-R	168.0	2.000	1.000	NB	1.000	0.63	94.60			----	84212
H1C25	BR	3.00	R.T.	1-L	175.3	1.990	0.503	CT	0.937	0.45	74.50			1979	DA001

TABLE 3.14.3.1

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 3.14.3.1 INDICATING EFFECT

OF STRESS RATIO

MATERIAL: STAINLESS STEEL 17-4PH
CONDITION: H900
ENVIRONMENT: R.T. ,LAB AIR

DELTA K (KSI*IN**1/2)			DA/DN (10**-6 IN./CYCLE) A	B	C	D
			R=+0.08			
DELTA K MIN	A:	7.54	.126			
	B:					
	C:					
	D:					
		8.00	.150			
		9.00	.217			
		10.00	.305			
		13.00	.745			
		16.00	1.54			
		20.00	3.38			
		25.00	7.25			
		30.00	13.1			
		35.00	20.9			
		40.00	30.5			
		50.00	53.1			
DELTA K MAX	A:	56.40	68.4			
	B:					
	C:					
	D:					
ROOT MEAN SQUARE PERCENT ERROR			22.74			
LIFE PREDICTION RATIO SUMMARY (NP/NA)		0.0-0.5				
		0.5-0.8				
		0.8-1.25	1			
		1.25-2.0				
		>2.0				

CONDITION/HT: H900
FORM: 0.56"TH PLATE
SPECIMEN TYPE: CT
ORIENTATION: L-T
FREQUENCY: 20.00 HZ
ENVIRONMENT: R.T., LAB AIR

YIELD STRENGTH: 170.5 KSI
ULT. STRENGTH: 192.7 KSI
SPECIMEN THK: 0.500"
SPECIMEN WIDTH: 1.969"
REFERENCES: DA001

STAIN. STEEL

17-4PH

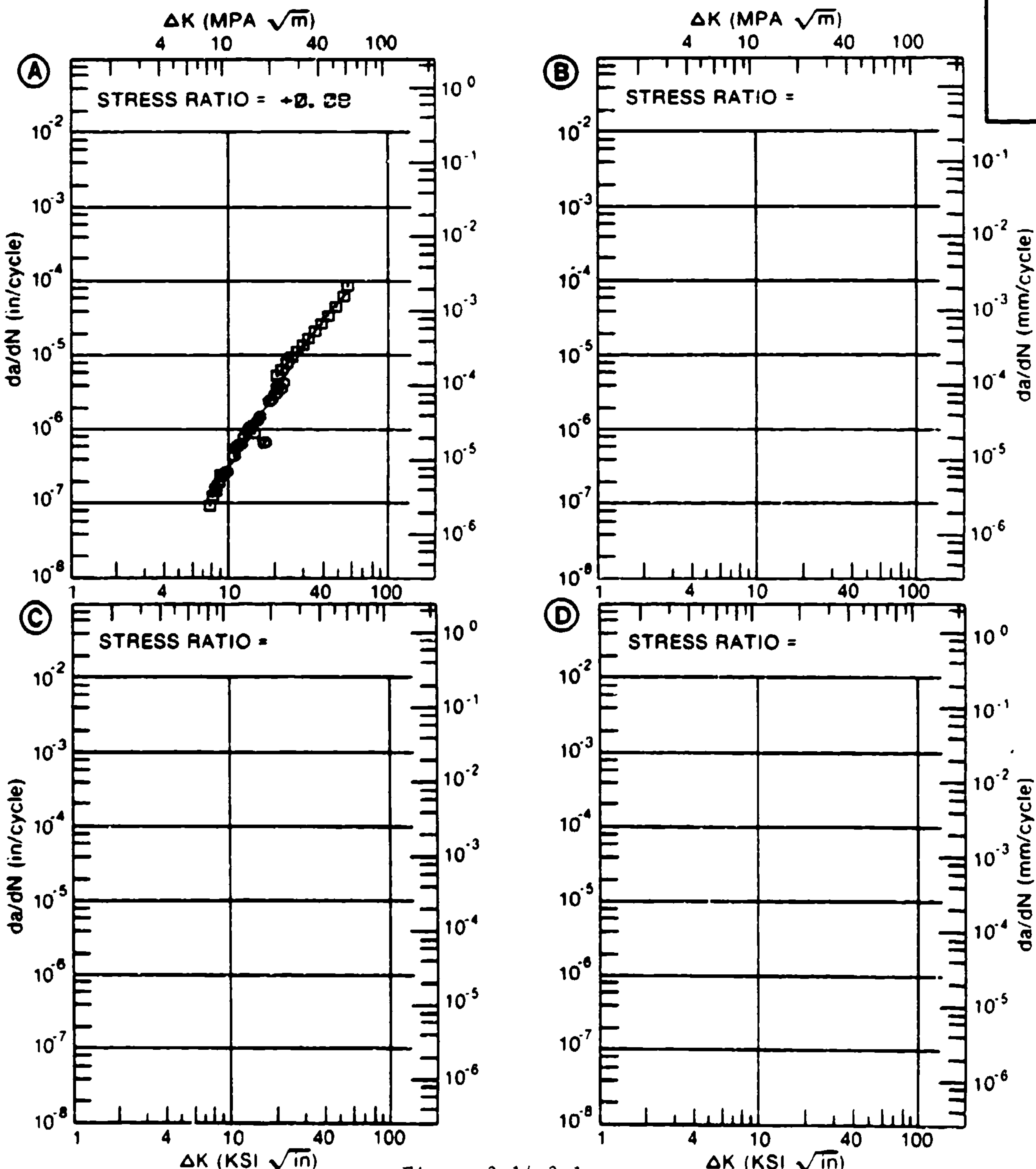


Figure 3.14.3.1

TABLE 3.14.3.2

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 3.14.3.2 INDICATING EFFECT

OF ENVIRONMENT

MATERIAL: STAINLESS STEEL 17-4PH
CONDITION: H1025

DELTA K (KSI*IN**1/2)		DA/DN (10**-6 IN./CYCLE) A	B	C	D
		E= R.T. H.H.A.			
DELTA K MIN	A: 8.33	.214			
	B:				
	C:				
	D:				
	9.00	.245			
	10.00	.330			
	13.00	.945			
	16.00	2.15			
	20.00	3.51			
DELTA K MAX	A: 20.04	3.51			
	B:				
	C:				
	D:				
ROOT MEAN SQUARE PERCENT ERROR		17.98			
LIFE PREDICTION RATIO SUMMARY (NP/NA)	0.0-0.5				
	0.5-0.8				
	0.8-1.25	2			
	1.25-2.0				
	>2.0				

CONDITION/HT: H1Ø25
FORM: Ø. 13"TH CASTING
SPECIMEN TYPE: CCP
ORIENTATION:
STRESS RATIO: +Ø. Ø2
FREQUENCY: 1. Ø HZ

YIELD STRENGTH:
ULT. STRENGTH:
SPECIMEN THK: Ø. 1Ø3- Ø. 113"
SPECIMEN WIDTH: 2. 915- 2. 955"
REFERENCES: GDØ1Ø

STAIN. STEEL

17-4PH

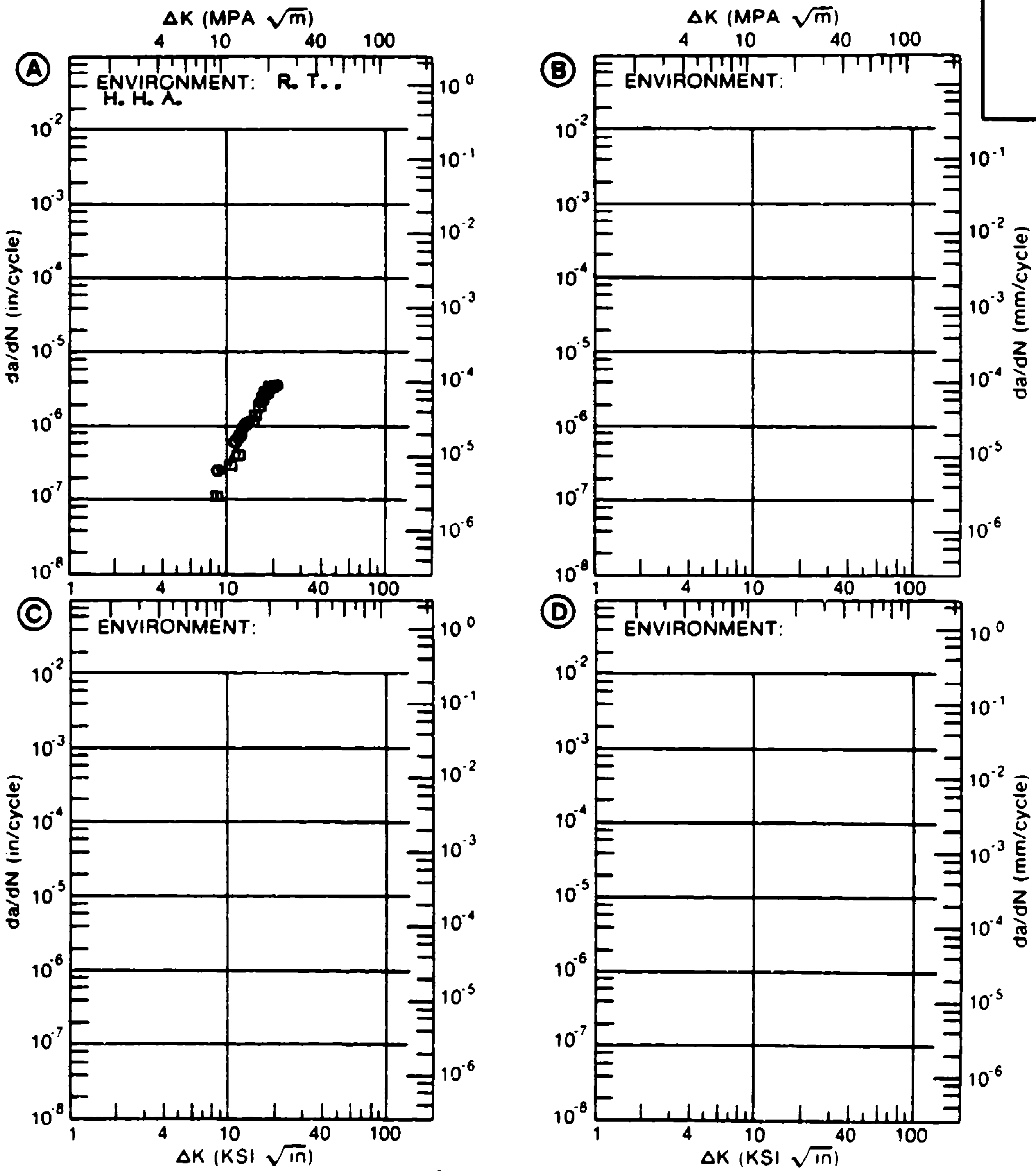


Figure 3.14.3.2

TABLE 3.14.3.3

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 3.14.3.3 INDICATING EFFECT

OF STRESS RATIO

MATERIAL: STAINLESS STEEL 17-4PH
CONDITION: H1025
ENVIRONMENT: R.T., LAB AIR

DELTA K (KSI*IN**1/2)			DA/DN (10**-6 IN./CYCLE) A	B	C	D
			R=+0.10	R=+0.50		
DELTA K MIN	A:	20.54	1.48			
	B:	11.39		.708		
	C:					
	D:					
		13.00		1.33		
		16.00		2.76		
		20.00		5.77		
		25.00	3.15	16.5		
		30.00	5.61			
		35.00	9.33			
		40.00	15.9			
DELTA K MAX	A:	49.82	54.3			
	B:	28.37		39.5		
	C:					
	D:					
ROOT MEAN SQUARE PERCENT ERROR			8.26	7.53		
LIFE PREDICTION RATIO SUMMARY (NP/NA)		0.0-0.5				
		0.5-0.8				
		0.8-1.25	1	1		
		1.25-2.0				
		>2.0				

CONDITION/HT: H1025
FORM: 3.0"TH ROUND BAR
SPECIMEN TYPE: CT
ORIENTATION: T-L
FREQUENCY: 10.0 HZ
ENVIRONMENT: R.T., LAB AIR

YIELD STRENGTH: 175.3 KSI
ULT. STRENGTH: 179.8 KSI
SPECIMEN THK: 0.50"
SPECIMEN WIDTH: 1.98- 2.00"
REFERENCES: DA001

STAIN. STEEL

17-4PH

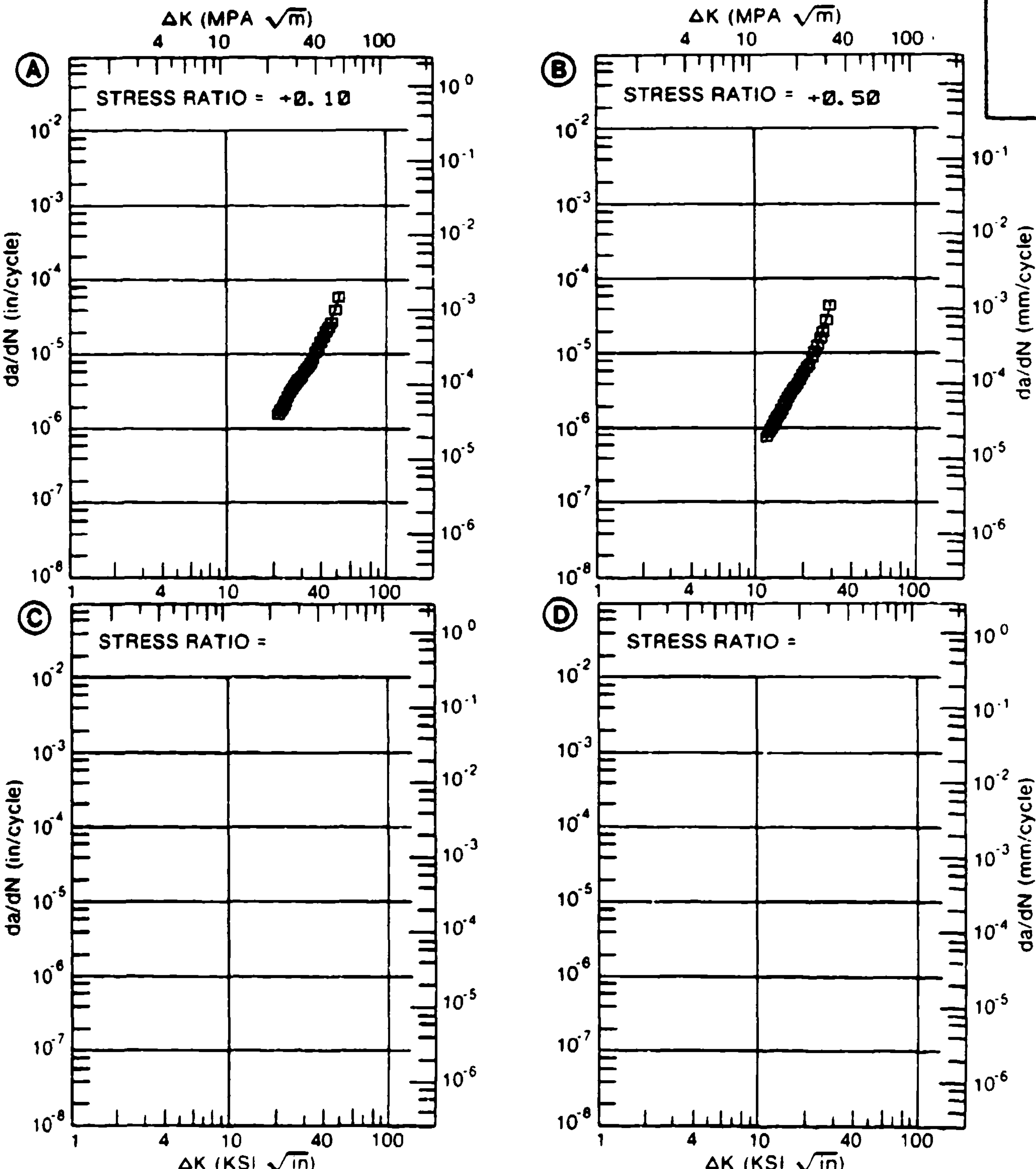


Figure 3.14.3.3

TABLE 3.14.3.4

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 3.14.3.4 INDICATING EFFECT

OF STRESS RATIO

MATERIAL: STAINLESS STEEL 17-4PH
CONDITION: H1025
ENVIRONMENT: R.T., LAB AIR

DELTA K (KSI*IN**1/2)			DA/DN (10**-6 IN./CYCLE) A	B	C	D
			R=+0.10	R=+0.50		
DELTA K MIN	A:	7.48	.0111			
	B:	4.00		.00984		
	C:					
	D:					
		5.00		.0357		
		6.00		.0802		
		7.00		.143		
		8.00	.0175	.229		
		9.00	.0344	.347		
		10.00	.0607	.512		
		13.00	.288			
		16.00	.899			
		20.00	2.00			
		25.00	3.66			
		30.00	7.22			
		35.00	13.7			
DELTA K MAX	A:	38.39	19.6			
	B:	12.62		1.41		
	C:					
	D:					
ROOT MEAN SQUARE PERCENT ERROR			11.17	6.89		
LIFE PREDICTION RATIO SUMMARY (NP/NA)		0.0-0.5				
		0.5-0.8				
		0.8-1.25	1	1		
		1.25-2.0				
		>2.0				

CONDITION/HT: H1025
FORM: 3.0"TH ROUND BAR
SPECIMEN TYPE: CT
ORIENTATION: T-L
FREQUENCY: 30.0 HZ
ENVIRONMENT: R.T., LAB AIR

YIELD STRENGTH: 175.3 KSI
ULT. STRENGTH: 179.8 KSI
SPECIMEN THK: 0.25"
SPECIMEN WIDTH: 1.99- 2.00"
REFERENCES: DA001

STAIN. STEEL

17-4PH

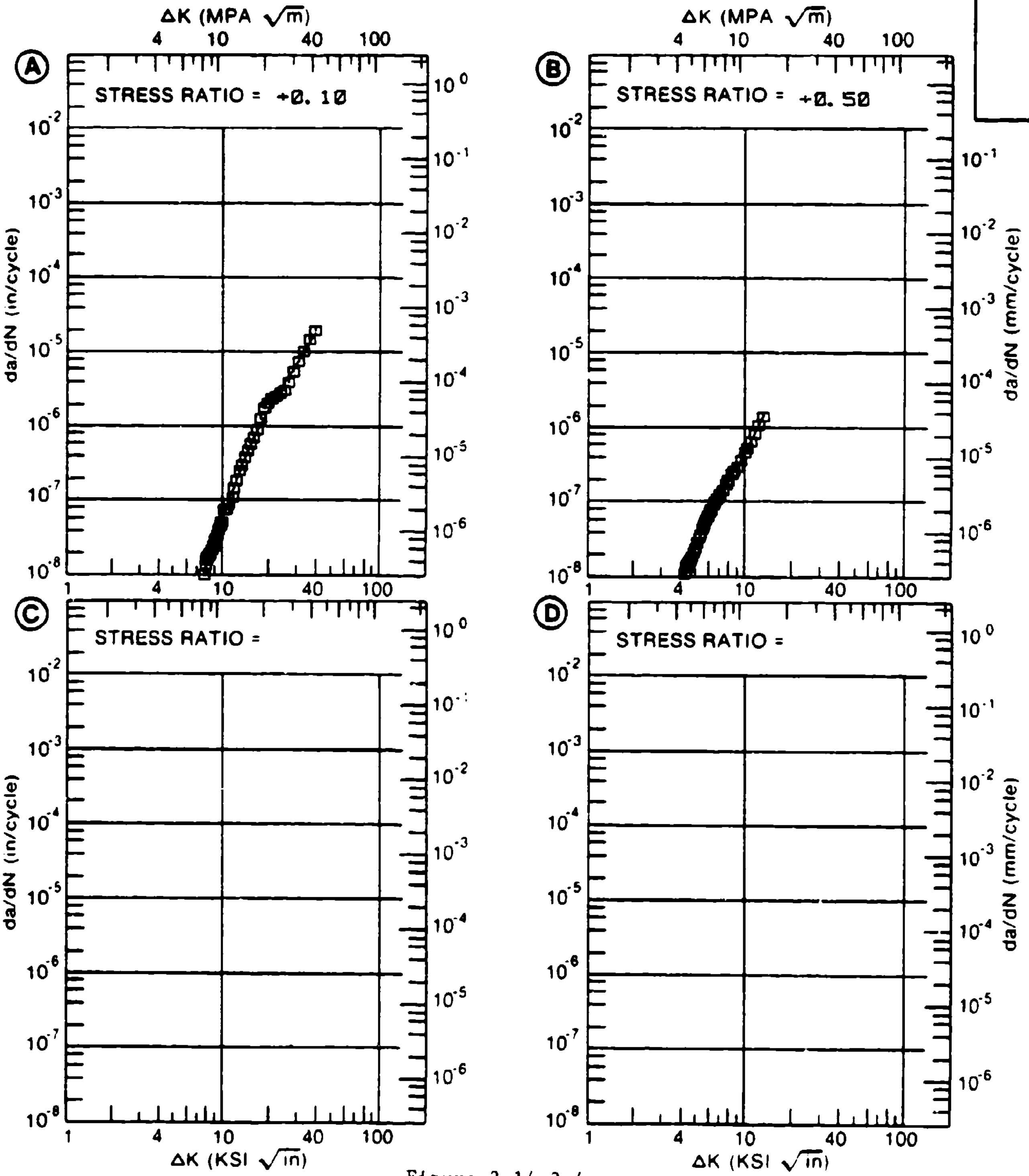


Figure 3.14.3.4

Table 3.14.3.5

STAINLESS STEEL 17-4PH K(ISCC)

CONDITION	PRODUCT FORM	PRODUCT THICK (IN)	TEST TEMP (F)	SPEC OR	YIELD STR (KSI)	ENVIRONMENT	SPECIMEN WIDTH (IN) W	SPECIMEN THICK (IN) B	SPECIMEN DESIGN (*=SC)	CRACK LENGTH (IN) A	K(Q) (KSI*SQRT IN)	K(ISCC) (KSI*SQRT IN)	MEAN	STAN DEV	TEST TIME (MIN)	DATE	REFER
H 900	B	1.75	R.T	---	176.5	3.5 PCT NACL	1.500	0.480	CANT	----	51.50	51.50			> 60000	1971	84333
H1000	B	1.75	R.T	---	157.9	3.5 PCT NACL	1.500	0.480	CANT	----	119.00	119.00*			> 60000	1971	84333

*NOTE-DATA WHICH DO NOT MEET MINIMUM SPECIMEN THICKNESS REQUIREMENTS OF 2.5(KISCC/TYS)SQUARED

Table 3.15.1.1

MEAN PLANE STRAIN FRACTURE TOUGHNESS DATA OF
STAINLESS STEEL ALLOY 17-7PH AT ROOM TEMPERATURE

CONDITION/HT	MEAN KIC ± STANDARD (KSI SQRT(IN)) DEVIATION	(NUMBER OF SPECIMENS)

ROLLED BAR

CONDITION/HT	L-T	T-L	S-L
RH1050	-----	47.0 ± 0.7 (3)	-----

Table 3.15.2.1

STAINLESS STEEL 17-7PH K(IC)

CONDITION	--PRODUCT-- FORM	THICK (IN)	TEST TEMP (F)	SPECIMEN ORIENT	YIELD STRENGTH (KSI)	------SPECIMEN------ WIDTH (IN) W	THICK (IN) B	DESIGN	CRACK LENGTH (IN) A	2.5*(K(IC)/TYS)**2 (IN)	K(IC) (KSI*SQRT IN)	K(IC) MEAN	STAN DEV	DATE	REFER
RH1050	RB	1.25	R.T.	T-L	190.0	2.000	1.000	CT	1.066	0.15	46.30			1973	86688
		1.25			190.0	2.000	1.000	CT	1.025	0.15	47.70			1973	86688
		1.25			190.0	2.000	1.000	CT	1.026	0.15	47.10	47.0/	0.7	1973	86688

TABLE 3.15.3.1

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 3.15.3.1 INDICATING EFFECT
OF STRESS RATIO

MATERIAL: STAINLESS STEEL 17-7PH
CONDITION: TH1050
ENVIRONMENT: R.T., LAB AIR

DELTA K (KSI*IN**1/2)			DA/DN (10**-6 IN./CYCLE) A	B	C	D
			R=+0.10			
DELTA K MIN	A:	2.85	.00325			
	B:					
	C:					
	D:					
		3.00	.00435			
		3.50	.00947			
		4.00	.0156			
		5.00	.0252			
		6.00	.0425			
		7.00	.0857			
		8.00	.162			
		9.00	.276			
		10.00	.433			
		13.00	1.19			
		16.00	2.38			
DELTA K MAX	A:	18.70	3.75			
	B:					
	C:					
	D:					

ROOT MEAN SQUARE PERCENT ERROR		11.25
LIFE PREDICTION RATIO SUMMARY (NP/NA)	0.0-0.5	
	0.5-0.8	1
	0.8-1.25	
	1.25-2.0	
	>2.0	

CONDITION/HT: TH1050
FORM: 0.50"TH PLATE
SPECIMEN TYPE: CT
ORIENTATION: L-T
FREQUENCY: 20.0 HZ
ENVIRONMENT: R.T., LAB AIR

YIELD STRENGTH: 184.0 KSI
ULT STRENGTH: 208.1 KSI
SPECIMEN THK: 0.500"
SPECIMEN WIDTH: 1.880"
REFERENCES: DA001

STAIN. STEEL

17-7PH

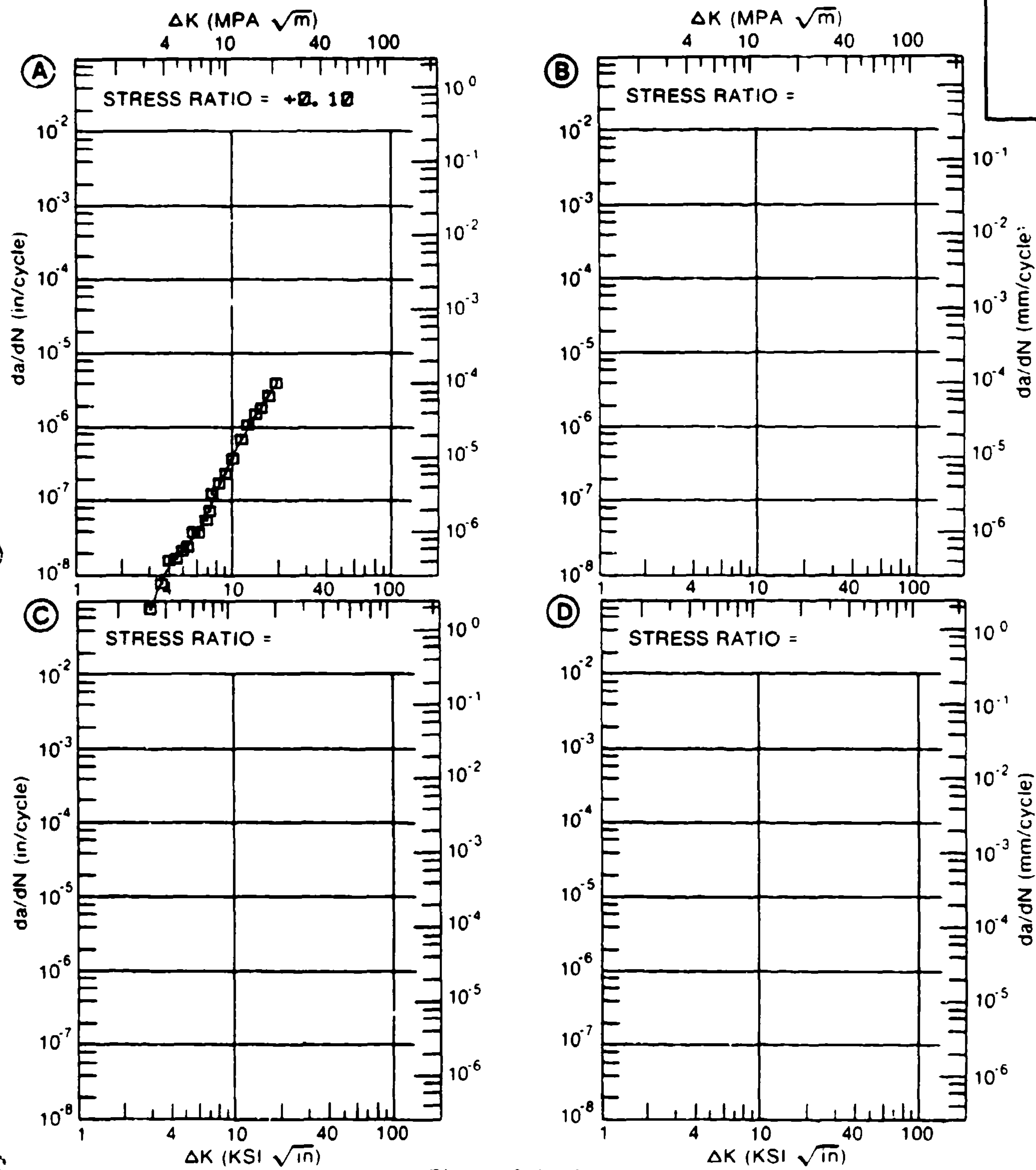


Figure 3.15.3.1

TABLE 3.15.3.2

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 3.15.3.2 INDICATING EFFECT

OF STRESS RATIO

MATERIAL: STAINLESS STEEL 17-7PH
CONDITION: TH1050
ENVIRONMENT: R.T., LAB AIR

DELTA K (KSI*IN**1/2)			DA/DN (10**-6 IN./CYCLE) A	B	C	D
			R=+0.10			
DELTA K MIN	A:	3.82	.00558			
	B:					
	C:					
	D:					
		4.00	.00944			
		5.00	.0264			
		6.00	.0447			
		7.00	.0841			
		8.00	.153			
		9.00	.253			
		10.00	.388			
		13.00	1.03			
		16.00	2.12			
		20.00	4.44			
		25.00	9.34			
		30.00	17.5			
		35.00	30.7			
		40.00	51.4			
DELTA K MAX	A:	49.65	205.			
	B:					
	C:					
	D:					

ROOT MEAN SQUARE PERCENT ERROR 11.14

LIFE PREDICTION RATIO SUMMARY (NP/NA)		
	0.0-0.5	
	0.5-0.8	1
	0.8-1.25	1
	1.25-2.0	
	>2.0	

CONDITION/HT: TH1050
FORM: 0.50"TH PLATE
SPECIMEN TYPE: CT
ORIENTATION: T-L
FREQUENCY: 20.0 HZ
ENVIRONMENT: R.T., LAB AIR

YIELD STRENGTH: 190.3 KSI
ULT. STRENGTH: 203.3 KSI
SPECIMEN THK: 0.500"
SPECIMEN WIDTH: 1.969"
REFERENCES: DA001

STAIN. STEEL

17-7PH

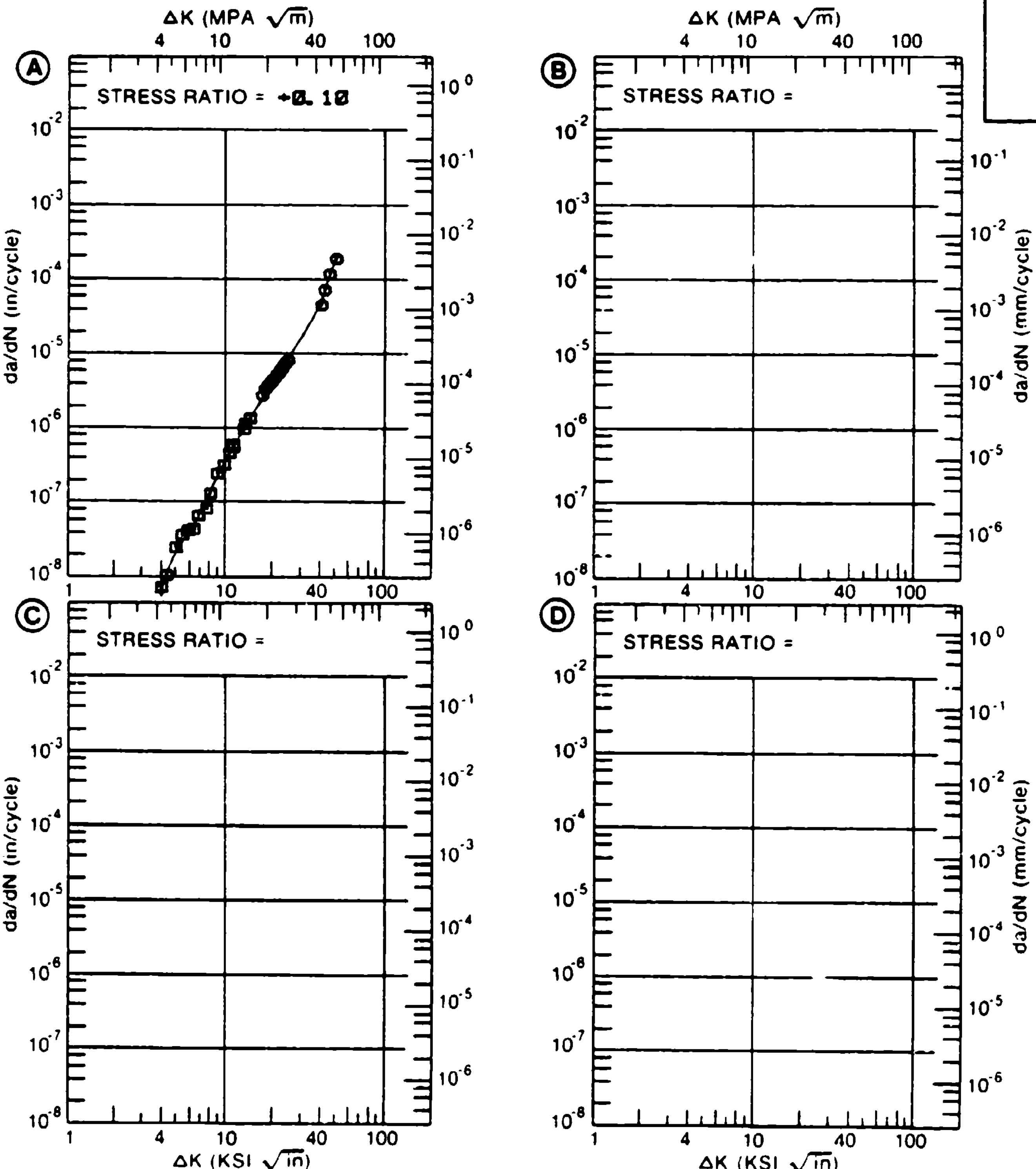


Figure 3.15.3.2

Table 3.15.3.3

STAINLESS STEEL 17-7PH K(ISCC)

CONDITION	PRODUCT FORM	PRODUCT THICK (IN)	TEST TEMP (F)	SPEC OR	YIELD STR (KSI)	ENVIRONMENT	SPECIMEN WIDTH (IN) W	SPECIMEN THICK (IN) B	SPECIMEN DESIGN (*=SC)	CRACK LENGTH (IN) A	K(Q) (KSI*SQRT IN)	K(ISCC) (KSI*SQRT IN)	MEAN	STAN DEV	TEST TIME (MIN)	DATE	REFER
RH 950	B	1.75	R.T.	---	171.3	3.5 PCT NACL	1.500	0.480	CANT	----	32.30	19.00			> 42000	1971	84333
RH1050	B	1.25	R.T.	T-L	190.5	INDUSTRIAL ATM	2.000	1.000	CT	----	47.00	24.00			----	1973	86688
RH1050	B	1.25	R.T.	T-L	190.5	SEACOAST ATM	2.000	1.000	CT	----	47.00	12.00			----	1973	86688
RH1050	B	1.25	R.T.	T-L	190.5	20 PCT NACL	2.000	1.000	CT	----	47.00	10.00			----	1973	86688
TH1050	B	1.75	R.T.	---	----	3.5 PCT NACL	1.500	0.480	CANT	----	38.70	15.80			> 30000	1971	84333

Table 3.16.1.1

FATIGUE CRACK GROWTH RATE AT DEFINED LEVELS OF THE STRESS-INTENSITY FACTOR

STAINLESS STEEL 304

TEST CONDITIONS

SPECIMEN ORIENTATION: Unknown

ENVIRONMENT: LAB AIR AT R.T.

CONDITION/HT	PRODUCT FORM	STRESS RATIO	FREQ. (HZ)	DELTA K LEVELS (KSI SQRT(IN))					
				FATIGUE CRACK GROWTH RATES (MICRO IN/CYCLE)					
				2.5	5	10	20	50	100
ANNEALED	SHEET	0.05	10.00			0.16	3.07		
ANNEALED	SHEET	0.05	15.00			0.13	2.83		
ANNEALED	SHEET	0.10	1.67				2.86		
ANNEALED	SHEET	0.10	6.00				2.56		
ANNEALED & AGE	PLATE	0.05	3.00				1.38		

Table 3.16.1.2

FATIGUE CRACK GROWTH RATE AT DEFINED LEVELS OF THE STRESS-INTENSITY FACTOR

STAINLESS STEEL 304

TEST CONDITIONS

SPECIMEN ORIENTATION: L-T

ENVIRONMENT: LAB AIR AT R.T.

CONDITION/HT	PRODUCT FORM	STRESS RATIO	FREQ. (HZ)	DELTA K LEVELS (KSI SQRT(IN))	FATIGUE CRACK GROWTH RATES (MICRO IN/CYCLE)					
					2.5	5	10	20	50	100
ANNEALED	PLATE	0.00	0.03						56.0	
ANNEALED	PLATE	0.00	6.67					1.92	28.5	

TABLE 3.16.3.1

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 3.16.3.1 INDICATING EFFECT OF FREQUENCY

MATERIAL: STAINLESS STEEL 304
CONDITION: ANNEALED
ENVIRONMENT: R.T., LAB AIR

DELTA K (KSI*IN**1/2)			DA/DN (10**-6 IN./CYCLE) A	B	C	D
			F(HZ)= 10.0	F(HZ)= 15.0		
	A:	9.98	.160			
DELTA K MIN	B:	9.16		.112		
	C:					
	D:					
		10.00	.163	.133		
		13.00	.438	.360		
		16.00	1.37	1.01		
		20.00	3.07	2.83		
	A:	23.49	6.30			
DELTA K MAX	B:	21.04		3.45		
	C:					
	D:					
ROOT MEAN SQUARE PERCENT ERROR			15.06	26.43		
LIFE PREDICTION RATIO SUMMARY (NP/NA)		0.0-0.5				
		0.5-0.8				
		0.8-1.25	3	3		
		1.25-2.0		1		
		>2.0				

CONDITION/HT: ANNEALED
FORM: SHEET
SPECIMEN TYPE: CCP
ORIENTATION:
STRESS RATIO: +0.05
ENVIRONMENT: R.T., LAB AIR

YIELD STRENGTH:
ULT. STRENGTH:
SPECIMEN THK: 0.018"
SPECIMEN WIDTH: 0.995- 1.998"
REFERENCES: HD009

STAIN. STEEL

304

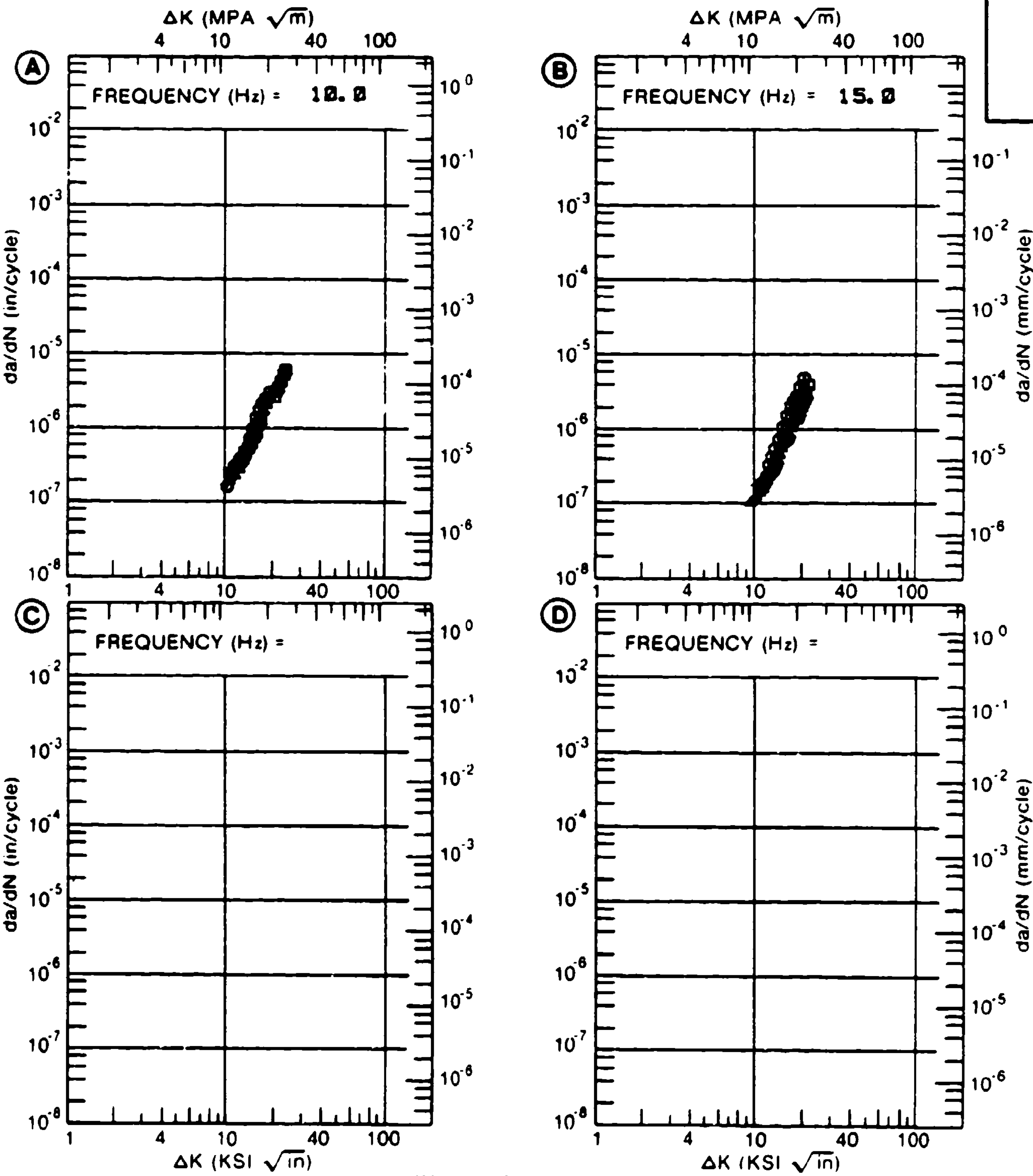


Figure 3.16.3.1

TABLE 3.16.3.2

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 3.16.3.2 INDICATING EFFECT

OF FREQUENCY

MATERIAL: STAINLESS STEEL 304
CONDITION: ANNEALED
ENVIRONMENT: R.T., LAB AIR

DELTA K (KSI*IN**1/2)			DA/DN (10**-6 IN./CYCLE) A	B	C	D
			F(HZ)= 1.67	F(HZ)= 6.00		
	A:	14.71	.772			
DELTA K	B:	10.85		.128		
MIN	C:					
	D:					
		13.00		.312		
		16.00	1.19	.657		
		20.00	2.86	2.56		
		25.00	4.61			
		30.00	10.6			
	A:	32.52	20.3			
DELTA K	B:	21.51		4.77		
MAX	C:					
	D:					
ROOT MEAN SQUARE PERCENT ERROR			23.51	8.28		
LIFE		0.0-0.5				
PREDICTION		0.5-0.8	2			
RATIO		0.8-1.25	2	1		
SUMMARY		1.25-2.0				
(NP/NA)		>2.0				

CONDITION/HT: ANNEALED
FORM: SHEET
SPECIMEN TYPE: CCP
ORIENTATION:
STRESS RATIO: +0.10
ENVIRONMENT: R.T., LAB AIR

YIELD STRENGTH:
ULT. STRENGTH:
SPECIMEN THK: 0.010"
SPECIMEN WIDTH: 2.000"
REFERENCES: HD008

STAIN. STEEL

304

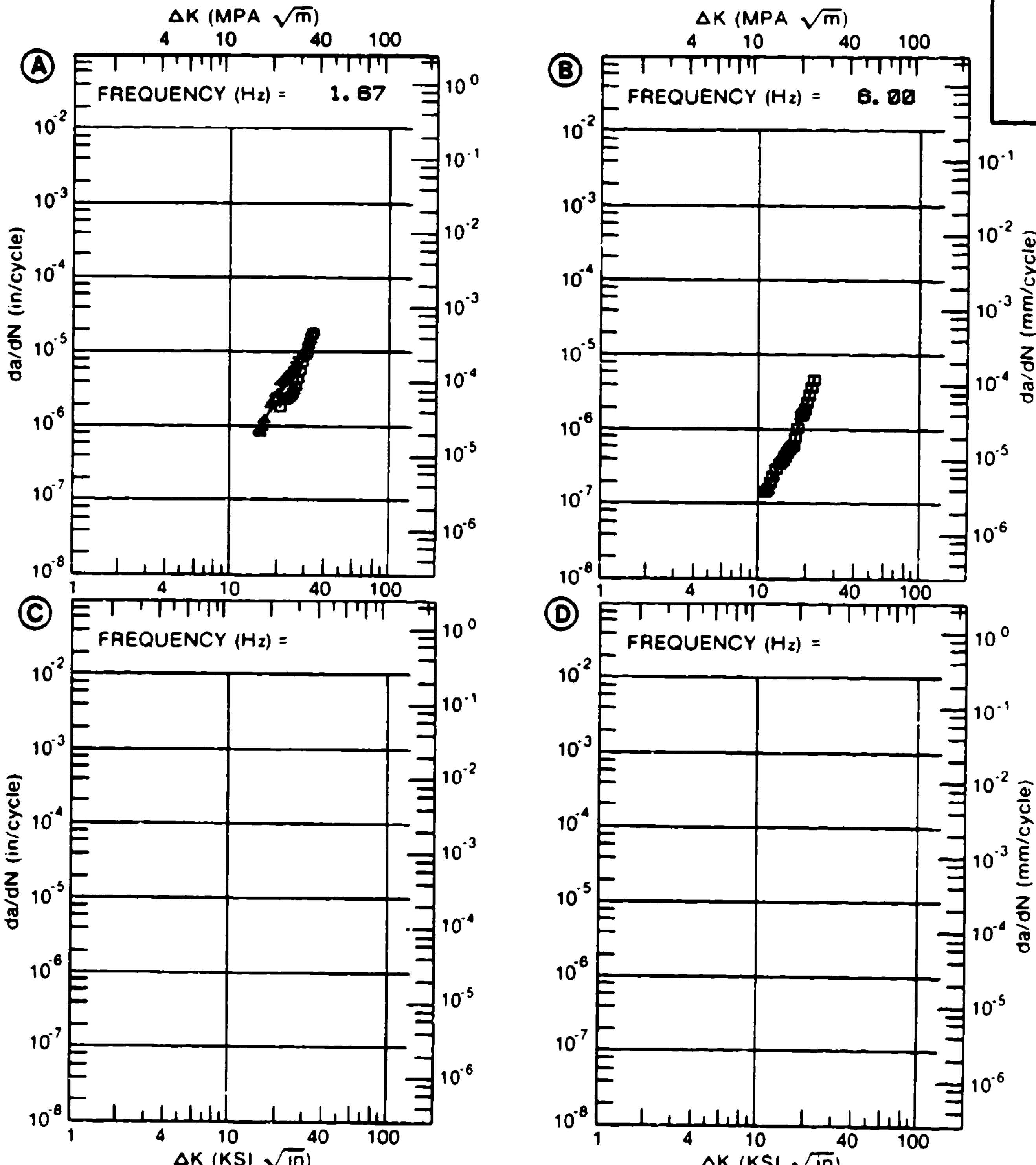


Figure 3.16.3.2

TABLE 3.16.3.3

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 3.16.3.3 INDICATING EFFECT

OF FREQUENCY

MATERIAL: STAINLESS STEEL 304
CONDITION: ANNEALED
ENVIRONMENT: R. T., LAB AIR

DELTA K (KSI*IN**1/2)			DA/DN (10**-6 IN./CYCLE)			
			A	B	C	D
			F(HZ)= 0.03	F(HZ)= 6.67		
DELTA K MIN	A:	32.53	11.1			
	B:	16.50		854		
	C:					
	D:					
		20.00		1.92		
		25.00		3.05		
		30.00		4.50		
		35.00	14.7	8.12		
		40.00	24.7	15.3		
		50.00	56.0	28.5		
		60.00	101.	45.7		
		70.00	154.			
		80.00	205.			
DELTA K MAX	A:	82.69	217.			
	B:	68.22		78.3		
	C:					
	D:					
ROOT MEAN SQUARE PERCENT ERROR			5.23	5.67		
LIFE PREDICTION RATIO SUMMARY (NP/NA)		0.0-0.5				
		0.5-0.8				
		0.8-1.25	1	1		
		1.25-2.0				
		>2.0				

CONDITION/HT: ANNEALED
FORM: 0.50"TH PLATE
SPECIMEN TYPE: SENT
ORIENTATION: L-T
STRESS RATIO: +0.00
ENVIRONMENT: R.T., LAB AIR

YIELD STRENGTH: 39.6 KSI
ULT. STRENGTH: 77.1 KSI
SPECIMEN THK: 0.491"
SPECIMEN WIDTH: 4.910- 4.950"
REFERENCES: HD007

STAIN. STEEL

304

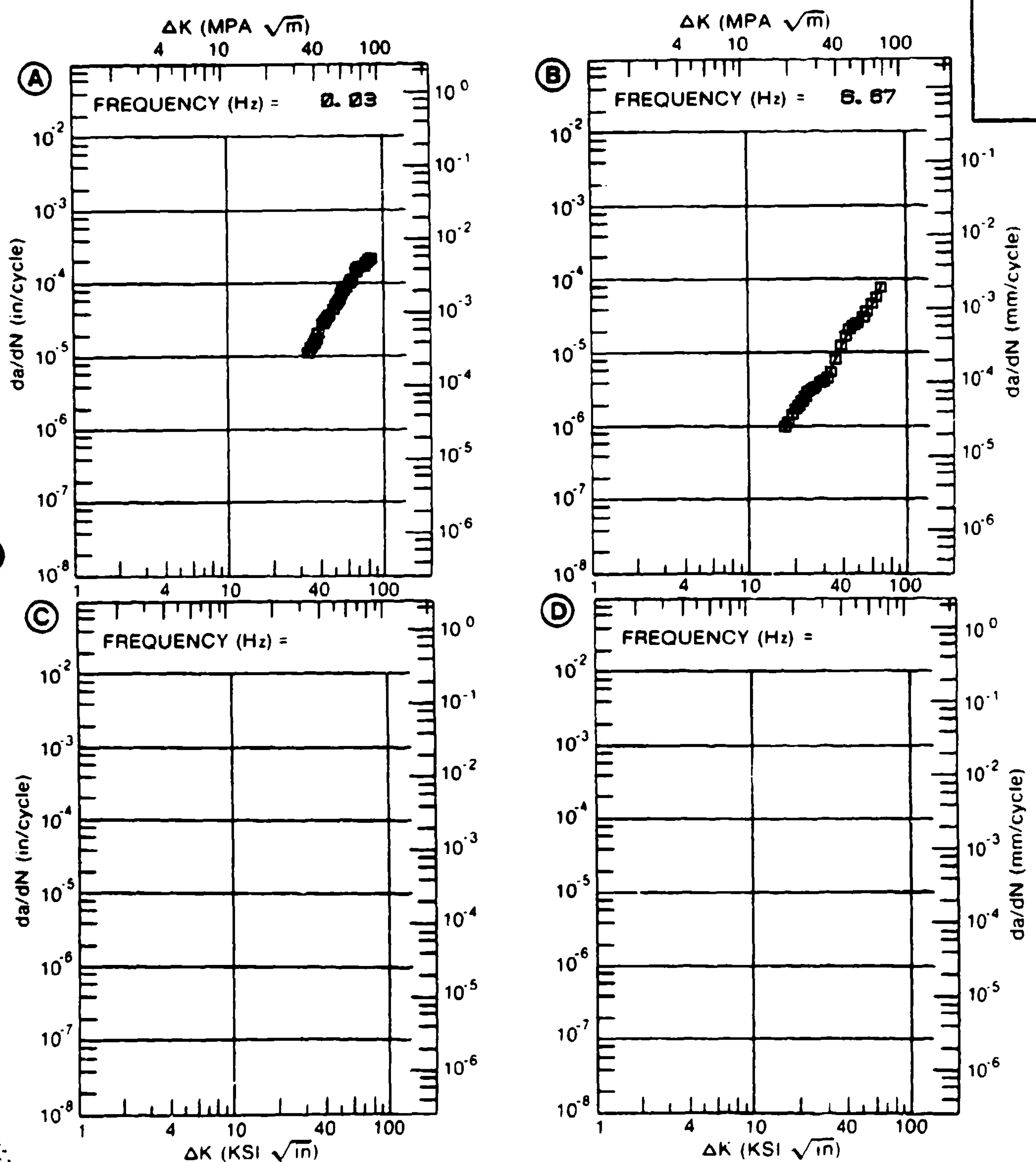


Figure 3.16.3.3

TABLE 3.16.3.4

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 3.16.3.4 INDICATING EFFECT OF STRESS RATIO

MATERIAL: STAINLESS STEEL 304
CONDITION: ANNEALED
ENVIRONMENT: R.T., LAB AIR

DELTA K (KSI*IN**1/2)	DA/DN (10**-6 IN./CYCLE)			
	A	B	C	D
	R=+0.05			
DELTA K MIN A:				
DELTA K MIN B:				
DELTA K MIN C:				
DELTA K MIN D:				
200.00				
DELTA K MAX A:				
DELTA K MAX B:				
DELTA K MAX C:				
DELTA K MAX D:				

ROOT MEAN SQUARE PERCENT ERROR: 0.00

LIFE PREDICTION RATIO SUMMARY (NP/NA)	
	0.0-0.5
	0.5-0.8
	0.8-1.25
	1.25-2.0
	>2.0

CONDITION/HT: ANNEALED
FORM: 0.50"TH PLATE
SPECIMEN TYPE: WOL
ORIENTATION: L-T
FREQUENCY: 1.00 HZ
ENVIRONMENT: R.T., LAB AIR

YIELD STRENGTH: 38.6 KSI
ULT. STRENGTH: 77.1 KSI
SPECIMEN THK: 0.494"
SPECIMEN WIDTH: 2.000"
REFERENCES: HD007

STAIN. STEEL

304

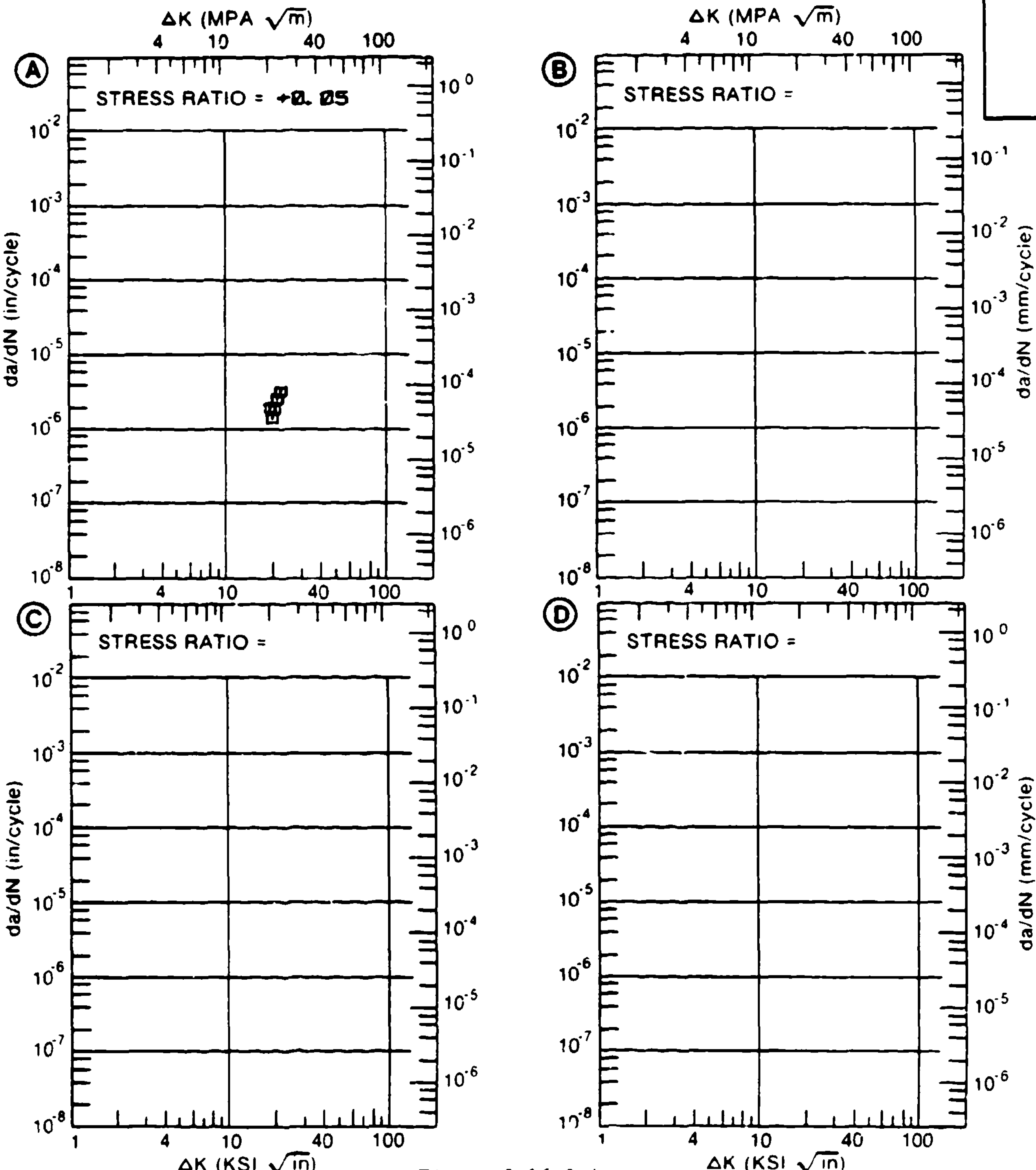


Figure 3.16.3.4

TABLE 3.16.3.5

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 3.16.3.5 INDICATING EFFECT

OF FREQUENCY

MATERIAL: STAINLESS STEEL 304
CONDITION: ANNEALED
ENVIRONMENT: R.T., LAB AIR

DELTA K (KSI*IN**1/2)			DA/DN (10**-6 IN./CYCLE) A	B	C	D
			F(HZ)= 3.00	F(HZ)= 6.67		
DELTA K MIN	A:					
	B:	16.13		1.09		
	C:					
	D:					
		20.00		1.86		
		25.00		3.44		
		30.00		5.93		
		35.00		9.64		
		40.00		15.0		
		50.00		32.5		
		60.00		63.2		
DELTA K MAX	A:					
	B:	67.92		101.		
	C:					
	D:					
ROOT MEAN SQUARE PERCENT ERROR			0.00	5.89		
LIFE PREDICTION RATIO SUMMARY (NP/NA)		0.0-0.5				
		0.5-0.8				
		0.8-1.25		1		
		1.25-2.0				
		>2.0				

CONDITION/HT: ANNEALED
FORM: 0.50"TH PLATE
SPECIMEN TYPE: SENT
ORIENTATION: T-L
STRESS RATIO: +0.00
ENVIRONMENT: R.T., LAB AIR

YIELD STRENGTH: 39.6 KSI
ULT. STRENGTH: 77.1 KSI
SPECIMEN THK: 0.493- 0.496"
SPECIMEN WIDTH: 4.910- 4.915"
REFERENCES: HD007

STAIN. STEEL

304

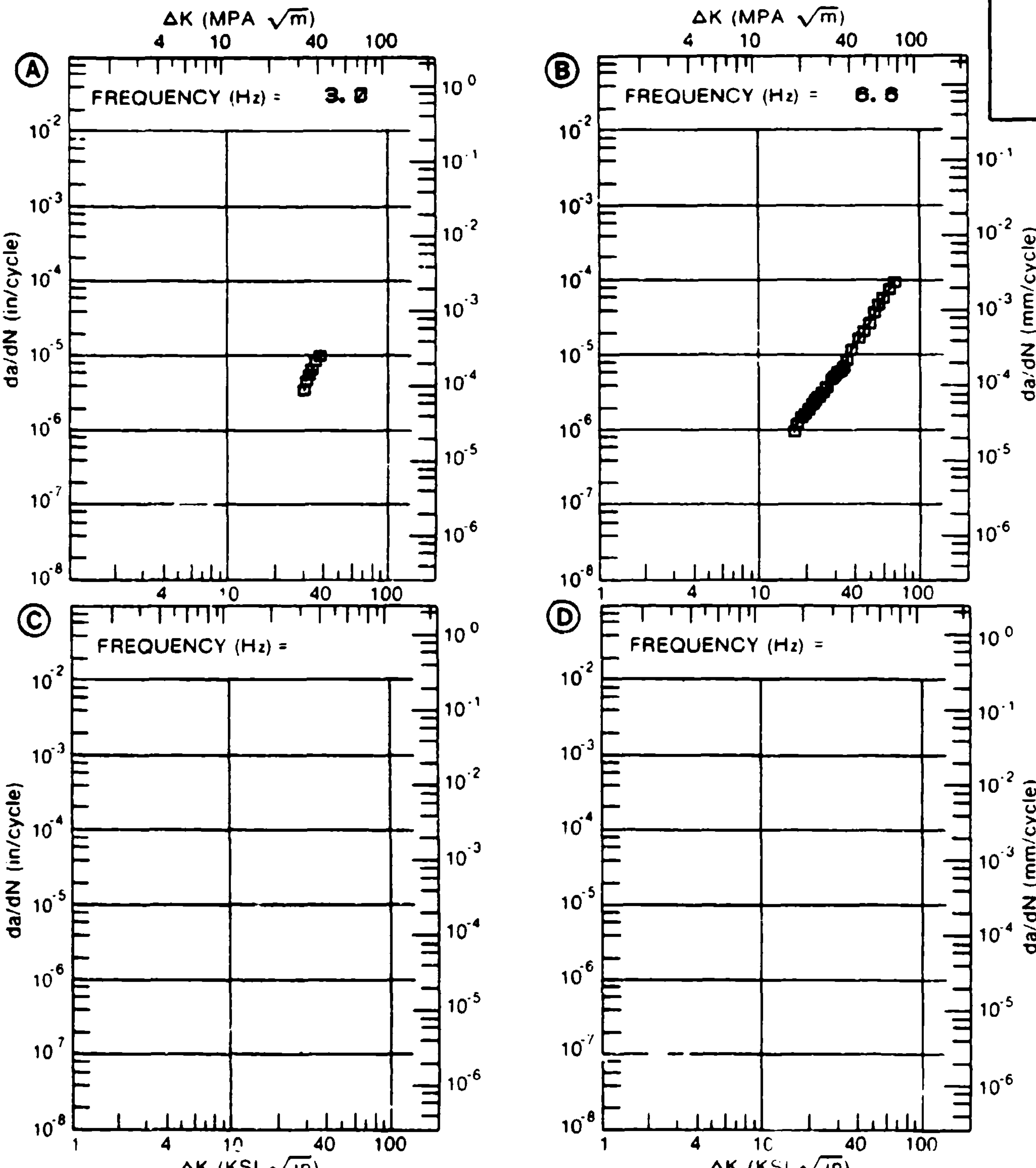


Figure 3.16.3.5

TABLE 3.16.3.6

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 3.16.3.6 INDICATING EFFECT

OF ENVIRONMENT

MATERIAL: STAINLESS STEEL 304
CONDITION: ANNEALED

DELTA K (KSI*IN**1/2)		DA/DN (10**-6 IN./CYCLE) A	B	C	D
		E=+ 800 F AIR			
DELTA K MIN	A: 12.99	1.46			
	B:				
	C:				
	D:				
	13.00	1.46			
	16.00	2.90			
	20.00	6.70			
	25.00	10.3			
	30.00	21.0			
DELTA K MAX	A: 34.83	47.9			
	B:				
	C:				
	D:				

ROOT MEAN SQUARE PERCENT ERROR		15.35
LIFE PREDICTION RATIO SUMMARY (NP/NA)	0.0-0.5	
	0.5-0.8	
	0.8-1.25	4
	1.25-2.0	1
	>2.0	

CONDITION/HT: ANNEALED
FORM: 0.50"TH PLATE
SPECIMEN TYPE: CT
ORIENTATION:
STRESS RATIO: +0.05
FREQUENCY: 0.6 HZ

YIELD STRENGTH: 39.6 KSI
ULT. STRENGTH: 77.5 KSI
SPECIMEN THK: 0.300- 0.500"
SPECIMEN WIDTH: 1.157- 2.998"
REFERENCES: HD011, HD012

STAIN. STEEL

304

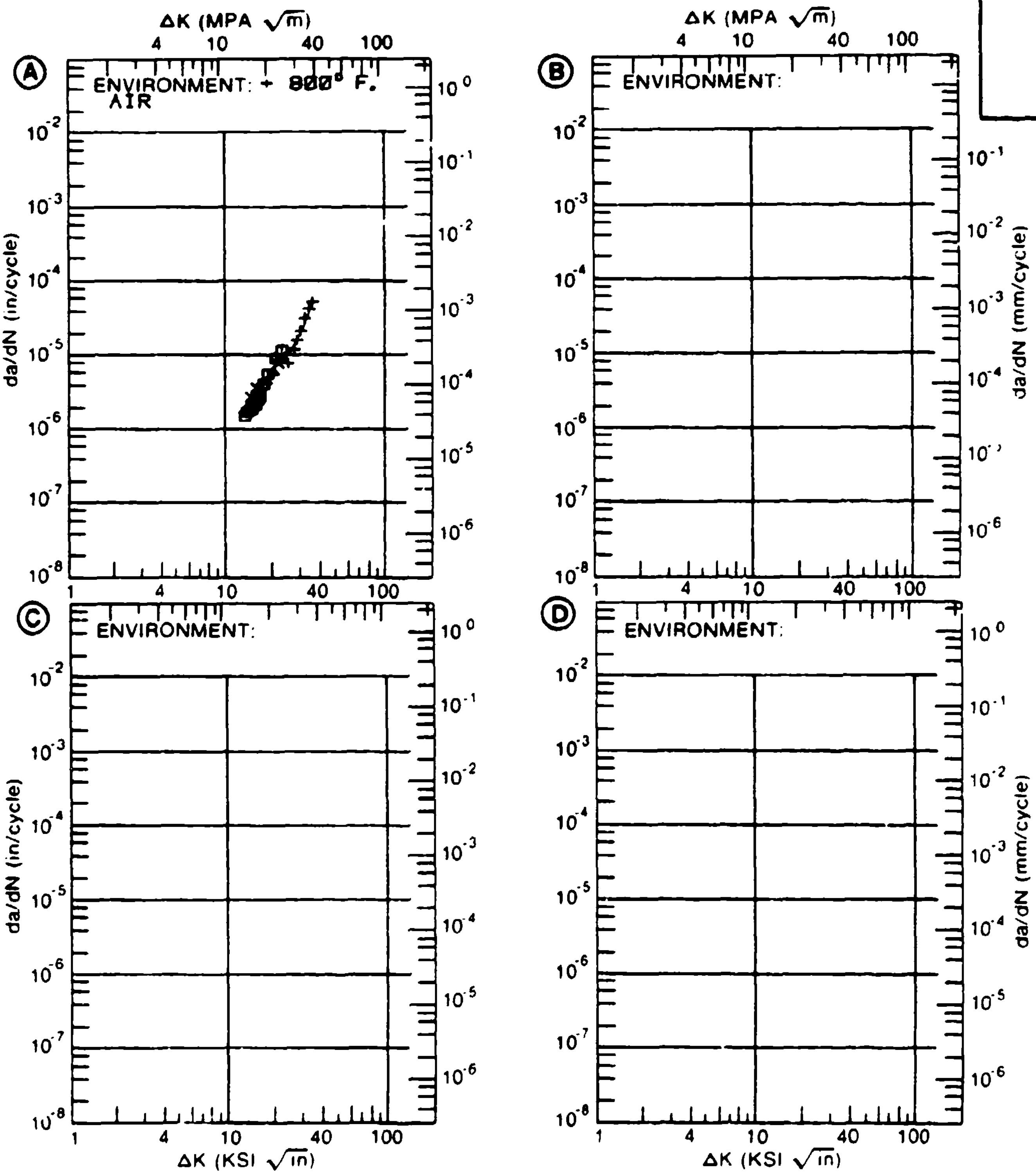


Figure 3.16.3.6

TABLE 3.16.3.7

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 3.16.3.7 INDICATING EFFECT

OF ENVIRONMENT

MATERIAL: STAINLESS STEEL 304
CONDITION: ANNEALED

DELTA K (KSI*IN**1/2)		DA/DN (10**-6 IN./CYCLE) A	B	C	D
		E=+ 550 F AIR			
DELTA K MIN	A: 17.34	1.23			
	B:				
	C:				
	D:				
	20.00	1.65			
	25.00	4.94			
	30.00	12.0			
	35.00	19.4			
	40.00	36.7			
	50.00	94.3			
DELTA K MAX	A: 51.20	86.4			
	B:				
	C:				
	D:				
ROOT MEAN SQUARE PERCENT ERROR		15.97			
LIFE PREDICTION RATIO SUMMARY (NP/NA)	0.0-0.5				
	0.5-0.8				
	0.8-1.25	2			
	1.25-2.0				
	>2.0				

CONDITION/HT: ANNEALED
FORM: 1.00"TH PLATE
SPECIMEN TYPE: CT
ORIENTATION: T-L
STRESS RATIO: +0.05
FREQUENCY: 2.5 HZ

YIELD STRENGTH: 39.0 KSI
ULT. STRENGTH: 84.0 KSI
SPECIMEN THK: 0.252- 0.999"
SPECIMEN WIDTH 1.999- 8.001"
REFERENCES:HD010

STAIN. STEEL

304

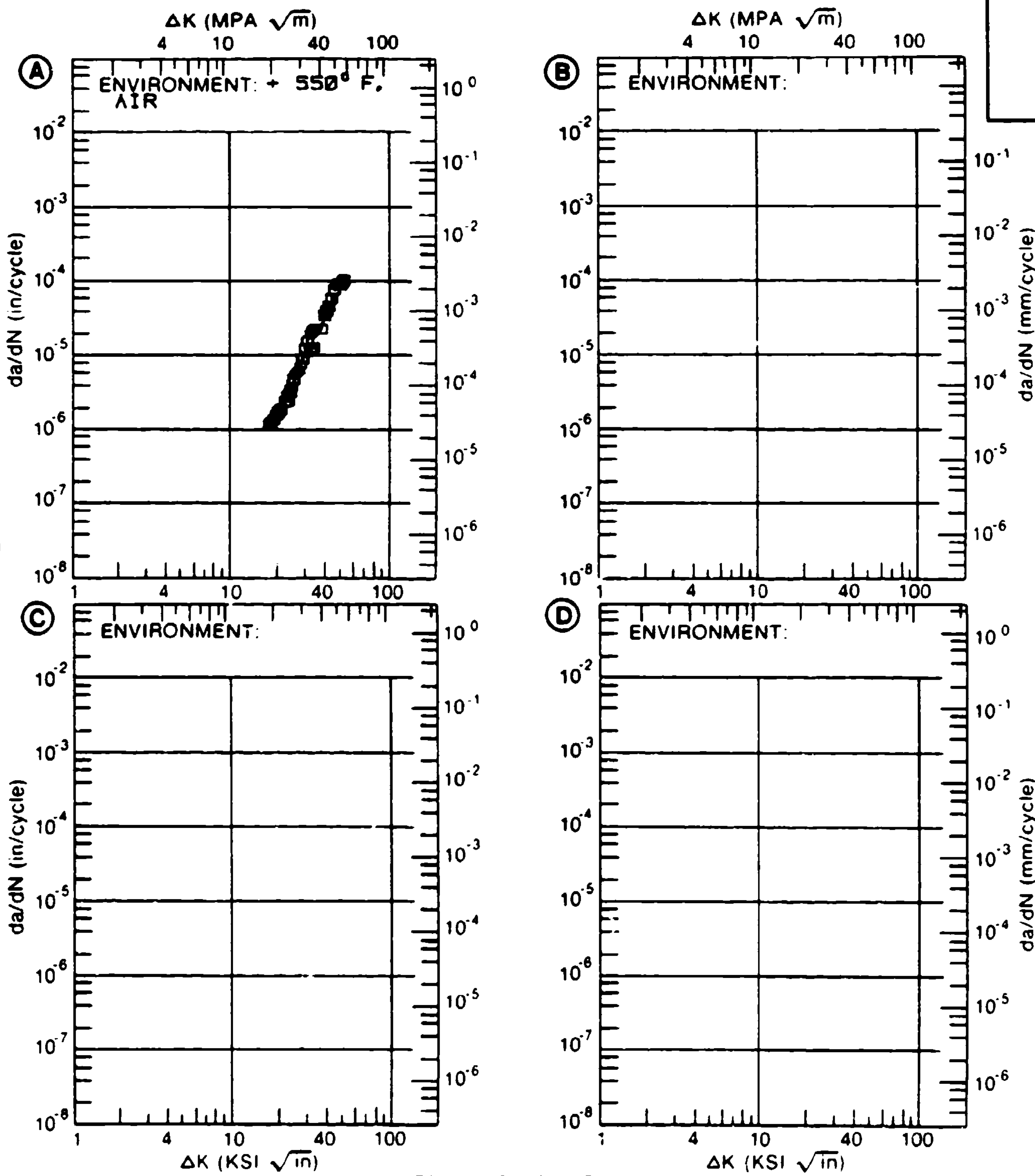


Figure 3.16.3.7

TABLE 3.16.3.8

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 3.16.3.8 INDICATING EFFECT

OF ENVIRONMENT

MATERIAL: STAINLESS STEEL 304
CONDITION: ANNEALED & AGED

DELTA K (KSI*IN**1/2)			DA/DN (10**-6 IN./CYCLE) A	B	C	D
			E= R.T. LAB AIR			
DELTA K MIN	A:	19.08	1.17			
	B:					
	C:					
	D:					
		20.00	1.38			
		25.00	3.99			
		30.00	11.4			
		35.00	27.8			
DELTA K MAX	A:	35.83	31.6			
	B:					
	C:					
	D:					
ROOT MEAN SQUARE PERCENT ERROR			8.08			
LIFE PREDICTION RATIO SUMMARY (NP/NA)		0.0-0.5				
		0.5-0.8				
		0.8-1.25	1			
		1.25-2.0				
		>2.0				

CONDITION/HT: ANNEALED & AGE
FORM: 0.50"TH PLATE
SPECIMEN TYPE: CT
ORIENTATION:
STRESS RATIO: +0.05
FREQUENCY: 3.0 HZ

YIELD STRENGTH: 38.6 KSI
ULT. STRENGTH: 77.1 KSI
SPECIMEN THK: 0.468"
SPECIMEN WIDTH: 2.001"
REFERENCES: HD008

STAIN. STEEL

304

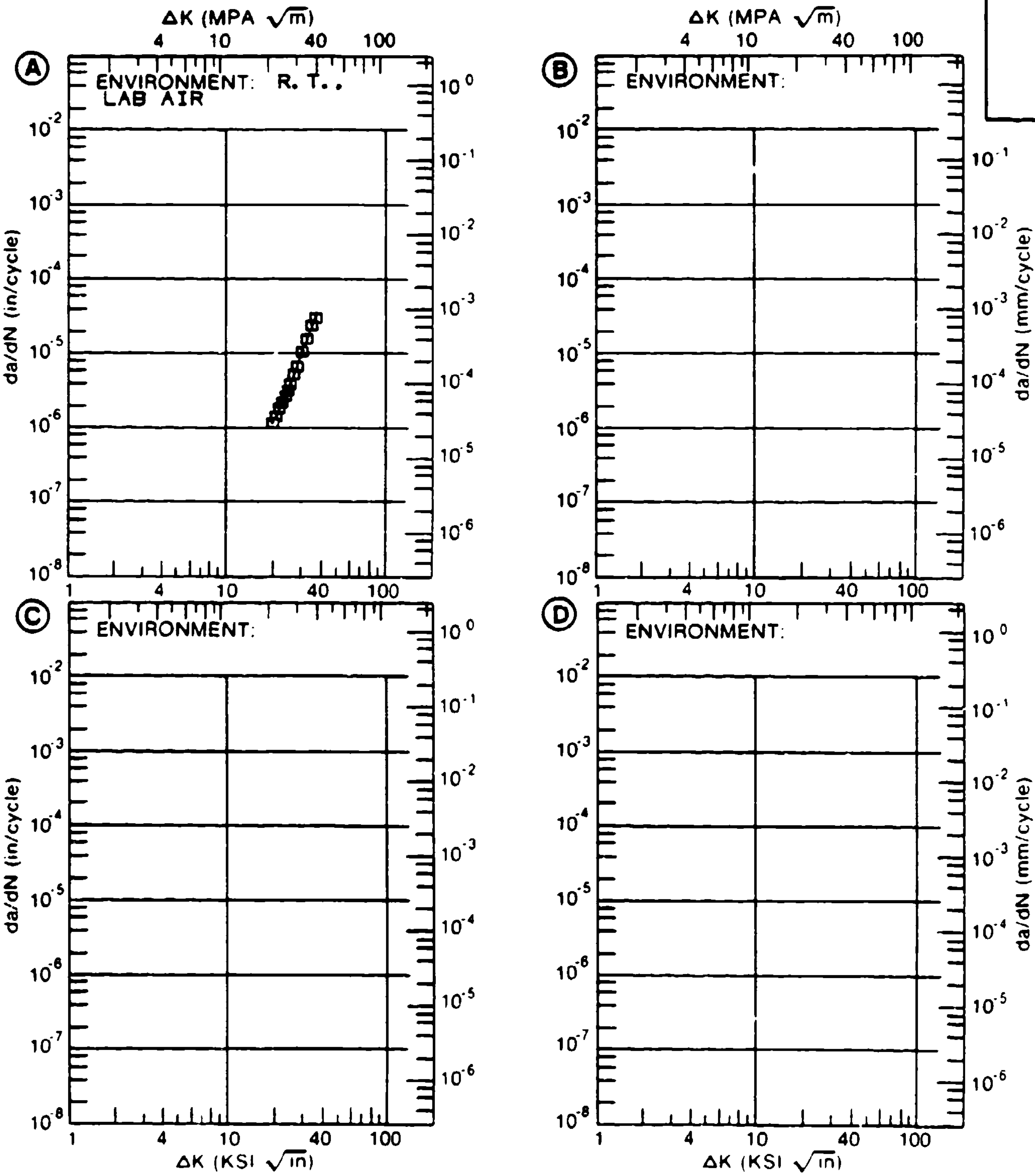


Figure 3.16.3.8

TABLE 3.17.3.1

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 3.17.3.1 INDICATING EFFECT OF ENVIRONMENT

MATERIAL: STAINLESS STEEL 316
CONDITION: ANNEALED

DELTA K (KSI*IN**1/2)		DA/DN (10**-6 IN./CYCLE) A	B	C	D
		E=+ 98 F AIR			
DELTA K MIN A:	17.85	.435			
DELTA K MIN B:					
DELTA K MIN C:					
DELTA K MIN D:					
	20.00	.868			
	25.00	2.81			
	30.00	6.38			
	35.00	12.0			
	40.00	20.1			
	50.00	47.3			
	60.00	98.5			
DELTA K MAX A:	60.48	102.			
DELTA K MAX B:					
DELTA K MAX C:					
DELTA K MAX D:					
ROOT MEAN SQUARE PERCENT ERROR		6.93			
LIFE PREDICTION RATIO SUMMARY (NP/NA)	0.0-0.5				
	0.5-0.8				
	0.8-1.25	1			
	1.25-2.0				
	>2.0				

CONDITION/HT: ANNEALED
FORM: 0.50"TH PLATE
SPECIMEN TYPE: SENT
ORIENTATION:
STRESS RATIO: +0.04
FREQUENCY: 0.8 HZ

YIELD STRENGTH: 44.1 KSI
ULT. STRENGTH: 82.1 KSI
SPECIMEN THK: 0.504"
SPECIMEN WIDTH: 4.501"
REFERENCES: HD013

STAIN. STEEL

318

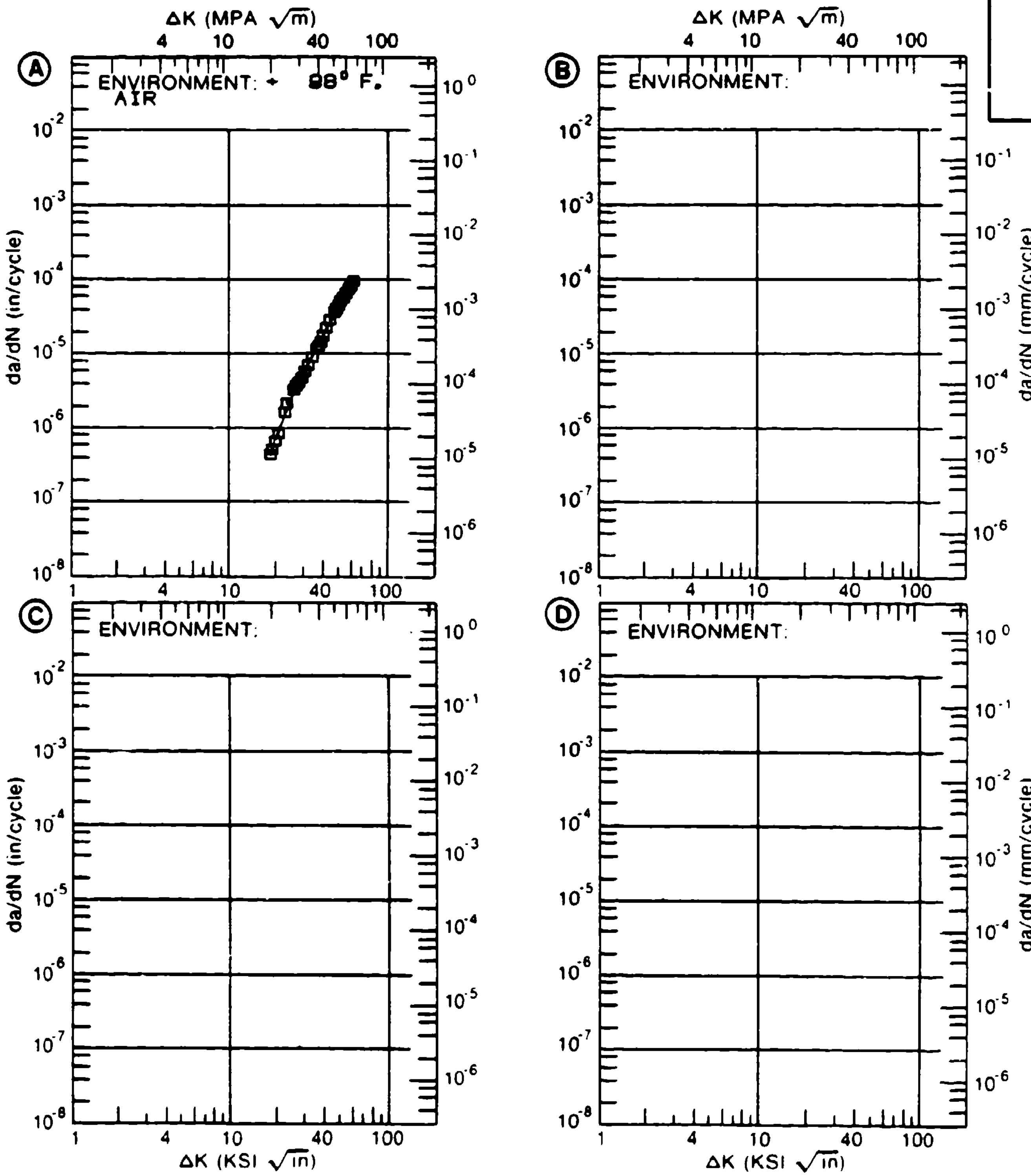


Figure 3.17.3.1

TABLE 3.17.3.2

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 3.17.3.2 INDICATING EFFECT

OF ENVIRONMENT

MATERIAL: STAINLESS STEEL 316
CONDITION: ANNEALED

DELTA K (KSI*IN**1/2)			DA/DN (10**-6 IN./CYCLE) A	B	C	D
			E=+ 600 F AIR	E=+ 800 F AIR		
DELTA K MIN	A:	13.24	1.10			
	B:	16.21		2.43		
	C:					
	D:					
		16.00	2.02			
		20.00	4.63	5.14		
		25.00	12.5	15.7		
		30.00		35.2		
DELTA K MAX	A:	28.41	18.5			
	B:	30.70		38.1		
	C:					
	D:					
ROOT MEAN SQUARE PERCENT ERROR			14.78	7.64		
LIFE PREDICTION RATIO SUMMARY (NP/NA)		0.0-0.5				
		0.5-0.8				
		0.8-1.25	2	1		
		1.25-2.0				
		>2.0				

CONDITION/HT: ANNEALED
FORM: 0.50"TH PLATE
SPECIMEN TYPE: CT
ORIENTATION:
STRESS RATIO: +0.05
FREQUENCY: 0.6 HZ

YIELD STRENGTH: 44.1 KSI
ULT. STRENGTH: 82.1 KSI
SPECIMEN THK: 0.486- 0.504"
SPECIMEN WIDTH: 1.998- 2.047"
REFERENCES:HD013, HD012

STAIN. STEEL

316

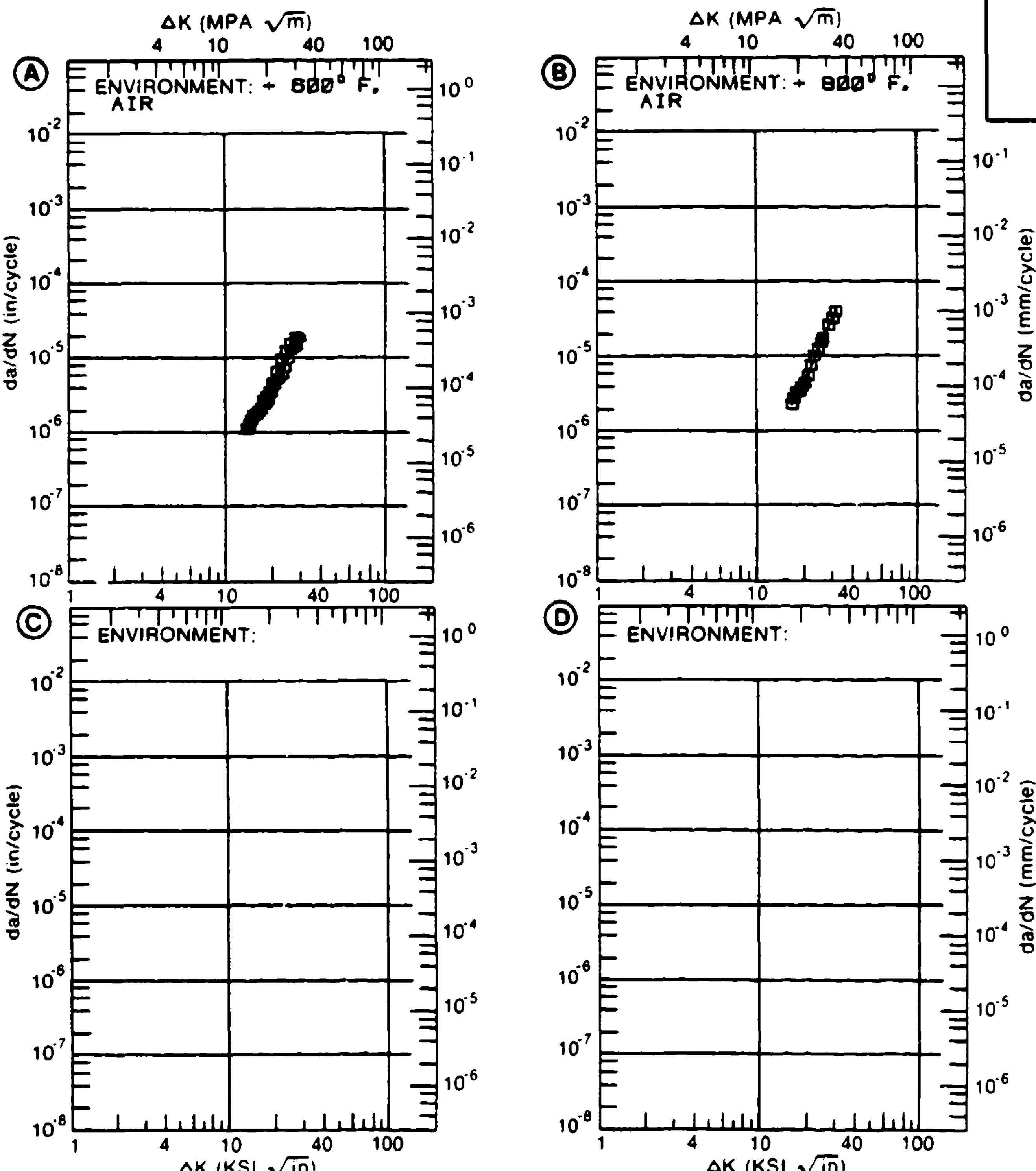


Figure 3.17.3.2

TABLE 3.17.3.3

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 3.17.3.3 INDICATING EFFECT

OF FREQUENCY

MATERIAL: STAINLESS STEEL 316
CONDITION: ANNEALED AT 1950F, 1HR, WQ
ENVIRONMENT: R.T., LAB AIR

DELTA K (KSI*IN**1/2)		DA/DN (10**-6 IN./CYCLE) A	B	C	D
		F(HZ)= 5.00	F(HZ)= 10.00		
DELTA K MIN	A: 21.20	2.84			
	B: 19.09		2.51		
	C:				
	D:				
	20.00		2.39		
	25.00	5.45	6.24		
	30.00	11.6	13.1		
	35.00	22.8	30.9		
	40.00	42.4	53.1		
DELTA K MAX	A: 40.78	46.5			
	B: 40.55		53.6		
	C:				
	D:				
ROOT MEAN SQUARE PERCENT ERROR		4.22	20.54		
LIFE PREDICTION RATIO SUMMARY (NP/NA)	0.0-0.5				
	0.5-0.8				
	0.8-1.25	1	1		
	1.25-2.0		1		
	>2.0				

CONDITION/HT: ANNEALED AT 1950F, 1HR, WQ
FORM: 0.50"TH PLATE
SPECIMEN TYPE: CT
ORIENTATION:
STRESS RATIO: +0.05
ENVIRONMENT: R.T., LAB AIR

YIELD STRENGTH: 43.0- 44.1 KSI
ULT. STRENGTH: 81.5- 82.1 KSI
SPECIMEN THK: 0.495- 0.525"
SPECIMEN WIDTH: 2.000- 2.001"
REFERENCES: HD014, HD013

STAIN. STEEL

316

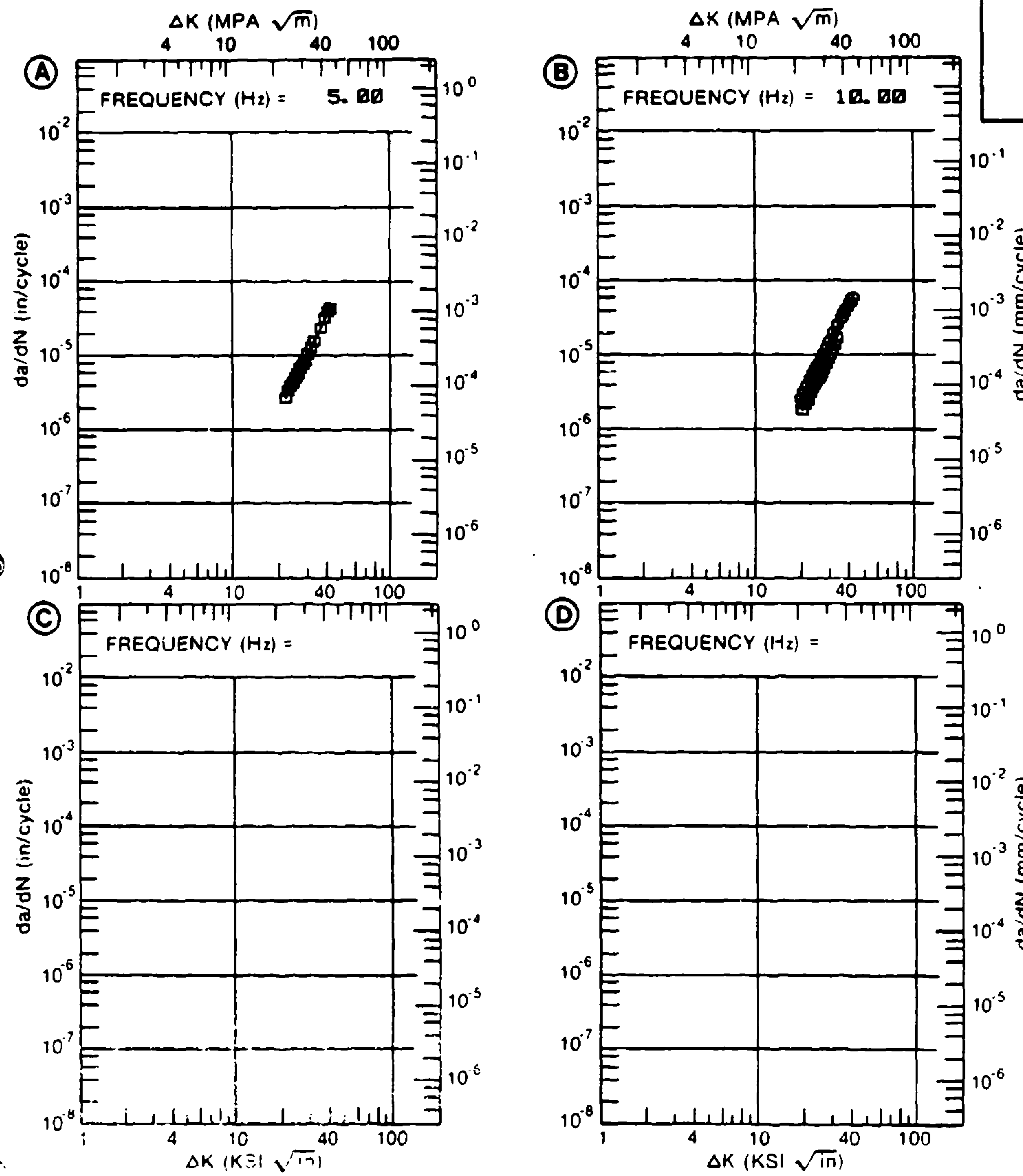


Figure 3.17.3.3

Figure 3.18.1.1

FATIGUE CRACK GROWTH RATE AT DEFINED LEVELS OF THE STRESS-INTENSITY FACTOR

STAINLESS STEEL 347

TEST CONDITIONS

[illegible]

ENVIRONMENT: LAB AIR
AT R.T.

[illegible]	[illegible]	STRESS RATIO	FREQ. (HZ)	DELTA K LEVELS (KSI SQRT(IN))	2.5	5	10	20	50	100
					FATIGUE CRACK GROWTH RATES (MICRO IN/CYCLE)					
050 IN FROM CENTERLINE	WELDMENT	0.10	30.00						9.83	
AT CENTERLINE	WELDMENT	0.10	30.00						13.1	
AT HEAT AFFECTED ZONE	WELDMENT	0.10	30.00						17.5	

TABLE 3.18.3.1

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 3.18.3.1 INDICATING EFFECT

OF STRESS RATIO

MATERIAL: STAINLESS STEEL 347
CONDITION: AT CENTERLINE
ENVIRONMENT: R.T. LAB AIR

DELTA K (KSI*IN**1/2)		DA/DN (10**-6 IN./CYCLE) A	B	C	D
		R=+0.10			
DELTA K MIN A:	36.67	1.71			
B:					
C:					
D:					
	40.00	3.05			
	50.00	13.1			
	60.00	44.1			
DELTA K MAX A:	69.67	92.0			
B:					
C:					
D:					
ROOT MEAN SQUARE PERCENT ERROR		12.11			

LIFE PREDICTION RATIO SUMMARY (NP/NA)

	0.0-0.5
	0.5-0.8
	0.8-1.25
	1.25-2.0
	>2.0

CONDITION/HT: AT CENTERLINE
FORM: WELDMENT
SPECIMEN TYPE: CT
ORIENTATION:
FREQUENCY: 30.0 HZ
ENVIRONMENT: R. T., LAB AIR

YIELD STRENGTH:
ULT. STRENGTH:
SPECIMEN THK: 1.000"
SPECIMEN WIDTH: 5.000"
REFERENCES: AM001

STAIN. STEEL

347

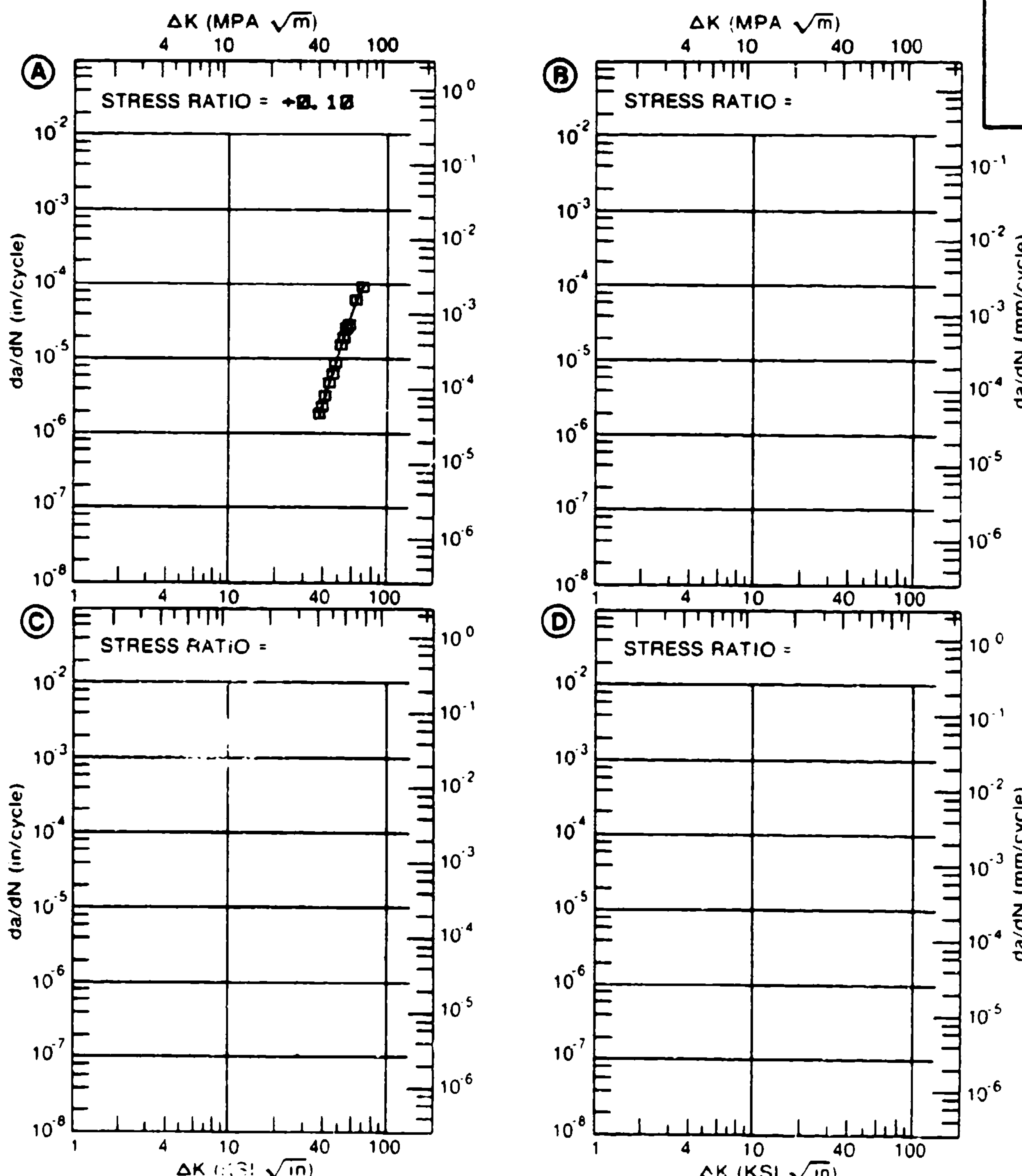


Figure 3.18.3.1

TABLE 3.18.3.2

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 3.18.3.2 INDICATING EFFECT

OF STRESS RATIO

MATERIAL: STAINLESS STEEL 347
CONDITION: AT HEAT AFFECTED ZONE
ENVIRONMENT: R. T. LAB AIR

DELTA K (KSI*IN**1/2)			DA/DN (10**-6 IN./CYCLE) A	B	C	D
			R=+0.10			
	A:	30.61	2.27			
DELTA K MIN	B:					
	C:					
	D:					
		35.00	4.06			
		40.00	6.87			
		50.00	17.5			
		60.00	46.5			
	A:	68.77	121.			
DELTA K MAX	B:					
	C:					
	D:					
ROOT MEAN SQUARE PERCENT ERROR			9.70			

LIFE	0.0-0.5
PREDICTION	0.5-0.8
RATIO	0.8-1.25
SUMMARY	1.25-2.0
(NP/NA)	>2.0

STAIN. STEEL

347

CONDITION/HT: AT HEAT AFFECTED ZONE
FORM: WELDMENT
SPECIMEN TYPE: CT
ORIENTATION:
FREQUENCY: 30.0 HZ
ENVIRONMENT: R. T., LAB AIR

YIELD STRENGTH:
ULT. STRENGTH:
SPECIMEN THK: 1.000"
SPECIMEN WIDTH: 5.000"
REFERENCES: AM001

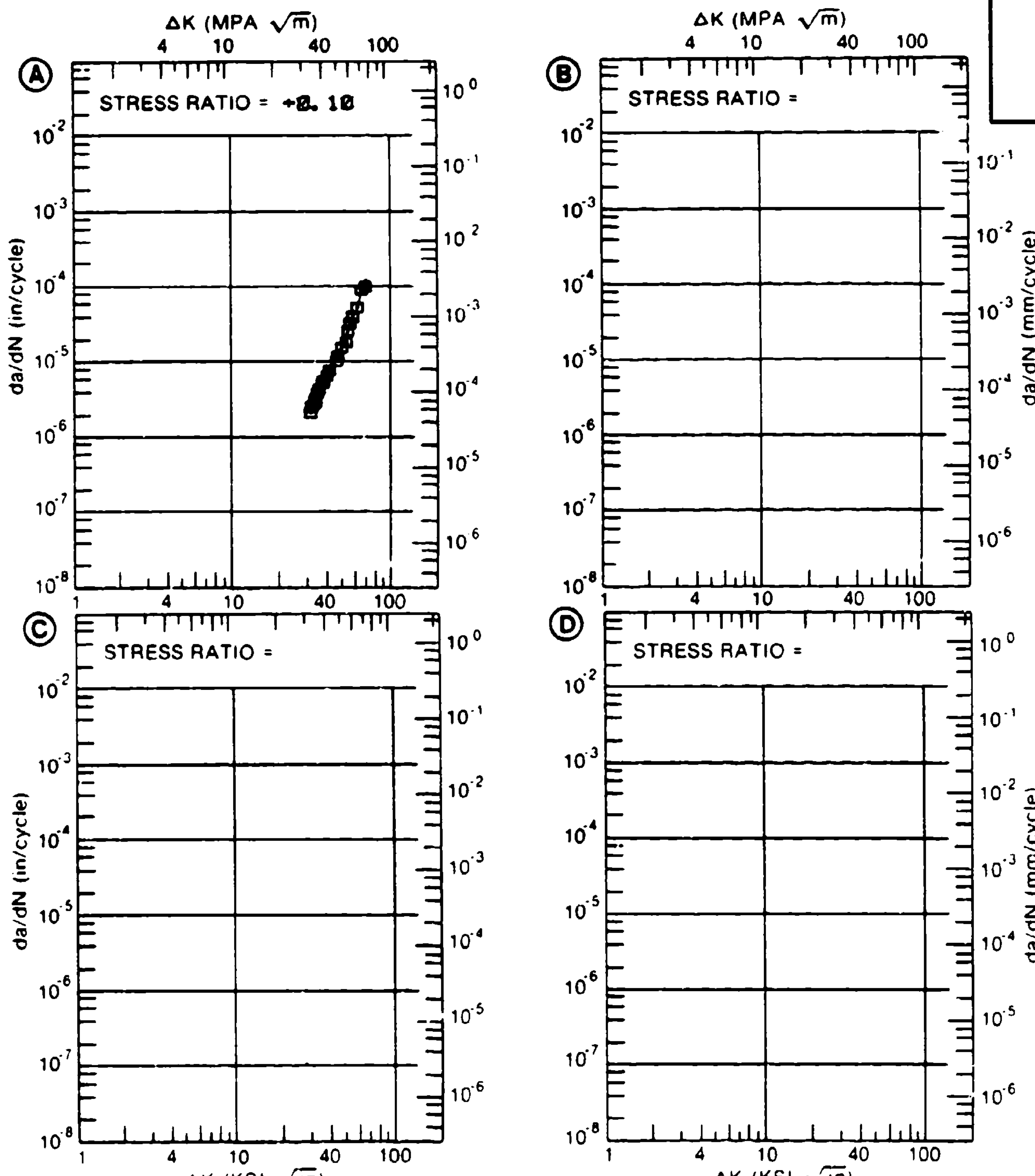


Figure 3.18.3.2

TABLE 3.18.3.3

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 3.18.3.3 INDICATING EFFECT

OF STRESS RATIO

MATERIAL: STAINLESS STEEL 347
CONDITION: .050 IN. FROM CENTERLINE
ENVIRONMENT: R.T. LAB AIR

DELTA K (KSI*IN**1/2)		DA/DN (10**-6 IN./CYCLE) A	B	C	D
		R=+0.10			
DELTA K MIN A:	36.21	2.53			
B:					
C:					
D:					
	40.00	4.98			
	50.00	9.83			
	60.00	18.0			
	70.00	47.3			
	80.00	89.2			
DELTA K MAX A:	81.77	93.9			
B:					
C:					
D:					

ROOT MEAN SQUARE PERCENT ERROR 10.14

LIFE PREDICTION RATIO SUMMARY (NP/NA)	
	0.0-0.5
	0.5-0.8
	0.8-1.25
	1.25-2.0
	>2.0

CONDITION/HT: .050 IN. FROM CENTERLINE
FORM: WELDMENT
SPECIMEN TYPE: CT
ORIENTATION:
FREQUENCY: 30.0 HZ
ENVIRONMENT: R.T., LAB AIR

YIELD STRENGTH:
ULT. STRENGTH:
SPECIMEN THK: 1.000"
SPECIMEN WIDTH: 5.000"
REFERENCES: AM001

STAIN. STEEL

347

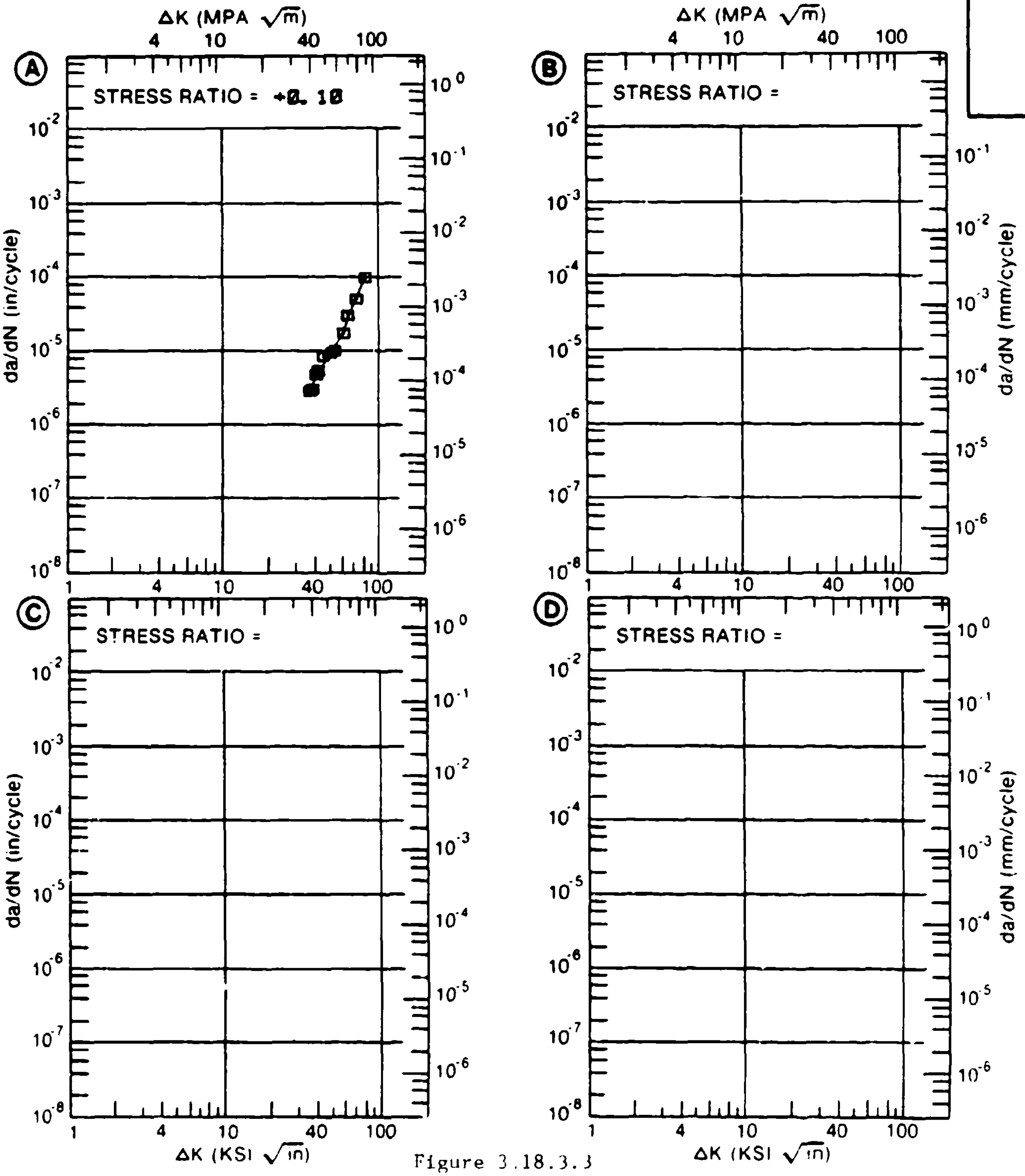


Figure 3.18.3.3

TABLE 3.19

REFERENCES FOR STAINLESS STEEL DATA

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Anon., "Fracture Toughness and Tear Tests," Air Force Materials Laboratory, Research and Technology Division, Report No. ML-TDR-64-238, October 1964.

70887 PH 13-8Mo K_{Iscc}

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83613 PH 13-8M K_{Iscc}

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84212 15-5 PH K_{Ic}
17-4 PH K_{Ic}

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84333 AM 355 K_{Iscc}
AM 362 K_{Iscc}
AM 364 K_{Iscc}
CUSTOM 455 K_{Iscc}
PH 13-8 Mo K_{Iscc}
PH 15-7 Mo K_{Iscc}
15-5 PH K_{Iscc}
17-4 PH K_{Iscc}
17-7 PH K_{Iscc}

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TABLE 3.19 (Continued)

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85034 PH 13-8 Mo K_{Ic}

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85837 PH 13-8 Mo da/dN

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85857 PH 13-8 Mo K_{Ic}

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86688 AM 355 K_{Iscc}
PH 13-8Mo K_{Iscc}
PH 15-7 Mo K_{Ic}
15-5 PH K_{Ic}
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TABLE 3.19 (Continued)

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BW004	15-5 PH da/dN	Watson, K. R., "Pylon Durability and Damage Tolerance Analysis," The Boeing Co., Wichita, KA., Contract No. F33657-78-C-0108-PZ0036, Document No. D361-400 41-2, September 1980.
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TABLE 3.19 Continued)

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316 da/dN

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MA001 PH 13-8Mo K_{Ic} da/dN

Fracture Toughness and Fatigue Crack Growth Rate Data for Stainless Steel PH 13-8 Mo. Data supplied by D. L. Rich of McDonnell Aircraft Co., St. Louis, Mo.; Attachment No. 1, Received March 12, 1982.

NC001 PH 13-8 Mo K_{Ic}

Plane Strain Fracture Toughness Data Sets on Aluminum, Steel and Titanium Alloys. Data sent from P.G. Porter of Northrop Corporation, March 1, 1982.

NC002 PH 13-8Mo da/dN

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RI004 CUSTOM 455 da/dN

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CHAPTER 4

TITANIUM ALLOY SECTIONS

4.0	Titanium Material Summaries
4.1	Beta
4.2	Beta C
4.3	Beta III
4.4	Corona 5
4.5	Ti-6Al-2Sn-2Zr-2Mo-2Cr-.25Si (also see Section 4.8)
4.6	Ti-4Al-3Mo-1V
4.7	Ti-5Al-2.5Sn
4.8	Ti-6-2-2-2-2 (also see Section 4.5)
4.9	Ti-6-2-4-2
4.10	Ti-6-2-4-6 (also see Section 4.15)
4.11	Ti-6Al-4V
4.12	Ti-6Al-4V (ELI)
4.13	Ti-6Al-6V-2Sn
4.14	Ti-6Al-6V-2.5Sn
4.15	Ti-6Al-2Sn-4Zr-6Mo (also see Section 4.10)
4.16	Ti-8Al-1Mo-1V
4.17	Ti-8Mo-8V-2Fe-3Al
4.18	Ti-5Al-2.5Sn (ELI)
4.19	Ti-6Al-6V-2Sn (ELI)
4.20	Bibliography

TABLE 4.0.1

AVAILABLE DATA FOR TITANIUM ALLOYS

ALLOY	CONDITION/HT	PRODUCT FORM	KIC	KC	R CURVES	DA/DN	DA/DT	KISCC
BETA	BETA STAB	SHEET						X
	1745F WQ	SHEET						X
	1745F WQ +1095F 61HR	SHEET						X
	1745F WQ. +1095F 1000HR	SHEET						X
	1745F WQ. +1095F 16HR	SHEET						X
	1745F WQ. +1095F 250HR	SHEET						X
	1745F WQ. +1095F 500HR	SHEET						X
BETA C	STA	PLATE	X					
BETA III	AGED 1000F, 100HR						X	
	AGED 1250F, 50HR						X	
	AGED 900F, 100HR						X	
	BETA STAB +AGED 900F 1HR	SHEET						X
	STA	PLATE				X		
	STA 900F 100HR						X	
	STA 900F 40HR						X	
	STA 900F 8HR						X	
	STA-1325F WQ, 1045F 8HR (ELECTRON BEAM WELD ZONE)	PLATE	X					
	STA-1325F WQ, 1045F 8HR (HEAT AFFECTED ZONE)	PLATE	X					
	STA-1325F WQ, 1045F 8 HR	PLATE	X					
	STA E B WELDMENT (WELD ZONE)	WELDMENT				X		
	STA, E B WELDMENT (HEAT AFFECTED ZONE)	WELDMENT				X		

TABLE 4.0.1 (Cont)

AVAILABLE DATA FOR TITANIUM ALLOYS

ALLOY	CONDITION/HT	PRODUCT FORM	KIC	KC	R CURVES	DA/DN	DA/DT	KISCC
BETA III	1325F 25HR.WQ 925F 8HR	PLATE	X					
	1350F 0.5 HR. WQ.950F 8HR.AC	EXTRUSION	X					
BETA III	BETA STABILIZED	SHEET					X	
BETA C	STA	SHEET				X		
CORONA 5	ALPHA-BETA FORGED & LOW ANNEAL & AGE	FORGING	X					
Ti5Al-2.5Sn(ELI)	ANNEALED	FORGING	X					
	ANNEALED (ES)	FORGING	X					
	ANNEALED (IS)	FORGING	X					
Ti6Al6V2Sn(ELI)	1600F 1 HR.WQ.1050F 4 HR.AC	PLATE	X					
	1650F 1 HR.WQ.1125F 4 HR.AC	PLATE	X					
Ti-4Al-3Mo-1V	MILL ANNEALED	PLATE						X
Ti-5Al-2.5Sn	--	SHEET				X		
	ANNEALED	SHEET		X		X		
Ti-6Al-2Sn-4Zr-6Mo	BETA PROCESSED	FORGING	X					
	RO.B FIN 10MA BETA UPSET. BETA FINISHED.10% PRIMARY ALPHA MILL ANNEALED 1300F 1 HR.AC	FORGING	X					
	RO.B FIN 10STA BETA UPSET. BETA FINISHED.10% PRIMARY ALPHA. SOLUTION TREATED & AGED 1625F 1 HR.AC.1100F 8 HR.AC	FORGING	X					

TABLE 4.0.1 (Cont)

AVAILABLE DATA FOR TITANIUM ALLOYS

ALLOY	CONDITION, HT	PRODUCT FORM	KIC	KC	R CURVES	DA/DN	DA/DT	KISCC
TI-6AL2SN4ZR6MO	BU.B FIN-10STO BETA UPSET BETA FINISHED.10%PRIMARY ALPHA SOLUTION TREATED&OVERAGED 1625F 1 HR.AC.1300F 1 HR.AC	FORGING	X					
	BU.B FIN-50MA BETA UPSET. BETA FINISHED.50% PRIMARY ALPHA. MILL ANNEALED 1300F 1 HR.AC	FORGING	X					
	BU.B FIN-50STABETA UPSET. BETA FINISHED 50% PRIMARY ALPHA. SOLUTION TREATED & AGED. 1625F 1 HR.AC.1100F 8 HR.AC	FORGING	X					
	BU.HABFIN10STA BETA UPSET. HI ALPHA BETA FINISHED.10% REDUCTION. SOLUTION TREATED & AGED 1625F 1HR.AC.1100F 8HR.AC	FORGING	X					
	BU.HABFIN30STA BETA UPSET.HI ALPHA BETA FINISHED.30% REDUCTION.SOLUTION TREATED & AGED.1625F 1 HR.AC.1100F 8HR.AC	FORGING	X					
	BU.LABFIN10STA BETA UPSET.LO ALPHA BETA FINISHED.10% REDUCTION.SOLUTION TREATED & AGED 1650F 1 HR.AC.1100F 8HR.AC	FORGING	X					
	STA 1625F 2 HR.AC.1100F 8 HR.AC	FORGING	X					
	50% PRIMARY ALPHA	FORGING	X					
TI-6AL-4V	----	----				X		X
	AB FORGED-MA ALPHA-BETA FORGED.MILL ANNEALED	FORGING	X					
	AB FORGED-RA ALPHA-BETA FORGED. RECRYSTALLIZED ANNEAL.1700F 4 HR.FC TO 1000F.AC	FORGING	X					

TABLE 4.0.1 (Cont)

AVAILABLE DATA FOR TITANIUM ALLOYS

ALLOY	CONDITION/HT	PRODUCT FORM	KIC	KC	R CURVES	DA/DN	DA/DT	KISCC
Ti-6AL-4V	ALPHA-BETA FORGED	FORGING				X		
	ANNEALED	FORGING	X					
		EXTRUSION	X					
		BILLET	X			X		
		SHEET		X				
	ANNEALED AT 1375F, 3HRS, AC	PLATE				X		
	ANNEALED 1000F 2 HR. AC	BILLET	X					
	ANNEALED 1300F 4 HR. AC	FORGING	X					
	ANNEALED 1375F 3HR, AC	PLATE	X					
	ANNEALED 2200F 2 HR	FORGING	X					
	AS RECEIVED	FORGED BAR	X					
	AS RECEIVED PROBABLY MA	PLATE						X
	AS RECEIVED AB (ALPHA-BETA FORGED)	FORGED BAR	X					
	AS WELDED E B WELDMENT (WELD ZONE)	WELDMENT				X		
	AS WELDED E B WELDMENT (HEAT AFFECTED ZONE)	WELDMENT				X		
	β FORGED BETA FORGED REHEATED TO 1950F DRAWN TO SIZE, ANNEALED 1300F	FORGED BAR	X					
	β FORGED MA BETA FORGED, MILL ANNEALED, 1300F 2 HR, AC	FORGING	X					
	BA	SHEET				X		
		PLATE				X		
		FORGING				X		

TABLE 4.0.1 (Cont)

AVAILABLE DATA FOR TITANIUM ALLOYS

ALLOY	CONDITION/HT	PRODUCT FORM	KIC	KC	R CURVES	DA/DN	DA/DT	KISCC
TI 6AL 4V	RB. AB FIN10STD BETA BLOCKED. ALPHA BETA FINISHED. 10% REDUCTION. SOLUTION TREATED & OVERAGED 1750F 1HR. WQ. 1300F 2 HR. AC	FORGING	X					
	BB. AB FIN30STD BETA-BLOCKED. ALPHA BETA FINISHED. 30% REDUCTION. SOLUTION TREATED & OVERAGED 1750F 1HR. WQ. 1300F 2 HR. AC	FORGING	X					
	RB. AB FIN-MA BETA BLOCKED. ALPHA-BETA FINISHED. MILL ANNEALED	FORGING	X					
	BB. AB FIN-RA BETA BLOCKED. ALPHA BETA FINISHED. RECRYSTALLIZED ANNEAL 1700F 4 HR. FC TO 1000F. AC	FORGING	X					
	BB. AB FIN-30MA BETA BLOCKED. ALPHA BETA FINISHED. 30% REDUCTION. MILL ANNEALED. 1300F 2 HR. AC	FORGING	X					
	BB. B FIN10STOA BETA FINISHED. 10%REDUCTION. SOLUTION TREATED & OVERAGED. 1750F 1 HR. WQ. 1300F 2HR. AC	FORGING						
	BB B FIN 10MA BETA BLOCKED. BETA FINISHED. 10%REDUCTION. MILL ANNEALED. 1300F 2 HR. AC	FORGING	X					
	BETA ANNEALED	PLATE	X					
	BETA FORGED	FORGING				X		
	BETA PROCESSED-MILL ANNEALED	SHEET				X		
		PLATE	X			X		

TABLE 4.0.1 (cont)

AVAILABLE DATA FOR TITANIUM ALLOYS

ALLOY	CONDITION/HT	PRODUCT FORM	KIC	KC	R CURVES	DA/DN	DA/DT	KISCC
TI-6AL-4V	DB	PLATE				X		
	DB + IH	PLATE				X		
	DB + 2DBTC	PLATE				X		
	DB + 4DBTC	PLATE				X		
	DBT + PC	PLATE				X		
	DBTC	PLATE				X		
	DBTC(RA)	PLATE				X		
	DIFFUSION BONDED	PLATE	X					
	DIFFUSION BONDED	BILLET	X					
	DIFFUSION BOND ANNEALED	BILLET	X					
	EB WELD, STRESS RELIEVED (HEAT AFFECTED ZONE)	WELDMENT					X	
	EB WELD, STRESS RELIEVED (WELD ZONE)	WELDMENT					X	
	FINISH ROLLED 1440F	PLATE						X
	GTA WELD POSTWELD 1200F 1HR (HEAT AFFECTED ZONE)	PLATE						X
	GTA WELD POSTWELD 1400F 1HR (HEAT AFFECTED ZONE)	PLATE						X
	GTA WELD POSTWELD 1100F 2HR (WELD ZONE)	PLATE						X
	GTA - WELD POSTWELD 1100F 2HR (HEAT AFFECTED ZONE)	PLATE						X

TABLE 4.0.1 (Cont)

AVAILABLE DATA FOR TITANIUM ALLOYS

ALLOY	CONDITION/HT	PRODUCT FORM	KIC	KC	R CURVES	DA/DN	DA/DT	KISCC
TI-6AL 4V	MA	PLATE		X		X		
		SHEET		X		X		
		EXTRUSION				X		
		FORGING				X		
	MA COARSE GRAIN 1300F 2 HR. AC	FORGING	X					
	MA FINE GRAIN 1300F 2 HR. AC	FORGING	X					
	MA 10-20%ALPHA 10 TO 20% PRIMARY ALPHA MILL ANNEALED 1300F 2 HR. AC	FORGING	X					
	MA 1300F 2HRS AC	DISK				X		
		----				X		
	MA 40 50%ALPHA 40 TO 50% PRIMARY ALPHA. MILL ANNEALED 1300F 2 HR. AC	FORGING	X					
	MILL ANNEALED	PLATE	X					X
		SHEET						X
		EXTRUSION	X					
	MILL ANNEALED 1300F 2HR. AC	FORGING	X					
		BILLET	X					
	MINUTEMAN CASING	PLATE						X
	RA	PLATE				X		X
		FORGING				X		X
	RA(FAST COOLED)	PLATE				X		
	RECRYSTALLIZE ANNEAL	PLATE	X					
		FORGING	X					

TABLE 4.0.1 (Cont)

AVAILABLE DATA FOR TITANIUM ALLOYS

ALLOY	CONDITION/HT	PRODUCT FORM	KIC	KC	R CURVES	DA/DN	DA/DT	KISCC
TI 6AL-4V	SOL TREATED 1050F 4HR. WELDED 1050F 4HR	FORGING						X
	SOL TREATED 1050F 4+4 HR	FORGING						X
	STA	PLATE	X					
		FORGING	X					
	STOA	PLATE				X		
		FORGING	X					
	STOA 1750F 1 HR. WQ. 1300F 2 HR. AC	FORGING	X					
	STRESS RELIEVED E B WELDMENT (WELD ZONE)	WELDMENT				X		
	STRESS RELIEVED E B WELDMENT (HEAT AFFECTED ZONE)	WELDMENT				X		
	WELDED & STRESS RELIEVED 1100F 2HRS (HAZ)	WELDMENT				X		
	1000F 2HR	FORGING					X	
	1300F 1HR. AC	FORGING		X				
	1300F 2HR AC	EXTRUSION						X
	1450F, 1HR, AC	PLATE	X					
	1550F 4HRS FC. 1000F 4HRS ARGON COOLED	FORGING				X		
	1700F 4HR FC TO 1400F AC. DIFFUSION BOND THERMAL CYCLE	PLATE						X
	1700F 6 HR. AC. 1400F 6 HR. AC	FORGING	X					

TABLE 4.0.1 (Cont)

AVAILABLE DATA FOR TITANIUM ALLOYS

ALLOY	CONDITION/HT	PRODUCT FORM	KIC	KC	R CURVES	DA/DN	DA/DT	KISCC
TI-6AL-4V	1725F 1HR WQ 1250F 4HR AC (STOA)	EXTRUSION						X
	1725F 1HR WQ, 1000F 1HR AC (STA)	EXTRUSION						X
	1750F WQ 1000F 8HR 1000F (ALPHA+BETA)	FORGING						X
	1750F 1 HR,WQ,1000F 4 HR	FORGING	X					
	1750F 1HR FC TO 1100F,AC	PLATE	X					
	1750F 1HR,FC TO RT	PLATE	X					
	1750F 1000F 2HR AC	FORGING						X
	1750F 2 HR,FC TO 900F AT 100F/HR,AC	FORGING	X					
	1750F 2HR,WQ, 1000F 2HR,AC, 1300F 2HR,AC,STA	PLATE	X					
	1750F 1.5HR WQ 1050F-1100F 8HR, 950F 8HR	FORGING						X
	1750F 4HRS ARGON COOLED, 100 0F 4HRS ARGON COOLED	FORGING				X		
	1775F 1HR WQ, 1675F 1HR WQ, 1000F 4HRS AC, 900F 5HRS AC	DISK				X		
	1775F 1HR WQ, 1675F 1HR WQ, 1000F 1200F 2-8HRS AC	DISK				X		
	1790F 1.5HR WQ 1150F 8HR + 1025F 8HR AC	SHEET						X
	1900F, 0.5HR AC 1350F, 2HRS AC	PLATE	X					
	1950F 4HRS WQ,1000F 4HRS ARGON COOLED	FORGING				X		

TABLE 4.0.1 (Cont)

AVAILABLE DATA FOR TITANIUM ALLOYS

ALLOY	CONDITION/HT	PRODUCT FORM	KIC	KC	R CURVES	DA/DN	DA/DT	KISCC
TI 6AL 4V (ELI)	ANNEALED	SHEET		X				
	BA	PLATE				X		
TI 6AL 4V(ELI)	ANNEALED	FORGING	X			X		
	BA	PLATE				X		
	RECRYSTALLIZE ANNEAL	PLATE	X					
	1800F 1HR HELIUM COOL	PLATE						X
TI-6AL-6V-2SN	ANNEALED 10-20 10-20% PRIMARY ALPHA ANNEALED 1350F 2 HR. AC	FORGING	X					
	ANNEALED 40-50 40-50% PRIMARY ALPHA ANNEALED 1350F 2 HR. AC	FORGING	X					
	ANNEAL-COARSE GRAIN-1350F 2 HR. AC	FORGING	X					
	ANNEAL-FINE GRAIN 1350F 2 HR. AC	FORGING	X					
	BA	PLATE				X		
	BB.AB FIN-10 BETA BLOCKED. ALPHA-BETA FINISHED. 10% REDUCTION. SOLUTION TREATED & OVERAGED 1650 1 HR. WQ 1300F 2 HR. AC	FORGING	X					
	BB.AB FIN-10MA BETA BLOCKED. ALPHA-BETA FINISHED 10% REDUCTION. MILL ANNEALED 1350F 2 HR. AC	FORGING	X					
	BB.AB FIN-30 BETA BLOCKED. ALPHA BETA FINISHED. 30% REDUCTION. SOLUTION TREATED & OVERAGED. 1650F 1HR. WQ 1300F 2 HR. AC	FORGING	X					

TABLE 4.0.1 (Cont)

AVAILABLE DATA FOR TITANIUM ALLOYS

ALLOY	CONDITION/HT	PRODUCT FORM	KIC	KC	R CURVES	DA/DN	DA/DT	KISCC
TI-6AL-6V-2SN	BB.AB FIN-30MA BETA BLOCKED. ALPHA BETA FINISHED. 30%REDUCTION. MILL ANNEALED 1350F 2 HR.AC	FORGING	X					
	BB.B FIN-10 BETA BLOCKED. BETA FINISHED.10%REDUCTION. SOLUTION TREATED & OVERAGED. 1650F 1 HR.WQ.1300F 2HR.AC	FORGING	X					
	BB.B FIN-10MA BETA BLOCKED. BETA FINISHED.10% REDUCTION. MILL ANNEALED 1350F 2 HR.AC	FORGING	X					
	BETA ANNEAL	PLATE	X					
	BETA ANNEAL 1810F 1 HR. ARGON COOL	PLATE	X					
	BETA ANNEAL & STOA-1800F 0.5HR.AC.1575F 0.5HR.WQ. 1050F 8 HR.AC	PLATE	X					
	BF.AB FOR-ANN BETA FLECTED. ALPHA BETA FORGED.ANNEALED. 1350F 2 HR.AC	FORGING	X					
	BF.B FOR-ANN BETA FLECTED. BETA FORGED. ANNEALED 1350F 2 HR.AC	FORGING	X					
	BF.LAB FOR-ANNBETA FLECTED. LOW ALPHA-BETA FORGED(1500F) .ANNEALED.1350F 2 HR.AC	FORGING	X					
	DUPLEX ANNEAL	PLATE	X					
	MA	-----				X		
		EXTRUSION				X		
		FORGING				X		
	MILL ANNEALED	PLATE	X					
		FORGING	X					

TABLE 4.0.1 (Cont)

AVAILABLE DATA FOR TITANIUM ALLOYS

ALLOY	CONDITION/HT	PRODUCT FORM	KIC	KC	R CURVES	DA/DN	DA/DT	KISCC
TI 6AL 6V 2SN	MILL ANNEALED	FORGED BAR	X					
		BILLET	X					
	MILL ANNEALED 1000F 2 HR. AC	BILLET	X					
	RA					X		
	RECRYSTALLIZE ANNEAL	PLATE	X					
	STA-1600F 0 5HR WQ 1000F 6 HR. AC	FORGING	X					
	STA-1650F 0 5HR. WQ. 1050F 24 HR. AC	FORGING	X					
	STA-1675F 0 25 HR. WQ. 1100F 4 HR	PLATE	X					
	STOA	PLATE				X		
	STOA-1600F 1 5HR. WQ. 1250F 6 HR. AC	EXTRUSION	X					
	STOA-1650F 1 HR. WQ. 1300F 2 HR. AC	FORGING	X					
	STOA 1700F 1 HR. WQ. 1400F 1 HR. AC	PLATE	X					
		BILLET	X					
	1100F 2HR	FORGING					X	
	1650F 1 HR WQ.	FORGING	X					
	1675F 2 HR. AC 1600F 1 HR. FC	PLATE	X					
	1675F 2 HR. AC 1600F 1 HR. FC	FORGING	X					
	1675F 2 HR. AC 1600F 1 HR. FC	FORGED BAR	X					

TABLE 4.0.1 (Cont)

AVAILABLE DATA FOR TITANIUM ALLOYS

ALLOY	CONDITION/HT	PRODUCT FORM	KIC	KC	R CURVES	DA/DN	DA/DT	KISCC
TI-6AL-6V-2SN	-----	PLATE						X
	1000F 2HR AC	FORGING						X
	1300F 2HR AC	FORGING						X
	1550F 1HR WQ, 900F 4HR AC	PLATE						X
TI 6-2-2-2-2	ST	PLATE				X		
	STA	PLATE				X		
TI-6-2-4-2	1790F 1HR AC, 1100F 8HRS AC	FORGING				X		
TI 6 2 4 6	--- --	EXTRUSION				X		
	1590F 2HRS AC, 1550F 2HRS OQ, 1100F 8HRS AC	FORGING				X		
TI 8AL 1MO 1V	-----	-----					X	
	---	SHEET				X	X	X
		PLATE						X
	DA	SHEET		X		X		
	MA	SHEET				X	X	
		PLATE					X	
	MILL ANNEALED	PLATE						X
	MILL ANNEALED 1435F 8HR FC	SHEET						X
	VAC ANNEALED	PLATE						X
	1570F 1HR, WQ	PLATE					X	
	1675F, 1HR, AC 1075F, 8HR, AC 1000F, 2HR, AC	PLATE						X
	1750F 1HR AC, 1200F 2HR WQ	PLATE						X
	1725F FC, 1200F 3HR WQ	PLATE					X	

TABLE 4.0.1 (Cont)

AVAILABLE DATA FOR TITANIUM ALLOYS

ALLOY	CONDITION/HT	PRODUCT FORM	KIC	KC	R CURVES	DA/DN	DA/DT	KISCC
TI-8AL-1MO-1V	1775F 0.5HR FC TO 1200F, 1200F 0.5HR AC, 1200F 2HR ARGON QUENCH	PLATE						X
	1825F 1HR AC	PLATE						X
	1825F 1HR AC, 1350F 2HRS AC					X		
	1800F 1HR WQ, 1100F 8HRS AC	FORGING	X			X		
	2000F, 0.5HR, AC	PLATE						X
TI-8MO8V2FE3AL	STA REAGED AT 1100F 6HR	PLATE	X					
	1475F 1.5 HR, WQ, 1000F 8 HR, AC	EXTRUSION	X					
TI-*	STA-1740F 1 HR, AC, 1000F 8HR, AC	PLATE	X					
	1740F 1 HR, AC	PLATE	X					
	ALPHA-BETA FORGED	FORGING						X

TABLE 4.0.2

PLANE STRAIN FRACTURE TOUGHNESS VALUES OF TITANIUM ALLOYS AT ROOM TEMPERATURE

ALLOY	CONDITION/ HT	PRODUCT FORM	RANGE OF PRODUCT THICKNESSES (IN)	KIC (KSI SQRT(IN))								
				L-T			T-L			S-L		
				SPECIMEN THICK *	MEAN	STD. DEV.	SPECIMEN THICK *	MEAN	STD. DEV.	SPECIMEN THICK *	MEAN	STD DEV.
BETA C	STA	PLATE	2.50	1.00	44.1	1.4	1.00	43.9	0.6	----	----	----
BETA III	1325F .25HR, WQ 925F 8HR	PLATE	0.80	0.75	49.8	1.2	----	----	----	----	----	----
TI-*	STA-1740F 1 HR, AC, 1000F 8HR, AC	PLATE	0.62	0.62	55.3	1.5	----	----	----	----	----	----
	1740F 1 HR, AC	PLATE	0.62	0.63	61.6	1.6	----	----	----	----	----	----
TI-6AL-4V	AS FORGED-MA ALPHA-BETA FORGED, MILL ANNEALED	FORGING	2.25	----	----	----	1.00	35.4	2.7	----	----	----
	ANNEALED	FORGING	3.00	1.50	84.4	1.8	1.49	83.4	9.9	----	----	----
		EXTRUSION	4.00	----	----	----	1.63	93.3	2.3	----	----	----
		BILLET	6.00	1.25	79.6	9.6	----	----	----	----	----	----
	ANNEALED 1000F 2 HR, AC	BILLET	2.30	1.25	50.9	0.6	----	----	----	----	----	----
	ANNEALED 1300F 4 HR, AC	FORGING	2.30	0.75	58.1	1.2	0.75	62.2	3.0	0.75	68.1	1.0
	ANNEALED 1375F 3HR, AC	PLATE	2.75	1.25	60.4	5.5	----	----	----	----	----	----
	AS RECEIVED	FORGED BAR	1.00-3.50	0.56	57.1	10.4	0.50	54.9	10.8	----	----	----
	B FORGED BETA FORGED REHEATED TO 1950F DRAWN TO SIZE, ANNEALED 1300F	FORGED BAR	2.25	----	----	----	1.00	42.6	4.3	----	----	----

* MINIMUM SPECIMEN THICKNESS (IN.)

TABLE 4.0.2 (Cont)

PLANE STRAIN FRACTURE TOUGHNESS VALUES OF TITANIUM ALLOYS AT ROOM TEMPERATURE

ALLOY	CONDITION/ HT	PRODUCT FORM	RANGE OF PRODUCT THICKNESSES (IN)	KIC (KSI SQRT(IN)) L-T SPECIMEN THICK *	L-T MEAN	L-T STD. DEV.	T-L SPECIMEN THICK *	T-L MEAN	T-L STD. DEV.	S-L SPECIMEN THICK *	S-L MEAN	S-L STD. DEV.
TI-6AL-4V	B FORGED-MA BETA FORGED, MILL ANNEALED 1300F 2 HR, AC	FORGING	2.00	1.00	70.6	4.9	1.00	71.0	0.4	1.00	73.9	2.5
	BETA PROCESSED MILL ANNEALED	PLATE	3.00	1.50	94.9	4.8	----	----	----	----	----	----
	DIFFUSION BOND ANNEALED	BILLET	1.00-3.50	0.98	68.2	9.7	0.68	64.2	11.8	----	----	----
	MILL ANNEAL	PLATE	1.00-1.50	1.24	55.6	1.3	----	----	----	----	----	----
	MILL ANNEALED	PLATE	1.25-2.00	----	----	----	1.25	100.6	6.8	----	----	----
		EXTRUSION	1.80-4.00	1.47	83.5	3.1	1.50	87.5	4.1	----	----	----
	MILL ANNEALED 1300F 2 HR, AC	FORGING	2.00	1.00	47.7	2.9	1.00	49.5	3.9	1.00	43.6	5.8
		BILLET	2.30	1.25	84.0	3.4	----	----	----	----	----	----
	RECRYSTALLIZE ANNEAL	PLATE	1.00-2.50	1.13	82.8	7.8	1.00	80.8	10.8	----	----	----
		FORGING	1.20-6.70	1.25	83.6	5.5	1.25	83.9	6.9	1.43	88.9	3.2
	STA	PLATE	0.62	----	----	----	0.63	42.6	2.0	----	----	----
	1700F 6 HR, AC, 1400F 6 HR, AC	FORGING	1.40	1.25	75.9	4.2	1.28	81.2	5.8	----	----	----
	1750F 1 HR, WQ, 1000F 4 HR	FORGING	3.00	----	----	----	2.00	79.3	4.9	----	----	----
	1750F 1HR FC TO 1100F, AC	PLATE	1.50	----	----	----	1.50	91.5	2.1	----	----	----
	1750F 1HR, FC TO RT	PLATE	1.50	1.50	71.8	3.2	1.50	91.6	1.3	----	----	----
	1750F 2HR, WQ, 1000F 2HR, AC, 1300F 2HR, AC, STA	PLATE	0.62	0.63	41.4	2.3	----	----	----	----	----	----

* MINIMUM SPECIMEN THICKNESS (IN.).

TABLE 4.0.2 (Cont)

PLANE STRAIN FRACTURE TOUGHNESS VALUES OF TITANIUM ALLOYS AT ROOM TEMPERATURE

ALLOY	CONDITION/ HT	PRODUCT FORM	RANGE OF PRODUCT THICKNESSES (IN)	KIC (KSI SQRT(IN)) L-T SPECIMEN THICK *	L-T MEAN	L-T STD. DEV.	T-L SPECIMEN THICK *	T-L MEAN	T-L STD. DEV.	S-L SPECIMEN THICK *	S-L MEAN	S-L STD. DEV.
TI-6AL-4V(ELI)	ANNEALED	FORGING	3.00	2.00	83.5	1.3	2.01	84.3	0.4	----	----	----
	RECRYSTALLIZE ANNEAL	PLATE	3.00	2.00	76.1	4.0	2.00	76.8	0.7	----	----	----
TI-6AL-6V-2SN	BETA ANNEAL 1810F 1 HR. ARGON COOL	PLATE	0.50	----	----	----	0.45	54.3	2.0	----	----	----
	BETA ANNEAL & STOA-1800F 0.5HR.AC.1575F 0.5HR.WQ.1050F 8 HR.AC	PLATE	0.62	0.63	50.1	1.8	----	----	----	----	----	----
	DUPLEX ANNEAL	PLATE	0.50	----	----	----	0.50	65.1	2.0	----	----	----
	MILL ANNEALED	PLATE	0.50-1.00	----	----	----	0.49	39.0	5.2	----	----	----
		FORGING	3.80	1.00	58.6	2.7	----	----	----	----	----	----
		BILLET	2.20	1.24	52.3	6.4	----	----	----	----	----	----
	MILL ANNEALED 1000F 2 HR.AC	BILLET	2.20	1.25	57.1	2.2	----	----	----	----	----	----
	STA-1600F 0.5HR.WQ.1000F 6 HR.AC	FORGING	3.80	1.01	30.8	0.7	----	----	----	----	----	----
	STA-1675F 0.25 HR.WQ. 1100F 4 HR	PLATE	1.25	----	----	----	0.50	34.1	3.8	----	----	----
	STOA-1700F 1 HR.WQ.1400F 1 HR.AC	PLATE	0.38	0.38	42.9	1.2	0.38	46.1	3.1	----	----	----
		BILLET	12.00	1.02	62.8	6.9	1.02	57.0	3.7	----	----	----
TI-8MO8V2FE3AL	STA.[illegible]AGED AT 1150F 5HR	PLATE	1.00	1.00	54.0	1.0	0.99	53.9	1.0	----	----	----

* MINIMUM SPECIMEN THICKNESS (IN.).

TABLE 4.0.2 (Cont)

PLANE STRAIN FRACTURE TOUGHNESS VALUES OF TITANIUM ALLOYS AT ROOM TEMPERATURE

ALLOY	CONDITION/ HT	PRODUCT FORM	RANGE OF PRODUCT THICKNESSES (IN)	KIC (KSI SQRT(IN))								
				L-T			T-L			S-L		
				SPECIMEN THICK *	MEAN	STD. DEV.	SPECIMEN THICK *	MEAN	STD. DEV.	SPECIMEN THICK *	MEAN	STD. DEV.
TI6AL6V2SN(ELI)	1600F 1 HR.WQ. 1050F 4 HR.AC	PLATE	1.00	0.25	29.8	0.5	----	----	----	----	----	----
	1650F 1 HR.WQ.	PLATE	1.00	0.25	34.0	3.5	----	----	----	----	----	----

* MINIMUM SPECIMEN THICKNESS (IN.).

TABLE 4.0.3

PLANE STRESS AND TRANSITIONAL FRACTURE TOUGHNESS OF
TITANIUM ALLOYS (WITH BUCKLING CONSTRAINTS)

Alloy	Condition/Ht	Test Temp. (°F)	Specimen Orient	Specimen Width (in.)	Yield Strength (Ksi)	K_c^* (Ksi $\sqrt{in}$) Specimen Thickness (in.) = 0.020	0.040	0.050
Ti-5Al-2.5Sn	Annealed	-423	L-T	3.0	203	116.8/4.5 (5)		
				6.0	203	109.4/6.6 (9)		
				12.0	203	104.2/4.0 (8)		
				16.0	203	97.1/9.6 (2)		
			T-L	12.0	210	107.7/16.0 (2)	147.6/28.9 (2)	
Ti-6Al-4V	MA	R. T.	L-T	24.0	136			196.4/19.9 (6)
		-110	T-L	8.0	163			159.4/7.5 (3)
Ti-6Al-4V (ELI)	Annealed	R. T.	L-T	18.0	136	161.6/6.5 (5)		
Ti-8Al-1Mo-1V	D. A.	R. T.	L-T	12.0	136	111.7/15.0(3)		
				20.0	134			220.5/15.8(4)

*Mean/Standard Deviation (No. of Specimens)

TABLE 4.0.4.1

COMPARISON OF FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS OF THE STRESS INTENSITY FACTOR FOR TITANIUM ALLOYS

TEST CONDITIONS:

SPECIMEN ORIENTATION: L-T — ENVIRONMENT: LAB AIR AT R.T.

STRESS RATIO: 0.00-0.10 — FREQUENCY: 0.10-50.00HZ

ALLOY	CONDITION/HT	PRODUCT FORM	STRESS RATIO	FREQUENCY	FATIGUE CRACK GROWTH RATES (MICRO IN/CYCLE) FOR DELTA K LEVELS (KSI SQRT(IN)) = 2.5	5.0	10.0	20.0	50.0	100.0
TI-5AL-2.5SN	ANNEALED	SHEET	0.10	30.00				11.6	124.	
	ANNEALED	SHEET	0.10	50.00				11.7		
TI-6-2-4-6	-----	EXTRUSION	0.10	20.00			.019	9.70		
TI-6AL-4V	ANNEALED	BILLET	0.02	10.00- 20.00			.270	9.49		
	ANNEALED AT 1375F, 3HRS, AC	PLATE	0.02	10.00- 20.00			.283	9.70		
	BA	FORGING	0.02	.10- 20.00				2.55	102.	
	BETA PROCESSED -MILL ANNEALED	PLATE	0.10	1.00				.917		
	MA	PLATE	0.02	.10- 30.00		.0193	.442	12.4		
	MA	PLATE	0.02	.10- 30.00			.154	8.92		
	MA	PLATE	0.04	20.00					96.5	
	MA	PLATE	0.05	20.00				6.97		
	MA	FORGING	0.02	1.00- 30.00				8.18	292.	
	MA	EXTRUSION	0.10	1.00- 20.00				9.50	202.	
TI-6AL-4V(ELI)	ANNEALED	FORGING	0.10	1.00- 10.00				12.9	206.	
	RA	PLATE	0.10	10.00				10.8		

TABLE 4.0.4.1 (Cont)

COMPARISON OF FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS OF THE STRESS INTENSITY FACTOR FOR TITANIUM ALLOYS

TEST CONDITIONS:

SPECIMEN ORIENTATION: L-T | ENVIRONMENT: LAB AIR AT R.T.

STRESS RATIO: 0.00-0.10 | FREQUENCY: 0.10-50.00HZ

ALLOY	CONDITION/HT	PRODUCT FORM	STRESS RATIO	FREQUENCY	FATIGUE CRACK GROWTH RATES (MICRO IN/CYCLE) FOR DELTA K LEVELS (KSI SQRT(IN)) = 2.5	5.0	10.0	20.0	50.0	100.0
TI-6AL-6V-2SN	MA	EXTRUSION	0.02	.10- 20.00		.0440	.620	7.73		
TI-8AL-1MO-1V	----	SHEET	0.02	.10- 12.00			2.28	13.9	144.	1243.
	DA	SHEET	0.00	1.00- 30.00					67.2	
	DA	SHEET	0.10	43.00				7.58	246.	
	MA	SHEET	0.10	43.00				7.47		

TABLE 4.0.4.2

COMPARISON OF FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS OF THE STRESS INTENSITY FACTOR FOR TITANIUM ALLOYS

TEST CONDITIONS:

SPECIMEN ORIENTATION: T-L   ENVIRONMENT: LAB AIR AT R. T.

STRESS RATIO: 0.02-0.10   FREQUENCY: 0.10-53.30HZ

ALLOY	CONDITION/HT	PRODUCT FORM	STRESS RATIO	FREQUENCY	FATIGUE CRACK GROWTH RATES (MICRO IN/CYCLE) FOR DELTA K LEVELS (KSI SQRT(IN)) = 2.5	5.0	10.0	20.0	50.0	100.0
TI-5AL-2.5SN	ANNEALED	SHEET	0.10	30.00- 53.30				11.8		
	ANNEALED	SHEET	0.10	30.00				11.9	141.	
TI-6AL-4V	AS WELDED E.B. WELDMENT (WELD ZONE)	WELDMENT	0.10	10.00				5.94		
	AS WELDED E.B. WELDMENT (HEAT AFFECTED ZONE)	WELDMENT	0.10	10.00				6.52		
	BA	FORGING	0.02	.10- 20.00				2.27	103.	3242.
	MA	EXTRUSION	0.10	5.00- 20.00				13.7	281.	
	RA	PLATE	0.10	10.00				21.3		
	STRESS RELIEVED E.B. WELDMENT (HEAT AFFECTED ZONE)	WELDMENT	0.10	.10- 10.00				14.2	344.	
	STRESS RELIEVED E.B. WELDMENT (WELD ZONE)	WELDMENT	0.10	.10- 10.00				10.1		
TI-6AL-4V(ELI)	ANNEALED	FORGING	0.10	1.00- 20.00				11.9	171.	
	RA	PLATE	0.10	1.00- 10.00				7.75	240.	

TABLE 4.0.4.3

COMPARISON OF FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS OF THE STRESS INTENSITY FACTOR FOR TITANIUM ALLOYS

TEST CONDITIONS:

SPECIMEN ORIENTATION: C-R — ENVIRONMENT: LAB AIR AT R.T.

STRESS RATIO: 0.03-0.10 — FREQUENCY: 0.16-30.00HZ

ALLOY	CONDITION/HT	PRODUCT FORM	STRESS RATIO	FREQUENCY	FATIGUE CRACK GROWTH RATES (MICRO IN/CYCLE) FOR DELTA K LEVELS (KSI SQRT(IN)) = 2.5	5.0	10.0	20.0	50.0	100.0
TI-6-2-4-2	1790F 1HR AC, 1100F 8HRS AC	FORGING	0.10	.16				10.3		
TI-6-2-4-6	1690F 2HRS AC, 1550F 2HRS OQ, 1100F 8HRS AC	FORGING	0.10	30.00		.105	.985			
TI-6AL-4V	1775F 1HR WQ, 1675F 1HR WQ, 1000F 4HRS AC, 900F 5HR	DISK	0.05	.33- 10.00					152.	
	1775F 1HR WQ, 1675F 1HR WQ, 1000F-1200F 2-8HRS AC	DISK	0.03	.33- 0.50			.865	1.0		
TI-8AL-1MO-1V	1830F 1HR WQ, 1100F 8HRS AC	FORGING	0.10	30.00		.107	1.50			

TABLE 4.0.5

STRESS CORROSION CRACKING THRESHOLD DATA FOR TITANIUM ALLOYS AT ROOM TEMPERATURE

ALLOY	CONDITION/HT	PRODUCT FORM	SPECIMEN ORIENTATION	ENVIRONMENTS K_{Iscc} (Ksi $\sqrt{in.}$) INDUSTRIAL ATMOSPHERE	SEACOAST ATMOSPHERE	SUMP TANK WATER	JP-4 FUEL	3.5% NaCl	SHOP CLEANING SOLVENT	FIELD CLEANING SOLVENT
Ti-6Al-4V	Alpha-Beta Forged	F	T-L	27.0	18.0			27.0		
	Beta Forged	F	T-L	42.0	42.0			34.0		
	Finish Rolled	P	T-S					76.2(7)		
	GTA Weld Postweld 2HR (Heat Affected Zone)	P	L-T			58.0				
	Mill Annealed	P	L-S					32.0		
	RA	P	L-T			59.3(7)				
			T-L			59.8(6)			69.0(2)	70.0
		F	T-L			53.0(2)				
			S-L			56.0(4)				
	1700F 4HR FC To 1400F AC Diffusion Bond Thermal Cycle	P	L-T			66.0(2)				
			T-L			55.2(5)			69.0	70.0
	1725F 1HR WQ, 1250F 4HR AC (STOA)	E	L-S					60.0		
	1725F 1HR WQ, 1000F 1HR AC (STA)	E	L-S					48.5(2)		
	1750F, 1000F 2HR AC	F	L-T			31.0	43.3			
Ti-6Al-6V-2Sn	1000F 2HR AC	F	L-T				30.5			
	1390F 2HR AC	F	L-T					32.4		
	1550F 1HR WQ 900F 4HR AC	P	T-S					21.0		

TABLE 4.0.5 (Cont)

STRESS CORROSION CRACKING THRESHOLD DATA FOR TITANIUM ALLOYS AT ROOM TEMPERATURE

ALLOY	CONDITION/HT	PRODUCT FORM	SPECIMEN ORIENTATION	ENVIRONMENTS K_{Iscc} (Ksi $\sqrt{in.}$) INDUSTRIAL ATMOSPHERE	SEACOAST ATMOSPHERE	SUMP TANK WATER	JP-4 FUEL	3.5% NaCl	SHOP CLEANING SOLVENT	FIELD CLEANING SOLVENT
Ti-8Al-1Mo-1V	Mill Annealed	P	L-S					20.0		
			T-S					39.4(5)		
	Mill Annealed 1435F 8HR FC	P	T-S					21.0		
	Vacuum Annealed	P	T-L					24.3(3)		
	1520 1HR WQ	P	T-L					21.4		
	1675F 1HR AC, 1075F 8HR AC, 1000F 2HR AC	P	T-L					26.4		
	1700F 1HR AC 1200F 2HR WQ	P	T-S					28.0		
	1825F 1HR AC	P	T-S					23.0		
	2000F 0.5 HR AC	P	T-L					47.3		

TABLE 4.1.3.1

SUSTAINED CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 4.1.3.1 INDICATING EFFECT

OF ENVIRONMENT

MATERIAL: TITANIUM BETA TI
CONDITION: BETA STABILIZED

K MAX (KSI*IN**1/2)	DA/DT (10**-3 IN/HOUR)			
	A	B	C	D
	E= 3.5% NACL			
K MAX MIN A:				
B:				
C:				
D:				
200.00				
K MAX MAX A:				
B:				
C:				
D:				

ROOT MEAN SQUARE PERCENT ERROR 0.00

CONDITION/HT: BETA STABILIZED
FORM: 0.1"TH SHEET
SPECIMEN TYPE:
ORIENTATION:
YIELD STRENGTH: 138.0 KSI
ULT. STRENGTH:

SPECIMEN THK: 0.160"
SPECIMEN WIDTH: 8.000"
CRACK LENGTH (A_0):
K_{ISCC}: 68.00 KSI (SQRT IN)
REFERENCES: 77458

TITAN. ALLOY

BETA TI

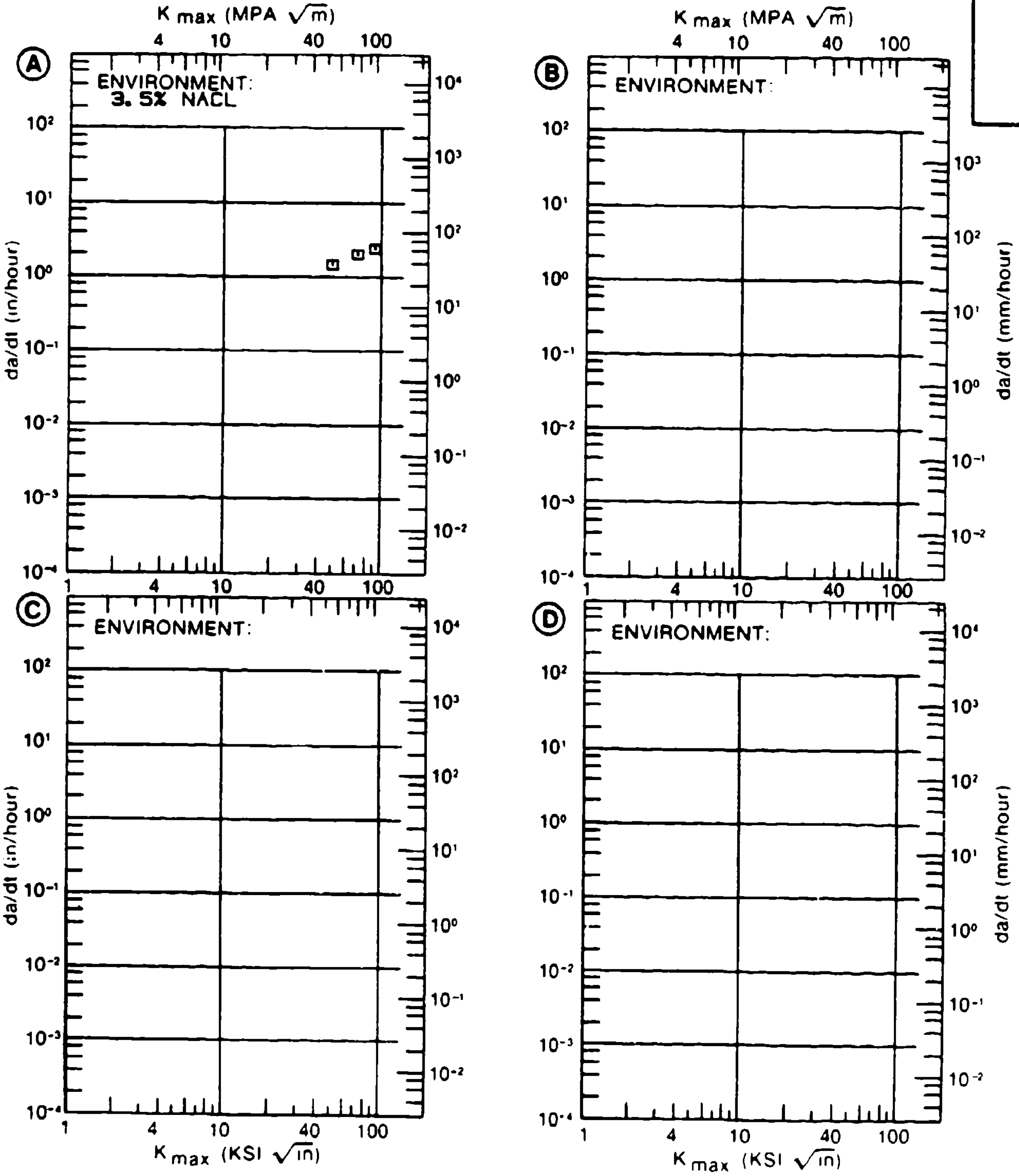

Figure 4.1.3.1

TABLE 4.1.3.2

TITANIUM BETA K(ISCC)

CONDITION	--PRODUCT-- FORM	--PRODUCT-- THICK (IN)	TEST TEMP (F)	SPEC OR	YIELD STR (KSI)	ENVIRONMENT	------SPECIMEN-------- WIDTH (IN) W	THICK (IN) B	DESIGN (*=SQ)	CRACK LENGTH (IN) A	K(Q) (KSI*SQRT IN)	K(ISCC) (KSI*SQRT IN)	MEAN	STAN DEV	TEST TIME (MIN)	DATE	REFER
BETA STAR	S	0.16	R.T.	L-S	136.0	3.5 PCT NACL	8.000	0.160	CNT	----	72.00	< 68.00*			20	1969	77456
1745F WQ	S	----	R.T.	---	----	.6M KCL, +1000MV	----	----	SENT	----	100.00	44.00			----	1970	82651
1745F WQ	S	----	R.T.	---	----	.6M KCL, -1000MV	----	----	SENT	----	100.00	> 55.00*			----	1970	82651
1745F WQ	S	----	R.T.	---	----	.6M KCL, 0 MV	----	----	SENT	----	100.00	32.00			----	1970	82651
1745F WQ	S	----	R.T.	---	----	.6M KCL, +500MV	----	----	SENT	----	100.00	34.00			----	1970	82651
1745F WQ	S	----	R.T.	---	----	.6M KCL, -500MV	----	----	SENT	----	100.00	22.00			----	1970	82651
1745F WQ	S	----	R.T.	---	----	.6M KCL, -750MV	----	----	SENT	----	100.00	28.00			----	1970	82651
1745F WQ, +1095F 61HR	S	----	R.T.	---	----	.6M KCL, -500MV	----	----	SENT	----	32.00	22.00			----	1970	82651
1745F WQ, +1095F 1000HR	S	----	R.T.	---	----	.6M KCL, -500MV	----	----	SENT	----	8.00	8.00			----	1970	82651
1745F WQ, +1095F 16HR	S	----	R.T.	---	----	.6M KCL, -500MV	----	----	SENT	----	60.00	26.00			----	1970	82651
1745F WQ, +1095F 250HR	S	----	R.T.	---	----	.6M KCL, -500MV	----	----	SENT	----	22.00	16.00			----	1970	82651
1745F WQ, +1095F 500HR	S	----	R.T.	---	----	.6M KCL, -500MV	----	----	SENT	----	8.00	8.00			----	1970	82651

*NOTE-DATA WHICH DO NOT MEET MINIMUM SPECIMEN THICKNESS REQUIREMENTS OF 2.5(KISCC/TYS)SQUARED

TABLE 4.2.1.1

MEAN PLANE STRAIN FRACTURE TOUGHNESS DATA OF TITANIUM ALLOY BETA C AT ROOM TEMPERATURE

CONDITION/HT — MEAN KIC ± STANDARD DEVIATION (KSI SQRT(IN)) (NUMBER OF SPECIMENS)

PLATE

CONDITION/HT	L-T	T-L	S-L
STA	44.1 ± 1.4 (3)	43.9 ± 0.6 (2)	-----

TABLE 4.2.2.1

TITANIUM BETA C K(IC)

CONDITION	--PRODUCT-- FORM	THICK (IN)	TEST TEMP (F)	SPECIMEN ORIENT	YIELD STRENGTH (KSI)	------SPECIMEN------ WIDTH (IN) W	THICK (IN) B	DESIGN	CRACK LENGTH (IN) A	2.5*(K(IC)/TYS)**2 (IN)	K(IC) (KSI*SQRT IN)	K(IC) MEAN	STAN DEV	DATE	REFER
STA	P	2.50	-65	L-T	----	1.995	1.001	CT	1.107	0.07	31.40			1974	88575 (1)
		2.50			----	2.002	1.000	CT	1.076	0.06	30.50			1974	88575 (1)
		2.50			----	1.988	0.978	CT	1.044	0.07	31.30			1974	88575 (1)
												31.1/	0.5		
STA	P	2.50	R.T.	L-T	180.0	1.973	0.999	CT	1.042	0.15	43.80			1974	88575
		2.50			180.0	1.974	1.004	CT	1.074	0.14	42.80			1974	88575
		2.50			180.0	1.976	1.00_	CT	1.090	0.16	45.60	44.1/	1.4	1974	88575
STA	P	2.50	R.T.	T-L	180.0	1.996	1.002	CT	1.047	0.14	43.40			1974	88575
		2.50			180.0	1.995	1.001	CT	1.041	0.15	44.30	43.9/	0.6	1974	88575

NOTES
(1) TYS APPROX 190

TABLE 4.2.3.1

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 4.2.3.1 INDICATING EFFECT

OF STRESS RATIO

MATERIAL: TITANIUM BETA-C
CONDITION: STA
ENVIRONMENT: R.T. , DRY AIR

DELTA K (KSI*IN**1/2)			DA/DN (10**-6 IN./CYCLE) A	B	C	D
			R=+0.10	R=+0.50		
	A:	5.37	.164			
DELTA K MIN	B:					
	C:					
	D:					
		6.00	.301			
		7.00	.624			
		8.00	1.07			
		9.00	1.62			
		10.00	2.26			
		13.00	4.56			
		16.00	7.40			
		20.00	12.3			
		25.00	21.6			
		30.00	37.1			
		35.00	63.5			
		40.00	110.			
	A:	41.22	125.			
DELTA K MAX	B:					
	C:					
	D:					
ROOT MEAN SQUARE PERCENT ERROR			22.03	0.00		
LIFE PREDICTION RATIO SUMMARY (NP/NA)		0.0-0.5				
		0.5-0.8				
		0.8-1.25	1			
		1.25-2.0	1			
		>2.0				

CONDITION/HT: STA
FORM: 0.13"TH SHEET
SPECIMEN TYPE: CCP
ORIENTATION: L-T
FREQUENCY: 6.00 HZ
ENVIRONMENT: R. T., DRY AIR

YIELD STRENGTH: 187.7 KSI
ULT. STRENGTH: 193.5 KSI
SPECIMEN THK: 0.125- 0.126"
SPECIMEN WIDTH: 6.002- 6.028"
REFERENCES: 88575

TITAN. ALLOY

BETA-C

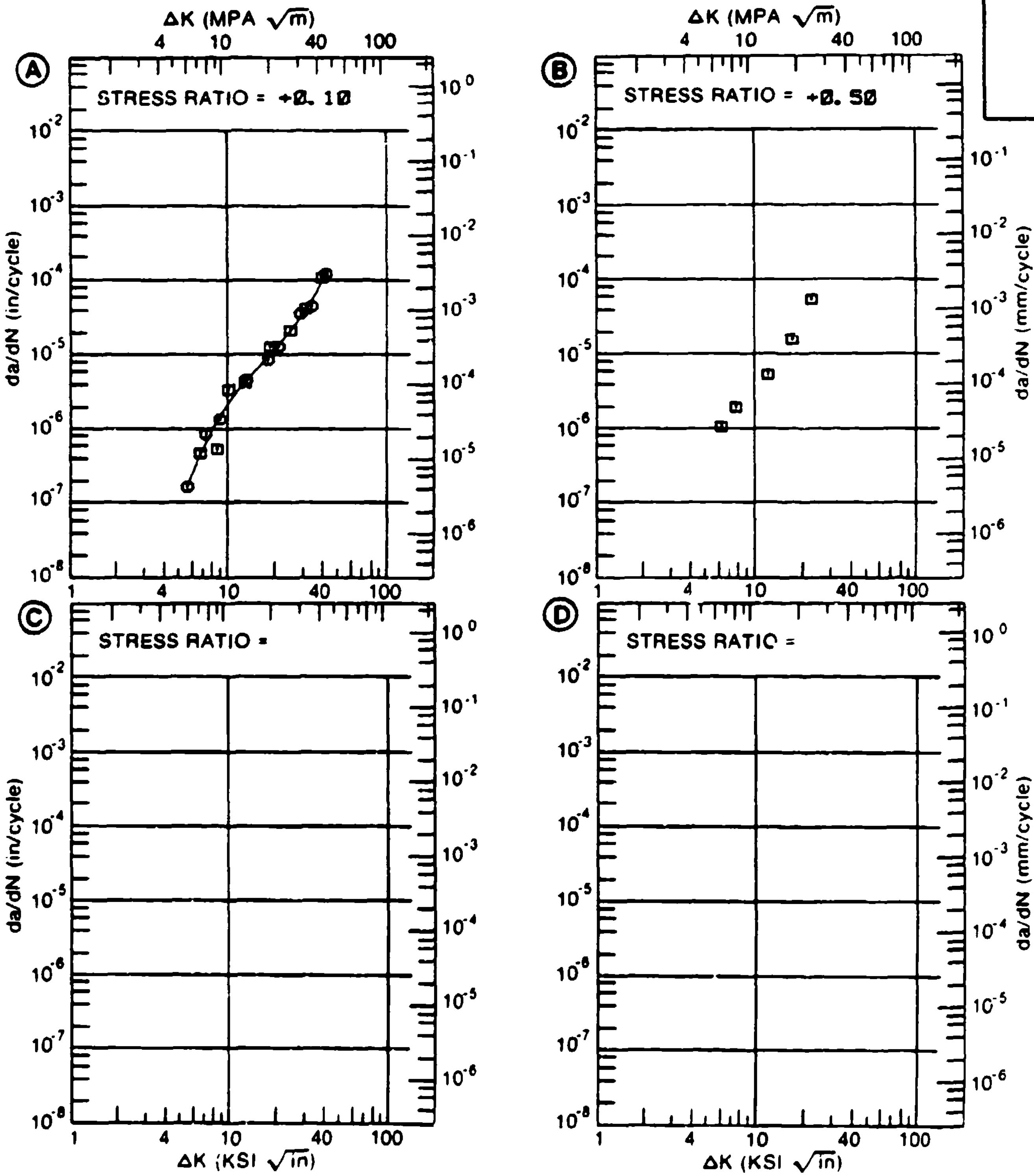

Figure 4.2.3.1

TABLE 4.2.3.2

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 4.2.3.2 INDICATING EFFECT

OF STRESS RATIO

MATERIAL: TITANIUM BETA-C
CONDITION: STA
ENVIRONMENT: R.T. ,S.T.W.

DELTA K (KSI*IN**1/2)		DA/DN (10**-6 IN./CYCLE) A R=+0.10	B R=+0.50	C	D
DELTA K MIN	A: 6.58	.805			
	B:				
	C:				
	D:				
	7.00	1.03			
	8.00	1.67			
	9.00	2.45			
	10.00	3.35			
	13.00	6.72			
	16.00	11.3			
	20.00	20.2			
	25.00	39.4			
	30.00	75.1			
	35.00	143.			
	40.00	271.			
DELTA K MAX	A: 42.90	394.			
	B:				
	C:				
	D:				
ROOT MEAN SQUARE PERCENT ERROR		29.18	0.00		

LIFE PREDICTION RATIO SUMMARY (NP/NA)		A	B	C	D
	0.0-0.5				
	0.5-0.8				
	0.8-1.25	4			
	1.25-2.0	1			
	>2.0				

CONDITION/HT: STA
FORM: Ø.12- Ø.13"TH SHEET
SPECIMEN TYPE: CCP
ORIENTATION: L-T
FREQUENCY: Ø.1Ø- 1.ØØ HZ
ENVIRONMENT: R.T., S.T.W.

YIELD STRENGTH: 187.7 KSI
ULT. STRENGTH: 183.5 KSI
SPECIMEN THK: Ø.118- Ø.127"
SPECIMEN WIDTH: 8.ØØ2- 8.Ø23"
REFERENCES: 88575

TITAN. ALLOY

BETA-C

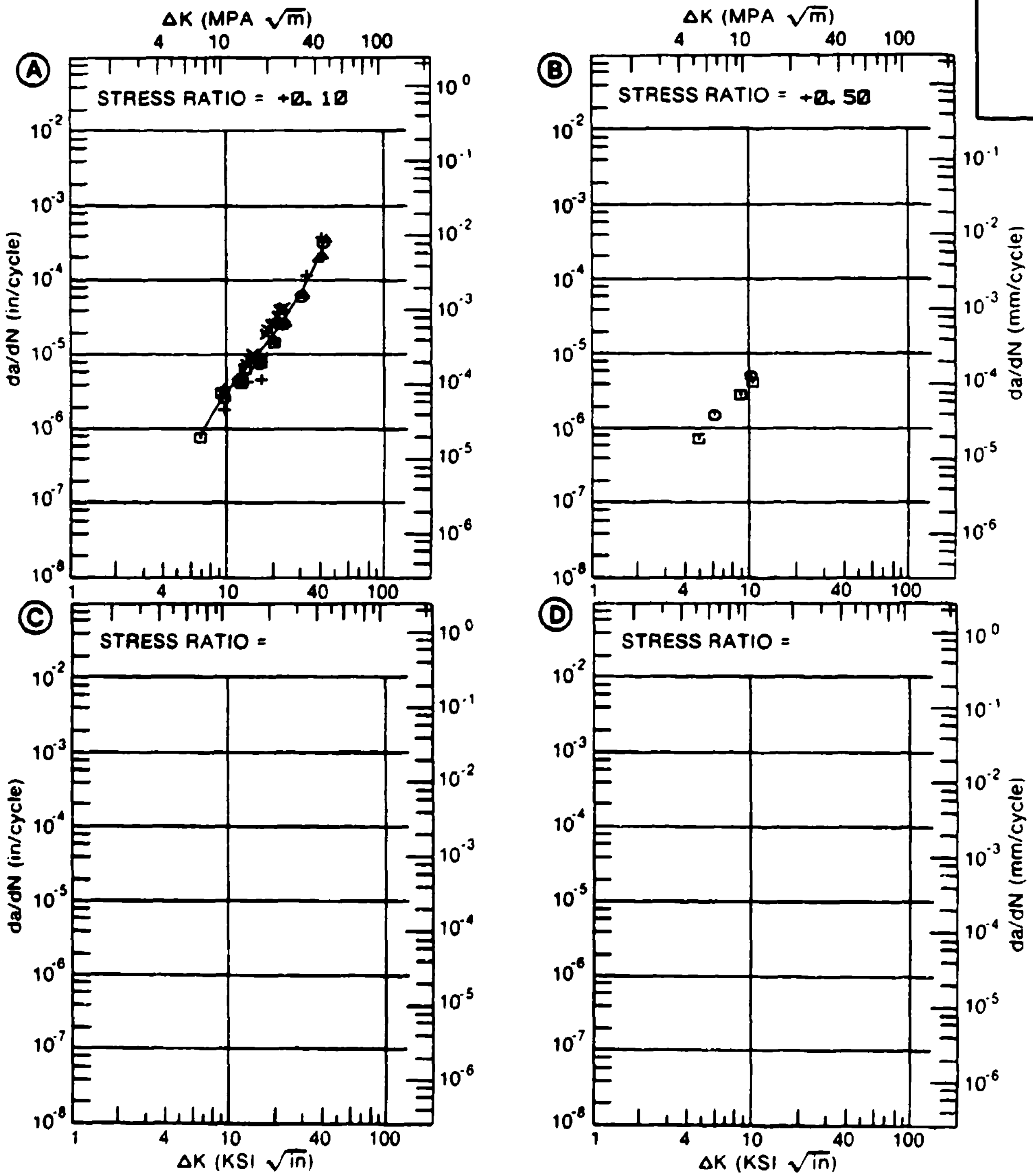

Figure 4.2.3.2

TABLE 4.2.3.3

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 4.2.3.3 INDICATING EFFECT

OF STRESS RATIO

MATERIAL: TITANIUM BETA-C
CONDITION: STA
ENVIRONMENT: R.T. ,S.T.W.

DELTA K (KSI*IN**1/2)	DA/DN (10**-6 IN./CYCLE) A	B	C	D
	R=+0.10			
DELTA K MIN A:				
DELTA K MIN B:				
DELTA K MIN C:				
DELTA K MIN D:				
200.00				
DELTA K MAX A:				
DELTA K MAX B:				
DELTA K MAX C:				
DELTA K MAX D:				

ROOT MEAN SQUARE PERCENT ERROR 0.00

LIFE PREDICTION RATIO SUMMARY (NP/NA)	
0.0-0.5	
0.5-0.8	
0.8-1.25	
1.25-2.0	
>2.0	

CONDITION/HT: STA
FORM: 0.13"TH SHEET
SPECIMEN TYPE: CCP
ORIENTATION: T-L
FREQUENCY: 1.00 HZ
ENVIRONMENT: R.T., S.T.W.

YIELD STRENGTH: 167.7 KSI
ULT. STRENGTH: 183.5 KSI
SPECIMEN THK: 0.127"
SPECIMEN WIDTH: 6.009"
REFERENCES: 88575

TITAN. ALLOY

BETA-C

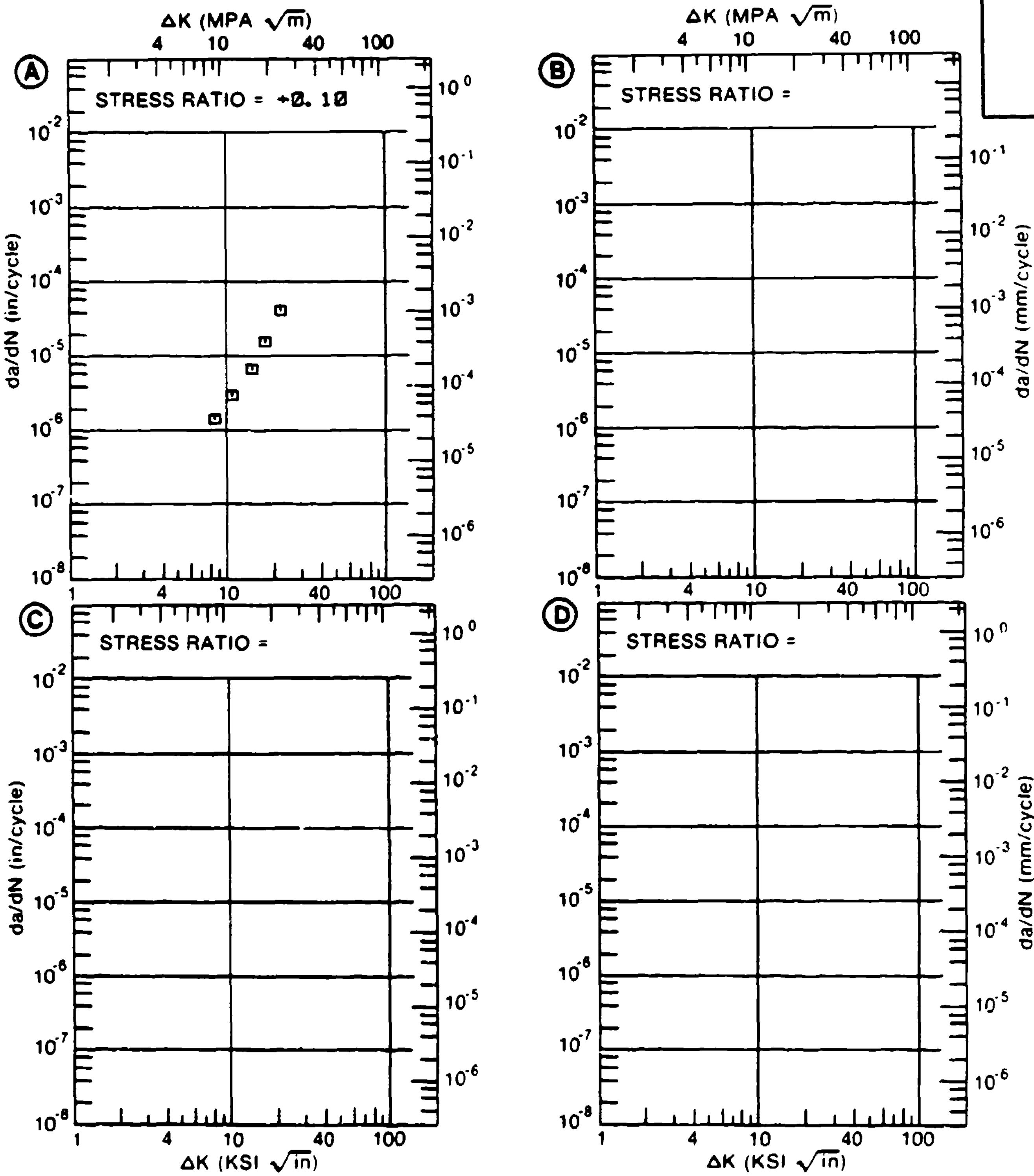

Figure 4.2.3.3

TABLE 4.3.1.1

MEAN PLANE STRAIN FRACTURE TOUGHNESS DATA OF TITANIUM ALLOY BETA III AT ROOM TEMPERATURE

CONDITION/HT — MEAN KIC ± STANDARD (KSI SQRT(IN)) DEVIATION (NUMBER OF SPECIMENS)

PLATE

CONDITION/HT	L-T	T-L	S-L
1325F .25HR.WQ 925F 8HR	49.8 ± 1.2 (3)	-----	-----

TABLE 4.3.1.2

FATIGUE CRACK GROWTH RATE AT DEFINED LEVELS OF THE STRESS-INTENSITY FACTOR

TITANIUM BETA III

TEST CONDITIONS

SPECIMEN ORIENTATION T-L

ENVIRONMENT: AIR AT 175 F

CONDITION/HT	PRODUCT FORM	STRESS RATIO	FREQ. (HZ)	DELTA K LEVELS: (KSI SQRT(IN)) FATIGUE CRACK GROWTH RATES (MICRO IN/CYCLE) 2.5	5	10	20	50	100
STA	PLATE	0.10	0.10-10.00					110	
STA, E B WELDMENT (HEAT AFFECTED ZONE)	WELDMENT	0.10	0.10-10.00					97.2	

TABLE 4.3.2.1

TITANIUM BETA III K(IC)

CONDITION	--PRODUCT-- FORM	THICK (IN)	TEST TEMP (F)	SPECIMEN ORIENT	YIELD STRENGTH (KSI)	------SPECIMEN------ WIDTH (IN) W	THICK (IN) B	DESIGN	CRACK LENGTH (IN) A	2.5*(K(IC)/TYS)**2 (IN)	K(IC) (KSI*SQRT IN)	K(IC) MEAN	STAN DEV	DATE	REFER
STA-1325F WQ,1045F 8HR (ELECTRON BEAM WELD ZONE)	P	1.00	R.T	T-L	150.0	2.000	0.991	CT	0.917	0.17	42.20			1973	88144
STA-1325F WQ,1045F 8HR (HEAT AFFECTED ZONE)	P	1.00	R.T.	T-L	150.0	2.000	0.996	CT	0.930	0.55	76.30			1973	88144
STA-1325F WQ,1045F 8 HR	P	1.00	R.T.	T-L	150.0	2.000	1.005	CT	0.977	0.67	83.70			1973	88144
1325F 25HR,WQ 925F 8HR	P	0.80	R.T	L-T	186.0	1.504	0.750	CT	0.763	0.17	48.40			1974	91793
		0.80			186.0	1.503	0.750	CT	0.795	0.18	50.50			1974	91793
		0.80			186.0	1.502	0.750	CT	0.775	0.18	50.40	49.8/	1.2	1974	91793
1350F 0.5 HR, WQ,950F 8HR,AC	E	3.00	R.T.	C-R	178.0	1.4[illegible]	0.730	CT	0.773	0.24	55.20			1973	87230 (1)
		3.00			178.0	1.4[illegible]	0.750	CT	0.789	0.26	56.80			1973	87230 (1)
		3.00			178.0	1.499	0.751	CT	0.790	0.23	53.20			1973	87230 (1)
												55.1/	1.8		

NOTES
(1) ALPHA PRECIPITATE IN BETA MATRIX
STRAIGHTNESS OF CRACK FRONT MAY NOT MEET ASTM E399-72 REQUIREMENTS

TABLE 4.3.3.1

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 4.3.3.1 INDICATING EFFECT

OF ENVIRONMENT

MATERIAL: TITANIUM BETA III
CONDITION: STA

DELTA K (KSI*IN**1/2)		DA/DN (10**-6 IN./CYCLE) A E=- 65F AIR	B E=+ 175F AIR	C	D
DELTA K MIN A:	26.74	28.9			
B:	20.02		10.1		
C:					
D:					
	25.00		19.1		
	30.00	34.0	31.8		
	35.00	41.6	47.8		
	40.00	52.2	66.7		
	50.00	100.	110.		
	60.00	260.			
DELTA K MAX A:	68.42	291.			
B:	58.85		149.		
C:					
D:					
ROOT MEAN SQUARE PERCENT ERROR		23.87	5.19		

LIFE PREDICTION RATIO SUMMARY (NP/NA)	
	0.0-0.5
	0.5-0.8
	0.8-1.25
	1.25-2.0
	>2.0

CONDITION/HT: STA
FORM: 1.00"TH PLATE
SPECIMEN TYPE: CT
ORIENTATION: T-L
STRESS RATIO: +0.10
FREQUENCY: 0.10- 10.00 HZ

YIELD STRENGTH:
ULT. STRENGTH:
SPECIMEN THK: 1.000"
SPECIMEN WIDTH: 2.550"
REFERENCES:88144

TITAN. ALLOY

BETA III

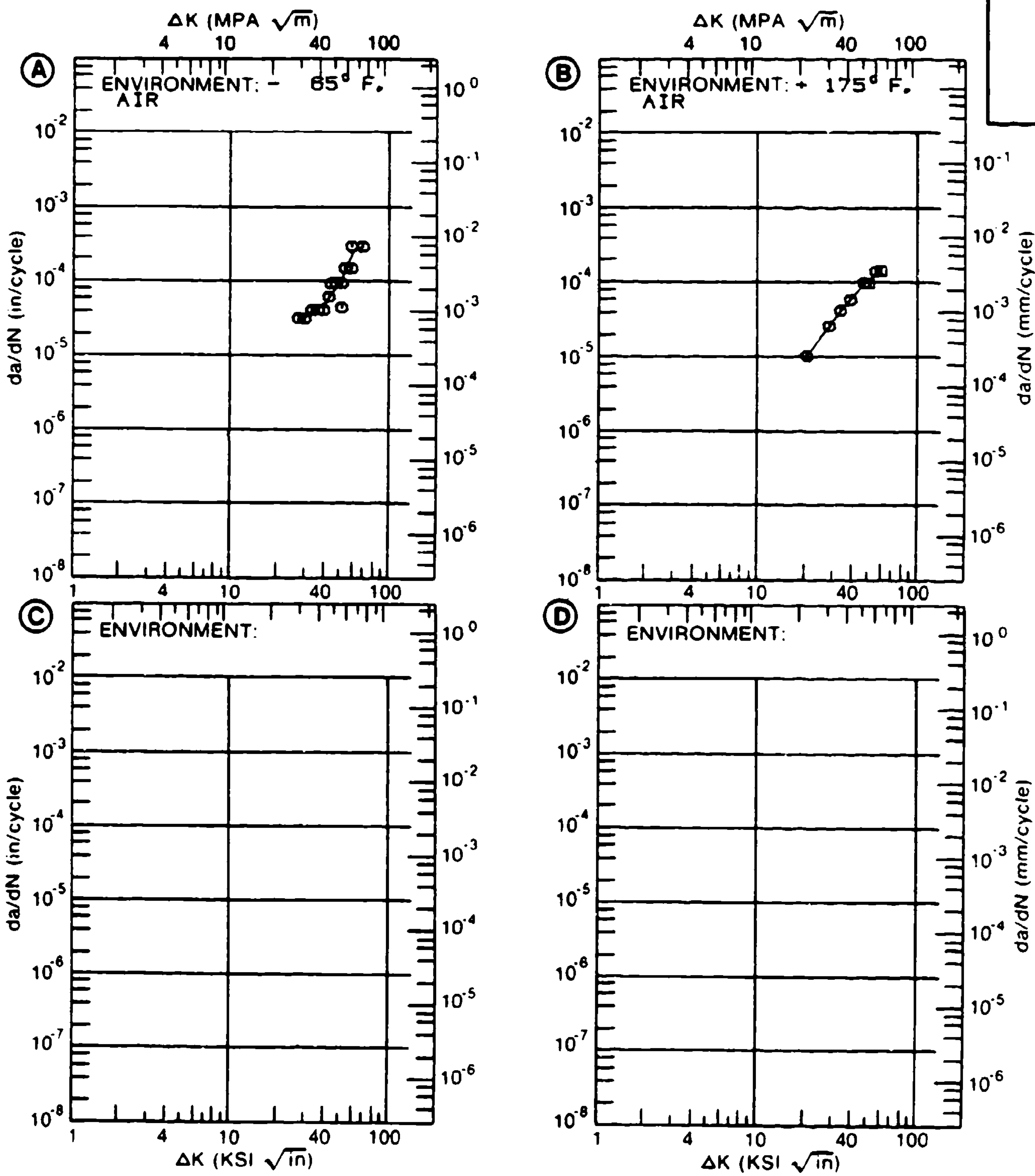

Figure 4.3.3.1

TABLE 4.3.3.2

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 4.3.3.2 INDICATING EFFECT

OF ENVIRONMENT

MATERIAL: TITANIUM BETA III
CONDITION: STA, E.B. WELDMENT (WELD ZONE)

DELTA K (KSI*IN**1/2)	DA/DN (10**-6 IN./CYCLE) A	B	C	D
	E= R.T. LAB AIR			
DELTA K MIN A:				
DELTA K MIN B:				
DELTA K MIN C:				
DELTA K MIN D:				
200.00				
DELTA K MAX A:				
DELTA K MAX B:				
DELTA K MAX C:				
DELTA K MAX D:				

ROOT MEAN SQUARE PERCENT ERROR 0.00

LIFE PREDICTION RATIO SUMMARY (NP/NA)	
	0.0-0.5
	0.5-0.8
	0.8-1.25
	1.25-2.0
	>2.0

CONDITION/HT: STA. E. B. WELDMENT (WELD ZONE)
FORM: 1.00"TH WELDMENT
SPECIMEN TYPE: CT
ORIENTATION: T-L
STRESS RATIO: +0.10
FREQUENCY: 10.00 HZ

YIELD STRENGTH:
ULT. STRENGTH:
SPECIMEN THK: 1.000"
SPECIMEN WIDTH: 2.550"
REFERENCES: 88144

TITAN. ALLOY

BETA III

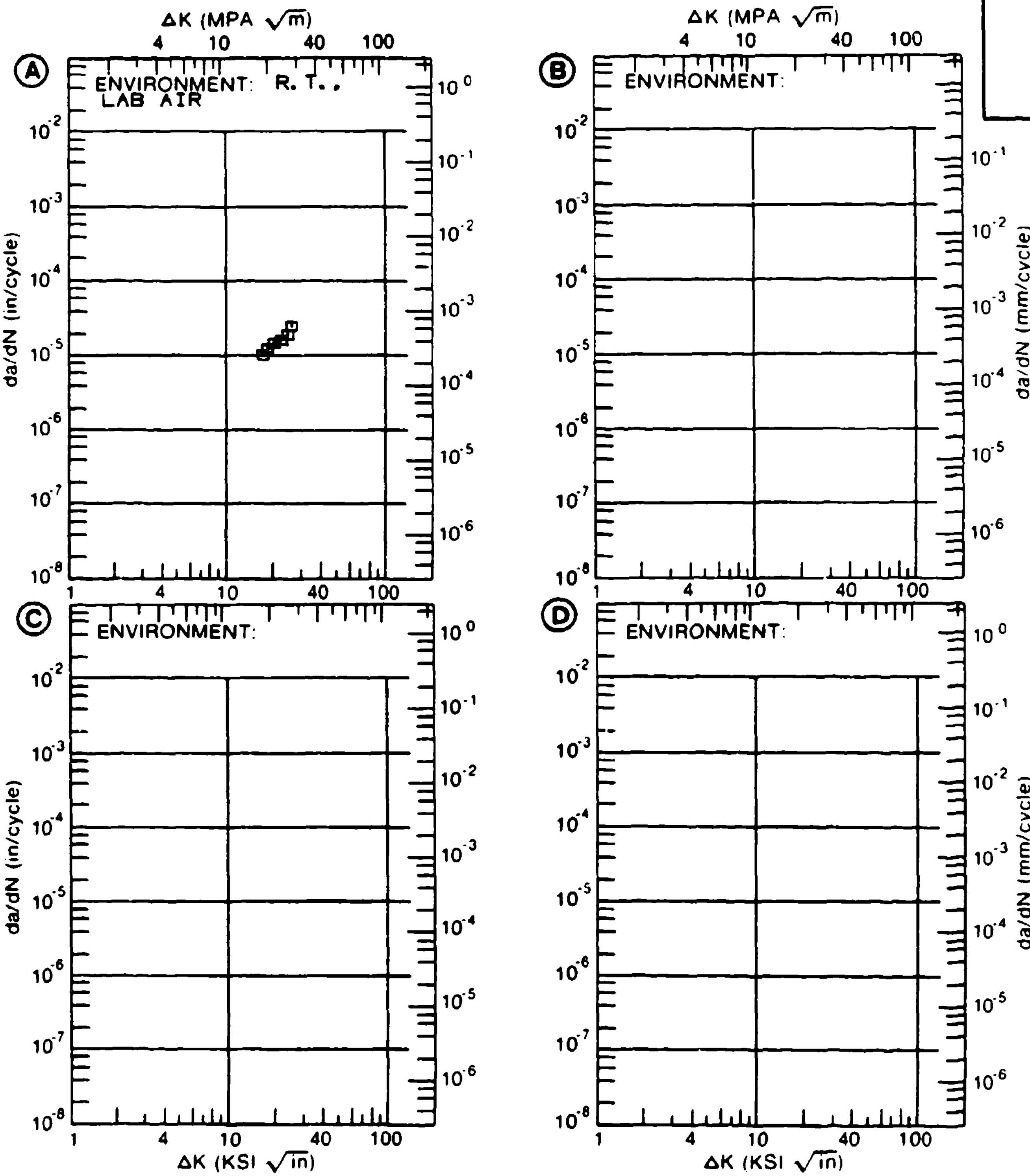

Figure 4.3.3.2

TABLE 4.3.3.3

FATIQUE CRACK GROWTH RATES AT DEFINED LEVELS OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 4.3.3.3 INDICATING EFFECT

OF ENVIRONMENT

MATERIAL: TITANIUM BETA III
CONDITION: STA, E.B. WELDMENT (HEAT AFFECTED ZONE)

DELTA K (KSI*IN**1/2)		DA/DN (10**-6 IN./CYCLE) A	B	C	D
		E=+ 175F AIR			
DELTA K MIN A:	24.74	12.8			
DELTA K MIN B:					
DELTA K MIN C:					
DELTA K MIN D:					
	25.00	13.2			
	30.00	23.2			
	35.00	35.2			
	40.00	50.1			
	50.00	97.2			
DELTA K MAX A:	58.23	171.			
DELTA K MAX B:					
DELTA K MAX C:					
DELTA K MAX D:					
ROOT MEAN SQUARE PERCENT ERROR		9.56			

LIFE PREDICTION RATIO SUMMARY (NP/NA)	
	0.0-0.5
	0.5-0.8
	0.8-1.25
	1.25-2.0
	>2.0

CONDITION/HT: STA. E.B. WELDMENT (HEAT AFFECTED ZONE)		TITAN. ALLOY
FORM: 1.00"TH WELDMENT	YIELD STRENGTH:	BETA III
SPECIMEN TYPE: CT	ULT. STRENGTH:	
ORIENTATION: T-L	SPECIMEN THK: 1.000"	
STRESS RATIO: +0.10	SPECIMEN WIDTH: 2.550"	
FREQUENCY: 0.10- 10.00 HZ	REFERENCES:88144	

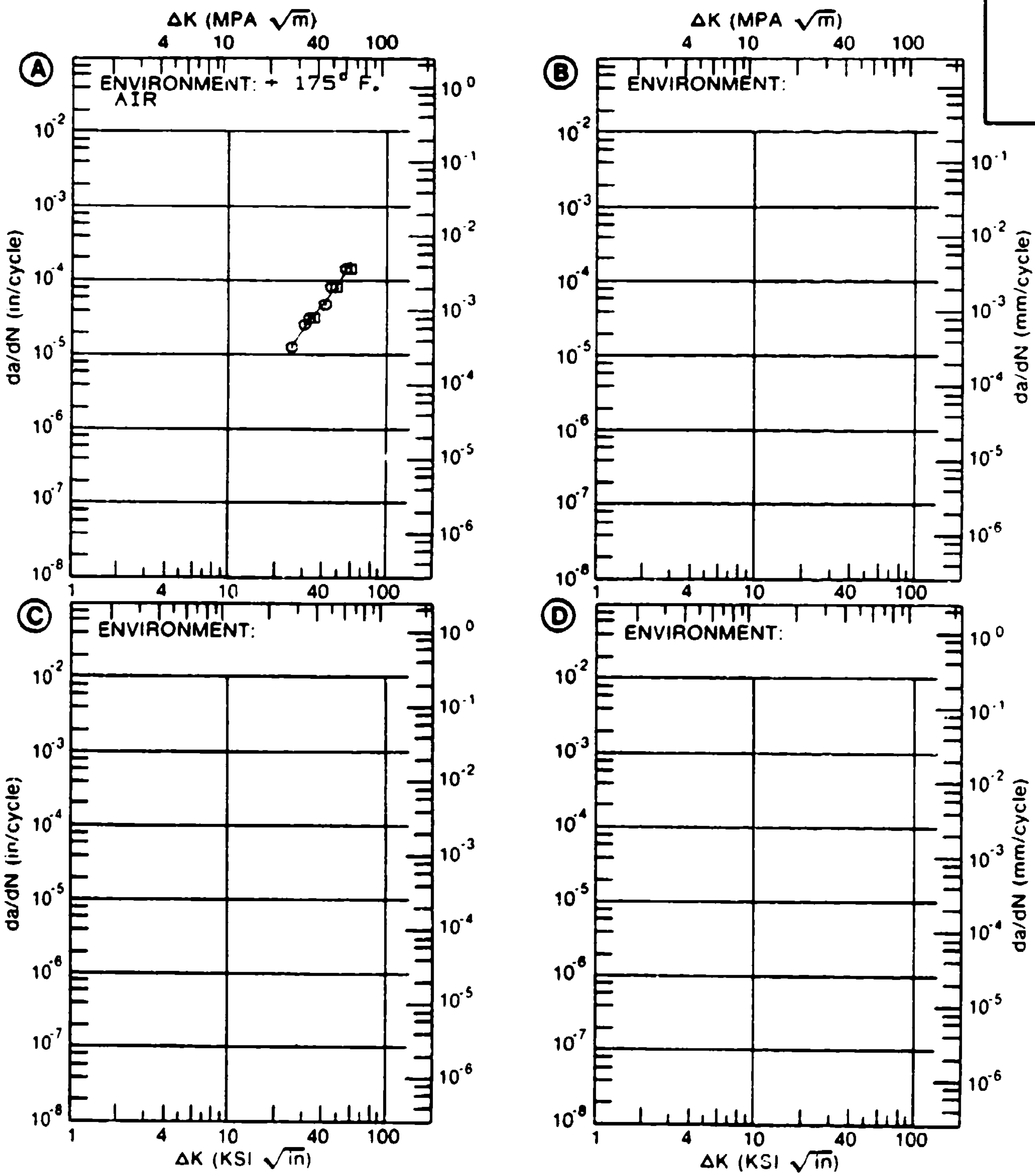

Figure 4.3.3.3

TABLE 4.3.3.4

SUSTAINED CRACK GROWTH RATES AT DEFINED LEVELS OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 4.3.3.4 INDICATING EFFECT OF CONDITION

MATERIAL: TITANIUM BETA III
ENVIRONMENT: R. T. , 0. 6M KCL

K MAX (KSI*IN**1/2)			DA/DT (10**-3 IN/HOUR) A	B	C	D
			C= AGED 900F 100HRS	C= AGED 1000F 100HRS	C= AGED 1250F 50HRS	
K MAX MIN	A:	15. 50	40051.			
	B:	23. 00		11709.		
	C:					
	D:					
		16. 00	40305.			
		20. 00	41048.			
		25. 00	40606.	13521.		
		30. 00	40032.	15835.		
		35. 00	39804.	16116.		
		40. 00	40045.	15677.		
		50. 00	41973.	15093.		
		60. 00		16211.		
		70. 00		19830.		
K MAX MAX	A:	59. 50	45536.			
	B:	80. 00		27367.		
	C:					
	D:					
ROOT MEAN SQUARE PERCENT ERROR			8. 50	6. 09	0. 00	

CONDITION/HT:
ENVIRONMENT: R. T., 0. 6M KCL
SPECIMEN TYPE: SENT
ORIENTATION
YIELD STRENGTH:
ULT. STRENGTH:

SPECIMEN THK:
SPECIMEN WIDTH:
CRACK LENGTH (A_o):
K_{ISCC}:
REFERENCES:82851

TITAN. ALLOY

BETA III

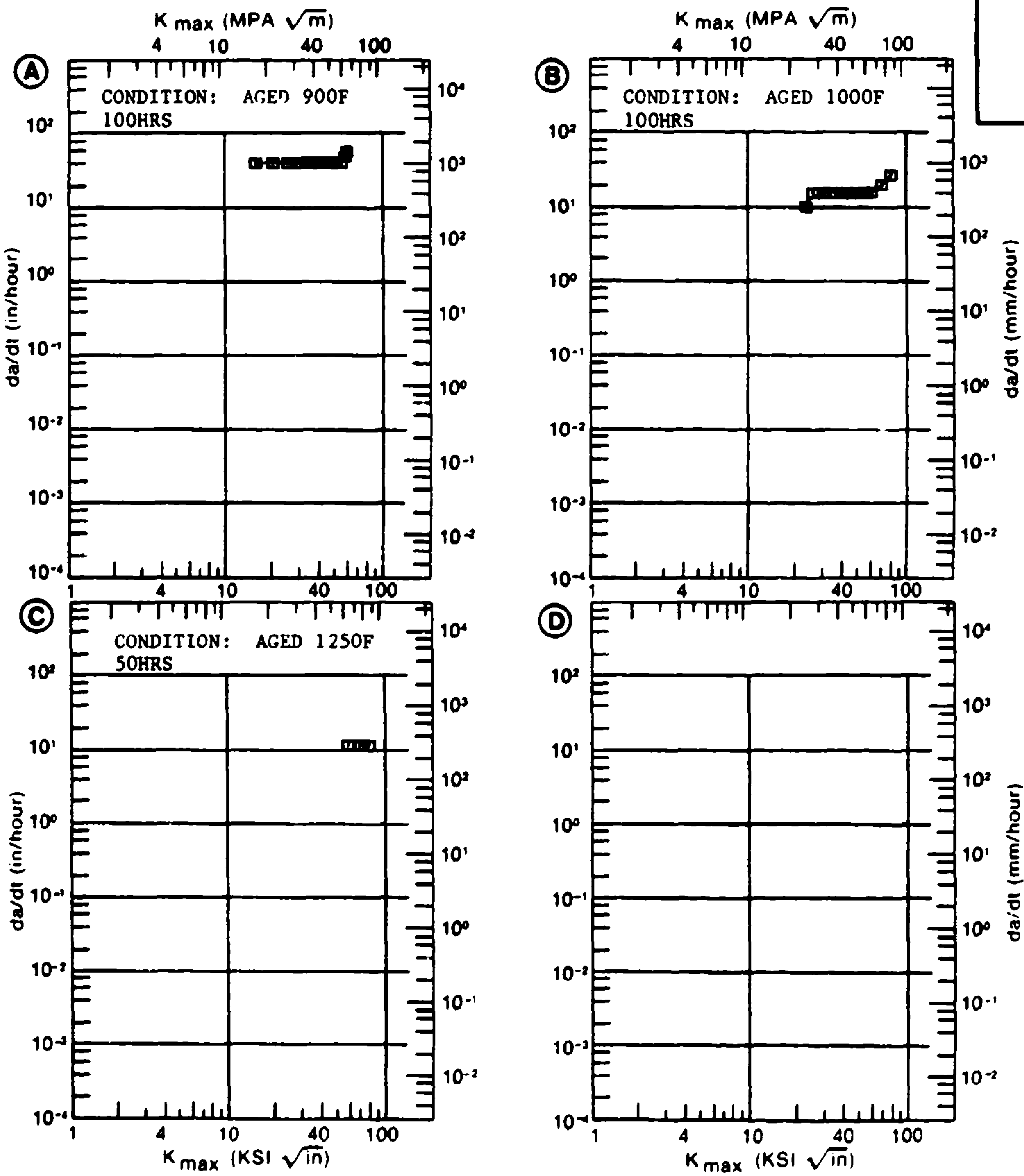

Figure 4.3.3.4

TABLE 4.3.3.5

SUSTAINED CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 4.3.3.5 INDICATING EFFECT

OF CONDITION

MATERIAL: TITANIUM BETA III
ENVIRONMENT: 0.6M KCL

K MAX (KSI*IN**1/2)			DA/DT (10**-3 IN/HOUR) A	B	C	D
			C= STA 900F 100HRS	C= STA 900F 8HRS	C= STA 900F 40HRS	
K MAX MIN	A:	15.00	35940.			
	B:					
	C:	25.50			2144.	
	D:					
		16.00	36148.			
		20.00	36335.			
		25.00	36035.			
		30.00	35746.		3216.	
		35.00	35668.		4046.	
		40.00	35843.		4457.	
		50.00	36930.		4444.	
K MAX MAX	A:	56.00	38016.			
	B:					
	C:	55.00			4234.	
	D:					
ROOT MEAN SQUARE PERCENT ERROR			7.67	0.00	6.13	

CONDITION/HT:
ENVIRONMENT: 0.6M KCL
SPECIMEN TYPE: SENT
ORIENTATION:
YIELD STRENGTH:
ULT. STRENGTH:

SPECIMEN THK:
SPECIMEN WIDTH:
CRACK LENGTH (A_o):
K_{ISCC}:
REFERENCES: 82651

TITAN. ALLOY

BETA III

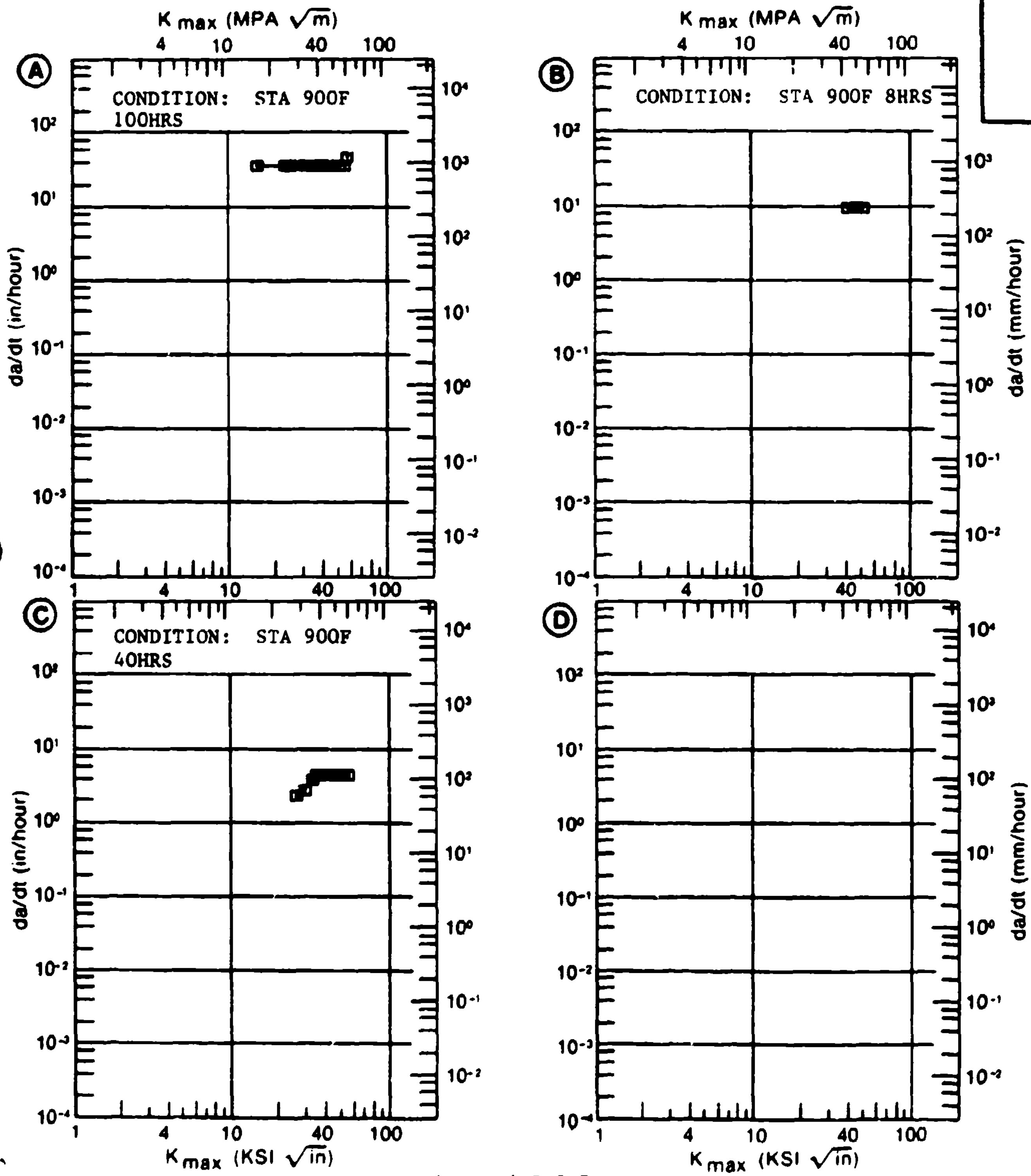

Figure 4.3.3.5

TABLE 4.3.3.6

TITANIUM BETA III K(ISCC)

CONDITION	PRODUCT FORM	PRODUCT THICK (IN)	TEST TEMP (F)	SPEC OR	YIELD STR (KSI)	ENVIRONMENT	SPECIMEN WIDTH (IN) W	SPECIMEN THICK (IN) B	SPECIMEN DESIGN (*=SC)	CRACK LENGTH (IN) A	K(Q) (KSI*SQRT IN)	K(ISCC) (KSI*SQRT IN)	MEAN	STAN DEV	TEST TIME (MIN)	DATE	REFER
BETA STAB +AGED 900F 1HR	S	----	R.T.	---	----	.6M KCL, -1500MV	----	----	SENT	----	65.00	55.00*			----	1970	82651
BETA STAB +AGED 900F 1HR	S	----	R.T.	---	----	.6M KCL, -1000MV	----	----	SENT	----	65.00	28.00			----	1970	82651
BETA STAB +AGED 900F 1HR	S	----	R.T.	---	----	.6M KCL, +1000MV	----	----	SENT	----	65.00	25.00			----	1970	82651
BETA STAB +AGED 900F 1HR	S	----	R.T.	---	----	.6M KCL, 0MV	----	----	SENT	----	65.00	21.00			----	1970	82651
BETA STAB +AGED 900F 1HR	S	----	R.T.	---	----	.6M KCL, +500MV	----	----	SENT	----	65.00	24.00			----	1970	82651
BETA STAB +AGED 900F 1HR	S	----	R.T.	---	----	.6M KCL, -500MV	----	----	SENT	----	65.00	14.00			----	1970	82651
BETA STAB +AGED 900F 1HR	S	----	R.T.	---	----	.6M KCL, -750MV	----	----	SENT	----	65.00	16.00			----	1970	82651

*NOTE-DATA WHICH DO NOT MEET MINIMUM SPECIMEN THICKNESS REQUIREMENTS OF 2.5(KISCC/TYS)SQUARED

TABLE 4.4.2.1

TITANIUM CORONA 5 K(IC)

CONDITION	--PRODUCT-- FORM	THICK (IN)	TEST TEMP (F)	SPECIMEN ORIENT	YIELD STRENGTH (KSI)	------SPECIMEN------ WIDTH (IN) W	THICK (IN) B	DESIGN	CRACK LENGTH (IN) A	2.5*(K(IC)/TYS)**2 (IN)	K(IC) (KSI*SQRT IN)	K(IC) MEAN	STAN DEV	DATE	REFER
ALPHA-BETA FORGED & LOW ANNEAL & AGE	F	2.00	R.T	---	136.3	----	2.000	--	----	0.57	64.84			----	R1005

TABLE 4.5.1.1

MEAN PLANE STRAIN FRACTURE TOUGHNESS DATA OF TITANIUM ALLOY TI-* AT ROOM TEMPERATURE

CONDITION/HT — MEAN KIC ± STANDARD (KSI SQRT(IN)) DEVIATION — (NUMBER OF SPECIMENS)

PLATE

CONDITION/HT	L-T	T-L	S-L
STA-1740F 1 HR.AC.1000F 8HR.AC	55.3 ± 1.5 (3)	-----	-----
1740F 1 HR.AC	61.6 ± 1.6 (3)	-----	-----

TABLE 4.5.2.1

TITANIUM TI-* K(IC)

CONDITION	--PRODUCT-- FORM	THICK (IN)	TEST TEMP (F)	SPECIMEN ORIENT	YIELD STRENGTH (KSI)	------SPECIMEN------ WIDTH (IN) W	THICK (IN) B	DESIGN	CRACK LENGTH (IN) A	2.5*(K(IC)/TYS)**2 (IN)	K(IC) (KSI*SQRT IN)	K(IC) MEAN	STAN DEV	DATE	REFER
STA-1740F	P	0.62	R.T.	L-T	157.0	2.000	0.624	CT	1.000	0.33	57.00			1974	88186 (1)
1 HR.AC.1000F		0.62			157.0	2.000	0.625	CT	1.000	0.30	54.70			1974	88186 (1)
8HR.AC		0.62			157.0	2.000	0.625	CT	1.000	0.30	54.30			1974	88186 (1)
												55.3/	1.5		
1740F 1 HR.AC	P	0.62	R.T.	L-T	148.0	2.000	0.626	CT	1.000	0.44	62.00			1974	88186 (1)
		0.62			148.0	2.000	0.625	CT	1.000	0.45	62.90			1974	88186 (1)
		0.62			148.0	2.000	0.625	CT	1.000	0.41	59.80			1974	88186 (1)
												61.6/	1.6		

NOTES
(1) *-6AL-2SN-2ZR-2MO-2CR-0.25SI

TABLE 4.6.3.1

TITANIUM TI-4AL-3MO-1V K(ISCC)

CONDITION	--PRODUCT-- FORM	THICK (IN)	TEST TEMP (F)	SPEC OR	YIELD STR (KSI)	ENVIRONMENT	------SPECIMEN-------- WIDTH (IN) W	THICK (IN) B	DESIGN (*=SG)	CRACK LENGTH (IN) A	K(Q) (KSI*SQRT IN)	K(ISCC)	MEAN	STAN DEV	TEST TIME (MIN)	DATE	REFER
MILL ANNEALED	P	0.50	R.T.	L-S	----	3.5 PCT NACL	----	----	--	----	117.00	105.00*			----	1969	75386

*NOTE-DATA WHICH DO NOT MEET MINIMUM SPECIMEN THICKNESS REQUIREMENTS OF 2.5(KISCC/TYS)SQUARED

TABLE 4.7.1.1

FATIGUE CRACK GROWTH RATE AT DEFINED LEVELS OF THE STRESS-INTENSITY FACTOR

TITANIUM TI-5AL-2 5SN

TEST CONDITIONS

SPECIMEN ORIENTATION L-T

ENVIRONMENT: DRY ARGON AT R.T.

CONDITION/HT	PRODUCT FORM	STRESS RATIO	FREQ. (HZ)	DELTA K LEVELS: (KSI SQRT(IN))	FATIGUE CRACK GROWTH RATES (MICRO IN/CYCLE) 2.5	5	10	20	30	100
ANNEALED	SHEET	0.10	30.00					5.56	94.7	
ANNEALED	SHEET	0.10	30.00					4.77		
ANNEALED	SHEET	0.67	55.00-58.30			0.03	0.27			

TABLE 4.7.1.2

FATIGUE CRACK GROWTH RATE AT DEFINED LEVELS OF THE STRESS-INTENSITY FACTOR

TITANIUM TI-5AL-2.5SN

TEST CONDITIONS

SPECIMEN ORIENTATION L-T

ENVIRONMENT: LAB AIR AT R.T

CONDITION/HT	PRODUCT FORM	STRESS RATIO	FREQ. (HZ)	DELTA K LEVELS: (KSI SQRT(IN)) 2.5	5	10	20	50	100
				FATIGUE CRACK GROWTH RATES (MICRO IN/CYCLE)					
ANNEALED	SHEET	0.10	30.00				11.6	124	
ANNEALED	SHEET	0.10	50.00				11.7		
ANNEALED	SHEET	0.67	55.00-58.30		0.15	2.13			

TABLE 4.7.1.3

FATIGUE CRACK GROWTH RATE AT DEFINED LEVELS OF THE STRESS-INTENSITY FACTOR

TITANIUM TI-5AL-2.5SN

TEST CONDITIONS

SPECIMEN ORIENTATION: L-T

ENVIRONMENT: DIST. H2O AT R.T.

CONDITION/HT	PRODUCT FORM	STRESS RATIO	FREQ. (HZ)	DELTA K LEVELS (KSI SQRT(IN)): 2.5	5	10	20	50	100
				FATIGUE CRACK GROWTH RATES (MICRO IN/CYCLE)					
ANNEALED	SHEET	0.10	30.00					124	
ANNEALED	SHEET	0.10	50.00				11.8		
ANNEALED	SHEET	0.67	55.00-58.30		0.25	3.49			

TABLE 4.7.1.4

FATIGUE CRACK GROWTH RATE AT DEFINED LEVELS OF THE STRESS-INTENSITY FACTOR

TITANIUM TI-5AL-2.5SN

TEST CONDITIONS

SPECIMEN ORIENTATION L-T

ENVIRONMENT 3.5% NACL AT R.T.

CONDITION/HT	PRODUCT FORM	STRESS RATIO	FREQ. (HZ)	DELTA K LEVELS: (KSI SQRT(IN)) 2.5	5	10	20	50	100
				FATIGUE CRACK GROWTH RATES (MICRO IN/CYCLE)					
ANNEALED	SHEET	0.10	30.00				30.2	157	
ANNEALED	SHEET	0.10	50.00				23.5		
ANNEALED	SHEET	0.67	55.00-58.30		0.29	7.97			

TABLE 4.7.1.5

FATIGUE CRACK GROWTH RATE AT DEFINED LEVELS OF THE STRESS-INTENSITY FACTOR

TITANIUM TI-5AL-2.5SN

TEST CONDITIONS

SPECIMEN ORIENTATION: T-L

ENVIRONMENT: DRY ARGON AT R.T.

CONDITION/HT	PRODUCT FORM	STRESS RATIO	FREQ. (HZ)	DELTA K LEVELS: (KSI SQRT(IN)) 2.5	5	10	20	50	100
				FATIGUE CRACK GROWTH RATES (MICRO IN/CYCLE)					
ANNEALED	SHEET	0.10	30.00				5.38	114	
ANNEALED	SHEET	0.10	50.00-53.30				5.35		
ANNEALED	SHEET	0.67	54.20-58.30			0.49			

TABLE 4.7.1.6

FATIGUE CRACK GROWTH RATE AT DEFINED LEVELS OF THE STRESS-INTENSITY FACTOR

TITANIUM TI-5AL-2.5SN

TEST CONDITIONS

SPECIMEN ORIENTATION T-L

ENVIRONMENT: LAB AIR AT R.T.

CONDITION/HT	PRODUCT FORM	STRESS RATIO	FREQ. (HZ)	DELTA K LEVELS: (KSI SQRT(IN))	FATIGUE CRACK GROWTH RATES (MICRO IN/CYCLE)					
					2.5	5	10	20	50	100
ANNEALED	SHEET	0.10	30.00					11.9	141	
ANNEALED	SHEET	0.10	50.00-53.30					11.8		
ANNEALED	SHEET	0.67	54.20-58.30			0.15	3.08			

TABLE 4.7.1.7

FATIGUE CRACK GROWTH RATE AT DEFINED LEVELS OF THE STRESS-INTENSITY FACTOR

TITANIUM TI-5AL-2.5SN

TEST CONDITIONS

SPECIMEN ORIENTATION: T-L

ENVIRONMENT: DIST. H2O AT R.T.

CONDITION/HT	PRODUCT FORM	STRESS RATIO	FREQ. (HZ)	DELTA K LEVELS: (KSI SQRT(IN)) → FATIGUE CRACK GROWTH RATES (MICRO IN/CYCLE) 2.5	5	10	20	50	100
ANNEALED	SHEET	0.10	30.00				12.5	130	
ANNEALED	SHEET	0.10	50.00-53.30				12.0		
ANNEALED	SHEET	0.67	54.20-58.30		0.36	3.72			

TABLE 4.7.1.8

FATIGUE CRACK GROWTH RATE AT DEFINED LEVELS OF THE STRESS-INTENSITY FACTOR

TITANIUM TI-5AL-2.5SN

TEST CONDITIONS

SPECIMEN ORIENTATION T-L

ENVIRONMENT: 3.5% NACL AT R.T.

CONDITION/HT	PRODUCT FORM	STRESS RATIO	FREQ. (HZ)	DELTA K LEVELS: (KSI SQRT(IN)) FATIGUE CRACK GROWTH RATES (MICRO IN/CYCLE) 2.5	5	10	20	50	100
ANNEALED	SHEET	0.10	30.00					176	
ANNEALED	SHEET	0.10	50.00-53.30				24.5		
ANNEALED	SHEET	0.67	54.20-58.30		0.98	14.6			

TABLE 4.7.2.1

TITANIUM TI-5AL-2.5SN K(C)

CONDITION	--PRODUCT-- FORM	THICK (IN)	TEST TEMP (F)	SPEC OR	YIELD STR (KSI)	---SPECIMEN--- WIDTH (IN) W	THICK (IN) B	CRACK LENGTH INIT (IN) 2A(O)	FINAL (IN) 2A(F)	GROSS STRESS ONSET (KSI) S(O)	MAX (KSI) S(MAX)	K(APP) (KSI*SQRT IN)	K(APP) MEAN / STAN DEV	K(C) (KSI*SQRT IN)	K(C) MEAN / STAN DEV	DATE	REFER
BUCKLING OF CRACK EDGES RESTRAINED																	
ANNEALED	S	0.02	-423	L-T	203.5	3.000	0.018	0.500	-----	---	110.10	99.28		-----		1967	68968
		0.02			203.5	3.000	0.019	1.040	1.300	---	69.00	95.36		111.85		1967	68968
		0.02			203.5	3.000	0.019	0.150	0.270	---	165.40	80.41*		108.26*		1967	68968
		0.02			203.5	3.000	0.019	1.000	-----	---	69.30	93.33		-----		1967	68968
		0.02			203.5	3.000	0.019	1.020	1.240	---	72.20	98.51		112.90		1967	68968
		0.02			203.5	3.000	0.019	0.320	0.500	---	129.90	92.75		117.13		1967	68968
		0.02			203.5	3.000	0.019	0.340	0.670	---	127.90	94.22		135.40*		1967	68968
		0.02			203.5	3.000	0.019	0.120	0.300	---	181.00	78.66*		125.02*		1967	68968
		0.02			203.5	3.000	0.019	0.340	0.810	---	103.60	97.37		122.41		1967	68968
		0.02			203.5	3.000	0.019	0.510	0.730	---	107.60	98.06	96.1/ 2.5	119.62	116.8/ 4.5	1967	68968
ANNEALED	S	0.02	-423	L-T	203.5	3.000	0.020	0.270	0.470	---	138.90	90.91		121.19*		1967	68968
		0.02			203.5	3.000	0.020	1.030	1.280	---	68.60	94.20		109.88		1967	68968
		0.02			203.5	3.000	0.020	0.150	0.330	---	172.70	83.96*	92.6/ 2.3	125.28*	-----/ ---	1967	68968
ANNEALED	S	0.02	-423	L-T	203.5	6.000	0.018	2.010	2.230	---	49.00	93.63		100.40		1967	68968
		0.02			203.5	6.000	0.017	2.000	2.390	---	50.10	95.42		107.82		1967	68968
		0.02			203.5	6.000	0.018	0.490	0.800	---	105.90	93.29		120.03		1967	68968
		0.02			203.5	6.000	0.018	0.490	0.640	---	110.50	97.34		111.98		1967	68968
		0.02			203.5	6.000	0.018	0.130	0.250	---	181.60	82.09*		113.92*		1967	68968
		0.02			203.5	6.000	0.019	0.250	0.530	---	153.30	96.17		140.55*		1967	68968
		0.02			203.5	6.000	0.019	0.240	0.640	---	156.40	96.12		157.72*		1967	68968
		0.02			203.5	6.000	0.018	1.000	1.330	---	73.70	93.98		109.87		1967	68968
		0.02			203.5	6.000	0.018	2.000	2.420	---	48.80	92.95		105.98		1967	68968
		0.02			203.5	6.000	0.019	0.500	0.720	---	109.10	97.10		117.07		1967	68968
		0.02			203.5	6.000	0.019	1.020	1.210	---	71.40	92.02		100.98		1967	68968
		0.02			203.5	6.000	0.019	0.250	0.610	---	157.20	98.62*		154.87*		1967	68968
		0.02			203.5	6.000	0.019	1.000	1.340	---	74.10	94.49		110.94		1967	68968
		0.02			203.5	6.000	0.018	0.130	0.220	---	191.90	86.74*	94.8/ 1.8	112.90*	109.4/ 6.6	1967	68968
ANNEALED	S	0.02	-423	L-T	203.5	12.000	0.018	0.490	0.620	---	104.30	91.60		103.10		1967	68968
		0.02			203.5	12.000	0.019	4.000	4.450	---	35.40	95.35		102.42		1967	68968
		0.02			203.5	12.000	0.019	0.490	0.660	---	108.60	95.30		110.78		1967	68968
		0.02			203.5	12.000	0.019	0.130	0.380	---	178.40	80.62*		137.92*		1967	68968
		0.02			203.5	12.000	0.018	0.980	1.190	---	76.00	94.68		104.54		1967	68968

*NOTE- NET SECTION STRESS EXCEEDS 80% OF YIELD STRENGTH. VALUE NOT INCLUDED IN MEAN OR STD. DEV

TABLE 4.7.2.1 (con't)

TITANIUM TI-5AL-2.5SN K(C)

CONDITION	PRODUCT FORM	PRODUCT THICK (IN)	TEST TEMP (F)	SPEC OR	YIELD STR (KSI)	SPECIMEN WIDTH (IN) W	SPECIMEN THICK (IN) B	CRACK LENGTH INIT (IN) 2A(O)	CRACK LENGTH FINAL (IN) 2A(F)	GROSS STRESS ONSET (KSI) S(O)	GROSS STRESS MAX (KSI) S(MAX)	K(APP) (KSI*SQRT IN)	K(APP) MEAN / STAN DEV	K(C) (KSI*SQRT IN)	K(C) MEAN / STAN DEV	DATE	REFER
BUCKLING OF CRACK EDGES RESTRAINED																	
ANNEALED	S	0.02	-423	L-T	203.5	12.000	0.019	2.000	2.460	---	51.20	92.34		103.34		1967	68968
		0.02			203.5	12.000	0.018	0.240	0.650	---	154.40	94.82		136.30*		1967	68968
		0.02			203.5	12.000	0.018	0.500	0.690	---	103.60	91.91		108.08		1967	68968
		0.02			203.5	12.000	0.019	1.000	1.170	---	71.30	89.75		97.23		1967	68968
		0.02			203.5	12.000	0.019	2.000	2.410	---	52.10	93.96	93.3/ 2.0	103.97	104.2/ 4.0	1967	68968
ANNEALED	S	0.02	-423	L-T	203.5	12.000	0.020	4.000	4.040	---	39.20	105.59		106.28		1967	68968
		0.02			203.5	12.000	0.020	0.120	0.260	---	183.90	79.85*		117.56*		1967	68968
		0.02			203.5	12.000	0.020	0.120	0.310	---	181.10	78.63*		126.43*		1967	68968
		0.02			203.5	12.000	0.021	2.000	2.330	---	51.60	93.06		101.08		1967	68968
		0.02			203.5	12.000	0.020	4.020	4.350	---	35.20	95.12		100.26		1967	68968
		0.02			203.5	12.000	0.021	0.240	0.400	---	151.30	92.92		120.01		1967	68968
		0.02			203.5	12.000	0.020	0.240	0.470	---	153.20	94.09		131.76		1967	68968
		0.02			203.5	12.000	0.021	0.990	1.370	---	70.90	88.79	94.9/ 5.7	104.85	110.7/12.5	1967	68968
ANNEALED	S	0.02	-423	L-T	193.3	15.930	0.016	4.980	5.480	---	32.80	97.69		103.92		1967	68968
		0.02			193.3	15.930	0.019	4.980	5.280	---	29.20	86.97	92.3/ 7.6	90.29	97.1/ 9.6	1967	68968
ANNEALED	S	0.06	-423	L-T	228.0	1.000	0.063	0.410	----	---	63.90	57.34		----		1971	80104
		0.06			228.0	1.000	0.064	0.480	----	---	54.60	55.53		----		1971	80104
		0.06			228.0	1.000	0.062	0.080	----	---	131.10	46.66		----		1971	80104
		0.06			228.0	1.000	0.064	0.170	----	---	115.50	60.77	55.1/ 6.0	----	----/ ---	1971	80104
ANNEALED	S	0.06	-423	L-T	228.0	2.000	0.063	0.180	----	---	115.10	61.51		----		1971	80104
		0.06			228.0	2.000	0.063	0.140	----	---	123.00	57.86		----		1971	80104
		0.06			220.0	2.000	0.063	0.790	----	---	46.80	57.80		----		1971	80104
		0.06			228.0	2.000	0.064	0.420	----	---	78.30	65.39		----		1971	80104
		0.06			228.0	2.000	0.062	0.080	----	---	147.10	52.20	59.0/ 4.9	----	----/ ---	1971	80104
ANNEALED	S	0.06	-423	L-T	228.0	3.000	0.064	0.990	----	---	48.50	64.89		----		1971	80104
ANNEALED	S	0.10	-423	L-T	211.0	1.000	0.113	0.240	----	---	116.90	74.44		----		1971	80104
		0.10			211.0	1.000	0.113	0.360	----	---	90.30	73.90		----		1971	80104
		0.10			211.0	1.000	0.111	0.120	----	---	161.30	70.66*	74.2/ 0.4	----	----/ ---	1971	80104

*NOTE- NET SECTION STRESS EXCEEDS 80% OF YIELD STRENGTH. VALUE NOT INCLUDED IN MEAN OR STD. DEV

TABLE 4.7.2.1 (con't)

TITANIUM TI-5AL-2.5SN K(C)

CONDITION	--PRODUCT-- FORM	THICK (IN)	TEST TEMP (F)	SPEC OR	YIELD STR (KSI)	---SPECIMEN--- WIDTH (IN) W	THICK (IN) B	CRACK LENGTH INIT (IN) 2A(O)	FINAL (IN) 2A(F)	GROSS STRESS ONSET (KSI) S(O)	MAX (KSI) S(MAX)	K(APP) (KSI*SQRT IN)	K(APP) MEAN/STAN DEV	K(C) (KSI*SQRT IN)	K(C) MEAN/STAN DEV	DATE	REFER
BUCKLING OF CRACK EDGES RESTRAINED																	
ANNEALED	S	0.10	-423	L-T	211.0	2.000	0.112	0.130	----	---	158.30	71.72*		----		1971	80104
		0.10			211.0	2.000	0.114	0.270	----	---	119.00	78.38		----		1971	80104
		0.10			211.0	2.000	0.113	0.380	----	---	97.30	76.89	77.6/ 1.1	----	----/ ---	1971	80104
ANNEALED	S	0.10	-423	L-T	211.0	3.000	0.116	1.050	----	---	55.20	76.77		----		1971	80104
		0.10			211.0	3.000	0.116	0.990	----	---	58.30	78.01	77.4/ 0.9	----	----/ ---	1971	80104
ANNEALED	S	0.06	-420	L-T	229.0	3.000	0.064	1.000	----	---	44.90	60.47		----		1971	80104
ANNEALED	S	0.02	-320	L-T	171.2	15.940	0.018	5.000	5.400	---	44.60	133.16		139.93		1967	68968
ANNEALED	S	0.02	-320	L-T	171.2	16.230	0.020	4.980	5.610	---	44.80	133.11		143.73		1967	68968
ANNEALED	S	0.02	R.T.	L-T	109.3	15.950	0.018	5.060	6.780	---	54.50	163.94		200.71*		1967	68968
ANNEALED	S	0.02	R.T.	L-T	109.3	16.390	0.018	5.070	6.660	---	58.70	176.16		211.86*		1967	68968
ANNEALED	S	0.20	R.T.	L-T	110.7	13.880	0.202	4.550	----	---	68.70	196.87*		----		1966	66218
ANNEALED	S	0.02	-423	T-L	211.8	12.000	0.015	1.130	1.390	---	64.70	86.67		96.40		1966	66103
		0.02			211.8	12.000	0.015	0.330	0.710	---	112.40	80.96	83.8/ 4.0	118.96	107.7/16.0	1966	66103
ANNEALED	S	0.03	-423	T-L	207.3	12.000	0.036	0.280	1.070	---	129.00	85.58		168.07		1966	66103
		0.03			207.3	12.000	0.036	1.200	1.840	---	73.70	101.81	93.7/11.5	127.14	147.6/28.9	1966	66103

*NOTE- NET SECTION STRESS EXCEEDS 80% OF YIELD STRENGTH. VALUE NOT INCLUDED IN MEAN OR STD. DEV.

TABLE 4.7.3.1

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 4.7.3.1 INDICATING EFFECT OF ENVIRONMENT

MATERIAL: TITANIUM TI-5AL-2.5SN
CONDITION: ANNEALED

DELTA K (KSI*IN**1/2)			DA/DN (10**-6 IN./CYCLE) A E= R.T. DRY ARGON	B E= R.T. LAB AIR	C E= R.T. DIST. H2O	D E= R.T. 3.5% NACL
	A:	16.59	2.12			
DELTA K MIN	B:	17.50		8.19		
	C:	16.62			7.49	
	D:	17.57				16.3
		20.00	4.77	11.7	11.8	23.5
		25.00	10.0	20.7	20.4	37.5
		30.00	17.3	32.5	31.1	50.5
		35.00	28.6	47.3	42.4	64.2
		40.00			52.7	
	A:	38.01	38.7			
DELTA K MAX	B:	37.81		57.0		
	C:	42.00			56.3	
	D:	38.00				73.6
ROOT MEAN SQUARE PERCENT ERROR			4.48	2.10	7.50	4.46
LIFE PREDICTION RATIO SUMMARY (NP/NA)		0.0-0.5				
		0.5-0.8				
		0.8-1.25	2	2	2	2
		1.25-2.0				
		>2.0				

CONDITION/HT: ANNEALED
FORM: 0.08"TH SHEET
SPECIMEN TYPE: CCP
ORIENTATION: L-T
STRESS RATIO: +0.10
FREQUENCY: 50.00 HZ

YIELD STRENGTH: 122.3 KSI
ULT. STRENGTH: 139.9 KSI
SPECIMEN THK: 0.083- 0.084"
SPECIMEN WIDTH: 2.754- 2.758"
REFERENCES: 88911

TITAN. ALLOY

TI-5AL-2.5SN

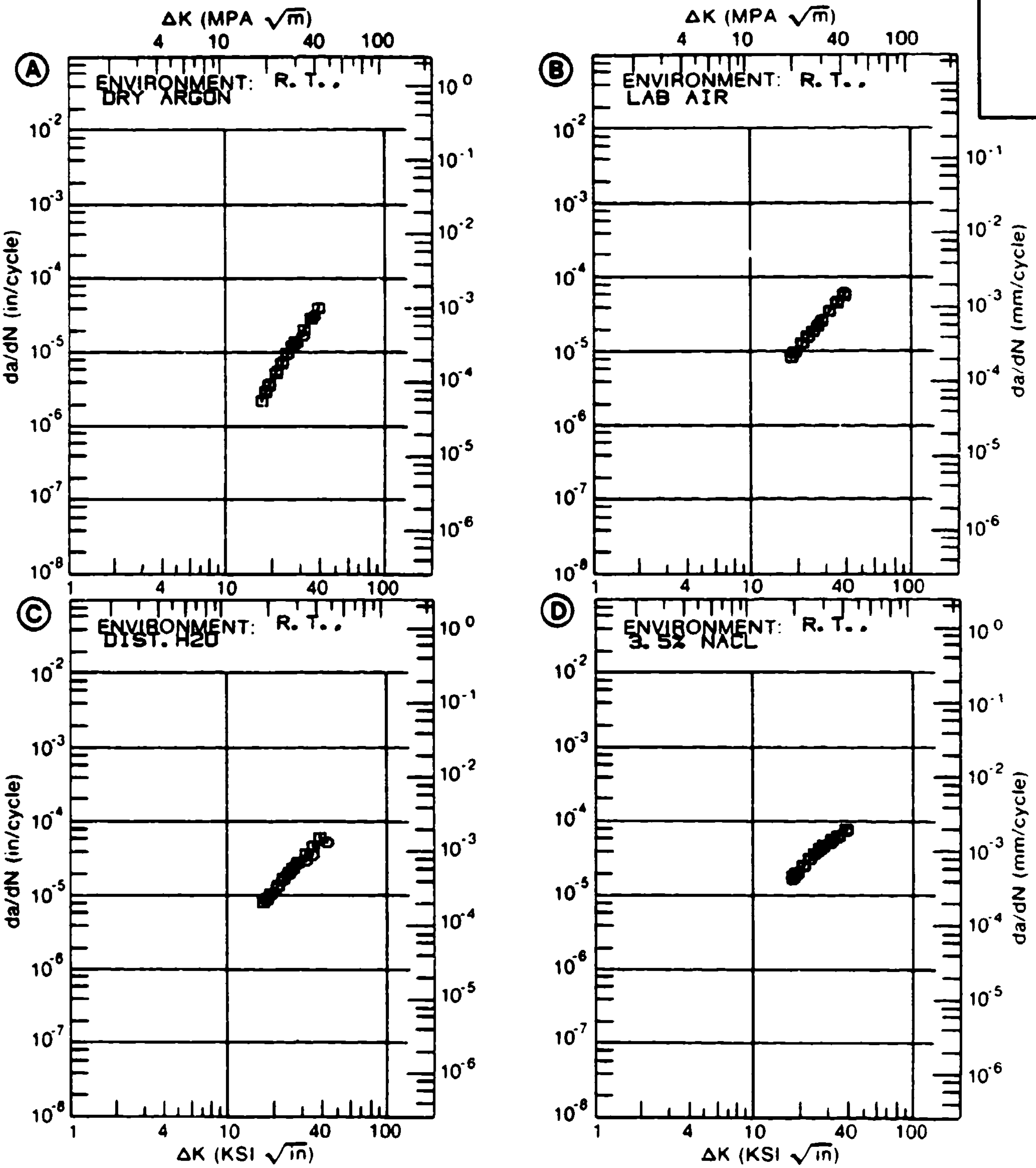

Figure 4.7.3.1

TABLE 4.7.3.2

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 4.7.3.2 INDICATING EFFECT

OF ENVIRONMENT

MATERIAL: TITANIUM TI-5AL-2.5SN
CONDITION: ANNEALED

DELTA K (KSI*IN**1/2)			DA/DN (10**-6 IN./CYCLE) A E= R.T. DRY ARGON	B E= R.T. LAB AIR	C E= R.T. DIST. H2O	D E= R.T. 3.5% NACL
	A:	18.13	4.02			
DELTA K	B:	18.23		8.87		
MIN	C:	21.49			16.0	
	D:	20.00				30.2
		20.00	5.56	11.6		
		25.00	11.6	21.3	23.4	51.1
		30.00	20.8	34.4	35.8	69.4
		35.00	33.6	51.0	51.0	86.5
		40.00	50.3	71.3	69.9	105.
		50.00	94.7	124.	124.	157.
	A:	53.17	112.			
DELTA K	B:	53.30		145.		
MAX	C:	53.14			148.	
	D:	53.17				181.
ROOT MEAN SQUARE PERCENT ERROR			4.36	3.18	4.21	4.45
LIFE		0.0-0.5				
PREDICTION		0.5-0.8				
RATIO		0.8-1.25	2	2	2	2
SUMMARY		1.25-2.0				
(NP/NA)		>2.0				

CONDITION/HT: ANNEALED
FORM: 0.08"TH SHEET
SPECIMEN TYPE: CCP
ORIENTATION: L-T
STRESS RATIO: +0.10
FREQUENCY: 30.00 HZ

YIELD STRENGTH: 122.3 KSI
ULT. STRENGTH: 133.9 KSI
SPECIMEN THK: 0.083- 0.084"
SPECIMEN WIDTH: 2.754- 2.764"
REFERENCES: 88811

TITAN. ALLOY

TI-5AL-2.5SN

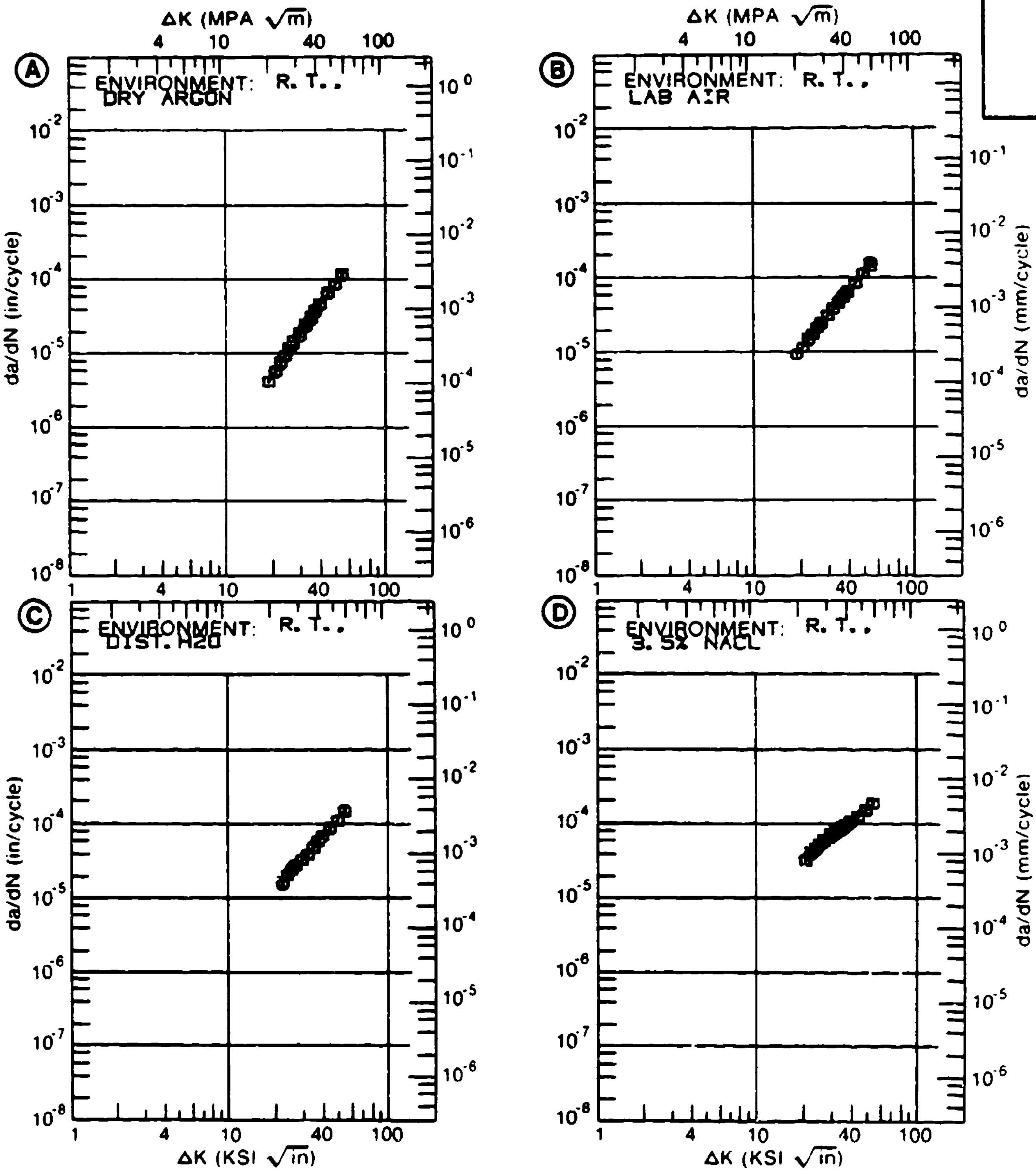

Figure 4.7.3.2

TABLE 4.7.3.3

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 4.7.3.3 INDICATING EFFECT

OF ENVIRONMENT

MATERIAL: TITANIUM TI-5AL-2.5SN
CONDITION: ANNEALED

DELTA K (KSI*IN**1/2)		DA/DN (10**-6 IN./CYCLE) A E= R.T. DRY ARGON	B E= R.T. LAB AIR	C E= R.T. DIST. H2O	D E= R.T. 3.5% NACL
DELTA K MIN A:	4.31	.0150			
B:	3.99		.0597		
C:	3.44			.0749	
D:	3.77				.125
	3.50			.0781	
	4.00		.0604	.114	.149
	5.00	.0301	.152	.253	.295
	6.00	.0444	.310	.526	.719
	7.00	.0558	.558	.984	2.34
	8.00	.0782	.922	1.65	5.30
	9.00	.136	1.43	2.51	7.20
	10.00	.278	2.13	3.49	7.97
DELTA K MAX A:	11.87	.999			
B:	12.86		5.60		
C:	12.87			5.99	
D:	12.93				12.4
ROOT MEAN SQUARE PERCENT ERROR		18.92	14.40	8.05	13.28
LIFE PREDICTION RATIO SUMMARY (NP/NA)	0.0-0.5				
	0.5-0.8	1			
	0.8-1.25	3	4	4	4
	1.25-2.0				
	>2.0				

CONDITION/HT: ANNEALED
FORM: 0.08"TH SHEET
SPECIMEN TYPE: CCP
ORIENTATION: L-T
STRESS RATIO: +0.07
FREQUENCY: 55.00- 58.30 HZ

YIELD STRENGTH: 122.3 KSI
ULT. STRENGTH: 133.9 KSI
SPECIMEN THK: 0.083- 0.085"
SPECIMEN WIDTH: 2.752- 2.758"
REFERENCES: 88811

TITAN. ALLOY

TI-5AL-2.5SN

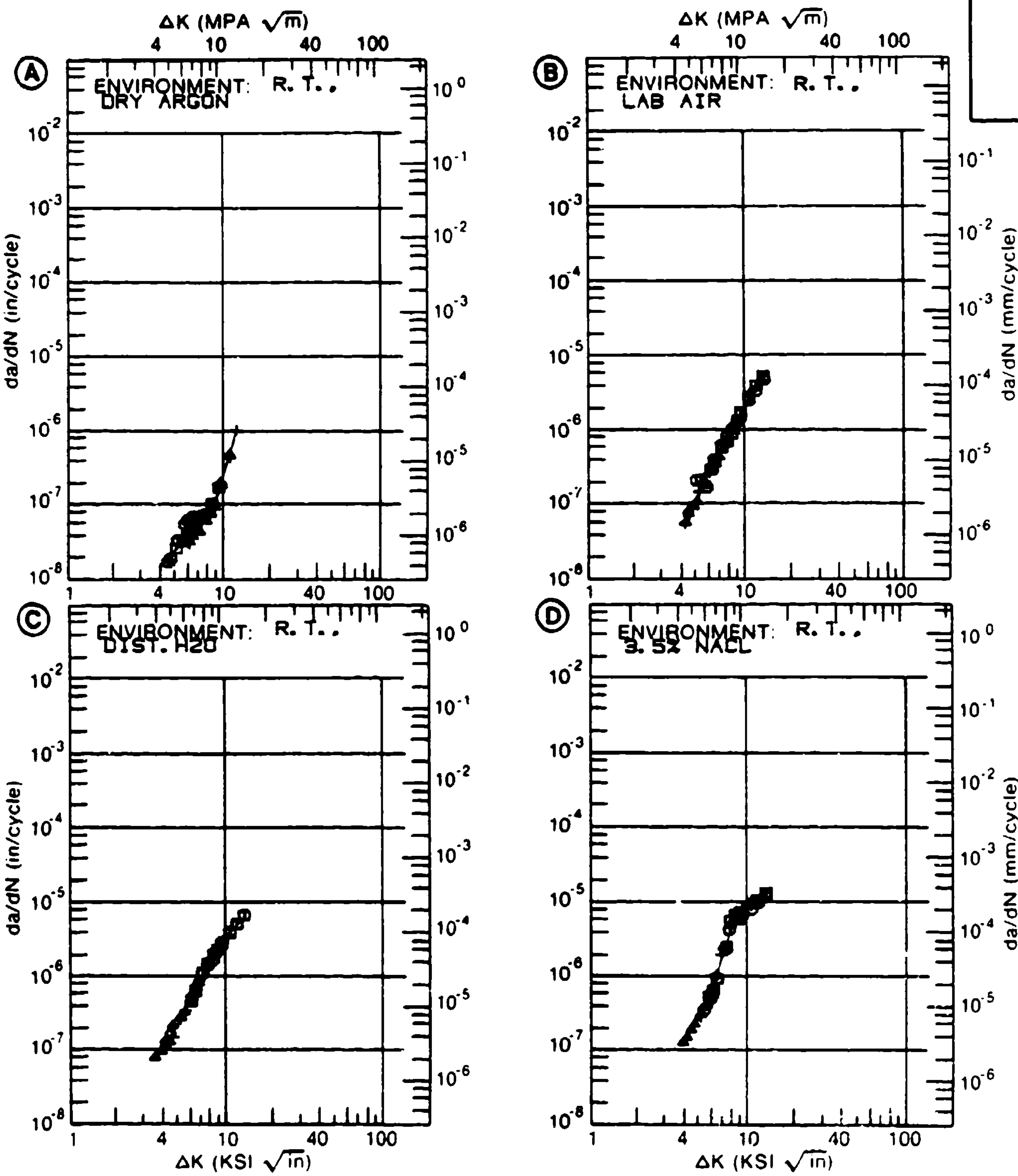

Figure 4.7.3.3

TABLE 4.7.3.4

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 4.7.3.4 INDICATING EFFECT

OF ENVIRONMENT

MATERIAL: TITANIUM TI-5AL-2.5SN
CONDITION: ANNEALED

DELTA K (KSI*IN**1/2)		DA/DN (10**-6 IN./CYCLE) A E= R.T. DRY ARGON	B E= R.T. LAB AIR	C E= R.T. DIST. H2O	D E= R.T. 3.5% NACL
A:	17.46	3.21			
DELTA K B:	16.63		7.03		
MIN C:	16.57			7.01	
D:	16.28				13.7
	20.00	5.35	11.8	12.0	24.5
	25.00	11.7	20.2	21.3	39.2
	30.00	21.2	31.1	33.4	53.7
	35.00	34.7	46.5	49.2	69.3
A:	37.87	44.6			
DELTA K B:	38.10		59.5		
MAX C:	37.79			59.9	
D:	37.84				79.1
ROOT MEAN SQUARE PERCENT ERROR		3.75	4.85	5.63	5.62
LIFE	0.0-0.5				
PREDICTION	0.5-0.8				
RATIO	0.8-1.25	2	2	2	2
SUMMARY	1.25-2.0				
(NP/NA)	>2.0				

CONDITION/HT: ANNEALED
FORM: 0.08"TH SHEET
SPECIMEN TYPE: CCP
ORIENTATION: T-L
STRESS RATIO: +0.10
FREQUENCY: 50.00- 53.30 HZ

YIELD STRENGTH: 125.4 KSI
ULT. STRENGTH: 133.8- 135.2 KSI
SPECIMEN THK: 0.083- 0.085"
SPECIMEN WIDTH: 2.755- 2.758"
REFERENCES: 88911

TITAN. ALLOY

TI-5AL-2.5SN

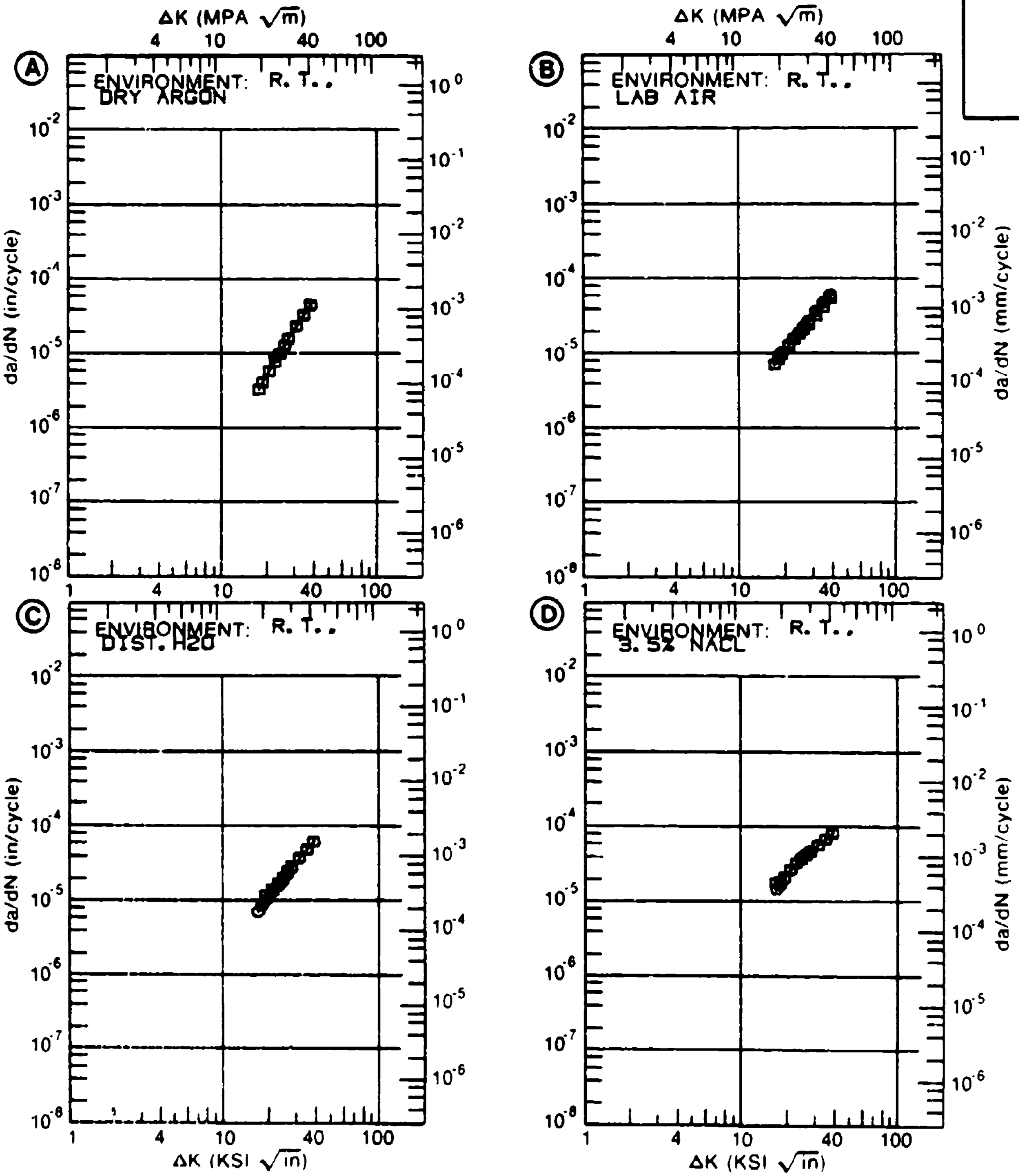

Figure 4.7.3.4

TABLE 4.7.3.5

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 4.7.3.5 INDICATING EFFECT

OF ENVIRONMENT

MATERIAL: TITANIUM TI-5AL-2.5SN
CONDITION: ANNEALED

DELTA K (KSI*IN**1/2)			DA/DN (10**-6 IN./CYCLE) A	B	C	D
			E= R.T. DRY ARGON	E= R.T. LAB AIR	E= R.T. DIST. H2O	E= R.T. 3.5% NACL
	A:	18.62	3.96			
DELTA K	B:	19.82		11.5		
MIN	C:	18.18			9.45	
	D:	21.52				35.6
		20.00	5.38	11.9	12.5	
		25.00	12.4	23.1	23.6	49.4
		30.00	22.2	37.4	38.6	68.1
		35.00	35.5	55.1	57.2	87.1
		40.00	53.5	77.2	79.0	109.
		50.00	114.	141.	130.	176.
	A:	53.29	145.			
DELTA K	B:	53.22		169.		
MAX	C:	53.08			148.	
	D:	53.13				207
ROOT MEAN SQUARE PERCENT ERROR			9.40	4.52	5.31	16.48
LIFE PREDICTION RATIO SUMMARY (NP/NA)		0.0-0.5				
		0.5-0.8				
		0.8-1.25	2	2	2	2
		1.25-2.0				
		>2.0				

CONDITION/HT: ANNEALED
FORM: 0.08"TH SHEET
SPECIMEN TYPE: CCP
ORIENTATION: T-L
STRESS RATIO: +0.10
FREQUENCY: 30.00 HZ

YIELD STRENGTH: 125.4 KSI
ULT. STRENGTH: 133.9- 135.2 KSI
SPECIMEN THK: 0.083- 0.085"
SPECIMEN WIDTH: 2.753- 2.757"
REFERENCES: 88911

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TI-5AL-2.5SN

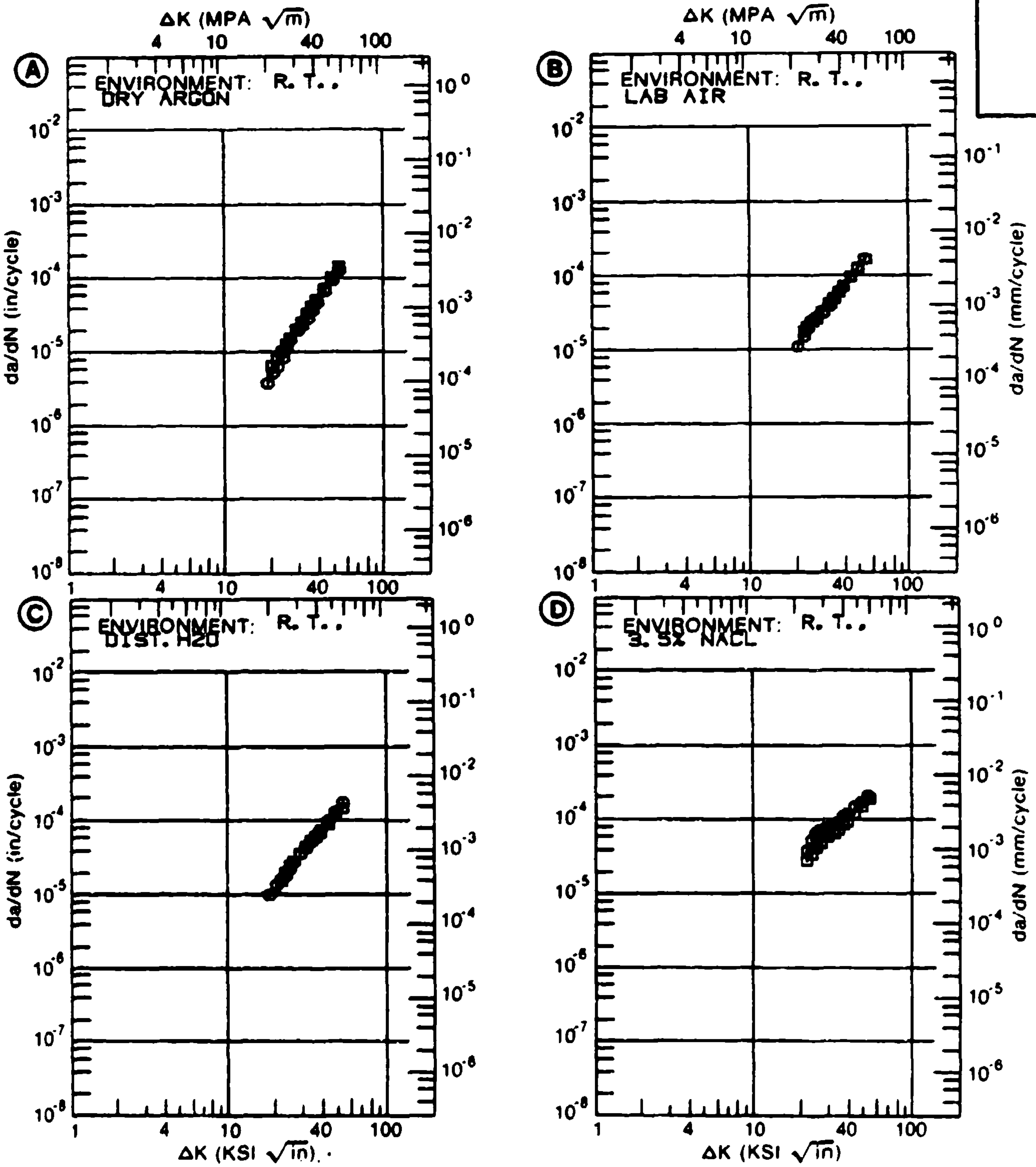

Figure 4.7.3.5

TABLE 4.7.3.6

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 4.7.3.6 INDICATING EFFECT OF ENVIRONMENT

MATERIAL: TITANIUM TI-5AL-2.5SN
CONDITION: ANNEALED

DELTA K (KSI*IN**1/2)			DA/DN (10**-6 IN./CYCLE) A E= R.T. DRY ARGON	B E= R.T. LAB AIR	C E= R.T. DIST. H2O	D E= R.T. 3.5% NACL
DELTA K MIN	A:	5.83	.0930			
	B:	3.69		.0501		
	C:	4.28			.237	
	D:	4.23				.209
		4.00		.0662		
		5.00		.158	.363	.981
		6.00	.0905	.347	.658	3.37
		7.00	.105	.685	1.13	6.92
		8.00	.164	1.23	1.81	10.5
		9.00	.285	2.02	2.68	13.1
		10.00	.497	3.08	3.72	14.6
		13.00	1.86	7.57		
DELTA K MAX	A:	13.02	1.87			
	B:	13.07		7.68		
	C:	12.74			6.71	
	D:	10.00				14.6
ROOT MEAN SQUARE PERCENT ERROR			16.96	11.13	7.18	37.84

LIFE PREDICTION RATIO SUMMARY (NP/NA)	A	B	C	D
0.0-0.5				
0.5-0.8	1			3
0.8-1.25	3	4	4	1
1.25-2.0				
>2.0				

CONDITION/HT: ANNEALED
FORM: 0.08"TH SHEET
SPECIMEN TYPE: CCP
ORIENTATION: T-L
STRESS RATIO: +0.07
FREQUENCY: 54.20- 58.30 HZ

YIELD STRENGTH: 125.4 KSI
ULT. STRENGTH: 133.9- 135.2 KSI
SPECIMEN THK: 0.083- 0.085"
SPECIMEN WIDTH: 2.753- 2.757"
REFERENCES: 88911

TITAN. ALLOY

TI-5AL-2.5SN

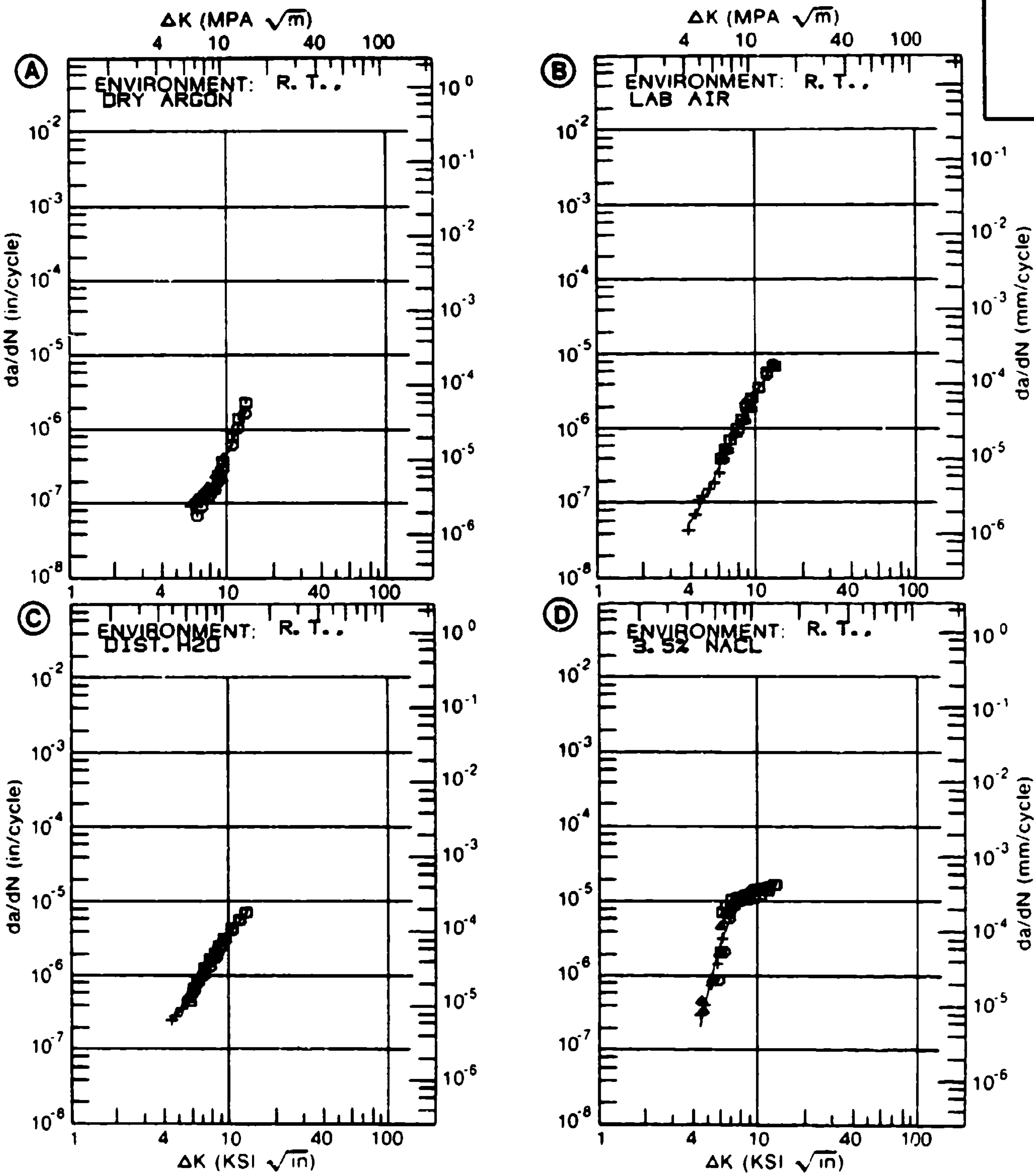

Figure 4.7.3.6

TABLE 4.8.1.1

FATIGUE CRACK GROWTH RATE AT DEFINED LEVELS OF THE STRESS-INTENSITY FACTOR

TITANIUM TI6-2-2-2-2

TEST CONDITIONS

SPECIMEN ORIENTATION L-T

ENVIRONMENT: H.H.A AT R.T.

CONDITION/HT	PRODUCT FORM	STRESS RATIO	FREQ (HZ)	DELTA K LEVELS: (KSI SQRT(IN)) 2.5	5	10	20	50	100
				FATIGUE CRACK GROWTH RATES (MICRO IN/CYCLE)					
ST	PLATE	0.10	1.00			2.38	13.3	271	
ST	PLATE	0.10	20.00			1.50	10.7	98.4	
STA	PLATE	0.10	1.00			1.87	17.3	423	
STA	PLATE	0.10	20.00		0.16	2.37	13.5		

TABLE 4.8.1.2

FATIGUE CRACK GROWTH RATE AT DEFINED LEVELS OF THE STRESS-INTENSITY FACTOR

TITANIUM TI6-2-2-2-2

TEST CONDITIONS

SPECIMEN ORIENTATION [illegible]-T

ENVIRONMENT: 3.5% NACL AT R.T.

CONDITION/HT	PRODUCT FORM	STRESS RATIO	FREQ (HZ)	DELTA K LEVELS: (KSI SQRT(IN))	FATIGUE CRACK GROWTH RATES (MICRO IN/CYCLE)					
					2.5	5	10	20	50	100
ST	PLATE	0.10	1.00				2.10	47.6	561	
ST	PLATE	0.10	20.00			0.31	4.70	30.7		
STA	PLATE	0.10	1.00					77.4		
STA	PLATE	0.10	20.00			0.47	5.90	15.2		

TABLE 4.8.3.1

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 4.8.3.1 INDICATING EFFECT

OF ENVIRONMENT

MATERIAL: TITANIUM TI62222
CONDITION: ST

DELTA K (KSI*IN**1/2)		DA/DN (10**-6 IN./CYCLE) A: E= R.T. H.H.A. 1HZ	B: E= R.T. H.H.A. 20HZ	C: E= R.T. 3.5% NACL 1HZ	D: E= R.T. 3.5% NACL 20HZ
DELTA K MIN A:	8.23	1.20			
DELTA K MIN B:	5.05		.076		
DELTA K MIN C:	6.77			.584	
DELTA K MIN D:	3.89				.048
	4.00				.0691
	5.00				.319
	6.00		.186		.742
	7.00		.378	.630	1.39
	8.00		.659	.915	2.27
	9.00	1.67	1.03	1.38	3.37
	10.00	2.38	1.50	2.10	4.70
	13.00	4.98	3.45	6.80	10.0
	16.00	8.12	6.12	18.0	17.6
	20.00	13.3	10.7	47.6	30.7
	25.00	22.3	18.2	110.	50.9
	30.00	36.4	27.7	194.	73.5
	35.00	59.0	39.8	291.	96.6
	40.00	96.4	55.1	390.	119.
	50.00	271.	98.4	561.	
	60.00	834.		673.	
	70.00	2775.			
DELTA K MAX A:	71.40	3301.			
DELTA K MAX B:	56.48		139.		
DELTA K MAX C:	63.48			697.	
DELTA K MAX D:	49.43				155.
ROOT MEAN SQUARE PERCENT ERROR		8.80	8.83	22.49	11.12
LIFE PREDICTION RATIO SUMMARY (NP/NA)	0.0-0.5				1
	0.5-0.8				
	0.8-1.25	1	1	1	
	1.25-2.0				
	>2.0				

CONDITION/HT: ST
FORM: 0.63"TH PLATE
SPECIMEN TYPE: CT
ORIENTATION: L-T
STRESS RATIO: +0.10
FREQUENCY:

YIELD STRENGTH: 157.0 KSI
ULT. STRENGTH:
SPECIMEN THK: 0.151- 0.152"
SPECIMEN WIDTH: 3.000"
REFERENCES: 88844

TITAN. ALLOY

TI-6-2-2-2-2

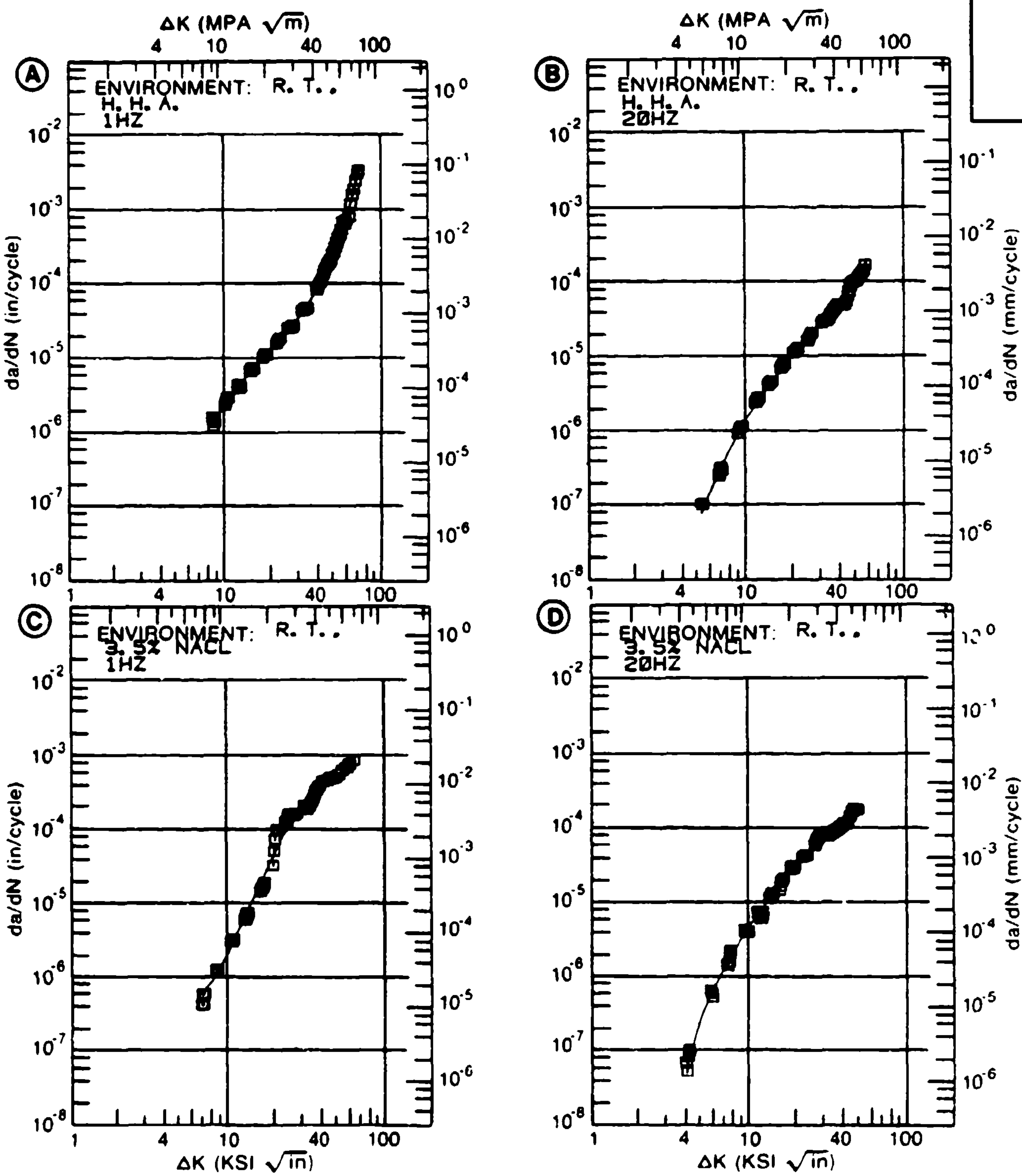

Figure 4.8.3.1

TABLE 4.8.3.2

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 4.8.3.2 INDICATING EFFECT

OF ENVIRONMENT

MATERIAL: TITANIUM TI62222
CONDITION: STA

DELTA K (KSI*IN**1/2)			DA/DN (10**-6 IN./CYCLE) A	B	C	D
			E= R.T. H.H.A. 1HZ	E= R.T. H.H.A. 20HZ	E= R.T. 3.5% NACL 1HZ	E= R.T. 3.5% NACL 20HZ
DELTA K MIN	A:	7.18	.54			
	B:	4.13		.06		
	C:	16.00			35.9	
	D:	3.64				.06
		4.00				.125
		5.00		.164		.471
		6.00		.369		1.13
		7.00		.686		2.09
		8.00	.811	1.12		3.27
		9.00	1.26	1.69		4.57
		10.00	1.87	2.37		5.90
		13.00	4.73	5.02		9.60
		16.00	9.07	8.36	35.9	12.5
		20.00	17.3	13.5	77.4	15.2
		25.00	32.7	20.3		
		30.00	56.9	27.1		
		35.00	95.6	33.8		
		40.00	158.	40.2		
		50.00	423.			
		60.00	1195.			
DELTA K MAX	A:	64.83	2030.			
	B:	41.87		42.5		
	C:	20.37			78.9	
	D:	20.05				15.2
ROOT MEAN SQUARE PERCENT ERROR			7.39	8.43	14.68	20.21
LIFE PREDICTION RATIO SUMMARY (NP/NA)		0.0-0.5				
		0.5-0.8				
		0.8-1.25	1	1	1	
		1.25-2.0				1
		>2.0				

CONDITION/HT: STA
FORM: 0.83"TH PLATE
SPECIMEN TYPE: CT
ORIENTATION: L-T
STRESS RATIO: +0.10
FREQUENCY:

YIELD STRENGTH: 157.0 KSI
ULT. STRENGTH:
SPECIMEN THK: 0.143- 0.147"
SPECIMEN WIDTH: 3.000"
REFERENCES: 88844

TITAN. ALLOY

TI-6-2-2-2-2

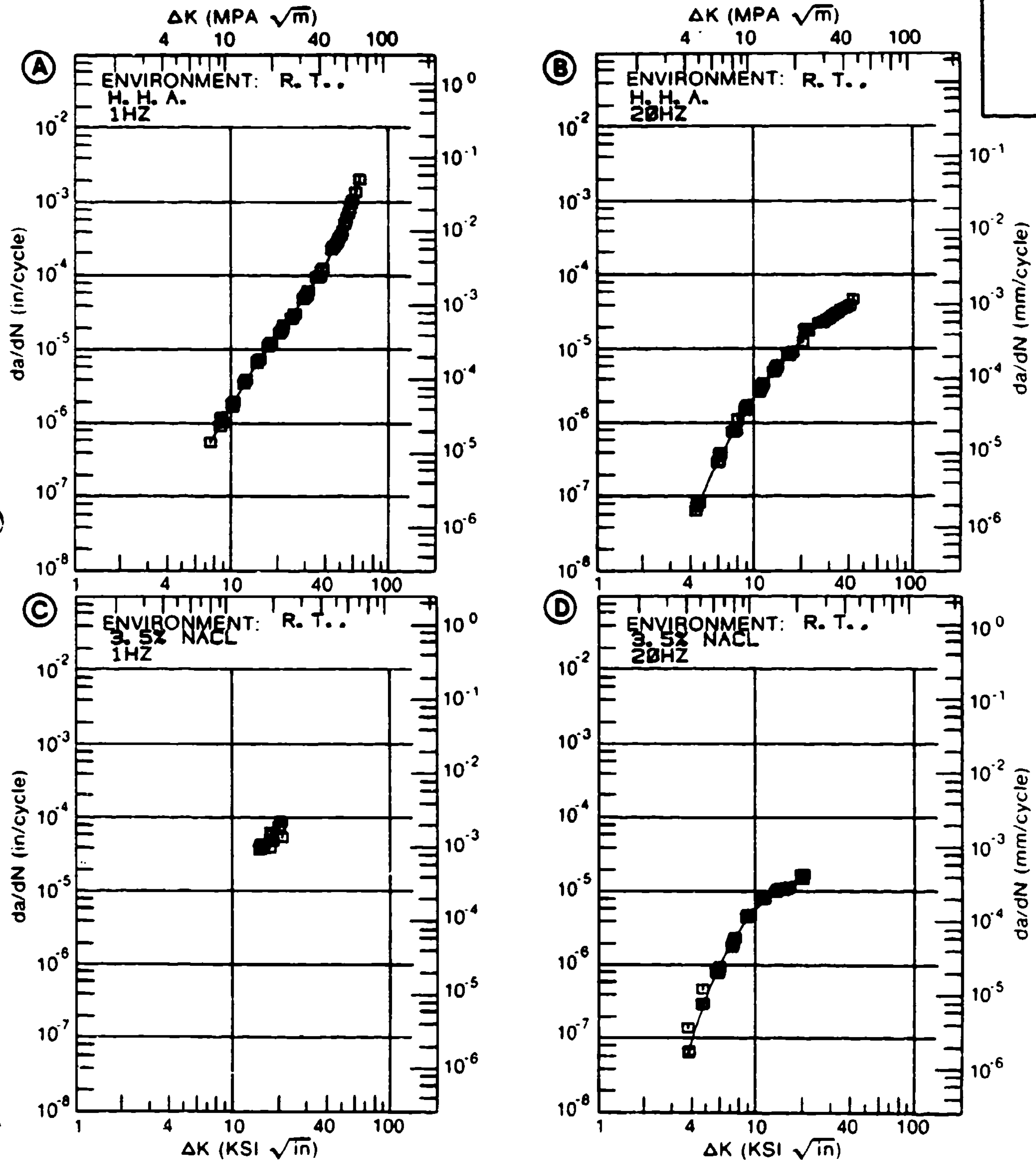

Figure 4.8.3.2

TABLE 4.9.1.1

FATIGUE CRACK GROWTH RATE AT DEFINED LEVELS OF THE STRESS-INTENSITY FACTOR

TITANIUM TI-6-2-4-2

TEST CONDITIONS

SPECIMEN ORIENTATION C-R

ENVIRONMENT: LAB AIR AT R.T.

CONDITION/HT	PRODUCT FORM	STRESS RATIO	FREQ. (HZ)	DELTA K LEVELS (KSI SQRT(IN))	2.5	5	10	20	50	100
				FATIGUE CRACK GROWTH RATES (MICRO IN/CYCLE)						
1790F 1HR AC. 1100F 8HRS AC	FORGING	0.10	0.16					10.3		
1790F 1HR AC. 1100F 8HRS AC	FORGING	0.50	0.16				2.27			

TABLE 4.9.1.2

[illegible] ROWTH RATE AT DEFINED LEVELS OF THE STRESS-INTENSITY FACTOR

TITANIUM TI-6-2-4-2

TES[illegible]

SPECIMEN ORIENTATION: [illegible]

ENVIRONMENT: AIR AT 800 F

CONDITION/HT	PRODUCT FORM	STRESS RATIO	FREQ. (HZ)	DELTA K LEVELS: (KSI SQRT(IN)) 2.5	5	10	20	50	100
				FATIGUE CRACK GROWTH RATES (MICRO IN/CYCLE)					
1790F 1HR AC. 1100F 8HRS AC	FORGING	0.10	30.00		0.27	1.22			
1790F 1HR AC. 1100F 8HRS AC	FORGING	0.50	------			5.69	20.9		
1790F 1HR AC. 1100F 8HRS AC	FORGING	0.70	0.16			5.35			

TABLE 4.9.1.3

FATIGUE CRACK GROWTH RATE AT DEFINED LEVELS OF THE STRESS-INTENSITY FACTOR

TITANIUM TI-6-2-4-2

TEST CONDITIONS

SPECIMEN ORIENTATION C-R

ENVIRONMENT AIR AT 1000 F

CONDITION/HT	PRODUCT FORM	STRESS RATIO	FREQ (HZ)	DELTA K LEVELS (KSI SQRT(IN)) 2.5	5	10	20	50	100
				FATIGUE CRACK GROWTH RATES (MICRO IN/CYCLE)					
1790F 1HR AC. 1100F 8HRS AC	FORGING	0.10	30.00			2.24			
1790F 1HR AC. 1100F 8HRS AC	FORGING	0.50	0.16			9.16	30.2		

TABLE 4.9.3.1

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 4.9.3.1 INDICATING EFFECT
OF STRESS RATIO

MATERIAL: TITANIUM TI-6-2-4-2
CONDITION: 1790F 1HR AC, 1100F 8HRS AC
ENVIRONMENT: R.T. ,LAB AIR

DELTA K (KSI*IN**1/2)		DA/DN (10**-6 IN./CYCLE) A R=+0.10	B R=+0.50	C	D
DELTA K MIN	A: 11.61	1.81			
	B: 7.05		.52		
	C:				
	D:				
	8.00		.919		
	9.00		1.50		
	10.00		2.27		
	13.00	2.52	5.70		
	16.00	4.82	10.5		
	20.00	10.3			
DELTA K MAX	A: 24.68	22.0			
	B: 19.52		17.1		
	C:				
	D:				
ROOT MEAN SQUARE PERCENT ERROR		7.82	9.78		

LIFE PREDICTION RATIO SUMMARY (NP/NA)	
	0.0-0.5
	0.5-0.8
	0.8-1.25
	1.25-2.0
	>2.0

CONDITION/HT: 1790F 1HR AC, 1100F 8HRS AC
FORM: 2.00"TH FORGING
SPECIMEN TYPE: CCP
ORIENTATION: C-R
FREQUENCY: 0.16 HZ
ENVIRONMENT: R.T., LAB AIR

YIELD STRENGTH: 139.4 KSI
ULT. STRENGTH: 151.6 KSI
SPECIMEN THK: 0.079"
SPECIMEN WIDTH: 1.750"
REFERENCES: PW002

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TI-6-2-4-2

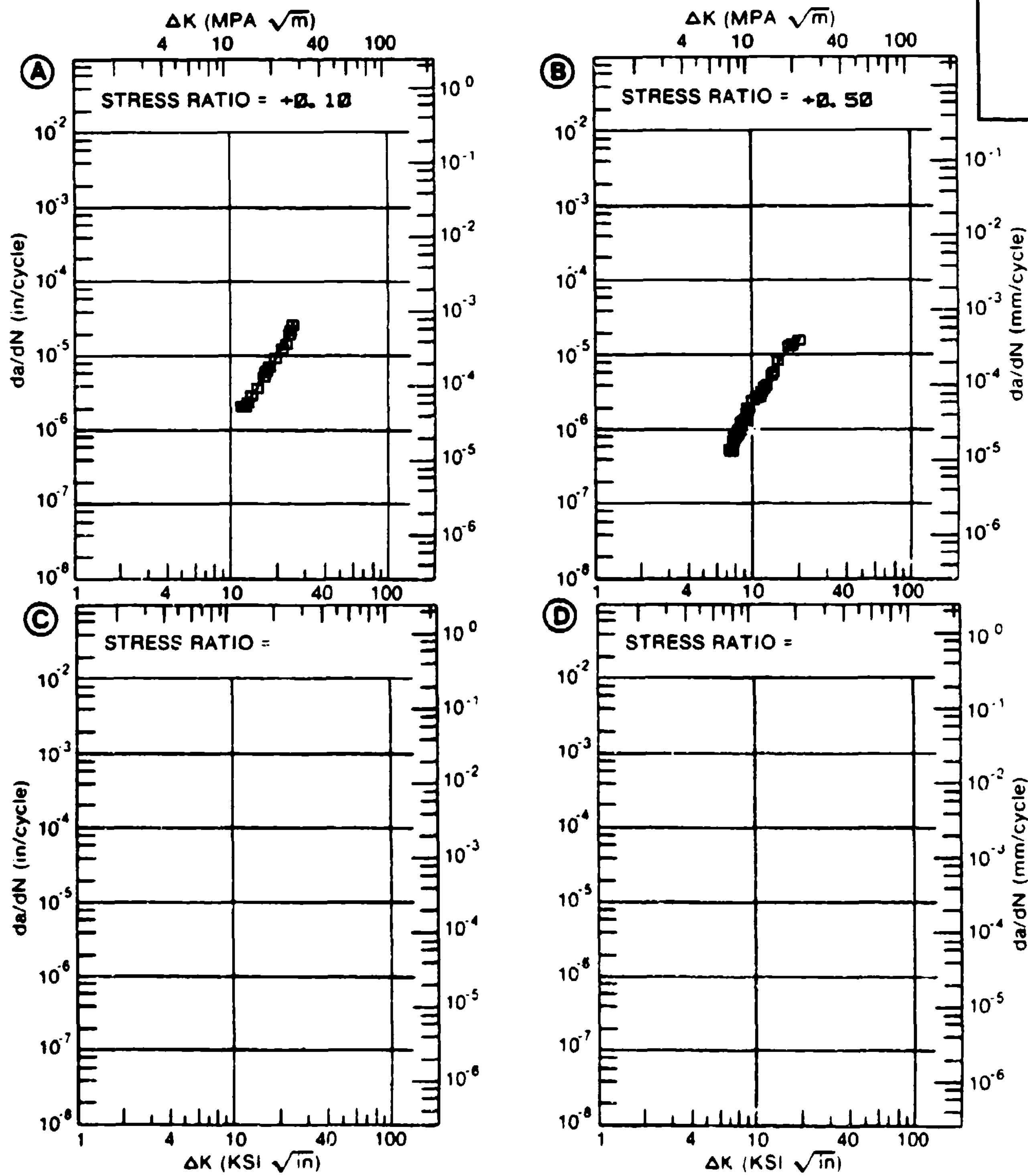

Figure 4.9.3.1

TABLE 4.9.3.2

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 4.9.3.2 INDICATING EFFECT

OF STRESS RATIO

MATERIAL: TITANIUM TI-6-2-4-2
CONDITION: 1790F 1HR AC, 1100F 8HRS AC
ENVIRONMENT: + 800F, AIR

DELTA K (KSI*IN**1/2)		DA/DN (10**-6 IN./CYCLE) A	B	C	D
		R=+0.70			
DELTA K MIN	A: 5.15	1.36			
	B:				
	C:				
	D:				
	6.00	2.04			
	7.00	2.71			
	8.00	3.36			
	9.00	4.16			
	10.00	5.35			
	13.00	15.5			
DELTA K MAX	A: 13.08	16.0			
	B:				
	C:				
	D:				
ROOT MEAN SQUARE PERCENT ERROR		15.01			

LIFE PREDICTION RATIO SUMMARY (NP/NA)	
	0.0-0.5
	0.5-0.8
	0.8-1.25
	1.25-2.0
	>2.0

CONDITION/HT: 1790F 1HR AC, 1100F 8HRS AC
FORM: 2.00"TH FORGING
SPECIMEN TYPE: CCP
ORIENTATION: C-R
FREQUENCY: 0.16 HZ
ENVIRONMENT: + 800° F, AIR

YIELD STRENGTH: 135.5- 140.9 KSI
ULT. STRENGTH: 148.5- 152.3 KSI
SPECIMEN THK: 0.080- 0.081"
SPECIMEN WIDTH: 1.750"
REFERENCES: PW002

TITAN. ALLOY

TI-6-2-4-2

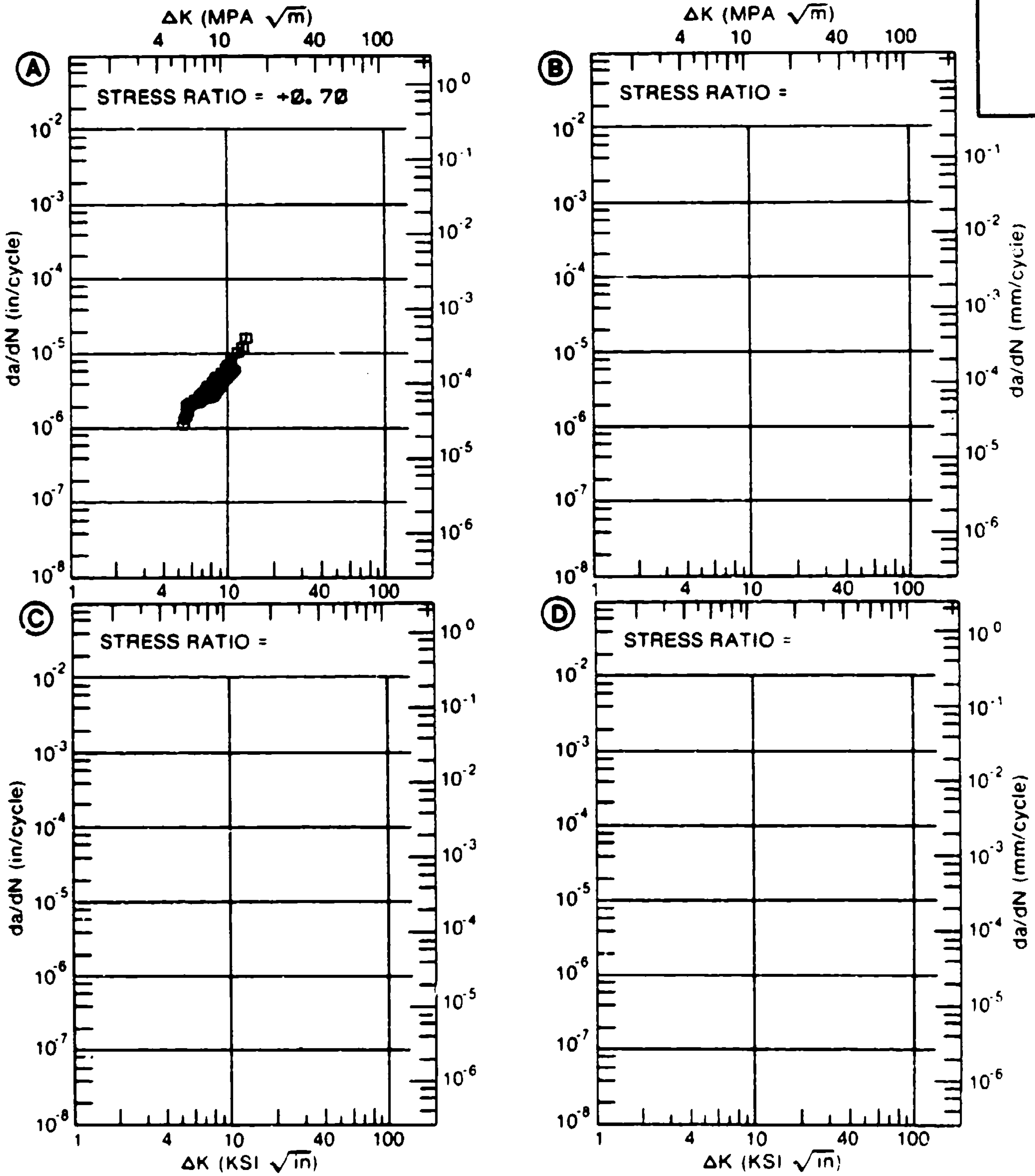

Figure 4.9.3.2

TABLE 4.9.3.3

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 4.9.3.3 INDICATING EFFECT

OF STRESS RATIO

MATERIAL: TITANIUM TI-6-2-4-2
CONDITION: 1790F 1HR AC, 1100F 8HRS AC
ENVIRONMENT: +1000F, AIR

DELTA K (KSI*IN**1/2)		DA/DN (10**-6 IN./CYCLE) A	B	C	D
		R=+0.50			
DELTA K MIN A:	5.60	3.89			
B:					
C:					
D:					
	6.00	4.28			
	7.00	5.34			
	8.00	6.50			
	9.00	7.77			
	10.00	9.16			
	13.00	14.0			
	16.00	20.1			
	20.00	30.2			
DELTA K MAX A:	20.12	30.5			
B:					
C:					
D:					
ROOT MEAN SQUARE PERCENT ERROR		4.85			

LIFE PREDICTION RATIO SUMMARY (NP/NA)	
	0.0-0.5
	0.5-0.8
	0.8-1.25
	1.25-2.0
	>2.0

CONDITION/HT: 1790F 1HR AC, 1100F 8HRS AC
FORM: 2.00"TH FORGING
SPECIMEN TYPE: CCP
ORIENTATION: C-R
FREQUENCY: 0.16 HZ
ENVIRONMENT: +1000° F, AIR

YIELD STRENGTH: 139.4 KSI
ULT. STRENGTH: 151.6 KSI
SPECIMEN THK: 0.074"
SPECIMEN WIDTH: 1.750"
REFERENCES: PW002

TITAN. ALLOY

TI-6-2-4-2

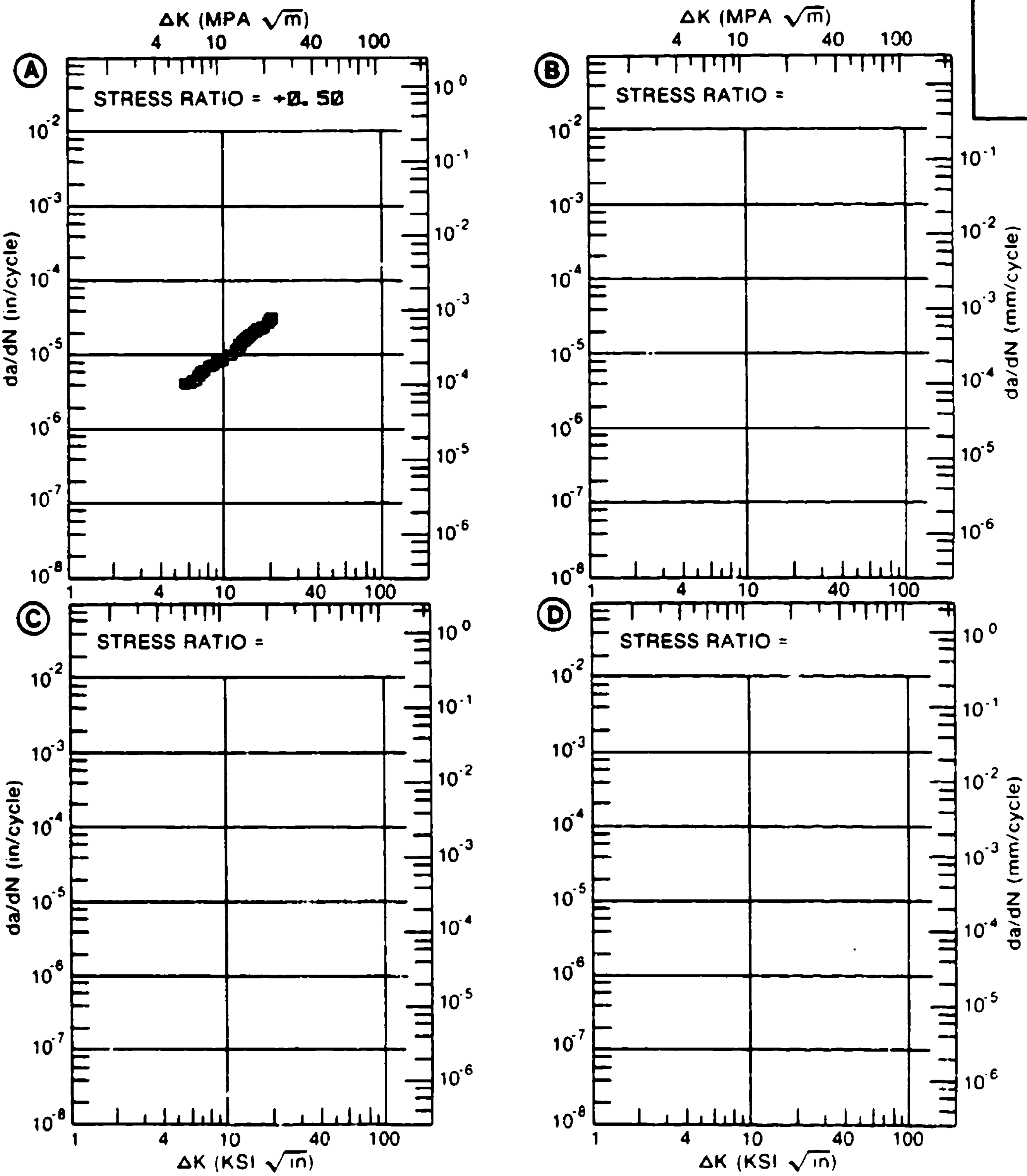

Figure 4.9.3.3

TABLE 4.9.3.4

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 4.9.3.4 INDICATING EFFECT

OF ENVIRONMENT

MATERIAL: TITANIUM TI-6-2-4-2
CONDITION: 1790F 1HR AC, 1100F 8HRS AC

DELTA K (KSI*IN**1/2)		DA/DN (10**-6 IN./CYCLE) A	B	C	D
		E=+ 800F AIR	E=+1000F AIR		
DELTA K MIN A:	4.95	.26			
DELTA K MIN B:	5.44		.70		
DELTA K MIN C:					
DELTA K MIN D:					
	5.00	.270			
	6.00	.378	.846		
	7.00	.511	1.12		
	8.00	.682	1.43		
	9.00	.910	1.80		
	10.00	1.22	2.24		
	13.00	2.99	4.34		
	16.00	6.35	8.64		
DELTA K MAX A:	18.28	9.39			
DELTA K MAX B:	18.45		15.5		
DELTA K MAX C:					
DELTA K MAX D:					
ROOT MEAN SQUARE PERCENT ERROR		5.58	4.40		

LIFE PREDICTION RATIO SUMMARY (NP/NA)	
	0.0-0.5
	0.5-0.8
	0.8-1.25
	1.25-2.0
	>2.0

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TI-6-2-4-2

CONDITION/HT: 1790F 1HR AC, 1100F 8HRS AC
FORM: 2.00"TH FORGING
SPECIMEN TYPE: CCP
ORIENTATION: C-R
STRESS RATIO: +0.10
FREQUENCY: 30.00 HZ

YIELD STRENGTH: 138.4- 140.9 KSI
ULT. STRENGTH: 151.6- 152.3 KSI
SPECIMEN THK: 0.073- 0.083"
SPECIMEN WIDTH: 1.750"
REFERENCES: PW002

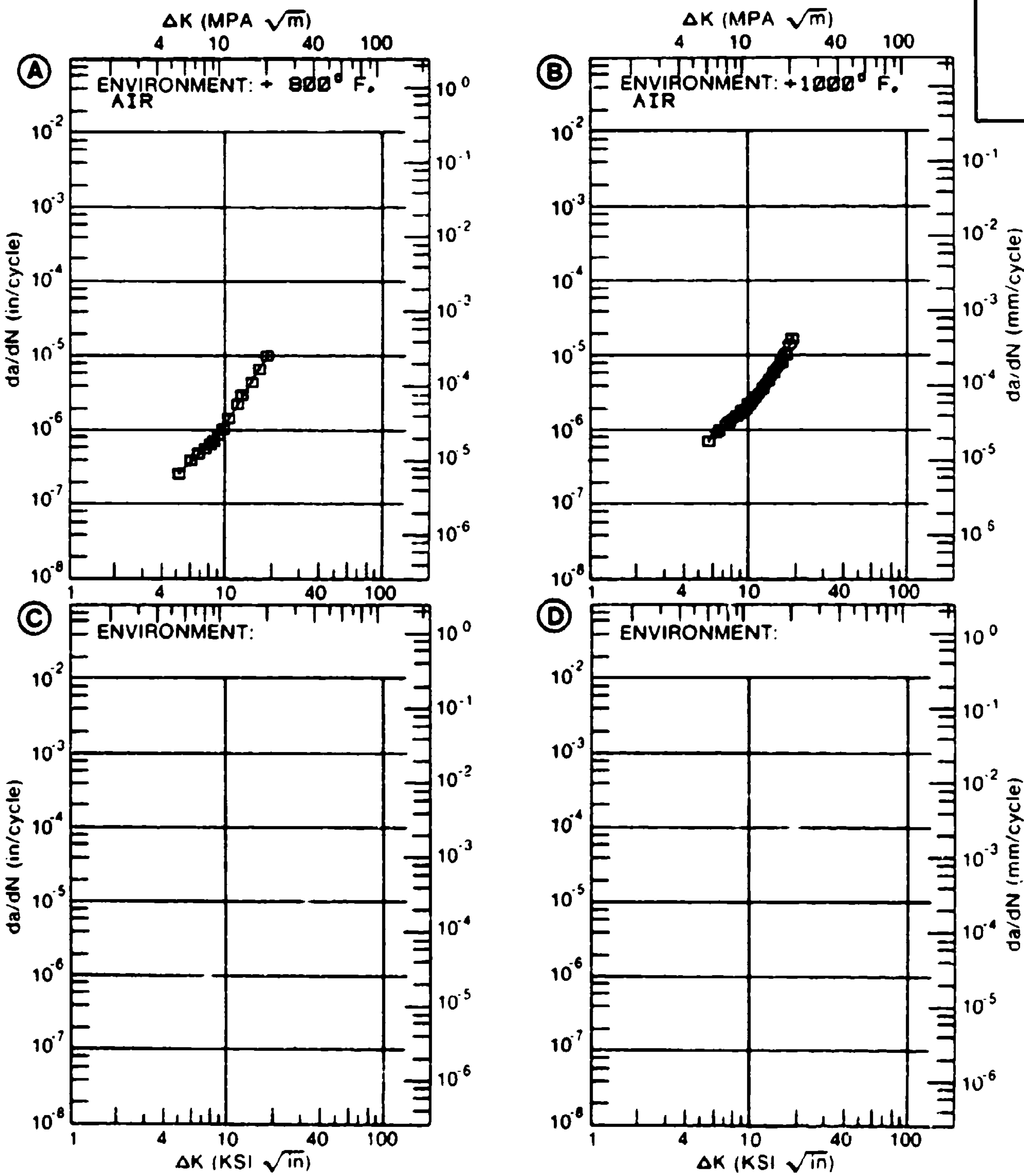

Figure 4.9.3.4

TABLE 4.9.3.5

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 4.9.3.5 INDICATING EFFECT

OF FREQUENCY

MATERIAL: TITANIUM TI-6-2-4-2
CONDITION: 1790F 1HR AC, 1100F 8HRS AC
ENVIRONMENT: + 800F, AIR

DELTA K (KSI*IN**1/2)			DA/DN (10**-6 IN./CYCLE) A	B	C	D
			F(HZ)=2 MIN. HOLD TRAPEZOIDAL WAVEFORM			
DELTA K MIN	A:	8.97	5.44			
	B:					
	C:					
	D:					
		9.00	5.44			
		10.00	5.69			
		13.00	7.89			
		16.00	12.0			
		20.00	20.9			
DELTA K MAX	A:	22.81	29.5			
	B:					
	C:					
	D:					
ROOT MEAN SQUARE PERCENT ERROR			7.30			
LIFE PREDICTION RATIO SUMMARY (NP/NA)		0.0-0.5				
		0.5-0.8				
		0.8-1.25				
		1.25-2.0				
		>2.0				

TITAN. ALLOY

TI-6-2-4-2

CONDITION/HT: 1790F 1HR AC. 1100F 8HRS AC
FORM: 2.00"TH FORGING
SPECIMEN TYPE: CCP
ORIENTATION: C-R
STRESS RATIO: +0.50
ENVIRONMENT: + 800° F. AIR

YIELD STRENGTH: 140.9 KSI
ULT. STRENGTH: 152.3 KSI
SPECIMEN THK: 0.082"
SPECIMEN WIDTH: 1.750"
REFERENCES: PW002

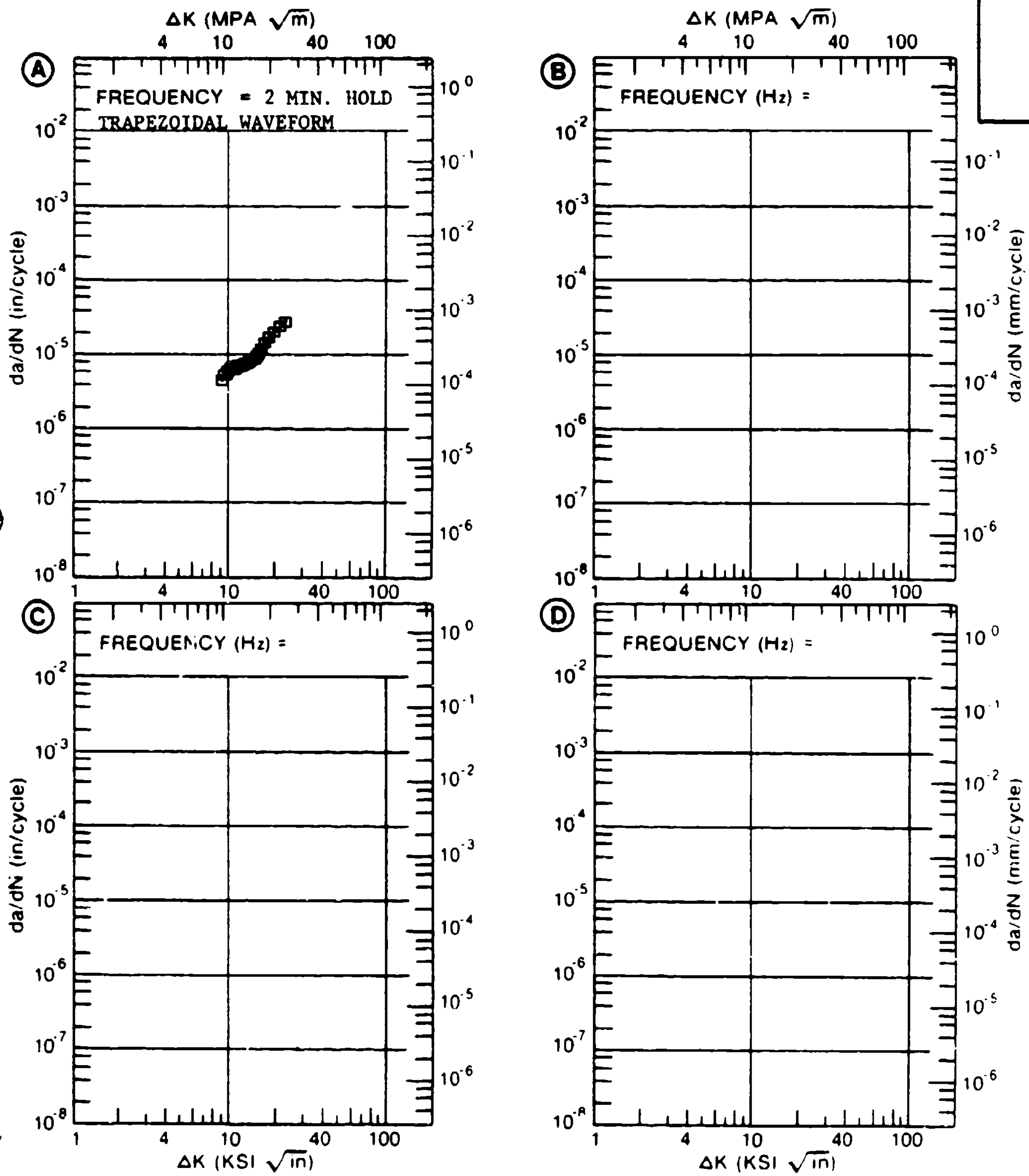

Figure 4.9.3.5

TABLE 4.10.1.1

FATIGUE CRACK GROWTH RATE AT DEFINED LEVELS OF THE STRESS-INTENSITY FACTOR

TITANIUM TI-6-2-4-6

TEST CONDITIONS

SPECIMEN ORIENTATION L-T

ENVIRONMENT AIR AT 800 F

CONDITION(S)	PRODUCT FORM	STRESS RATIO	FREQ. (HZ)	DELTA K LEVELS (KSI SQRT(IN))						
				FATIGUE CRACK GROWTH RATES (MICRO IN/CYCLE)						
				2.5	5	10	20	50	100
----	EXTRUSION	0.10	20.00			1.69	10.1		
	EXTRUSION	0.30	20.00			2.09	12.3		
	EXTRUSION	0.50	20.00			3.11			
	EXTRUSION	0.70	20.00		0.81	3.42			

TABLE 4.10.1.2

FATIGUE CRACK GROWTH RATE AT DEFINED LEVELS OF THE STRESS-INTENSITY FACTOR

TITANIUM TI 6-2-4-6

TEST CONDITIONS

SPECIMEN ORIENTATION C-R

ENVIRONMENT AIR AT 600 F

CONDITION/HT	PRODUCT FORM	STRESS RATIO	FREQ (HZ)	DELTA K LEVELS: (KSI SQRT(IN)) 2.5	5	10	20	50	100
				FATIGUE CRACK GROWTH RATES (MICRO IN/CYCLE)					
1690F 2HRS AC, 1550F 2HRS OQ, 1100F 8HRS AC	FORGING	0.10	0.16				9.04		
1690F 2HRS AC, 1550F 2HRS OQ, 1100F 8HRS AC	FORGING	0.10	30.00			1.41			
1690F 2HRS AC, 1550F 2HRS OQ, 1100F 8HRS AC	FORGING	0.50	0.16			3.80			
1690F 2HRS AC, 1550F 2HRS OQ, 1100F 8HRS AC	FORGING	0.50	2 MIN HOLDTIME TRAPEZOIDAL WAVEFORM				12.0		

TABLE 4.10.1.3

FATIGUE CRACK GROWTH RATE AT DEFINED LEVELS OF THE STRESS-INTENSITY FACTOR

TITANIUM TI-6-2-4-6

TEST CONDITIONS

SPECIMEN ORIENTATION C-R

ENVIRONMENT: AIR AT 800 F

CONDITION/HT	PRODUCT FORM	STRESS RATIO	FREQ (HZ)	DELTA K LEVELS (KSI SQRT(IN)) 2.5	5	10	20	50	100
				FATIGUE CRACK GROWTH RATES (MICRO IN/CYCLE)					
1690F 2HRS AC, 1550F 2HRS OQ, 1100F 8HRS AC	FORGING	0.06	30.00			2.03			
1690F 2HRS AC, 1550F 2HRS OQ, 1100F 8HRS AC	FORGING	0.10	0.16				11.5		
1690F 2HRS AC, 1550F 2HRS OQ, 1100F 8HRS AC	FORGING	0.10	30.00			1.87			
1690F 2HRS AC, 1550F 2HRS OQ, 1100F 8HRS AC	FORGING	0.50	0.16			4.67			
1690F 2HRS AC, 1550F 2HRS OQ, 1100F 8HRS AC	FORGING	0.70	0.16		2.48	6.71			

TABLE 4.10.3.1

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 4.10.3.1 INDICATING EFFECT OF STRESS RATIO

MATERIAL: TITANIUM TI-6-2-4-6
CONDITION:
ENVIRONMENT: R. T. ,LAB AIR

DELTA K (KSI*IN**1/2)			DA/DN (10**-6 IN./CYCLE) A	B	C	D
			R=+0.10			
DELTA K MIN	A:	7.20	.185			
	B:					
	C:					
	D:					
		8.00	.291			
		9.00	.496			
		10.00	.819			
		13.00	2.65			
		16.00	5.25			
		20.00	9.70			
		25.00	22.0			
		30.00	48.0			
DELTA K MAX	A:	33.04	61.9			
	B:					
	C:					
	D:					

ROOT MEAN SQUARE PERCENT ERROR 21.73

LIFE PREDICTION RATIO SUMMARY (NP/NA)	
	0.0-0.5
	0.5-0.8
	0.8-1.25
	1.25-2.0
	>2.0

CONDITION/HT:
FORM: EXTRUSION
SPECIMEN TYPE: CT
ORIENTATION: L-T
FREQUENCY: 20.00 HZ
ENVIRONMENT: R.T., LAB AIR

YIELD STRENGTH 147.2 KSI
ULT. STRENGTH: 159.1 KSI
SPECIMEN THK: 0.300"
SPECIMEN WIDTH: 1.400"
REFERENCES: UD001

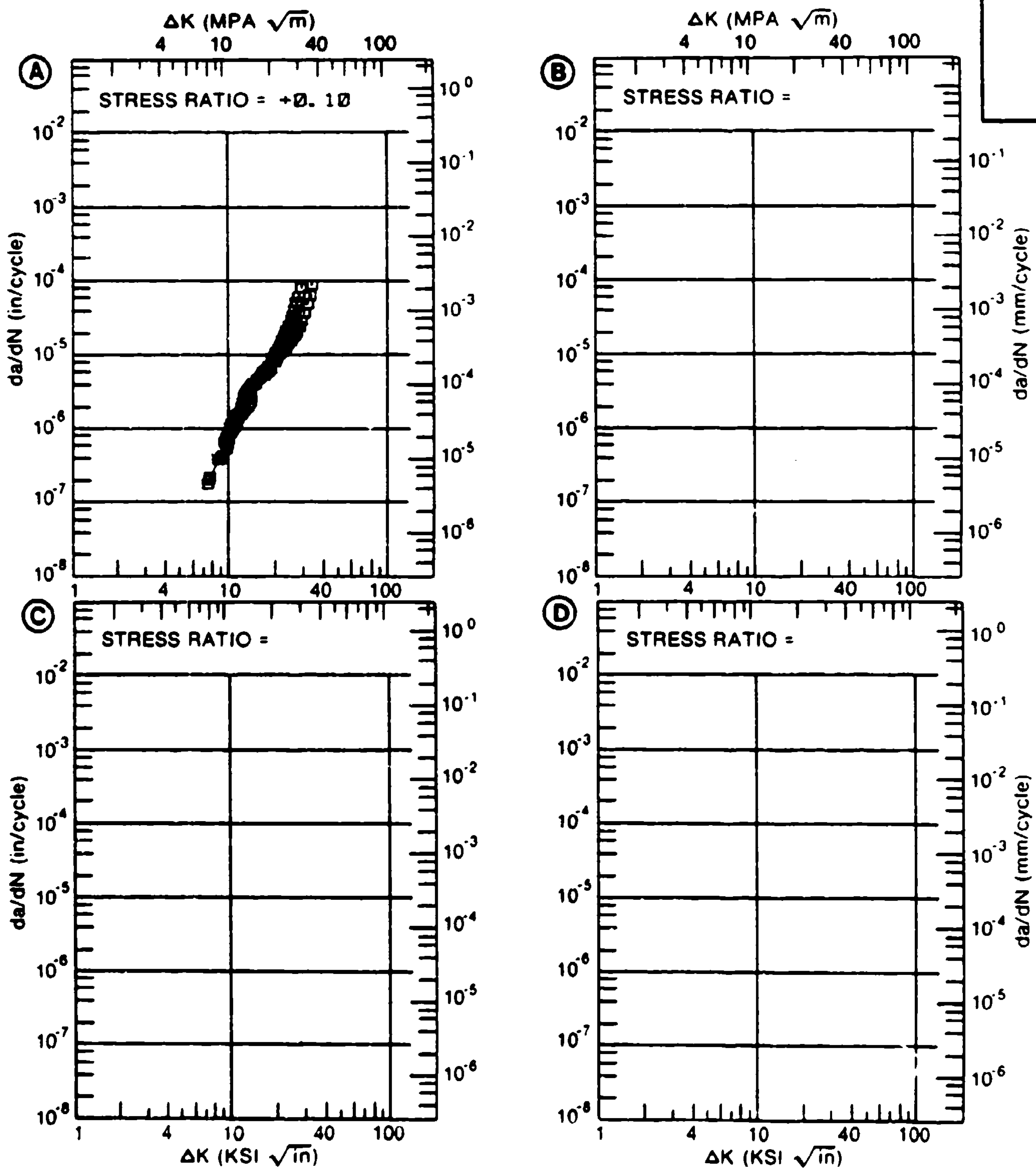

Figure 4.10.3.1

TABLE 4.10.3.2

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 4.10.3.2 INDICATING EFFECT

OF STRESS RATIO

MATERIAL: TITANIUM TI-6-2-4-6
CONDITION:
ENVIRONMENT: + 80OF, AIR

DELTA K (KSI*IN**1/2)		DA/DN (10**-6 IN./CYCLE) A R=+0.10	B R=+0.30	C R=+0.50	D R=+0.70
DELTA K MIN	A: 8.87	1.05			
	B: 5.52		.654		
	C: 5.54			.861	
	D: 4.89				.815
	5.00				.819
	6.00		.747	.977	.976
	7.00		.984	1.31	1.31
	8.00		1.28	1.77	1.83
	9.00	1.14	1.65	2.37	2.53
	10.00	1.69	2.09	3.11	3.42
	13.00	3.27	3.96	6.30	6.81
	16.00	5.65	6.77	10.8	
	20.00	10.1	12.3		
	25.00	17.1	22.5		
	30.00	24.7	36.9		
	35.00		55.4		
DELTA K MAX	A: 33.38	29.7			
	B: 35.34		56.8		
	C: 19.33			16.9	
	D: 13.67				7.59
ROOT MEAN SQUARE PERCENT ERROR		10.51	7.69	4.42	9.94

LIFE PREDICTION RATIO SUMMARY (NP/NA)	
	0.0-0.5
	0.5-0.8
	0.8-1.25
	1.25-2.0
	>2.0

CONDITION/HT:
FORM: EXTRUSION
SPECIMEN TYPE: CT
ORIENTATION: L-T
FREQUENCY: 20.00 HZ
ENVIRONMENT: + 800° F, AIR

YIELD STRENGTH: 147.2 KSI
ULT. STRENGTH: 159.1 KSI
SPECIMEN THK: 0.300"
SPECIMEN WIDTH: 1.400"
REFERENCES: UD001

TITAN. ALLOY
TI-6-2-4-6

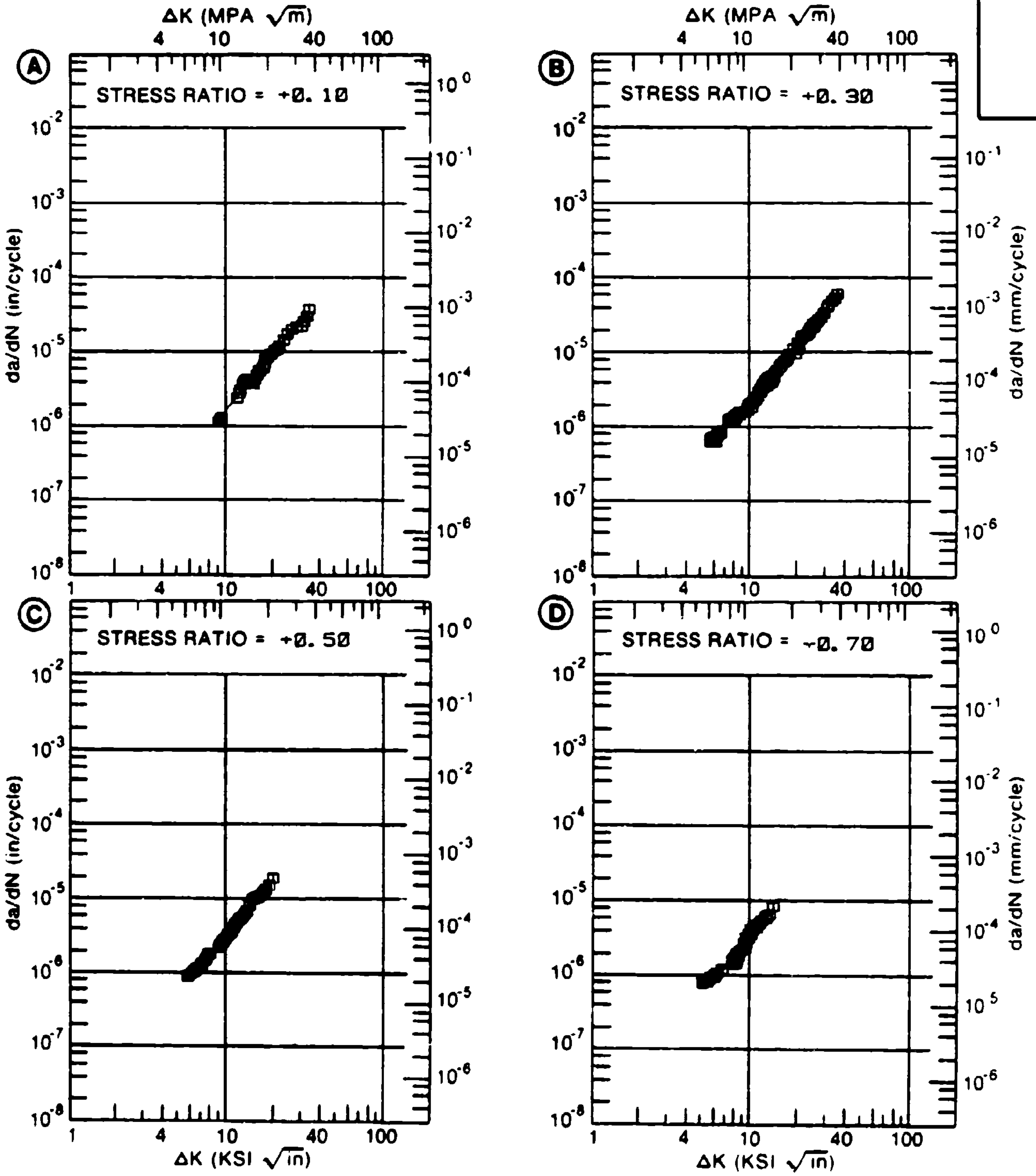

Figure 4.10.3.2

TABLE 4.10.3.3

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 4.10.3.3 INDICATING EFFECT

OF ENVIRONMENT

MATERIAL: TITANIUM TI-6-2-4-6
CONDITION: 1690F 2HRS AC, 1550F 2HRS OQ, 1100F 8HRS
AC

DELTA K (KSI*IN**1/2)			DA/DN (10**-6 IN./CYCLE) A	B	C	D
			E=+ 800F AIR			
DELTA K MIN	A:	5.05	.43			
	B:					
	C:					
	D:					
		6.00	.587			
		7.00	.816			
		8.00	1.12			
		9.00	1.52			
		10.00	2.03			
		13.00	4.36			
DELTA K MAX	A:	14.76	6.43			
	B:					
	C:					
	D:					

ROOT MEAN SQUARE PERCENT ERROR 5.79

LIFE PREDICTION RATIO SUMMARY (NP/NA)	
	0.0-0.5
	0.5-0.8
	0.8-1.25
	1.25-2.0
	>2.0

CONDITION/HT: 1690F 2HRS AC, 1550F 2HRS OQ, 1100F 8HRS AC
FORM: 1.00"TH FORGING
SPECIMEN TYPE: CCP
ORIENTATION: C-R
STRESS RATIO: +0.06
FREQUENCY: 30.00 HZ

YIELD STRENGTH: 165.5 KSI
ULT. STRENGTH: 180.8 KSI
SPECIMEN THK: 0.077"
SPECIMEN WIDTH: 1.750"
REFERENCES: PW002

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TI-6-2-4-6

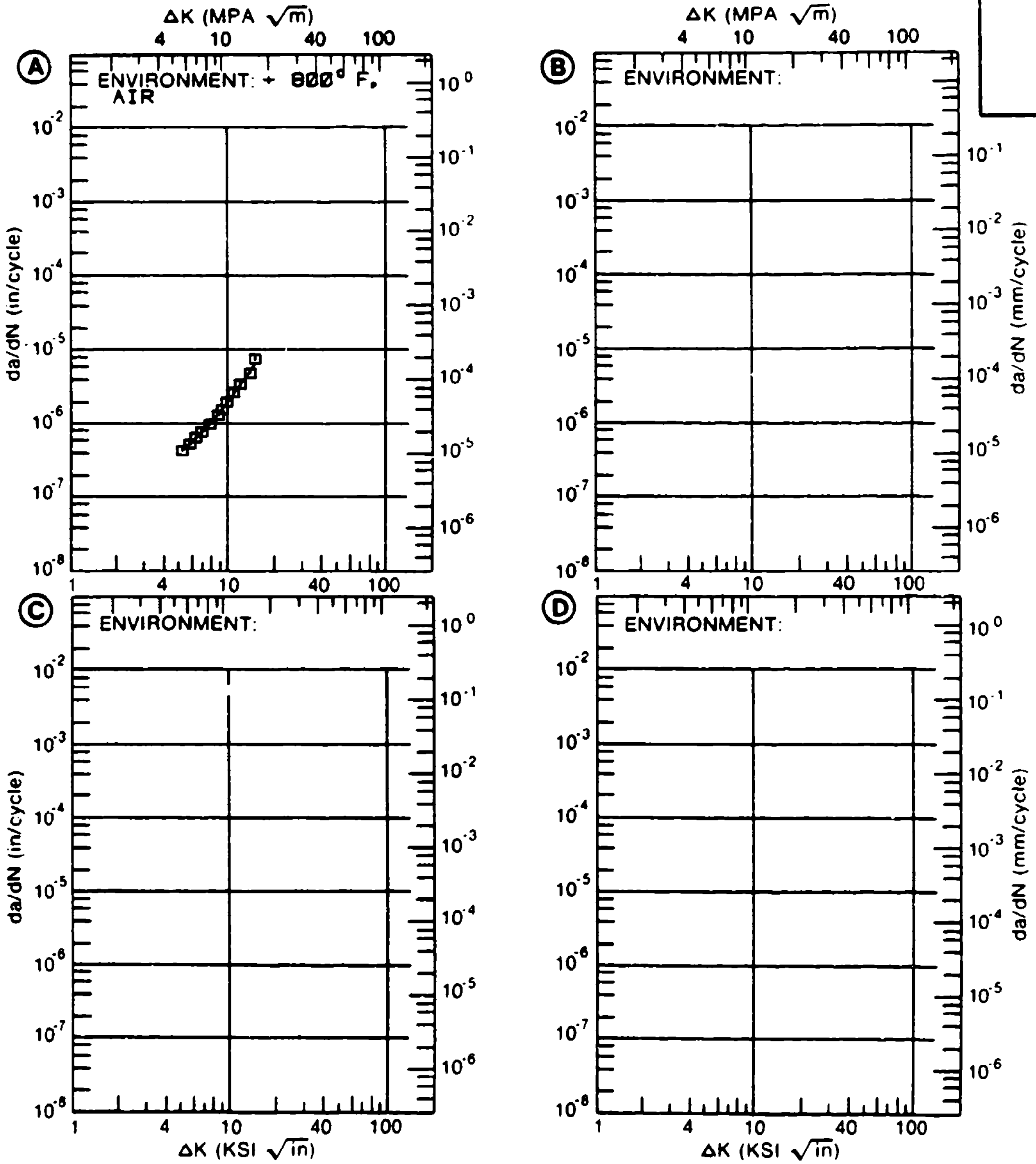

Figure 4.10.3.3

TABLE 4.10.3.4

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 4.10.3.4 INDICATING EFFECT

OF ENVIRONMENT

MATERIAL: TITANIUM TI-6-2-4-6
CONDITION: 1690F 2HRS AC, 1550F 2HRS OQ, 1100F 8HRS AC

DELTA K (KSI*IN**1/2)		DA/DN (10**-6 IN./CYCLE) A	B	C	D
		E=+ 600F AIR			
DELTA K MIN A:	13.85	4.87			
B:					
C:					
D:					
	16.00	7.10			
	20.00	12.0			
	25.00	19.6			
	30.00	29.6			
	35.00	43.1			
	40.00	61.6			
DELTA K MAX A:	47.39	103.			
B:					
C:					
D:					
ROOT MEAN SQUARE PERCENT ERROR		8.21			

LIFE PREDICTION RATIO SUMMARY (NP/NA)	
	0.0-0.5
	0.5-0.8
	0.8-1.25
	1.25-2.0
	>2.0

CONDITION/HT: 1690F 2HRS AC, 1550F 2HRS OQ, 1100F 8HRS AC
FORM: 1.80"TH FORGING
SPECIMEN TYPE: CCP
ORIENTATION: C-R
STRESS RATIO: +0.50
FREQUENCY: 2 MIN. HOLDTIME TRAPEZOIDAL WAVEFORM
YIELD STRENGTH: 165.5 KSI
ULT. STRENGTH: 180.8 KSI
SPECIMEN THK: 0.074"
SPECIMEN WIDTH: 1.750"
REFERENCES: PW002

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TI-6-2-4-6

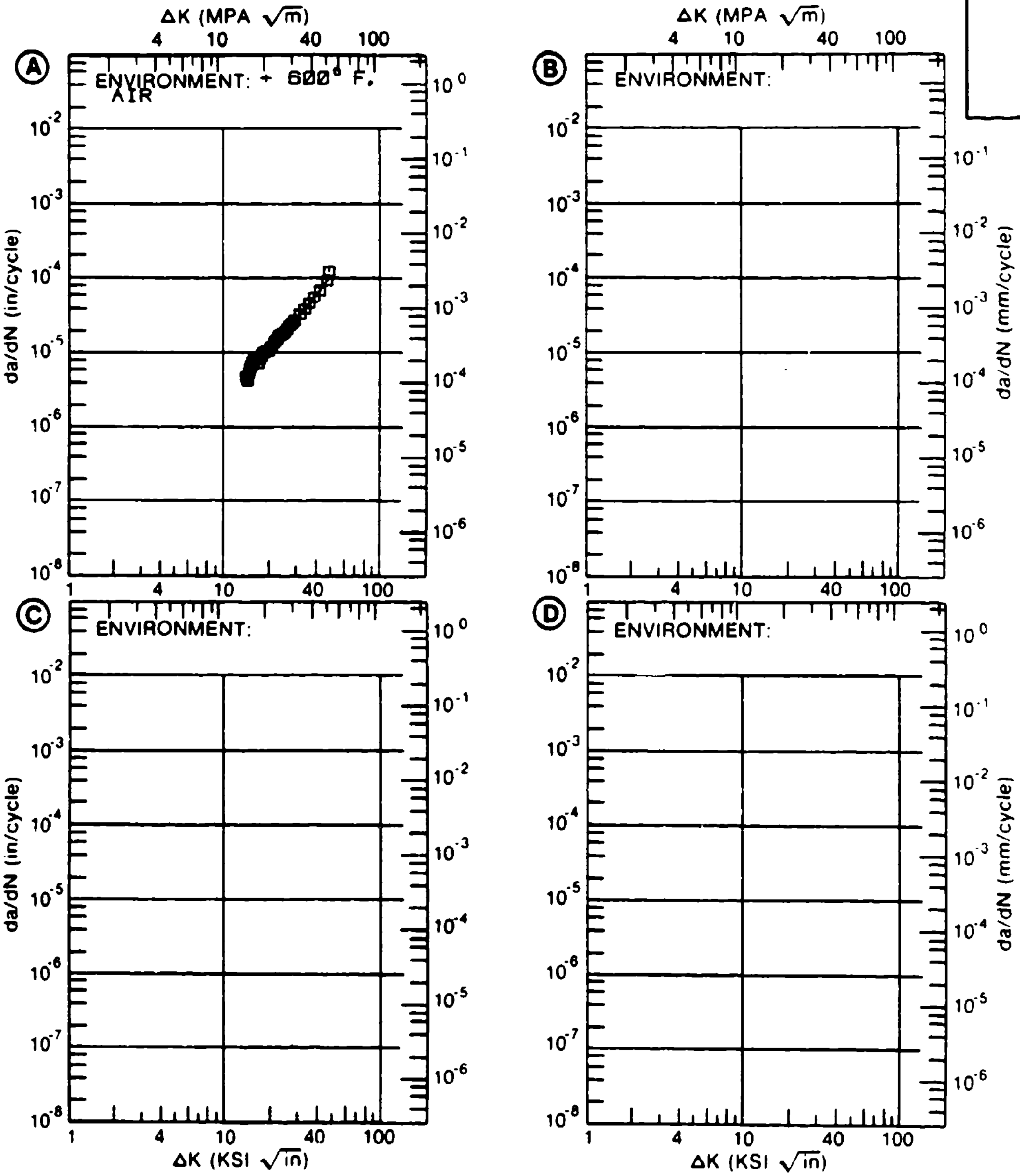

Figure 4.10.3.4

TABLE 4.10.3.5

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 4.10.3.5 INDICATING EFFECT
OF ENVIRONMENT

MATERIAL: TITANIUM TI-6-2-4-6
CONDITION: 1690F 2HRS AC, 1550F 2HRS OQ, 1100F 8HRS
AC

DELTA K (KSI*IN**1/2)		DA/DN (10**-6 IN./CYCLE) A	B	C	D
		E=+ 800F AIR			
DELTA K MIN A:	4.73	2.46			
B:					
C:					
D:					
	5.00	2.48			
	6.00	2.81			
	7.00	3.43			
	8.00	4.31			
	9.00	5.40			
	10.00	6.71			
	13.00	11.6			
DELTA K MAX A:	14.43	14.3			
B:					
C:					
D:					
ROOT MEAN SQUARE PERCENT ERROR		5.34			

LIFE PREDICTION RATIO SUMMARY (NP/NA)
0.0-0.5
0.5-0.8
0.8-1.25
1.25-2.0
>2.0

CONDITION/HT: 1800F 2HRS AC. 1550F 2HRS OQ. 1100F 8HRS AC
FORM: 1.00"TH FORGING
SPECIMEN TYPE: CCP
ORIENTATION: C-R
STRESS RATIO: +0.70
FREQUENCY: 0.16 HZ

YIELD STRENGTH: 165.5 KSI
ULT. STRENGTH: 180.8 KSI
SPECIMEN THK: 0.083"
SPECIMEN WIDTH: 1.750"
REFERENCES: PW002

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TI-6-2-4-6

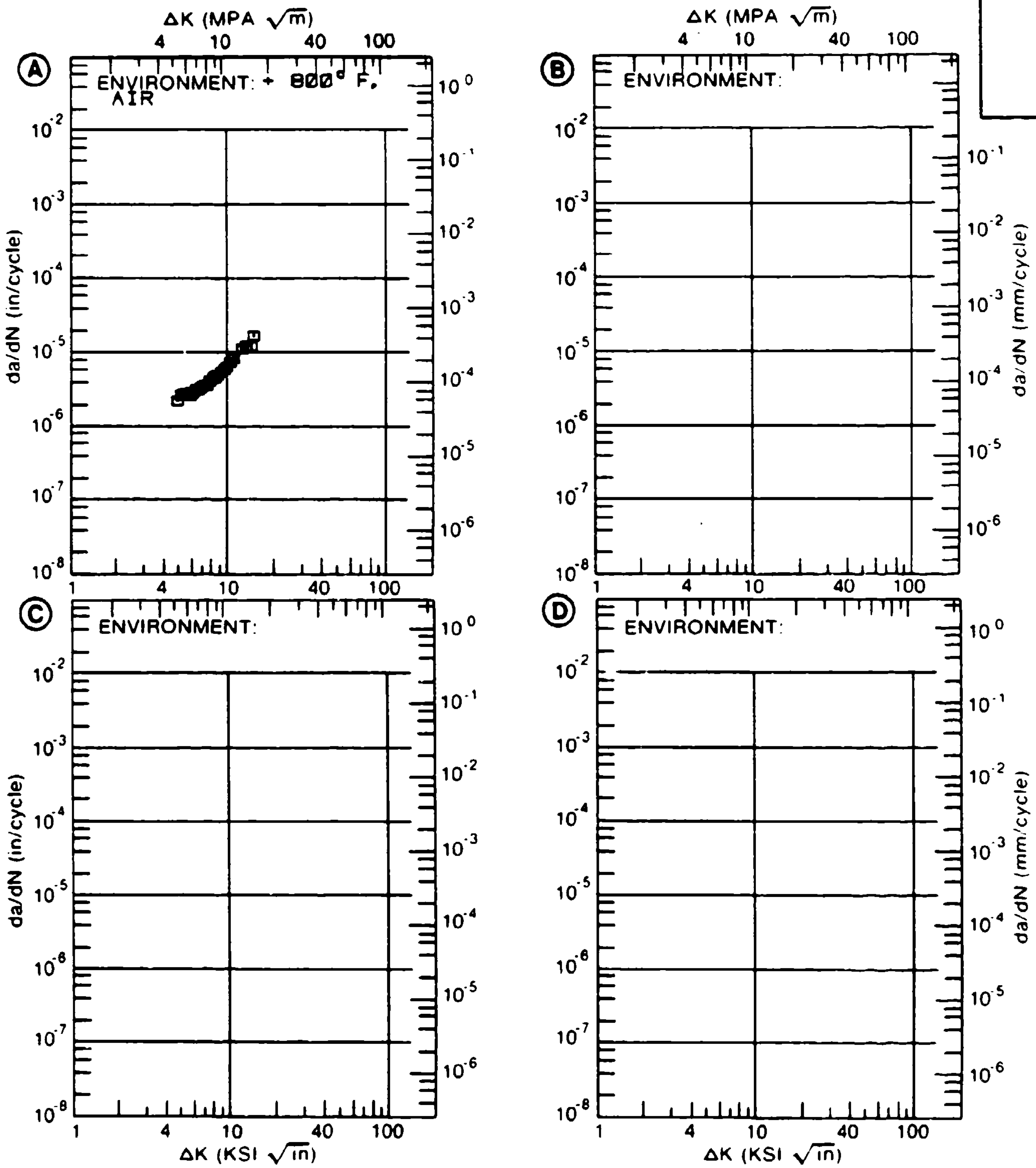

Figure 4.10.3.5

TABLE 4.10.3.6

FATIQUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 4.10.3.6 INDICATING EFFECT

OF ENVIRONMENT

MATERIAL: TITANIUM TI-6-2-4-6
CONDITION: 1690F 2HRS AC, 1550F 2HRS OQ, 1100F 8HRS
AC

DELTA K (KSI*IN**1/2)		DA/DN (10**-6 IN./CYCLE) A	B	C	D
		E= R.T. LAB AIR	E=+ 600F AIR	E=+ 800F AIR	
DELTA K MIN	A: 4.87	.09			
	B: 8.23		.71		
	C: 8.51			1.09	
	D:				
	5.00	.105			
	6.00	.185			
	7.00	.314			
	8.00	.496			
	9.00	.718	.991	1.36	
	10.00	.985	1.41	1.87	
	13.00	2.44	3.20	3.49	
	16.00		6.41	7.28	
DELTA K MAX	A: 14.06	5.88			
	B: 17.43		8.91		
	C: 17.28			11.0	
	D:				
ROOT MEAN SQUARE PERCENT ERROR		5.96	3.55	6.28	

LIFE PREDICTION RATIO SUMMARY (NP/NA)	
	0.0-0.5
	0.5-0.8
	0.8-1.25
	1.25-2.0
	>2.0

CONDITION/HT: 1690F 2HRS AC, 1550F 2HRS OQ, 1100F 8HRS AC
FORM: 2.80"TH FORGING
SPECIMEN TYPE: CCP
ORIENTATION: C-R
STRESS RATIO: +0.10
FREQUENCY: 30.00 HZ

YIELD STRENGTH: 166.0 KSI
ULT. STRENGTH: 182.3 KSI
SPECIMEN THK: 0.078- 0.082"
SPECIMEN WIDTH: 1.750"
REFERENCES: PW002

TITAN. ALLOY

TI-6-2-4-6

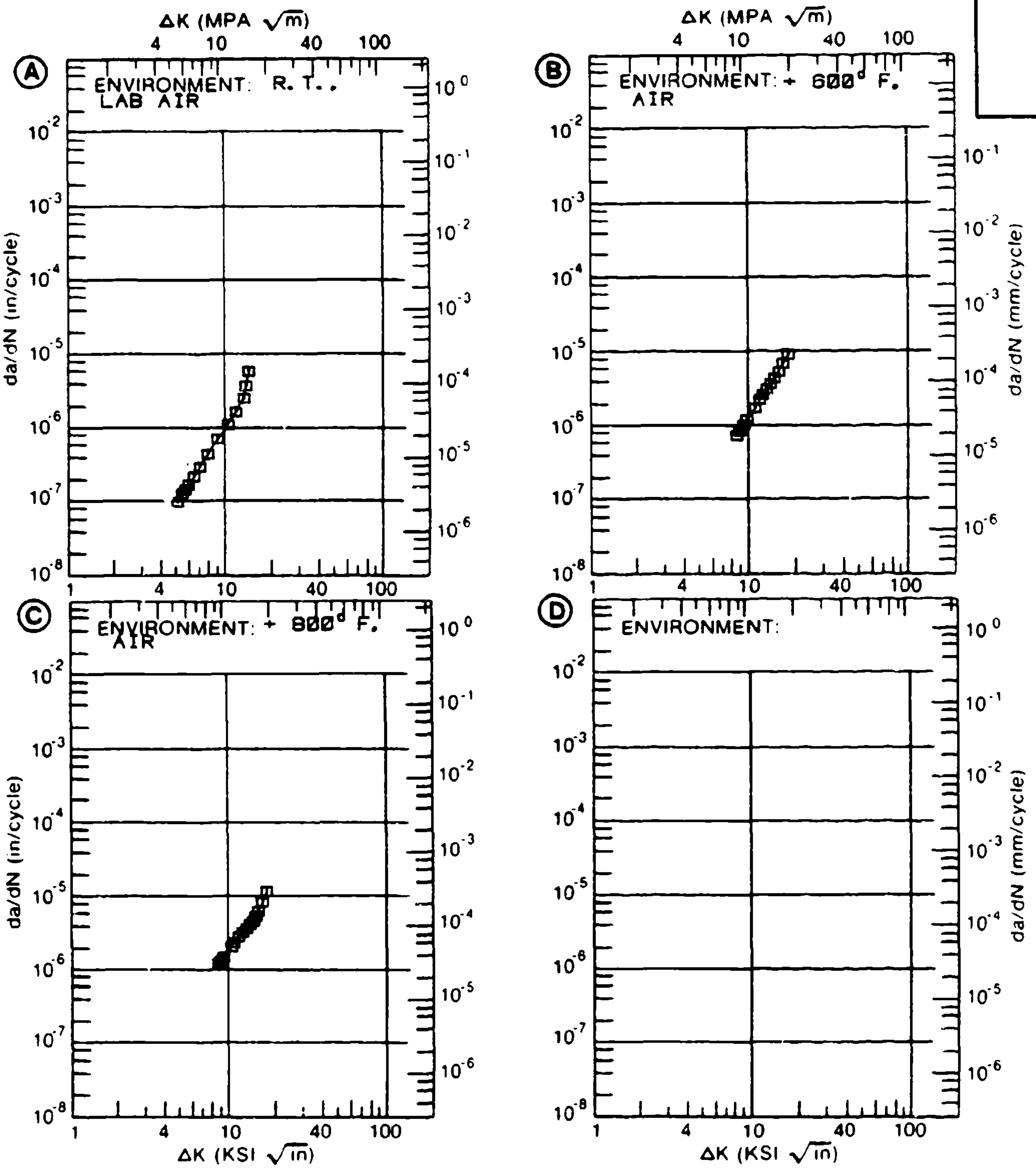

Figure 4.10.3.6

TABLE 4.10.3.7

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 4.10.3.7 INDICATING EFFECT

OF ENVIRONMENT

MATERIAL: TITANIUM TI-6-2-4-6
CONDITION: 1690F 2HRS AC, 1550F 2HRS OQ, 1100F 8HRS
AC

DELTA K (KSI*IN**1/2)			DA/DN (10**-6 IN./CYCLE) A	B	C	D
			E=+ 600F AIR	E=+ 800F AIR		
DELTA K MIN	A:	10.60	1.71			
	B:	13.03		4.20		
	C:					
	D:					
		13.00	2.58			
		16.00	4.56	6.96		
		20.00	9.04	11.5		
		25.00	17.6	18.9		
		30.00	28.0	29.3		
		35.00		44.4		
DELTA K MAX	A:	32.52	33.1			
	B:	39.00		61.4		
	C:					
	D:					
ROOT MEAN SQUARE PERCENT ERROR			12.22	7.08		

LIFE PREDICTION RATIO SUMMARY (NP/NA)	
	0.0-0.5
	0.5-0.8
	0.8-1.25
	1.25-2.0
	>2.0

CONDITION/HT: 1690F 2HRS AC, 1550F 2HRS OQ, 1100F 8HRS AC
FORM: 2.00"TH FORGING
SPECIMEN TYPE: CCP
ORIENTATION: C-R
STRESS RATIO: +0.10
FREQUENCY: 0.16 HZ

YIELD STRENGTH: 166.0 KSI
ULT. STRENGTH: 182.3 KSI
SPECIMEN THK: 0.079- 0.081"
SPECIMEN WIDTH: 1.750"
REFERENCES: PW002

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TI-6-2-4-6

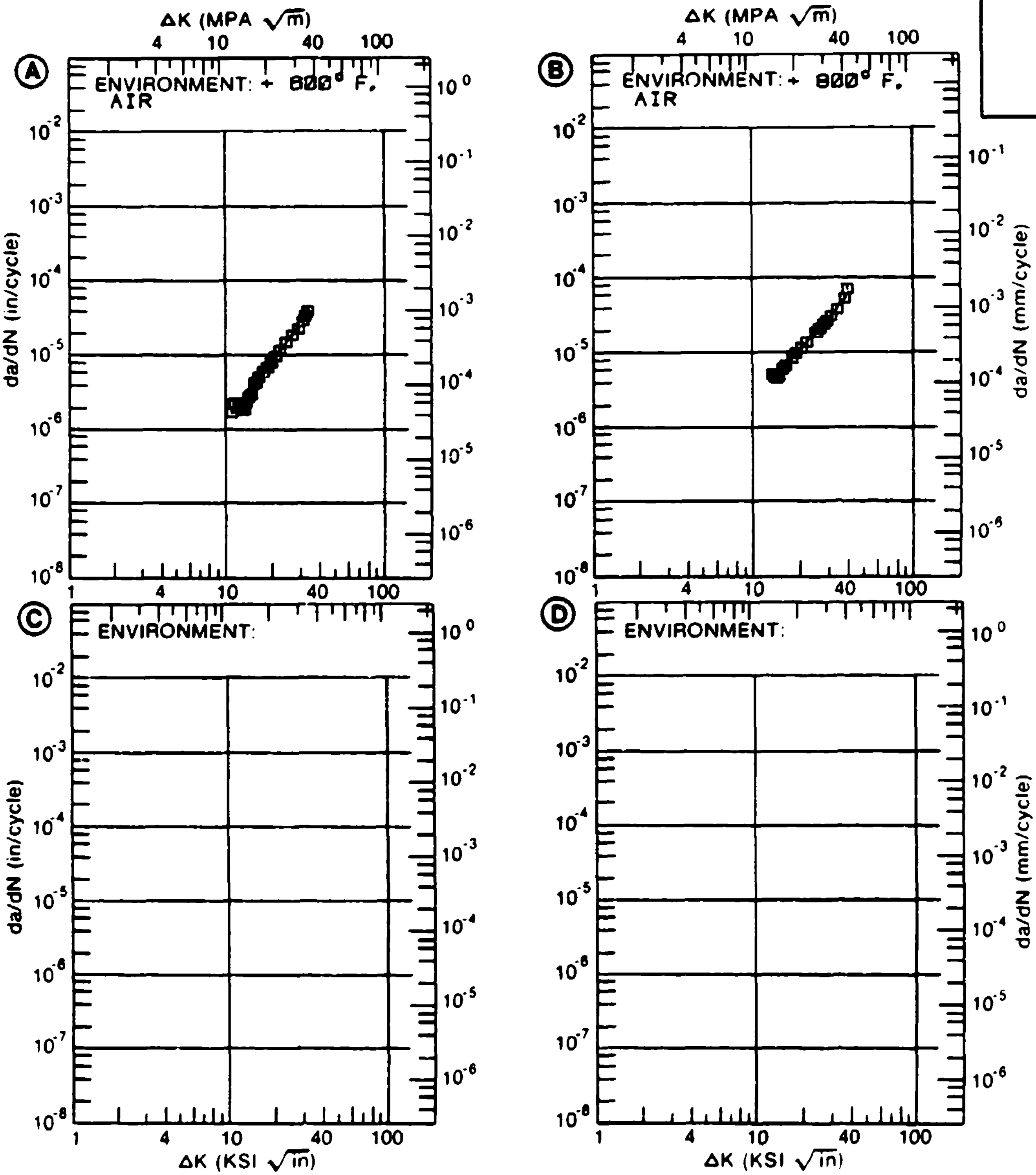

Figure 4.10.3.7

TABLE 4.10.3.8

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 4.10.3.8 INDICATING EFFECT

OF ENVIRONMENT

MATERIAL: TITANIUM TI-6-2-4-6
CONDITION: 1690F 2HRS AC, 1550F 2HRS OQ, 1100F 8HRS
AC

DELTA K (KSI*IN**1/2)		DA/DN (10**-6 IN./CYCLE) A	B	C	D
		E=+ 600F AIR	E=+ 800F AIR		
DELTA K MIN A:	7.88	1.35			
DELTA K MIN B:	8.16		3.26		
DELTA K MIN C:					
DELTA K MIN D:					
	8.00	1.51			
	9.00	2.80	3.82		
	10.00	3.80	4.67		
	13.00		8.96		
	16.00		18.1		
DELTA K MAX A:	12.83	7.75			
DELTA K MAX B:	16.58		20.9		
DELTA K MAX C:					
DELTA K MAX D:					
ROOT MEAN SQUARE PERCENT ERROR		6.25	4.12		

LIFE PREDICTION RATIO SUMMARY (NP/NA)	
	0.0-0.5
	0.5-0.8
	0.8-1.25
	1.25-2.0
	>2.0

CONDITION/HT: 1800F 2HRS AC, 1550F 2HRS OQ, 1100F 8HRS AC
FORM: 2.00"TH FORGING
SPECIMEN TYPE: CCP
ORIENTATION: C-R
STRESS RATIO: +0.50
FREQUENCY: 0.16 HZ

YIELD STRENGTH: 166.0 KSI
ULT. STRENGTH: 182.3 KSI
SPECIMEN THK: 0.080- 0.081"
SPECIMEN WIDTH: 1.750"
REFERENCES: PW002

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TI-6-2-4-6

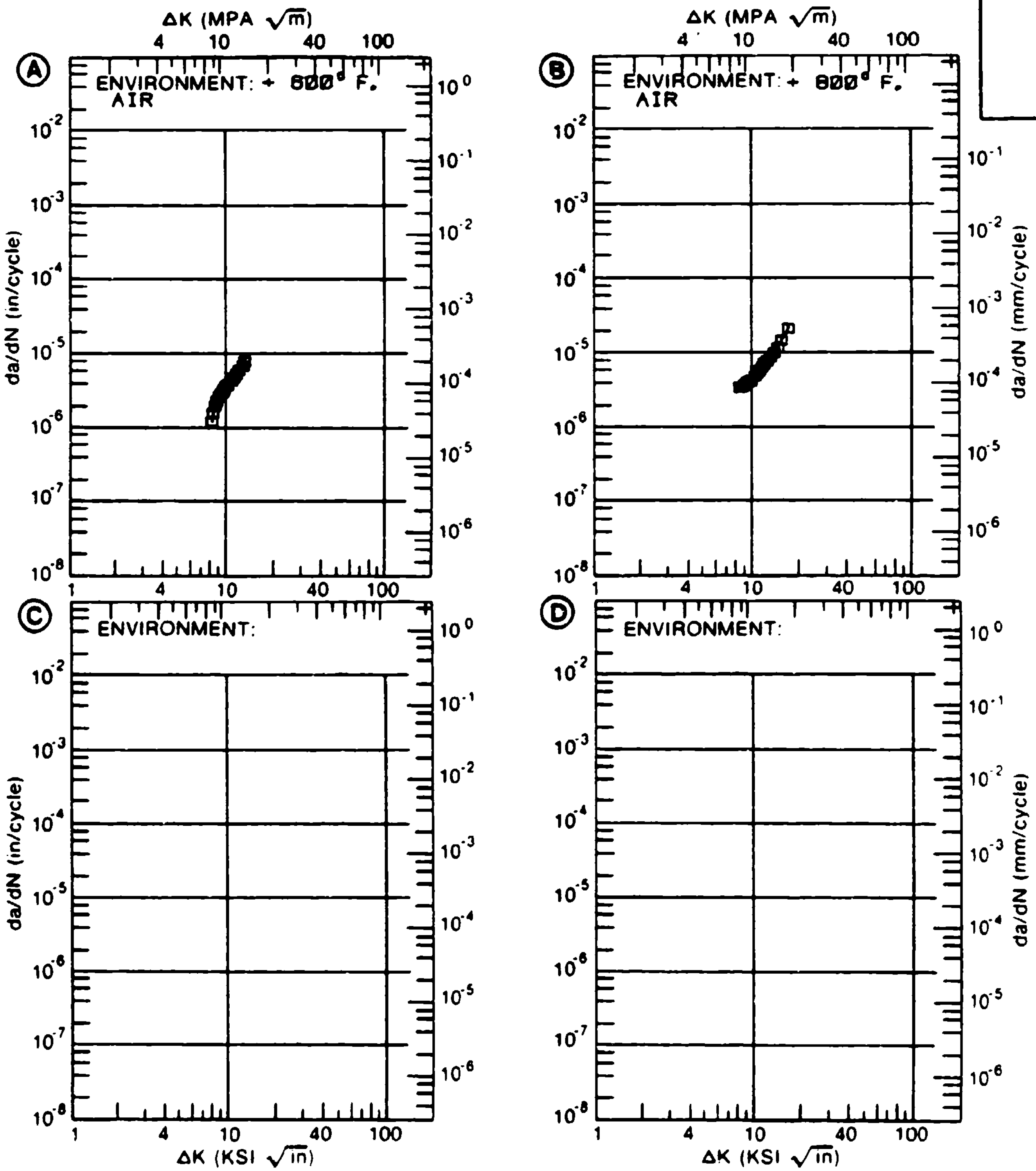

Figure 4.10.3.8

TABLE 4.10.3.9

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 4.10.3.9 INDICATING EFFECT OF ENVIRONMENT

MATERIAL: TITANIUM TI-6-2-4-6
CONDITION: 1690F 2HRS AC, 1550F 2HRS OQ, 1100F 8HRS AC

DELTA K (KSI*IN**1/2)			DA/DN (10**-6 IN./CYCLE) A: E= R.T. LAB AIR .16HZ	B: E= R.T. LAB AIR 999.99HZ	C: E=+ 600F AIR .16HZ	D
DELTA K MIN	A:	3.89	.31			
	B:	1.86		.00		
	C:	4.41			.79	
	D:					
		2.00		.0130		
		2.50		.0636		
		3.00		.121		
		3.50		.176		
		4.00	.317	.237		
		5.00	.524	.460	1.12	
		6.00	1.53		1.65	
		7.00	4.73		2.18	
		8.00	12.2		2.80	
		9.00			3.61	
		10.00			4.74	
		13.00			12.5	
DELTA K MAX	A:	8.59	18.9			
	B:	5.84		1.48		
	C:	14.50			22.0	
	D:					
ROOT MEAN SQUARE PERCENT ERROR			12.54	20.47	7.74	

LIFE PREDICTION RATIO SUMMARY (NP/NA)	
	0.0-0.5
	0.5-0.8
	0.8-1.25
	1.25-2.0
	>2.0

CONDITION/HT: 1800F 2HRS AC, 1550F 2HRS OQ, 1100F 8HRS AC
FORM: 2.80"TH FORGING
SPECIMEN TYPE: CCP
ORIENTATION: C-R
STRESS RATIO: +0.70
FREQUENCY:

YIELD STRENGTH: 166.0 KSI
ULT. STRENGTH: 182.3 KSI
SPECIMEN THK: 0.079- 0.081"
SPECIMEN WIDTH: 1.750"
REFERENCES: PW002

TITAN. ALLOY

TI-6-2-4-6

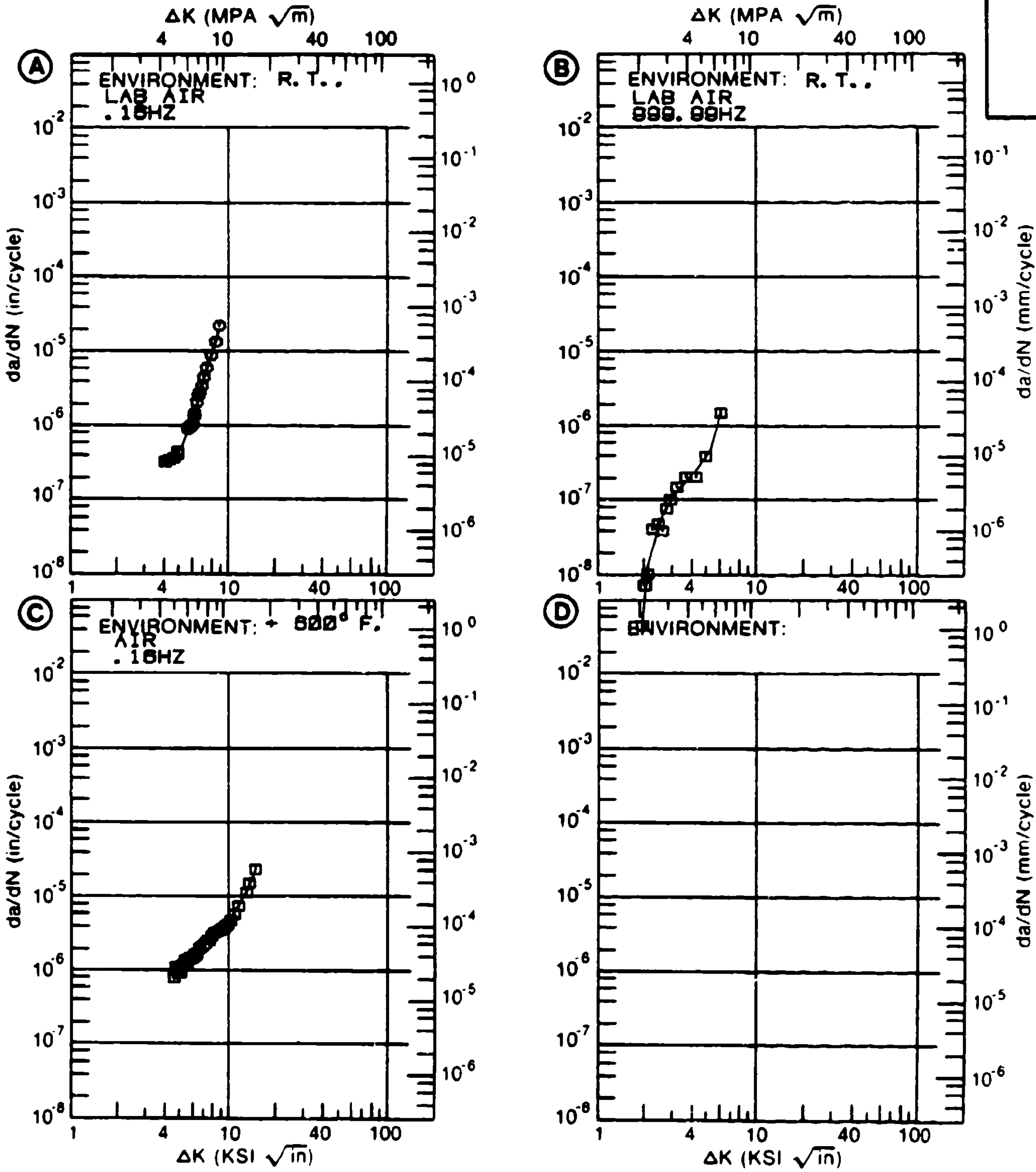

Figure 4.10.3.9

TABLE 4.11.1.1

MEAN PLANE STRAIN FRACTURE TOUGHNESS DATA OF TITANIUM ALLOY TI-6AL-4V AT ROOM TEMPERATURE

CONDITION/HT — MEAN KIC ± STANDARD DEVIATION (KSI SQRT(IN)) (NUMBER OF SPECIMENS)

PLATE

CONDITION/HT	L-T	T-L	S-L
ANNEALED 1375F 3HR. AC	60.4 ± 5.5 (2)	-----	-----
BETA PROCESSED MILL ANNEALED	94.9 ± 4.8 (3)	-----	-----
MILL ANNEAL	55.6 ± 1.3 (2)	-----	-----
MILL ANNEALED	-----	100.6 ± 6.8 (6)	-----
RECRYSTALLIZE ANNEAL	82.8 ± 7.8 (22)	80.8 ±10.8 (22)	-----
STA	-----	42.6 ± 2.0 (3)	-----
1750F 1HR FC TO 1100F, AC	-----	91.5 ± 2.1 (2)	-----
1750F 1HR, FC TO RT	71.8 ± 3.2 (2)	91.6 ± 1.3 (2)	-----
1750F 2HR, WQ, 1000F 2HR, AC, 1300F 2HR, AC, STA	41.4 ± 2.3 (2)	-----	-----

FORGING

CONDITION/HT	L-T	T-L	S-L
AS FORGED-MA ALPHA-BETA FORGED, MILL ANNEALED	-----	35.4 ± 2.7 (4)	-----
ANNEALED	84.4 ± 1.8 (2)	83.4 ± 9.9 (2)	-----
ANNEALED 1300F 4 HR, AC	58.1 ± 1.2 (3)	62.2 ± 3.0 (3)	68.1 ± 1.0 (2)

TABLE 4.11.1.1 (con't)

MEAN PLANE STRAIN FRACTURE TOUGHNESS DATA OF
TITANIUM ALLOY TI-6AL-4V AT ROOM TEMPERATURE

CONDITION/HT	MEAN KIC ± STANDARD (KSI SQRT(IN)) DEVIATION	(NUMBER OF SPECIMENS)	
FORGING			
CONDITION/HT	L-T	T-L	S-L
B FORGED-MA BETA FORGED, MILL ANNEALED 1300F 2 HR, AC	70.6 ± 4.9 (3)	71.0 ± 0.4 (3)	73.9 ± 2.5 (2)
MILL ANNEALED 1300F 2 HR, AC	47.7 ± 2.9 (3)	49.5 ± 3.9 (3)	43.6 ± 5.8 (3)
RECRYSTALLIZE ANNEAL	83.6 ± 5.5 (41)	83.9 ± 6.9 (50)	88.9 ± 3.2 (9)
1700F 6 HR, AC, 1400F 6 HR, AC	75.9 ± 4.2 (6)	81.2 ± 5.8 (6)	-----
1750F 1 HR, WQ, 1000F 4 HR	-----	79.3 ± 4.9 (3)	-----
EXTRUSION			
CONDITION/HT	L-T	T-L	S-L
ANNEALED	-----	93.3 ± 2.3 (2)	-----
MILL ANNEALED	83.5 ± 3.1 (5)	87.5 ± 4.1 (6)	-----
FORGED BAR			
CONDITION/HT	L-T	T-L	S-L
AS RECEIVED	57.1 ±10.4 (14)	54.9 ±10.8 (21)	-----
B FORGED BETA FORGED REHEATED TO 1950F DRAWN TO SIZE, ANNEALED 1300F	-----	42.6 ± 4.3 (4)	-----

TABLE 4.11.1.1 (con't)

MEAN PLANE STRAIN FRACTURE TOUGHNESS DATA OF
TITANIUM ALLOY TI-6AL-4V AT ROOM TEMPERATURE

CONDITION/HT — MEAN KIC ± STANDARD DEVIATION (KSI SQRT(IN)) (NUMBER OF SPECIMENS)

BILLET

CONDITION/HT	L-T	T-L	S-L
ANNEALED	79.6 ± 9.6 (2)	-----	-----
ANNEALED 1000F 2 HR, AC	50.9 ± 0.6 (2)	-----	-----
DIFFUSION BOND ANNEALED	68.2 ± 9.7 (9)	64.2 ±11.8 (13)	-----
MILL ANNEALED 1300F 2 HR, AC	84.0 ± 3.4 (3)	-----	-----

TABLE 4.11.1.2

FATIGUE CRACK GROWTH RATE AT DEFINED LEVELS OF THE STRESS-INTENSITY FACTOR

TITANIUM TI-6AL-4V

<u>TEST CONDITIONS</u>

SPECIMEN ORIENTATION: L-T

ENVIRONMENT: DRY AIR AT R.T.

CONDITION/HT	PRODUCT FORM	STRESS RATIO	FREQ. (HZ)	FATIGUE CRACK GROWTH RATES (MICRO IN/CYCLE) — DELTA K LEVELS: (KSI SQRT(IN)) 2.5	5	10	20	50	100
BA	PLATE	0.10	6.00			0.22	9.19		
BA	PLATE	0.10	6.00			0.06	5.42	85.6	
BA	PLATE	0.30	6.00			0.30	9.75		
BA	PLATE	0.50	6.00			1.19	10.9		
BETA PROCESSED -MILL ANNEALED	SHEET	0.10	10.00					48.8	
BETA PROCESSED -MILL ANNEALED	PLATE	0.10	10.00				4.51		
BETA PROCESSED -MILL ANNEALED	PLATE	0.10	10.00					48.7	
BETA PROCESSED -MILL ANNEALED	PLATE	0.10	10.00				4.66		

TABLE 4.11.1.3

FATIGUE CRACK GROWTH RATE AT DEFINED LEVELS OF THE STRESS-INTENSITY FACTOR

TITANIUM TI-6AL-4V

TEST CONDITIONS

SPECIMEN ORIENTATION L-T

ENVIRONMENT: L.H.A AT R.T.

CONDITION/HT	PRODUCT FORM	STRESS RATIO	FREQ. (HZ)	DELTA K LEVELS: (KSI SQRT(IN))	2.5	5	10	20	50	100
DBTC	PLATE	0.08	1.00					16.4	753	
DBTC	PLATE	0.30	1.00	SPEC THK=1.00"			0.35	13.1	285	
DBTC	PLATE	0.30	1.00	SPEC THK=0.50"			0.62	19.4	2180	
MA	SHEET	0.08	6.00				1.79	13.7		
MA	SHEET	0.30	6.00				2.24			
MA	SHEET	0.50	6.00				2.30	21.1		
MA	PLATE	0.30	1.00	DATA OUT OF TREND				72.6		
MA	PLATE	0.30	1.00- 6.00				0.42	24.7	402.	
MA	PLATE	0.30	1.00- 6.00				0.46	11.2	255.	
MA	EXTRUSION	0.08	1.00					13.9		
MA	EXTRUSION	0.08	6.00				0.37	11.7		
MA	EXTRUSION	0.30	6.00					16.8		
MA	EXTRUSION	0.50	6.00					17.3		
RA	PLATE	0.08	6.00					10.4		
RA	PLATE	0.08	6.00					7.80		
RA	PLATE	0.08	6.00	DATA OUT OF TREND				3.34	145	
RA	PLATE	0.08	6.00				0.72	11.3		

TABLE 4.11.1.3 (Con't)

FATIGUE CRACK GROWTH RATE AT DEFINED LEVELS OF THE STRESS-INTENSITY FACTOR

TITANIUM TI-6AL-4V

TEST CONDITIONS

SPECIMEN ORIENTATION L-T

ENVIRONMENT. L H A AT R. T

CONDITION/HT	PRODUCT FORM	STRESS RATIO	FREQ. (HZ)	DELTA K LEVELS: (KSI SQRT(IN)) 2.5	5	10	20	50	100
				FATIGUE CRACK GROWTH RATES (MICRO IN/CYCLE)					
RA	PLATE	0.08	6.00			0.49	9.42	171	
RA	PLATE	0.30	6.00			1.39	15.9		
RA	PLATE	0.50	6.00			1.94	16.8		
RA	PLATE	0.70	6.00			3.12			
RA	FORGING	0.08	1.00			0.38	5.78	166	
RA	FORGING	0.08	6.00				6.76		
RA	FORGING	0.30	6.00			1.22	16.2	324	

TABLE 4.11.1.4

FATIGUE CRACK GROWTH RATE AT DEFINED LEVELS OF THE STRESS-INTENSITY FACTOR

TITANIUM TI-6AL-4V

TEST CONDITIONS

SPECIMEN ORIENTATION: L-T

ENVIRONMENT: LAB AIR AT R.T

CONDITION/HT	PRODUCT FORM	STRESS RATIO	FREQ. (HZ)	DELTA K LEVELS: (KSI SQRT(IN))	2.5	5	10	20	50	100
					FATIGUE CRACK GROWTH RATES (MICRO IN/CYCLE)					
ANNEALED	BILLET	0.02	10.00-20.00				0.27	9.49		
ANNEALED AT 1375F, 3HRS, AC	PLATE	0.02	10.00-20.00				0.28	9.70		
BA	FORGING	0.02	0.10-20.00					2.55	102	
BETA PROCESSED -MILL ANNEALED	PLATE	0.10	1.00					0.91		
BETA PROCESSED MILL ANNEALED	PLATE	0.50	1.00				1.47			
MA	PLATE	-1.00	10.00				1.14	12.8	328	
MA	PLATE	0.02	0.10-30.00	DATA OUT OF TREND		0.01	0.44	12.4		
MA	PLATE	0.02	0.10-30.00				0.15	5.92		
MA	PLATE	0.04	20.00						96.5	
MA	PLATE	0.05	20.00					6.97		
MA	PLATE	0.30	20.00				0.99			
MA	PLATE	0.50	10.00				8.52	92.4		
MA	FORGING	0.02	1.00-30.00					8.18	292	

TABLE 4.11.1.5

FATIGUE CRACK GROWTH RATE AT DEFINED LEVELS OF THE STRESS-INTENSITY FACTOR

TITANIUM TI-6AL-4V

TEST CONDITIONS

SPECIMEN
ORIENTATION L-T

ENVIRONMENT: H.H.A
AT R.T.

CONDITION/HT	PRODUCT FORM	STRESS RATIO	FREQ. (HZ)	DELTA K LEVELS: (KSI SQRT(IN))						
				FATIGUE CRACK GROWTH RATES (MICRO IN/CYCLE)						
					2.5	5	10	20	50	100
BA	PLATE	0.10	0.10					4.10	115	
BA	PLATE	0.30	0.10					9.31		
BA	PLATE	0.50	0.10					12.0	1009	

TABLE 4.11.1.6

FATIGUE CRACK GROWTH RATE AT DEFINED LEVELS OF THE STRESS-INTENSITY FACTOR

TITANIUM TI-6AL-4V

TEST CONDITIONS

SPECIMEN ORIENTATION L-T

ENVIRONMENT: J.P.4 AT R.T.

CONDITION/HT	PRODUCT FORM	STRESS RATIO	FREQ. (HZ)	DELTA K LEVELS: (KSI SQRT(IN))	2.5	5	10	20	50	100
					FATIGUE CRACK GROWTH RATES (MICRO IN/CYCLE)					
BA	FORGING	0.02	0.10- 20.00					2.08	88.2	4343.0
MA	EXTRUSION	0.08	6.00				1.47	12.9		
MA	EXTRUSION	0.08	1.00					12.0		
RA	PLATE	0.08	1.00				0.66	12.8		
RA	FORGING	0.08	1.00					5.54		

TABLE 4.11.1.7

FATIGUE CRACK GROWTH RATE AT DEFINED LEVELS OF THE STRESS-INTENSITY FACTOR

TITANIUM TI-6AL-4V

TEST CONDITIONS

SPECIMEN ORIENTATION: L-T

ENVIRONMENT: S.T.W. AT R.T.

CONDITION/HT	PRODUCT FORM	STRESS RATIO	FREQ. (HZ)	DELTA K LEVELS: (KSI SQRT(IN))	FATIGUE CRACK GROWTH RATES (MICRO IN/CYCLE) 2.5	5	10	20	50	100
BA	PLATE	0.10	1.00					11.1	163	
DBTC	PLATE	0.08	1.00				0.62	13.9		
MA	SHEET	0.08	1.00				3.22			
MA	PLATE	0.03	1.00	SPEC THK=0.50"				87.5		
MA	PLATE	0.03	1.00	SPEC THK=1.00"			589	31.5		
MA	EXTRUSION	0.08	1.00					14.3	266.	
MA	EXTRUSION	0.10	1.00- 10.00					11.2	254.	
RA	PLATE	0.08	0.10					11.0		
RA	PLATE	0.08	1.00				0.59	8.98	344	
RA	PLATE	0.08	1.00					9.34		
RA	PLATE	0.08	1.00				0.77	13.4		
RA	PLATE	0.30	1.00				2.27	24.5		
RA	PLATE	0.50	1.00				4.23			
RA	FORGING	0.08	1.00				1.65	36.8		

TABLE 4.11.1.8

FATIGUE CRACK GROWTH RATE AT DEFINED LEVELS OF THE STRESS-INTENSITY FACTOR

TITANIUM TI-6AL-4V

TEST CONDITIONS

SPECIMEN ORIENTATION T-S

ENVIRONMENT: 3.5% NACL AT R.T.

CONDITION/HT	PRODUCT FORM	STRESS RATIO	FREQ. (HZ)	DELTA K LEVELS: (KSI SQRT(IN)) 2.5	5	10	20	50	100
				FATIGUE CRACK GROWTH RATES (MICRO IN/CYCLE)					
BA	PLATE	0.10	10.00			0.62	17.6		
RA	PLATE	0.10	10.00				49.7		

TABLE 4.11.1.9

FATIGUE CRACK GROWTH RATE AT DEFINED LEVELS OF THE STRESS-INTENSITY FACTOR

TITANIUM TI-6AL-4V

TEST CONDITIONS

SPECIMEN ORIENTATION T-L

ENVIRONMENT DRY AIR AT R T

CONDITION/HT	PRODUCT FORM	STRESS RATIO	FREQ. (HZ)	DELTA K LEVELS: (KSI SQRT(IN))	2.5	5	10	20	50	100
					FATIGUE CRACK GROWTH RATES (MICRO IN/CYCLE)					
RA	PLATE	0.10	0.10						224	
RA	PLATE	0.10	1.00					9.08	164	
RA	PLATE	0.50	0.10				1.08	20.4		
RA	PLATE	0.50	1.00				1.52	17.2		

TABLE 4.11.1.10

FATIGUE CRACK GROWTH RATE AT DEFINED LEVELS OF THE STRESS-INTENSITY FACTOR

TITANIUM TI-6AL-4V

TEST CONDITIONS

SPECIMEN ORIENTATION T-L

ENVIRONMENT: L.H.A. AT R.T.

CONDITION/HT	PRODUCT FORM	STRESS RATIO	FREQ (HZ)	DELTA K LEVELS: (KSI SQRT(IN))	FATIGUE CRACK GROWTH RATES (MICRO IN/CYCLE)					
					2.5	5	10	20	50	100
DB	PLATE	0.08	6.00				0.39	12.1		
DB	PLATE	0.30	6.00					33.1		
DBTC	PLATE	0.08	1.00					7.70	169	
DBTC	PLATE	0.30	1.00				0.56	12.5	278	
MA	SHEET	0.08	6.00					9.22		
MA	PLATE	0.30	1.00- 6.00				0.46	11.2	255	
MA	EXTRUSION	0.08	6.00					12.7		
RA	PLATE	0.08	6.00				0.53	11.4	208	
RA	PLATE	0.08	6.00					9.89		
RA	FORGING	0.08	6.00					7.65	135	
RA	FORGING	0.50	6.00				2.68	19.8		

TABLE 4.11.1.11

FATIGUE CRACK GROWTH RATE AT DEFINED LEVELS OF THE STRESS-INTENSITY FACTOR

TITANIUM TI-6AL-4V

TEST CONDITIONS

SPECIMEN ORIENTATION: T-L

ENVIRONMENT: LAB AIR AT R.T.

CONDITION/HT	PRODUCT FORM	STRESS RATIO	FREQ. (HZ)	DELTA K LEVELS: (KSI SQRT(IN)) 2.5	5	10	20	50	100
AS WELDED E.B. WELDMENT (WELD ZONE)	WELDMENT	0.10	10.00				5.94		
AS WELDED E.B. WELDMENT (HEAT AFFECTED ZONE)	WELDMENT	0.10	10.00				6.52		
BA	FORGING	0.02	0.10-20.00				2.27	103.	3242
MA	EXTRUSION	0.10	5.00- 20.00				13.7	281.	
RA	PLATE	0.10	10.00				21.3		
STRESS RELIEVED E.B. WELDMENT (HEAT AFFECTED ZONE)	WELDMENT	0.10	0.10-10.00				14.2	344	
STRESS RELIEVED E.B. WELDMENT (WELD ZONE)	WELDMENT	0.10	0.10-10.00				10.1		

Fatigue crack growth rates in MICRO IN/CYCLE.

TABLE 4.11.1.12

FATIGUE CRACK GROWTH RATE AT DEFINED LEVELS OF THE STRESS-INTENSITY FACTOR

TITANIUM TI-6AL-4V

TEST CONDITIONS

SPECIMEN ORIENTATION T-L

ENVIRONMENT: AIR AT 175 F

CONDITION/HT	PRODUCT FORM	STRESS RATIO	FREQ (HZ)	DELTA K LEVELS: (KSI SQRT(IN))	2.5	5	10	20	50	100
					FATIGUE CRACK GROWTH RATES (MICRO IN/CYCLE)					
MA	PLATE	0.10	0.10-10.00					11.7	135	
STRESS RELIEVED E B WELDMENT (HEAT AFFECTED ZONE)	WELDMENT	0.10	0.10-10.00					8.82	150	

TABLE 4.11.1.13

FATIGUE CRACK GROWTH RATE AT DEFINED LEVELS OF THE STRESS-INTENSITY FACTOR

TITANIUM TI-6AL-4V

TEST CONDITIONS

SPECIMEN ORIENTATION T-L

ENVIRONMENT: H.H.A. AT R.T

CONDITION/HT	PRODUCT FORM	STRESS RATIO	FREQ. (HZ)	DELTA K LEVELS: (KSI SQRT(IN))	2.5	5	10	20	50	100
					FATIGUE CRACK GROWTH RATES (MICRO IN/CYCLE)					
RA	PLATE	0.10	10.00					14.4		
RA	PLATE	0.10	10.00				3.57	23.8		
RA	PLATE	0.50	10.00			0.32	3.63	64.9		
RA	PLATE	0.50	10.00	DATA OUT OF TREND			6.45	26.8		

TABLE 4.11.1.14

FATIGUE CRACK GROWTH RATE AT DEFINED LEVELS OF THE STRESS-INTENSITY FACTOR

TITANIUM TI-6AL-4V

TEST CONDITIONS

SPECIMEN ORIENTATION: T-L

ENVIRONMENT: JP-4 FUEL AT R.T.

CONDITION/HT	PRODUCT FORM	STRESS RATIO	FREQ. (HZ)	DELTA K LEVELS: (KSI SQRT(IN))	FATIGUE CRACK GROWTH RATES (MICRO IN/CYCLE) 2.5	5	10	20	50	100
BA	FORGING	0.02	0.10-20.00					2.40	103	
RA	PLATE	0.08	1.00				0.72	14.2		
STRESS RELIEVED F.B. WELDMENT (HEAT AFFECTED ZONE)	WELDMENT	0.10	0.10-10.00					9.65	1560	

TABLE 4.11.1.15

FATIGUE CRACK GROWTH RATE AT DEFINED LEVELS OF THE STRESS-INTENSITY FACTOR

TITANIUM TI-6AL-4V

TEST CONDITIONS

SPECIMEN ORIENTATION T-L

ENVIRONMENT: WATER SATURATED JP-4 FUEL AT R. T.

CONDITION/HT	PRODUCT FORM	STRESS RATIO	FREQ. (HZ)	FATIGUE CRACK GROWTH RATES (MICRO IN/CYCLE)					
DELTA K LEVELS: (KSI SQRT(IN))				2.5	5	10	20	50	100
RA	PLATE	0.10	0.10					204	
RA	PLATE	0.10	1.00					179	
RA	PLATE	0.50	0.10				17.0		
RA	PLATE	0.50	1.00			1.53	18.4		

TABLE 4.11.1.16

FATIGUE CRACK GROWTH RATE AT DEFINED LEVELS OF THE STRESS-INTENSITY FACTOR

TITANIUM TI-6AL-4V

TEST CONDITIONS

SPECIMEN ORIENTATION T-L

ENVIRONMENT DIST. WATER AT R. T.

CONDITION/HT	PRODUCT FORM	STRESS RATIO	FREQ. (HZ)	DELTA K LEVELS: (KSI SQRT(IN)) 2.5	5	10	20	50	100
				FATIGUE CRACK GROWTH RATES (MICRO IN/CYCLE)					
BA	PLATE	0.10	0.10					126	
RA	PLATE	0.00	15.00			0.43			
RA	PLATE	0.10	0.10				19.0	254	
RA	PLATE	0.10	1.00					197	
RA	PLATE	0.50	0.10				21.8		
RA	PLATE	0.50	1.00			2.64	36.8		
STRESS RELIEVED E B WELDMENT (WELD ZONE)	WELDMENT	0.10	0.10-10.00					2052	

TABLE 4.11.1.17

FATIGUE CRACK GROWTH RATE AT DEFINED LEVELS OF THE STRESS-INTENSITY FACTOR

TITANIUM TI-6AL-4V

TEST CONDITIONS

SPECIMEN ORIENTATION T-L

ENVIRONMENT: DIST. WATER AT 175 F

CONDITION/HT	PRODUCT FORM	STRESS RATIO	FREQ (HZ)	DELTA K LEVELS: (KSI SQRT(IN)) 2.5	5	10	20	50	100
				FATIGUE CRACK GROWTH RATES (MICRO IN/CYCLE)					
RA	PLATE	0 50	1 00				29.6		
STRESS RELIEVED E B WELDMENT (HEAT AFFECTED ZONE)	WELDMENT	0.10	0 10-10 00					952	

TABLE 4.11.1.18

FATIGUE CRACK GROWTH RATE AT DEFINED LEVELS OF THE STRESS-INTENSITY FACTOR

TITANIUM TI-6AL-4V

TEST CONDITIONS

SPECIMEN ORIENTATION T-L

ENVIRONMENT 3 5%NACL AT R.T.

CONDITION/HT	PRODUCT FORM	STRESS RATIO	FREQ. (HZ)	DELTA K LEVELS (KSI SQRT(IN))	FATIGUE CRACK GROWTH RATES (MICRO IN/CYCLE) 2.5	5	10	20	50	100
BA	PLATE	0.10	1.00					38.5	281	
BA	PLATE	0.10	10.00				0.98	13.8	109	
RA	PLATE	0.00	15.00				0.64			
RA	PLATE	0.10	0.10						1852	
RA	PLATE	0.10	0.10				3.50	44.7		
RA	PLATE	0.10	1.00					28.6	526	
RA	PLATE	0.10	10.00				4.86	63.0		
RA	PLATE	0.10	10.00					58.9		
RA	PLATE	0.50	0.10				2.55			
RA	PLATE	0.50	1.00				2.65	117		
RA	PLATE	0.50	10.00	DATA OUT OF TREND			33.7	168		
STRESS RELIEVED E.B. WELDMENT (WELD ZONE)	WELDMENT	0.10	0.10-10.00						18134	
STRESS RELIEVED E.B. WELDMENT (HEAT AFFECTED ZONE)	WELDMENT	0.10	0.10-10.00					13.9		

TABLE 4.11.1.19

FATIGUE CRACK GROWTH RATE AT DEFINED LEVELS OF THE STRESS-INTENSITY FACTOR

TITANIUM TI-6AL-4V

TEST CONDITIONS

SPECIMEN ORIENTATION T-L

ENVIRONMENT. S.T.W. AT R.T.

CONDITION/HT	PRODUCT FORM	STRESS RATIO	FREQ. (HZ)	DELTA K LEVELS: (KSI SQRT(IN))	2.5	5	10	20	50	100
					FATIGUE CRACK GROWTH RATES (MICRO IN/CYCLE)					
BA	PLATE	0.10	0.10	DATA OUT OF TREND			0.58	6.43	400	
BA	PLATE	0.10	1.00					35.3	192	
BA	PLATE	0.10	10.00					18.6	94.3	
DB	PLATE	0.08	1.00					8.20	214	
DB + 2DBTC	PLATE	0.08	1.00					7.93	244	
DB + 4DBTC	PLATE	0.08	1.00					9.03	209	
DBT + PC	PLATE	0.08	1.00					11.2		
DBTC	PLATE	0.08	1.00				1.83	18.4		
MA	EXTRUSION	0.08	6.00				0.62	11.1		
MA	EXTRUSION	0.10	1.00-10.00					25.9	324.	
RA	PLATE	0.00	15.00				0.64			
RA	PLATE	0.08	1.00	DATA OUT OF TREND			2.08	48.7		
RA	PLATE	0.08	1.00				0.96	12.7	285.	

TABLE 4.11.1.19 (Con't)

FATIGUE CRACK GROWTH RATE AT DEFINED LEVELS OF THE STRESS-INTENSITY FACTOR

TITANIUM TI-6AL-4V

TEST CONDITIONS

SPECIMEN ORIENTATION T-L

ENVIRONMENT S.T.W. AT R.T.

CONDITION/HT	PRODUCT FORM	STRESS RATIO	FREQ (HZ)	DELTA K LEVELS: (KSI SQRT(IN)) 2.5	5	10	20	50	100
				FATIGUE CRACK GROWTH RATES (MICRO IN/CYCLE)					
RA	PLATE	0.08	1.00				9.12		
RA	PLATE	0.08	1.00				8.98		
RA	PLATE	0.10	0.10					905	
RA	PLATE	0.10	0.10					3950	
RA	PLATE	0.10	1.00					310	
RA	PLATE	0.50	1.00			2.02	52.5		
RA	FORGING	0.08	1.00				16.1	225.	
RA	FORGING	0.08	1.00			0.69	14.0	192.	
RA	FORGING	0.08	1.00			0.74	14.9		
RA	FORGING	0.50	1.00			3.39	61.3		

TABLE 4.11.1.20

FATIGUE CRACK GROWTH RATE AT DEFINED LEVELS OF THE STRESS-INTENSITY FACTOR

TITANIUM TI-6AL-4V

TEST CONDITIONS

SPECIMEN ORIENTATION S-T

ENVIRONMENT: S.T.W. AT R.T.

CONDITION/HT	PRODUCT FORM	STRESS RATIO	FREQ. (HZ)	DELTA K LEVELS (KSI SQRT(IN))						
				FATIGUE CRACK GROWTH RATES (MICRO IN/CYCLE)						
					2.5	5	10	20	50	100
DB	PLATE	0.08	1.00				0.78	21.3		
DB + TR	PLATE	0.08	1.00					9.78		

TABLE 4.11.1.21

FATIGUE CRACK GROWTH RATE AT DEFINED LEVELS OF THE STRESS-INTENSITY FACTOR

TITANIUM TI-6AL-4V

TEST CONDITIONS

SPECIMEN ORIENTATION L-R

ENVIRONMENT: AIR AT 300 F

CONDITION/HT	PRODUCT FORM	STRESS RATIO	FREQ. (HZ)	DELTA K LEVELS: (KSI SQRT(IN)) 2.5	5	10	20	50	100
				FATIGUE CRACK GROWTH RATES (MICRO IN/CYCLE)					
MA 1300F 2HRS AC	DISK	0.00	0.33				6.72		
MA 1300F 2HRS AC	DISK	0.25	0.33				13.5		
MA 1300F 2HRS AC	DISK	0.54	0.33			1.19			

TABLE 4.11.1.22

FATIGUE CRACK GROWTH RATE AT DEFINED LEVELS OF THE STRESS-INTENSITY FACTOR

TITANIUM TI-6AL-4V

TEST CONDITIONS

SPECIMEN ORIENTATION R-C

ENVIRONMENT ARGON AT R. T.

CONDITION/HT	PRODUCT FORM	STRESS RATIO	FREQ (HZ)	DELTA K LEVELS (KSI SQRT(IN)) 2.5	5	10	20	50	100
				FATIGUE CRACK GROWTH RATES (MICRO IN/CYCLE)					
1550F 4HRS FC. 1000F 4HRS. ARGON COOLED	FORGING	0.10	10.00			0.19	3.81		
1550F 4HRS FC. 1000F 4HRS. ARGON COOLED	FORGING	0.10	10.00				4.08		
1750F 4HRS ARGON COOLED. 1000F 4HRS. ARGON COOLED	FORGING	0.10	9.99				4.13		
1750F 4HRS ARGON COOLED. 1000F 4HRS. ARGON COOLED	FORGING	0.10	10.00				4.05		
1950F 4HRS WQ. 1000F 4HRS ARGON COOLED	FORGING	0.10	10.00				2.38	257	

TABLE 4.11.1.23

FATIGUE CRACK GROWTH RATE AT DEFINED LEVELS OF THE STRESS-INTENSITY FACTOR

TITANIUM TI-6AL-4V

TEST CONDITIONS

SPECIMEN ORIENTATION: C-R

ENVIRONMENT: ARGON AT R.T

CONDITION/HT	PRODUCT FORM	STRESS RATIO	FREQ. (HZ)	DELTA K LEVELS: (KSI SQRT(IN))	FATIGUE CRACK GROWTH RATES (MICRO IN/CYCLE) 2.5	5	10	20	50	100
1750F 4HRS ARGON COOLED. 1000F 4HRS ARGON COOLED	FORGING	0.10	10.00					4.61		
1950F 4HRS WQ. 1000F 4HRS ARGON COOLED	FORGING	0.10	10.00					3.37		

TABLE 4.11.1.24

FATIGUE CRACK GROWTH RATE AT DEFINED LEVELS OF THE STRESS-INTENSITY FACTOR

TITANIUM TI-6AL-4V

TEST CONDITIONS

SPECIMEN ORIENTATION: C-R

ENVIRONMENT: LAB AIR AT R.T

CONDITION/HT	PRODUCT FORM	STRESS RATIO	FREQ. (HZ)	DELTA K LEVELS: (KSI SQRT(IN)) 2.5	5	10	20	50	100
				FATIGUE CRACK GROWTH RATES (MICRO IN/CYCLE)					
1775F 1HR WQ. 1675F 1HR WQ. 1000F 4HRS AC. 900F 5HR	DISK	0.05	0.33-10.00					152	
1775F 1HR WQ. 1675F 1HR WQ. 1000F-1200F 2-8HRS AC	DISK	0.03	0.33- .50			0.86	11.0		
1775F 1HR WQ. 1675F 1HR WQ. 1000F-1200F 2-8HRS AC	DISK	0.25	0.33- 50				18.9		

TABLE 4.11.1.25

FATIGUE CRACK GROWTH RATE AT DEFINED LEVELS OF THE STRESS-INTENSITY FACTOR

TITANIUM TI-6AL-4V

TEST CONDITIONS

SPECIMEN ORIENTATION: C-R

ENVIRONMENT: AIR AT 300 F

CONDITION/HT	PRODUCT FORM	STRESS RATIO	FREQ. (HZ)	DELTA K LEVELS: (KSI SQRT(IN)) 2.5	5	10	20	50	100
				FATIGUE CRACK GROWTH RATES (MICRO IN/CYCLE)					
1775F 1HR WQ. 1675F 1HR WQ. 1000F-1200F 2-8HRS AC	DISK	0.03	0.33			0.74	10.1		
1775F 1HR WQ. 1675F 1HR WQ. 1000F-1200F 2-8HRS AC	DISK	0.25	0.33				11.9		

TABLE 4.11.1.26

FATIGUE CRACK GROWTH RATE AT DEFINED LEVELS OF THE STRESS-INTENSITY FACTOR

TITANIUM TI-6AL-4V

TEST CONDITIONS

SPECIMEN ORIENTATION C-R

ENVIRONMENT AIR AT 600 F

CONDITION/HT	PRODUCT FORM	STRESS RATIO	FREQ (HZ)	DELTA K LEVELS: (KSI SQRT(IN)) 2.5	5	10	20	50	100
						FATIGUE CRACK GROWTH RATES (MICRO IN/CYCLE)			
1775F 1HR WQ. 1675F 1HR WQ. 1000F-1200F 2-8HRS AC	DISK	0.03	0.33			1.05	9.87		
1775F 1HR WQ. 1675F 1HR WQ. 1000F-1200F 2-8HRS AC	DISK	0.03	0.33			1.77	12.6		
1775F 1HR WQ. 1675F 1HR WQ. 1000F-1200F 2-8HRS AC	DISK	0.25	0.33			2.04	13.3		
1775F 1HR WQ. 1675F 1HR WQ. 1000F-1200F 2-8HRS AC	DISK	0.54	0.33			2.12			

TABLE 4.11.2.1

TITANIUM   TI-6AL-4V   K(IC)

CONDITION	--PRODUCT-- FORM	THICK (IN)	TEST TEMP (F)	SPECIMEN ORIENT	YIELD STRENGTH (KSI)	------SPECIMEN------ WIDTH (IN) W	THICK (IN) B	DESIGN	CRACK LENGTH (IN) A	2.5*(K(IC)/TYS)**2 (IN)	K(IC) (KSI*SQRT IN)	K(IC) MEAN	STAN DEV	DATE	REFER
AB FORGED-MA	F	----	R.T.	--	133.0	2.500	1.250	CT	1.250	0.57	63.60			1973	90584 (1)
ALPHA-BETA		----			133.0	2.500	1.250	CT	1.250	0.50	59.40			1973	90584 (1)
FORGED, MILL		----			134.0	2.500	1.250	CT	1.250	0.62	66.50			1973	90584 (1)
ANNEALED		----			134.0	2.500	1.250	CT	1.250	0.41	54.10			1973	90584 (1)
		----			134.0	2.500	1.250	CT	1.250	0.43	55.90			1973	90584 (1)
		----			134.0	2.500	1.250	CT	1.250	0.44	56.30			1973	90584 (1)
		2.75			136.0	2.000	1.000	CT	1.000	0.44	57.20			1974	88962 (2)
		2.75			136.0	2.000	1.000	CT	1.000	0.41	55.20			1974	88962 (2)
												58.5/	4.4		
AB FORGED-MA	F	2.25	R.T.	T-L	145.0	2.000	1.000	CT	1.065	0.18	38.60			1973	86688
ALPHA-BETA		2.25			145.0	3.000	1.500	CT	1.556	0.12	32.20			1973	86688
FORGED, MILL		2.25			145.0	2.000	1.000	CT	1.071	0.15	36.00			1973	86688
ANNEALED		2.25			145.0	2.000	1.000	CT	1.074	0.14	34.90	35.4/	2.7	1973	86688
AB FORGED-RA	F	----	R.T.	--	128.0	2.500	1.250	CT	1.250	0.74	69.90			1973	90584 (1)
ALPHA-BETA		----			128.0	2.500	1.250	CT	1.250	0.79	72.10			1973	90584 (1)
FORGED,		----			128.0	2.500	1.250	CT	1.250	0.72	68.60			1973	90584 (1)
RECRYSTALLIZED		----			128.0	2.500	1.250	CT	1.250	0.70	68.00			1973	90584 (1)
ANNEAL, 1700F		----			128.0	2.500	1.250	CT	1.250	0.74	69.60			1973	90534 (1)
4 HR, FC TO		----			128.0	2.500	1.250	CT	1.250	0.70	67.70			1973	90584 (1)
1000F, AC		----			132.0	2.500	1.250	CT	1.250	0.60	64.50			1973	90584 (1)
		----			132.0	2.500	1.250	CT	1.250	0.54	61.70			1973	90584 (1)
												67.8/	3.3		
ANNEALED	F	3.00	R.T.	L-T	114.0	3.001	1.501	CT	1.566	1.41	85.70			1973	85034
		3.00			119.0	2.998	1.500	CT	1.556	1.22	83.10	84.4/	1.8	1973	85034
ANNEALED	F	3.00	R.T.	T-L	118.0	3.003	1.500	CT	1.549	1.46	90.40			1973	85034
		3.00			120.0	3.001	1.494	CT	1.618	1.01	76.40	83.4/	9.9	1973	85034
ANNEALED	E	4.00	R.T.	L-T	122.0	4.006	1.624	CT	2.027	1.42	92.00			1973	85836 (3)
ANNEALED	E	4.00	R.T.	T-L	122.0	4.003	1.629	CT	2.027	1.51	94.90			1973	85836 (3)
		4.00			122.0	4.003	1.625	CT	1.995	1.41	91.70			1973	85836 (3)
												93.3/	2.3		
ANNEALED	BT	6.00	R.T.	L-T	123.0	2.501	1.250	CT	1.249	0.87	72.00			1975	MA003

NOTES:
(1) F-14 OUTBOARD COVER
(2) COMP DISK
(3) COMPOSITION(WT PERCENT) 6.35AL, 4.31V, 0.022C, 0.16FE, 0.009N, 0.006H, 0.160

TABLE 4.11.2.1 (con't)

TITANIUM TI-6AL-4V K(IC)

CONDITION	--PRODUCT-- FORM	THICK (IN)	TEST TEMP (F)	SPECIMEN ORIENT	YIELD STRENGTH (KSI)	------SPECIMEN------ WIDTH (IN) W	THICK (IN) B	DESIGN	CRACK LENGTH (IN) A	2.5* (K(IC)/TYS)**2 (IN)	K(IC) (KSI*SQRT IN)	K(IC) MEAN	STAN DEV	DATE	REFER
ANNEALED 1375F 3HR, AC	P	2.75	R.T.	L-T	129.0	2.499	1.250	CT	1.224	0.48	56.59			1975	MA003
		2.75			129.0	2.497	1.250	CT	1.200	0.62	64.30	60.4/	5.5	1975	MA003
ANNEALED 2200F 2 HR	F	1.00	R.T.	--	140.0	2.000	1.000	CT	1.000	0.50	62.80			1974	88962 (1)
		1.00			140.0	2.000	1.000	CT	1.000	0.43	58.20			1974	88962 (1)
		1.00			140.0	2.000	1.000	CT	1.000	0.39	55.20			1974	88962 (1)
		1.00			140.0	2.000	1.000	CT	1.000	0.44	50.80			1974	88962 (1)
		1.00			140.0	2.000	1.000	CT	1.000	0.35	52.40			1974	88962 (1)
												57.5/	3.9		
AS RECEIVED	FB	----	R.T.	L-T	124.0	2.000	1.002	CT	1.020	0.61	61.10			1974	90012
		----			126.0	2.006	1.000	CT	1.074	0.59	61.30			1974	90012
		3.50			126.0	1.998	1.001	CT	1.019	0.62	62.50			1974	90012
		1.80			126.0	1.997	0.625	CT	0.994	0.59	61.30			1974	90012
		3.50			129.0	1.976	1.002	CT	1.006	0.48	56.60			1974	90012
		----			130.0	1.998	1.000	CT	1.029	0.79	72.90			1974	90012
		----			130.0	2.000	1.000	CT	1.053	0.53	60.10			1974	90012
		3.50			131.0	1.978	0.998	CT	1.036	0.72	70.60			1974	90012
		1.30			134.0	2.000	0.563	CT	1.005	0.32	47.70			1974	90012
		----			134.0	1.998	1.003	CT	1.013	0.61	66.10			1974	90012
		1.50			136.0	1.998	1.003	CT	1.053	0.20	38.40			1974	90012
		2.50			137.0	2.000	0.999	CT	1.032	0.37	52.50			1974	90012
		2.60			137.0	2.001	1.000	CT	1.021	0.24	42.60			1974	90012
		2.70			143.0	2.001	0.999	CT	1.022	0.26	45.70	57.1/	10.4	1974	90012
AS RECEIVED	FB	3.50	R.T.	T-L	127.0	1.978	0.998	CT	1.064	0.68	66.40			1974	90012
		----			128.0	1.978	0.752	CT	1.023	0.42	52.50			1974	90012
		1.00			129.0	1.997	0.779	CT	1.018	0.66	66.50			1974	90012
		1.50			130.0	1.998	0.502	CT	1.000	0.41	52.60			1974	90012
		----			130.0	1.779	0.645	CT	0.998	0.43	54.00			1974	90012
		2.00			131.0	1.998	1.003	CT	1.023	0.53	60.10			1974	90012
		1.50			132.0	1.999	1.002	CT	1.055	0.16	33.80			1974	90012
		----			133.0	2.000	1.002	CT	1.027	0.69	69.90			1974	90012
		----			133.0	1.998	1.001	CT	1.024	0.50	59.40			1974	90012
		3.50			133.0	1.978	1.005	CT	1.045	0.56	62.70			1974	90012
		3.50			134.0	2.000	1.000	CT	1.028	0.58	64.50			1974	90012

NOTES
(1) INTERMEDIATE GRAIN SIZE

TABLE 4.11.2.1 (con't)

TITANIUM TI-6AL-4V K(IC)

CONDITION	--PRODUCT-- FORM	THICK (IN)	TEST TEMP (F)	SPECIMEN ORIENT	YIELD STRENGTH (KSI)	------SPECIMEN------ WIDTH (IN) W	THICK (IN) B	DESIGN	CRACK LENGTH (IN) A	2.5*(K(IC)/TYS)**2 (IN)	K(IC) (KSI*SQRT IN)	K(IC) MEAN	STAN DEV	DATE	REFER
AS RECEIVED	FB	1.50	R.T.	T-L	135.0	1.996	0.560	CT	0.994	0.45	57.40			1974	90012
		----			135.0	2.003	1.001	CT	1.023	0.46	57.80			1974	90012
		----			139.0	2.001	1.002	CT	1.016	0.44	58.20			1974	90012
		----			139.0	2.000	0.654	CT	1.010	0.37	53.50			1974	90012
		----			139.0	1.998	1.003	CT	1.033	0.35	52.10			1974	90012
		2.60			140.0	2.002	0.999	CT	1.014	0.14	32.80			1974	90012
		1.30			141.0	2.002	1.001	CT	1.033	0.18	37.40			1974	90012
		1.80			142.0	1.999	0.999	CT	1.048	0.36	53.70			1974	90012
		1.90			142.0	1.973	1.001	CT	1.054	0.55	66.80			1974	90012
		2.50			145.0	2.000	0.999	CT	1.028	0.19	40.10	54.9/	10.8	1974	90012
AS RECEIVED-AB (ALPHA-BETA FORGED)	FB	3.50	R.T.	L-T	127.0	2.000	1.000	CT	1.023	0.92	77.10			1974	90012
AS RECEIVED-AB (ALPHA-BETA FORGED)	FB	3.50	R.T.	T-L	131.0	2.000	1.000	CT	1.023	0.95	80.90			1974	90012
B FORGED	FB	2.25	R.T.	T-L	135.0	2.000	1.000	CT	1.046	0.30	46.80			1973	86688
BETA FORGED		2.25			135.0	3.000	1.500	CT	1.471	0.20	37.80			1973	86688
REHEATED TO		2.25			135.0	2.000	1.000	CT	1.038	0.28	45.60			1973	86688
1750F DRAWN TO		2.25			135.0	2.000	1.000	CT	1.058	0.22	40.20			1973	86688
SIZE, ANNEALED 1300F												42.6/	4.3		
B FORGED-MA	F	2.75	R.T.	---	131.0	2.000	1.000	CT	1.000	0.88	77.70			1974	88962 (1)
BETA FORGED,		2.75			131.0	2.000	1.000	CT	1.000	0.77	72.90			1974	88962 (1)
MILL ANNEALED, 1300F 2 HR, AC												75.3/	3.4		
B FORGED-MA	F	2.00	R.T.	L-T	137.0	2.000	1.000	CT	----	0.59	66.40			1971	80538
BETA FORGED,		2.00			137.0	2.000	1.000	CT	----	0.77	76.00			1971	80538
MILL ANNEALED		2.00			137.0	2.000	1.000	CT	----	0.64	69.30			1971	80538
1300F 2 HR, AC												70.6/	4.9		
B FORGED-MA	F	2.00	R.T.	T-L	131.0	2.000	1.000	CT	----	0.73	70.60			1971	80538
BETA FORGED, MILL ANNEALED 1300F 2 HR, AC															

NOTES:
(1) COMP. DISK

TABLE 4.11.2.1 (con't)

TITANIUM TI-6AL-4V K(IC)

CONDITION	--PRODUCT-- FORM	THICK (IN)	TEST TEMP (F)	SPECIMEN ORIENT	YIELD STRENGTH (KSI)	------SPECIMEN------ WIDTH (IN) W	THICK (IN) B	DESIGN	CRACK LENGTH (IN) A	2.5*(K(IC)/TYS)**2 (IN)	K(IC) (KSI*SQRT IN)	K(IC) MEAN	STAN DEV	DATE	REFER
B FORGED-MA	F	2.00	R.T.	T-L	131.0	2.000	1.000	CT	----	0.74	71.10			1971	80538
BETA FORGED,		2.00			131.0	2.000	1.000	CT	----	0.74	71.40			1971	80538
MILL ANNEALED 1300F 2 HR.AC												71.0/	0.4		
B FORGED-MA	F	2.00	R.T.	S-L	132.0	2.000	1.000	CT	----	0.74	72.10			1971	80538
BETA FORGED,		2.00			132.0	2.000	1.000	CT	----	0.82	75.70			1971	D0538
MILL ANNEALED 1300F 2 HR.AC												73.9/	2.5		
BB.AB FIN-MA	F	----	R.T.	---	132.0	2.500	1.250	CT	1.250	0.78	73.50			1973	90584 (1)
BETA BLOCKED,		----			132.0	2.500	1.250	CT	1.250	0.89	78.70			1973	90584 (1)
ALPHA-BETA		----			134.0	2.500	1.250	CT	1.250	0.59	65.10			1973	90584 (1)
FINISHED, MILL		----			134.0	2.500	1.250	CT	1.250	0.72	72.10			1973	90584 (1)
ANNEALED												72.4/	5.6		
BB.AB FIN-RA	F	----	R.T.	--	135.0	2.500	1.250	CT	1.250	0.89	80.70			1973	90584 (1)
BETA BLOCKED,		----			135.0	2.500	1.250	CT	1.250	0.76	74.40			1973	90584 (1)
ALPHA-BETA		----			137.0	2.500	1.250	CT	1.250	0.74	74.80			1973	90584 (1)
FINISHED,		----			137.0	2.500	1.250	CT	1.250	0.66	70.30			1973	90584 (1)
RECRYSTALLIZED ANNEAL 1700F 4 HR.FC TO 1000F.AC												75.1/	4.3		
BB.AB FIN-30MA	F	2.50	R.T.	---	127.0	2.000	1.000	CT	1.000	1.00	80.50			1974	88962
BETA BLOCKED,		2.50			127.0	2.000	1.000	CT	1.000	0.89	75.90			1974	88962
ALPHA-BETA FINISHED, 30%REDUCTION, MILL ANNEALED, 1300F 2 HR.AC												78.2/	3.3		
BB.AB FIN10STO	F	2.50	R.T.	--	136.0	2.000	1.000	CT	1.000	0.84	77.00			1974	88962
BETA-BLOCKED,		2.50			136.0	2.000	1.000	CT	1.000	0.99	85.50			1974	88962
ALPHA-BETA		2.50			136.0	2.000	1.000	CT	1.000	0.88	80.50			1974	88962
FINISHED, 10% REDUCTION, SOLUTION TREATED & OVERAGED, 1750F 1 HR.WQ, 1300F 2 HR.AC												81.7/	3.4		

NOTES:
(1) F-14 OUTBOARD COVER

TABLE 4.11.2.1 (con't)

TITANIUM TI-6AL-4V K(IC)

CONDITION	--PRODUCT-- FORM	THICK (IN)	TEST TEMP (F)	SPECIMEN ORIENT	YIELD STRENGTH (KSI)	------SPECIMEN------ WIDTH (IN) W	THICK (IN) B	DESIGN	CRACK LENGTH (IN) A	2.5*(K(IC)/TYS)**2 (IN)	K(IC) (KSI*SQRT IN)	K(IC) MEAN	STAN DEV	DATE	REFER
DB.AB FIN30STO	F	2.50	R.T.	--	137.0	2.000	1.000	CT	1.000	0.81	78.00			1974	88962
BETA-BLOCKED,		2.50			137.0	2.000	1.000	CT	1.000	0.60	67.40			1974	88962
ALPHA-BETA		2.50			137.0	2.000	1.000	CT	1.000	0.72	73.80			1974	88962
FINISHED. 30% REDUCTION. SOLUTION TREATED & OVERAGED,1750F 1 HR,WQ,1300F 2 HR,AC												73.1/	5.3		
DB.B FIN-10MA	F	2.50	R.T.	--	128.0	2.000	1.000	CT	1.000	0.85	74.50			1974	88962
BETA BLOCKED,		2.50			128.0	2.000	1.000	CT	1.000	0.84	74.40			1974	88962
BETA FINISHED,		2.50			128.0	2.000	1.000	CT	1.000	0.77	71.10			1974	88962
10%REDUCTION. MILL ANNEALED,1300F 2 HR,AC												73.3/	1.9		
DB.B FIN10STOA	F	2.50	R.T.	--	138.0	2.000	1.000	CT	1.000	0.96	85.60			1974	88962
BETA BLOCKED,		2.50			138.0	2.000	1.000	CT	1.000	0.98	86.40			1974	88962
BETA FINISHED,		2.50			138.0	2.000	1.000	CT	1.000	0.98	86.40			1974	88962
10%REDUCTION,SOLUTION TREATED & OVERAGED,1750F 1 HR,WQ,1300F 2 HR,AC												86.1/	0.5		
BETA ANNEALED	P	2.50	R.T.	--	116.0	1.994	0.999	CT	1.133	0.90	69.80			1974	88575
PLATE EB		2.50			116.0	1.992	0.951	CT	1.140	0.87	68.50			1974	88575
WELDED THEN BETA ANN,EB WELD IN PLANE OF FRACTURE												69.2/	0.9		
BETA ANNEALED	P	2.50	-65	L-T	125.0	3.997	2.001	CT	2.072	1.90	109.10			1974	88575
		2.50			125.0	4.003	1.998	CT	2.105	1.79	105.90			1974	88575
		2.50			125.0	4.003	1.991	CT	2.116	2.06	113.50			1974	88575
		2.50			125.0	4.005	2.000	CT	2.152	1.95	110.50			1974	88575
		2.50			125.0	4.009	2.005	CT	2.084	1.86	108.00	109.4/	2.8	1974	88575
BETA ANNEALED	P	1.00	R.T.	T-L	126.0	2.530	1.000	WOL	----	0.98	79.20			1977	JEM01
BETA PROCESSED	P	3.00	R.T.	L-T	130.4	3.000	1.500	CT	----	1.44	99.00			1975	UD008
MILL ANNEALED		3.00			130.4	3.000	1.500	CT	----	1.35	96.00			1975	UD008
		3.00			130.4	3.000	1.500	CT	----	1.18	87.60	94.9/	4.8	1975	UD008

TABLE 4.11.2.1 (con't)

TITANIUM TI-6AL-4V K(IC)

CONDITION	--PRODUCT-- FORM	THICK (IN)	TEST TEMP (F)	SPECIMEN ORIENT	YIELD STRENGTH (KSI)	------SPECIMEN------ WIDTH (IN) W	THICK (IN) B	DESIGN	CRACK LENGTH (IN) A	2.5*(K(IC)/TYS)**2 (IN)	K(IC) (KSI*SQRT IN)	K(IC) MEAN	STAN DEV	DATE	REFER
DIFFUSION BONDED	P	0.62	R.T.	--	120.0	4.005	2.002	CT	1.966	1.47	92.10			1973	85836 (1)
DIFFUSION BONDED	P	0.62	R.T.	L-T	120.0	3.004	1.500	CT	1.574	1.11	79.90			1973	85836 (1)
DIFFUSION BONDED	P	0.62	R.T.	T-L	120.0	3.005	1.501	CT	1.575	1.20	83.10			1973	85836 (1)
DIFFUSION BONDED	P	1.50	R.T.	S-T	120.0	4.000	1.500	CT	----	1.34	88.00			1974	89004 (1)
		1.50			120.0	4.000	1.500	CT	----	1.31	87.00			1974	89004 (1)
		1.50			120.0	4.000	1.500	CT	----	1.16	82.00			1974	89004 (1)
												85.7/	3.2		
DIFFUSION BONDED	P	2.50	R.T.	S-L	120.0	4.000	1.500	CT	----	1.14	81.00			1974	89004 (1)
DIFFUSION BONDED	BT	0.62	R.T.	L-T	120.0	3.000	1.500	CT	----	1.11	80.00			1974	89004 (1)
DIFFUSION BOND ANNEALED	BT	3.50	R.T.	L-T	127.0	2.000	1.000	CT	1.072	0.93	77.50			1974	90012 (2)
		1.00			129.0	2.001	1.002	CT	1.092	0.98	80.70			1974	90012 (2)
		----			129.0	2.002	1.004	CT	1.032	0.75	70.80			1974	90012 (2)
		1.50			132.0	2.000	1.003	CT	1.019	0.45	56.10			1974	90012 (2)
		----			132.0	1.995	1.000	CT	1.083	0.83	76.30			1974	90012 (2)
		3.50			132.0	1.999	1.003	CT	1.029	0.68	69.00			1974	90012 (2)
		2.60			133.0	1.996	0.975	CT	1.017	0.48	58.10			1974	90012 (2)
		3.50			134.0	1.999	1.000	CT	1.030	0.69	70.40			1974	90012 (2)
		2.70			137.0	2.000	1.001	CT	1.024	0.40	54.70			1974	90012 (2)
												68.2/	9.7		
DIFFUSION BONDED	BT	0.62	R.T.	T-L	120.0	3.000	1.500	CT	----	1.20	83.00			1974	89004 (1)
DIFFUSION BOND ANNEALED	BT	----	R.T.	T-L	125.0	2.000	1.003	CT	1.032	0.80	70.80			1974	90012 (2)
		----			125.0	1.997	0.676	CT	0.992	0.65	64.00			1974	90012 (2)
		----			128.0	2.001	0.999	CT	1.043	0.90	76.90			1974	90012 (2)
		3.50			131.0	1.995	1.000	CT	1.048	0.84	76.00			1974	90012 (2)
		3.50			132.0	1.998	0.999	CT	1.013	0.67	68.20			1974	90012 (2)
		2.00			133.0	1.998	1.000	CT	1.028	0.75	72.70			1974	90012 (2)
		3.50			133.0	2.000	0.999	CT	1.019	0.72	71.40			1974	90012 (2)

NOTES:
(1) DIFFUSION BONDED - 1700F 4HR,FC TO 1400F AT 100F/HR THEN TO 900F IN 0.75HR
(2) DIFFUSION BOND ANNEALED = 1750F 1.5 TO 4HR,FC TO 900F AT 100F/HR

TABLE 4.11.2.1 (con't)

TITANIUM TI-6AL-4V K(IC)

CONDITION	PRODUCT FORM	PRODUCT THICK (IN)	TEST TEMP (F)	SPECIMEN ORIENT	YIELD STRENGTH (KSI)	SPECIMEN WIDTH (IN) W	SPECIMEN THICK (IN) B	SPECIMEN DESIGN	CRACK LENGTH (IN) A	2.5*(K(IC)/TYS)**2 (IN)	K(IC) (KSI*SQRT IN)	K(IC) MEAN	STAN DEV	DATE	REFER
DIFFUSION BOND ANNEALED	BT	1.50	R.T.	T-L	134.0	2.000	1.000	CT	1.043	0.39	53.10			1974	90012 (1)
		----			135.0	2.000	1.001	CT	1.033	0.66	69.20			1974	90012 (1)
		2.50			137.0	1.798	0.877	CT	1.021	0.33	47.50			1974	90012 (1)
		2.60			138.0	1.997	0.979	CT	1.031	0.27	45.10			1974	90012 (1)
		2.70			140.0	2.000	1.004	CT	1.018	0.25	44.60			1974	90012 (1)
		1.00			142.0	2.001	1.000	CT	1.042	0.66	72.70			1974	90012 (1)
												64.2/	11.8		
DIFFUSION BONDED	BT	8.00	R.T.	S-T	----	3.995	1.495	CT	1.926	1.32	87.40			1972	84306 (2)
		8.00			----	3.999	1.457	CT	1.881	1.18	82.40			1972	84306 (2)
		8.00			----	3.998	1.495	CT	1.920	1.33	87.80			1972	84306 (2)
		8.00			----	3.978	1.495	CT	1.963	1.43	90.90			1972	84306 (2)
		8.00			----	3.998	1.492	CT	1.969	1.45	91.60			1972	84306 (2)
												88.0/	3.6		
MA COARSE GRAIN 1300F 2 HR.AC	F	14.00	R.T.	--	139.0	2.000	1.000	CT	1.000	0.35	52.20			1974	88962
		14.00			139.0	2.000	1.000	CT	1.000	0.36	53.20			1974	88962
		14.00			139.0	2.000	1.000	CT	1.000	0.40	55.30			1974	88962
		14.00			139.0	2.000	1.000	CT	1.000	0.42	56.70			1974	88962
		14.00			139.0	2.000	1.000	CT	1.000	0.35	52.10	53.9/	2.0	1974	88962
MA FINE GRAIN 1300F 2 HR.AC	F	6.00	R.T.	--	138.0	2.000	1.000	CT	1.000	0.46	59.60			1974	88962
		6.00			138.0	2.000	1.000	CT	1.000	0.62	69.10			1974	88962
		6.00			138.0	2.000	1.000	CT	1.000	0.60	67.60			1974	88962
		6.00			138.0	2.000	1.000	CT	1.000	0.54	64.00			1974	88962
		6.00			138.0	2.000	1.000	CT	1.000	0.85	80.60			1974	88962
		6.00			138.0	2.000	1.000	CT	1.000	0.76	76.10	69.5/	7.7	1974	88962
MA 10-20%ALPHA 10 TO 20% PRIMARY ALPHA. MILL ANNEALED 1300F 2 HR.AC	F	2.50	R.T.	--	141.0	2.000	1.000	CT	1.000	0.57	67.10			1974	88962
		2.50			141.0	2.000	1.000	CT	1.000	0.67	73.10			1974	88962
		2.50			141.0	2.000	1.000	CT	1.000	0.58	68.00			1974	88962
												69.4/	3.2		

NOTES:
(1) DIFFUSION BOND ANNEALED = 1700F 1.5 TO 4HR,FC TO 900F AT 100F/HR
(2) DIFFUSION BONDED = 1700F 4HR,FC TO 1400F AT 100F/HR THEN TO 900F IN 0.75HR

TABLE 4.11.2.1 (con't)

TITANIUM TI-6AL-4V K(IC)

CONDITION	--PRODUCT-- FORM	THICK (IN)	TEST TEMP (F)	SPECIMEN ORIENT	YIELD STRENGTH (KSI)	------SPECIMEN------ WIDTH (IN) W	THICK (IN) B	DESIGN	CRACK LENGTH (IN) A	2.5*(K(IC)/TYS)**2 (IN)	K(IC) (KSI*SQRT IN)	K(IC) MEAN	STAN DEV	DATE	REFER
MA 40-50%ALPHA	F	2.50	R.T	--	135.0	2.000	1.000	CT	1.000	0.70	71.50			1974	88962
40 TO 50%		2.50			135.0	2.000	1.000	CT	1.000	0.58	65.20			1974	88962
PRIMARY ALPHA,		2.50			135.0	2.000	1.000	CT	1.000	0.68	70.60			1974	88962
MILL ANNEALED 1300F 2 HR,AC												69.1/	3.4		
MILL ANNEAL	P	1.50	R.T.	L-T	133.0	2.496	1.244	CT	1.330	0.45	56.59			1981	MA002
		1.50			133.0	2.502	1.255	CT	1.297	0.42	54.70	55.6/	1.3	1981	MA002
MILL ANNEAL	P	1.00	R.T.	T-L	146.1	2.550	1.000	WOL	----	0.17	38.20			1977	JEM01
MILL ANNEALED	P	2.00	R.T.	L-T	127.0	4.000	2.003	CT	2.137	1.94	112.00			1972	85064
MILL ANNEALED	P	2.00	65	T-L	157.0	4.000	2.002	CT	1.980	0.94	85.70			1973	88144
		2.00			157.0	4.000	2.004	CT	1.970	1.03	89.70			1973	88144
		2.00			157.0	4.000	2.003	CT	1.990	0.99	88.20	87.9/	2.0	1973	88144
MILL ANNEALED	P	1.25	R.T.	T-L	119.4	3.475	1.245	CT	1.741	1.16	95.30			1972	84306
		1.25			119.4	3.479	1.245	CT	1.824	1.20	97.00			1972	84306
		1.25			119.4	3.500	1.247	CT	1.817	1.15	94.80			1972	84306
		2.00			126.0	4.000	2.002	CT	2.038	1.53	98.70			1972	85064
		2.00			126.0	4.000	2.001	CT	2.097	1.94	112.00			1972	85064
		2.00			126.0	4.000	2.002	CT	2.048	1.75	105.50	100.6/	6.8	1972	85064
MILL ANNEALED	E	4.00	R.T.	L-T	123.5	3.997	1.465	CT	1.957	1.21	87.60			1972	84306 (1)
		1.80			124.0	3.934	1.578	CT	2.031	1.17	85.09			1976	NC001
		1.80			124.0	3.930	1.578	CT	2.036	1.12	83.06			1976	NC001
		1.80			124.5	3.995	1.577	CT	2.049	1.09	82.37			1976	NC001
		1.80			124.5	3.995	1.578	CT	2.115	1.01	79.17	83.5/	3.1	1976	NC001
MILL ANNEALED	E	4.00	R.T.	T-L	----	4.000	1.496	CT	1.947	1.30	92.50			1972	84306 (2)
		4.00			----	4.000	1.496	CT	2.084	1.29	92.10			1972	84306 (2)
		1.80			125.5	3.995	1.575	CT	2.102	1.06	81.82			1976	NC001
		1.80			125.5	3.995	1.577	CT	2.113	1.21	87.42			1976	NC001
		1.80			127.0	3.975	1.578	CT	2.096	1.13	85.71			1976	NC001
		1.80			127.0	3.738	1.577	CT	2.079	1.13	85.64	87.5/	4.1	1976	NC001

NOTES
(1) COMPOSITION(WT PERCENT) 6.51AL, 4.06V, 0.024C, 0.19FE, 0.012N, 0.006H, 0.150
(2) COMPOSITION(WT PERCENT) 6.35AL, 4.31V, 0.022C, 0.16FE, 0.009N, 0.006H, 0.160

TABLE 4.11.2.1 (con't)

TITANIUM   TI-6AL-4V   K(IC)

CONDITION	--PRODUCT-- FORM	THICK (IN)	TEST TEMP (F)	SPECIMEN ORIENT	YIELD STRENGTH (KSI)	-------SPECIMEN------ WIDTH (IN) W	THICK (IN) B	DESIGN	CRACK LENGTH (IN) A	2.5*(K(IC)/TYS)**2 (IN)	K(IC) (KSI*SQRT IN)	K(IC) MEAN	STAN DEV	DATE	REFER
MILL ANNEALED 1200F 2HR.AC	F	4.50	R.T.	L-T	130.0	2.478	1.248	CT	1.355	0.54	60.59			1981	MA002
MILL ANNEALED 1300F 2 HR.AC	F	2.00	R.T.	L-T	132.0	2.000	1.000	CT	----	0.31	46.70			1971	80538
		2.00			132.0	2.000	1.000	CT	----	0.30	45.40			1971	80538
		2.00			132.0	2.000	1.000	CT	----	0.37	51.00	47.7/	2.9	1971	80538
MILL ANNEALED 1300F 2 HR.AC	F	2.00	R.T.	T-L	133.0	2.000	1.000	CT	----	0.30	46.50			1971	80538
		2.00			133.0	2.000	1.000	CT	----	0.32	48.00			1971	80538
		2.00			133.0	2.000	1.000	CT	----	0.41	53.90	49.5/	3.9	1971	80538
MILL ANNEALED 1300F 2 HR.AC	F	2.00	R.T.	S-L	140.0	2.000	1.000	CT	----	0.18	37.90			1971	80538
		2.00			140.0	2.000	1.000	CT	----	0.31	49.50			1971	80538
		2.00			140.0	2.000	1.000	CT	----	0.24	43.50	43.6/	5.8	1971	80538
MILL ANNEALED 1300F 2 HR.AC	BT	2.30	R.T.	L-T	120.0	2.500	1.250	CT	1.277	1.13	80.30			1971	84360
		2.30			127.0	2.500	1.253	CT	1.271	1.16	86.80			1971	84360
		2.30			127.0	2.498	1.251	CT	1.225	1.11	85.00	84.0/	3.4	1971	84360
RECRYSTALLIZE ANNEAL	P	1.50	-65	L-T	----	3.999	1.502	CT	2.044	0.63	60.40			1972	84306 (1)
RECRYSTALLIZE ANNEAL	P	1.50	R.T.	L-T	118.0	4.003	1.502	CT	2.021	0.97	74.90			1972	84306 (1)
		1.50			118.0	4.005	1.502	CT	2.004	1.08	79.00			1972	84306 (1)
		2.00			119.0	6.003	1.873	CT	3.138	1.62	96.60			1972	84306 (1)
		2.00			119.0	6.002	1.780	CT	3.075	1.64	97.30			1972	84306 (1)
		1.50			120.0	4.000	1.501	CT	2.103	1.16	81.80			1973	85836 (1)
		2.50			120.0	4.000	2.000	CT	----	0.95	74.00			1974	89004 (1)
		2.50			120.0	4.000	2.000	CT	----	1.11	80.00			1974	89004 (1)
		1.25			120.0	----	1.250	CT	----	1.08	79.00			1974	89004 (1)
		2.50			120.0	2.979	1.126	CT	1.526	0.83	67.00			1973	85836 (1)
		1.25			120.0	----	1.250	CT	----	1.03	77.00			1974	89004 (1)
		2.50			120.0	----	----	CT	----	1.38	89.00			1974	89004 (1)
		1.25			120.0	----	1.250	CT	----	0.98	75.00			1974	89004 (1)
		2.50			120.0	----	----	CT	----	1.31	87.00			1974	89004 (1)
		1.25			120.0	----	1.250	CT	----	0.92	73.00			1974	89004 (1)
		2.50			120.0	4.000	2.000	CT	----	1.17	82.00			1974	89004 (1)

NOTES
(1) RECRYSTALLIZE ANNEAL=1700F 4 HR.FC TO 1400F AT 100F/HR.COOL TO 900F IN .75HR

TABLE 4.11.2.1 (con't)

TITANIUM TI-6AL-4V K(IC)

CONDITION	--PRODUCT-- FORM	THICK (IN)	TEST TEMP (F)	SPECIMEN ORIENT	YIELD STRENGTH (KSI)	------SPECIMEN------ WIDTH (IN) W	THICK (IN) B	DESIGN	CRACK LENGTH (IN) A	2.5*(K(IC)/TYS)**2 (IN)	K(IC) (KSI*SQRT IN)	K(IC) MEAN STAN DEV	DATE	REFER
RECRYSTALLIZE ANNEAL	P	1.25	R.T.	L-T	120.0	----	1.250	CT	----	1.14	81.00		1974	89004 (1)
		1.50			120.0	6.000	1.370	CT	----	1.11	80.00		1974	89004 (1)
		1.50			121.0	6.002	1.496	CT	3.080	1.44	91.00		1972	84306 (1)
		1.50			121.0	3.500	1.500	CT	----	1.29	87.00		1974	89004 (1)
		1.50			121.0	3.500	1.500	CT	----	1.44	92.00		1974	89004 (1)
		1.50			121.0	6.003	1.500	CT	3.103	1.30	86.60		1972	84306 (1)
		1.50			121.0	6.001	1.497	CT	3.065	1.41	90.20		1972	84306 (1)
												82.8/ 7.8		
RECRYSTALLIZE ANNEAL	P	1.50	- 65	T-L	----	3.997	1.496	CT	2.110	1.03	77.00		1972	84306 (1)
RECRYSTALLIZE ANNEAL	P	2.50	R.T.	T-L	120.0	3.000	1.108	CT	1.520	0.83	69.30		1973	85836 (1)
		1.25			120.0	----	1.250	CT	----	0.92	73.00		1974	89004 (1)
		2.50			120.0	4.000	2.000	CT	----	1.25	85.00		1974	89004 (1)
		1.25			120.0	----	1.250	CT	----	1.00	76.00		1974	89004 (1)
		2.50			120.0	4.000	2.000	CT	----	0.83	69.00		1974	89004 (1)
		2.50			120.0	----	----	CT	----	1.50	93.00		1974	89004 (1)
		2.00			120.0	6.001	2.009	CT	3.048	1.97	106.40		1973	85836 (1)
		1.25			120.0	----	1.250	CT	----	0.95	74.00		1974	89004 (1)
		1.50			120.0	6.000	1.370	CT	----	1.28	86.00		1974	89004 (1)
		1.50			120.0	4.001	1.498	CT	2.131	1.45	91.50		1973	85836 (1)
		1.25			120.0	----	1.250	CT	----	1.14	81.00		1974	89004 (1)
		2.50			120.0	4.000	2.000	CT	----	0.98	75.00		1974	89004 (1)
		1.50			120.0	3.000	1.500	CT	----	1.25	85.00		1974	89004 (1)
		2.50			120.0	----	----	CT	----	1.44	91.00		1974	89004 (1)
		2.50			120.0	3.000	1.127	CT	1.544	0.90	71.90		1973	85836 (1)
		2.00			120.0	5.999	1.997	CT	3.056	1.79	101.50		1973	85836 (1)
		2.50			120.0	2.997	1.374	CT	1.534	0.84	69.40		1973	85836 (1)
		2.50			120.0	----	----	CT	----	1.14	81.00		1974	89004 (1)
		1.25			120.0	----	1.250	CT	----	0.85	70.00		1974	89004 (1)
		2.50			120.0	4.000	2.000	CT	----	1.00	76.00		1974	89004 (1)
		1.50			121.0	3.500	1.500	CT	----	1.18	83.00		1974	89004 (1)
		1.00			135.0	2.550	1.000	WOL	----	0.65	69.20		1977	JEM01 (2)
												80.8/ 10.8		
RECRYSTALLIZE ANNEAL	F	----	R.T.	L-T	----	3.000	1.500	CT	----	1.03	77.00		1974	89004 (2)
		----			----	4.000	2.020	CT	----	1.20	83.00		1974	89004 (2)
		----			----	3.000	1.500	CT	----	0.92	73.00		1974	89004 (2)
		----			----	4.000	1.790	CT	----	1.06	78.00		1974	89004 (2)
		2.25			114.0	2.997	1.499	CT	1.528	1.43	86.10		1973	85034 (1)

NOTES:
(1) RECRYSTALLIZE ANNEAL=1700F 4 HR.FC TO 1400F AT 100F/HR.COOL TO 900F IN .75HR
(2) RECRYSTALLIZE ANNEAL=1700F 4 HR.FC TO 1400F AT 100F/HR.COOL TO 900F IN .75HR
TYS APPROX 120

TABLE 4.11.2.1 (con't)

TITANIUM TI-6AL-4V K(IC)

CONDITION	--PRODUCT-- FORM	THICK (IN)	TEST TEMP (F)	SPECIMEN ORIENT	YIELD STRENGTH (KSI)	------SPECIMEN------ WIDTH (IN) W	THICK (IN) B	DESIGN	CRACK LENGTH (IN) A	2.5*(K(IC)/TYS)**2 (IN)	K(IC) (KSI*SQRT IN)	K(IC) MEAN	STAN DEV	DATE	REFER
RECRYSTALLIZE ANNEAL	F	2.25	R.T.	L-T	115.0	2.999	1.500	CT	1.524	1.49	89.00			1973	85034 (1)
		2.25			116.0	2.978	1.499	CT	1.535	1.30	83.60			1973	85034 (1)
		3.40			117.0	2.999	1.503	CT	1.554	1.47	89.70			1973	85034 (1)
		2.25			117.0	3.002	1.500	CT	1.539	1.05	76.00			1973	85034 (1)
		5.62			118.0	3.004	1.499	CT	1.540	1.46	90.30			1973	85034 (1)
		2.25			118.0	2.999	1.499	CT	1.526	1.19	81.30			1973	85034 (1)
		5.62			119.0	3.008	1.497	CT	1.536	1.46	90.90			1973	85034 (1)
		2.20			119.0	3.007	1.498	CT	1.563	1.49	91.90			1973	85857 (1)
		2.20			119.0	3.005	1.500	CT	1.552	1.36	87.80			1973	85857 (1)
		3.40			119.0	3.002	1.501	CT	1.533	1.39	88.90			1973	85034 (1)
		2.20			120.0	3.006	1.505	CT	1.581	1.41	90.10			1973	85857 (1)
		6.70			121.0	3.000	1.502	CT	1.541	0.96	75.10			1973	85034 (1)
		1.20			121.0	3.004	1.376	CT	1.615	1.22	84.40			1973	85857 (1)
		1.20			121.0	3.005	1.374	CT	1.588	1.27	86.10			1973	85857 (1)
		1.20			121.0	3.010	1.345	CT	1.556	1.15	82.10			1973	85857 (1)
		6.70			121.0	3.001	1.500	CT	1.548	1.06	78.70			1973	85034 (1)
		2.20			121.0	3.003	1.502	CT	1.589	1.17	82.80			1973	85857 (1)
		2.20			121.0	3.002	1.504	CT	1.555	1.24	85.10			1973	85857 (1)
		2.20			122.0	3.003	1.499	CT	1.633	1.18	83.90			1973	85857 (1)
		1.20			122.0	3.009	1.318	CT	1.583	1.12	81.70			1973	85857 (1)
		1.50			123.0	2.998	1.417	CT	1.593	0.95	75.70			1973	85034 (1)
		1.20			123.0	3.006	1.377	CT	1.605	1.17	84.30			1973	85857 (1)
		1.50			123.0	3.002	1.377	CT	1.578	0.80	73.20			1973	85034 (1)
		2.20			124.0	3.003	1.501	CT	1.607	1.16	84.40			1973	85857 (1)
		1.50			124.0	3.004	1.409	CT	1.577	0.94	76.00			1973	85034 (1)
		3.20			124.0	3.001	1.504	CT	1.583	1.49	95.70			1973	85857 (1)
		1.50			124.0	2.999	1.397	CT	1.585	0.98	77.80			1973	85034 (1)
		2.50			124.0	3.005	1.504	CT	1.549	1.08	81.50			1973	85034 (1)
		1.20			125.0	3.001	1.375	CT	1.612	1.14	84.60			1973	85857 (1)
		2.20			126.0	3.003	1.495	CT	1.591	1.11	83.80			1973	85857 (1)
		1.50			127.0	3.001	1.248	CT	1.542	1.17	86.70			1973	85857 (1)
		1.50			127.0	3.003	1.250	CT	1.527	1.24	89.50			1973	85857 (1)
		1.50			127.0	3.001	1.250	CT	1.583	1.20	88.00			1973	85857 (1)
		1.50			129.0	2.999	1.248	CT	1.588	1.07	84.40			1973	85857 (1)
		1.50			129.0	2.997	1.249	CT	1.440	1.08	84.80			1973	85857 (1)
		1.50			130.0	3.002	1.372	CT	1.560	0.92	78.80			1973	85034 (1)
												83.6/	5.5		
RECRYSTALLIZE ANNEAL	F	----	R.T.	T-L	----	3.500	1.750	CT	----	1.31	87.00			1974	89004 (2)

NOTES:
(1) RECRYSTALLIZE ANNEAL=1700F 4 HR,FC TO 1400F AT 100F/HR,COOL TO 900F IN .75HR
(2) RECRYSTALLIZE ANNEAL=1700F 4 HR,FC TO 1400F AT 100F/HR,COOL TO 900F IN .75HR
TYS APPROX 120

TABLE 4.11.2.1 (con't)

TITANIUM TI-6AL-4V K(IC)

CONDITION	--PRODUCT-- FORM	--PRODUCT-- THICK (IN)	TEST TEMP (F)	SPECIMEN ORIENT	YIELD STRENGTH (KSI)	-------SPECIMEN------- WIDTH (IN) W	THICK (IN) B	DESIGN	CRACK LENGTH (IN) A	2.5*(K(IC)/TYS)**2 (IN)	K(IC) (KSI*SQRT IN)	K(IC) MEAN	STAN DEV	DATE	REFER
RECRYSTALLIZE ANNEAL	F	----	R.T.	T-L	----	3.000	1.500	CT	----	1.03	77.00			1974	89004 (1)
		----			----	3.000	1.500	CT	----	0.85	70.00			1974	89004 (1)
		----			----	3.500	1.750	CT	----	1.40	90.00			1974	89004 (1)
		3.40			116.0	3.000	1.502	CT	1.544	1.36	85.70			1973	85034 (1)
		5.62			117.0	3.001	1.500	CT	1.537	1.24	82.90			1973	85034 (1)
		6.70			118.0	2.997	1.501	CT	1.578	1.32	85.80			1973	85034 (1)
		5.62			119.0	3.001	1.500	CT	1.543	1.18	81.80			1973	85034 (1)
		3.40			119.0	3.002	1.500	CT	1.545	1.27	84.90			1973	85034 (1)
		5.62			120.0	2.777	1.499	CT	1.518	1.03	77.00			1973	85034 (1)
		3.50			120.0	3.007	1.502	CT	1.574	1.35	88.40			1973	85857 (1)
		5.62			120.0	3.005	1.498	CT	1.520	1.25	84.70			1973	85034 (1)
		1.50			121.0	3.004	1.250	CT	1.573	1.11	80.20			1973	85857 (1)
		6.70			121.0	3.002	1.500	CT	1.546	0.81	68.80			1973	85034 (1)
		1.50			122.0	3.000	1.245	CT	1.475	1.20	84.80			1973	85857 (1)
		1.50			122.0	3.000	1.248	CT	1.547	0.96	75.50			1973	85857 (1)
		3.40			123.0	2.998	1.497	CT	1.493	0.82	70.40			'3	85034 (1)
		4.75			123.0	3.004	1.502	CT	1.558	1.11	82.00			1' 3	85034 (1)
		6.70			123.0	3.000	1.501	CT	1.544	1.33	89.60			1973	85034 (1)
		3.50			123.0	2.978	1.500	CT	1.530	1.32	89.20			1973	85034 (1)
		2.20			124.0	3.002	1.502	CT	1.572	1.24	87.30			1973	85857 (1)
		6.70			124.0	2.996	1.502	CT	1.501	1.12	83.00			1973	85034 (1)
		4.75			125.0	3.001	1.502	CT	1.541	1.24	87.90			1973	85034 (1)
		2.20			125.0	3.006	1.498	CT	1.593	1.03	80.30			1973	85857 (1)
		3.20			126.0	3.000	1.508	CT	1.589	1.30	90.70			1973	85857 (1)
		2.25			126.0	2.995	1.502	CT	1.535	1.31	91.30			1973	85034 (1)
		2.25			126.0	2.998	1.500	CT	1.516	1.02	80.90			1973	85034 (1)
		3.20			126.0	3.000	1.501	CT	1.521	1.47	96.50			1973	85857 (1)
		2.20			127.0	3.008	1.502	CT	1.733	1.38	94.40			1973	85857 (1)
		2.25			127.0	3.001	1.500	CT	1.552	1.34	93.10			1973	85034 (1)
		2.20			127.0	3.002	1.500	CT	1.577	1.03	81.40			1973	85857 (1)
		1.50			128.0	3.002	1.398	CT	1.595	0.97	79.70			1973	85034 (1)
		2.20			128.0	3.006	1.500	CT	1.601	0.88	75.90			1973	85857 (1)
		1.50			129.0	3.001	1.377	CT	1.575	0.85	75.40			1973	85034 (1)
		1.50			129.0	3.003	1.424	CT	1.583	0.83	74.20			1973	85034 (1)
		1.50			129.0	2.979	1.355	CT	1.586	1.11	85.90			1973	85034 (1)
		1.50			129.0	3.000	1.367	CT	1.586	1.02	82.20			1973	85034 (1)
		1.20			130.0	3.004	1.347	CT	1.587	1.26	92.50			1973	85857 (1)
		1.50			130.0	3.001	1.368	CT	1.564	1.16	88.60			1973	85034 (1)
		1.20			130.0	3.010	1.319	CT	1.649	1.22	90.80			1973	85857 (1)

NOTES:
(1) RECRYSTALLIZE ANNEAL=1700F 4 HR.FC TO 1400F AT 100F/HR.COOL TO 900F IN .75HR
TYS APPROX 120

TABLE 4.11.2.1 (con't)

TITANIUM TI-6AL-4V K(IC)

CONDITION	PRODUCT FORM	PRODUCT THICK (IN)	TEST TEMP (F)	SPECIMEN ORIENT	YIELD STRENGTH (KSI)	SPECIMEN WIDTH (IN) W	SPECIMEN THICK (IN) B	SPECIMEN DESIGN	CRACK LENGTH (IN) A	2.5*(K(IC)/TYS)**2 (IN)	K(IC) (KSI*SQRT IN)	K(IC) MEAN	STAN DEV	DATE	REFER
RECRYSTALLIZE ANNEAL	F	1.50	R.T.	T-L	130.0	3.004	1.399	CT	1.587	0.99	81.70			1973	85034 (1)
		1.20			130.0	3.008	1.344	CT	1.653	1.27	92.60			1973	85857 (1)
		2.25			130.0	3.000	1.500	CT	1.522	1.32	94.50			1973	85034 (1)
		1.20			131.0	3.005	1.375	CT	1.599	0.85	76.30			1973	85857 (1)
		2.20			131.0	3.006	1.497	CT	1.592	0.95	80.60			1973	85857 (1)
		1.50			132.0	3.000	1.409	CT	1.583	0.81	75.00			1973	85034 (1)
		1.20			133.0	3.006	1.374	CT	1.577	0.86	77.90			1973	85857 (1)
		2.25			134.0	2.998	1.499	CT	1.537	1.04	86.50			1973	85034 (1)
		1.20			134.0	3.009	1.380	CT	1.625	1.15	91.00			1973	85857 (1)
		1.20			136.0	3.007	1.377	CT	1.585	1.08	89.60			1973	85857 (1)
												83.9/	6.9		
RECRYSTALLIZE ANNEAL	F	----	R.T.	S-L	----	3.000	1.500	CT	----	1.20	83.00			1974	89004 (2)
		4.60			118.0	3.003	1.428	CT	1.559	1.42	89.30			1973	85634 (1)
		6.70			121.0	3.001	1.502	CT	1.552	1.46	92.50			1973	85034 (1)
		6.70			122.0	3.000	1.502	CT	1.540	1.40	91.10			1973	85034 (1)
		4.75			122.0	3.000	1.500	CT	1.573	1.37	90.20			1973	85034 (1)
		6.70			122.0	2.997	1.501	CT	1.532	1.37	90.40			1973	85034 (1)
		4.60			122.0	3.001	1.500	CT	1.540	1.26	86.70			1973	85634 (1)
		4.75			124.0	3.002	1.502	CT	1.544	1.37	91.70			1973	85034 (1)
		6.70			129.0	3.001	1.501	CT	1.543	1.17	85.60			1973	85034 (1)
												88.9/	3.2		
STA	P	0.62	R.T.	T-L	160.0	3.503	0.633	CT	1.831	0.16	40.30			1973	85836
		0.62			160.0	3.503	0.634	CT	1.801	0.18	43.50			1973	85836
		0.62			160.0	3.501	0.632	CT	1.790	0.19	44.00	42.6/	2.0	1973	85836
STA	F	2.00	R.T.	---	126.9	----	2.000	--	----	1.32	92.32			----	R1005
STOA	F	2.00	R.T.	---	132.0	----	2.000	--	----	1.00	83.52			----	R1005
STOA 1750F 1 HR, WQ, 1300F 2 HR, AC	F	2.50	R.T.	--	142.0	2.000	1.000	CT	1.000	0.44	59.80			1974	88962
		2.50			142.0	2.000	1.000	CT	1.000	0.40	56.90			1974	88962
		2.50			142.0	2.000	1.000	CT	1.000	0.47	61.40	59.4/	2.3	1974	88962

NOTES:
(1) RECRYSTALLIZE ANNEAL=1700F 4 HR,FC TO 1400F AT 100F/HR,COOL TO 900F IN .75HR
(2) RECRYSTALLIZE ANNEAL=1700F 4 HR,FC TO 1400F AT 100F/HR,COOL TO 900F IN .75HR
TYS APPROX. 120

TABLE 4.11.2.1 (con't)

TITANIUM TI-6AL-4V K(IC)

CONDITION	--PRODUCT-- FORM	THICK (IN)	TEST TEMP (F)	SPECIMEN ORIENT	YIELD STRENGTH (KSI)	------SPECIMEN------ WIDTH (IN) W	THICK (IN) B	DESIGN	CRACK LENGTH (IN) A	2.5*(K(IC)/TYS)**2 (IN)	K(IC) (KSI*SQRT IN)	K(IC) MEAN	STAN DEV	DATE	REFER
1450F, 1HR, AC	P	1.00	R.T.	T-L	146.0	----	1.000	CT	----	0.23	44.00			1981	NR001
1700F 6 HR.AC. 1400F 6 HR.AC	F	1.40	R.T.	L-T	118.0	3.006	1.317	CT	1.605	0.97	74.10			1973	85857
		1.40			119.0	3.002	1.365	CT	1.615	1.16	81.20			1973	85857
		1.40			119.0	3.002	1.251	CT	1.587	0.91	71.60			1973	85857
		1.40			119.0	3.004	1.350	CT	1.588	1.16	81.10			1973	85857
		1.40			119.0	3.003	1.301	CT	1.583	0.94	73.00			1973	85857
		1.40			120.0	3.002	1.290	CT	1.604	1.07	74.40	75.9/	4.2	1973	85857
1700F 6 HR.AC. 1400F 6 HR.AC	F	1.40	R.T.	T-L	126.0	3.001	1.357	CT	1.564	1.17	86.30			1973	85857
		1.40			126.0	3.002	1.311	CT	1.599	0.91	76.00			1973	85857
		1.40			127.0	3.004	1.353	CT	1.617	1.18	87.50			1973	85857
		1.40			129.0	3.006	1.325	CT	1.500	0.88	74.80			1973	85857
		1.40			129.0	3.005	1.279	CT	1.568	1.09	85.20			1973	85857
		1.40			129.0	3.006	1.336	CT	1.632	0.92	77.10	81.2/	5.8	1973	85857
1750F 1 HR.WQ. 1000F 4 HR	F	3.00	-75	T-L	159.0	5.100	2.000	WOL	1.998	0.43	66.30			1966	76411
		3.00			159.0	5.100	2.000	WOL	2.091	0.48	70.00	68.2/	2.6	1966	76411
1750F 1 HR.WQ. 1000F 4 HR	F	3.00	-40	T-L	153.0	5.100	2.000	WOL	2.088	0.63	76.80			1966	76411
		3.00			153.0	5.100	2.000	WOL	2.059	0.47	66.20	71.5/	7.5	1966	76411
1750F 1 HR.WQ. 1000F 4 HR	F	3.00	0	T-L	147.0	5.100	2.000	WOL	1.998	0.51	66.40			1966	76411
		3.00			147.0	5.100	2.000	WOL	2.081	0.61	72.90	69.7/	4.6	1966	76411
1750F 1 HR.WQ. 1000F 4 HR	F	3.00	32	T-L	148.0	5.100	2.000	WOL	2.041	0.47	64.40			1966	76411
		3.00			148.0	5.100	2.000	WOL	2.011	0.49	65.50	65.0/	0.8	1966	76411
1750F 1 HR.WQ. 1000F 4 HR	F	3.00	R.T.	T-L	140.0	5.100	2.000	WOL	1.986	0.71	84.90			1966	76411
		3.00			140.0	5.100	2.000	WOL	2.019	0.75	76.60			1966	76411
		3.00			140.0	5.100	2.000	WOL	2.010	0.74	76.30	79.3/	4.9	1966	76411
1750F 1 HR.WQ. 1000F 4 HR	F	3.00	100	T-L	133.0	5.100	2.000	WOL	1.969	0.75	72.90			1966	76411
		3.00			133.0	5.100	2.000	WOL	2.049	0.68	67.30	71.1/	2.5	1966	76411

TABLE 4.11.2.1 (con't)

TITANIUM TI-6AL-4V K(IC)

CONDITION	--PRODUCT-- FORM	THICK (IN)	TEST TEMP (F)	SPECIMEN ORIENT	YIELD STRENGTH (KSI)	------SPECIMEN------ WIDTH (IN) W	THICK (IN) B	DESIGN	CRACK LENGTH (IN) A	2.5*(K(IC)/TYS)**2 (IN)	K(IC) (KSI*SQRT IN)	K(IC) MEAN	STAN DEV	DATE	REFER
1750F 1 HR.WQ.	F	3.00	150	T-L	127.0	5.100	2.000	WOL	1.970	0.85	74.00			1966	76411
1000F 4 HR		3.00			127.0	5.100	2.000	WOL	2.033	1.00	82.00	78.0/	5.7	1966	76411
1750F 1HR FC TO 1100F.AC	P	1.50	R.T.	L-T	120.0	4.005	1.501	CT	1.991	1.20	83.00			1973	85836
1750F 1HR FC	P	1.50	R.T.	T-L	120.0	4.004	1.501	CT	1.938	1.41	90.00			1973	85836
TO 1100F.AC		1.50			120.0	4.000	1.500	CT	----	1.50	93.00	91.5/	2.1	1974	89004
1750F 1HR.FC	P	1.50	R.T.	L-T	120.0	4.004	1.502	CT	1.717	0.84	69.50			1973	85836
TO RT		1.50			120.0	4.004	1.501	CT	1.718	0.95	74.00	71.8/	3.2	1973	85836
1750F 1HR.FC	P	1.50	R.T.	T-L	120.0	4.008	1.502	CT	1.956	1.43	90.60			1973	85836
TO RT		1.50			120.0	4.003	1.502	CT	1.986	1.49	92.50	91.6/	1.3	1973	85836
1750F 2 HR.FC TO 900F AT 100F/HR.AC	F	3.00	R.T.	L-T	115.0	3.005	1.500	CT	1.716	1.20	79.80			1973	88440
1750F 2 HR.FC TO 900F AT 100F/HR.AC	F	3.00	R.T.	T-L	130.0	3.005	1.500	CT	1.581	1.21	90.50			1973	88440
1750F 2HR.WQ.	P	0.62	R.T.	L-T	150.0	3.501	0.634	CT	1.865	0.17	39.80			1973	85836
1000F 2HR.AC.		0.62			150.0	3.501	0.633	CT	1.880	0.20	43.00			1973	85836
1300F 2HR.AC.STA												41.4/	2.3		
1900F, 0.5HR, AC 1350F, 2HRS, AC	P	1.00	R.T.	T-L	126.0	----	1.000	CT	----	1.44	95.60			1981	NR001

TABLE 4.11.2.2

TITANIUM TI-6AL-4V K(C)

CONDITION	PRODUCT FORM	PRODUCT THICK (IN)	TEST TEMP (F)	SPEC OR	YIELD STR (KSI)	SPECIMEN WIDTH (IN) W	SPECIMEN THICK (IN) B	CRACK LENGTH INIT (IN) 2A(O)	CRACK LENGTH FINAL (IN) 2A(F)	GROSS STRESS ONSET (KSI) S(O)	GROSS STRESS MAX (KSI) S(MAX)	K(APP) (KSI*SQRT IN)	K(APP) MEAN	K(APP) STAN DEV	K(C) (KSI*SQRT IN)	K(C) MEAN	K(C) STAN DEV	DATE	REFER
BUCKLING OF CRACK EDGES RESTRAINED																			
ANNEALED	S	0.04	-109	L-T	163.0	8.000	0.040	3.060	----	---	47.40	114.42			----			1963	54304
		0.04			163.0	8.000	0.040	1.040	----	---	94.10	121.54			----			1963	54304
		0.04			163.0	8.000	0.040	0.890	----	---	101.00	117.52			----			1963	54304
		0.04			163.0	8.000	0.040	1.540	----	---	77.20	122.89			----			1963	54304
		0.04			163.0	8.000	0.040	2.000	----	---	73.60	135.72			----			1963	54304
		0.04			163.0	8.000	0.040	4.840	----	---	33.60	121.50			----			1963	54304
		0.04			163.0	8.000	0.040	4.440	----	---	35.30	116.22	121 4/	7.0	----	----/	---	1963	54304
ANNEALED	S	0.04	R.T.	L-T	137.3	8.000	0.040	4.050	----	---	47.50	143.18			----			1963	54304
		0.04			137.3	8.000	0.040	5.030	----	---	36.20	137.12			----			1963	54304
		0.04			137.3	8.000	0.040	2.020	----	---	78.60	145.78			----			1963	54304
		0.04			137.3	8.000	0.040	0.950	----	---	108.30	133.46*			----			1963	54304
		0.04			137.3	8.000	0.040	1.550	----	---	95.50	152.56*			----			1963	54304
		0.04			137.3	8.000	0.040	3.030	----	---	61.20	146.71			----			1963	54304
		0.04			137.3	8.000	0.040	0.480	----	---	126.00	109.65*	143 2/	4.3	----	----/	---	1963	54304
ANNEALED	S	0.04	550	L-T	96.7	8.000	0.040	0.250	----	---	111.20	69.73*			----			1963	54304
		0.04			96.7	8.000	0.040	1.260	----	---	91.00	130.02*			----			1963	54304
		0.04			96.7	8.000	0.040	0.570	----	---	101.20	96.06*			----			1963	54304
		0.04			96.7	8.000	0.040	0.950	----	---	94.90	116.95*			----			1963	54304
		0.04			96.7	8.000	0.040	2.020	----	---	80.50	149.31*			----			1963	54304
BUCKLING OF CRACK EDGES UNKNOWN																			
MA	P	0.25	R.T.	L-T	130.0	9.630	0.286	5.780	6.860	18.70	37.80	148.60			187.79*			1971	83984
		0.25			130.0	9.630	0.280	3.800	5.220	25.60	51.70	140.00			182.38*			1971	83984
		0.25			130.0	9.630	0.293	1.920	----	36.50	85.10	151.52*	144 3/	6.1	----	----/	---	1971	83984
MA	P	0.25	R.T.	L-T	130.0	16.110	0.285	12.930	13.550	11.30	15.40	125.65			142.95			1971	83984
MA	P	0.25	R.T.	L-T	130.0	16.120	0.260	8.020	10.580	31.30	45.10	189.99			256.45*			1971	83984
		0.25			130.0	16.120	0.275	3.990	6.100	31.10	67.50	175.67	182 8/	10.1	229.56*	----/	---	1971	83984

*NOTE - NET SECTION STRESS EXCEEDS 80% OF YIELD STRENGTH. VALUE NOT INCLUDED IN MEAN OR STD. DEV

TABLE 4.11.2.2 (con't)

TITANIUM TI-6AL-4V K(C)

CONDITION	PRODUCT FORM	PRODUCT THICK (IN)	TEST TEMP (F)	SPEC OR	YIELD STR (KSI)	SPECIMEN WIDTH (IN) W	SPECIMEN THICK (IN) B	CRACK LENGTH INIT (IN) 2A(O)	CRACK LENGTH FINAL (IN) 2A(F)	GROSS STRESS ONSET (KSI) S(O)	GROSS STRESS MAX (KSI) S(MAX)	K(APP) (KSI*SQRT IN)	K(APP) MEAN/STAN DEV (KSI*SQRT IN)	K(C) (KSI*SQRT IN)	K(C) MEAN/STAN DEV (KSI*SQRT IN)	DATE	REFER
BUCKLING OF CRACK EDGES UNKNOWN																	
MA	P	0.25	R.T.	L-T	130.0	18.000	0.265	4.540	----	53.90	75.30	209.36		----		1971	83984
		0.25			130.0	18.000	0.265	4.640	----	35.60	75.40	212.33	210.8/ 2.1	----	----/ ---	1971	83984
MA	P	0.25	R.T.	L-T	130.0	32.130	0.275	8.010	----	30.60	58.90	217.31		----		1971	83984
		0.25			130.0	32.140	0.273	19.200	21.700	14.20	26.20	187.15		218.88		1971	83984
		0.25			130.0	32.150	0.270	12.720	17.000	33.40	47.00	233.00	212.5/23.3	295.74	257.3/54.3	1971	83984
MA	P	0.25	R.T.	L-T	130.0	32.160	0.262	6.020	----	39.20	75.20	236.38		----		1971	83984
		0.25			130.0	32.160	0.288	8.070	----	40.20	55.40	205.27	220.8/22.0	----	----/ ---	1971	83984
BUCKLING OF CRACK EDGES RESTRAINED																	
MA	S	0.05	R.T.	L-T	136.5	23.900	0.049	5.990	----	---	47.30	150.98		----		1964	57573
		0.05			136.5	23.990	0.050	6.000	----	---	47.50	151.72		----		1964	57573
		0.05			133.8	24.020	0.048	6.000	6.550	51.80	52.10	166.39		175.22		1964	57573
		0.05			133.8	24.050	0.050	6.000	----	41.30	51.50	164.46		----		1964	57573
		0.05			136.5	24.060	0.049	6.000	----	---	60.70	193.83		----		1964	57573
		0.05			136.5	24.060	0.049	6.000	10.500	43.60	49.60	158.39		228.75		1964	57573
		0.05			136.5	24.060	0.050	3.000	----	---	78.80	172.72		----		1964	57573
		0.05			136.5	24.070	0.047	10.000	----	---	41.60	184.97		----		1964	57573
		0.05			136.5	24.070	0.050	6.000	----	---	56.60	180.74		----		1964	57573
		0.05			136.7	24.070	0.052	6.010	7.350	41.10	51.80	165.57		186.87		1964	57573
		0.05			136.7	24.070	0.050	6.000	----	---	53.20	169.88		----		1964	57573
		0.05			136.7	24.070	0.052	6.010	8.750	43.80	51.40	164.29		207.75		1964	57573
		0.05			136.0	24.080	0.055	6.010	8.170	45.90	51.50	164.60		198.79		1964	57573
		0.05			136.0	24.080	0.054	6.000	8.120	30.40	47.00	150.08	167.0/12.8	180.69	196.4/19.9	1964	57573
MA	S	0.05	R.T.	L-T	136.7	24.370	0.052	5.990	----	---	54.20	172.73		----		1964	57573
MA	S	0.20	R.T.	L-T	127.3	24.060	0.212	6.000	----	---	81.00	258.66*		----		1964	57573
		0.20			127.3	24.070	0.218	6.000	----	---	76.40	243.96		----		1964	57573
		0.20			129.3	24.070	0.212	6.010	----	65.60	70.60	225.66		----		1964	57573

*NOTE- NET SECTION STRESS EXCEEDS 80% OF YIELD STRENGTH. VALUE NOT INCLUDED IN MEAN OR STD. DEV

TABLE 4.11.2.2 (con't)

TITANIUM TI-6AL-4V K(C)

CONDITION	PRODUCT FORM	PRODUCT THICK (IN)	TEST TEMP (F)	SPEC OR	YIELD STR (KSI)	SPECIMEN WIDTH (IN) W	SPECIMEN THICK (IN) B	CRACK LENGTH INIT (IN) 2A(O)	CRACK LENGTH FINAL (IN) 2A(F)	GROSS STRESS ONSET (KSI) S(O)	GROSS STRESS MAX (KSI) S(MAX)	K(APP) (KSI*SQRT IN)	K(APP) MEAN/STAN DEV (KSI*SQRT IN)	K(C) (KSI*SQRT IN)	K(C) MEAN/STAN DEV (KSI*SQRT IN)	DATE	REFER
BUCKLING OF CRACK EDGES RESTRAINED																	
MA	S	0.20	R.T.	L-T	129.3	24.070	0.212	3.010	----	---	93.10	204.41*		----		1964	57573
		0.20			129.3	24.080	0.220	10.000	----	---	55.30	245.86	238.5/11.2	----	----/ ---	1964	57573
MA	S	0.05	82	L-T	136.5	24.070	0.051	5.990	7.100	43.30	47.50	151.53		167.72		1964	57573
MA	S	0.05	- 110	T-L	163.3	8.000	0.050	1.980	3.130	35.00	84.70	155.28		207.78*		1964	57573
		0.05			163.3	8.010	0.050	1.970	2.540	72.50	77.30	141.29		164.74		1964	57573
		0.05			164.3	8.010	0.052	1.920	2.370	66.60	75.50	135.97	144 2/10.0	154.07	159.4/ 7.5	1964	57573
MA	S	0.03	R.T.	T-L	127.0	8.040	0.025	1.980	2.600	61.20	75.60	138.54		163.45*		1964	57573
MA	S	0.05	R.T.	T-L	136.0	8.010	0.052	2.000	2.220	90.00	95.30	175.72*		186.89*		1964	57573
MA	S	0.13	R.T.	T-L	139.7	8.050	0.127	1.980	2.740	48.00	103.70	190.02*		231.93*		1964	57573
MA	S	0.03	650	T-L	80.2	8.030	0.025	2.060	2.460	75.70	77.70	145.73*		162.23*		1964	57573
MA	S	0.05	650	T-L	81.7	8.020	0.051	2.000	2.090	63.40	75.40	139.01*		142.64*		1964	57573
BUCKLING OF CRACK EDGES NOT RESTRAINED																	
1300F 1HR, AC	F	----	R.T.	L-T	147.1	5.970	0.382	2.020	3.200	---	53.50	102.64		146.98		1964	58782
		----			147.1	5.970	0.382	2.020	3.180	---	51.90	99.57	101.1/ 2.2	141.72	144.4/ 3.7	1964	58782
1300F 1HR, AC	F	----	R.T.	L-T	147.1	8.970	0.732	3.000	5.000	---	54.40	126.94		190.38*		1964	58782
1300F 1HR, AC	F	----	R.T.	L-T	147.1	8.970	0.998	3.000	5.200	---	28.30	66.05		103.28		1964	58782

*NOTE- NET SECTION STRESS EXCEEDS 80% OF YIELD STRENGTH VALUE NOT INCLUDED IN MEAN OR STD. DEV.

TABLE 4.11.3.1

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 4.11.3.1 INDICATING EFFECT

OF ENVIRONMENT

MATERIAL: TITANIUM TI-6AL-4V
CONDITION:

DELTA K (KSI*IN**1/2)		DA/DN (10**-6 IN./CYCLE) A	B	C	D
		E= R.T. LAB AIR			
DELTA K MIN A:	6.09	.129			
DELTA K MIN B:					
DELTA K MIN C:					
DELTA K MIN D:					
	7.00	.238			
	8.00	.340			
	9.00	.572			
	10.00	1.36			
DELTA K MAX A:	12.31	2.80			
DELTA K MAX B:					
DELTA K MAX C:					
DELTA K MAX D:					

ROOT MEAN SQUARE PERCENT ERROR 12.09

LIFE PREDICTION RATIO SUMMARY (NP/NA)	
	0.0-0.5
	0.5-0.8
	0.8-1.25
	1.25-2.0
	>2.0

CONDITION/HT:	
FORM:	YIELD STRENGTH:
SPECIMEN TYPE:	ULT. STRENGTH:
ORIENTATION:	SPECIMEN THK: 0.081"
STRESS RATIO: +0.10	SPECIMEN WIDTH: 2.500"
FREQUENCY: 30.00 HZ	REFERENCES: PW003

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TI-6AL-4V

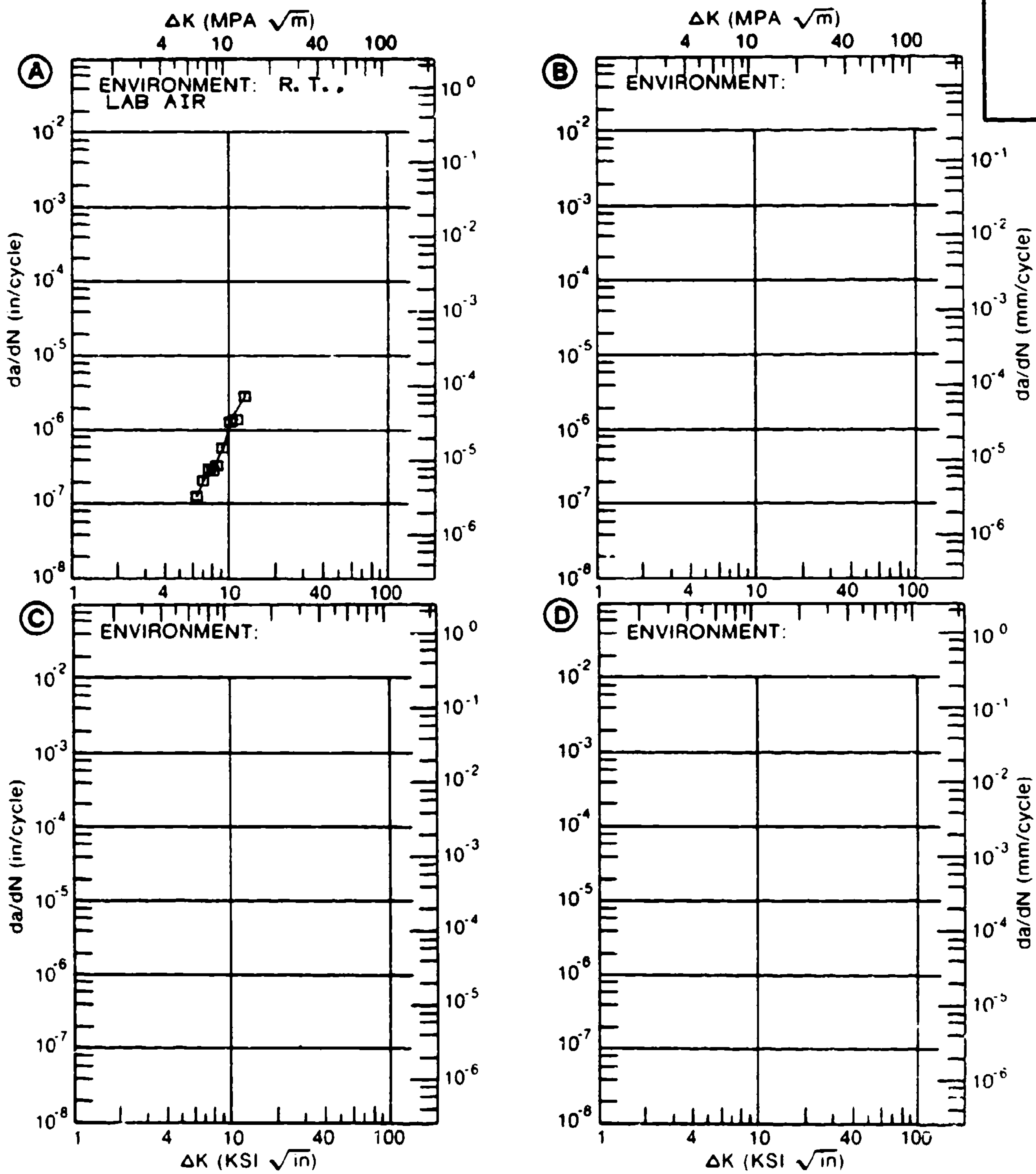

Figure 4.11.3.1

TABLE 4.11.3.2

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 4.11.3.2 INDICATING EFFECT
OF STRESS RATIO

MATERIAL: TITANIUM TI-6AL-4V
CONDITION:
ENVIRONMENT: R. T. , LAB AIR

DELTA K (KSI*IN**1/2)		DA/DN (10**-6 IN./CYCLE) A R=+0.10	B R=+0.30	C R=+0.50	D R=+0.70
DELTA K MIN A:	11.07	1.31			
DELTA K MIN B:	7.27		.201		
DELTA K MIN C:	5.18			.0883	
DELTA K MIN D:	3.07				.0336
	3.50				.0473
	4.00				.0707
	5.00				.152
	6.00			.165	.300
	7.00			.334	.544
	8.00		.400	.656	1.04
	9.00		.904	1.14	
	10.00		1.65	1.81	
	13.00	2.86	4.56	5.34	
	16.00	5.86	8.52	12.1	
	20.00	10.4	17.0		
	25.00	17.8			
	30.00	31.2			
	35.00	58.9			
	40.00	121.			
DELTA K MAX A:	41.03	142.			
DELTA K MAX B:	21.70		20.4		
DELTA K MAX C:	18.26			18.5	
DELTA K MAX D:	8.80				1.80
ROOT MEAN SQUARE PERCENT ERROR		12.53	16.74	28.71	12.56

LIFE PREDICTION RATIO SUMMARY (NP/NA)
0.0-0.5
0.5-0.8
0.8-1.25
1.25-2.0
>2.0

CONDITION/HT:
FORM:
SPECIMEN TYPE: CT
ORIENTATION: C-R
FREQUENCY: 20.00 HZ
ENVIRONMENT: R.T., LAB AIR

YIELD STRENGTH:
ULT. STRENGTH:
SPECIMEN THK: 0.280- 0.299"
SPECIMEN WIDTH: 2.500"
REFERENCE: SPW003

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TI-6AL-4V

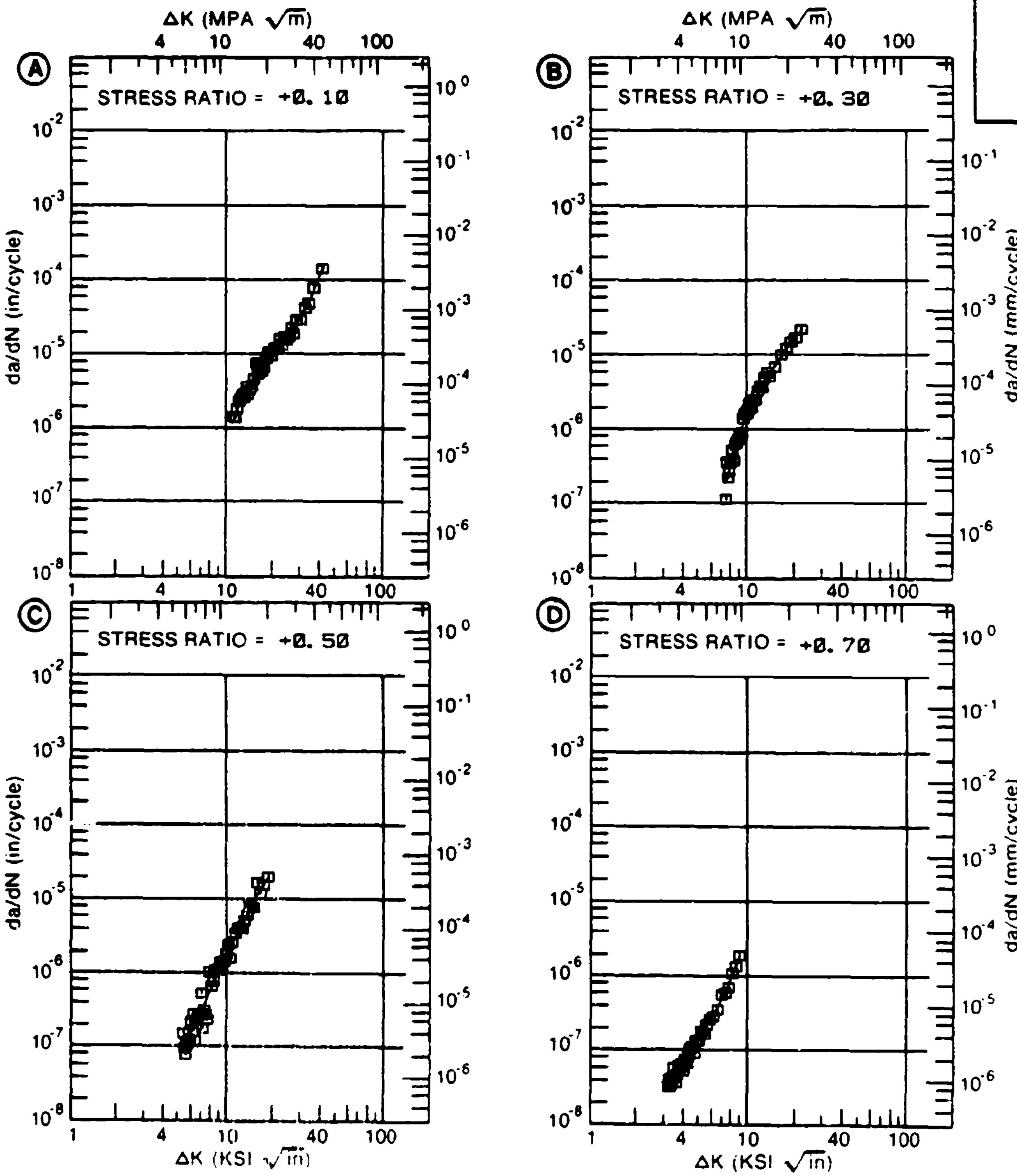

Figure 4.11.3.2

TABLE 4.11.3.3

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 4.11.3.3 INDICATING EFFECT

OF ENVIRONMENT

MATERIAL: TITANIUM TI-6AL-4V
CONDITION:

DELTA K (KSI*IN**1/2)		DA/DN (10**-6 IN./CYCLE) A: E= R.T. LAB AIR	B: E=+ 300F AIR	C	D
DELTA K MIN A:	8.55	.799			
DELTA K MIN B:	8.26		.885		
DELTA K MIN C:					
DELTA K MIN D:					
	9.00	.849	.976		
	10.00	1.13	1.26		
	13.00	4.02	3.60		
	16.00	12.1	9.07		
DELTA K MAX A:	17.54	20.1			
DELTA K MAX B:	18.42		15.0		
DELTA K MAX C:					
DELTA K MAX D:					
ROOT MEAN SQUARE PERCENT ERROR		11.07	23.47		

LIFE PREDICTION RATIO SUMMARY (NP/NA)	
0.0-0.5	
0.5-0.8	
0.8-1.25	
1.25-2.0	
>2.0	

CONDITION/HT:
FORM:
SPECIMEN TYPE: CCP
ORIENTATION: C-R
STRESS RATIO: -1.00
FREQUENCY: 0.16 HZ

YIELD STRENGTH:
ULT. STRENGTH:
SPECIMEN THK: 0.297- 0.301"
SPECIMEN WIDTH: 2.500"
REFERENCES:PW003

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TI-6AL-4V

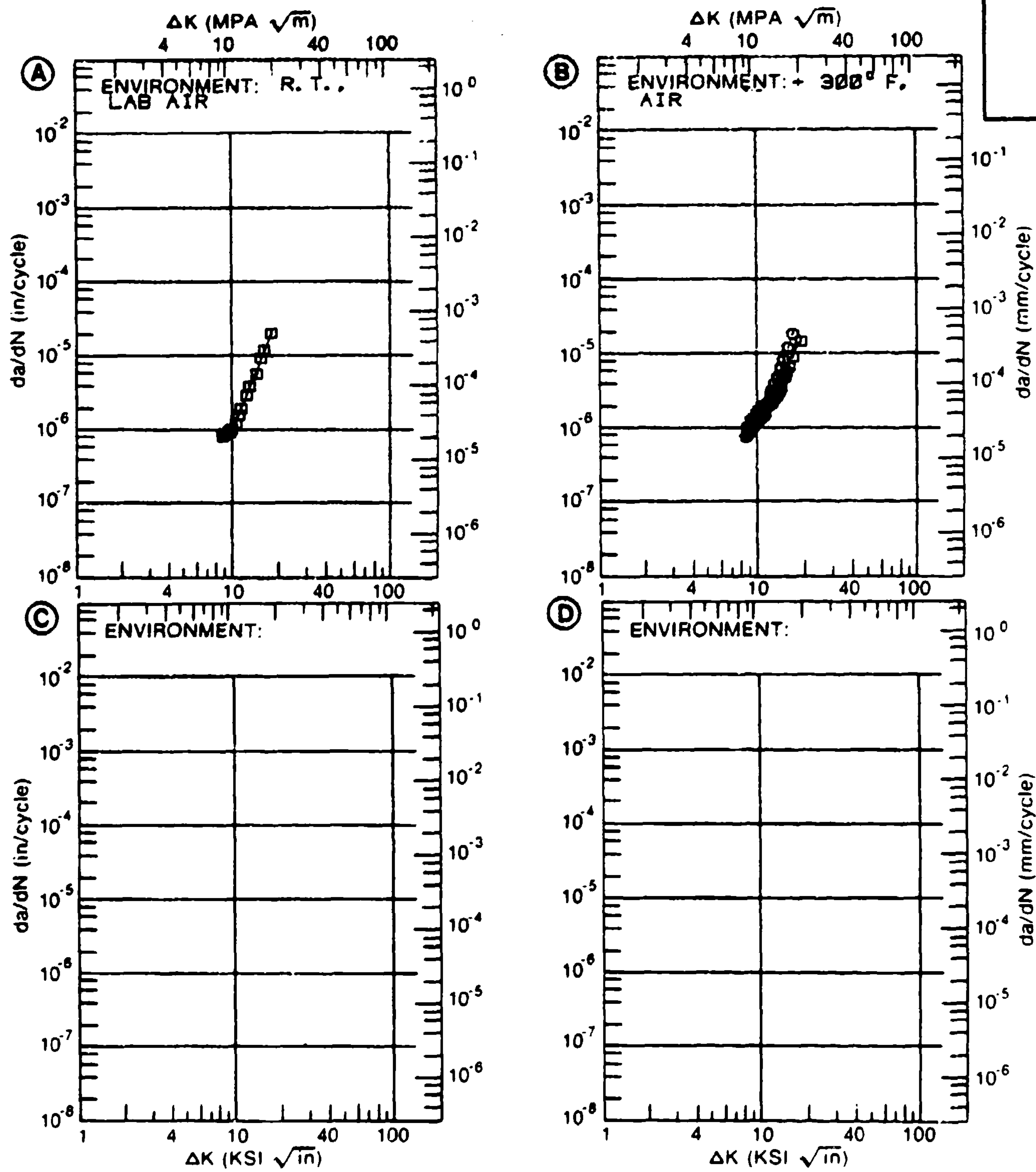

Figure 4.11.3.3

TABLE 4.11.3.4

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 4.11.3.4 INDICATING EFFECT

OF ENVIRONMENT

MATERIAL: TITANIUM TI-6AL-4V
CONDITION:

DELTA K (KSI*IN**1/2)		DA/DN (10**-6 IN./CYCLE) A	B	C	D
		E= R.T. LAB AIR	E=+ 300F AIR		
DELTA K MIN A:	8.19	.424			
DELTA K MIN B:	8.12		.208		
DELTA K MIN C:					
DELTA K MIN D:					
	9.00	.695	.495		
	10.00	1.14	.971		
	13.00	3.68	2.95		
	16.00	11.3	6.42		
DELTA K MAX A:	16.57	14.2			
DELTA K MAX B:	18.48		13.6		
DELTA K MAX C:					
DELTA K MAX D:					
ROOT MEAN SQUARE PERCENT ERROR		17.73	27.56		

LIFE PREDICTION RATIO SUMMARY (NP/NA)	
	0.0-0.5
	0.5-0.8
	0.8-1.25
	1.25-2.0
	>2.0

CONDITION/HT:	YIELD STRENGTH:
FORM:	ULT. STRENGTH:
SPECIMEN TYPE: CCP	SPECIMEN THK: 0.301- 0.302"
ORIENTATION: C-R	SPECIMEN WIDTH: 2.500"
STRESS RATIO: -0.50	REFERENCES:PW003
FREQUENCY: 0.16 HZ	

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TI-6AL-4V

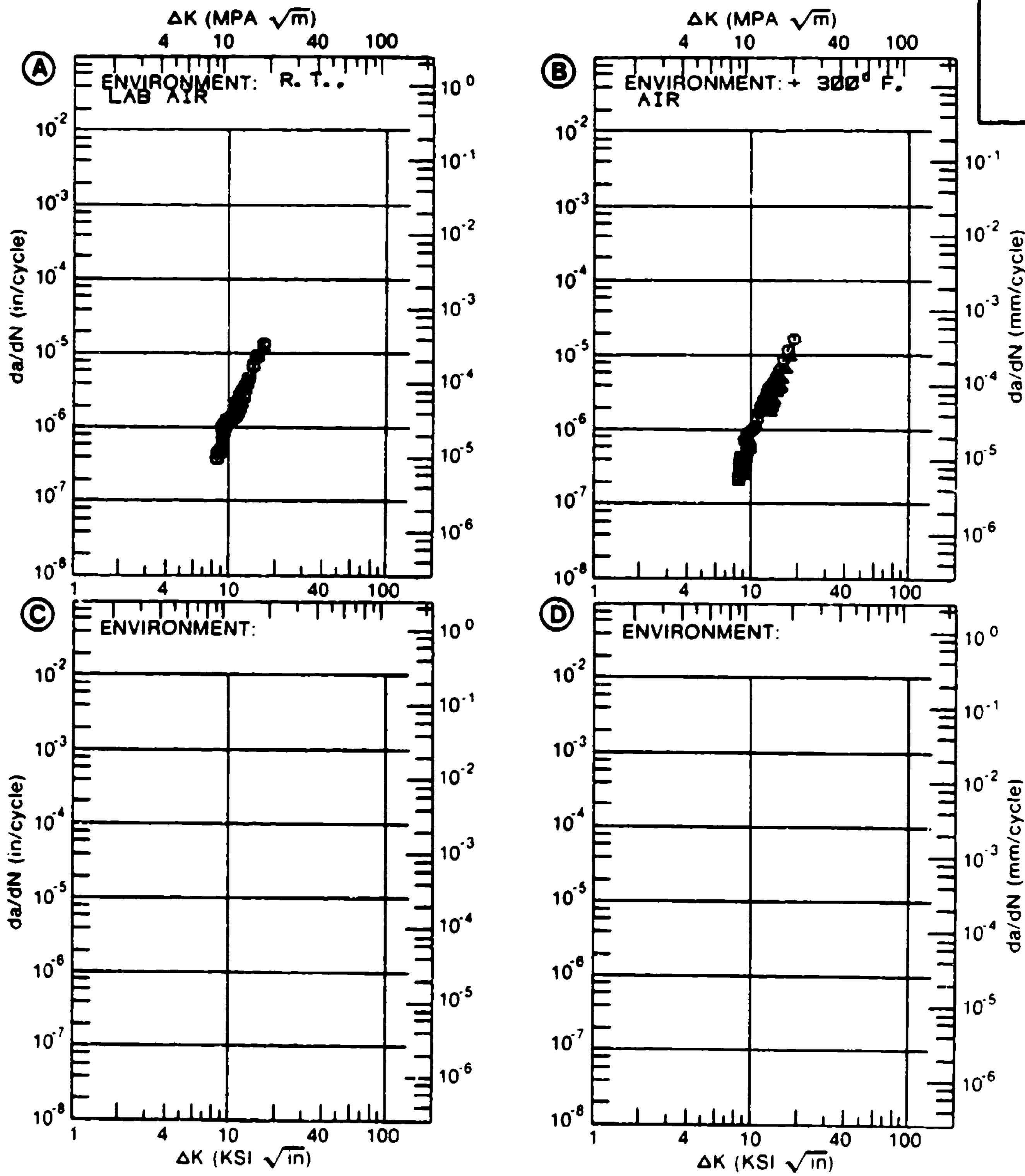

Figure 4.11.3.4

TABLE 4.11.3.5

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 4.11.3.5 INDICATING EFFECT

OF STRESS RATIO

MATERIAL: TITANIUM TI-6AL-4V
CONDITION: ANNEALED
ENVIRONMENT: R.T. ,LAB AIR

DELTA K (KSI*IN**1/2)		DA/DN (10**-6 IN./CYCLE) A	B	C	D
		R=+0.02			
DELTA K MIN	A: 9.04	.135			
	B:				
	C:				
	D:				
	10.00	.270			
	13.00	1.30			
	16.00	3.67			
	20.00	9.49			
	25.00	21.3			
	30.00	38.2			
	35.00	60.1			
	40.00	87.2			
DELTA K MAX	A: 44.93	120.			
	B:				
	C:				
	D:				

ROOT MEAN SQUARE PERCENT ERROR		24.21
LIFE PREDICTION RATIO SUMMARY (NP/NA)	0.0-0.5	
	0.5-0.8	1
	0.8-1.25	1
	1.25-2.0	
	>2.0	

CONDITION/HT: ANNEALED
FORM: 6.00"TH BILLET
SPECIMEN TYPE: WOL
ORIENTATION: L-T
FREQUENCY: 10.00- 20.00 HZ
ENVIRONMENT: R.T., LAB AIR

YIELD STRENGTH: 123.0 KSI
ULT. STRENGTH: 135.0 KSI
SPECIMEN THK: 1.250"
SPECIMEN WIDTH: 5.000"
REFERENCES: MA003

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TI-6AL-4V

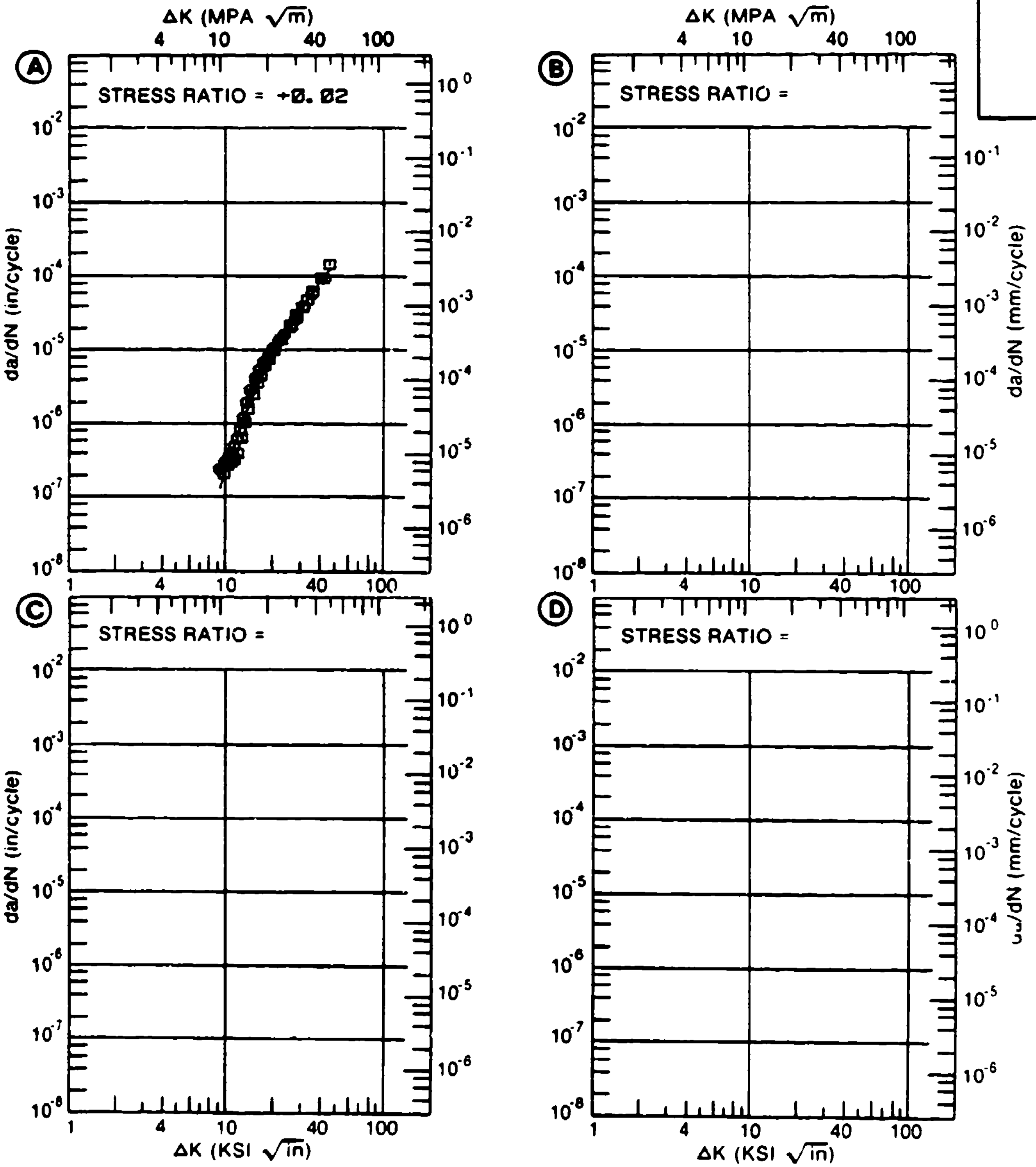

Figure 4.11.3.5

TABLE 4.11.3.6

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 4.11.3.6 INDICATING EFFECT
OF STRESS RATIO

MATERIAL: TITANIUM TI-6AL-4V
CONDITION: ANNEALED AT 1375F, 3HRS, AC
ENVIRONMENT: R. T. ,LAB AIR

DELTA K (KSI*IN**1/2)			DA/DN (10**-6 IN./CYCLE) A	B	C	D
			R=+0.02			
DELTA K MIN	A:	8.52	.0853			
	B:					
	C:					
	D:					
		9.00	.131			
		10.00	.283			
		13.00	1.41			
		16.00	3.88			
		20.00	9.70			
		25.00	21.7			
		30.00	40.8			
		35.00	70.2			
		40.00	116.			
DELTA K MAX	A:	42.37	145.			
	B:					
	C:					
	D:					
ROOT MEAN SQUARE PERCENT ERROR			25.31			
LIFE PREDICTION RATIO SUMMARY (NP/NA)		0.0-0.5				
		0.5-0.8	2			
		0.8-1.25				
		1.25-2.0				
		>2.0				

CONDITION/HT: ANNEALED AT 1375F, 3HRS, AC
FORM: 2.75"TH PLATE
SPECIMEN TYPE: WOL
ORIENTATION: L-T
FREQUENCY: 10.00- 20.00 HZ
ENVIRONMENT: R.T., LAB AIR

YIELD STRENGTH: 129.0 KSI
ULT. STRENGTH: 139.0 KSI
SPECIMEN THK: 1.250"
SPECIMEN WIDTH: 5.000"
REFERENCES: MA003

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TI-6AL-4V

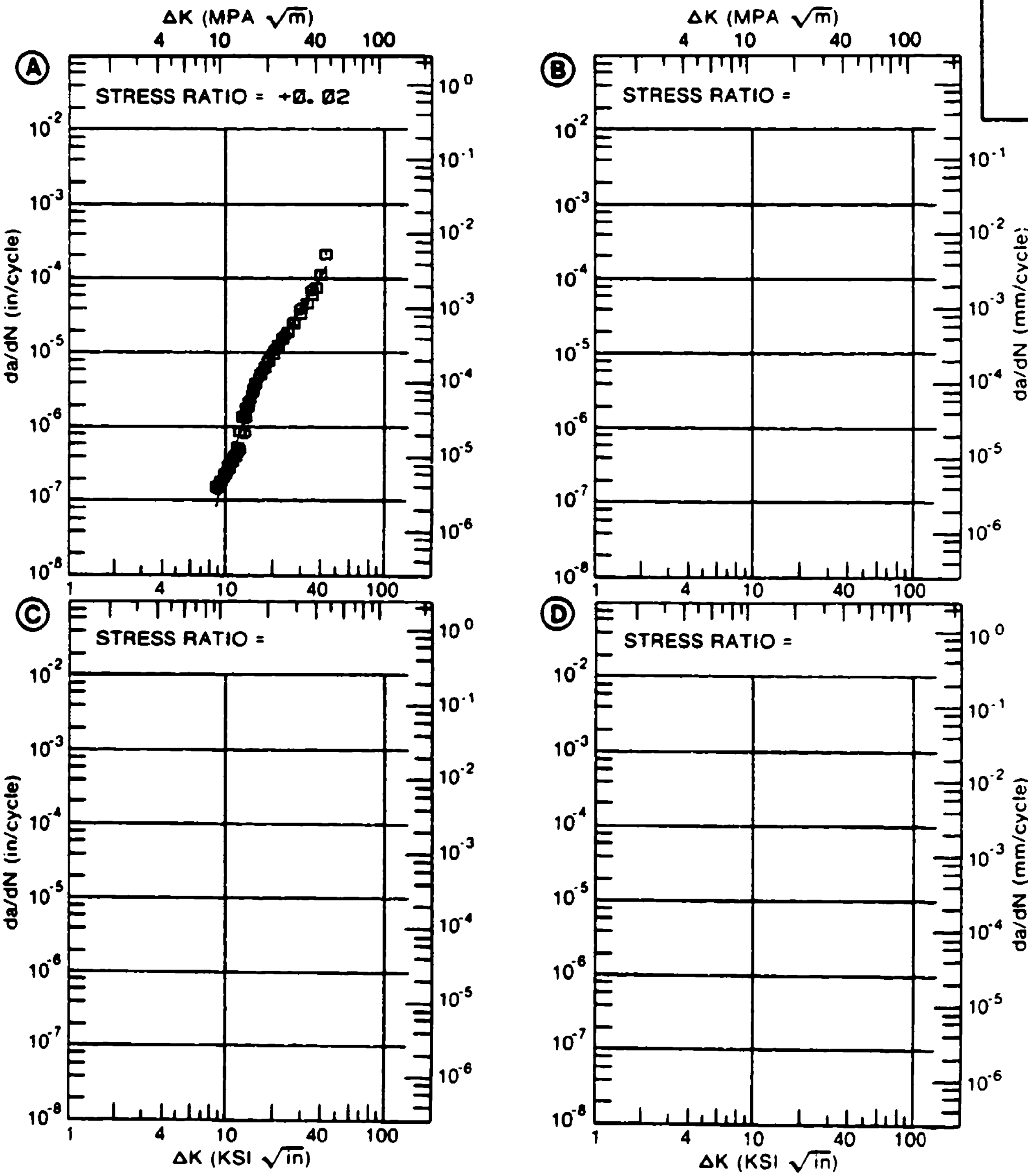

Figure 4.11.3.6

TABLE 4.11.3.7

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 4.11.3.7 INDICATING EFFECT
OF STRESS RATIO

MATERIAL: TITANIUM TI-6AL-4V
CONDITION: BA
ENVIRONMENT: R. T. , LAB AIR

DELTA K (KSI*IN**1/2)		DA/DN (10**-6 IN./CYCLE) A	B	C	D
		R=+0.10			
DELTA K MIN	A: 5.13	1.45			
	B:				
	C:				
	D:				
	6.00	1.91			
	7.00	2.47			
	8.00	3.10			
	9.00	3.82			
	10.00	4.66			
	13.00	8.43			
	16.00	15.4			
DELTA K MAX	A: 18.19	24.2			
	B:				
	C:				
	D:				
ROOT MEAN SQUARE PERCENT ERROR		16.35			

LIFE PREDICTION RATIO SUMMARY (NP/NA)		
	0.0-0.5	
	0.5-0.8	
	0.8-1.25	2
	1.25-2.0	
	>2.0	

CONDITION/HT: BA
FORM: 0.05"TH SHEET
SPECIMEN TYPE: CT
ORIENTATION:
FREQUENCY: 10.00 HZ
ENVIRONMENT: R.T., LAB AIR

YIELD STRENGTH: 130.0 KSI
ULT. STRENGTH:
SPECIMEN THK: 0.050"
SPECIMEN WIDTH: 3.940"
REFERENCES: NL001

TITAN. ALLOY

TI-6AL-4V

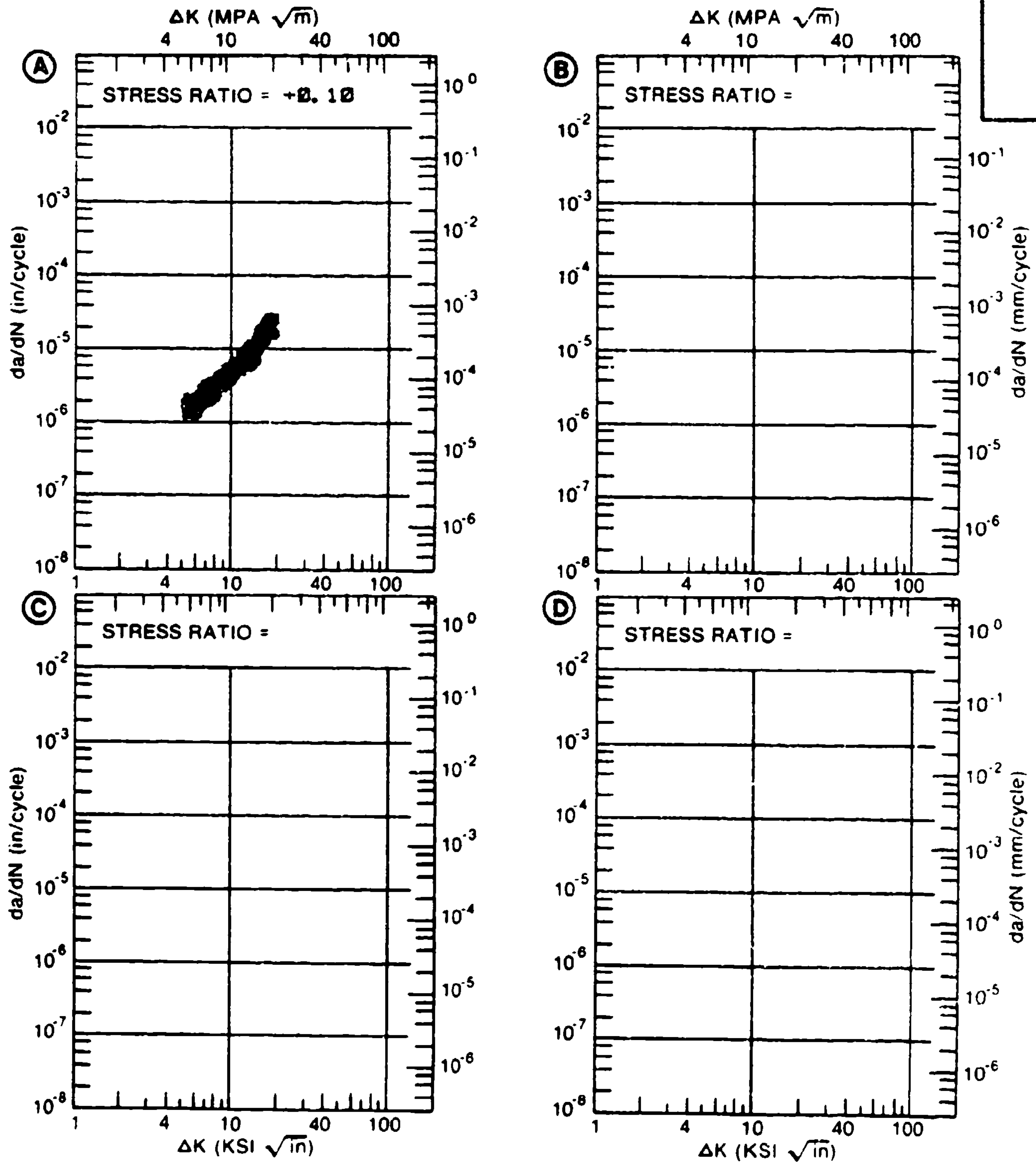

Figure 4.11.3.7

TABLE 4.11.3.8

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 4.11.3.8 INDICATING EFFECT OF STRESS RATIO

MATERIAL: TITANIUM TI-6AL-4V
CONDITION: BA
ENVIRONMENT: R. T. ,LAB AIR

DELTA K (KSI*IN**1/2)		DA/DN (10**-6 IN./CYCLE) A R=+0.10	B R=+0.30	C R=+0.70	D
DELTA K MIN	A: 9.98	1.84			
	B: 17.87		10.4		
	C: 9.03			2.34	
	D:				
	10.00	1.86		3.90	
	13.00	4.87		9.31	
	16.00	8.71		14.6	
	20.00	14.5	15.1	24.4	
	25.00	22.7	26.9	53.8	
	30.00	32.7	40.7	150.	
	35.00	45.7	59.7		
	40.00	63.2	89.2		
	50.00	121.	224.		
	60.00	238.			
	70.00	476.			
DELTA K MAX	A: 71.28	521.			
	B: 59.74		643.		
	C: 33.00			311.	
	D:				
ROOT MEAN SQUARE PERCENT ERROR		8.97	11.51	15.91	
LIFE PREDICTION RATIO SUMMARY (NP/NA)	0.0-0.5				
	0.5-0.8	2	1	1	
	0.8-1.25				
	1.25-2.0				
	>2.0				

CONDITION/HT: BA
FORM: 0.05"TH SHEET
SPECIMEN TYPE: CCP
ORIENTATION:
FREQUENCY: 10.00 HZ
ENVIRONMENT: R.T., LAB AIR

YIELD STRENGTH: 130.0 KSI
ULT. STRENGTH:
SPECIMEN THK: 0.050"
SPECIMEN WIDTH: 3.150"
REFERENCES: NL001

TITAN. ALLOY

TI-6AL-4V

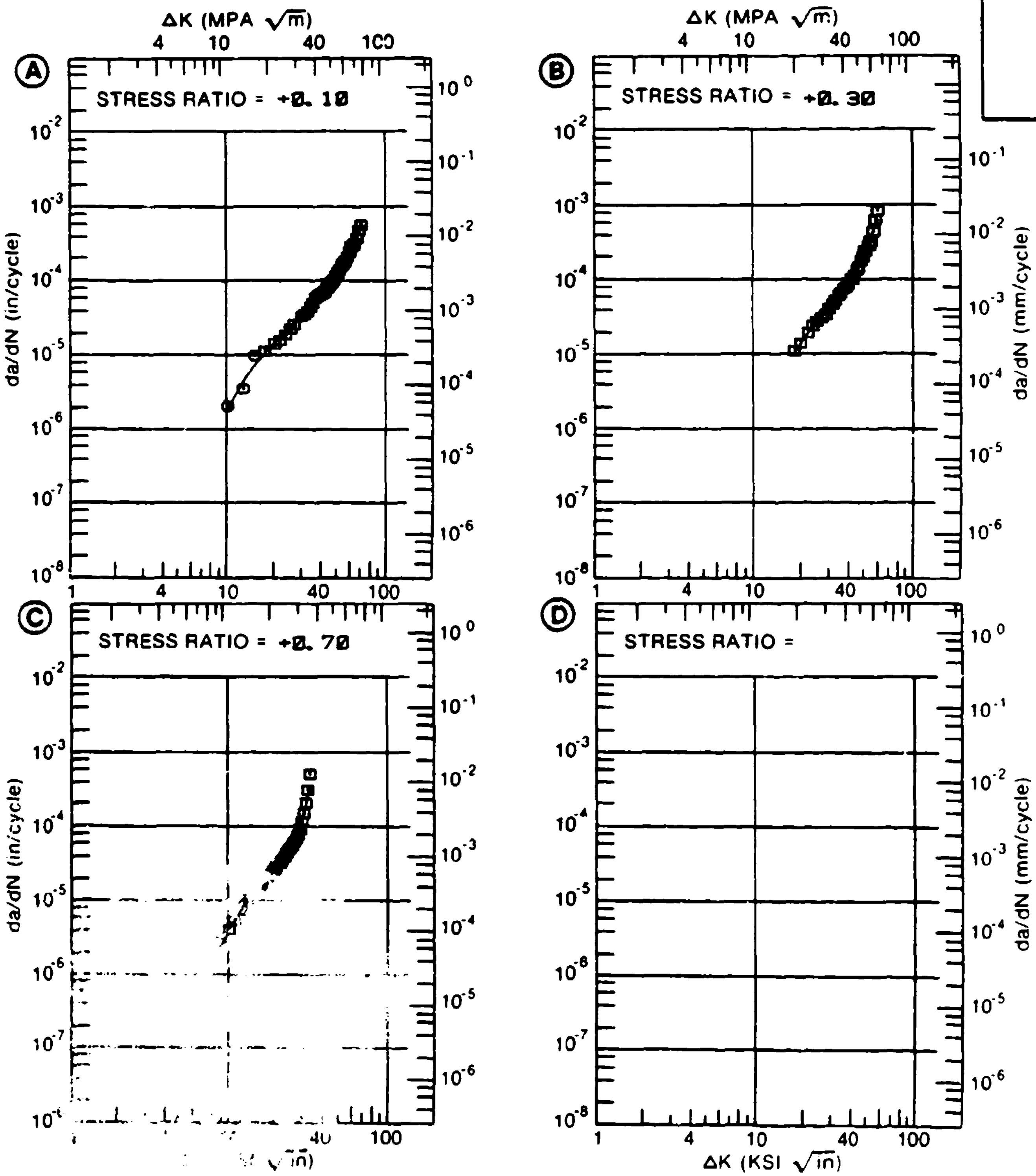

Figure 4.11.3.8

TABLE 4.11.3.9

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 4.11.3.9 INDICATING EFFECT

OF FREQUENCY

MATERIAL: TITANIUM TI-6AL-4V
CONDITION: BA
ENVIRONMENT: R.T. ,3.5% NACL

DELTA K (KSI*IN**1/2)			DA/DN (10**-6 IN./CYCLE)			
			A	B	C	D
			F(HZ)= 10.00			
DELTA K MIN	A:	9.65	.46			
	B:					
	C:					
	D:					
		10.00	.625			
		13.00	3.62			
		16.00	9.15			
		20.00	17.6			
		25.00	26.5			
		30.00	33.4			
DELTA K MAX	A:	34.71	39.3			
	B:					
	C:					
	D:					

ROOT MEAN SQUARE PERCENT ERROR 4.39

LIFE PREDICTION RATIO SUMMARY (NP/NA)	0.0-0.5
	0.5-0.8
	0.8-1.25
	1.25-2.0
	>2.0

CONDITION/HT: BA
FORM: 0.63"TH PLATE
SPECIMEN TYPE: PTSF
ORIENTATION: T-S
STRESS RATIO: +0.10
ENVIRONMENT: R.T., 3.5% NACL

YIELD STRENGTH: 124.5 KSI
ULT. STRENGTH: 136.4 KSI
SPECIMEN THK: 0.672"
SPECIMEN WIDTH: 1.500"
REFERENCES: 90981

TITAN. ALLOY

TI-6AL-4V

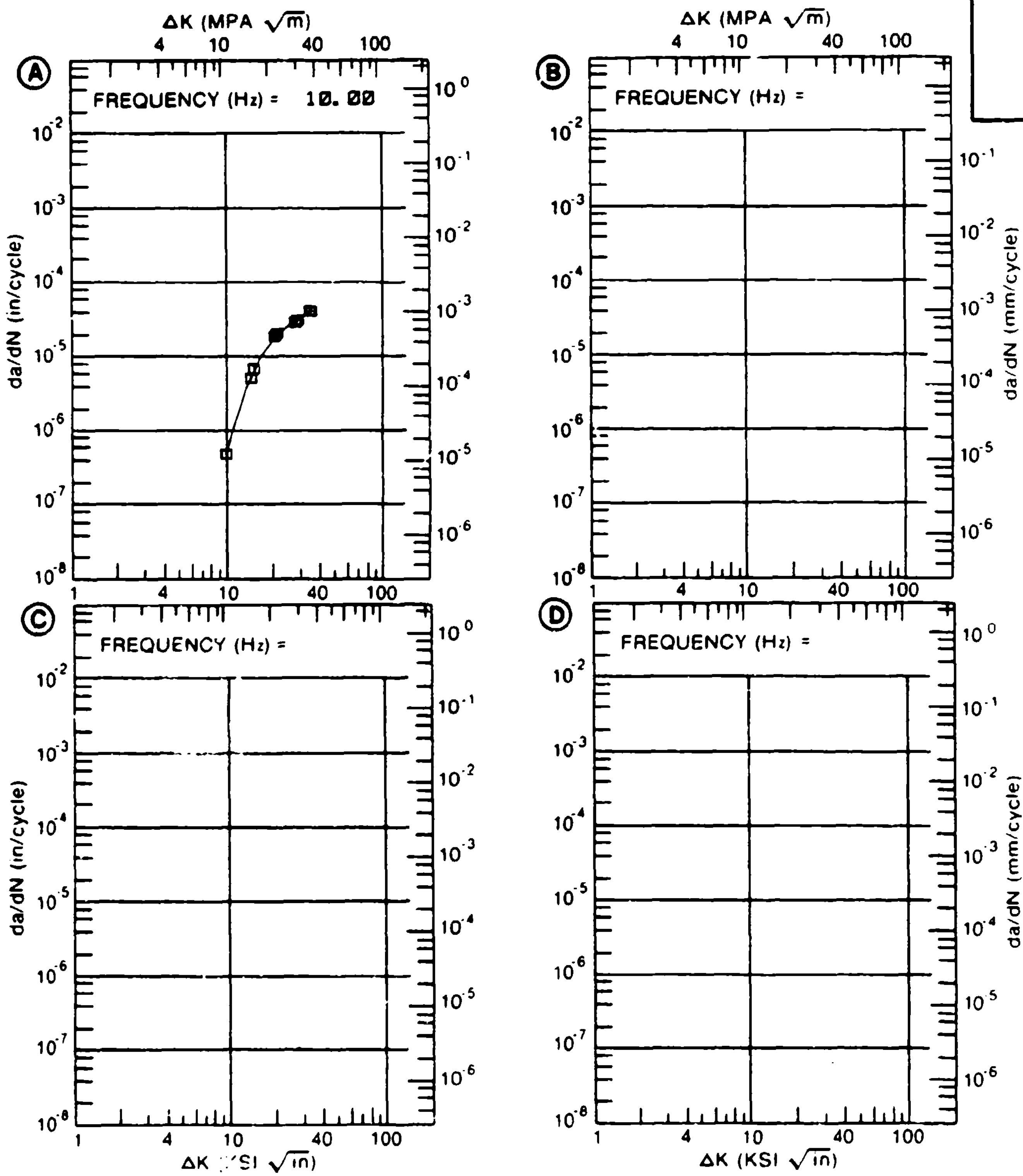

Figure 4.11.3.9

TABLE 4.11.3.10

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 4.11.3.10 INDICATING EFFECT

OF ENVIRONMENT

MATERIAL: TITANIUM TI-6AL-4V
CONDITION: BA

DELTA K (KSI*IN**1/2)		DA/DN (10**-6 IN./CYCLE) A	B	C	D
		E= R.T. DRY AIR	E= R.T. 3.5%NACL		
DELTA K MIN A:					
DELTA K MIN B:	8.24		.237		
DELTA K MIN C:					
DELTA K MIN D:					
	9.00		.574		
	10.00		.985		
	13.00		2.65		
	16.00		6.65		
	20.00		13.8		
	25.00		22.6		
	30.00		31.4		
	35.00		41.7		
	40.00		55.9		
	50.00		109.		
	60.00		245.		
DELTA K MAX A:					
DELTA K MAX B:	68.19		517.		
DELTA K MAX C:					
DELTA K MAX D:					
ROOT MEAN SQUARE PERCENT ERROR		0.00	18.95		
LIFE PREDICTION RATIO SUMMARY (NP/NA)	0.0-0.5				
	0.5-0.8				
	0.8-1.25				
	1.25-2.0		1		
	>2.0				

CONDITION/HT: BA
FORM: 0.63"TH PLATE
SPECIMEN TYPE: CT
ORIENTATION: T-L
STRESS RATIO: +0.10
FREQUENCY: 10.00 HZ

YIELD STRENGTH: 124.5 KSI
ULT. STRENGTH: 138.4 KSI
SPECIMEN THK: 0.660"
SPECIMEN WIDTH: 2.550- 2.554"
REFERENCES: 90981

TITAN. ALLOY

TI-6AL-4V

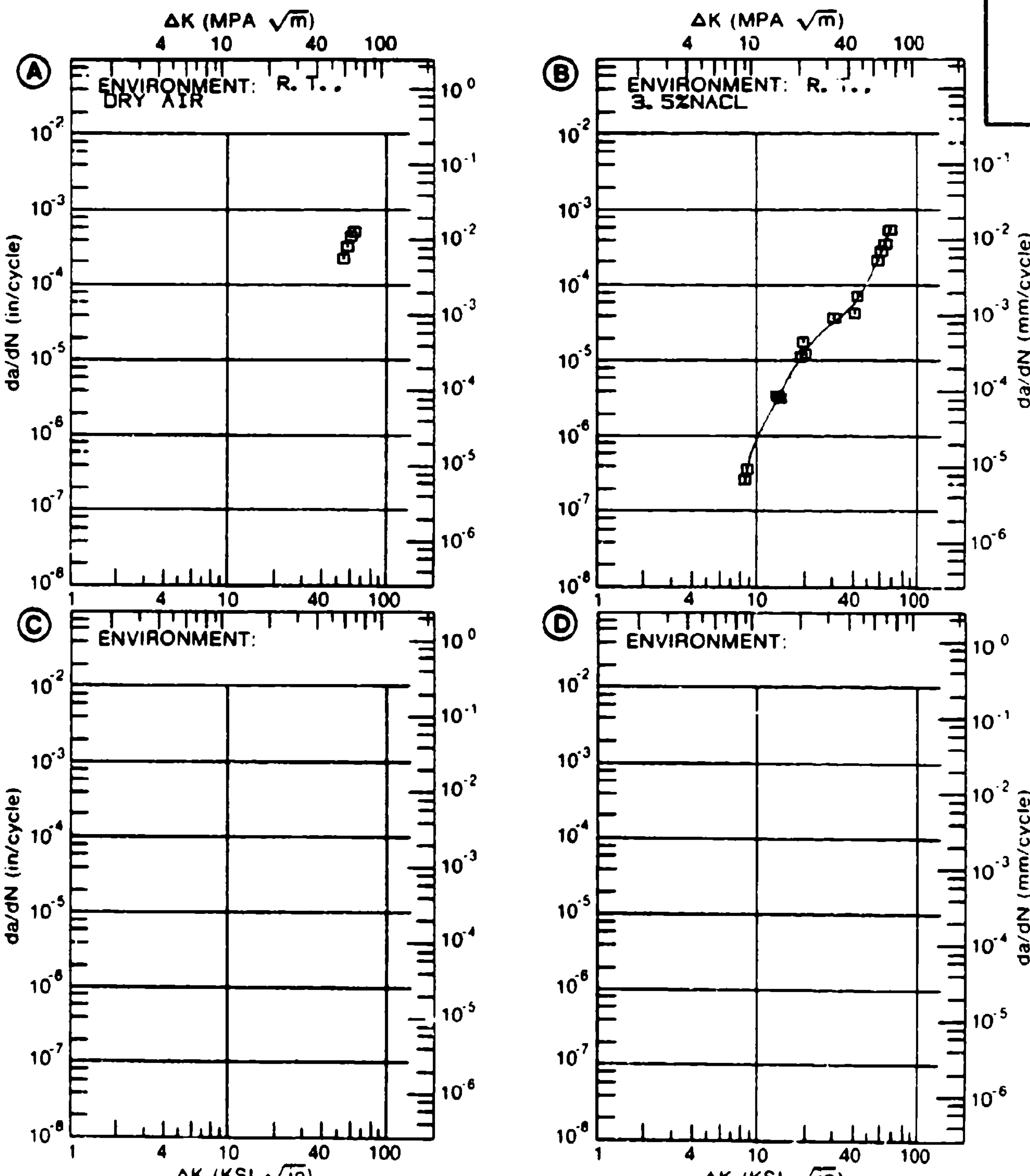

Figure 4.11.3.10

TABLE 4.11.3.11

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 4.11.3.11 INDICATING EFFECT

OF ENVIRONMENT

MATERIAL: TITANIUM TI-6AL-4V
CONDITION: BA

DELTA K (KSI*IN**1/2)			DA/DN (10**-6 IN./CYCLE) A	B	C	D
			E= R.T. S.T.W.			
DELTA K MIN	A:	15.85	11.7			
	B:					
	C:					
	D:					
		16.00	11.9			
		20.00	18.6			
		25.00	28.3			
		30.00	39.2			
		35.00	51.3			
		40.00	64.5			
		50.00	94.3			
		60.00	129.			
		70.00	168.			
		80.00	213.			
DELTA K MAX	A:	87.57	252.			
	B:					
	C:					
	D:					

ROOT MEAN SQUARE PERCENT ERROR		10.42
LIFE PREDICTION RATIO SUMMARY (NP/NA)	0.0-0.5	
	0.5-0.8	
	0.8-1.25	1
	1.25-2.0	
	>2.0	

CONDITION/HT: BA
FORM: 0.63"TH PLATE
SPECIMEN TYPE: CT
ORIENTATION: T-L
STRESS RATIO: +0.10
FREQUENCY: 10.00 HZ

YIELD STRENGTH: 124.5 KSI
ULT. STRENGTH: 136.4 KSI
SPECIMEN THK: 0.660"
SPECIMEN WIDTH: 2.554"
REFERENCES: 90981

TITAN. ALLOY

TI-6AL-4V

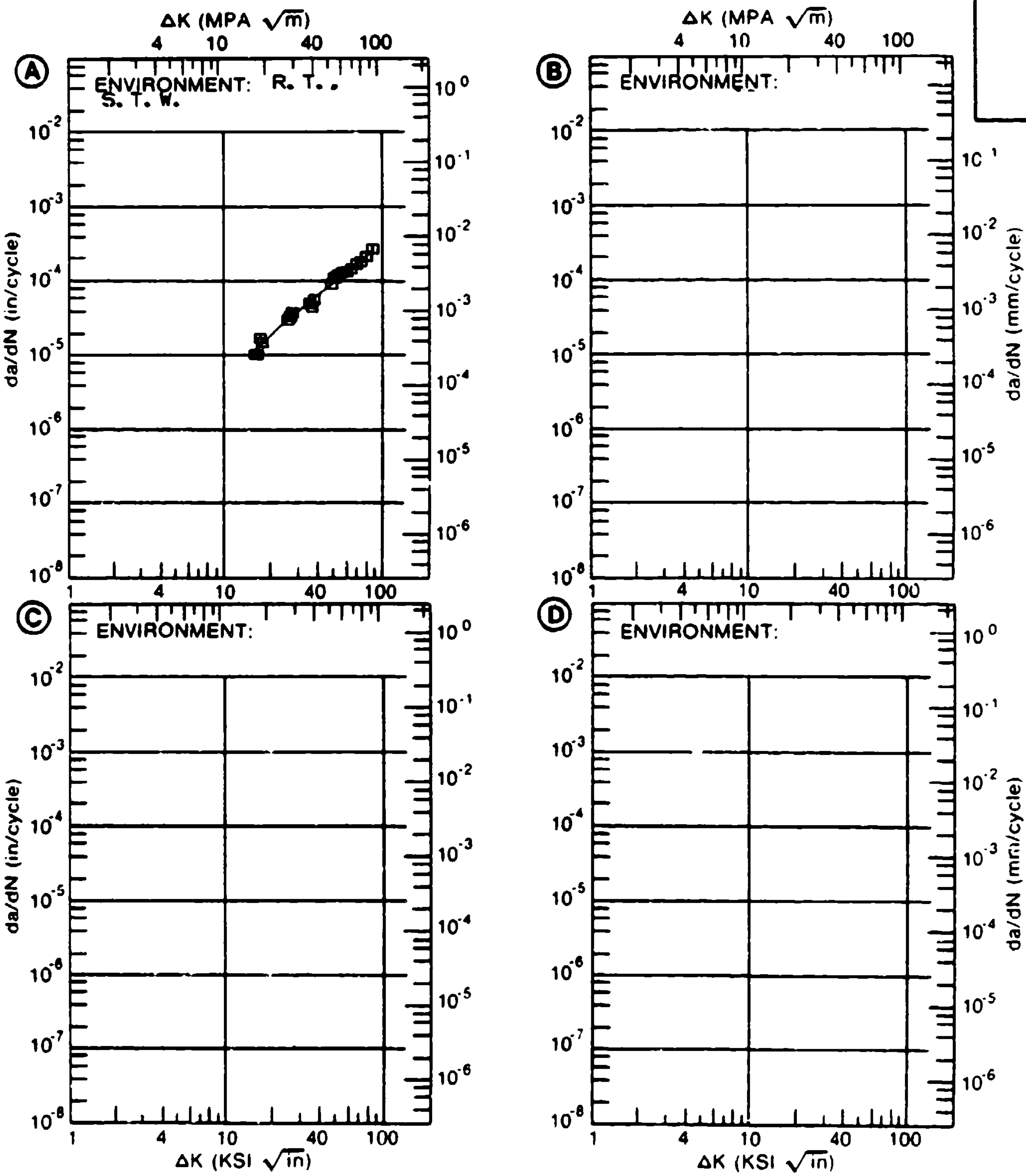

Figure 4.11.3.11

TABLE 4.11.3.12

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 4.11.3.12 INDICATING EFFECT OF ENVIRONMENT

MATERIAL: TITANIUM TI-6AL-4V
CONDITION: BA

DELTA K (KSI*IN**1/2)			DA/DN (10**-6 IN./CYCLE) A	B	C	D
			E= R.T. 3.5%NACL	E= R.T. S.T.W.		
DELTA K MIN	A:	10.21	.250			
	B:	18.51		30.5		
	C:					
	D:					
		13.00	5.35			
		16.00	16.0			
		20.00	38.5	35.3		
		25.00	66.4	73.3		
		30.00	83.1	95.4		
		35.00	100.	103.		
		40.00	136.	112.		
		50.00	281.	192.		
		60.00		489.		
DELTA K MAX	A:	57.34	342.			
	B:	69.64		1087.		
	C:					
	D:					
ROOT MEAN SQUARE PERCENT ERROR			17.39	15.35		
LIFE PREDICTION RATIO SUMMARY (NP/NA)		0.0-0.5				
		0.5-0.8				
		0.8-1.25		1		
		1.25-2.0	1			
		>2.0				

CONDITION/HT: BA
FORM: 0.63"TH PLATE
SPECIMEN TYPE: CT
ORIENTATION: T-L
STRESS RATIO: +0.10
FREQUENCY: 1.00 HZ

YIELD STRENGTH: 124.5 KSI
ULT. STRENGTH: 136.4 KSI
SPECIMEN THK: 0.660"
SPECIMEN WIDTH: 2.550- 2.554"
REFERENCES: 90981

TITAN. ALLOY

TI-6AL-4V

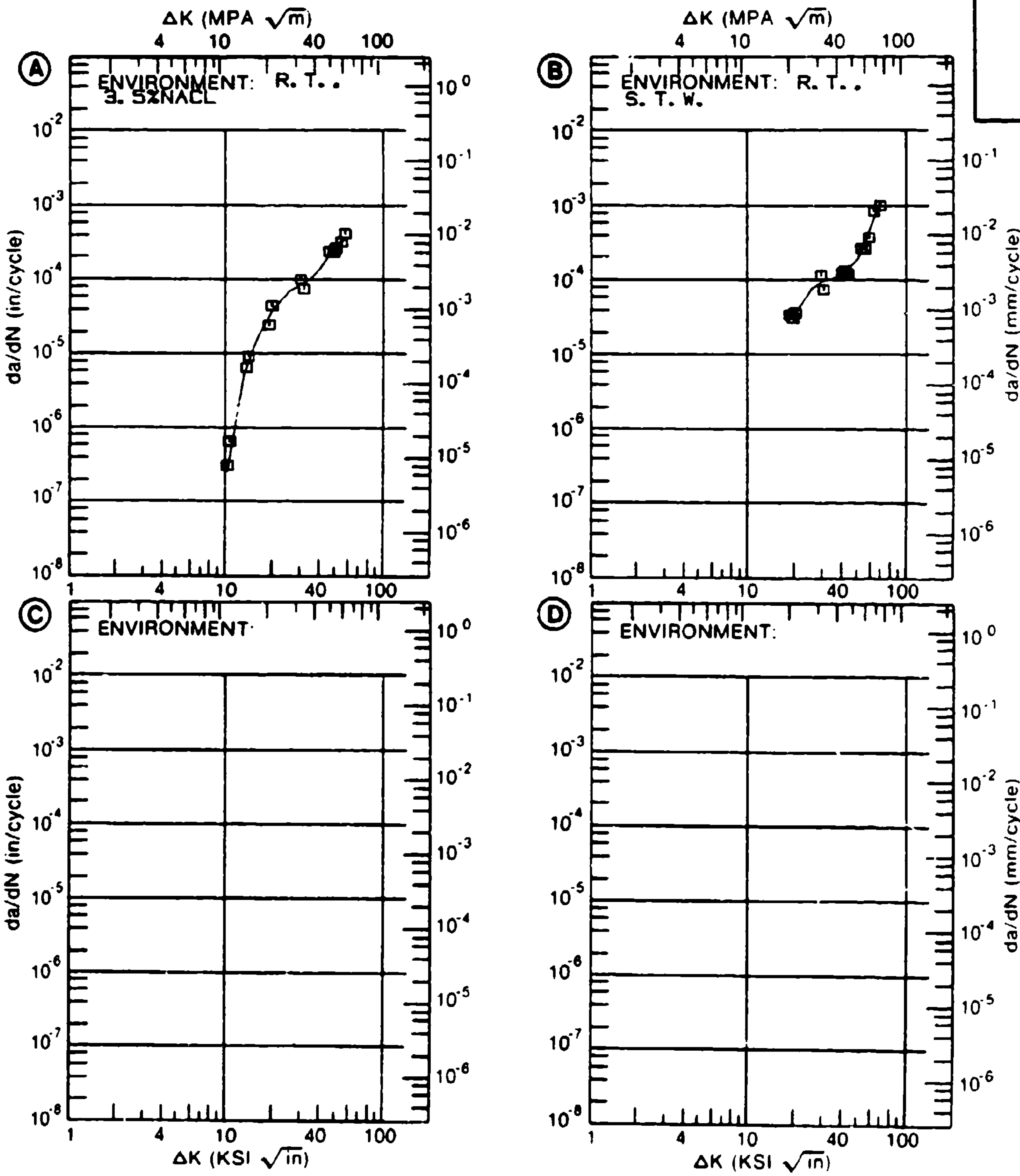

Figure 4.11.3.12

TABLE 4.11.3.13

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 4.11.3.13 INDICATING EFFECT

OF ENVIRONMENT

MATERIAL: TITANIUM TI-6AL-4V
CONDITION: BA

DELTA K (KSI*IN**1/2)		DA/DN (10**-6 IN./CYCLE) A	B	C	D
		E= R.T. S.T.W.			
DELTA K MIN	A: 9.81	.55			
	B:				
	C:				
	D:				
	10.00	.581			
	13.00	1.31			
	16.00	2.73			
	20.00	6.43			
	25.00	16.2			
	30.00	36.1			
	35.00	72.9			
	40.00	136.			
	50.00	400.			
	60.00	987.			
DELTA K MAX	A: 69.91	2127.			
	B:				
	C:				
	D:				

ROOT MEAN SQUARE PERCENT ERROR 43.57

LIFE PREDICTION RATIO SUMMARY (NP/NA)		
	0.0-0.5	
	0.5-0.8	
	0.8-1.25	
	1.25-2.0	1
	>2.0	

CONDITION/HT: BA
FORM: 0.63"TH PLATE
SPECIMEN TYPE: CT
ORIENTATION: T-L
STRESS RATIO: +0.10
FREQUENCY: 0.10 HZ

YIELD STRENGTH: 124.5 KSI
ULT. STRENGTH: 136.4 KSI
SPECIMEN THK: 0.660"
SPECIMEN WIDTH: 2.550"
REFERENCES: 90081

TITAN. ALLOY

TI-6AL-4V

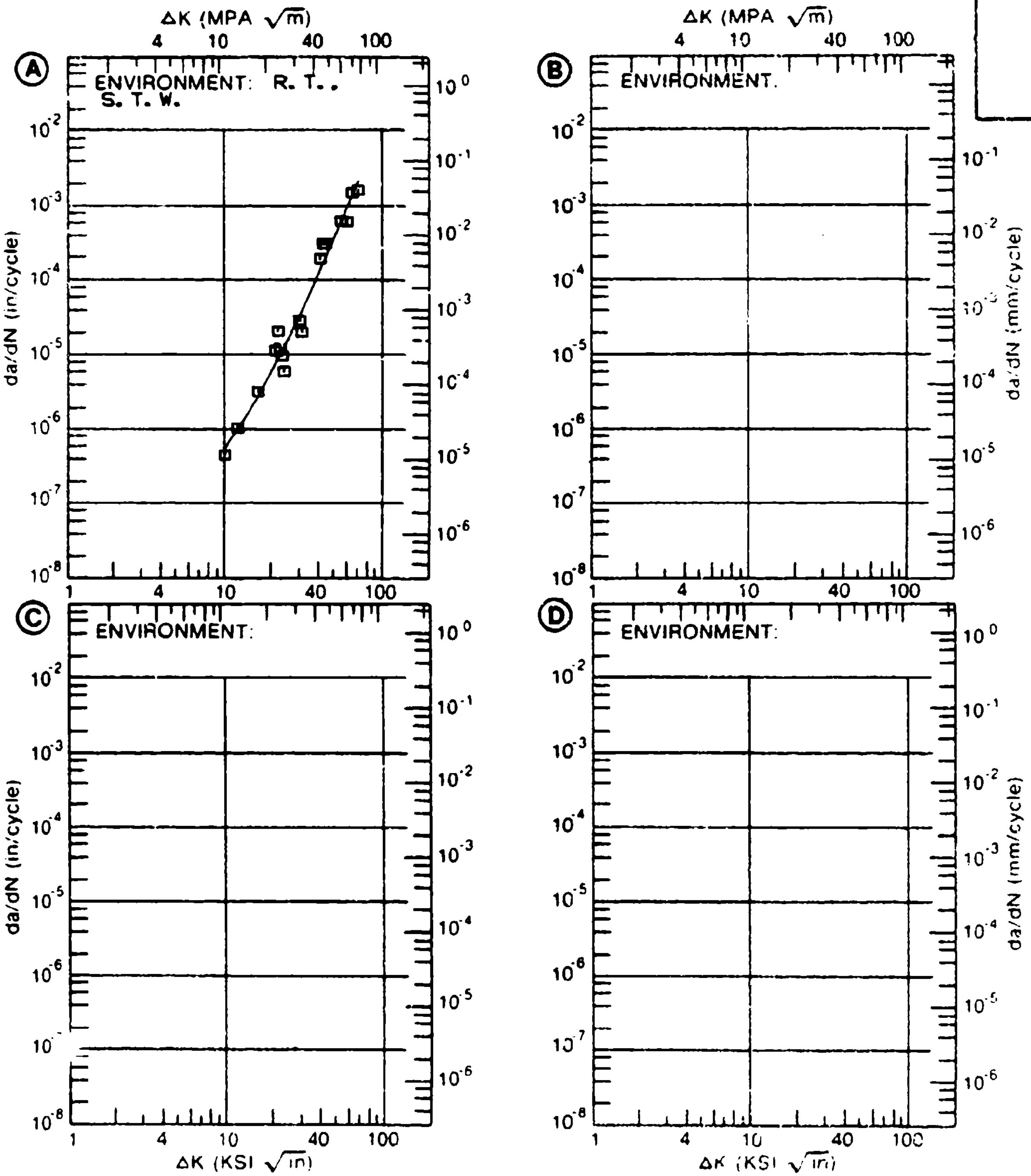

Figure 4.11.3.13

TABLE 4.11.3.14

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 4.11.3.14 INDICATING EFFECT OF STRESS RATIO

MATERIAL: TITANIUM TI-6AL-4V
CONDITION: BA
ENVIRONMENT: R.T. ,DRY AIR

DELTA K (KSI*IN**1/2)		DA/DN (10**-6 IN./CYCLE) A	B	C	D
		R=+0.10	R=+0.30		
DELTA K MIN A:	7.64	.108			
B:	9.89		.284		
C:					
D:					
	8.00	.113			
	9.00	.150			
	10.00	.227	.302		
	13.00	.937	1.79		
	16.00	3.17	4.90		
	20.00	9.10	9.75		
	25.00	19.6	18.5		
	30.00	33.0	32.2		
	35.00	51.5	52.4		
	40.00	78.0			
DELTA K MAX A:	45.52	122.			
B:	39.92		80.2		
C:					
D:					
ROOT MEAN SQUARE PERCENT ERROR		16.21	10.73		
LIFE PREDICTION RATIO SUMMARY (NP/NA)	0.0-0.5				
	0.5-0.8				
	0.8-1.25		1		
	1.25-2.0	1			
	>2.0				

CONDITION/HT: BA
FORM: 0.78"TH PLATE
SPECIMEN TYPE: CT
ORIENTATION: L-T
FREQUENCY: 6.00 HZ
ENVIRONMENT: R.T., DRY AIR

YIELD STRENGTH: 116.3 KSI
ULT. STRENGTH: 125.7 KSI
SPECIMEN THK: 0.747- 0.748"
SPECIMEN WIDTH: 4.995- 5.008"
REFERENCE: 88575

TITAN. ALLOY

TI-6AL-4V

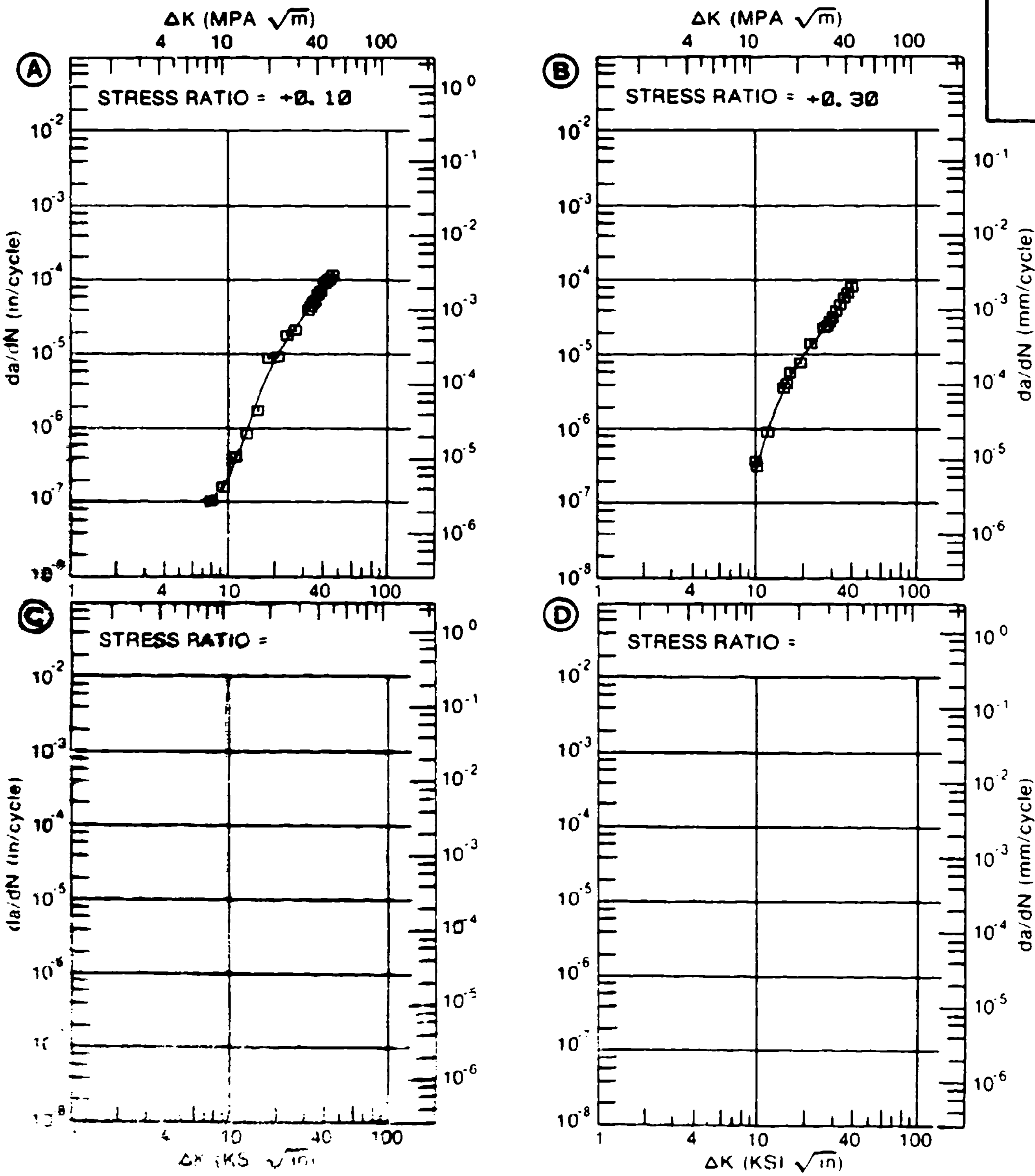

Figure 4.11.3.14

TABLE 4.11.3.15

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 4.11.3.15 INDICATING EFFECT

OF STRESS RATIO

MATERIAL: TITANIUM TI-6AL-4V
CONDITION: BA
ENVIRONMENT: R.T. ,S.T.W.

DELTA K (KSI*IN**1/2)		DA/DN (10**-6 IN./CYCLE) A R=+0.10	B R=+0.50	C	D
DELTA K MIN A:	11.43	.30			
DELTA K MIN B:	24.08		53.3		
DELTA K MIN C:					
DELTA K MIN D:					
	13.00	.730			
	16.00	3.08			
	20.00	11.1			
	25.00	27.6	61.5		
	30.00	48.0	86.0		
	35.00	70.5	119.		
	40.00	95.9			
	50.00	163.			
DELTA K MAX A:	59.09	264.			
DELTA K MAX B:	36.06		134.		
DELTA K MAX C:					
DELTA K MAX D:					
ROOT MEAN SQUARE PERCENT ERROR		16.76	3.81		
LIFE PREDICTION RATIO SUMMARY (NP/NA)	0.0-0.5				
	0.5-0.8				
	0.8-1.25		1		
	1.25-2.0	2			
	>2.0				

CONDITION/HT: BA
FORM: Ø.75- Ø.76"TH PLATE
SPECIMEN TYPE: CT
ORIENTATION: L-T
FREQUENCY: 1.ØØ HZ
ENVIRONMENT: R.T., S.T.W.

YIELD STRENGTH: 116.3 KSI
ULT. STRENGTH: 125.7 KSI
SPECIMEN THK: Ø.746- Ø.751"
SPECIMEN WIDTH: 4.986- 5.Ø19"
REFERENCES: 88575

TITAN. ALLOY
TI-6AL-4V

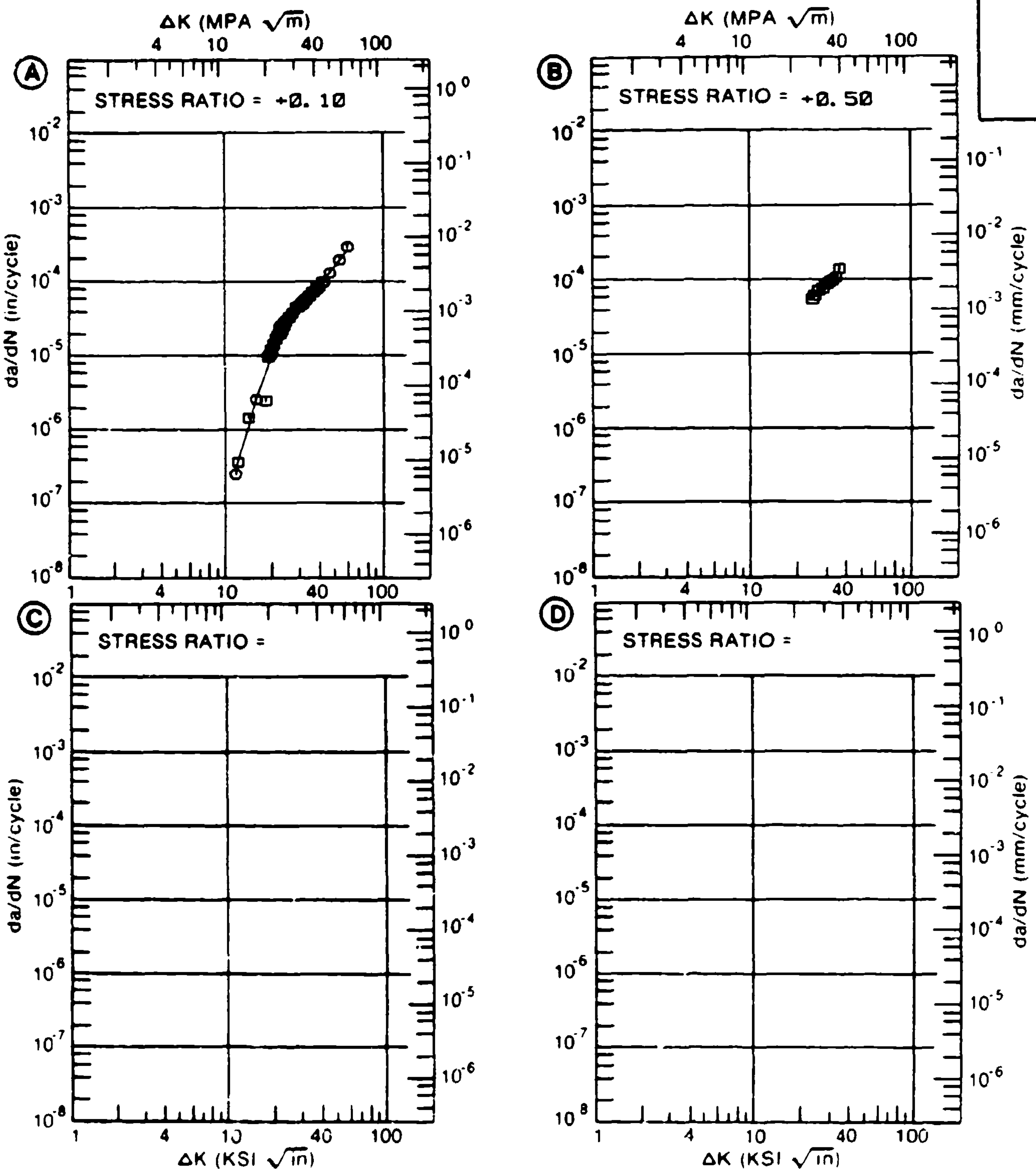

Figure 4.11.3.15

TABLE 4.11.3.16

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 4.11.3.16 INDICATING EFFECT

OF FREQUENCY

MATERIAL: TITANIUM TI-6AL-4V
CONDITION: BA
ENVIRONMENT: R.T. ,S.T.W.

DELTA K (KSI*IN**1/2)	DA/DN (10**-6 IN./CYCLE) A	B	C	D
	F(HZ)= 0.10 ,			
DELTA K MIN A:				
B:				
C:				
D:				
200.00				
DELTA K MAX A:				
B:				
C:				
D:				

ROOT MEAN SQUARE PERCENT ERROR 0.00

LIFE PREDICTION RATIO SUMMARY (NP/NA)	
	0.0-0.5
	0.5-0.8
	0.8-1.25
	1.25-2.0
	>2.0

CONDITION/HT: BA
FORM: Ø.75"TH PLATE
SPECIMEN TYPE: CT
ORIENTATION: L-T
STRESS RATIO: +Ø.5Ø
ENVIRONMENT: R.T., S.T.W.

YIELD STRENGTH: 116.3 KSI
ULT. STRENGTH: 125.7 KSI
SPECIMEN THK: Ø.75Ø"
SPECIMEN WIDTH: 5.ØØ8"
REFERENCES: 88575

TITAN. ALLOY

TI-6AL-4V

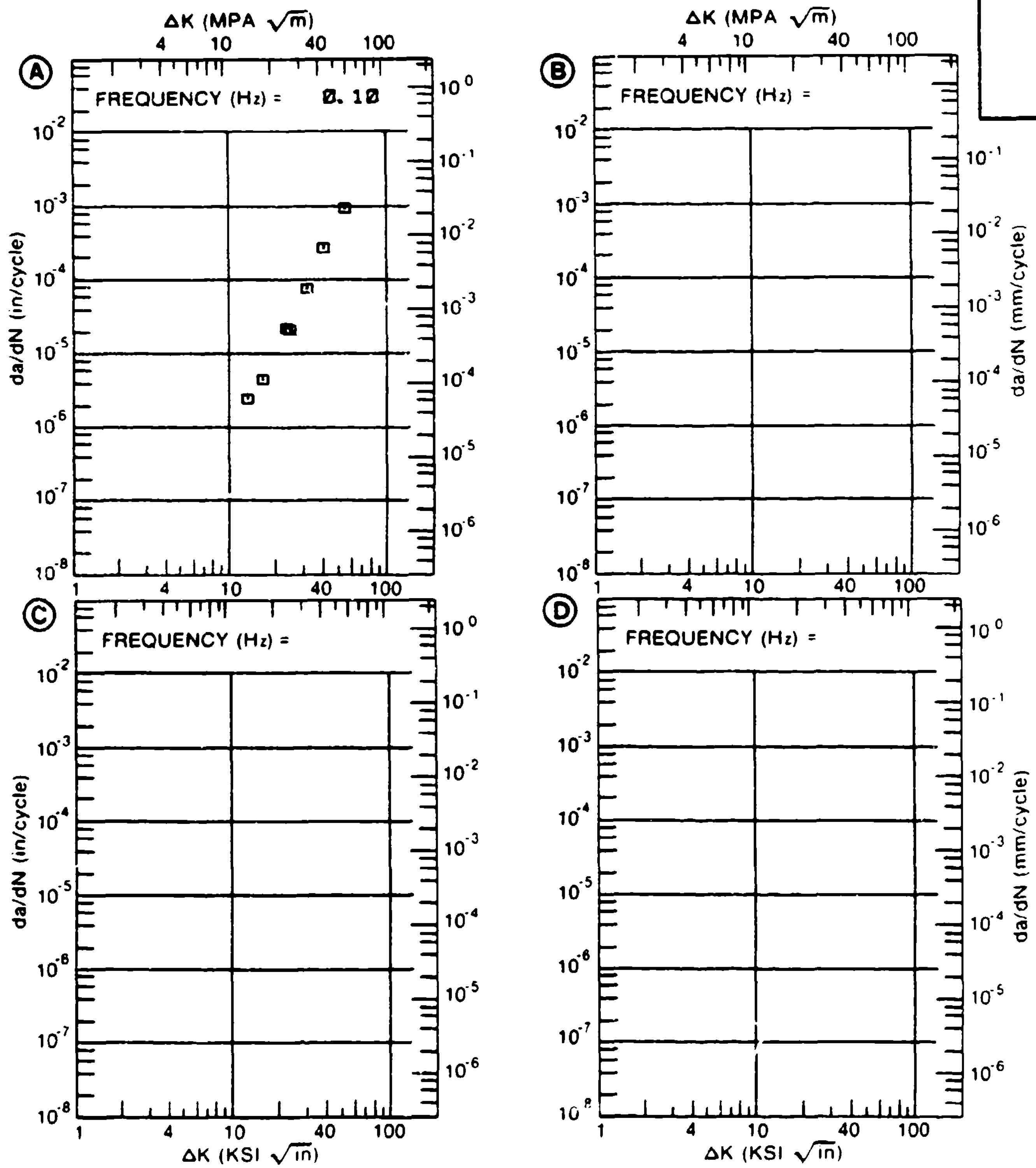

Figure 4.11.3.16

TABLE 4.11.3.17

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 4.11.3.17INDICATING EFFECT

OF STRESS RATIO

MATERIAL: TITANIUM TI-6AL-4V
CONDITION: BA
ENVIRONMENT: R. T. , DIST. WATER

DELTA K (KSI*IN**1/2)			DA/DN (10**-6 IN./CYCLE) A	B	C	D
			R=+0.10	R=+0.50		
DELTA K MIN	A:	26.53	15.5			
	B:					
	C:					
	D:					
		30.00	26.2			
		35.00	45.2			
		40.00	67.8			
		50.00	126.			
		60.00	218.			
DELTA K MAX	A:	63.96	271.			
	B:					
	C:					
	D:					
ROOT MEAN SQUARE PERCENT ERROR			5.71	0.00		

LIFE	0.0-0.5
PREDICTION	0.5-0.8
RATIO	0.8-1.25
SUMMARY	1.25-2.0
(NP/NA)	>2.0

CONDITION/HT: BA
FORM: 1.00"TH PLATE
SPECIMEN TYPE: DCB
ORIENTATION: T-L
FREQUENCY: 0.10 HZ
ENVIRONMENT: R.T., DIST. WATER

YIELD STRENGTH:
ULT. STRENGTH:
SPECIMEN THK:
SPECIMEN WIDTH:
REFERENCES: 88140

TITAN. ALLOY

TI-6AL-4V

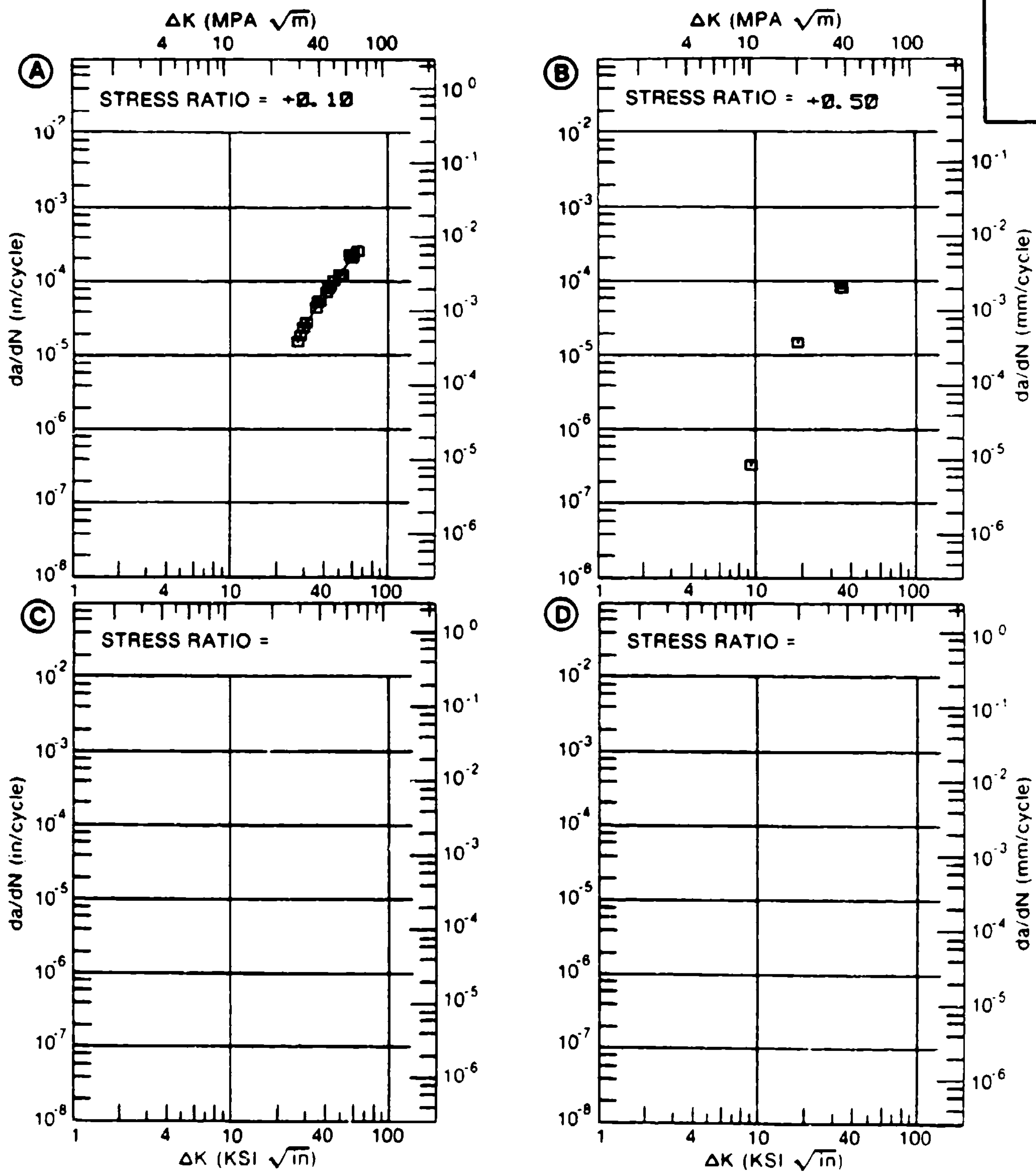

Figure 4.11.3.17

TABLE 4.11.3.18

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 4.11.3.18 INDICATING EFFECT

OF STRESS RATIO

MATERIAL: TITANIUM TI-6AL-4V
CONDITION: BA
ENVIRONMENT: R. T. , H. H. A.

DELTA K (KSI*IN**1/2)			DA/DN (10**-6 IN./CYCLE)			
			A	B	C	D
			R=+0.10	R=+0.30	R=+0.50	
DELTA K MIN	A:	12.84	.965			
	B:	10.82		.451		
	C:	10.92			1.47	
	D:					
		13.00	.929	1.15	1.62	
		16.00	1.19	3.13	3.85	
		20.00	4.10	9.31	12.0	
		25.00	12.4	23.5	27.6	
		30.00	25.3	38.6	44.0	
		35.00	41.9	52.8	78.0	
		40.00	62.0	84.8	182.	
		50.00	115.		1010.	
		60.00	208.			
DELTA K MAX	A:	66.20	454.			
	B:	48.80		210.		
	C:	50.10			1013.	
	D:					
ROOT MEAN SQUARE PERCENT ERROR			15.43	11.45	16.49	
LIFE PREDICTION RATIO SUMMARY (NP/NA)		0.0-0.5				
		0.5-0.8				
		0.8-1.25	1		1	
		1.25-2.0		1		
		>2.0				

CONDITION/HT: BA
FORM: 2.25"TH PLATE
SPECIMEN TYPE: CT
ORIENTATION: L-T
FREQUENCY: 0.10 HZ
ENVIRONMENT: R.T., H.H.A.

YIELD STRENGTH: 117.0 KSI
ULT. STRENGTH: 129.4 KSI
SPECIMEN THK: 0.749- 0.753"
SPECIMEN WIDTH: 5.009- 5.013"
REFERENCES: G0007

TITAN. ALLOY

TI-6AL-4V

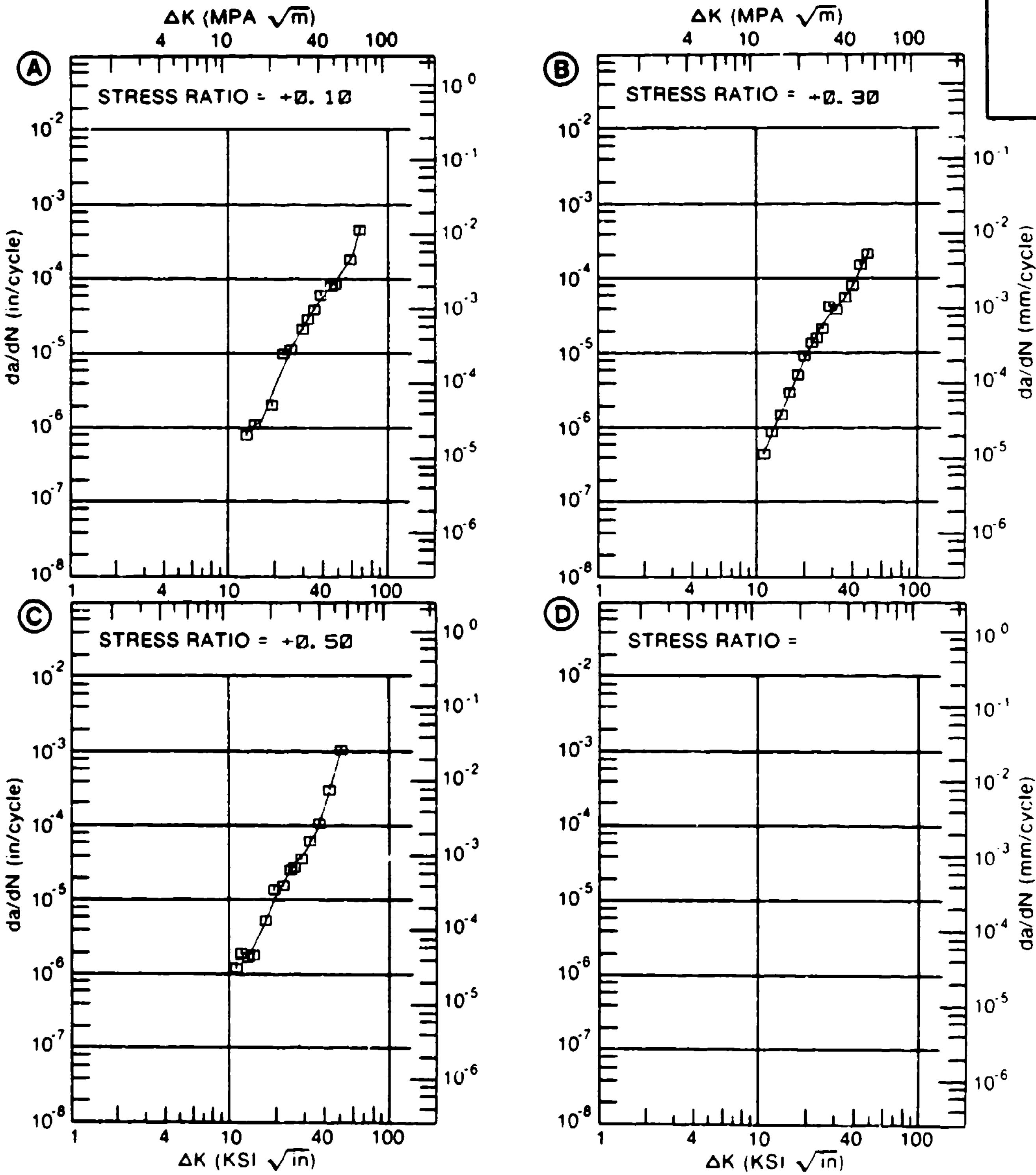

Figure 4.11.3.18

TABLE 4.11.3.19

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 4.11.3.19 INDICATING EFFECT OF STRESS RATIO

MATERIAL: TITANIUM TI-6AL-4V
CONDITION: BA
ENVIRONMENT: R.T. , DRY AIR

DELTA K (KSI*IN**1/2)		DA/DN (10**-6 IN./CYCLE) A	B	C	D
		R=+0.10	R=+0.50		
DELTA K MIN	A: 9.56	.04			
	B: 7.43		.40		
	C:				
	D:				
	8.00		.538		
	9.00		.826		
	10.00	.0692	1.19		
	13.00	.482	2.85		
	16.00	1.62	5.49		
	20.00	5.42	10.9		
	25.00	15.7	21.5		
	30.00	32.2	38.1		
	35.00	51.7	62.5		
	40.00	69.3			
	50.00	85.6			
DELTA K MAX	A: 50.68	85.7			
	B: 36.97		74.9		
	C:				
	D:				
ROOT MEAN SQUARE PERCENT ERROR		22.63	47.03		
LIFE PREDICTION RATIO SUMMARY (NP/NA)	0.0-0.5				
	0.5-0.8				
	0.8-1.25				
	1.25-2.0	1	1		
	>2.0				

CONDITION/HT: BA
FORM: 2.79"TH PLATE
SPECIMEN TYPE: CT
ORIENTATION: L-T
FREQUENCY: 6.00 HZ
ENVIRONMENT: R.T., DRY AIR

YIELD STRENGTH: 116.3 KSI
ULT. STRENGTH: 125.7 KSI
SPECIMEN THK: 0.760- 0.762"
SPECIMEN WIDTH: 4.993- 4.996"
REFERENCES: 88575

TITAN. ALLOY

TI-6AL-4V

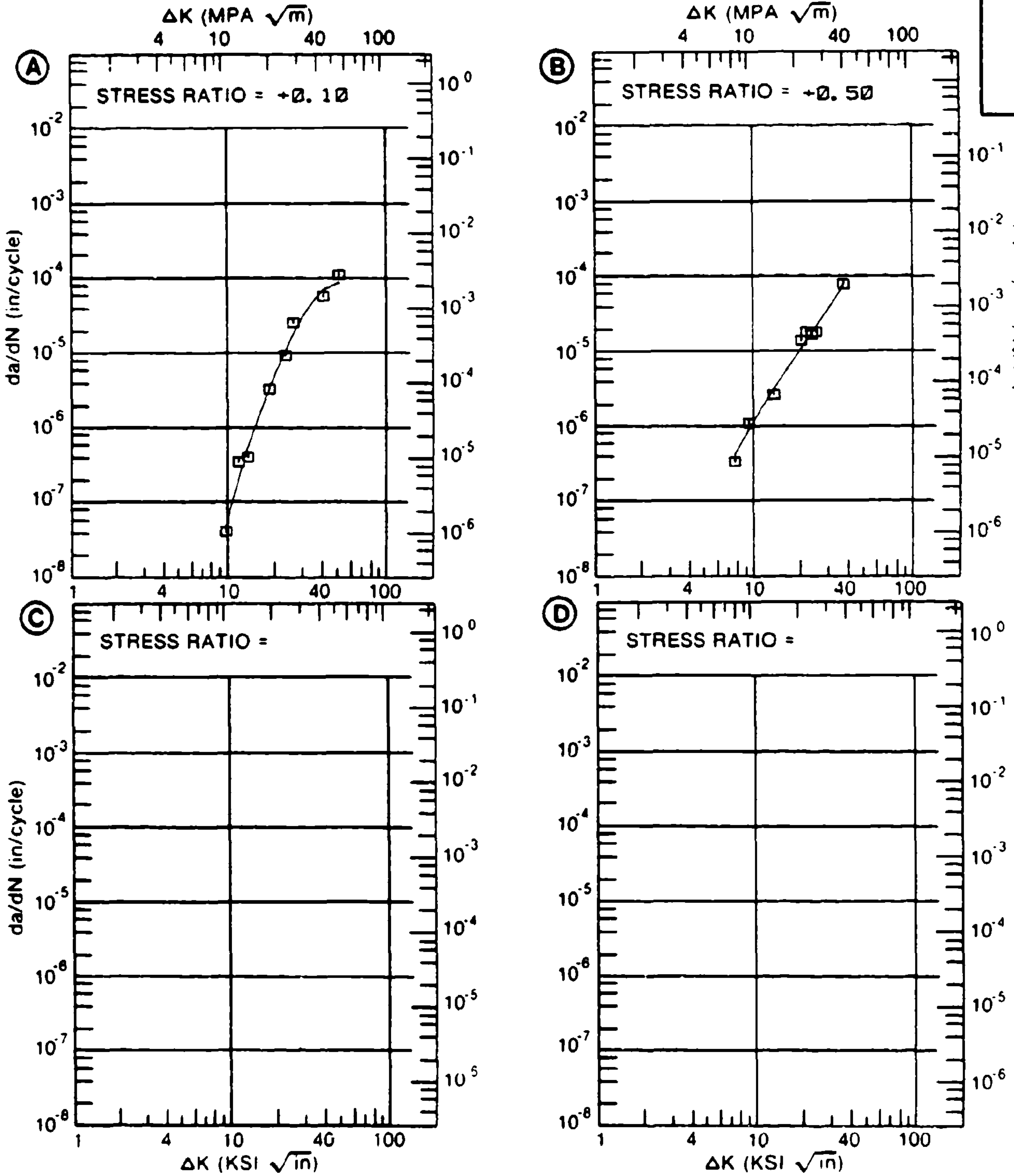

Figure 4.11.3.19

TABLE 4.11.3.20

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 4.11.3.20 INDICATING EFFECT

OF ENVIRONMENT

MATERIAL: TITANIUM TI-6AL-4V
CONDITION: BA

DELTA K (KSI*IN**1/2)	DA/DN (10**-6 IN./CYCLE) A	B	C	D
	E= R.T. S.T.W.			
DELTA K MIN A:				
B:				
C:				
D:				
200.00				
DELTA K MAX A:				
B:				
C:				
D:				

ROOT MEAN SQUARE PERCENT ERROR 0.00

LIFE PREDICTION RATIO SUMMARY (NP/NA)	
	0.0-0.5
	0.5-0.8
	0.8-1.25
	1.25-2.0
	>2.0

CONDITION/HT: BA
FORM: 2.79"TH PLATE
SPECIMEN TYPE: CT
ORIENTATION: S-L
STRESS RATIO: +0.10
FREQUENCY: 1.00 HZ

YIELD STRENGTH: 116.3 KSI
ULT. STRENGTH: 125.7 KSI
SPECIMEN THK: 1.002"
SPECIMEN WIDTH: 1.996"
REFERENCES: 88575

TITAN. ALLOY

TI-6AL-4V

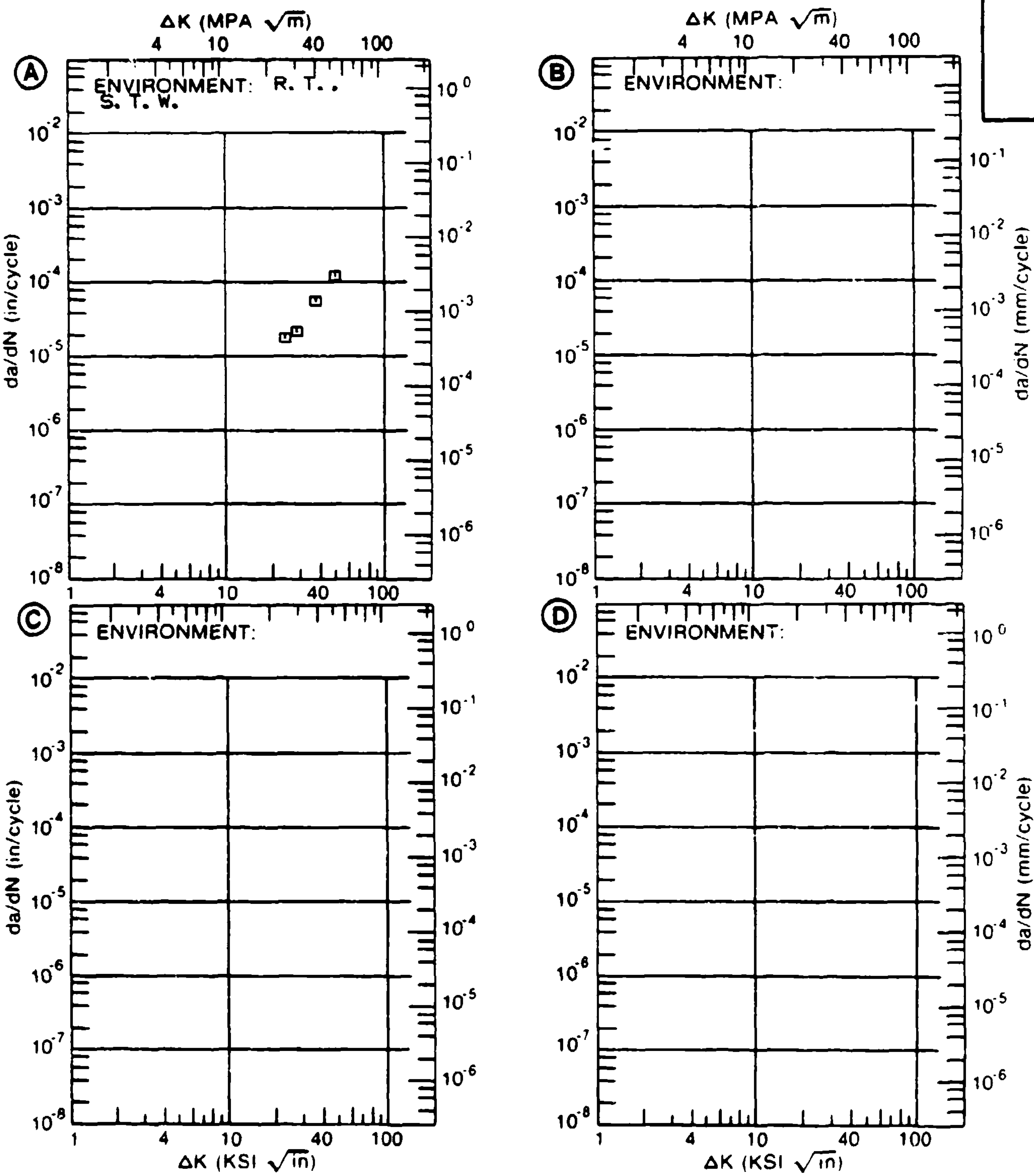

Figure 4.11.3.20

TABLE 4.11.3.21

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 4.11.3.21 INDICATING EFFECT

OF ENVIRONMENT

MATERIAL: TITANIUM TI-6AL-4V
CONDITION: BA

DELTA K (KSI*IN**1/2)		DA/DN (10**-6 IN./CYCLE) A E= R.T. LAB AIR	B E= R.T. JP-4 FUEL	C E= R.T. SIM SEA WATER	D
DELTA K MIN A:	10.25	.0872			
DELTA K MIN B:	12.23		.115		
DELTA K MIN C:	10.06			.219	
DELTA K MIN D:					
	13.00	.284	.165	.779	
	16.00	.820	.566	1.94	
	20.00	2.55	2.08	4.82	
	25.00	7.52	6.89	11.6	
	30.00	17.1	16.1	23.8	
	35.00	31.9	28.9	43.1	
	40.00	51.8	44.6	70.5	
	50.00	102.	88.2	149.	
	60.00	183.	168.	254.	
	70.00	356.	339.	438.	
	80.00	794.	736.	933.	
	90.00	2039.	1726.	2619.	
	100.00		4343.		
DELTA K MAX A:	99.83	5876.			
DELTA K MAX B:	101.83		5178.		
DELTA K MAX C:	99.93			9645.	
DELTA K MAX D:					
ROOT MEAN SQUARE PERCENT ERROR		26.01	24.42	25.45	

LIFE PREDICTION RATIO SUMMARY (NP/NA)	
	0.0-0.5
	0.5-0.8
	0.8-1.25
	1.25-2.0
	>2.0

CONDITION/HT: BA
FORM: 1.30"TH FORGING
SPECIMEN TYPE: WOL
ORIENTATION: L-T
STRESS RATIO: +0.02
FREQUENCY: 0.10- 20.00 HZ

YIELD STRENGTH: 111.0- 111.5 KSI
ULT. STRENGTH: 122.5- 127.5 KSI
SPECIMEN THK: 1.250"
SPECIMEN WIDTH: 5.000"
REFERENCES: MA005

TITAN. ALLOY

TI-6AL-4V

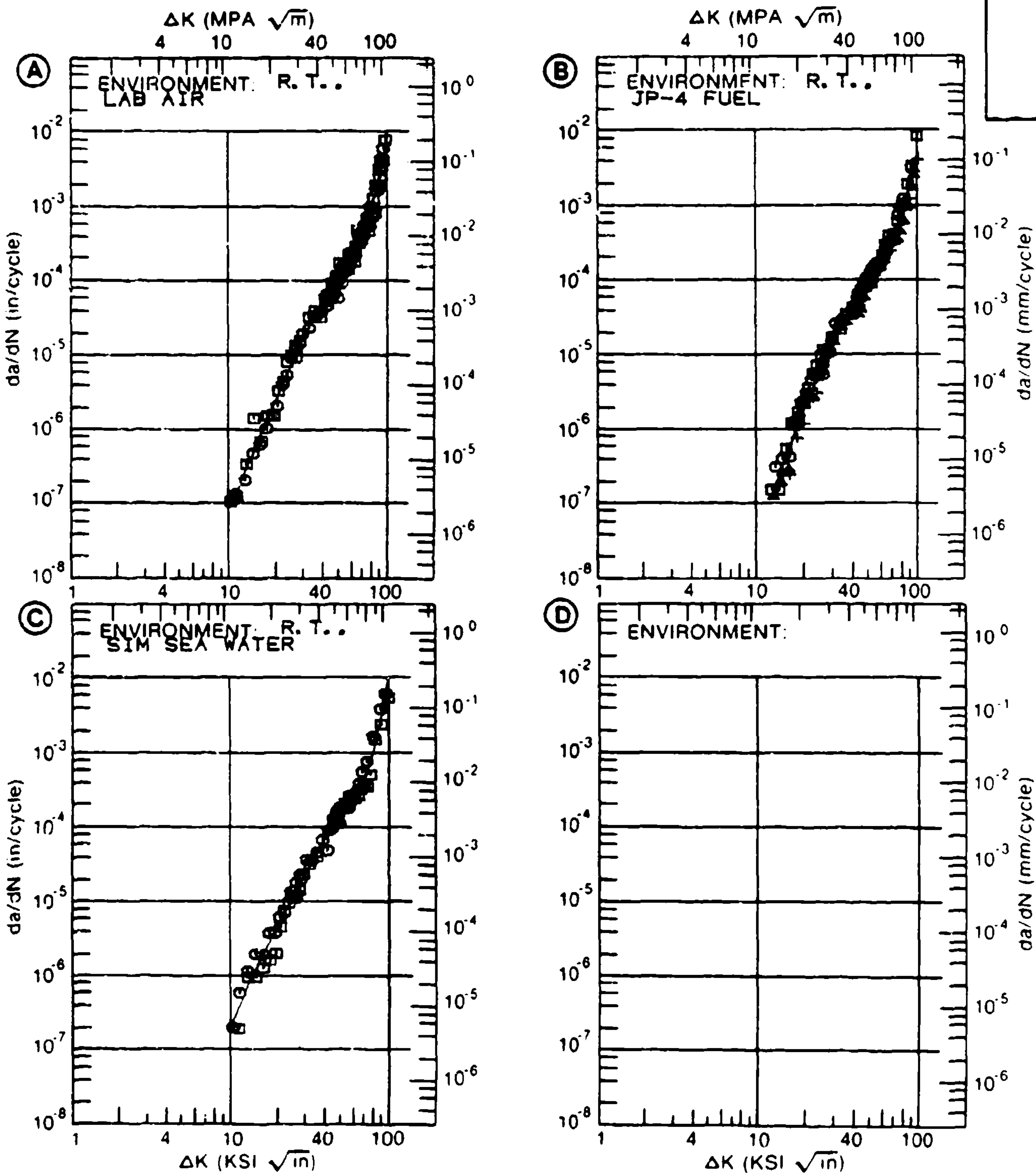

Figure 4.11.3.21

TABLE 4.11.3.22

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 4.11.3.22 INDICATING EFFECT

OF ENVIRONMENT

MATERIAL: TITANIUM TI-6AL-4V
CONDITION: BA

DELTA K (KSI*IN**1/2)		DA/DN (10**-6 IN./CYCLE) A E= R.T. LAB AIR	B E= R.T. JP-4 FUEL	C E= R.T. SIM SEA WATER	D
DELTA K MIN A:	10.97	.0750			
DELTA K MIN B:	11.53		.0872		
DELTA K MIN C:	10.11			.177	
DELTA K MIN D:					
	13.00	.226	.204	.651	
	16.00	.743	.741	1.66	
	20.00	2.27	2.40	4.09	
	25.00	6.15	6.63	9.39	
	30.00	13.1	14.0	18.0	
	35.00	24.3	25.6	31.2	
	40.00	41.5	42.9	50.5	
	50.00	103.	103.	118.	
	60.00	227.	224.	250.	
	70.00	467.	457.	499.	
	80.00	918.	903.	959.	
	90.00	1746.	1743.	1789.	
	100.00	3242.		3259.	
DELTA K MAX A:	104.34	4214.			
DELTA K MAX B:	99.96		3302.		
DELTA K MAX C:	102.34			3739.	
DELTA K MAX D:					
ROOT MEAN SQUARE PERCENT ERROR		27.58	29.08	34.70	

LIFE PREDICTION RATIO SUMMARY (NP/NA)	
	0.0-0.5
	0.5-0.8
	0.8-1.25
	1.25-2.0
	>2.0

CONDITION/HT: BA
FORM: 1.30"TH FORGING
SPECIMEN TYPE: WOL
ORIENTATION: T-L
STRESS RATIO: +0.02
FREQUENCY: 0.10- 20.00 HZ

YIELD STRENGTH: 110.0- 110.5 KSI
ULT. STRENGTH: 124.5- 125.0 KSI
SPECIMEN THK: 1.250"
SPECIMEN WIDTH: 5.000"
REFERENCES: MA005

TITAN. ALLOY

TI-6AL-4V

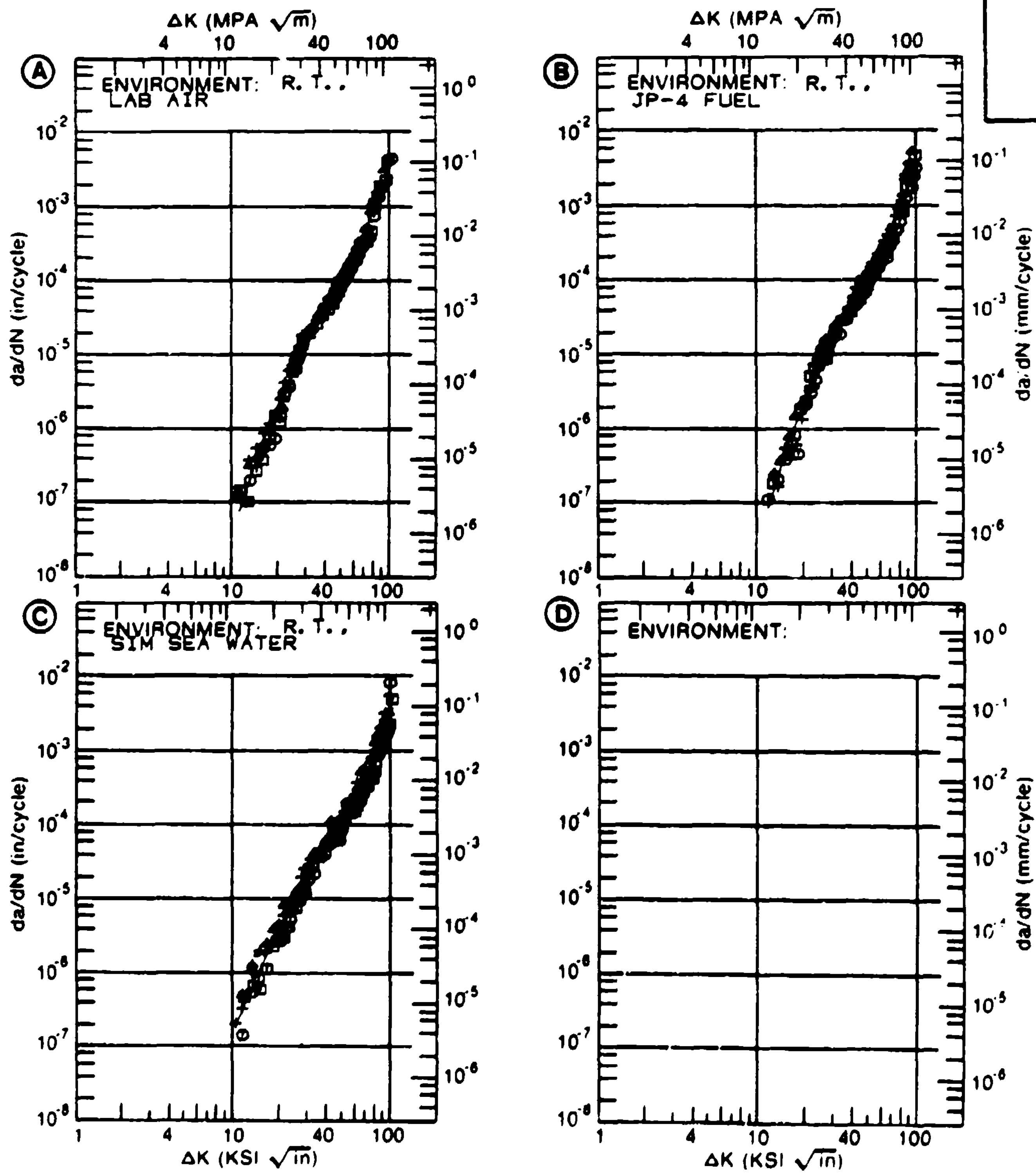

Figure 4.11.3.22

TABLE 4.11.3.23

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 4.11.3.23 INDICATING EFFECT

OF ENVIRONMENT

MATERIAL: TITANIUM TI-6AL-4V
CONDITION: BETA PROCESSED-MILL ANNEALED

DELTA K (KSI*IN**1/2)		DA/DN (10**-6 IN./CYCLE) A	B	C	D
		E= R.T. DRY AIR			
DELTA K MIN A:	23.05	5.27			
DELTA K MIN B:					
DELTA K MIN C:					
DELTA K MIN D:					
	25.00	6.45			
	30.00	10.3			
	35.00	15.7			
	40.00	23.4			
	50.00	48.8			
DELTA K MAX A:	59.48	94.0			
DELTA K MAX B:					
DELTA K MAX C:					
DELTA K MAX D:					
ROOT MEAN SQUARE PERCENT ERROR		7.55			

LIFE PREDICTION RATIO SUMMARY (NP/NA)	
	0.0-0.5
	0.5-0.8
	0.8-1.25
	1.25-2.0
	>2.0

CONDITION/HT: BETA PROCESSED-MILL ANNEALED
FORM: 0.13"TH SHEET
SPECIMEN TYPE: CT
ORIENTATION: L-T
STRESS RATIO: +0.10
FREQUENCY: 10.00 HZ

YIELD STRENGTH:
ULT. STRENGTH:
SPECIMEN THK:
SPECIMEN WIDTH:
REFERENCES:81332

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TI-6AL-4V

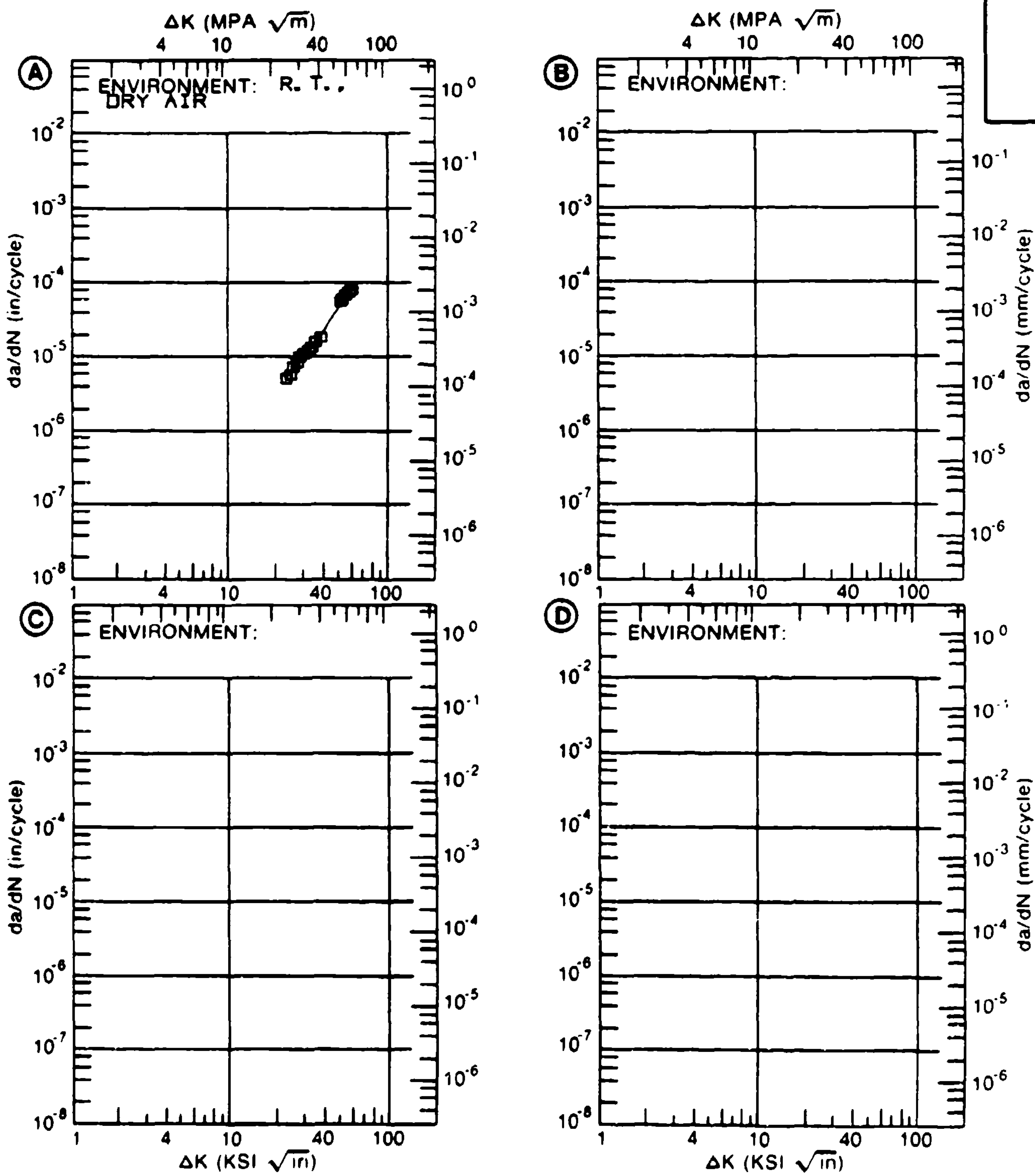

Figure 4.11.3.23

TABLE 4.11.3.24

FATIQUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 4.11.3.24 INDICATING EFFECT

OF ENVIRONMENT

MATERIAL: TITANIUM TI-6AL-4V
CONDITION: BETA PROCESSED-MILL ANNEALED

DELTA K (KSI*IN**1/2)		DA/DN (10**-6 IN./CYCLE) A	B	C	D
		E= R.T. DRY AIR			
DELTA K MIN A:	23.71	5.76			
DELTA K MIN B:					
DELTA K MIN C:					
DELTA K MIN D:					
	25.00	6.20			
	30.00	9.23			
	35.00	14.6			
	40.00	22.9			
	50.00	48.7			
	60.00	82.7			
DELTA K MAX A:	60.18	83.4			
DELTA K MAX B:					
DELTA K MAX C:					
DELTA K MAX D:					

ROOT MEAN SQUARE PERCENT ERROR 15.14

LIFE PREDICTION RATIO SUMMARY (NP/NA)	
	0.0-0.5
	0.5-0.8
	0.8-1.25
	1.25-2.0
	>2.0

CONDITION/HT: BETA PROCESSED-MILL ANNEALED
FORM: 0.30"TH PLATE
SPECIMEN TYPE: CT
ORIENTATION: L-T
STRESS RATIO: +0.10
FREQUENCY: 10.00 HZ

YIELD STRENGTH:
ULT. STRENGTH:
SPECIMEN THK:
SPECIMEN WIDTH:
REFERENCES: 91332

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TI-6AL-4V

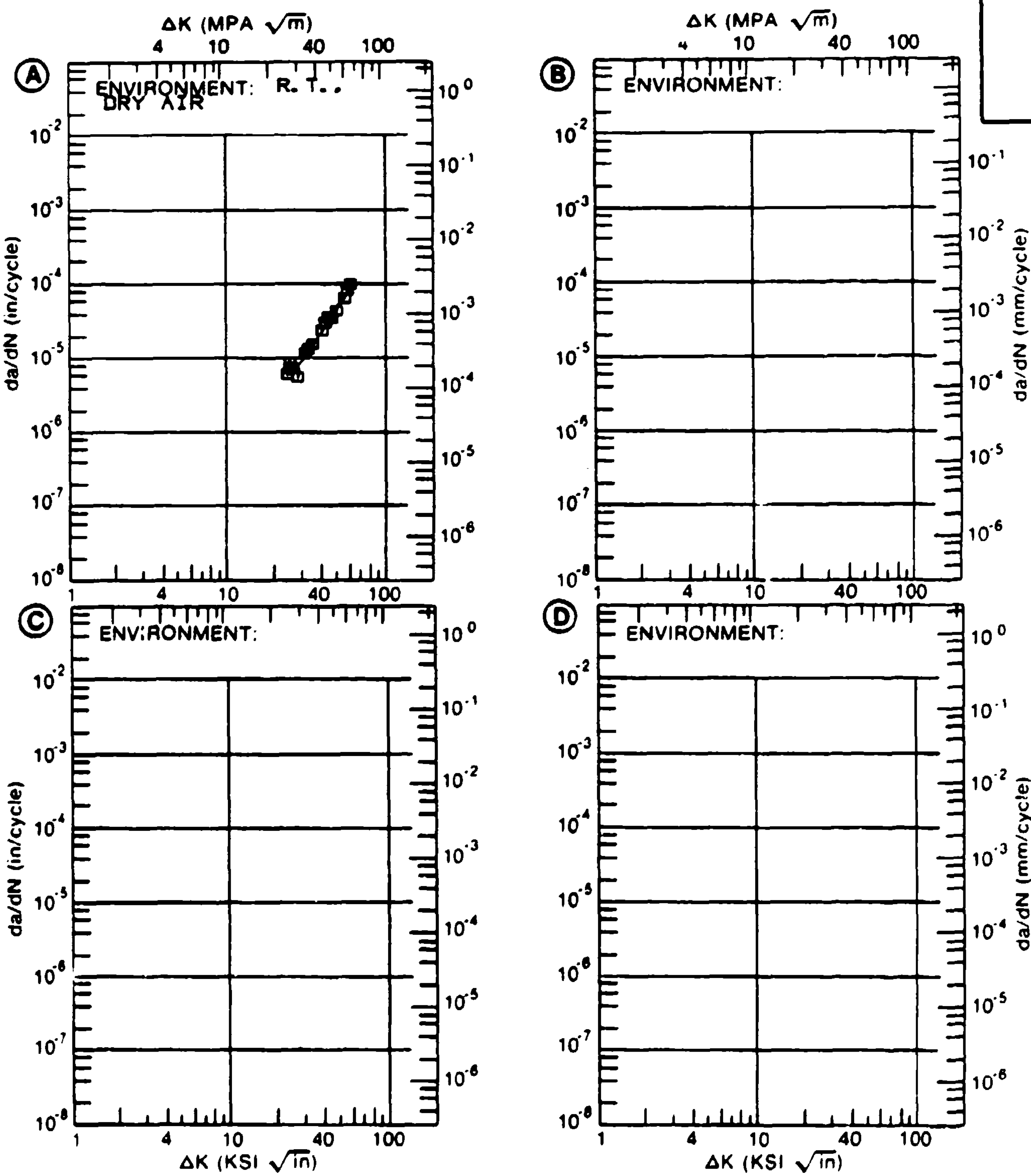

Figure 4.11.3.24

TABLE 4.11.3.25

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 4.11.3.25 INDICATING EFFECT
OF STRESS RATIO

MATERIAL: TITANIUM TI-6AL-4V
CONDITION: BETA PROCESSED-MILL ANNEALED
ENVIRONMENT: R.T. ,DRY AIR

DELTA K (KSI*IN**1/2)			DA/DN (10**-6 IN./CYCLE) A	B	C	D
			R=+0.10			
DELTA K MIN	A:	17.02	2.69			
	B:					
	C:					
	D:					
		20.00	4.51			
		25.00	9.81			
		30.00	16.8			
		35.00	28.4			
DELTA K MAX	A:	35.59	31.4			
	B:					
	C:					
	D:					
ROOT MEAN SQUARE PERCENT ERROR			7.19			

LIFE PREDICTION RATIO SUMMARY (NP/NA)	
	0.0-0.5
	0.5-0.8
	0.8-1.25
	1.25-2.0
	>2.0

CONDITION/HT: BETA PROCESSED-MILL ANNEALED
FORM: 0.50"TH PLATE
SPECIMEN TYPE: CT
ORIENTATION: L-T
FREQUENCY: 10.00 HZ
ENVIRONMENT: R.T., DRY AIR

YIELD STRENGTH:
ULT. STRENGTH:
SPECIMEN THK:
SPECIMEN WIDTH:
REFERENCES: 91332

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TI-6AL-4V

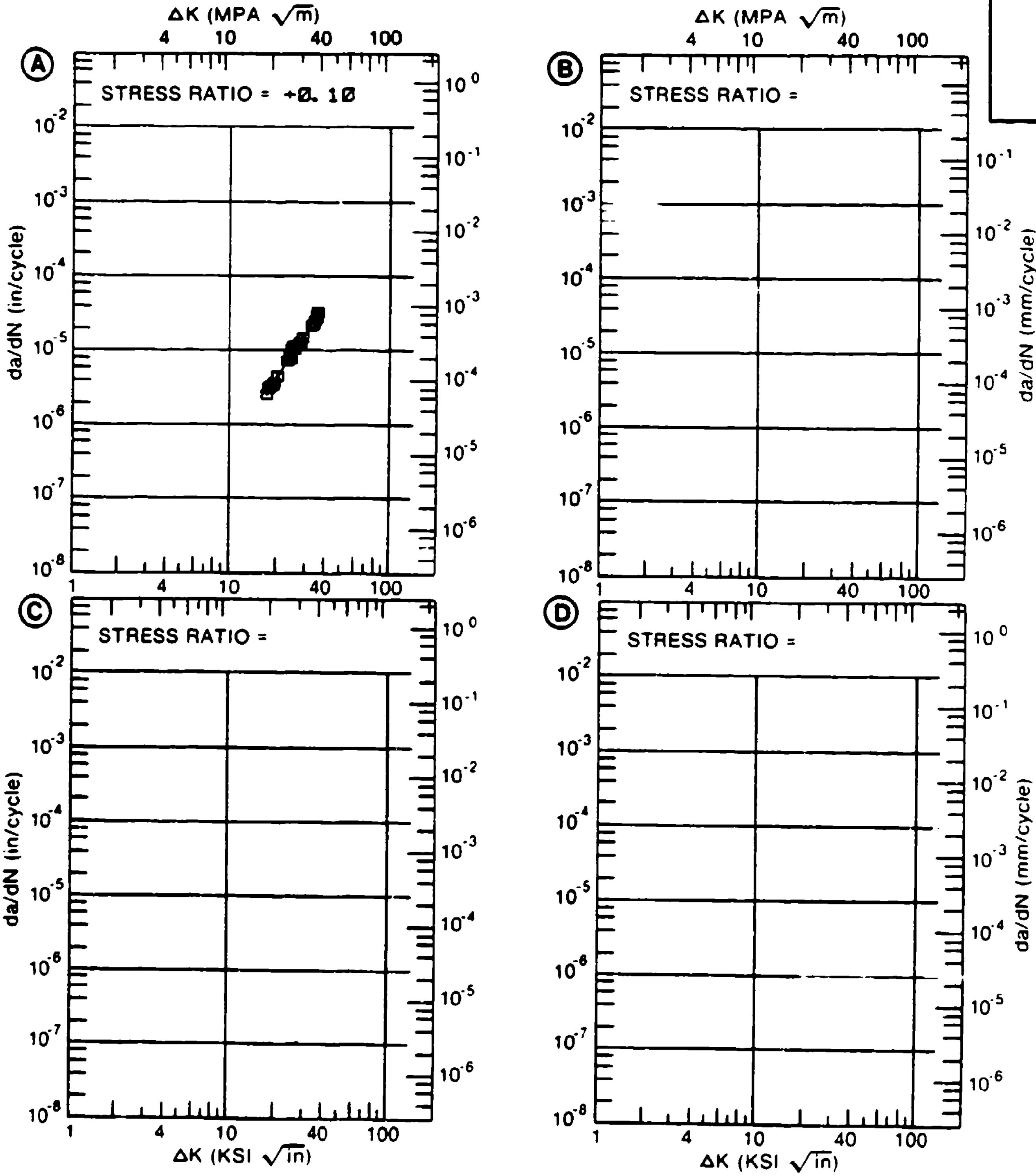

Figure 4.11.3.25

TABLE 4.11.3.26

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE4.11.3.26 INDICATING EFFECT

OF ENVIRONMENT

MATERIAL: TITANIUM TI-6AL-4V
CONDITION: BETA PROCESSED-MILL ANNEALED

DELTA K (KSI*IN**1/2)			DA/DN (10**-6 IN./CYCLE)			
			A	B	C	D
			E= R.T. DRY AIR			
	A:	16.77	2.51			
DELTA K MIN	B:					
	C:					
	D:					
		20.00	4.66			
		25.00	9.56			
		30.00	16.9			
		35.00	27.8			
	A:	36.12	30.9			
DELTA K MAX	B:					
	C:					
	D:					
ROOT MEAN SQUARE PERCENT ERROR			6.21			

LIFE PREDICTION RATIO SUMMARY (NP/NA)	
	0.0-0.5
	0.5-0.8
	0.8-1.25
	1.25-2.0
	>2.0

CONDITION/HT: BETA PROCESSED-MILL ANNEALED
FORM: 0.50"TH PLATE
SPECIMEN TYPE: CT
ORIENTATION: L-T
STRESS RATIO: +0.10
FREQUENCY: 10.00 HZ

YIELD STRENGTH:
ULT. STRENGTH:
SPECIMEN THK:
SPECIMEN WIDTH:
REFERENCES: 01332

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TI-6AL-4V

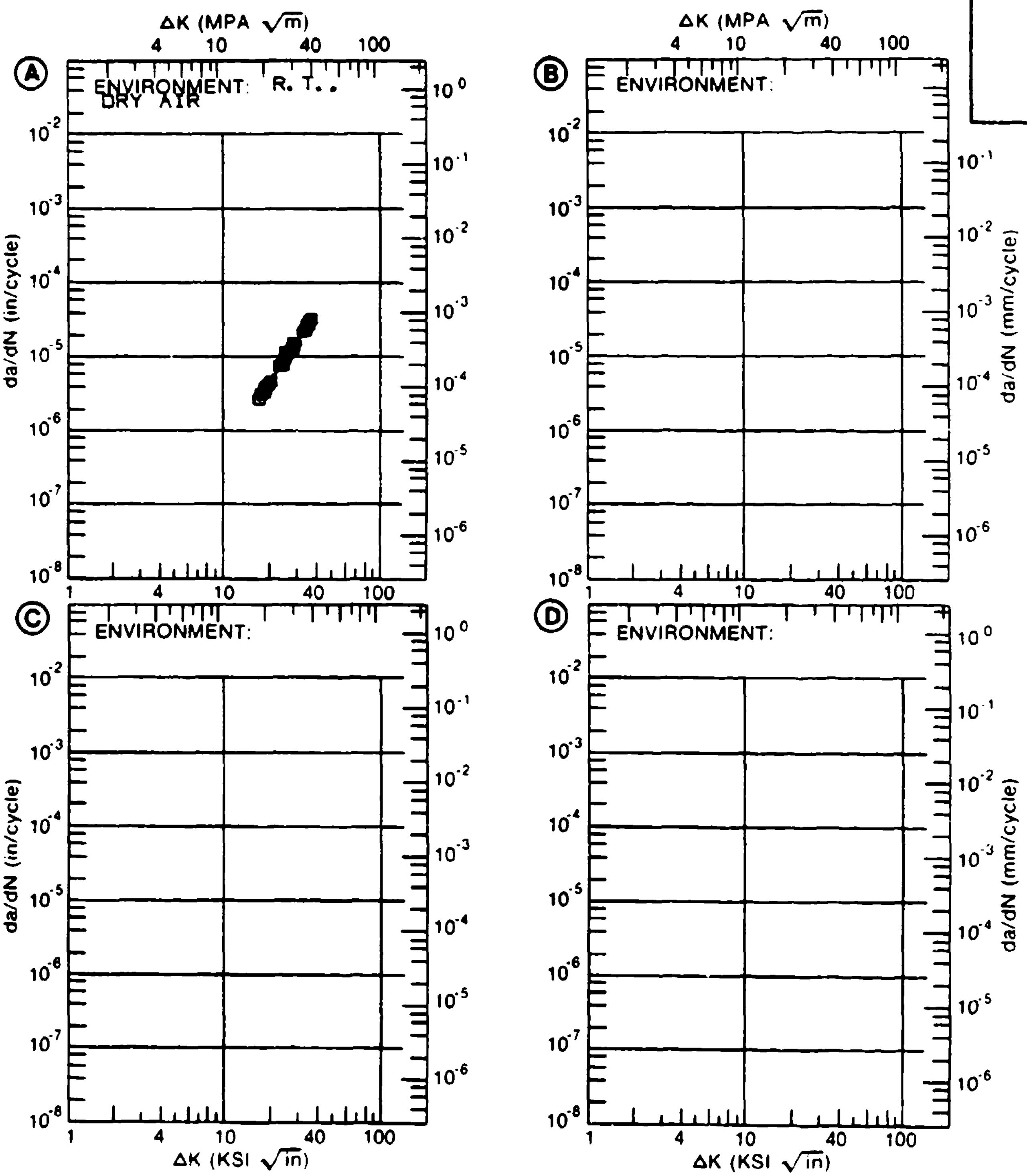

Figure 4.11.3.26

TABLE 4.11.3.27

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 4.11.3.27 INDICATING EFFECT
OF STRESS RATIO

MATERIAL: TITANIUM TI-6AL-4V
CONDITION: BETA PROCESSED-MILL ANNEALED
ENVIRONMENT: R.T. ,LAB AIR

DELTA K (KSI*IN**1/2)		DA/DN (10**-6 IN./CYCLE) A	B	C	D
		R=+0.10	R=+0.50		
DELTA K MIN A:	14.50	.518			
B:	6.57		.0730		
C:					
D:					
	7.00		.133		
	8.00		.387		
	9.00		.827		
	10.00		1.47		
	13.00		4.98		
	16.00	.593	13.6		
	20.00	.917			
	25.00	2.12			
	30.00	6.80			
	35.00	25.7			
DELTA K MAX A:	38.26	43.2			
B:	16.76		17.6		
C:					
D:					
ROOT MEAN SQUARE PERCENT ERROR		13.98	18.86		

LIFE PREDICTION RATIO SUMMARY (NP/NA)	
	0.0-0.5
	0.5-0.8
	0.8-1.25
	1.25-2.0
	>2.0

CONDITION/HT: BETA PROCESSED-MILL ANNEALED
FORM: 3.00"TH PLATE
SPECIMEN TYPE: WOL
ORIENTATION: L-T
FREQUENCY: 1.00 HZ
ENVIRONMENT: R.T., LAB AIR

YIELD STRENGTH: 130.4 KSI
ULT. STRENGTH: 138.1 KSI
SPECIMEN THK: 1.000"
SPECIMEN WIDTH: 2.550"
REFERENCES: UD008

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TI-6AL-4V

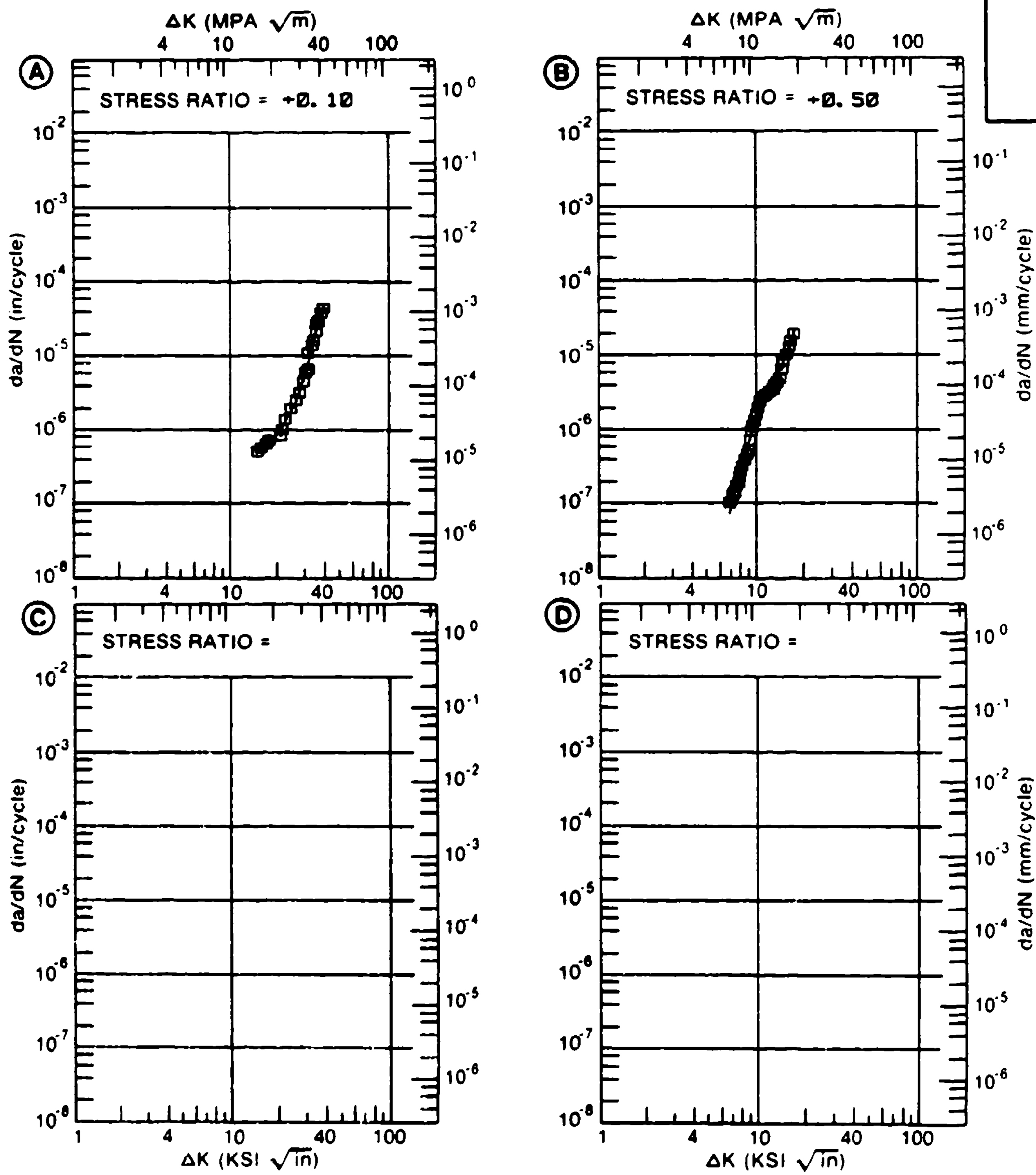

Figure 4.11.3.27

TABLE 4.11.3.28

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 4.11.3.28 INDICATING EFFECT

OF FREQUENCY

MATERIAL: TITANIUM TI-6AL-4V
CONDITION: DB
ENVIRONMENT: R. T. , L. H. A.

DELTA K (KSI*IN**1/2)			DA/DN (10**-6 IN./CYCLE) A	B	C	D
			F(HZ)= 6.00			
DELTA K MIN	A:	13.23	14.0			
	B:					
	C:					
	D:					
		16.00	21.7			
		20.00	33.1			
		25.00	61.3			
		30.00	144.			
		35.00	415.			
DELTA K MAX	A:	37.82	1316.			
	B:					
	C:					
	D:					

ROOT MEAN SQUARE PERCENT ERROR		12.23
LIFE PREDICTION RATIO SUMMARY (NP/NA)	0.0-0.5	
	0.5-0.8	
	0.8-1.25	1
	1.25-2.0	
	>2.0	

CONDITION/HT: DB
FORM: 0.63"TH PLATE
SPECIMEN TYPE: CT
ORIENTATION: T-L
STRESS RATIO: +0.30
ENVIRONMENT: R.T., L.H.A.

YIELD STRENGTH: 153.0 KSI
ULT. STRENGTH: 165.0 KSI
SPECIMEN THK: 1.000"
SPECIMEN WIDTH: 6.000"
REFERENCES: 88579

TITAN. ALLOY

TI-6AL-4V

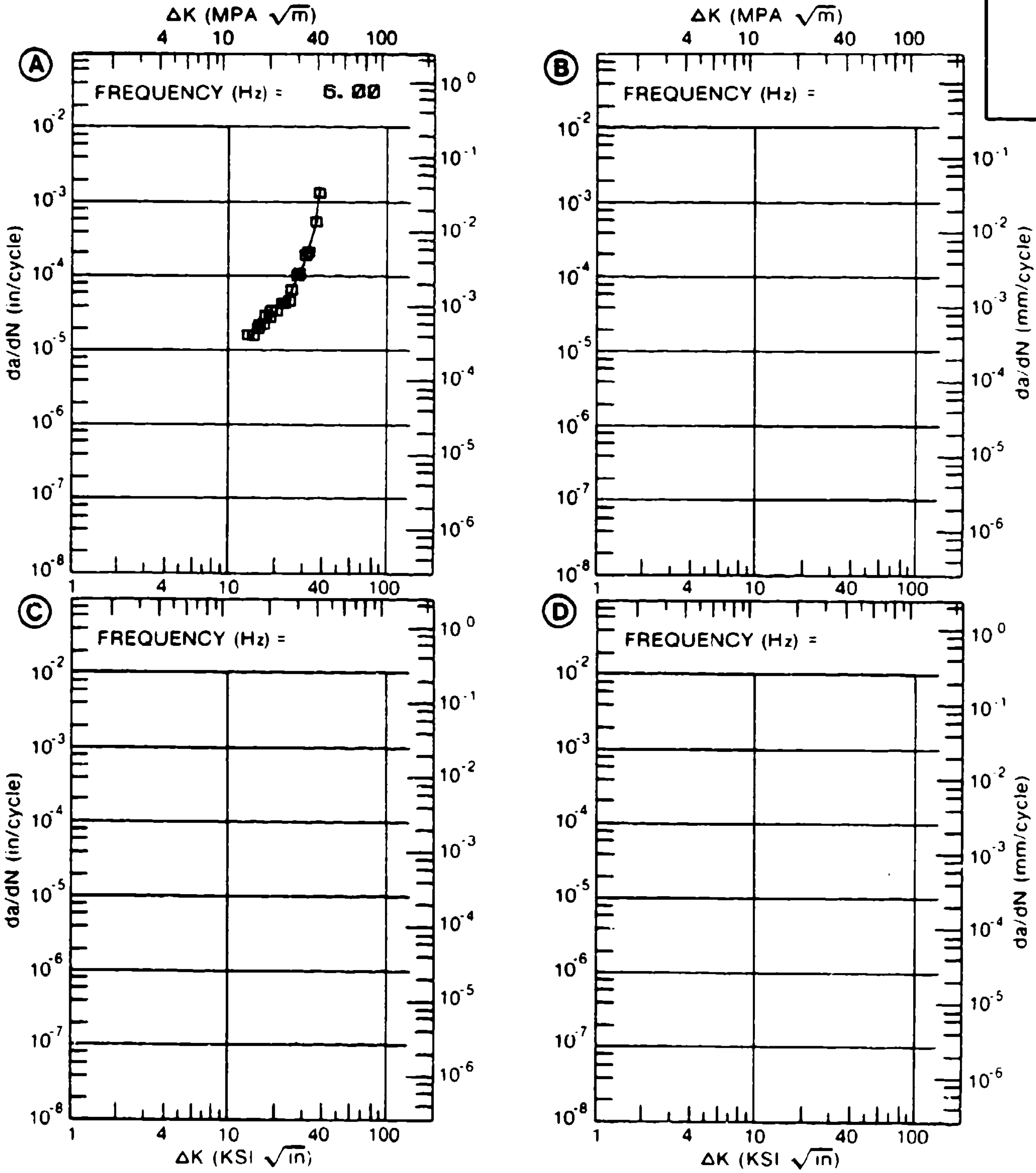

Figure 4.11.3.28

TABLE 4.11.3.29

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 4.11.3.29 INDICATING EFFECT
OF ENVIRONMENT

MATERIAL: TITANIUM TI-6AL-4V
CONDITION: DB

DELTA K (KSI*IN**1/2)			DA/DN (10**-6 IN./CYCLE) A	B	C	D
			E= R.T. L.H.A.			
DELTA K MIN	A:	7.88	.139			
	B:					
	C:					
	D:					
		8.00	.147			
		9.00	.242			
		10.00	.397			
		13.00	1.52			
		16.00	4.41			
		20.00	12.1			
		25.00	25.6			
		30.00	35.2			
DELTA K MAX	A:	32.73	36.6			
	B:					
	C:					
	D:					

ROOT MEAN SQUARE PERCENT ERROR 17.52

LIFE PREDICTION RATIO SUMMARY (NP/NA)		
	0.0-0.5	
	0.5-0.8	
	0.8-1.25	
	1.25-2.0	1
	>2.0	

CONDITION/HT: DB
FORM: 1.50"TH PLATE
SPECIMEN TYPE: CT
ORIENTATION: T-L
STRESS RATIO: +0.08
FREQUENCY: 8.00 HZ

YIELD STRENGTH: 115.0 KSI
ULT. STRENGTH: 126.0 KSI
SPECIMEN THK: 1.000"
SPECIMEN WIDTH: 4.940"
REFERENCES: 88579

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TI-6AL-4V

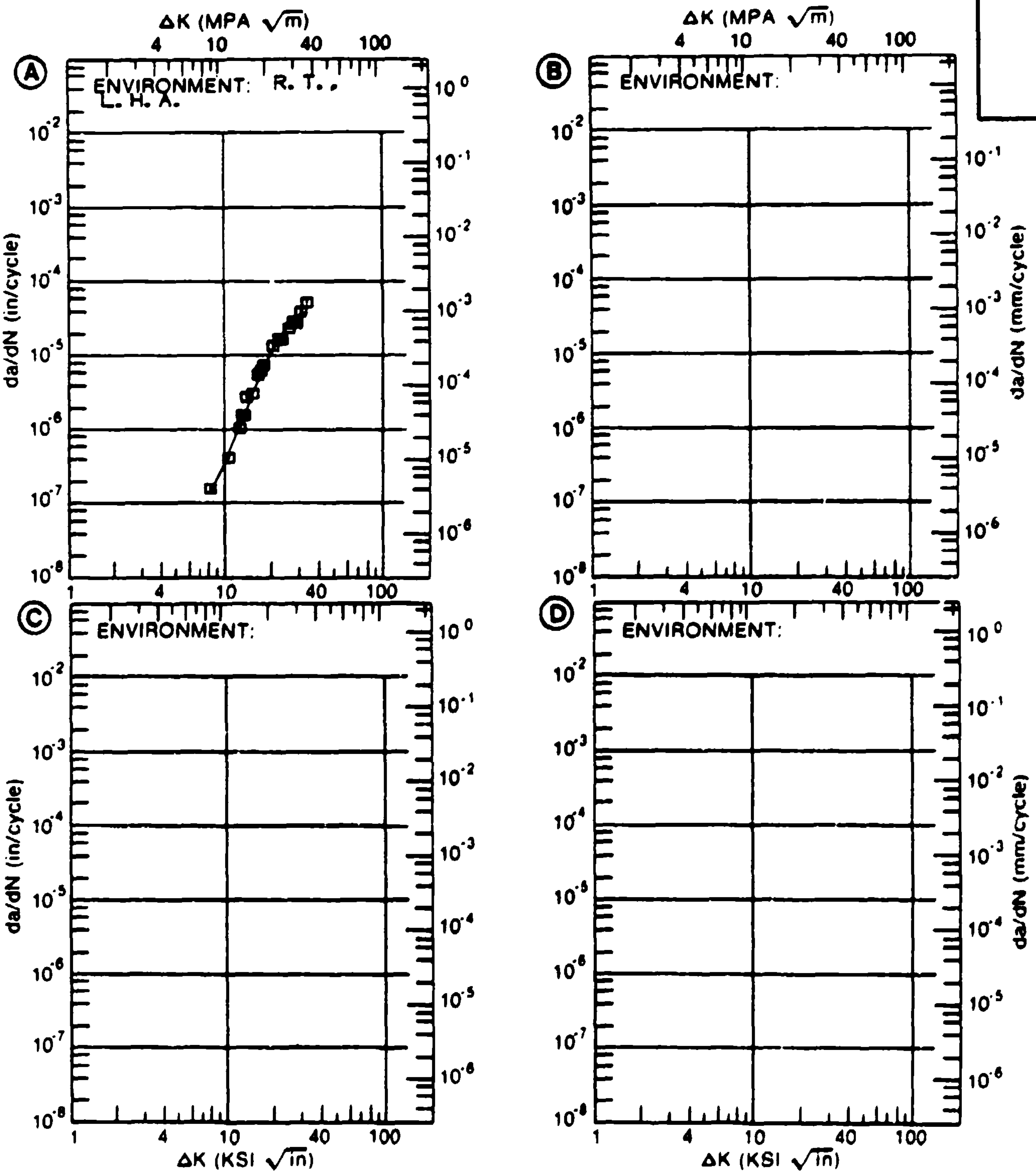

Figure 4.11.3.29

TABLE 4.11.3.30

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 4.11.3.30 INDICATING EFFECT

OF ENVIRONMENT

MATERIAL: TITANIUM TI-6AL-4V
CONDITION: DB

DELTA K (KSI*IN**1/2)		DA/DN (10**-6 IN./CYCLE) A	B	C	D
		E= R.T. S.T.W.			
DELTA K MIN	A: 12.21	.149			
	B:				
	C:				
	D:				
	13.00	.469			
	16.00	1.98			
	20.00	8.20			
	25.00	22.2			
	30.00	41.4			
	35.00	65.8			
	40.00	98.3			
	50.00	214.			
DELTA K MAX	A: 54.03	296.			
	B:				
	C:				
	D:				

ROOT MEAN SQUARE PERCENT ERROR		19.51			

LIFE PREDICTION RATIO SUMMARY (NP/NA)	0.0-0.5				
	0.5-0.8				
	0.8-1.25	1			
	1.25-2.0				
	>2.0				

CONDITION/HT: DB
FORM: 8.00"TH PLATE
SPECIMEN TYPE: CT
ORIENTATION: T-L
STRESS RATIO: +0.08
FREQUENCY: 1.00 HZ

YIELD STRENGTH: 118.0 KSI
ULT. STRENGTH: 128.0 KSI
SPECIMEN THK: 0.992"
SPECIMEN WIDTH: 6.000"
REFERENCES: 85837

TITAN. ALLOY

TI-6AL-4V

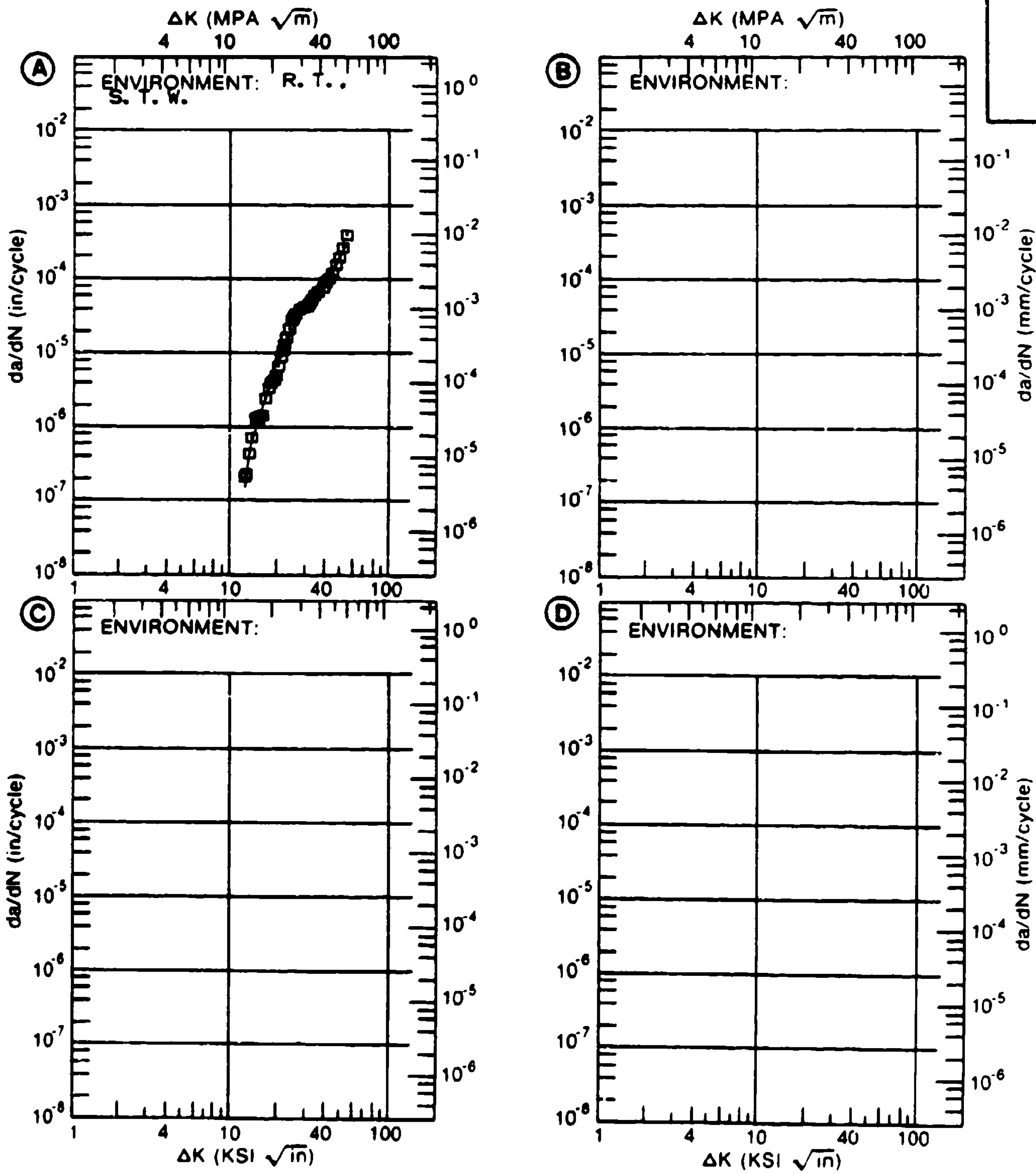

Figure 4.11.3.30

TABLE 4.11.3.31

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 4.11.3.31 INDICATING EFFECT
OF ENVIRONMENT

MATERIAL: TITANIUM TI-6AL-4V
CONDITION: DB

DELTA K (KSI*IN**1/2)			DA/DN (10**-6 IN./CYCLE) A	B	C	D
			E= R.T. S.T.W.			
	A:	9.39	.371			
DELTA K MIN	B:					
	C:					
	D:					
		10.00	.782			
		13.00	4.03			
		16.00	11.4			
		20.00	21.3			
		25.00	31.5			
		30.00	46.2			
		35.00	77.1			
		40.00	151.			
	A:	47.88	497.			
DELTA K MAX	B:					
	C:					
	D:					

ROOT MEAN SQUARE PERCENT ERROR		9.26			
LIFE PREDICTION RATIO SUMMARY (NP/NA)	0.0-0.5				
	0.5-0.8				
	0.8-1.25	1			
	1.25-2.0				
	>2.0				

CONDITION/HT: DB
FORM: 8.00"TH PLATE
SPECIMEN TYPE: CT
ORIENTATION: S-T
STRESS RATIO: +0.08
FREQUENCY: 1.00 HZ

YIELD STRENGTH: 114.0 KSI
ULT. STRENGTH: 128.0 KSI
SPECIMEN THK: 0.993"
SPECIMEN WIDTH: 4.940"
REFERENCES: 85837

TITAN. ALLOY

TI-6AL-4V

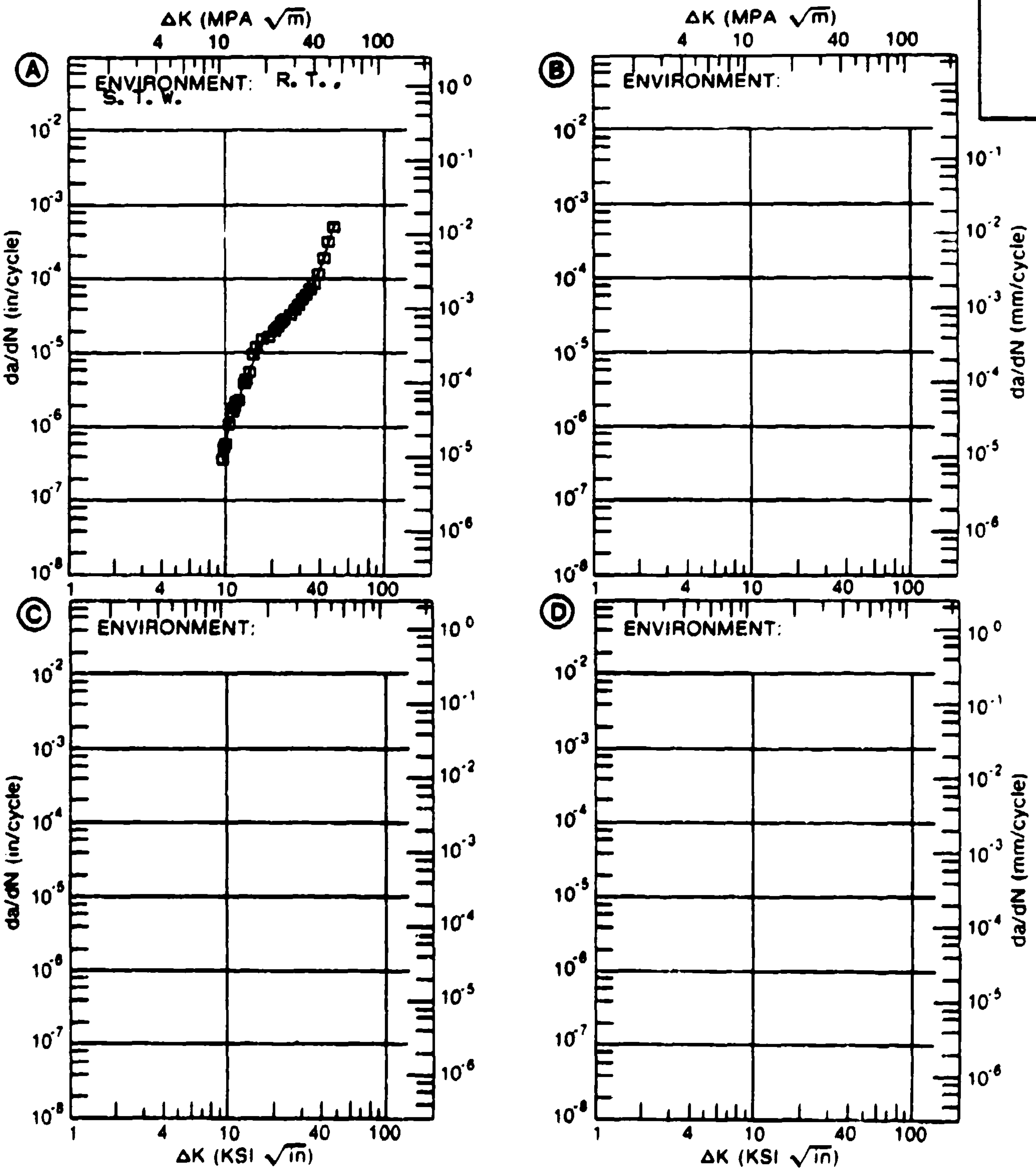

Figure 4.11.3.31

TABLE 4.11.3.32

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 4.11.3.32 INDICATING EFFECT

OF ENVIRONMENT

MATERIAL: TITANIUM TI-6AL-4V
CONDITION: DB + TR

DELTA K (KSI*IN**1/2)		DA/DN (10**-6 IN./CYCLE) A	B	C	D
		E= R.T. S.T.W.			
DELTA K MIN A:	10.12	.176			
DELTA K MIN B:					
DELTA K MIN C:					
DELTA K MIN D:					
	13.00	.448			
	16.00	2.01			
	20.00	9.78			
	25.00	29.1			
	30.00	50.6			
	35.00	83.1			
	40.00	155.			
DELTA K MAX A:	44.78	337.			
DELTA K MAX B:					
DELTA K MAX C:					
DELTA K MAX D:					

ROOT MEAN SQUARE PERCENT ERROR		15.89

LIFE PREDICTION RATIO SUMMARY (NP/NA)		A
	0.0-0.5	
	0.5-0.8	
	0.8-1.25	1
	1.25-2.0	
	>2.0	

CONDITION/HT: DB + TR
FORM: 1.50"TH PLATE
SPECIMEN TYPE: CT
ORIENTATION: S-T
STRESS RATIO: +0.08
FREQUENCY: 1.00 HZ

YIELD STRENGTH: 111.0 KSI
ULT. STRENGTH: 128.0 KSI
SPECIMEN THK: 1.000"
SPECIMEN WIDTH: 5.000"
REFERENCES: 88579

TITAN. ALLOY

TI-6AL-4V

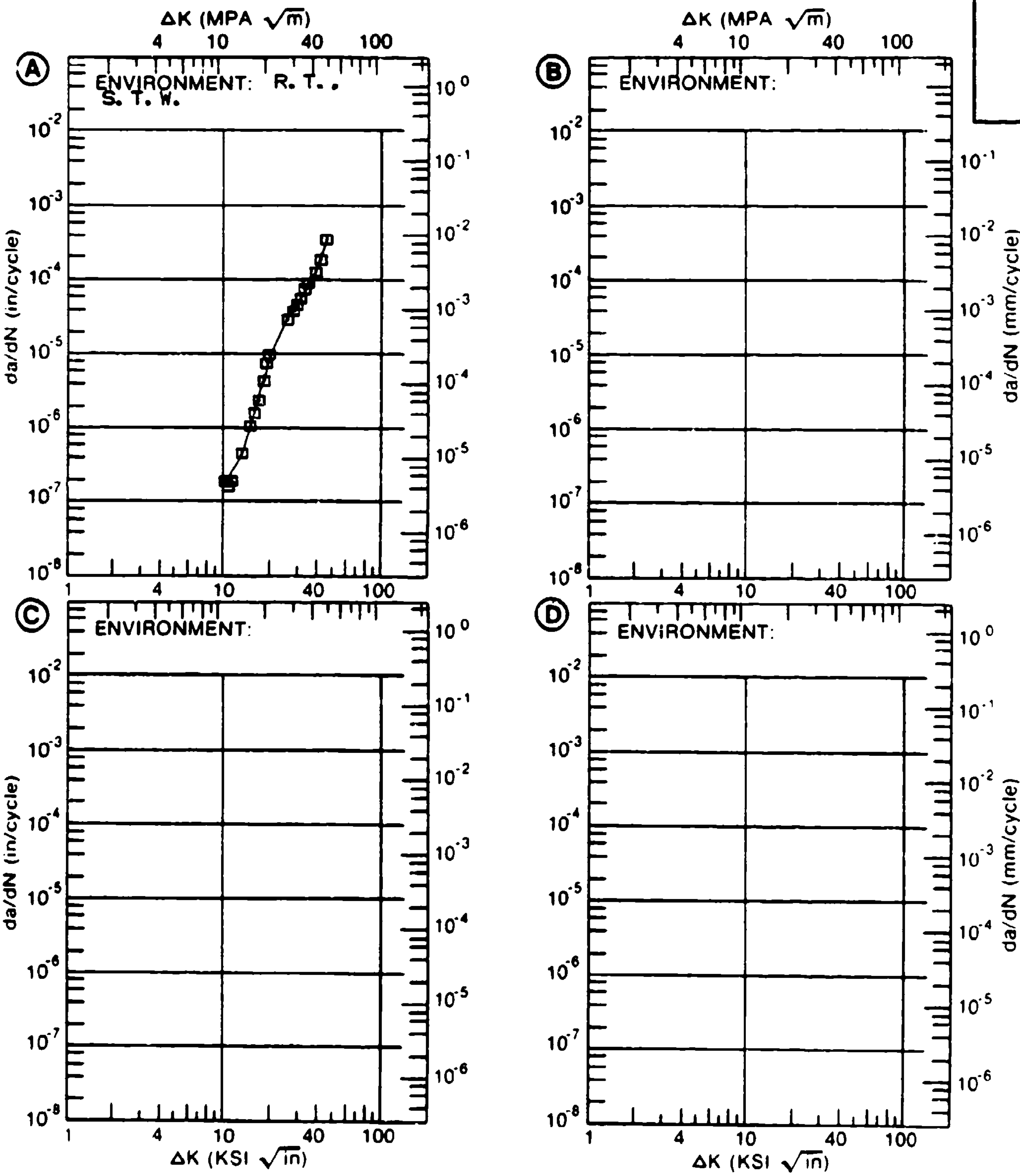

Figure 4.11.3.32

TABLE 4.11.3.33

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 4.11.3.33 INDICATING EFFECT

OF ENVIRONMENT

MATERIAL: TITANIUM TI-6AL-4V
CONDITION: DB + 2DBTC

DELTA K (KSI*IN**1/2)			DA/DN (10**-6 IN./CYCLE) A E= R.T. S.T.W.	B	C	D
	A:	13.92	1.11			
DELTA K MIN	B:					
	C:					
	D:					
		16.00	2.14			
		20.00	7.93			
		25.00	23.1			
		30.00	45.2			
		35.00	74.0			
		40.00	112.			
		50.00	244.			
		60.00	545.			
	A:	62.46	671.			
DELTA K MAX	B:					
	C:					
	D:					
ROOT MEAN SQUARE PERCENT ERROR			6.56			
LIFE PREDICTION RATIO SUMMARY (NP/NA)		0.0-0.5				
		0.5-0.8				
		0.8-1.25	1			
		1.25-2.0				
		>2.0				

CONDITION/HT: DB + 2DBTC
FORM: 8.00"TH PLATE
SPECIMEN TYPE: CT
ORIENTATION: T-L
STRESS RATIO: +0.08
FREQUENCY: 1.00 HZ

YIELD STRENGTH: 114.0 KSI
ULT. STRENGTH: 128.0 KSI
SPECIMEN THK: 0.998"
SPECIMEN WIDTH: 6.000"
REFERENCES: 85837

TITAN. ALLOY

TI-6AL-4V

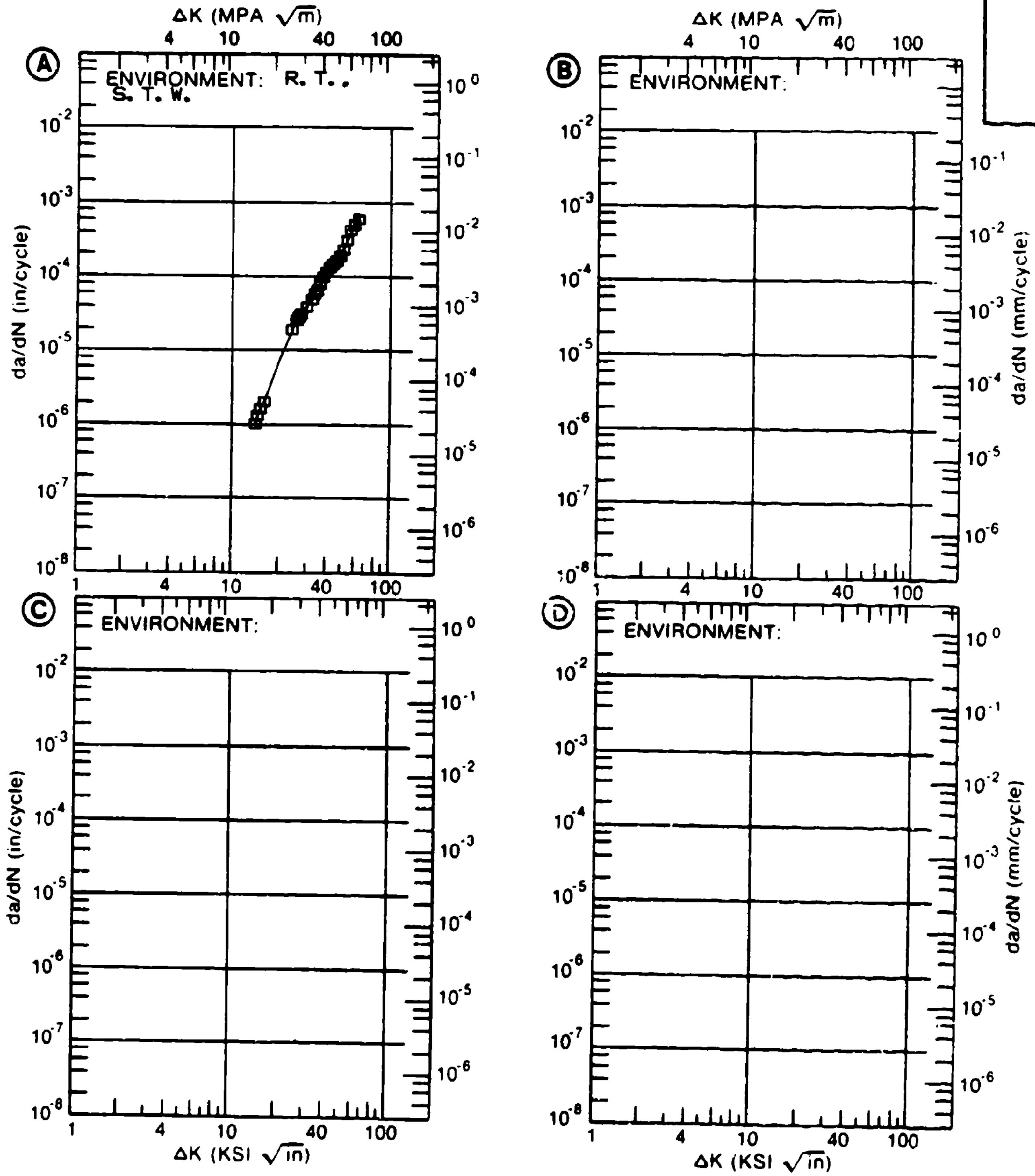

Figure 4.11.3.33

TABLE 4.11.3.34

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 4.11.3.34 INDICATING EFFECT
OF ENVIRONMENT

MATERIAL: TITANIUM TI-6AL-4V
CONDITION: DB + 2DBTC

DELTA K (KSI*IN**1/2)			DA/DN (10**-6 IN./CYCLE) A	B	C	D
			E= R.T. L.H.A.			
DELTA K MIN	A:	14.18	2.57			
	B:					
	C:					
	D:					
		16.00	5.81			
		20.00	8.36			
		25.00	30.9			
DELTA K MAX	A:	26.83	31.9			
	B:					
	C:					
	D:					

ROOT MEAN SQUARE PERCENT ERROR	16.76

LIFE PREDICTION RATIO SUMMARY (NP/NA)		
	0.0-0.5	
	0.5-0.8	
	0.8-1.25	1
	1.25-2.0	
	>2.0	

CONDITION/HT: DB + 2DBTC
FORM: 8.00"TH PLATE
SPECIMEN TYPE: CT
ORIENTATION: S-T
STRESS RATIO: +0.08
FREQUENCY: 8.00 HZ

YIELD STRENGTH: 114.0 KSI
ULT. STRENGTH: 128.0 KSI
SPECIMEN THK: 0.983"
SPECIMEN WIDTH: 4.950"
REFERENCES: 85837

TITAN. ALLOY
TI-6AL-4V

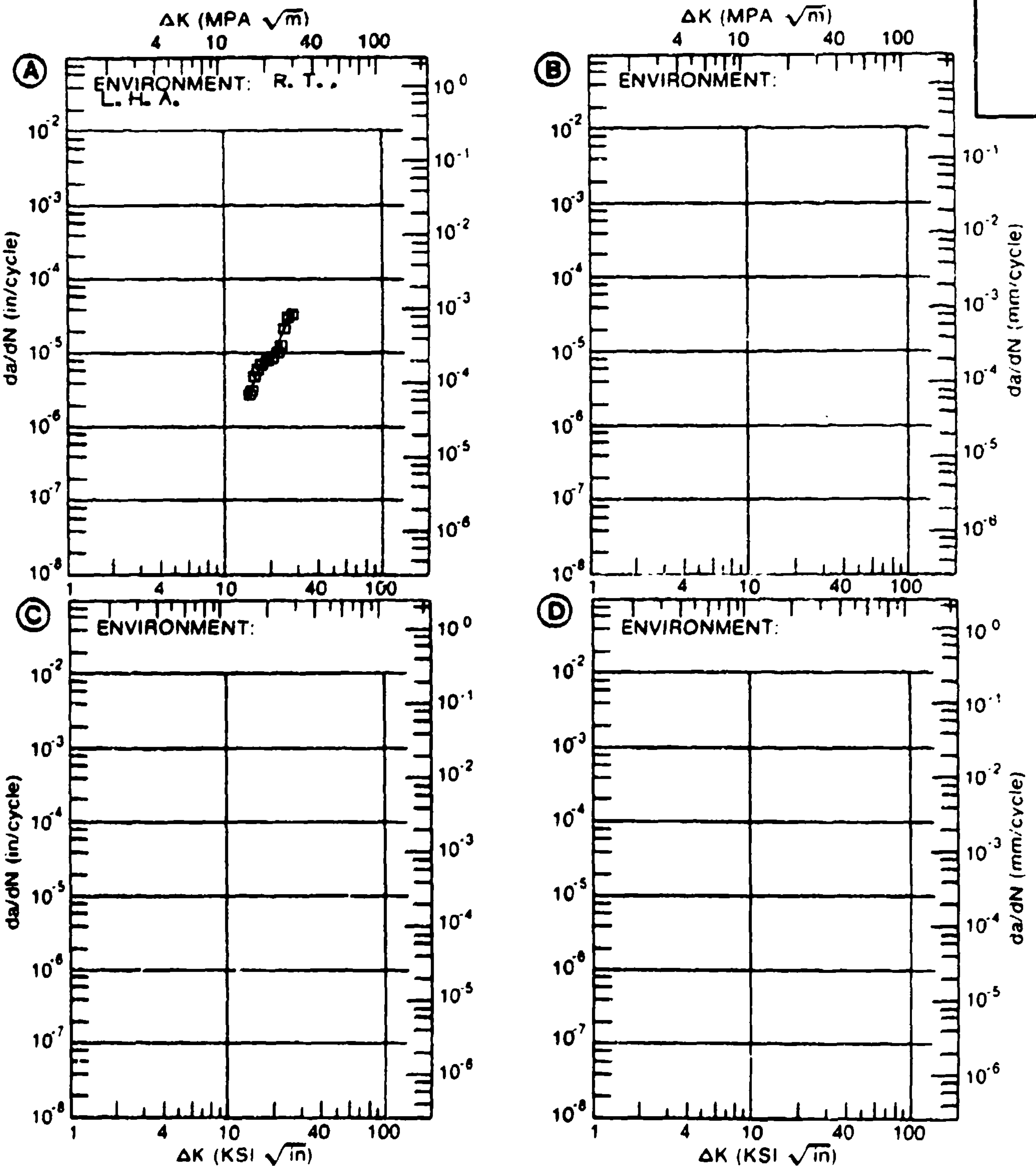

Figure 4.11.3.34

TABLE 4.11.3.35

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 4.11.3.35 INDICATING EFFECT

OF ENVIRONMENT

MATERIAL: TITANIUM TI-6AL-4V
CONDITION: DB + 4DBTC

DELTA K (KSI*IN**1/2)		DA/DN (10**-6 IN./CYCLE) A	B	C	D
		E= R.T. S.T.W.			
DELTA K MIN A:	11.85	.262			
DELTA K MIN B:					
DELTA K MIN C:					
DELTA K MIN D:					
	13.00	.473			
	16.00	2.26			
	20.00	9.02			
	25.00	28.2			
	30.00	48.5			
	35.00	77.4			
	40.00	112.			
	50.00	209.			
DELTA K MAX A:	54.46	270.			
DELTA K MAX B:					
DELTA K MAX C:					
DELTA K MAX D:					

ROOT MEAN SQUARE PERCENT ERROR		13.83
LIFE PREDICTION RATIO SUMMARY (NP/NA)	0.0-0.5	
	0.5-0.8	
	0.8-1.25	1
	1.25-2.0	
	>2.0	

CONDITION/HT: DB + 4DBTC
FORM: 8.00"TH PLATE
SPECIMEN TYPE: CT
ORIENTATION: T-L
STRESS RATIO: +0.08
FREQUENCY: 1.00 HZ

YIELD STRENGTH: 115.0 KSI
ULT. STRENGTH: 126.0 KSI
SPECIMEN THK: 0.980"
SPECIMEN WIDTH: 6.000"
REFERENCES: 85837

TITAN. ALLOY

TI-6AL-4V

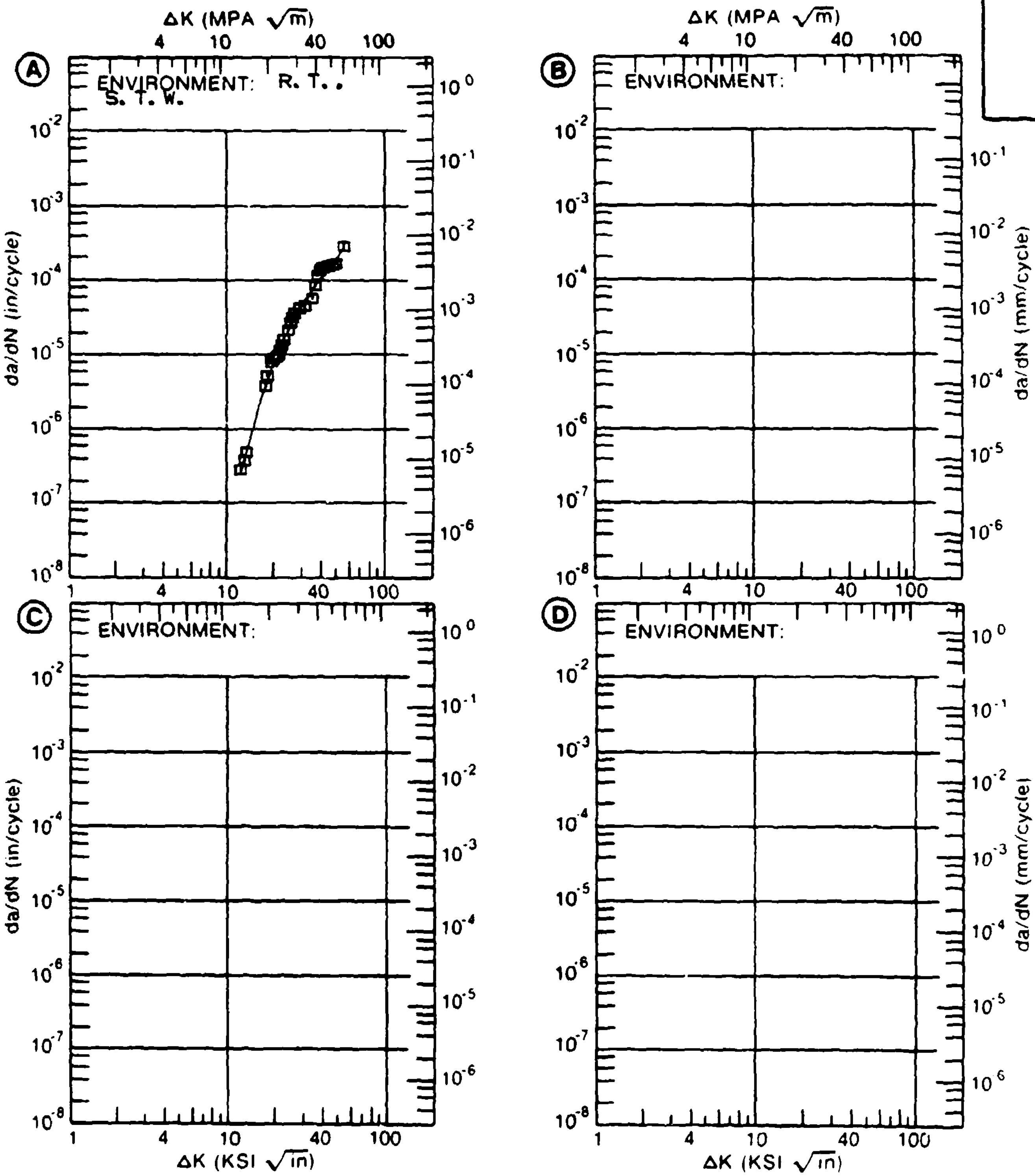

Figure 4.11.3.35

TABLE 4.11.3.36

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 4.11.3.36 INDICATING EFFECT

OF ENVIRONMENT

MATERIAL: TITANIUM TI-6AL-4V
CONDITION: DBT + PC

DELTA K (KSI*IN**1/2)			DA/DN (10**-6 IN./CYCLE) A	B	C	D
			E= R.T. S.T.W.			
DELTA K MIN	A:	10.37	.256			
	B:					
	C:					
	D:					
		13.00	.631			
		16.00	1.82			
		20.00	11.2			
		25.00	30.5			
DELTA K MAX	A:	27.18	41.3			
	B:					
	C:					
	D:					
ROOT MEAN SQUARE PERCENT ERROR			24.25			
LIFE PREDICTION RATIO SUMMARY (NP/NA)		0.0-0.5				
		0.5-0.8	1			
		0.8-1.25				
		1.25-2.0				
		>2.0				

CONDITION/HT: DBT + PC	
FORM: 2.50"TH PLATE	YIELD STRENGTH: 122.0 KSI
SPECIMEN TYPE: CT	ULT. STRENGTH: 135.0 KSI
ORIENTATION: T-L	SPECIMEN THK: 0.350"
STRESS RATIO: +0.08	SPECIMEN WIDTH: 7.400"
FREQUENCY: 1.00 HZ	REFERENCES: 88579

TITAN. ALLOY

TI-6AL-4V

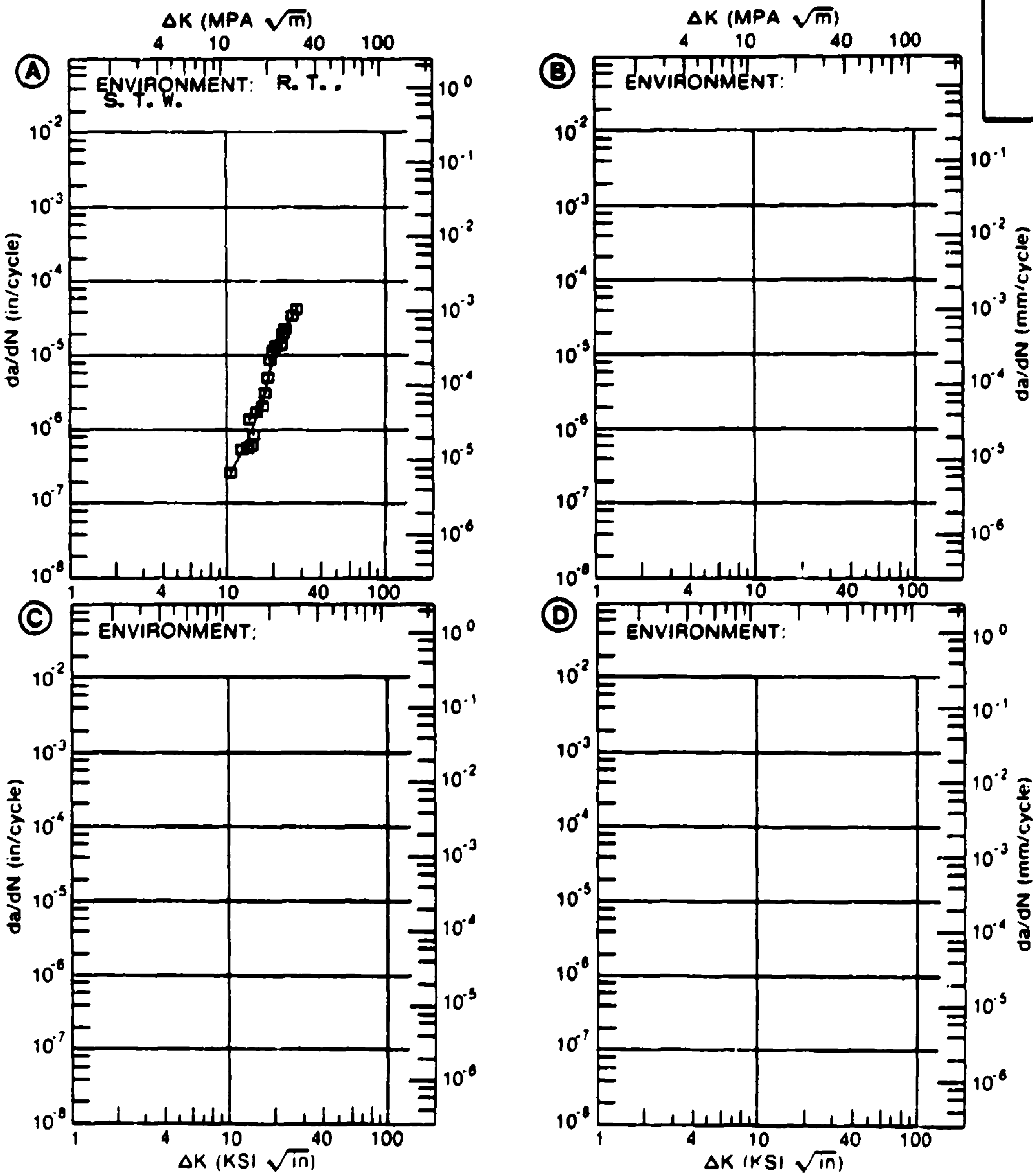

Figure 4.11.3.36

TABLE 4.11.3.37

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 4.11.3.37 INDICATING EFFECT
OF STRESS RATIO

MATERIAL: TITANIUM TI-6AL-4V
CONDITION: DBTC
ENVIRONMENT: R. T. , L. H. A.

DELTA K (KSI*IN**1/2)		DA/DN (10**-6 IN. /CYCLE) A	B	C	D
		R=+0. 08	R=+0. 30		
DELTA K MIN A:	13. 74	3. 40			
B:	9. 83		. 53		
C:					
D:					
	10. 00		. 626		
	13. 00		3. 62		
	16. 00	8. 58	8. 93		
	20. 00	16. 4	19. 4		
	25. 00	29. 4	44. 3		
	30. 00	51. 4	108.		
	35. 00	95. 1	286.		
	40. 00	191.	683.		
	50. 00	753.	2181.		
DELTA K MAX A:	58. 30	1802.			
B:	56. 14		4408.		
C:					
D:					
ROOT MEAN SQUARE PERCENT ERROR		11. 57	11. 54		
LIFE PREDICTION RATIO SUMMARY (NP/NA)	0. 0-0. 5				
	0. 5-0. 8				
	0. 8-1. 25	1	1		
	1. 25-2. 0				
	>2. 0				

CONDITION/HT: DBTC
FORM: 0.62- 0.63"TH PLATE
SPECIMEN TYPE: CT
ORIENTATION: L-T
FREQUENCY: 1.00 HZ
ENVIRONMENT: R.T., L.H.A.

YIELD STRENGTH: 138.0- 140.0 KSI
ULT. STRENGTH: 148.0- 150.0 KSI
SPECIMEN THK: 0.496- 0.500"
SPECIMEN WIDTH: 6.000"
REFERENCES: 88579, 85837

TITAN. ALLOY

TI-6AL-4V

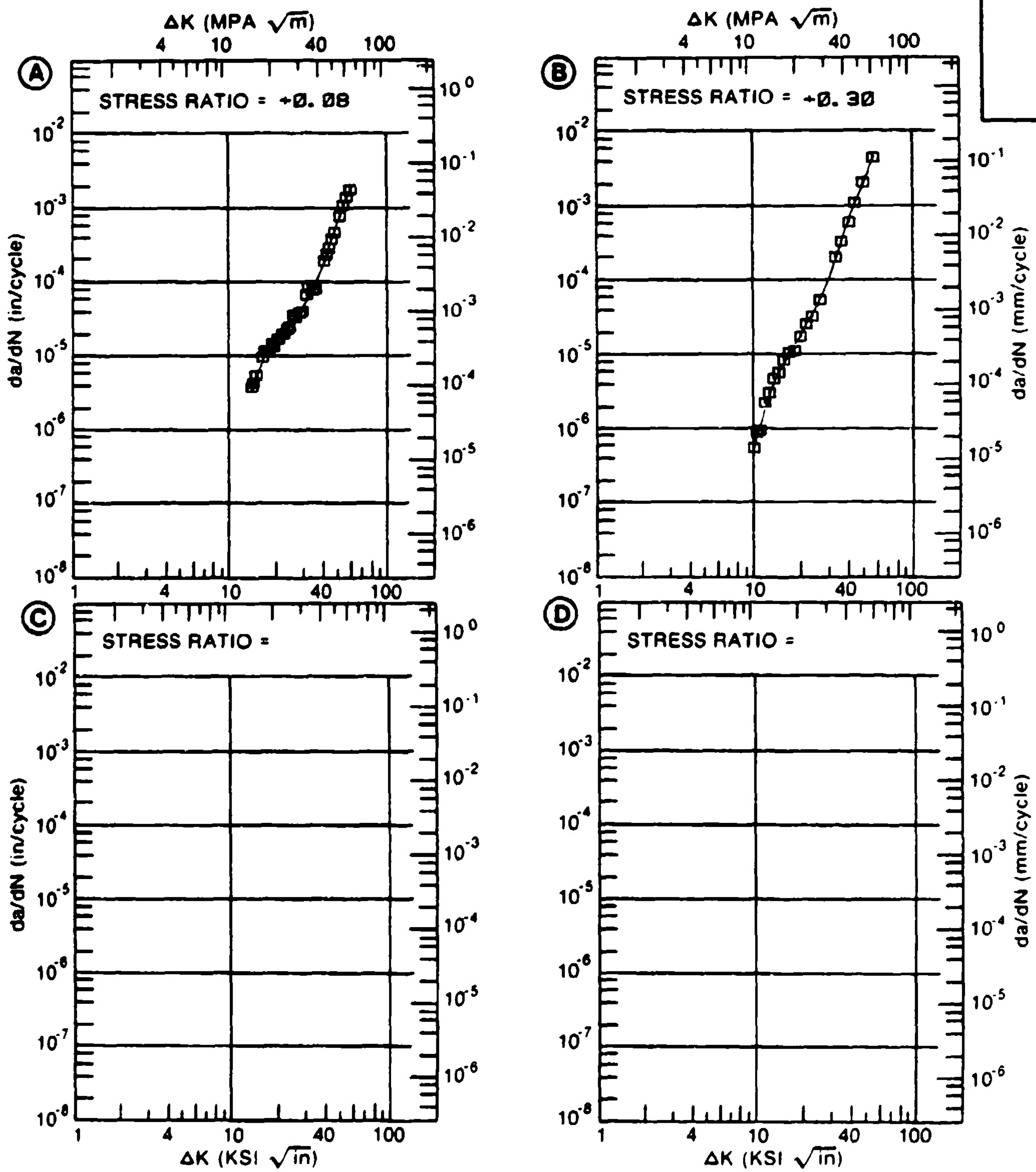

Figure 4.11.3.37

TABLE 4.11.3.38

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 4.11.3.38 INDICATING EFFECT
OF ENVIRONMENT

MATERIAL: TITANIUM TI-6AL-4V
CONDITION: DBTC

DELTA K (KSI*IN**1/2)			DA/DN (10**-6 IN./CYCLE) A E= R.T. L.H.A.	B E= R.T. S.T.W.	C	D
	A:	10.00	.359			
DELTA K MIN	B:					
	C:					
	D:					
		13.00	1.30			
		16.00	4.77			
		20.00	13.1			
		25.00	26.2			
		30.00	43.1			
		35.00	69.0			
		40.00	110.			
		50.00	285.			
	A:	59.95	750.			
DELTA K MAX	B:					
	C:					
	D:					
ROOT MEAN SQUARE PERCENT ERROR			29.28	0.00		
LIFE PREDICTION RATIO SUMMARY (NP/NA)		0.0-0.5				
		0.5-0.8	1			
		0.8-1.25				
		1.25-2.0				
		>2.0				

CONDITION/HT: DBTC
FORM: 1.25"TH PLATE
SPECIMEN TYPE: CT
ORIENTATION: L-T
STRESS RATIO: +0.30
FREQUENCY: 1.00 HZ

YIELD STRENGTH: 125.0 KSI
ULT. STRENGTH: 137.0 KSI
SPECIMEN THK: 0.990- 1.000"
SPECIMEN WIDTH: 6.000"
REFERENCES: 98579, 95837

TITAN. ALLOY

TI-6AL-4V

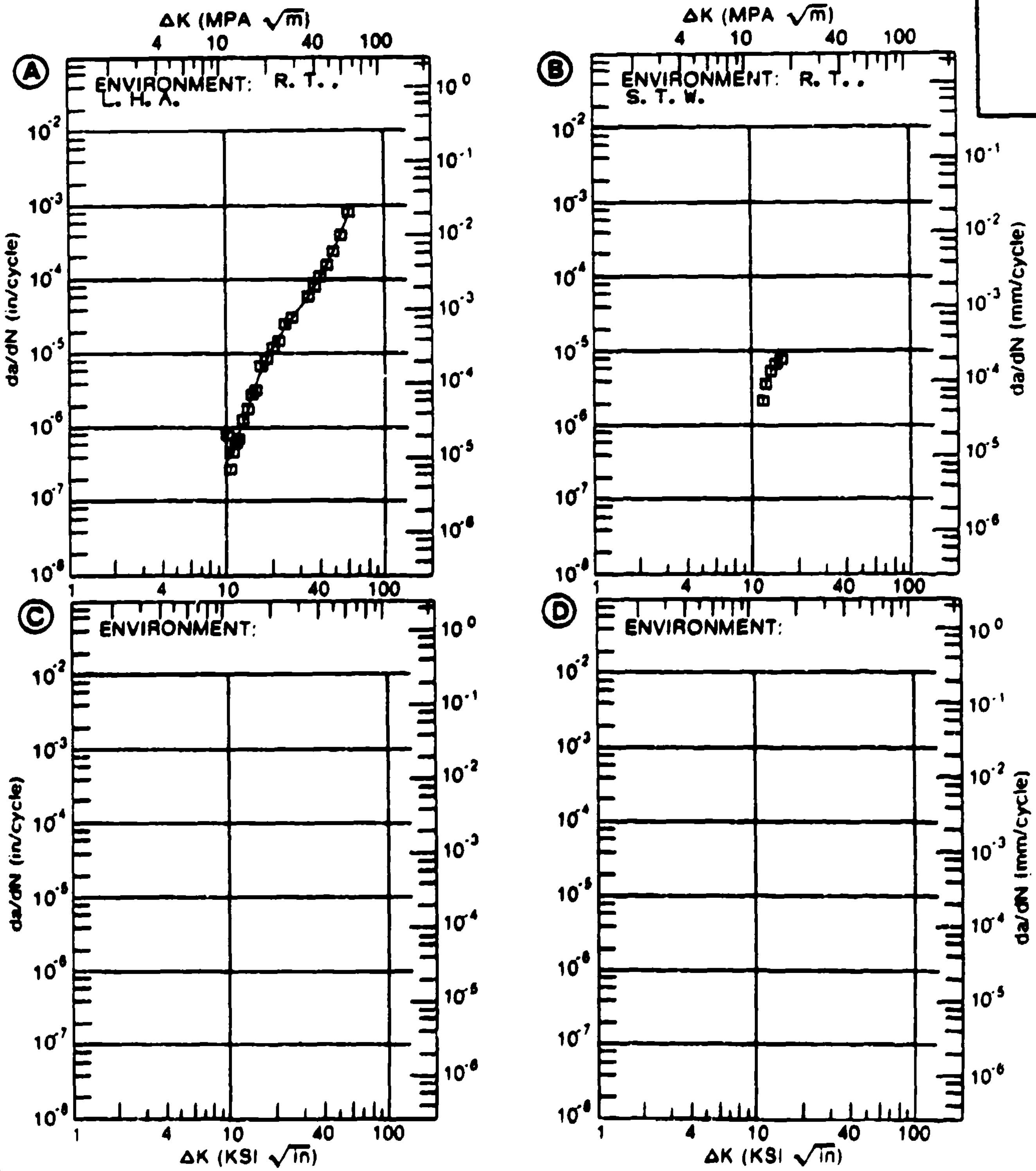

Figure 4.11.3.38

TABLE 4.11.3.39

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 4.11.3.39 INDICATING EFFECT

OF ENVIRONMENT

MATERIAL: TITANIUM TI-6AL-4V
CONDITION: DBTC

DELTA K (KSI*IN**1/2)		DA/DN (10**-6 IN./CYCLE) A	B	C	D
		E= R.T. L.H.A.			
DELTA K MIN	A: 9.82	.564			
	B:				
	C:				
	D:				
	10.00	.567			
	13.00	1.45			
	16.00	4.82			
	20.00	12.5			
	25.00	24.0			
	30.00	41.1			
	35.00	69.5			
	40.00	114.			
	50.00	278.			
DELTA K MAX	A: 56.48	685.			
	B:				
	C:				
	D:				

ROOT MEAN SQUARE PERCENT ERROR 14.29

LIFE PREDICTION RATIO SUMMARY (NP/NA)		
	0.0-0.5	
	0.5-0.8	
	0.8-1.25	1
	1.25-2.0	
	>2.0	

CONDITION/HT: DBTC
FORM: 1.25"TH PLATE
SPECIMEN TYPE: CT
ORIENTATION: T-L
STRESS RATIO: +0.30
FREQUENCY: 1.00 HZ

YIELD STRENGTH: 128.0 KSI
ULT. STRENGTH: 138.0 KSI
SPECIMEN THK: 1.000"
SPECIMEN WIDTH: 8.000"
REFERENCES: 88578

TITAN. ALLOY

TI-6AL-4V

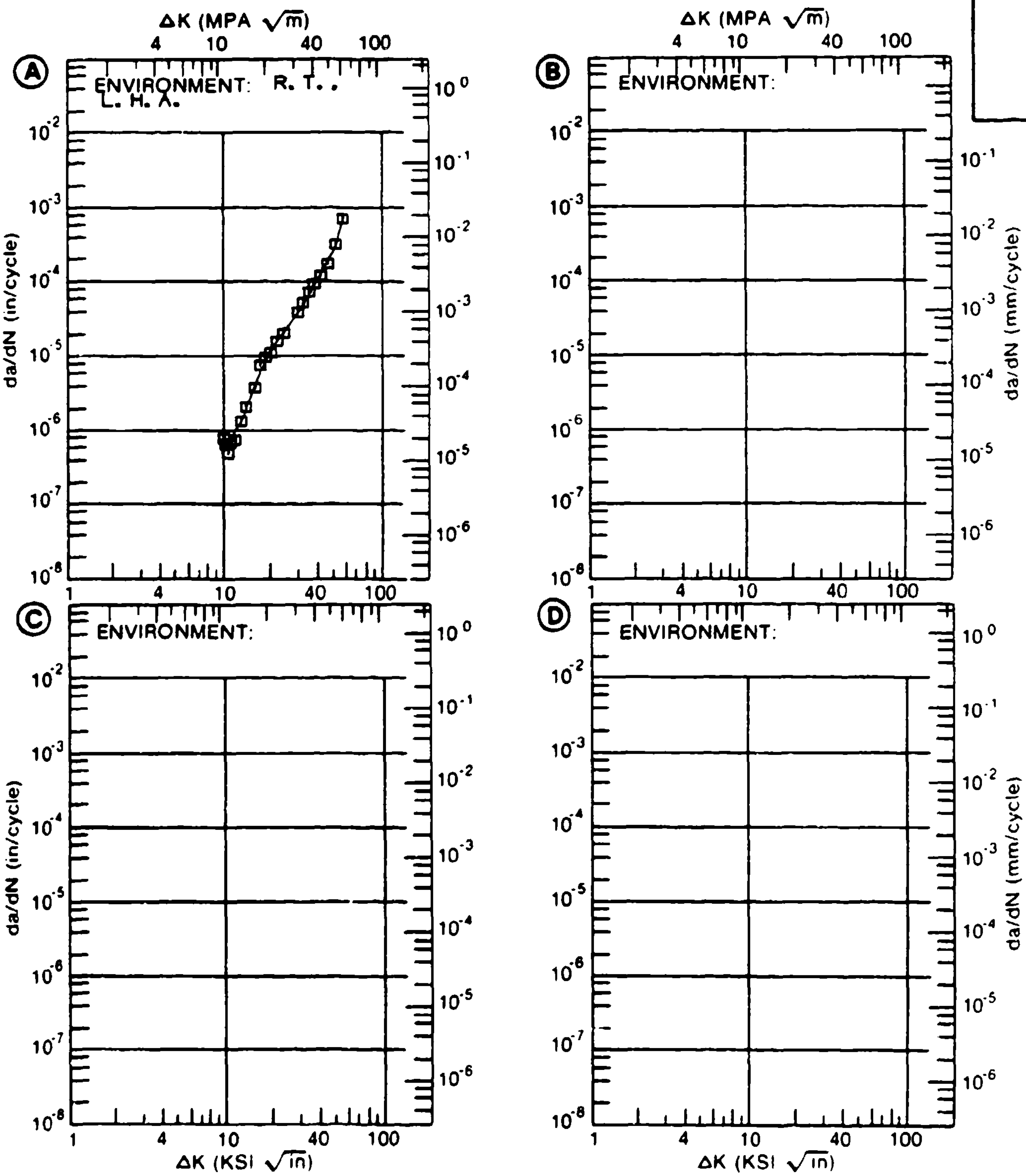

Figure 4.11.3.39

TABLE 4.11.3.40

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 4.11.3.40 INDICATING EFFECT

OF ENVIRONMENT

MATERIAL: TITANIUM TI-6AL-4V
CONDITION: DBTC

DELTA K (KSI*IN**1/2)		DA/DN (10**-6 IN./CYCLE) A	B	C	D
		E= R.T. S.T.W.			
DELTA K MIN A:	6.24	.115			
DELTA K MIN B:					
DELTA K MIN C:					
DELTA K MIN D:					
	7.00	.122			
	8.00	.192			
	9.00	.349			
	10.00	.629			
	13.00	2.52			
	16.00	6.33			
	20.00	13.9			
	25.00	27.4			
	30.00	48.6			
	35.00	84.4			
DELTA K MAX A:	36.57	100.			
DELTA K MAX B:					
DELTA K MAX C:					
DELTA K MAX D:					

ROOT MEAN SQUARE PERCENT ERROR 33.64

LIFE PREDICTION RATIO SUMMARY (NP/NA)		
	0.0-0.5	
	0.5-0.8	
	0.8-1.25	2
	1.25-2.0	1
	>2.0	

CONDITION/HT: DBTC
FORM: 1.50"TH PLATE
SPECIMEN TYPE: CT
ORIENTATION: L-T
STRESS RATIO: +0.08
FREQUENCY: 1.00 HZ

YIELD STRENGTH: 117.0- 124.0 KSI
ULT. STRENGTH: 129.0- 138.0 KSI
SPECIMEN THK: 0.990- 1.000"
SPECIMEN WIDTH: 7.400"
REFERENCES: 88578, 85837

TITAN. ALLOY

TI-6AL-4V

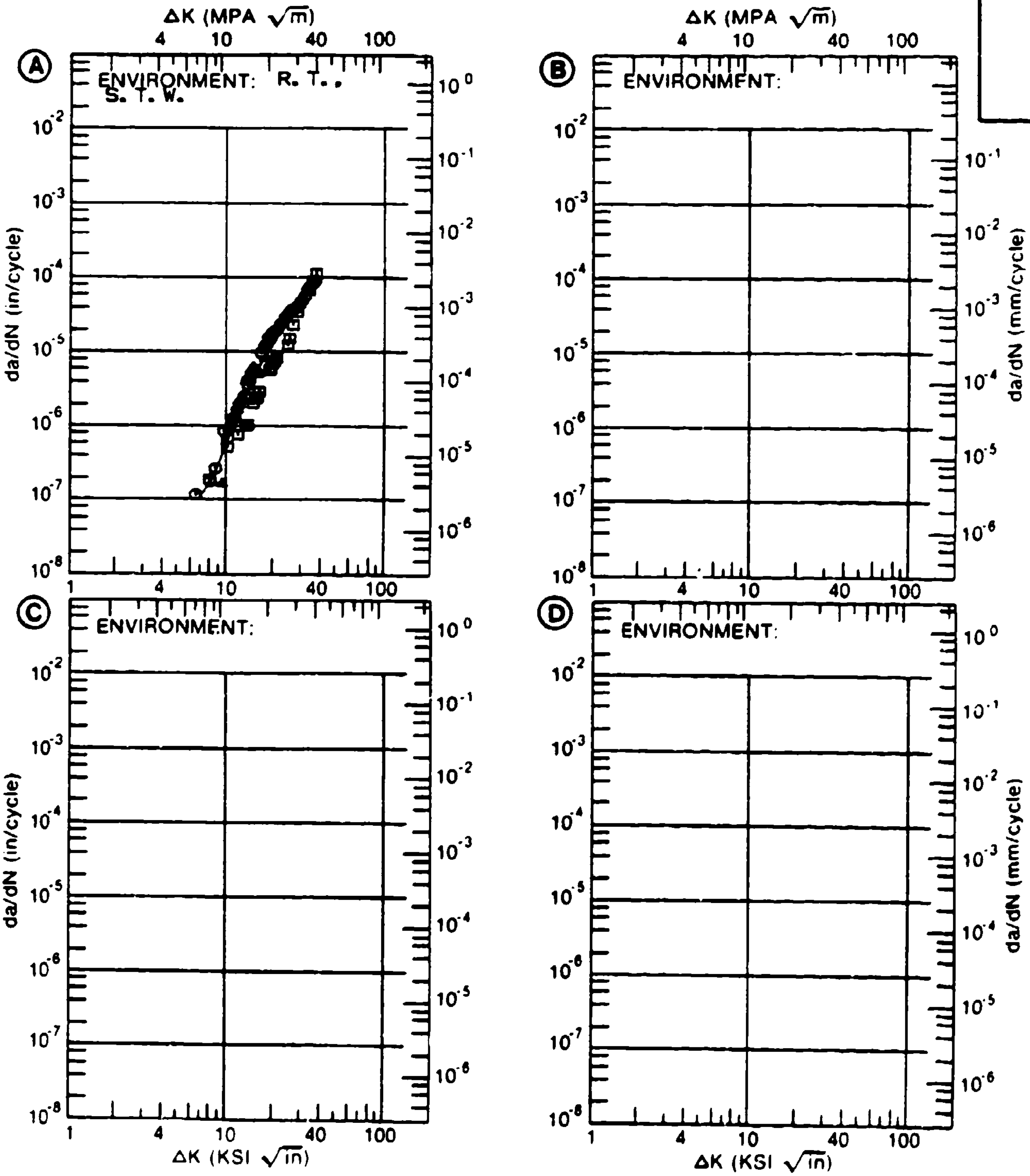

Figure 4.11.3.40

TABLE 4.11.3.41

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 4.11.3.41 INDICATING EFFECT

OF ENVIRONMENT

MATERIAL: TITANIUM TI-6AL-4V
CONDITION: DBTC

DELTA K (KSI*IN**1/2)			DA/DN (10**-6 IN./CYCLE) A	B	C	D
			E= R.T. L.H.A.	E= R.T. S.T.W.		
DELTA K MIN	A:	12.36	.999			
	B:	9.01		1.16		
	C:					
	D:					
		10.00		1.83		
		13.00	1.31	4.86		
		16.00	3.42	9.41		
		20.00	7.70	18.4		
		25.00	15.2	37.3		
		30.00	26.0			
		35.00	41.9			
		40.00	66.5			
		50.00	169.			
DELTA K MAX	A:	57.13	336.			
	B:	29.65		68.3		
	C:					
	D:					
ROOT MEAN SQUARE PERCENT ERROR			8.80	14.34		
LIFE PREDICTION RATIO SUMMARY (NP/NA)		0.0-0.5				
		0.5-0.8				
		0.8-1.25	1	2		
		1.25-2.0				
		>2.0				

CONDITION/HT: DBTC
FORM: 1.50"TH PLATE
SPECIMEN TYPE: CT
ORIENTATION: T-L
STRESS RATIO: +0.08
FREQUENCY: 1.00 HZ

YIELD STRENGTH: 119.0- 125.0 KSI
ULT. STRENGTH: 134.0- 135.0 KSI
SPECIMEN THK: 0.960- 0.994"
SPECIMEN WIDTH: 7.390- 7.460"
REFERENCES: 88579, 85837

TITAN. ALLOY

TI-6AL-4V

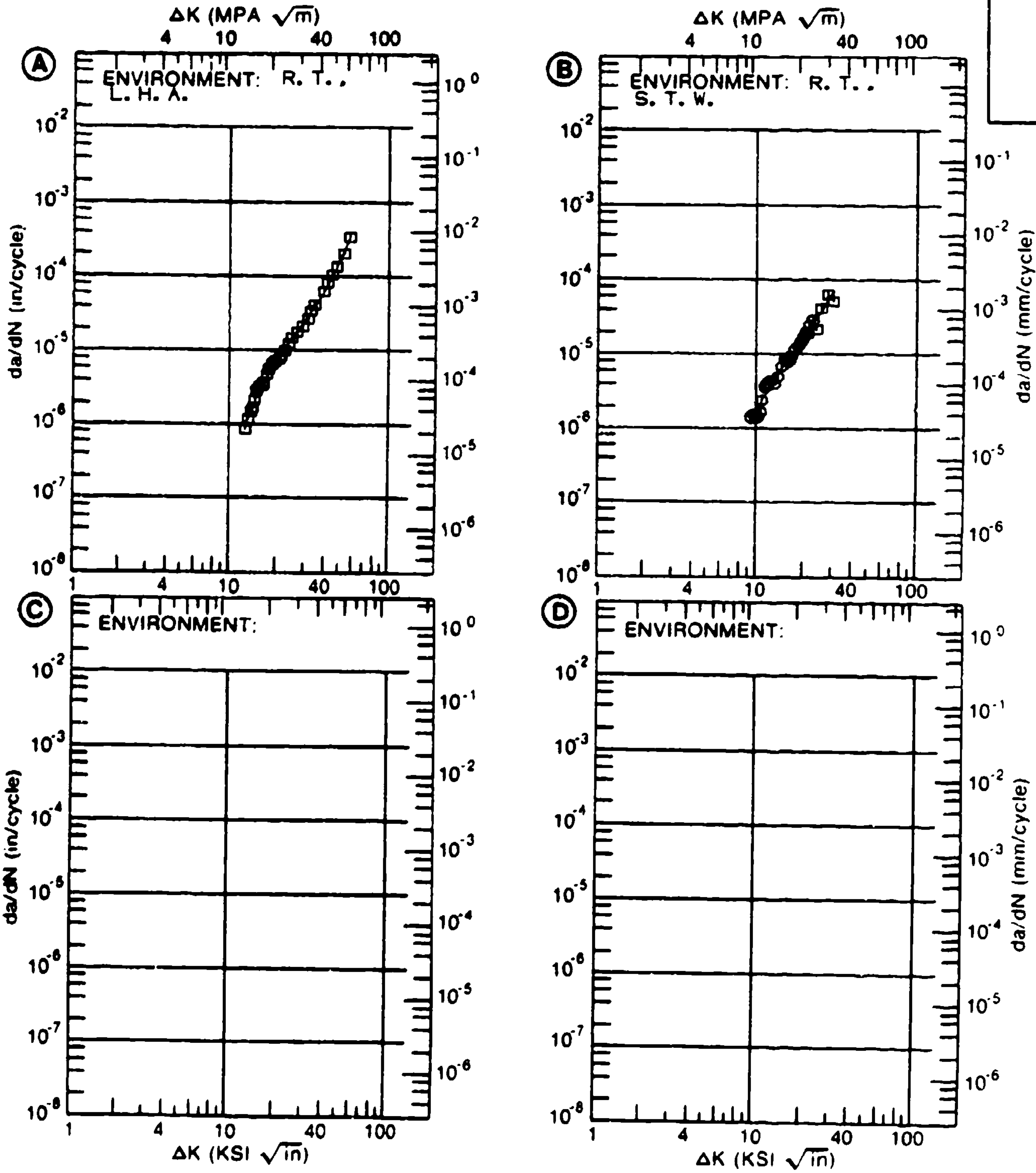

Figure 4.11.3.41

TABLE 4.11.3.42

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 4.11.3.42 INDICATING EFFECT
OF ENVIRONMENT

MATERIAL: TITANIUM TI-6AL-4V
CONDITION: DBTC

DELTA K (KSI*IN**1/2)		DA/DN (10**-6 IN./CYCLE) A	B	C	D
		E= R.T. STW/JP4			
DELTA K MIN	A: 9.95	.448			
	B:				
	C:				
	D:				
	10.00	.450			
	13.00	.892			
	16.00	2.13			
	20.00	5.48			
	25.00	14.0			
	30.00	27.0			
DELTA K MAX	A: 32.61	33.8			
	B:				
	C:				
	D:				
ROOT MEAN SQUARE PERCENT ERROR		9.81			

LIFE PREDICTION RATIO SUMMARY (NP/NA)		
	0.0-0.5	
	0.5-0.8	
	0.8-1.25	1
	1.25-2.0	
	>2.0	

CONDITION/HT: DBTC
FORM: 2.50"TH PLATE
SPECIMEN TYPE: CT
ORIENTATION: T-L
STRESS RATIO: +0.08
FREQUENCY: 1.00 HZ

YIELD STRENGTH: 119.0 KSI
ULT. STRENGTH: 132.0 KSI
SPECIMEN THK: 1.000"
SPECIMEN WIDTH: 4.940"
REFERENCES: 88579

TITAN. ALLOY

TI-6AL-4V

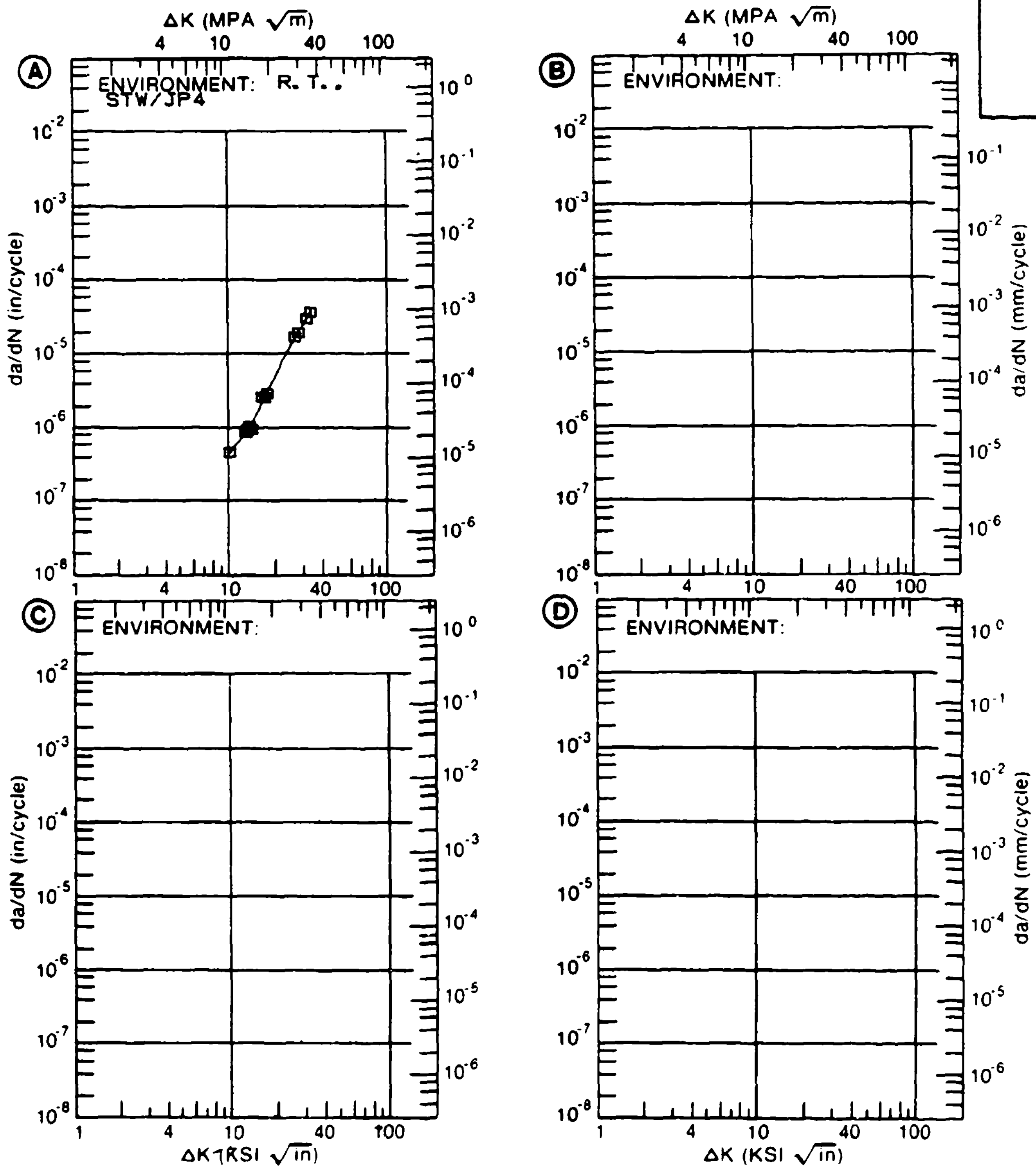

Figure 4.11.3.42

TABLE 4.11.3.43

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 4.11.3.43 INDICATING EFFECT

OF STRESS RATIO

MATERIAL: TITANIUM TI-6AL-4V
CONDITION: DBTC(RA)
ENVIRONMENT: R.T. ,L.H.A.

DELTA K (KSI*IN**1/2)		DA/DN (10**-6 IN./CYCLE) A	B	C	D
		R=+0.30			
DELTA K MIN	A: 30.88	57.1			
	B:				
	C:				
	D:				
	35.00	116.			
	40.00	182.			
DELTA K MAX	A: 40.98	198.			
	B:				
	C:				
	D:				
ROOT MEAN SQUARE PERCENT ERROR		13.89			

LIFE PREDICTION RATIO SUMMARY (NP/NA)		
	0.0-0.5	
	0.5-0.8	
	0.8-1.25	1
	1.25-2.0	
	>2.0	

CONDITION/HT: DBTC (RA)	
FORM: 0.63"TH PLATE	YIELD STRENGTH: 134.0 KSI
SPECIMEN TYPE: CT	ULT. STRENGTH: 145.0 KSI
ORIENTATION: L-T	SPECIMEN THK: 0.500"
FREQUENCY: 1.00 HZ	SPECIMEN WIDTH: 5.000"
ENVIRONMENT: R. T., L. H. A.	REFERENCES: 88579

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TI-6AL-4V

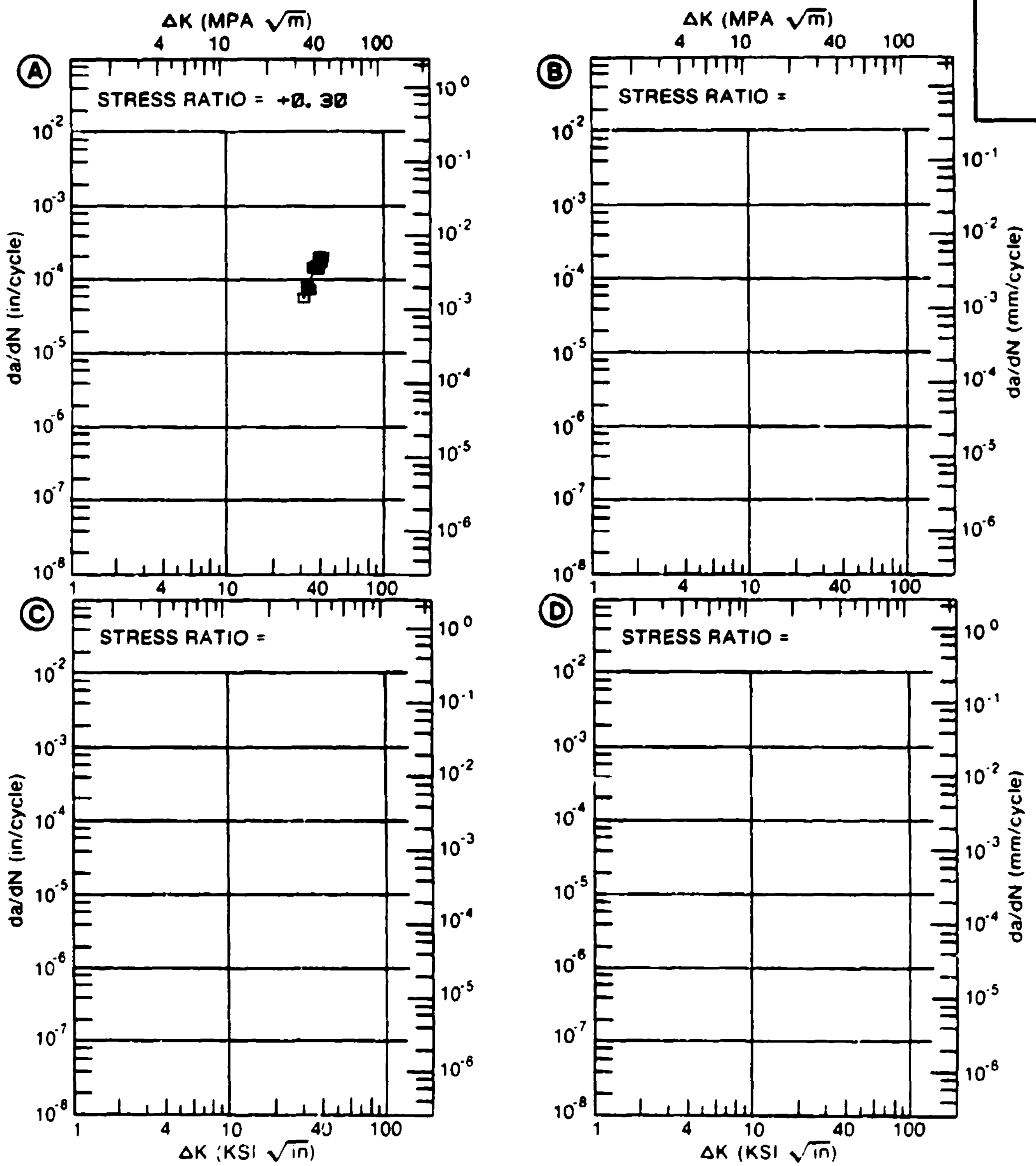

Figure 4.11.3.43

TABLE 4.11.3.44

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 4.11.3.44 INDICATING EFFECT

OF STRESS RATIO

MATERIAL: TITANIUM TI-6AL-4V
CONDITION: MA
ENVIRONMENT: R.T. ,L.H.A.

DELTA K (KSI*IN**1/2)		DA/DN (10**-6 IN./CYCLE) A R=+0.08	B R=+0.30	C R=+0.50	D
DELTA K MIN A:	7.65	.624			
B:	6.62		.529		
C:	8.06			.930	
D:					
	7.00		.504		
	8.00	.755	.790		
	9.00	1.21	1.44	1.53	
	10.00	1.79	2.24	2.30	
	13.00	4.27	4.98	5.34	
	16.00	7.75	7.91	9.87	
	20.00	13.7		21.1	
	25.00	23.2			
	30.00	34.8			
DELTA K MAX A:	30.60	36.4			
B:	17.28		9.32		
C:	20.31			22.4	
D:					
ROOT MEAN SQUARE PERCENT ERROR		12.56	13.85	4.35	
LIFE PREDICTION RATIO SUMMARY (NP/NA)	0.0-0.5				
	0.5-0.8				
	0.8-1.25	2	1	1	
	1.25-2.0				
	>2.0				

CONDITION/HT: MA
FORM: 0.10"TH SHEET
SPECIMEN TYPE: CCP
ORIENTATION: L-T
FREQUENCY: 6.00 HZ
ENVIRONMENT: R.T., L.H.A.

YIELD STRENGTH: 137.0 KSI
ULT. STRENGTH: 147.0 KSI
SPECIMEN THK. 0.093- 0.101"
SPECIMEN WIDTH: 23.980- 24.220"
REFERENCES 86575

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TI-6AL-4V

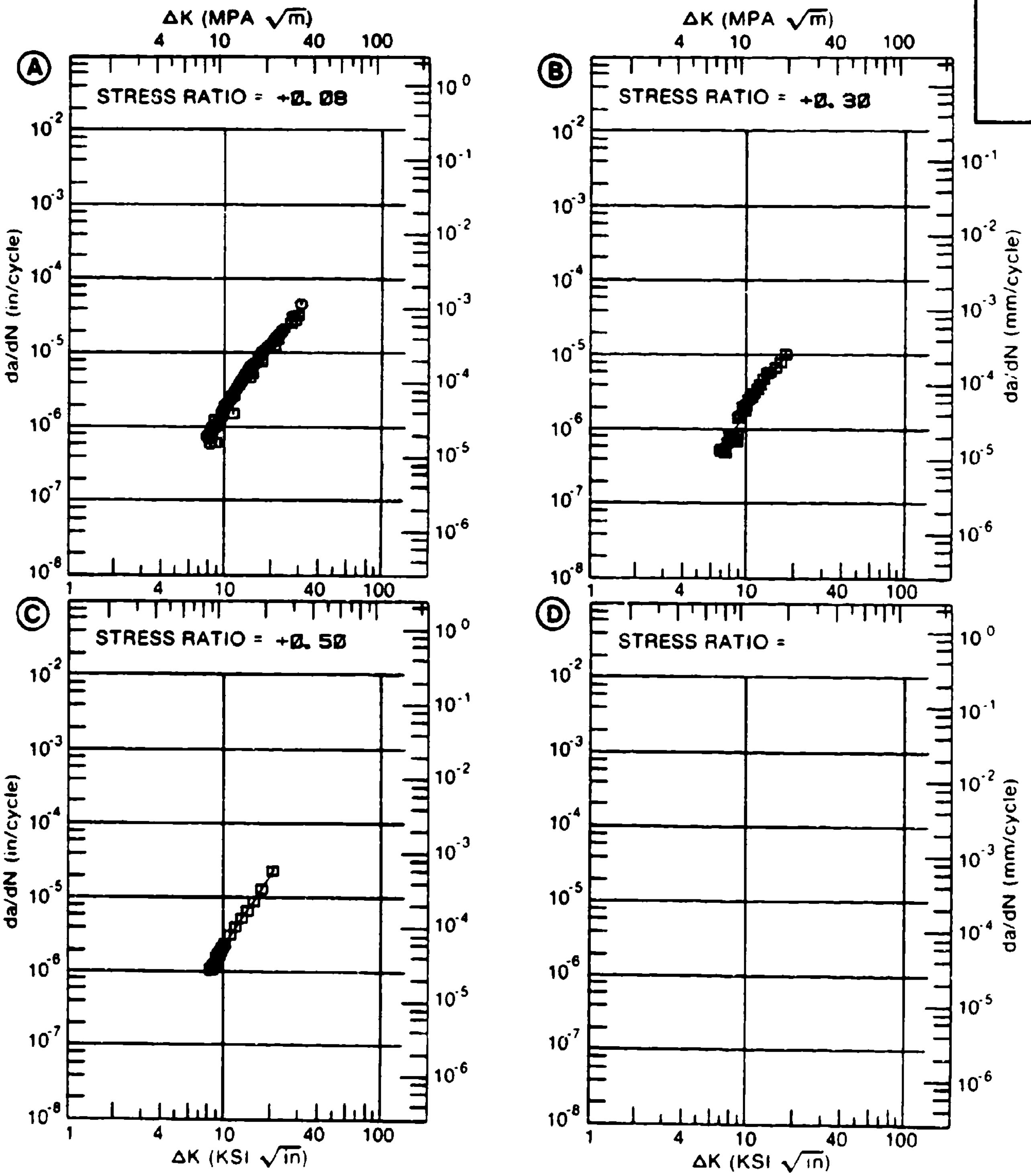

Figure 4.11.3.44

TABLE 4.11.3.45

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 4.11.3.45 INDICATING EFFECT OF ENVIRONMENT

MATERIAL: TITANIUM TI-6AL-4V
CONDITION: MA

DELTA K (KSI*IN**1/2)		DA/DN (10**-6 IN./CYCLE) A	B	C	D
		E= R.T. L.H.A. 1HZ	E= R.T. JP-4 FUEL 6HZ	E= R.T. S.T.W. 1HZ	
DELTA K MIN A:	9.64	1.36			
DELTA K MIN B:	8.05		1.10		
DELTA K MIN C:	5.67			.45	
DELTA K MIN D:					
	6.00			.505	
	7.00			.743	
	8.00			1.16	
	9.00		1.23	1.91	
	10.00	1.57	1.47	3.22	
	13.00	4.02	2.88	15.0	
	16.00	7.47	5.82	30.2	
	20.00	12.9	12.9		
	25.00		24.2		
	30.00		30.2		
DELTA K MAX A:	24.57	19.3			
DELTA K MAX B:	30.58		30.3		
DELTA K MAX C:	19.01			37.1	
DELTA K MAX D:					
ROOT MEAN SQUARE PERCENT ERROR		7.29	21.18	6.77	
LIFE PREDICTION RATIO SUMMARY (NP/NA)	0.0-0.5				
	0.5-0.8				
	0.8-1.25	1	1	1	
	1.25-2.0				
	>2.0				

CONDITION/HT: MA
FORM: 0.10"TH SHEET
SPECIMEN TYPE: CCP
ORIENTATION: L-T
STRESS RATIO: +0.08
FREQUENCY:

YIELD STRENGTH: 137.0 KSI
ULT. STRENGTH: 147.0 KSI
SPECIMEN THK: 0.092- 0.096"
SPECIMEN WIDTH: 24.000"
REFERENCES: 86575

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TI-6AL-4V

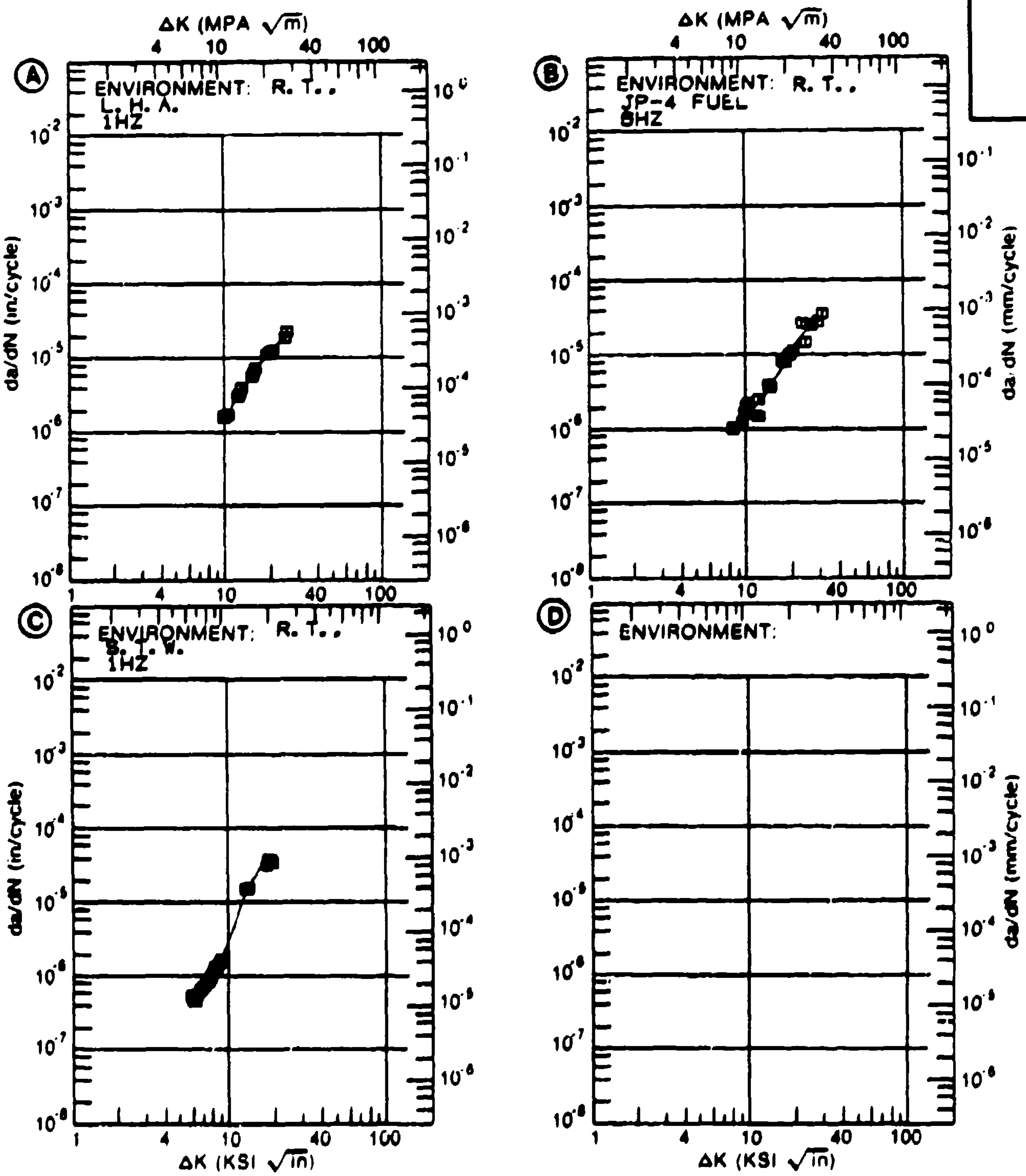

Figure 4.11.3.45

TABLE 4.11.3.46

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 4.11.3.46 INDICATING EFFECT

OF ENVIRONMENT

MATERIAL: TITANIUM TI-6AL-4V
CONDITION: MA

DELTA K (KSI*IN**1/2)		DA/DN (10**-6 IN./CYCLE) A E= R.T. L.H.A.	B E= R.T. S.T.W.	C	D
DELTA K MIN	A: 11.52	2.24			
	B:				
	C:				
	D:				
	13.00	3.06			
	16.00	5.19			
	20.00	9.22			
	25.00	16.7			
	30.00	28.0			
	35.00	44.3			
	40.00	67.5			
DELTA K MAX	A: 44.86	99.0			
	B:				
	C:				
	D:				
ROOT MEAN SQUARE PERCENT ERROR		5.77	0.00		

LIFE PREDICTION RATIO SUMMARY (NP/NA)		
	0.0-0.5	
	0.5-0.8	
	0.8-1.25	
	1.25-2.0	1
	>2.0	

CONDITION/HT: MA
FORM: 0.10"TH SHEET
SPECIMEN TYPE: CCP
ORIENTATION: T-L
STRESS RATIO: +0.08
FREQUENCY: 6.00 HZ

YIELD STRENGTH: 143.0 KSI
ULT. STRENGTH: 151.0 KSI
SPECIMEN THK: 0.096- 0.097"
SPECIMEN WIDTH: 24.000"
REFERENCES: 86575

TITAN. ALLOY

TI-6AL-4V

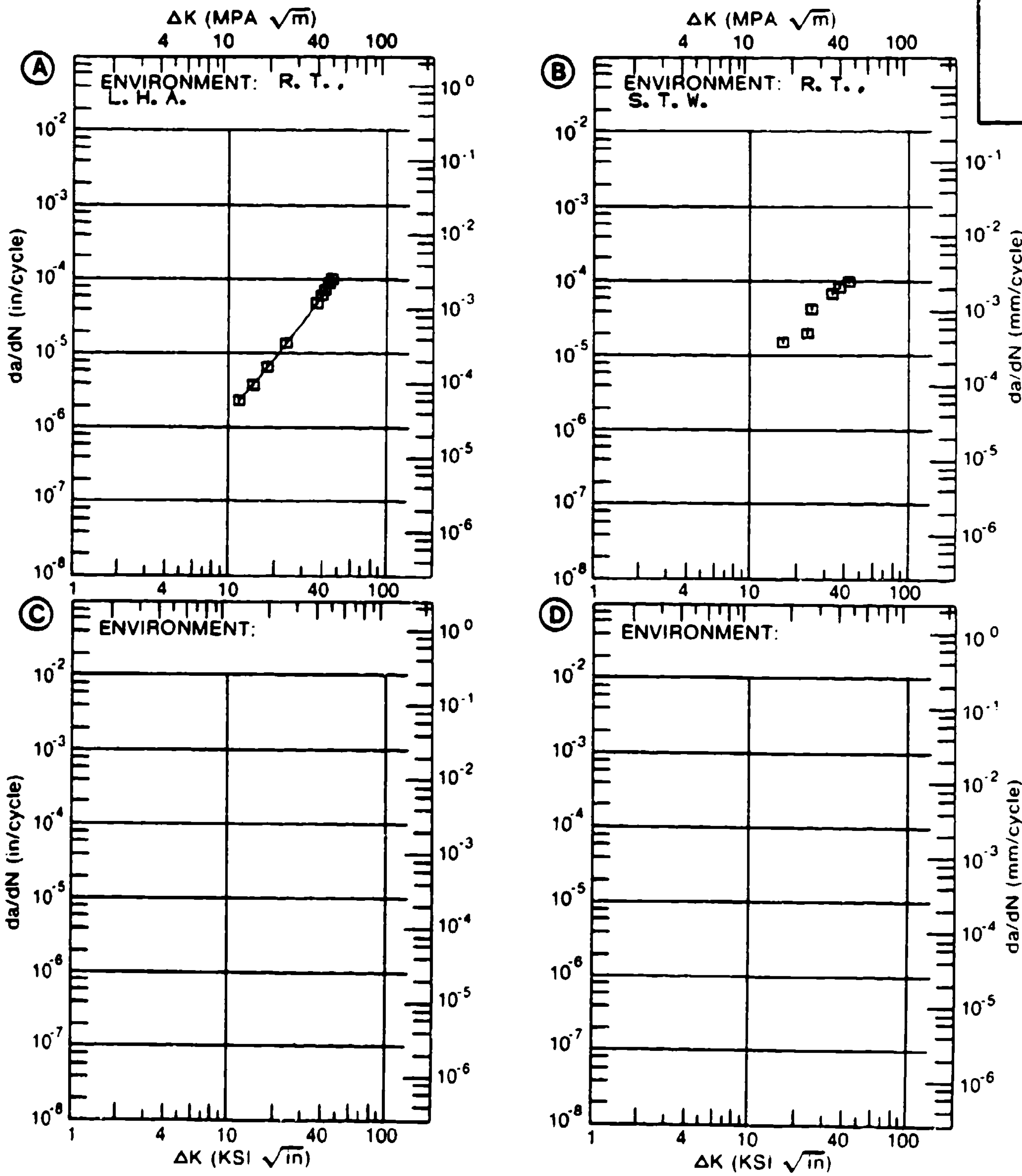

Figure 4.11.3.46

TABLE 4.11.3.47

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 4.11.3.47 INDICATING EFFECT
OF STRESS RATIO

MATERIAL: TITANIUM TI-6AL-4V
CONDITION: MA
ENVIRONMENT: R.T. ,LAB AIR

DELTA K (KSI*IN**1/2)			DA/DN (10**-6 IN./CYCLE) A	B	C	D
			R=+0.02			
DELTA K MIN	A:	4.82	.0166			
	B:					
	C:					
	D:					
		5.00	.0193			
		6.00	.0414			
		7.00	.0822			
		8.00	.152			
		9.00	.266			
		10.00	.442			
		13.00	1.59			
		16.00	4.34			
		20.00	12.4			
		25.00	33.5			
		30.00	71.4			
		35.00	129.			
DELTA K MAX	A:	38.83	185.			
	B:					
	C:					
	D:					
ROOT MEAN SQUARE PERCENT ERROR			27.55			

LIFE PREDICTION RATIO SUMMARY (NP/NA)		
	0.0-0.5	
	0.5-0.8	
	0.8-1.25	2
	1.25-2.0	
	>2.0	

CONDITION/HT: MA
FORM: 0.38"TH PLATE
SPECIMEN TYPE: CCP
ORIENTATION: L-T
FREQUENCY: 0.10- 30.00 HZ
ENVIRONMENT: R.T., LAB AIR

YIELD STRENGTH: 137.0 KSI
ULT. STRENGTH: 145.0 KSI
SPECIMEN THK: 0.241- 0.242"
SPECIMEN WIDTH: 3.952- 3.953"
REFERENCES: MA002

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TI-6AL-4V

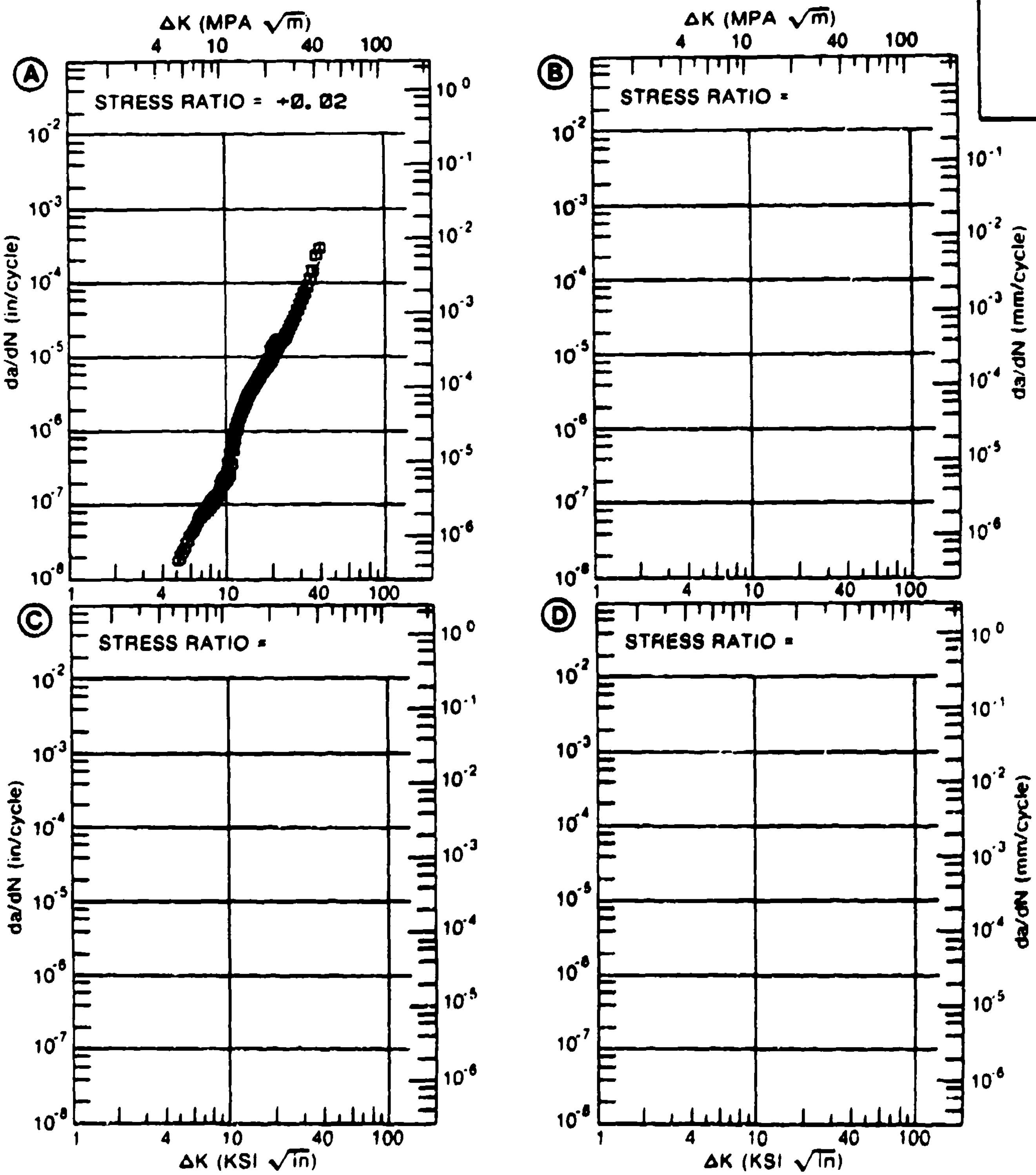

Figure 4.11.3.47

TABLE 4.11.3.48

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 4.11.3.48 INDICATING EFFECT

OF ENVIRONMENT

MATERIAL: TITANIUM TI-6AL-4V
CONDITION: MA

DELTA K (KSI*IN**1/2)		DA/DN (10**-6 IN./CYCLE) A	B	C	D
		E= R.T. L.H.A. SP. THK. =.67"	E= R.T. L.H.A. SP. THK. =.50"	E= R.T. S.T.W. SP. THK. =.49"	
DELTA K MIN A:	26.05	144.			
DELTA K MIN B:	11.30		4.69		
DELTA K MIN C:	10.36			21.1	
DELTA K MIN D:					
	13.00		8.27	33.8	
	16.00		20.4	47.9	
	20.00		72.6	87.5	
	25.00		452.		
	30.00	313.	2286.		
	35.00	679.			
DELTA K MAX A:	39.74	1469.			
DELTA K MAX B:	33.26		3567.		
DELTA K MAX C:	23.71			198.	
DELTA K MAX D:					
ROOT MEAN SQUARE PERCENT ERROR		7.55	17.55	22.03	
LIFE PREDICTION RATIO SUMMARY (NP/NA)	0.0-0.5				
	0.5-0.8				
	0.8-1.25	1	1	1	
	1.25-2.0				
	>2.0				

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TI-6AL-4V

CONDITION/HT: MA
FORM: 0.63"TH PLATE
SPECIMEN TYPE: CT
ORIENTATION: L-T
STRESS RATIO: +0.30
FREQUENCY: 1.00 HZ

YIELD STRENGTH: 138.0 KSI
ULT. STRENGTH: 148.0 KSI
SPECIMEN THK:
SPECIMEN WIDTH: 6.000"
REFERENCES: 88579

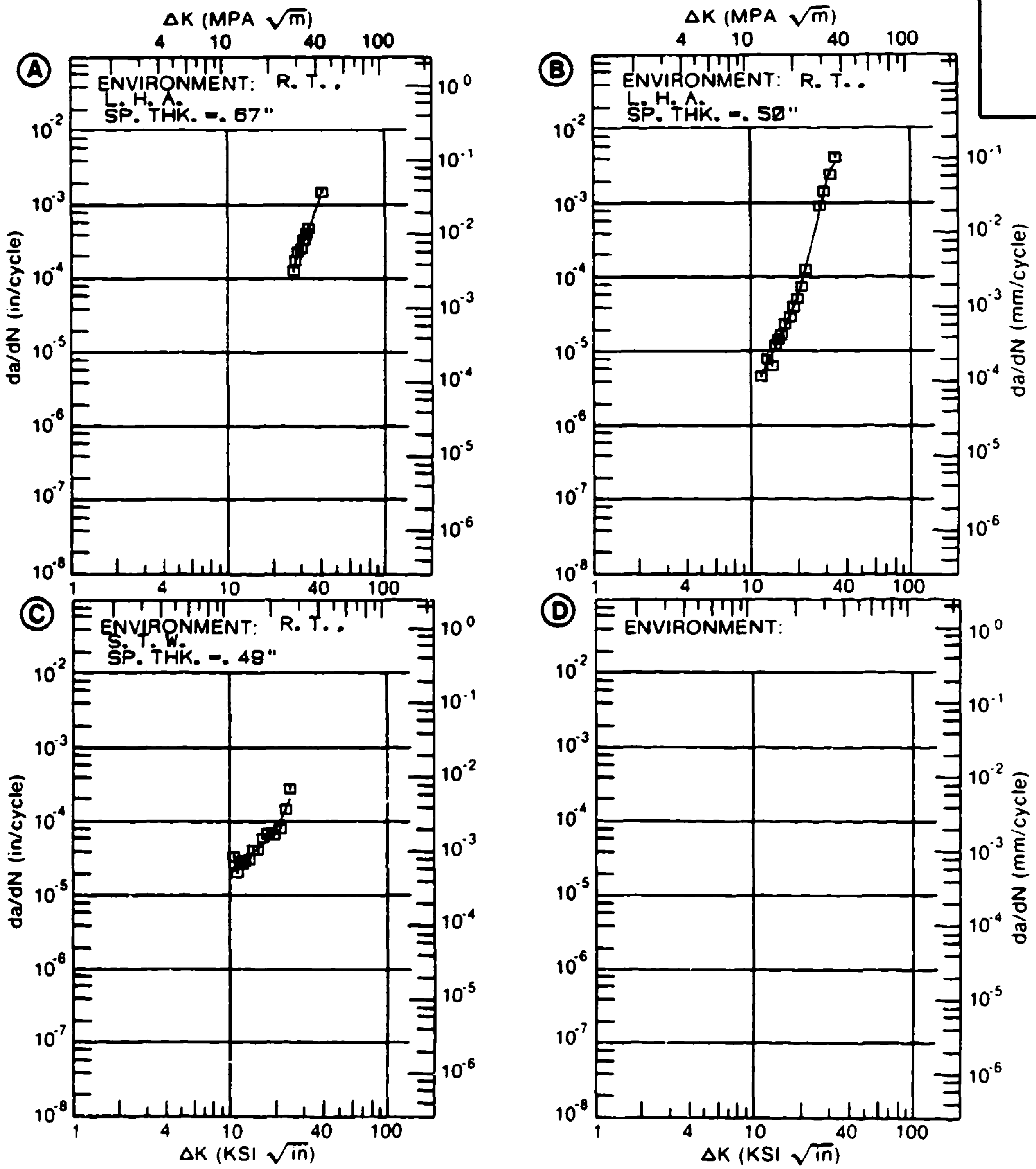

Figure 4.11.3.48

TABLE 4.11.3.49

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 4.11.3.49 INDICATING EFFECT OF STRESS RATIO

MATERIAL: TITANIUM TI-6AL-4V
CONDITION: MA
ENVIRONMENT: R.T. ,LAB AIR

DELTA K (KSI*IN**1/2)			DA/DN (10**-6 IN./CYCLE) A	B	C	D
			R=+0.05	R=+0.30		
	A:	11.31	.313			
DELTA K MIN	B:	8.78		.342		
	C:					
	D:					
		9.00		.429		
		10.00		.995		
		13.00	.568	3.46		
		16.00	2.98			
		20.00	6.97			
		25.00	9.80			
		30.00	13.8			
		35.00	25.4			
	A:	38.24	45.0			
DELTA K MAX	B:	14.23		4.08		
	C:					
	D:					
ROOT MEAN SQUARE PERCENT ERROR			24.23	22.40		
LIFE PREDICTION RATIO SUMMARY (NP/NA)		0.0-0.5				
		0.5-0.8		1		
		0.8-1.25	2			
		1.25-2.0				
		>2.0				

CONDITION/HT: MA	YIELD STRENGTH: 135.3 KSI
FORM: 0.75"TH PLATE	ULT. STRENGTH: 137.6 KSI
SPECIMEN TYPE: CT	SPECIMEN THK: 0.250"
ORIENTATION: L-T	SPECIMEN WIDTH: 2.500"
FREQUENCY: 20.00 HZ	REFERENCES: 88468
ENVIRONMENT: R.T., LAB AIR	

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TI-6AL-4V

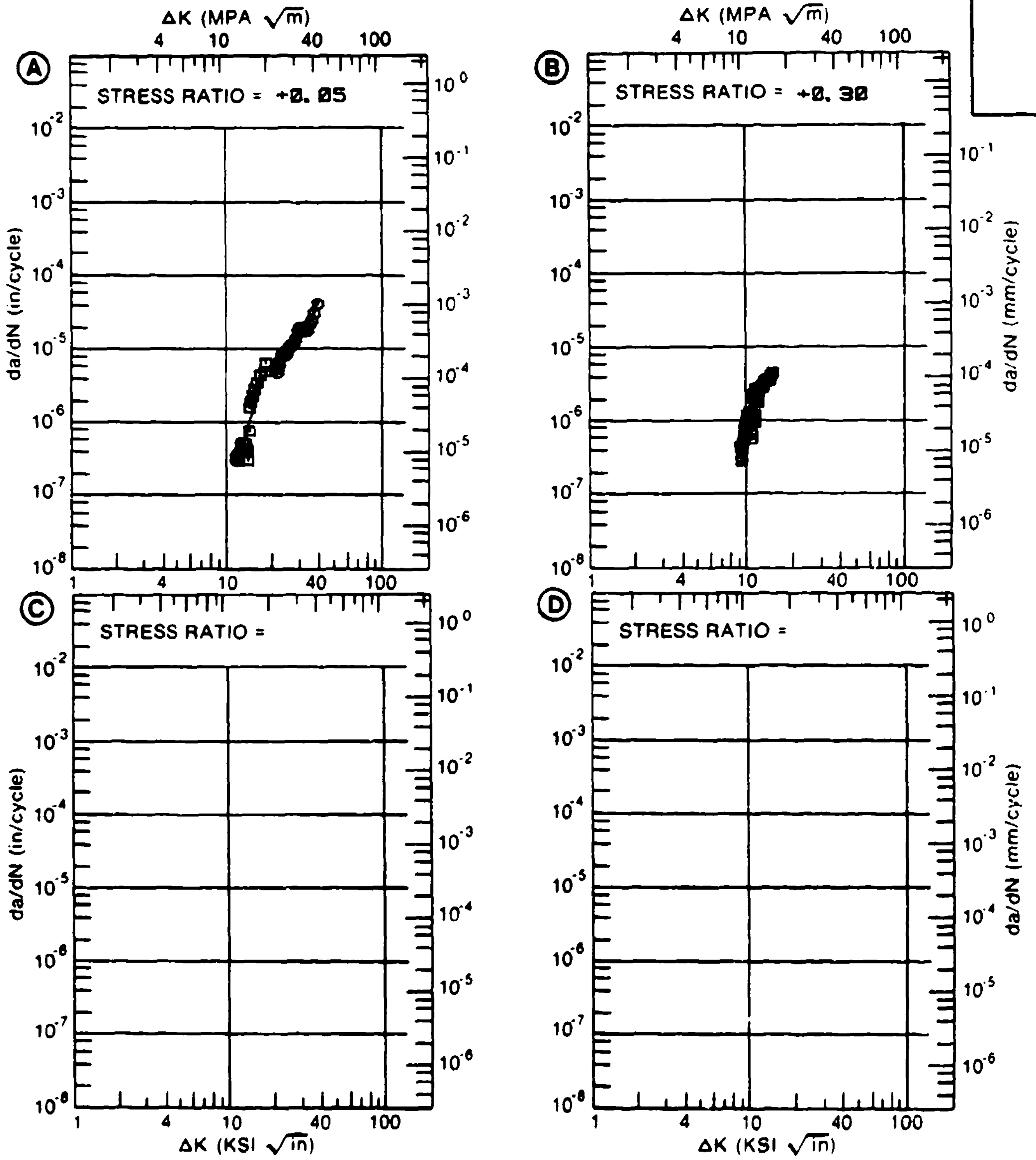

Figure 4.11.3.49

TABLE 4.11.3.50

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 4.11.3.50 INDICATING EFFECT

OF ENVIRONMENT

MATERIAL: TITANIUM TI-6AL-4V
CONDITION: MA

DELTA K (KSI*IN**1/2)			DA/DN (10**-6 IN./CYCLE) A	B	C	D
			E= R.T. LAB AIR			
DELTA K MIN	A:	31.29	17.0			
	B:					
	C:					
	D:					
		35.00	25.5			
		40.00	39.6			
		50.00	96.5			
DELTA K MAX	A:	59.30	220.			
	B:					
	C:					
	D:					

ROOT MEAN SQUARE PERCENT ERROR		8.28
LIFE PREDICTION RATIO SUMMARY (NP/NA)	0.0-0.5	
	0.5-0.8	
	0.8-1.25	1
	1.25-2.0	
	>2.0	

CONDITION/HT: MA
FORM: 0.75"TH PLATE
SPECIMEN TYPE: CCP
ORIENTATION: L-T
STRESS RATIO: +0.04
FREQUENCY: 20.00 HZ

YIELD STRENGTH: 135.3 KSI
ULT. STRENGTH: 137.6 KSI
SPECIMEN THK: 0.290"
SPECIMEN WIDTH: 6.011"
REFERENCES: 88468

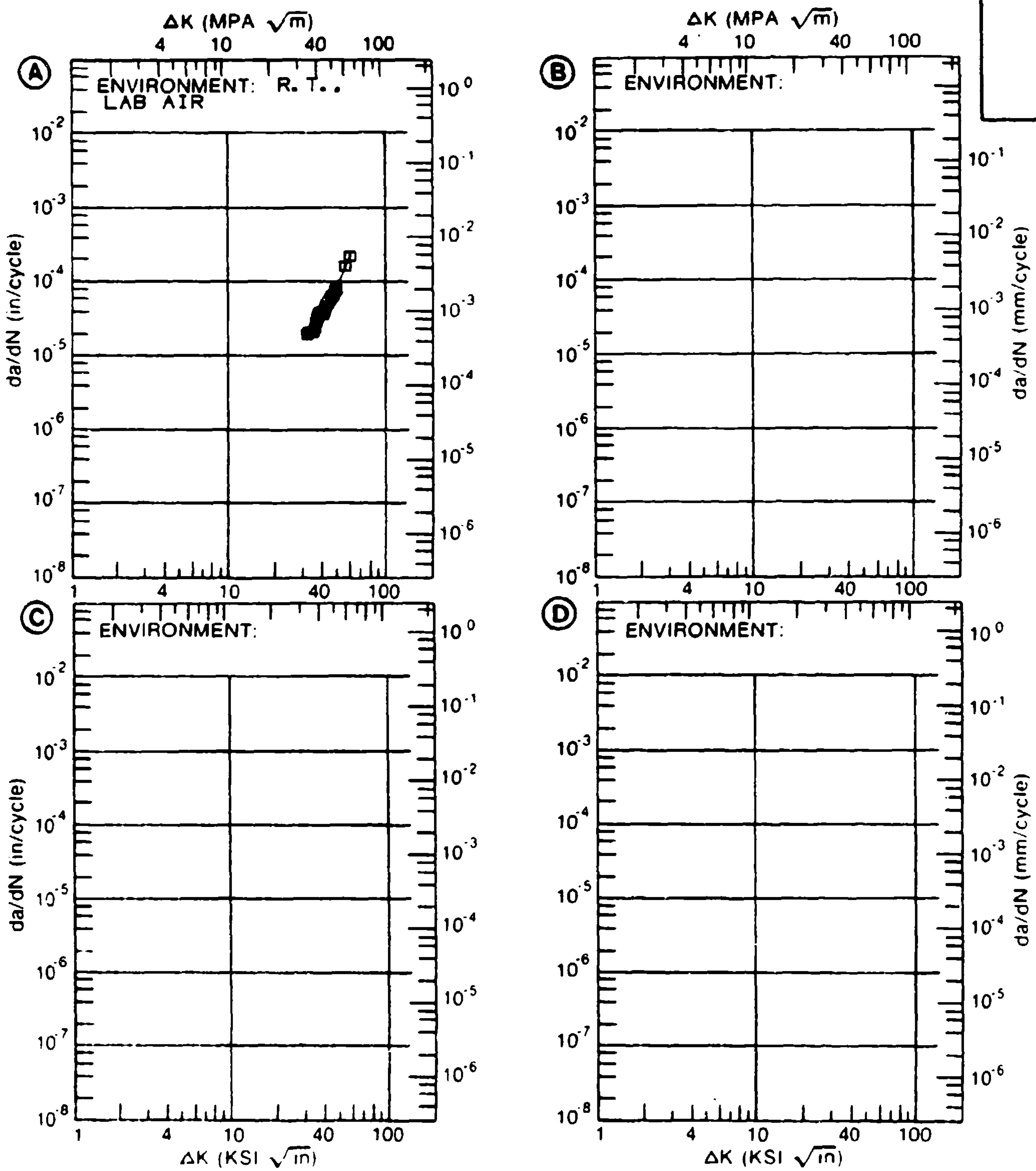

Figure 4.11.3.50

TABLE 4.11.3.51

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 4.11.3.51 INDICATING EFFECT
OF STRESS RATIO

MATERIAL: TITANIUM TI-6AL-4V
CONDITION: MA
ENVIRONMENT: R. T. , LAB AIR

DELTA K (KSI*IN**1/2)		DA/DN (10**-6 IN./CYCLE) A	B	C	D
		R=-1.00	R=+0.50		
DELTA K MIN A:	8.85	.632			
DELTA K MIN B:	5.43		.380		
DELTA K MIN C:					
DELTA K MIN D:					
	6.00		.734		
	7.00		1.77		
	8.00		3.40		
	9.00	.688	5.65		
	10.00	1.14	8.52		
	13.00	3.27	21.2		
	16.00	6.55	41.9		
	20.00	12.8	92.4		
	25.00	24.8	206.		
	30.00	44.0	316.		
	35.00	75.3	381.		
	40.00	127.	524.		
	50.00	328.			
	60.00	724.			
	70.00	1345.			
	80.00	2115.			
	90.00	2858.			
DELTA K MAX A:	92.48	3016.			
DELTA K MAX B:	49.27		1688.		
DELTA K MAX C:					
DELTA K MAX D:					
ROOT MEAN SQUARE PERCENT ERROR		10.15	18.86		

LIFE PREDICTION RATIO SUMMARY (NP/NA)	
	0.0-0.5
	0.5-0.8
	0.8-1.25
	1.25-2.0
	>2.0

CONDITION/HT: MA	
FORM: 1.00"TH PLATE	YIELD STRENGTH: 132.5 KSI
SPECIMEN TYPE: CCP	ULT. STRENGTH: 138.0 KSI
ORIENTATION: L-T	SPECIMEN THK: 0.250"
FREQUENCY: 10.00 HZ	SPECIMEN WIDTH: 4.000"
ENVIRONMENT: R.T., LAB AIR	REFERENCES: MA006

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TI-6AL-4V

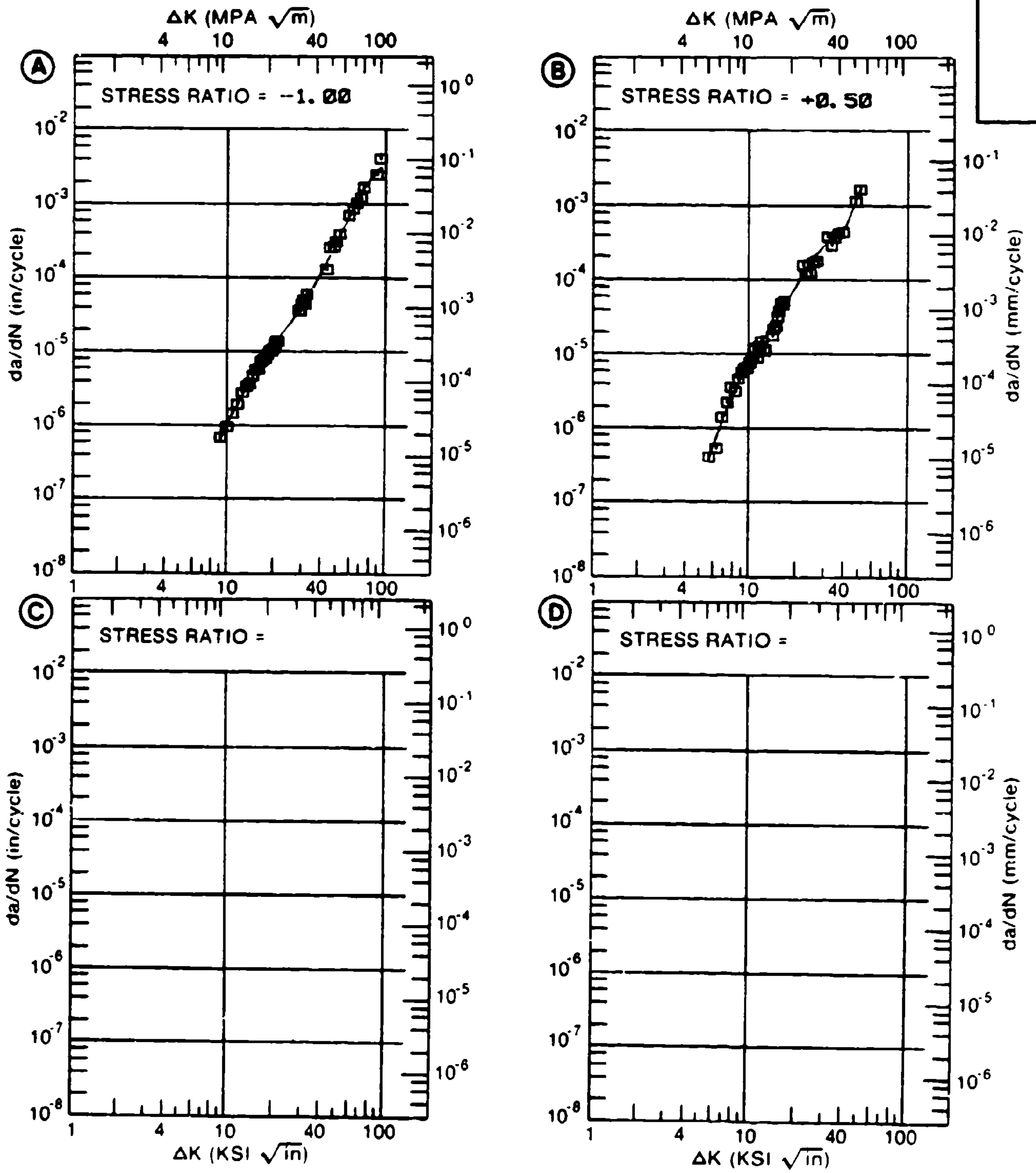

Figure 4.11.3.51

TABLE 4.11.3.52

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 4.11.3.52 INDICATING EFFECT

OF ENVIRONMENT

MATERIAL: TITANIUM TI-6AL-4V
CONDITION: MA

DELTA K (KSI*IN**1/2)		DA/DN (10**-6 IN./CYCLE) A	B	C	D
		E=- 65F AIR	E=+ 175F AIR		
DELTA K MIN	A: 25.62	26.3			
	B: 17.93		8.57		
	C:				
	D:				
	20.00		11.7		
	25.00		20.6		
	30.00	55.6	31.8		
	35.00	158.	46.5		
	40.00	1500.	66.6		
	50.00		135.		
	60.00		280.		
DELTA K MAX	A: 41.96	5475.			
	B: 65.73		429.		
	C:				
	D:				
ROOT MEAN SQUARE PERCENT ERROR		39.40	11.28		

LIFE PREDICTION RATIO SUMMARY (NP/NA)	
	0.0-0.5
	0.5-0.8
	0.8-1.25
	1.25-2.0
	>2.0

CONDITION/HT: MA
FORM: 1.00"TH PLATE
SPECIMEN TYPE: CT
ORIENTATION: T-L
STRESS RATIO: +0.10
FREQUENCY: 0.10- 10.00 HZ

YIELD STRENGTH:
ULT. STRENGTH:
SPECIMEN THK: 1.000"
SPECIMEN WIDTH: 2.550"
REFERENCES: 88144

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TI-6AL-4V

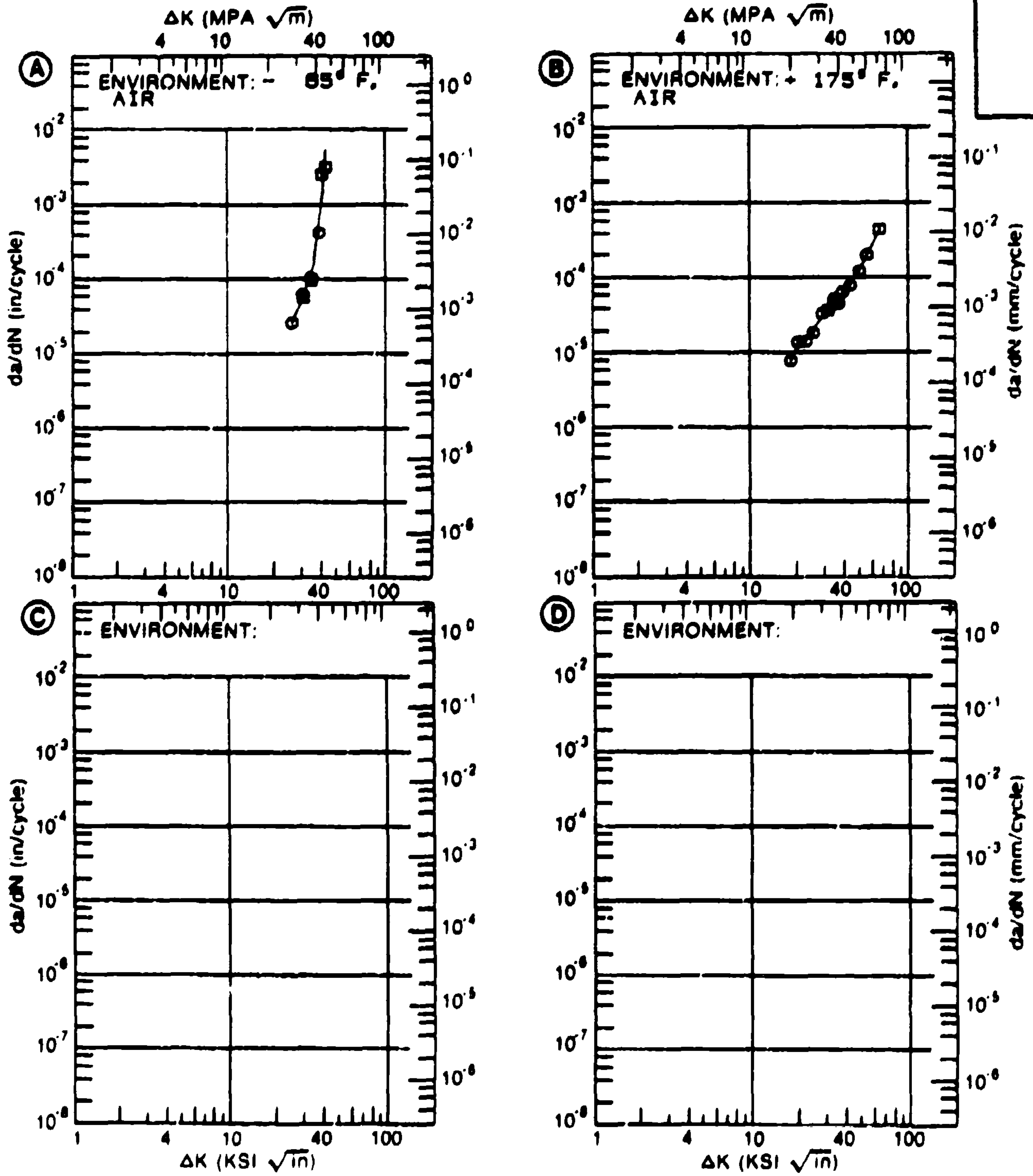

Figure 4.11.3.52

TABLE 4.11.3.53

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 4.11.3.53 INDICATING EFFECT

OF ENVIRONMENT

MATERIAL: TITANIUM TI-6AL-4V
CONDITION: MA

DELTA K (KSI*IN**1/2)		DA/DN (10**-6 IN./CYCLE) A E= R.T. L.H.A. 1-6HZ	B E= R.T. S.T.W. 1HZ	C	D
DELTA K MIN A:	6.95	.123			
DELTA K MIN B:	8.19		.441		
DELTA K MIN C:					
DELTA K MIN D:					
	7.00	.127			
	8.00	.203			
	9.00	.286	.436		
	10.00	.415	.589		
	13.00	2.22	2.89		
	16.00	9.87	11.3		
	20.00	24.7	31.5		
	25.00	38.2	58.6		
	30.00	49.7	77.8		
	35.00	68.7			
	40.00	109.			
	50.00	402.			
DELTA K MAX A:	55.67	771.			
DELTA K MAX B:	32.78		84.7		
DELTA K MAX C:					
DELTA K MAX D:					
ROOT MEAN SQUARE PERCENT ERROR		14.83	22.37		
LIFE PREDICTION RATIO SUMMARY (NP/NA)	0.0-0.5				
	0.5-0.8		1		
	0.8-1.25	2	1		
	1.25-2.0				
	>2.0				

CONDITION/HT: MA
FORM: 1.25"TH PLATE
SPECIMEN TYPE: CT
ORIENTATION: L-T
STRESS RATIO: +0.30
FREQUENCY:

YIELD STRENGTH: 120.0 KSI
ULT. STRENGTH: 134.0 KSI
SPECIMEN THK: 0.990- 0.997"
SPECIMEN WIDTH: 6.000- 6.010"
REFERENCES: 85837

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TI-6AL-4V

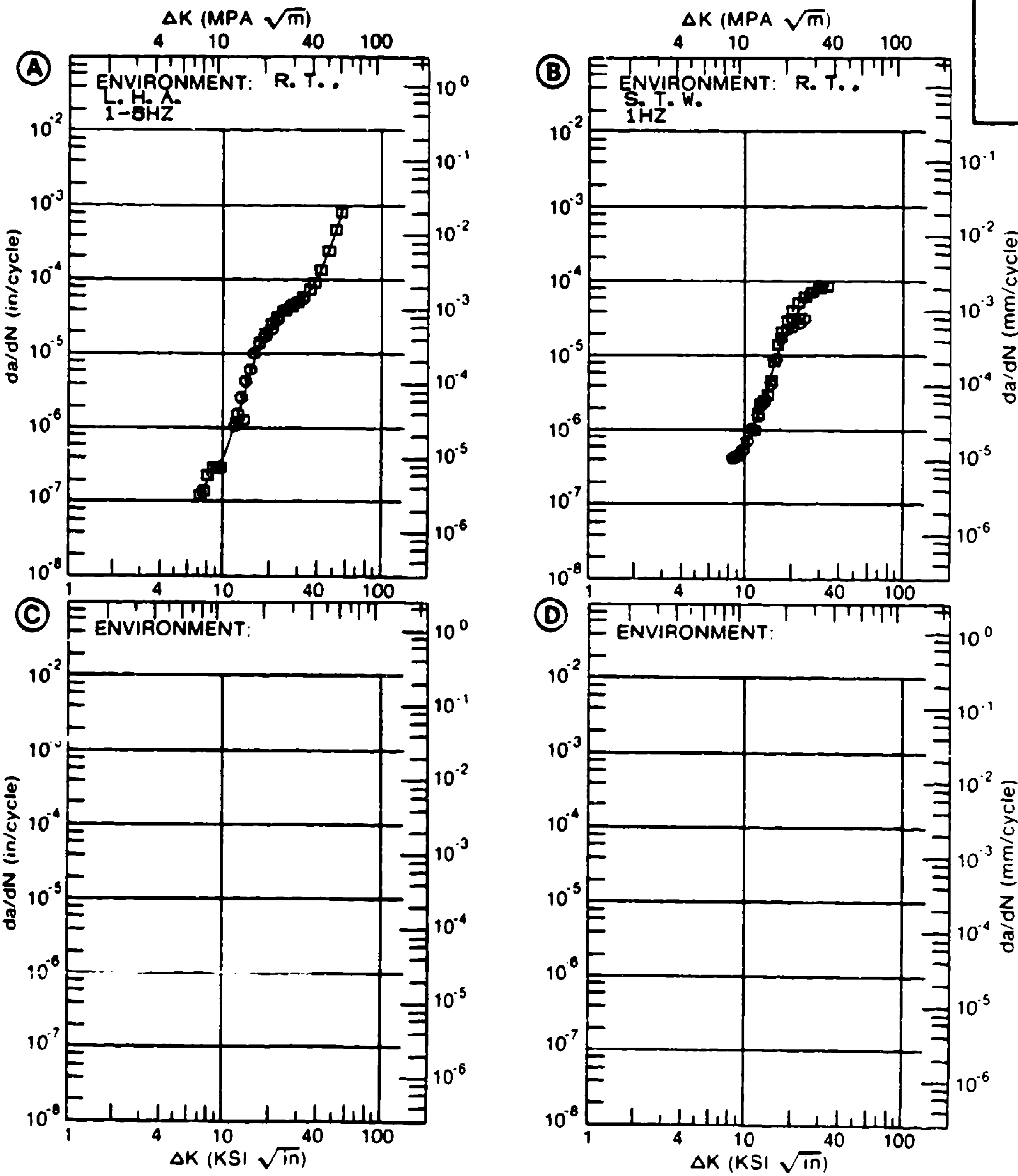

Figure 4.11.3.53

TABLE 4.11.3.54

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 4.11.3.54 INDICATING EFFECT

OF STRESS RATIO

MATERIAL: TITANIUM TI-6AL-4V
CONDITION: MA
ENVIRONMENT: R. T. , L. H. A.

DELTA K (KSI*IN**1/2)			DA/DN (10**-6 IN./CYCLE) A	B	C	D
			R=+0.30			
DELTA K MIN	A:	6.36	.14			
	B:					
	C:					
	D:					
		7.00	.147			
		8.00	.195			
		9.00	.293			
		10.00	.460			
		13.00	1.63			
		16.00	4.30			
		20.00	11.2			
		25.00	26.4			
		30.00	48.3			
		35.00	75.9			
		40.00	113.			
		50.00	255.			
DELTA K MAX	A:	58.57	557.			
	B:					
	C:					
	D:					

ROOT MEAN SQUARE PERCENT ERROR 12.47

LIFE PREDICTION RATIO SUMMARY (NP/NA)	
0.0-0.5	
0.5-0.8	
0.8-1.25	1
1.25-2.0	
>2.0	

CONDITION/HT: MA
FORM: 1.5"TH PLATE
SPECIMEN TYPE: CT
ORIENTATION: L-T
FREQUENCY: 1.00- 6.00 HZ
ENVIRONMENT: R. T., L. H. A.

YIELD STRENGTH: 120.1 KSI
ULT. STRENGTH: 134.1 KSI
SPECIMEN THK: 1.000"
SPECIMEN WIDTH: 8.000"
REFERENCES: 84381

TITAN. ALLOY

TI-6AL-4V

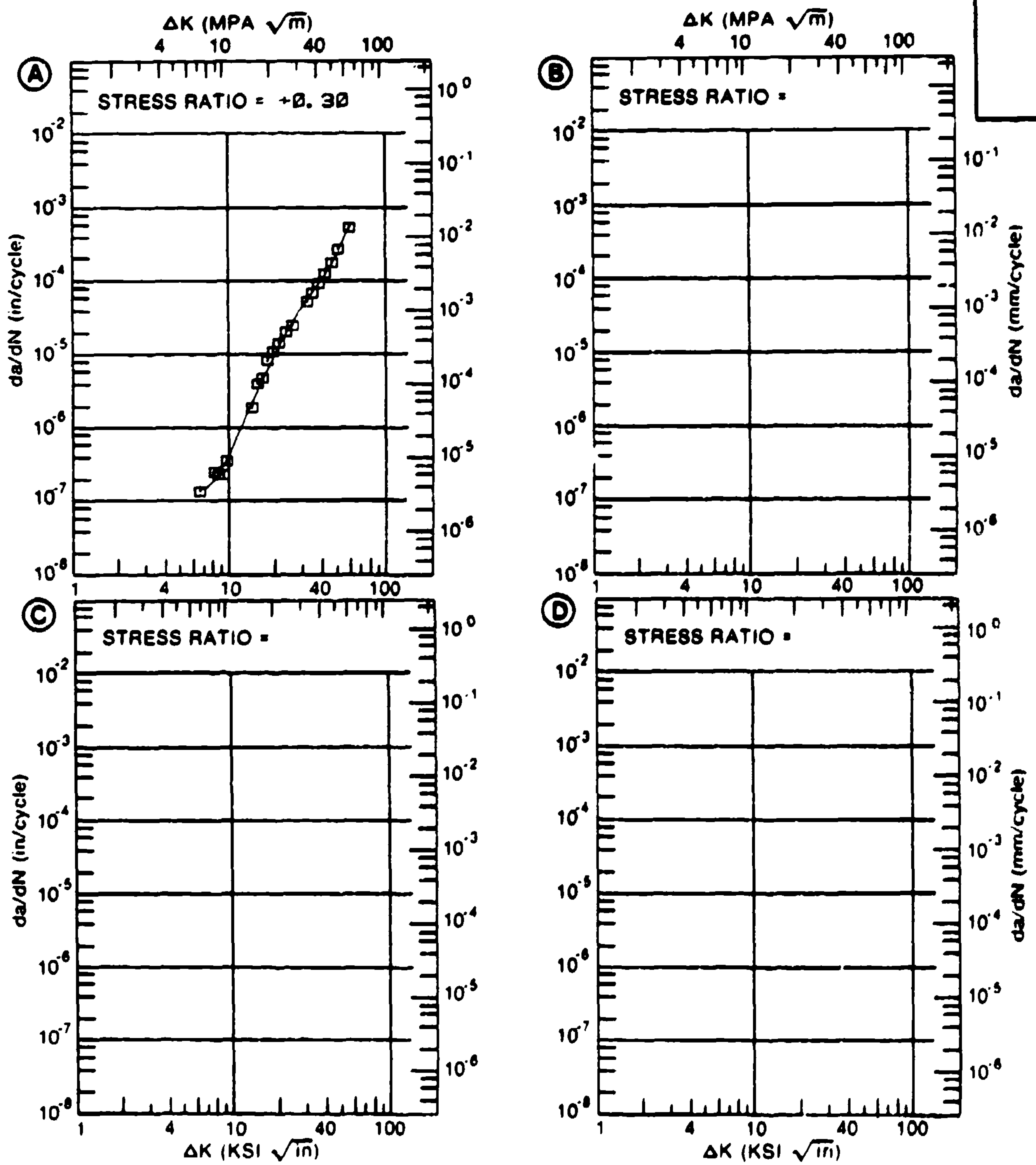

Figure 4.11.3.54

TABLE 4.11.3.55

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 4.11.3.55 INDICATING EFFECT
OF STRESS RATIO

MATERIAL: TITANIUM   TI-6AL-4V
CONDITION: MA
ENVIRONMENT: R.T. ,LAB AIR

DELTA K (KSI*IN**1/2)			DA/DN (10**-6 IN./CYCLE) A	B	C	D
			R=+0.02			
	A:	5.91	.0335			
DELTA K	B:					
MIN	C:					
	D:					
		6.00	.0340			
		7.00	.0448			
		8.00	.0653			
		9.00	.0996			
		10.00	.184			
		13.00	.554			
		16.00	1.71			
		20.00	5.92			
		25.00	19.4			
		30.00	46.1			
		35.00	86.0			
		40.00	133.			
	A:	44.29	171.			
DELTA K	B:					
MAX	C:					
	D:					

ROOT MEAN SQUARE PERCENT ERROR   35.86

LIFE PREDICTION RATIO SUMMARY (NP/NA)	
0.0-0.5	
0.5-0.8	
0.8-1.25	2
1.25-2.0	
>2.0	

CONDITION/HT: MA
FORM: 1.50"TH PLATE
SPECIMEN TYPE: CCP
ORIENTATION: L-T
FREQUENCY: 0.10- 30.00 HZ
ENVIRONMENT: R.T., LAB AIR

YIELD STRENGTH: 133.0 KSI
ULT. STRENGTH: 142.0 KSI
SPECIMEN THK: 0.188- 0.191"
SPECIMEN WIDTH: 3.957- 3.964"
REFERENCES: MA002

TITAN. ALLOY

TI-6AL-4V

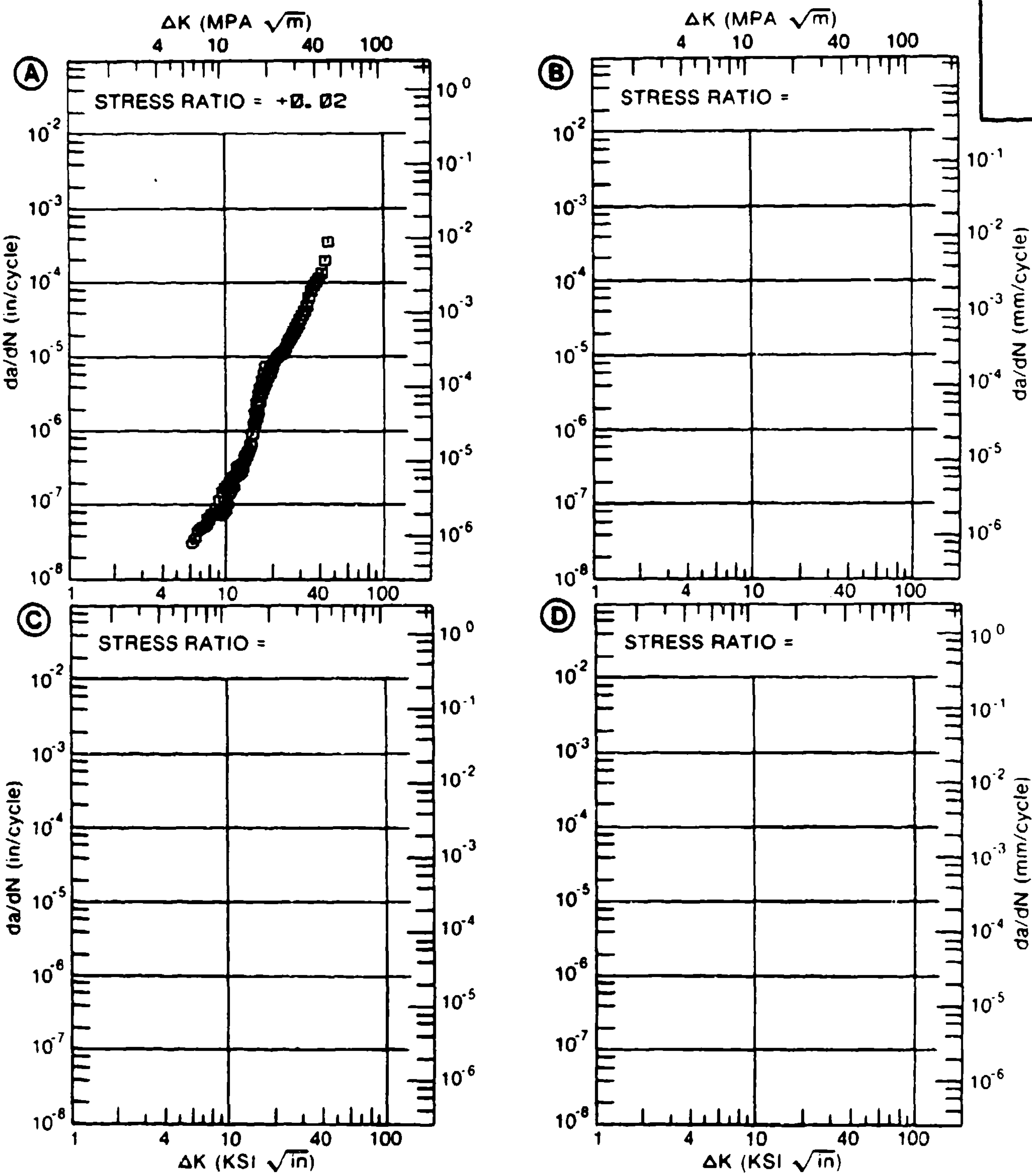

Figure 4.11.3.55

TABLE 4.11.3.56

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 4.11.3.56 INDICATING EFFECT

OF STRESS RATIO

MATERIAL: TITANIUM TI-6AL-4V
CONDITION: MA
ENVIRONMENT: R.T. ,L.H.A.

DELTA K (KSI*IN**1/2)		DA/DN (10**-6 IN./CYCLE) A R=+0.08	B R=+0.30	C R=+0.50	D
DELTA K MIN A:	7.76	.147			
DELTA K MIN B:	11.48		1.20		
DELTA K MIN C:	10.32			1.70	
DELTA K MIN D:					
	8.00	.161			
	9.00	.241			
	10.00	.373			
	13.00	1.36	3.31	5.53	
	16.00	4.04	9.32	9.75	
	20.00	11.7	16.8	17.3	
	25.00	25.9	38.1	47.0	
	30.00	36.2	66.0	94.0	
DELTA K MAX A:	34.01	36.7			
DELTA K MAX B:	30.00		66.0		
DELTA K MAX C:	30.83			94.6	
DELTA K MAX D:					
ROOT MEAN SQUARE PERCENT ERROR		21.28	14.01	8.00	
LIFE PREDICTION RATIO SUMMARY (NP/NA)	0.0-0.5				
	0.5-0.8				
	0.8-1.25	2	1	1	
	1.25-2.0				
	>2.0				

CONDITION/HT: MA
FORM: EXTRUSION
SPECIMEN TYPE: CT
ORIENTATION: L-T
FREQUENCY: 6.00 HZ
ENVIRONMENT: R.T., L.H.A.

YIELD STRENGTH: 122.0- 123.5 KSI
ULT. STRENGTH: 135.5- 139.0 KSI
SPECIMEN THK: 0.993- 0.997"
SPECIMEN WIDTH: 3.770- 4.940"
REFERENCES 85837

TITAN. ALLOY

TI-6AL-4V

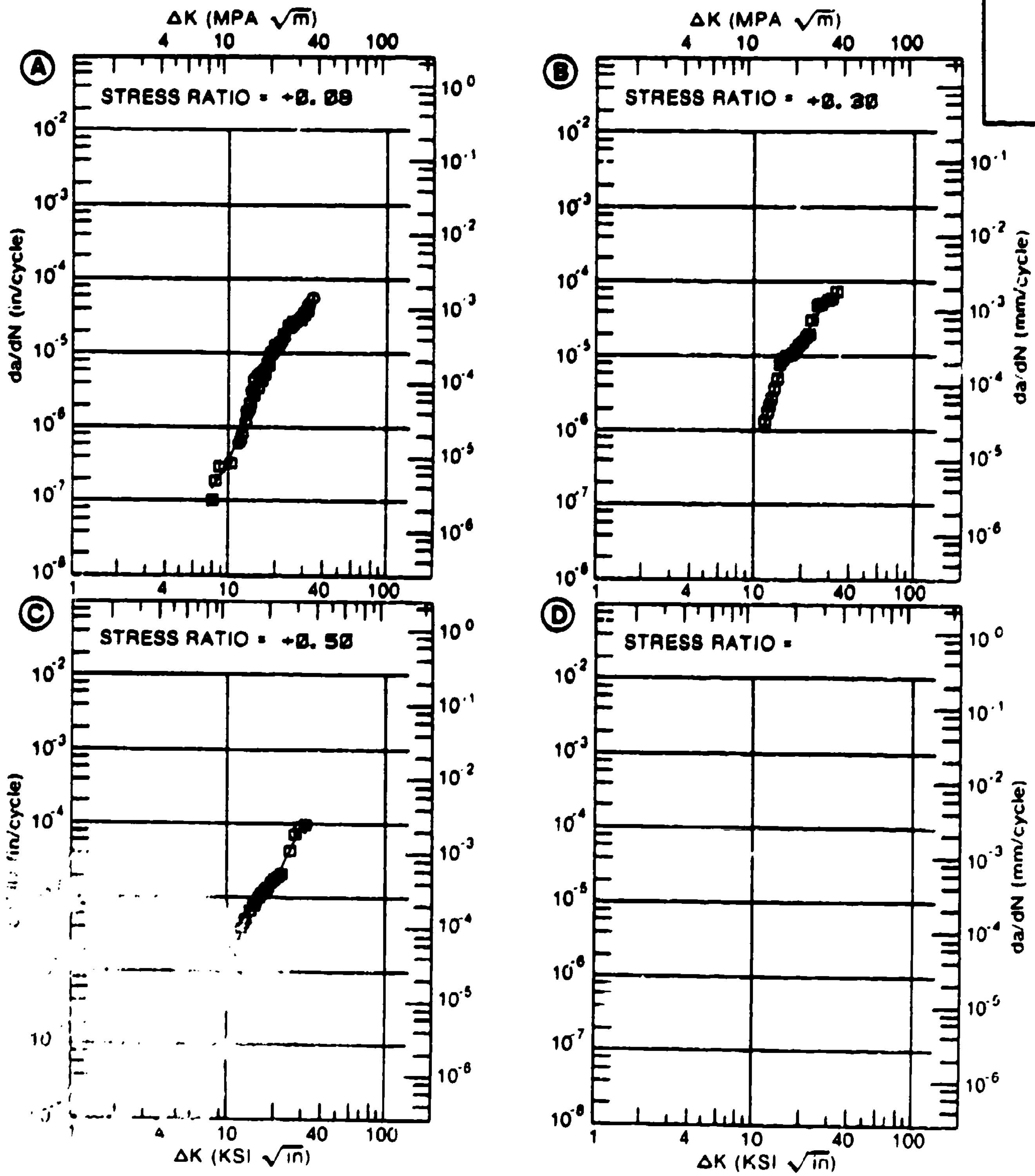

Figure 4.11.3.56

TABLE 4.11.3.57

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 4.11.3.57 INDICATING EFFECT

OF ENVIRONMENT

MATERIAL: TITANIUM TI-6AL-4V
CONDITION: MA

DELTA K (KSI*IN**1/2)		DA/DN (10**-6 IN./CYCLE) A E= R.T. L.H.A.	B E= R.T. J.P.4	C E= R.T. S.T.W.	D
DELTA K MIN A:	13.17	1.51			
B:	18.10		8.27		
C:	11.48			1.35	
D:					
	13.00			1.82	
	16.00	5.07		5.04	
	20.00	13.9	12.0	14.3	
	25.00	28.7	25.1	32.4	
	30.00	46.5	43.5	53.9	
	35.00	68.2	68.4	80.4	
	40.00	97.1	103.	117.	
	50.00			266.	
DELTA K MAX A:	42.59	116.			
B:	46.81		171.		
C:	51.63			308.	
D:					
ROOT MEAN SQUARE PERCENT ERROR		13.77	3.38	8.04	
LIFE PREDICTION RATIO SUMMARY (NP/NA)	0.0-0.5				
	0.5-0.8				
	0.8-1.25	1	1	1	
	1.25-2.0				
	>2.0				

CONDITION/HT: MA
FORM: EXTRUSION
SPECIMEN TYPE: CT
ORIENTATION: L-T
STRESS RATIO: +0.08
FREQUENCY: 1.00 HZ

YIELD STRENGTH: 123.5- 127.0 KSI
ULT. STRENGTH: 135.5- 139.0 KSI
SPECIMEN THK: 0.994- 1.000"
SPECIMEN WIDTH: 3.770"
REFERENCES: 85837, 88579

TITAN. ALLOY

TI-6AL-4V

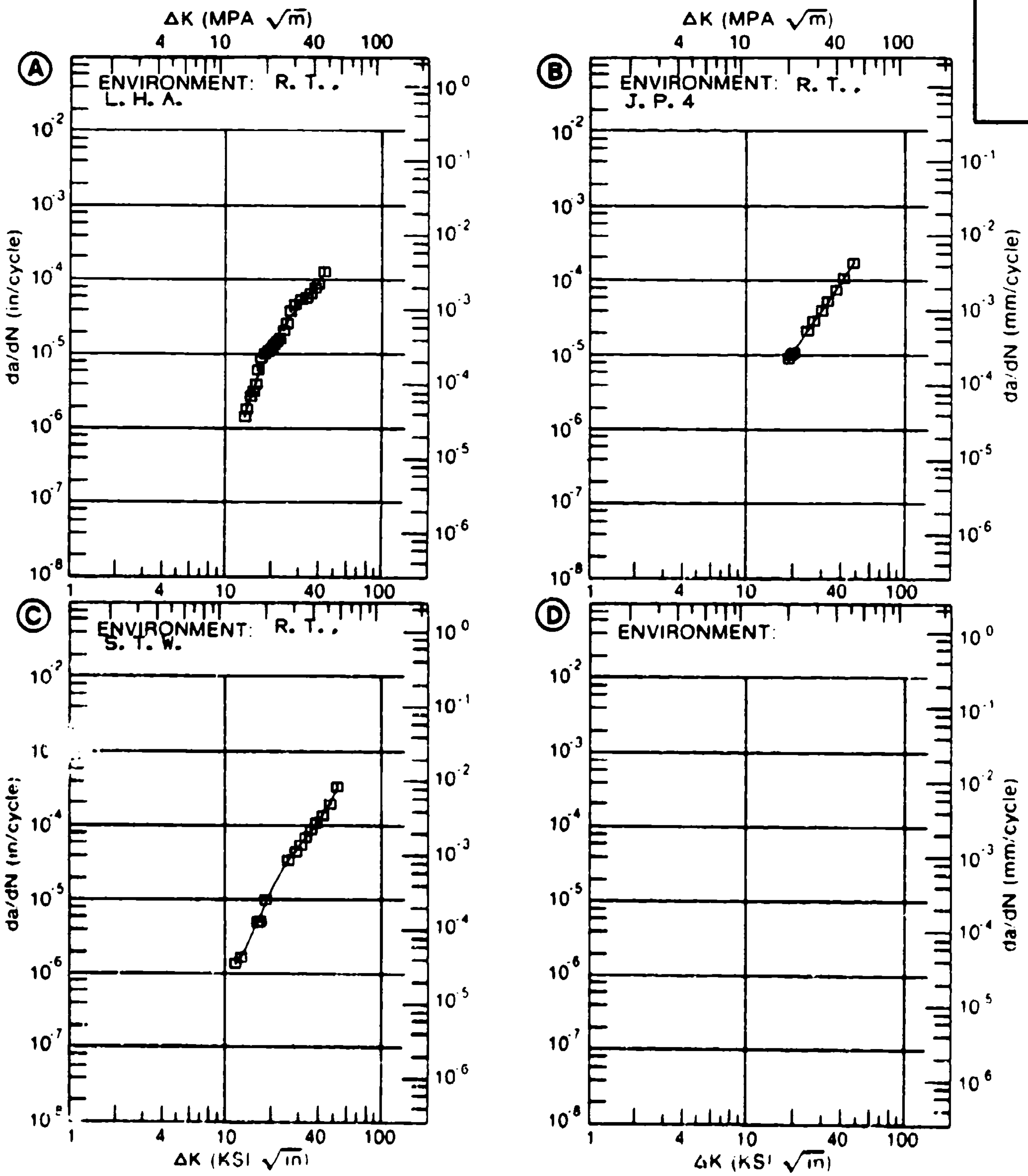

Figure 4.11.3.57

TABLE 4.11.3.58

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 4.11.3.58 INDICATING EFFECT

OF ENVIRONMENT

MATERIAL: TITANIUM TI-6AL-4V
CONDITION: MA

DELTA K (KSI*IN**1/2)		DA/DN (10**-6 IN./CYCLE) A	B	C	D
		E= R.T. L.H.A. 6HZ	E= R.T. S.T.W. 6HZ		
DELTA K MIN A:	13.81	1.76			
DELTA K MIN B:	9.22		.428		
DELTA K MIN C:					
DELTA K MIN D:					
	10.00		.620		
	13.00		1.97		
	16.00	5.21	4.67		
	20.00	12.7	11.1		
	25.00	15.9	24.8		
	30.00	36.0	45.1		
	35.00		71.6		
DELTA K MAX A:	32.77	90.6			
DELTA K MAX B:	39.27		98.5		
DELTA K MAX C:					
DELTA K MAX D:					
ROOT MEAN SQUARE PERCENT ERROR		16.43	6.59		
LIFE PREDICTION RATIO SUMMARY (NP/NA)	0.0-0.5				
	0.5-0.8				
	0.8-1.25	1	1		
	1.25-2.0				
	>2.0				

CONDITION/HT: MA
FORM: EXTRUSION
SPECIMEN TYPE: CT
ORIENTATION: T-L
STRESS RATIO: +0.08
FREQUENCY:

YIELD STRENGTH: 125.0 KSI
ULT. STRENGTH: 142.0 KSI
SPECIMEN THK: 0.984"
SPECIMEN WIDTH: 3.770"
REFERENCES: 85837

TITAN. ALLOY

TI-6AL-4V

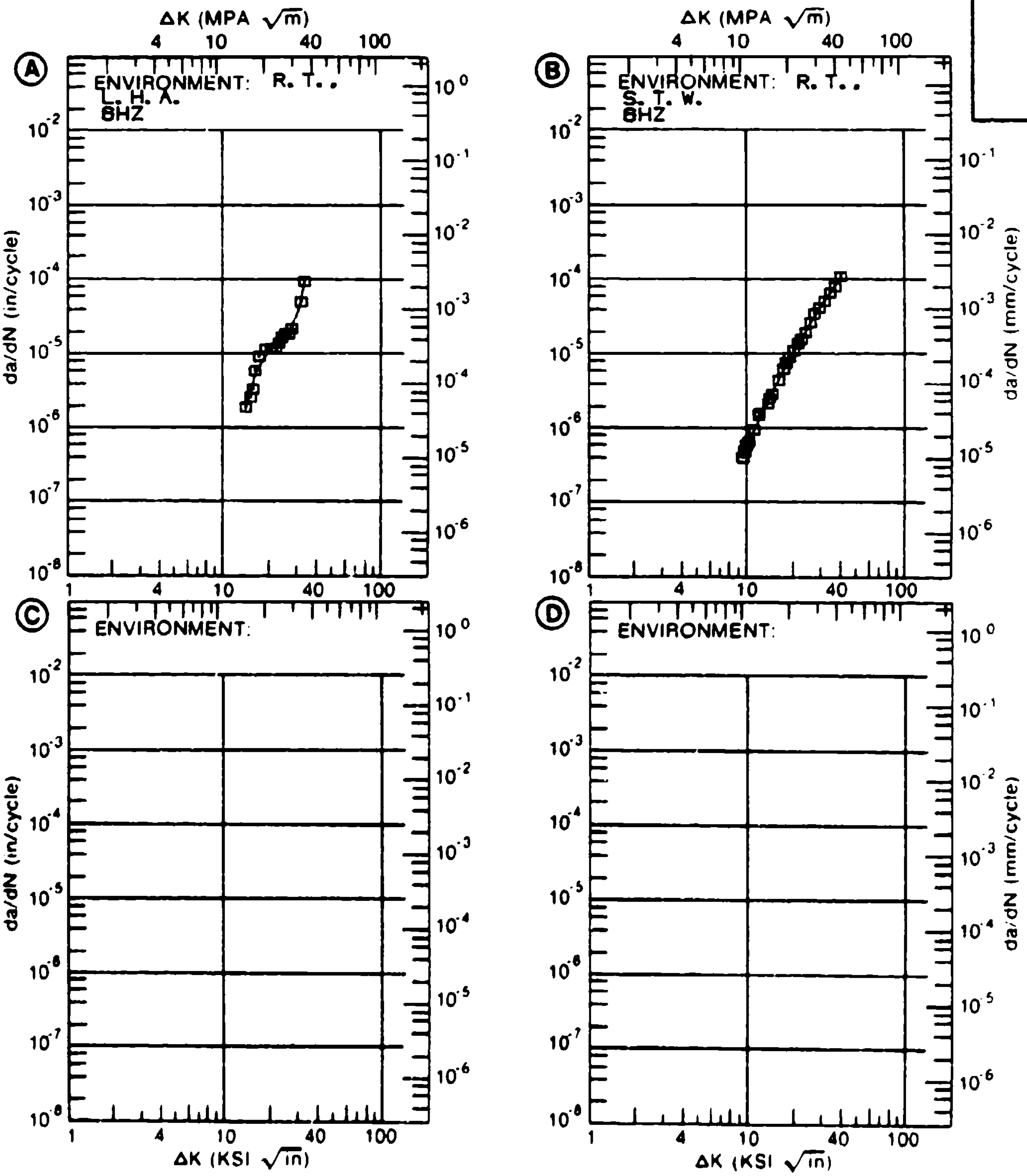

Figure 4.11.3.58

TABLE 4.11.3.59

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 4.11.3.59 INDICATING EFFECT OF ENVIRONMENT

MATERIAL: TITANIUM TI-6AL-4V
CONDITION: MA

DELTA K (KSI*IN**1/2)		DA/DN (10**-6 IN./CYCLE) A	B	C	D
		E= R.T. LAB AIR 1-20HZ	E= R.T. S.T.W. 1-10HZ	E= R.T. SIM. SEA WATER 1-10HZ	
DELTA K MIN A:	12.95	.690			
DELTA K MIN B:	10.86		1.21		
DELTA K MIN C:	10.22			.987	
DELTA K MIN D:					
	13.00	.712	2.42	2.42	
	16.00	3.12	5.16	4.84	
	20.00	9.50	11.2	9.69	
	25.00	21.0	23.9	19.3	
	30.00	35.6	43.9	34.5	
	35.00	55.1	73.8	58.5	
	40.00	83.7	116.	95.9	
	50.00	202.	254.	242.	
	60.00	548.	496.	580.	
	70.00	1660.			
DELTA K MAX A:	74.97	2988.			
DELTA K MAX B:	60.69		518.		
DELTA K MAX C:	66.66			1019.	
DELTA K MAX D:					
ROOT MEAN SQUARE PERCENT ERROR		18.14	27.52	31.04	
LIFE PREDICTION RATIO SUMMARY (NP/NA)	0.0-0.5				
	0.5-0.8				
	0.8-1.25	2	2	2	
	1.25-2.0				
	>2.0				

CONDITION/HT: MA
FORM: 1.00"TH EXTRUSION
SPECIMEN TYPE: CT
ORIENTATION: L-T
STRESS RATIO: +0.10
FREQUENCY:

YIELD STRENGTH: 124.4 KSI
ULT. STRENGTH: 135.3 KSI
SPECIMEN THK: 1.000- 1.003"
SPECIMEN WIDTH: 4.500"
REFERENCES: NC002

TITAN. ALLOY

TI-6AL-4V

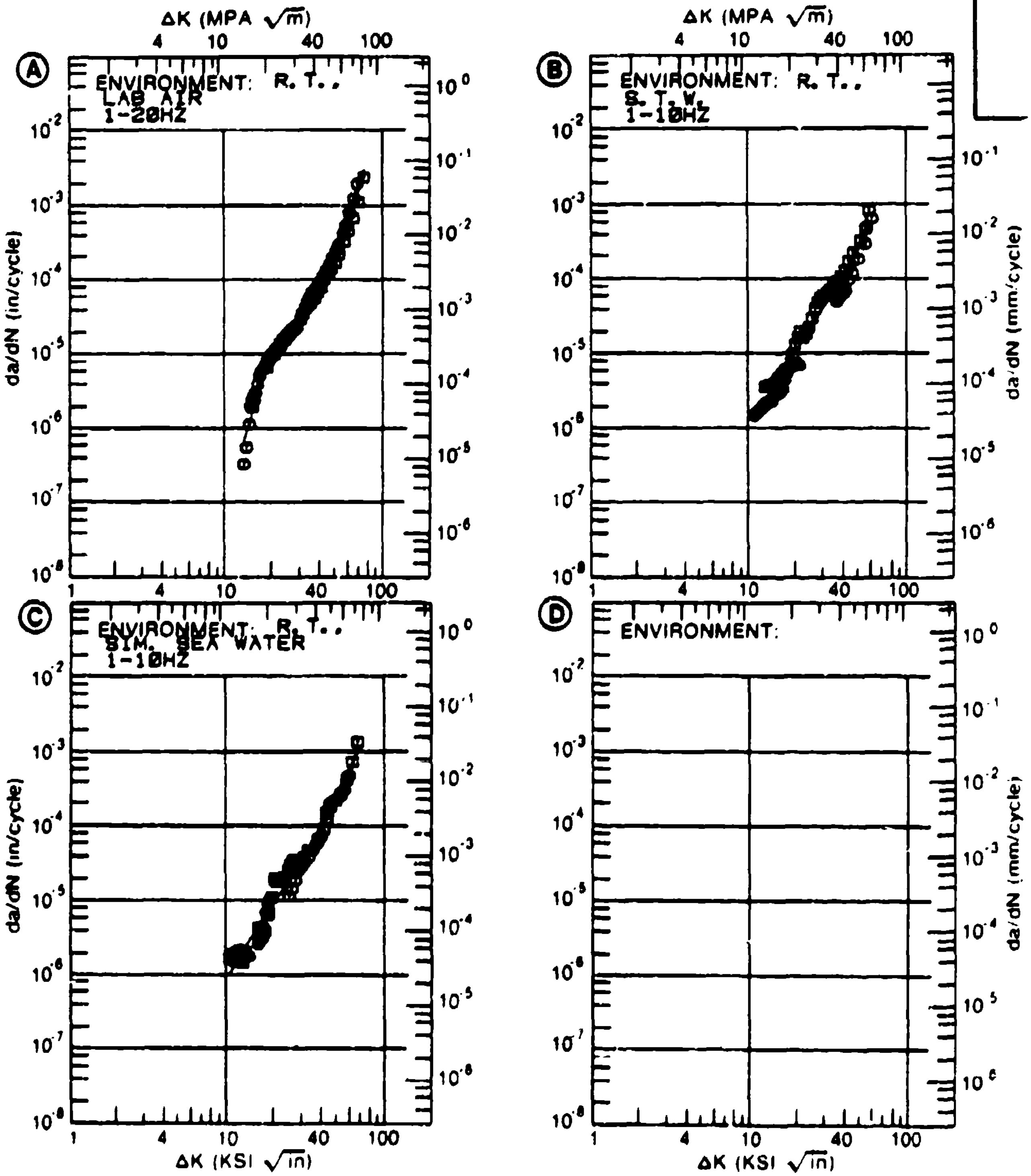

Figure 4.11.3.59

TABLE 4.11.3.60

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 4.11.3.60 INDICATING EFFECT

OF ENVIRONMENT

MATERIAL: TITANIUM TI-6AL-4V
CONDITION: MA

DELTA K (KSI*IN**1/2)			DA/DN (10**-6 IN./CYCLE) A	B	C	D
			E= R.T. LAB AIR 5-20HZ	E= R.T. S.T.W. 1-10HZ	E= R.T. SIM. SEA WATER 1-10HZ	
DELTA K MIN	A:	11.73	1.23			
	B:	10.58		2.31		
	C:	10.52			2.98	
	D:					
		13.00	2.34	4.93	3.88	
		16.00	6.39	11.3	9.08	
		20.00	13.7	25.9	18.0	
		25.00	24.8	47.7	31.2	
		30.00	39.5	67.3	47.3	
		35.00	61.7	90.6	69.1	
		40.00	98.6	128.	100.	
		50.00	281.	324.	220.	
		60.00			538.	
DELTA K MAX	A:	59.40	863.			
	B:	56.74		737.		
	C:	63.55			874.	
	D:					
ROOT MEAN SQUARE PERCENT ERROR			11.97	17.66	28.94	
LIFE PREDICTION RATIO SUMMARY (NP/NA)		0.0-0.5				
		0.5-0.8			1	
		0.8-1.25	2	2		
		1.25-2.0			1	
		>2.0				

CONDITION/HT: MA
FORM: 1.80"TH EXTRUSION
SPECIMEN TYPE: CT
ORIENTATION: T-L
STRESS RATIO: +0.10
FREQUENCY:

YIELD STRENGTH: 126.6 KSI
ULT. STRENGTH: 138.6 KSI
SPECIMEN THK: 1.000- 1.003"
SPECIMEN WIDTH: 4.500"
REFERENCES: NC002

TITAN. ALLOY

TI-6AL-4V

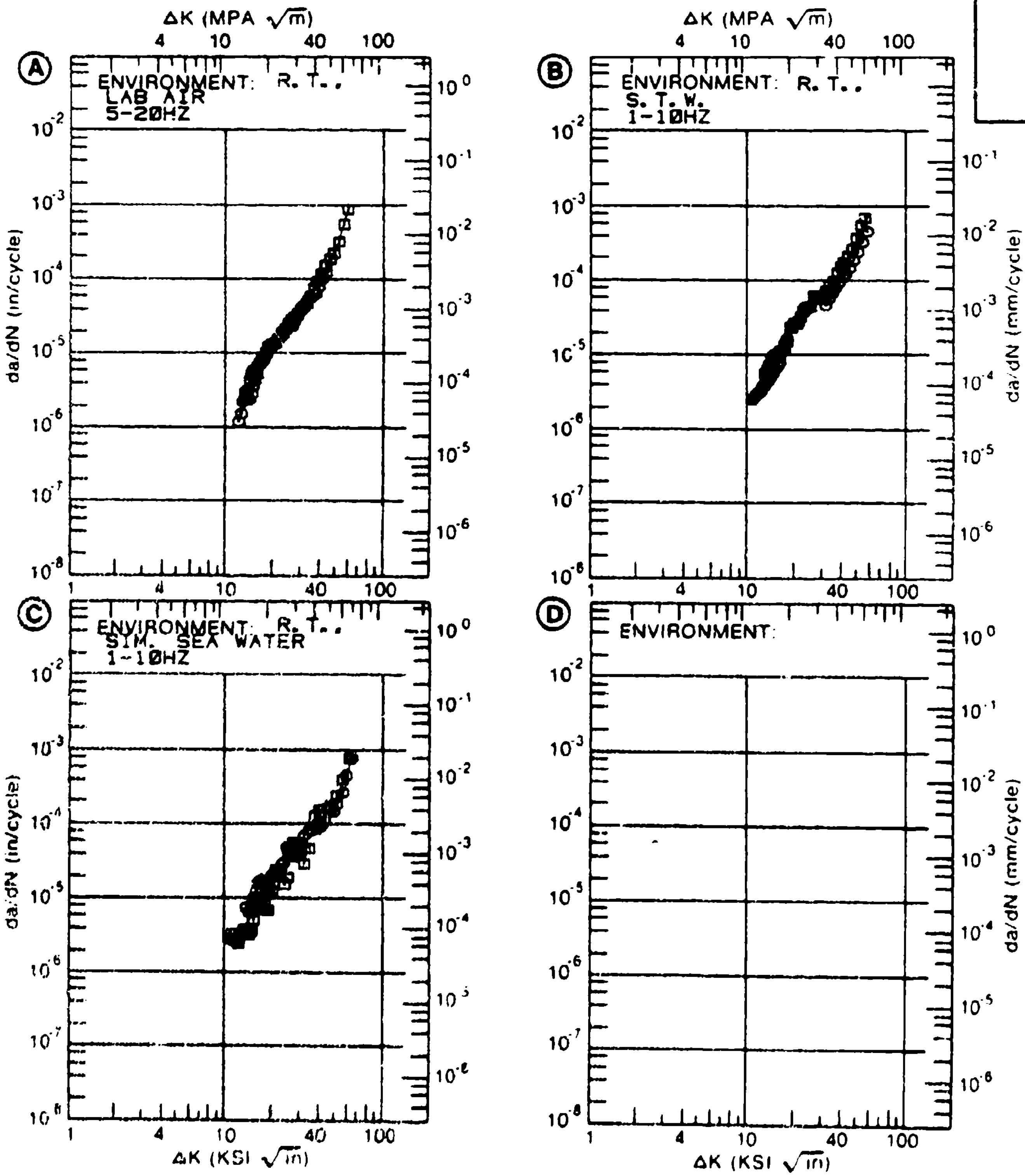

Figure 4.11.3.66

TABLE 4.11.3.61

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 4.11.3.61 INDICATING EFFECT

OF ENVIRONMENT

MATERIAL: TITANIUM TI-6AL-4V
CONDITION: MA

DELTA K (KSI*IN**1/2)			DA/DN (10**-6 IN./CYCLE) A E= R.T. DRY ARGON 10HZ	B E= R.T. DRY AIR .08-10HZ	C E= R.T. SIMULATED FUEL .09-10HZ	D
DELTA K MIN	A:					
	B:	15.25		5.87		
	C:	13.51			2.61	
	D:					
		16.00		7.15	5.95	
		20.00		15.6	14.2	
		25.00		30.9	31.1	
		30.00		55.5	63.1	
		35.00		99.4	130.	
		40.00		183.	280.	
		50.00		696.	1513.	
DELTA K MAX	A:					
	B:	51.67		882.		
	C:	51.36			1932.	
	D:					
ROOT MEAN SQUARE PERCENT ERROR			0.00	59.69	39.37	

LIFE PREDICTION RATIO SUMMARY (NP/NA)	
0.0-0.5	
0.5-0.8	
0.8-1.25	
1.25-2.0	
>2.0	

CONDITION/HT: MA
FORM: 2.00"TH FORGING
SPECIMEN TYPE: DCB
ORIENTATION: L-T
STRESS RATIO: +0.02
FREQUENCY:

YIELD STRENGTH: 127.0- 145.0 KSI
ULT. STRENGTH: 139.0- 156.0 KSI
SPECIMEN THK: 0.750"
SPECIMEN WIDTH: 5.500"
REFERENCES: 84380

TITAN. ALLOY

TI-6AL-4V

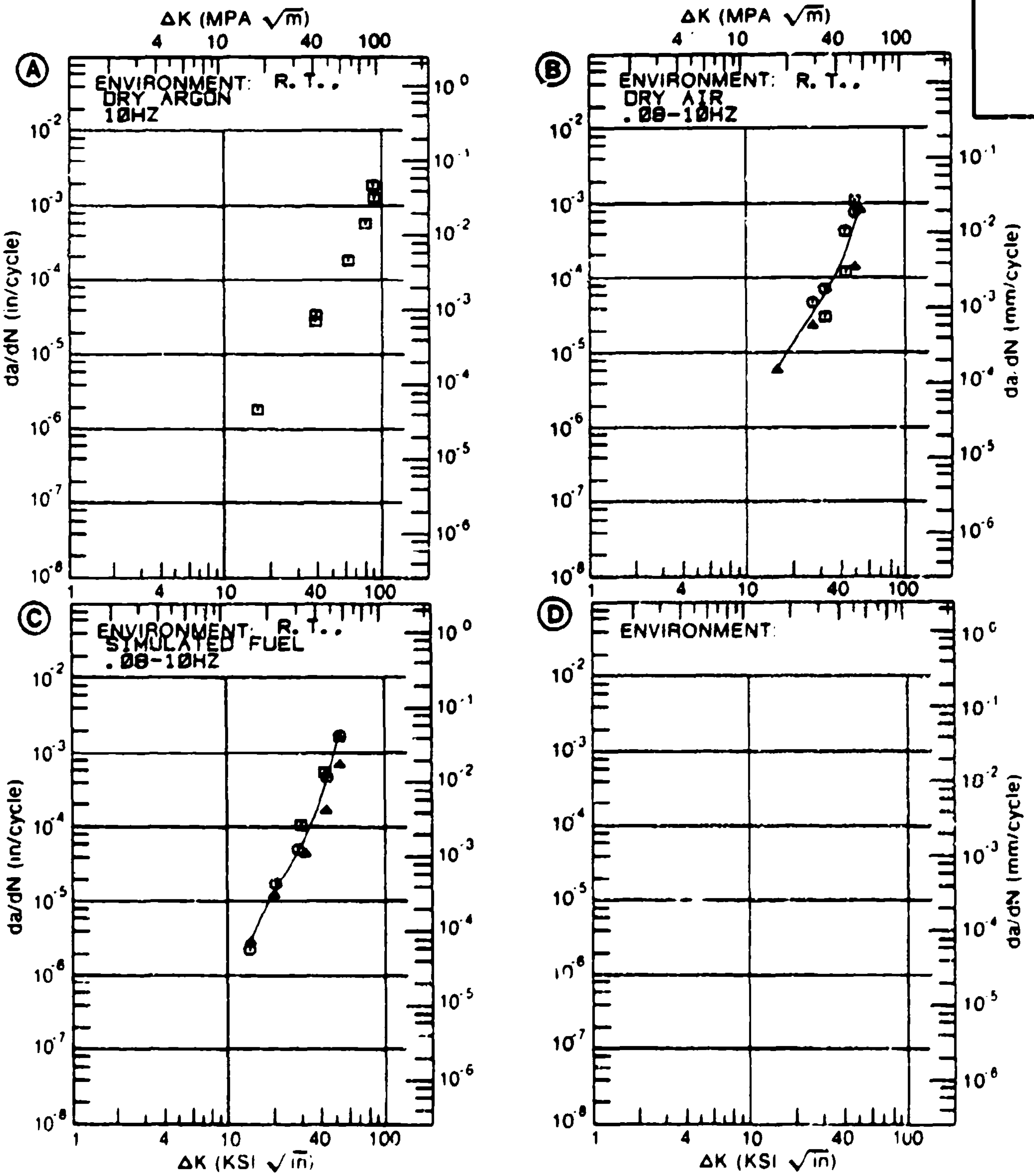

Figure 4.11.3.61

TABLE 4.11.3.62

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 4.11.3.62 INDICATING EFFECT
OF ENVIRONMENT

MATERIAL: TITANIUM TI-6AL-4V
CONDITION: MA

DELTA K (KSI*IN**1/2)		DA/DN (10**-6 IN./CYCLE) A: E= R.T. DIST. WATER 10HZ	B: E= R.T. 3.5% NACL 1-10HZ	C	D
DELTA K MIN A:					
DELTA K MIN B:	21.94		13.3		
DELTA K MIN C:					
DELTA K MIN D:					
	25.00		29.1		
	30.00		61.4		
	35.00		93.1		
	40.00		123.		
	50.00		197.		
	60.00		342.		
	70.00		694.		
	80.00		1657.		
DELTA K MAX A:					
DELTA K MAX B:	82.01		2010.		
DELTA K MAX C:					
DELTA K MAX D:					
ROOT MEAN SQUARE PERCENT ERROR		0.00	41.05		

LIFE PREDICTION RATIO SUMMARY (NP/NA)	
	0.0-0.5
	0.5-0.8
	0.8-1.25
	1.25-2.0
	>2.0

CONDITION/HT: MA
FORM: 2.00"TH FORGING
SPECIMEN TYPE: DCB
ORIENTATION: L-T
STRESS RATIO: +0.02
FREQUENCY:

YIELD STRENGTH: 145.0 KSI
ULT. STRENGTH: 156.0 KSI
SPECIMEN THK: 0.750- 0.875"
SPECIMEN WIDTH: 5.500"
REFERENCES: 84380

TITAN. ALLOY

TI-6AL-4V

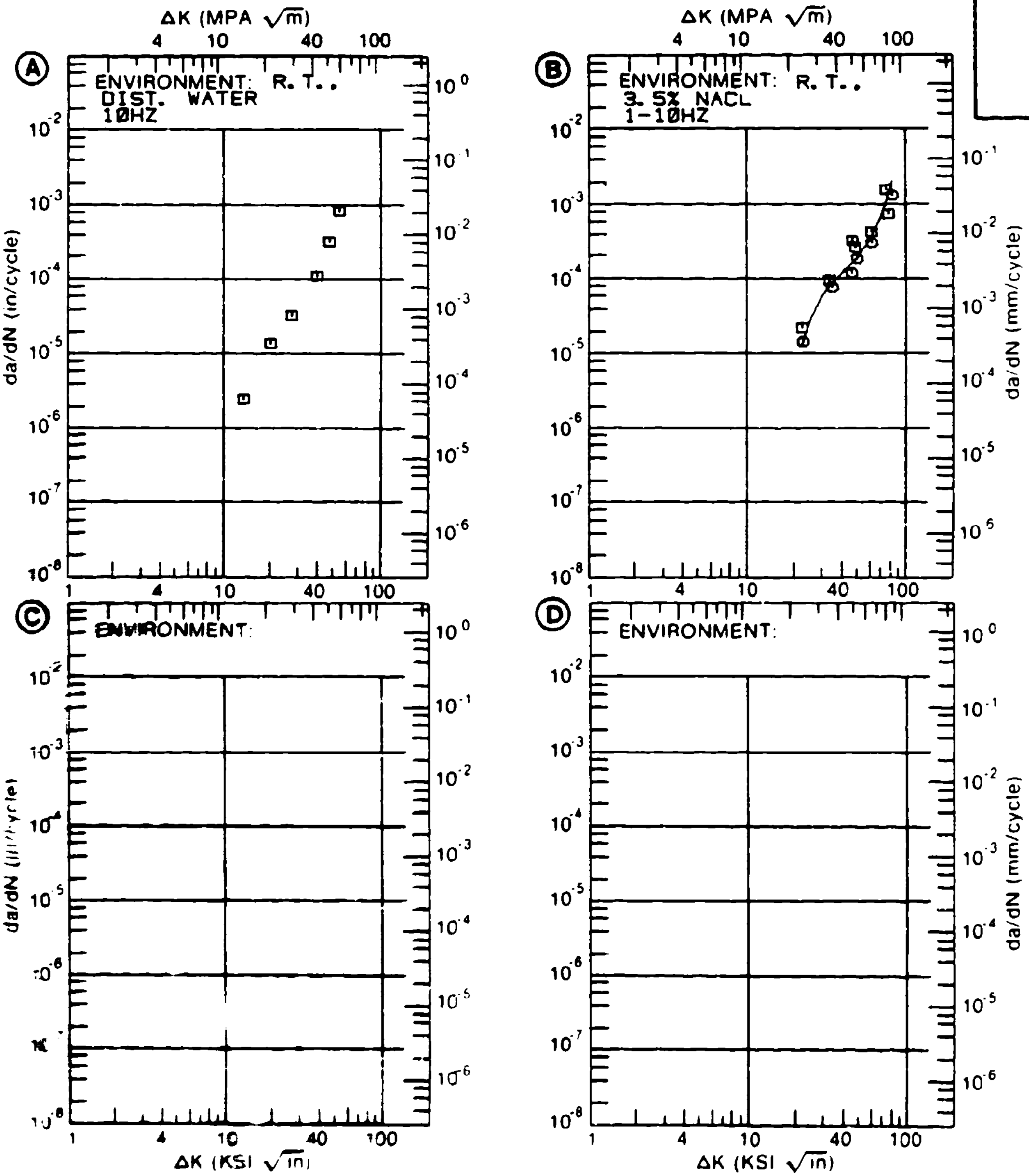

Figure 4.11.3.62

TABLE 4.11.3.63

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 4.11.3.63 INDICATING EFFECT

OF STRESS RATIO

MATERIAL: TITANIUM TI-6AL-4V
CONDITION: MA
ENVIRONMENT: R.T. ,LAB AIR

DELTA K (KSI*IN**1/2)			DA/DN (10**-6 IN./CYCLE) A	B	C	D
			R=+0.02			
DELTA K MIN	A:	18.15	6.34			
	B:					
	C:					
	D:					
		20.00	8.18			
		25.00	15.7			
		30.00	29.2			
		35.00	53.0			
		40.00	95.0			
		50.00	292.			
		60.00	857.			
DELTA K MAX	A:	60.61	914.			
	B:					
	C:					
	D:					
ROOT MEAN SQUARE PERCENT ERROR			13.19			
LIFE PREDICTION RATIO SUMMARY (NP/NA)		0.0-0.5				
		0.5-0.8	1			
		0.8-1.25	1			
		1.25-2.0				
		>2.0				

CONDITION/HT: MA
FORM: 4.50"TH FORGING
SPECIMEN TYPE: WOL
ORIENTATION: L-T
FREQUENCY: 1.00- 30.00 HZ
ENVIRONMENT: R.T., LAB AIR

YIELD STRENGTH: 130.0 KSI
ULT. STRENGTH: 139.0 KSI
SPECIMEN THK: 0.553- 0.555"
SPECIMEN WIDTH: 4.999- 5.000"
REFERENCES: MA002

TITAN. ALLOY

TI-6AL-4V

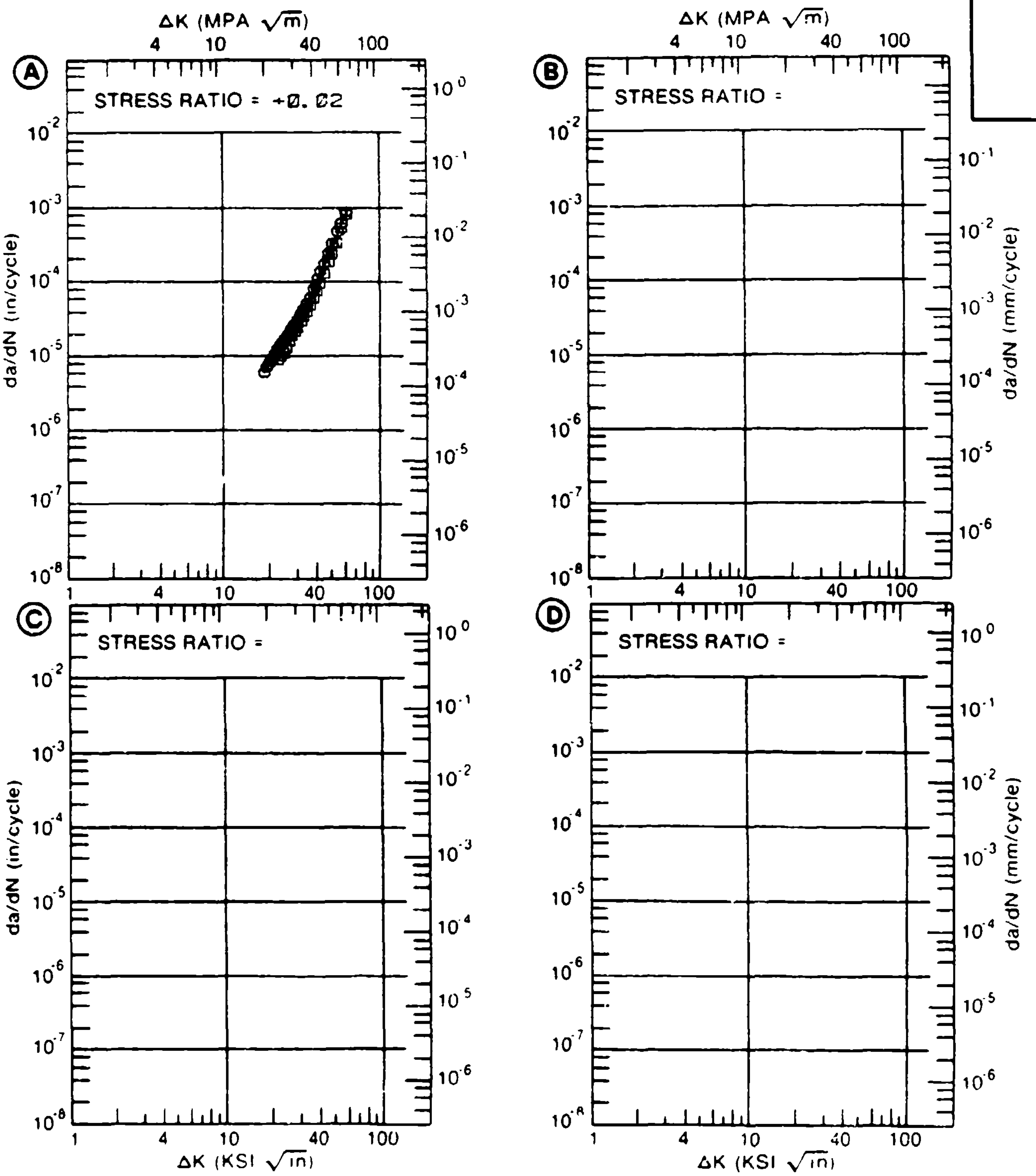

Figure 4.11.3.63

TABLE 4.11.3.64

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 4.11.3.64INDICATING EFFECT

OF STRESS RATIO

MATERIAL: TITANIUM TI-6AL-4V
CONDITION: MA 1300F 2HRS AC
ENVIRONMENT: + 300F, AIR

DELTA K (KSI*IN**1/2)		DA/DN (10**-6 IN./CYCLE) A R=+0.00	B R=+0.25	C R=+0.54	D
DELTA K MIN A:	10.32	.610			
B:	10.79		1.01		
C:	7.74			.589	
D:					
	8.00			.621	
	9.00			.825	
	10.00			1.19	
	13.00	1.29	2.58	3.77	
	16.00	2.79	6.11	9.69	
	20.00	6.72	13.5		
	25.00	16.1	28.1		
	30.00	31.4			
	35.00	52.2			
	40.00	76.6			
DELTA K MAX A:	44.22	97.8			
B:	27.30		37.7		
C:	19.93			20.8	
D:					
ROOT MEAN SQUARE PERCENT ERROR		20.23	28.07	43.68	

LIFE PREDICTION RATIO SUMMARY (NP/NA)	
	0.0-0.5
	0.5-0.8
	0.8-1.25
	1.25-2.0
	>2.0

CONDITION/HT: MA 1300F 2HRS AC
FORM: 1.75"TH DISK
SPECIMEN TYPE: KB BAR
ORIENTATION: L-R
FREQUENCY: 0.33 HZ
ENVIRONMENT: + 300° F, AIR

YIELD STRENGTH: 120.0 KSI
ULT. STRENGTH:
SPECIMEN THK: 0.244- 0.250"
SPECIMEN WIDTH: 1.000- 1.005"
REFERENCES: CE007

TITAN. ALLOY

TI-6AL-4V

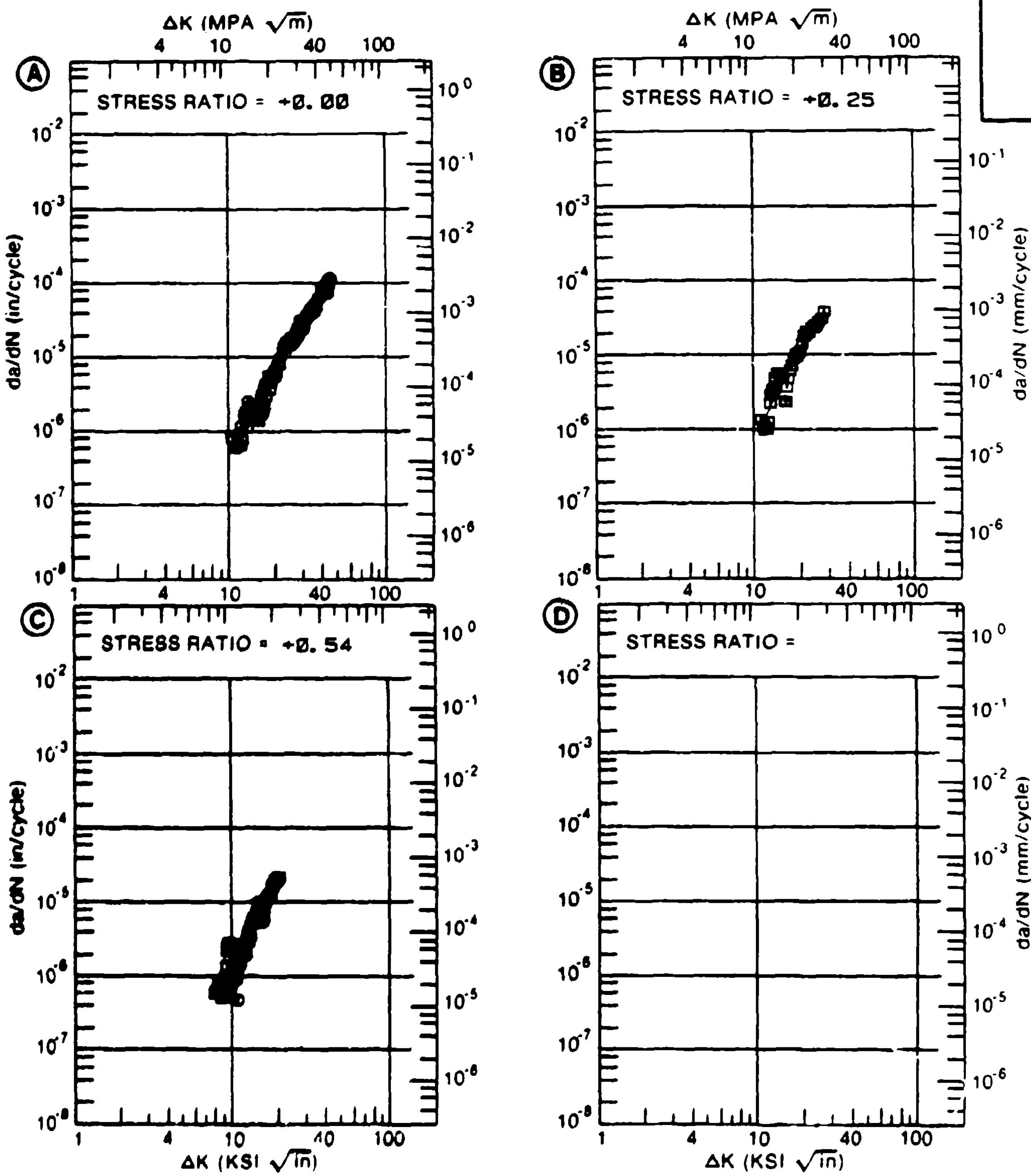

Figure 4.11.3.64

TABLE 4.11.3.65

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 4.11.3.65 INDICATING EFFECT

OF STRESS RATIO

MATERIAL: TITANIUM TI-6AL-4V
CONDITION: MA 1300F 2HRS AC
ENVIRONMENT: + 600F, AIR

DELTA K (KSI*IN**1/2)		DA/DN (10**-6 IN./CYCLE) A	B	C	D
		R=+0.00	R=+0.25	R=+0.54	
DELTA K MIN	A: 10.19	1.49			
	B: 8.78		1.23		
	C: 8.13			.684	
	D:				
	9.00		1.21	.964	
	10.00		1.24	1.46	
	13.00	2.32	2.08	4.75	
	16.00	3.90	4.36	12.4	
	20.00	7.83	11.2	30.9	
	25.00	18.0	28.1		
	30.00	39.4			
	35.00	81.4			
	40.00	160.			
DELTA K MAX	A: 41.78	202.			
	B: 28.82		46.2		
	C: 20.36			32.9	
	D:				
ROOT MEAN SQUARE PERCENT ERROR		21.78	23.65	26.02	

LIFE PREDICTION RATIO SUMMARY (NP/NA)	
	0.0-0.5
	0.5-0.8
	0.8-1.25
	1.25-2.0
	>2.0

CONDITION/HT: MA 1300F 2HRS AC
FORM: 1.75"TH FORWARD SPOOL
SPECIMEN TYPE: KB BAR
ORIENTATION: L-R
FREQUENCY: 0.33 HZ
ENVIRONMENT: + 600° F. AIR

YIELD STRENGTH: 120.0 KSI
ULT. STRENGTH:
SPECIMEN THK: 0.249- 0.253"
SPECIMEN WIDTH: 0.995- 1.003"
REFERENCES: GE007

TITAN. ALLOY

TI-6AL-4V

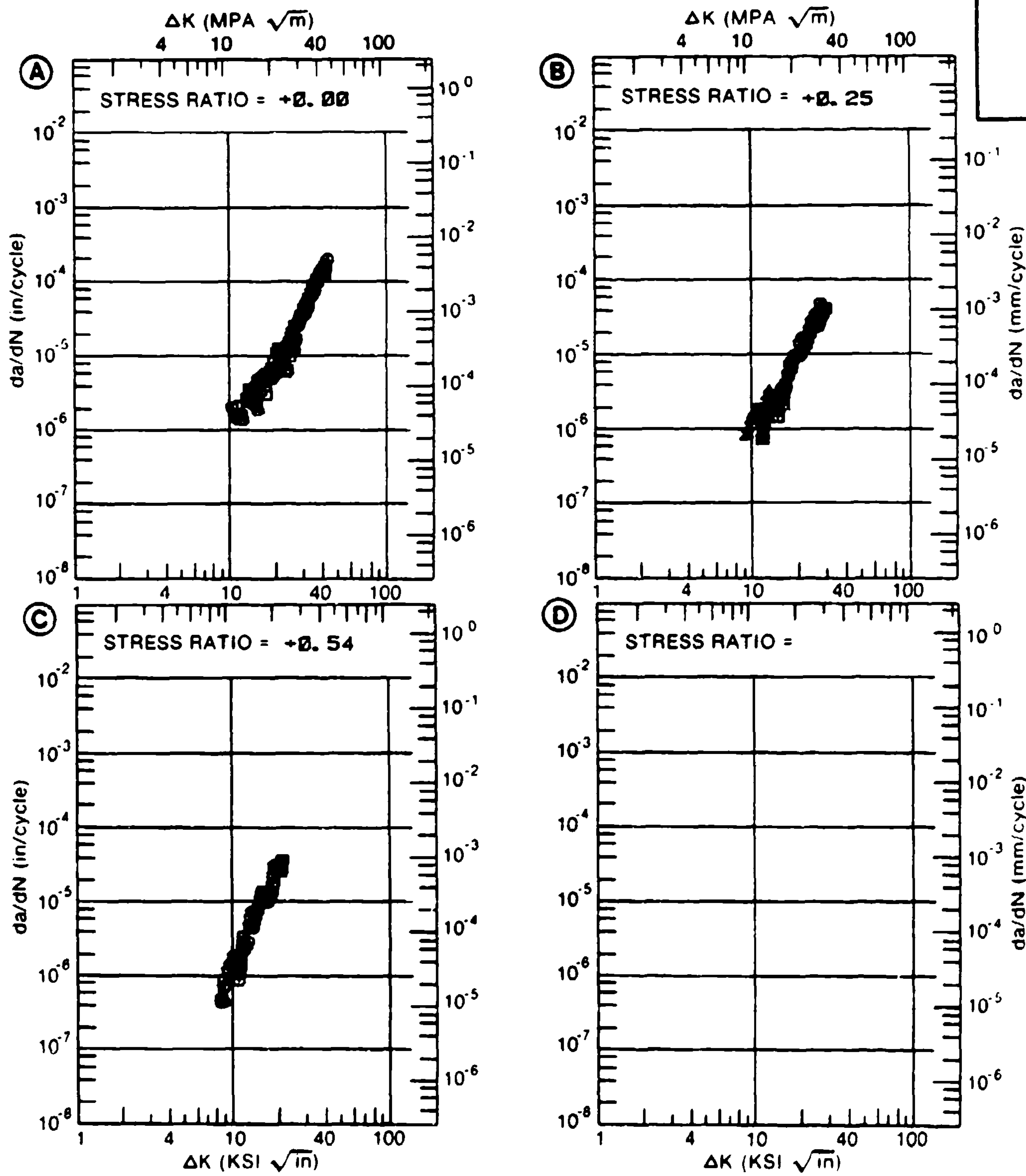

Figure 4.11.3.65

TABLE 4.11.3.66

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 4.11.3.66 INDICATING EFFECT

OF STRESS RATIO

MATERIAL: TITANIUM TI-6AL-4V
CONDITION: RA
ENVIRONMENT: R. T. , H. H. A.

DELTA K (KSI*IN**1/2)			DA/DN (10**-6 IN./CYCLE) A	B	C	D
			R=+0.10	R=+0.50		
DELTA K MIN	A:	8.50	2.47			
	B:	4.86		.285		
	C:					
	D:					
		5.00		.326		
		6.00		.698		
		7.00		1.21		
		8.00		1.85		
		9.00	2.81	2.65		
		10.00	3.57	3.63		
		13.00	6.80	8.44		
		16.00	12.0	19.2		
		20.00	23.8	64.9		
		25.00	51.6			
		30.00	105.			
		35.00	203.			
		40.00	378.			
DELTA K MAX	A:	42.13	487.			
	B:	22.81		169.		
	C:					
	D:					
ROOT MEAN SQUARE PERCENT ERROR			8.97	13.03		

LIFE PREDICTION RATIO SUMMARY (NP/NA)		A	B	C	D
	0.0-0.5				
	0.5-0.8				
	0.8-1.25	1	1		
	1.25-2.0				
	>2.0				

CONDITION/HT: RA
FORM: 0.13"TH PLATE
SPECIMEN TYPE: CCP
ORIENTATION: T-L
FREQUENCY: 10.00 HZ
ENVIRONMENT: R. T., H. H. A.

YIELD STRENGTH: 149.1- 149.2 KSI
ULT. STRENGTH: 156.2 KSI
SPECIMEN THK: 0.124- 0.125"
SPECIMEN WIDTH: 5.000"
REFERENCES: 90981

TITAN. ALLOY

TI-6AL-4V

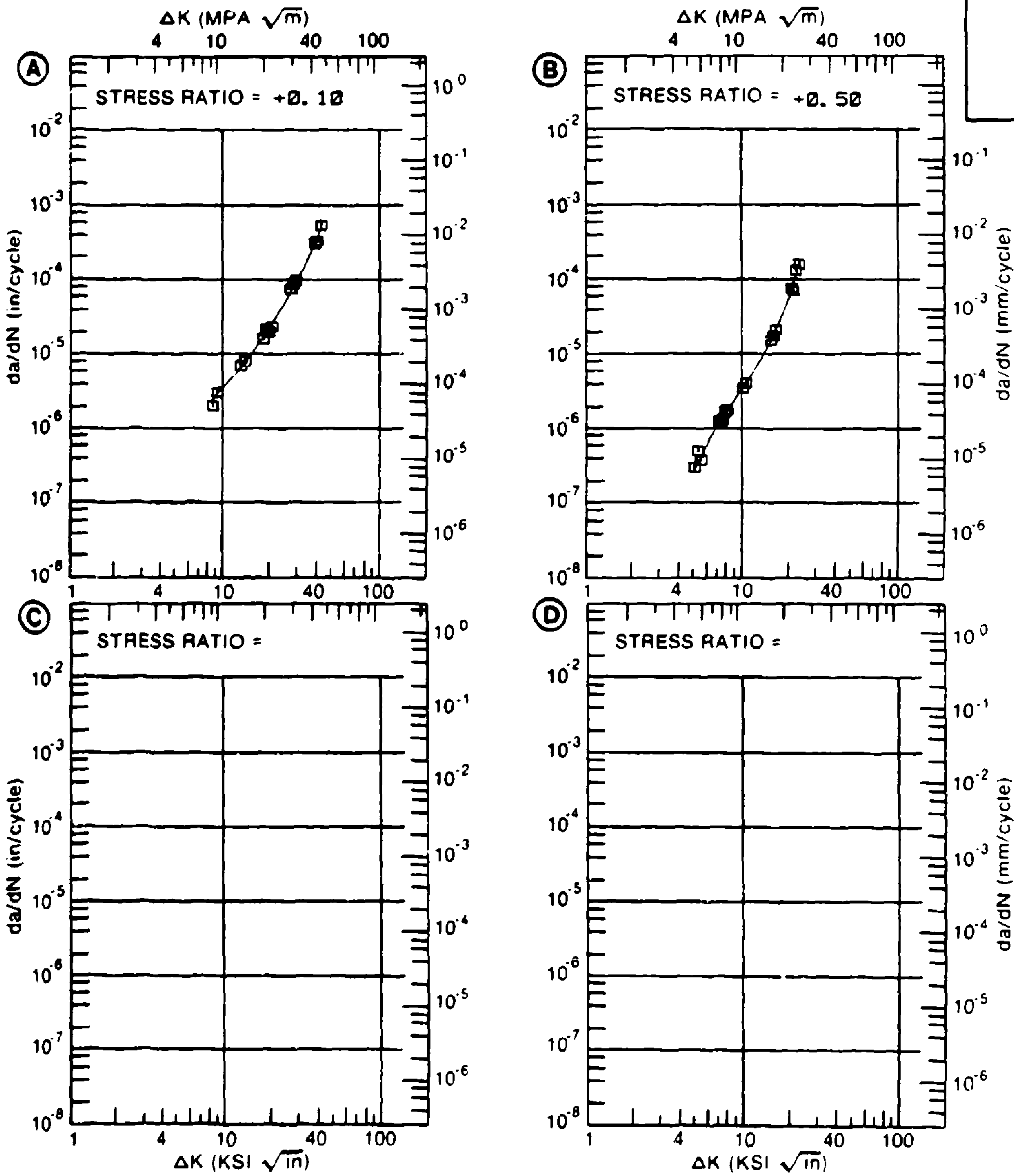

Figure 4.11.3.66

TABLE 4.11.3.67

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 4.11.3.67 INDICATING EFFECT OF FREQUENCY

MATERIAL: TITANIUM TI-6AL-4V
CONDITION: RA
ENVIRONMENT: R.T. , 3.5% NACL

DELTA K (KSI*IN**1/2)		A	B	C	D
		F(HZ)= 0.10	F(HZ)= 10.00		
DELTA K MIN	A: 8.36	2.00			
	B: 8.72		2.33		
	C:				
	D:				
	9.00	2.47	2.79		
	10.00	3.50	4.86		
	13.00	9.45	15.6		
	16.00	21.1	32.6		
	20.00	44.7	63.0		
	25.00	74.0	111.		
	30.00		168.		
	35.00		237.		
	40.00		321.		
DELTA K MAX	A: 26.41	79.4			
	B: 42.50		370.		
	C:				
	D:				
ROOT MEAN SQUARE PERCENT ERROR		9.04	9.11		
LIFE PREDICTION RATIO SUMMARY (NP/NA)	0.0-0.5				
	0.5-0.8	1			
	0.8-1.25		1		
	1.25-2.0				
	>2.0				

Note: DA/DN column units are (10**-6 IN./CYCLE).

CONDITION/HT: RA
FORM: 0.13"TH PLATE
SPECIMEN TYPE: CCP
ORIENTATION: T-L
FREQUENCY: +0.10
ENVIRONMENT: R.T., 3.5% NACL

YIELD STRENGTH: 149.2 KSI
ULT. STRENGTH: 156.2 KSI
SPECIMEN THK: 0.125"
SPECIMEN WIDTH: 5.000"
REFERENCES: 90981

TITAN. ALLOY

TI-6AL-4V

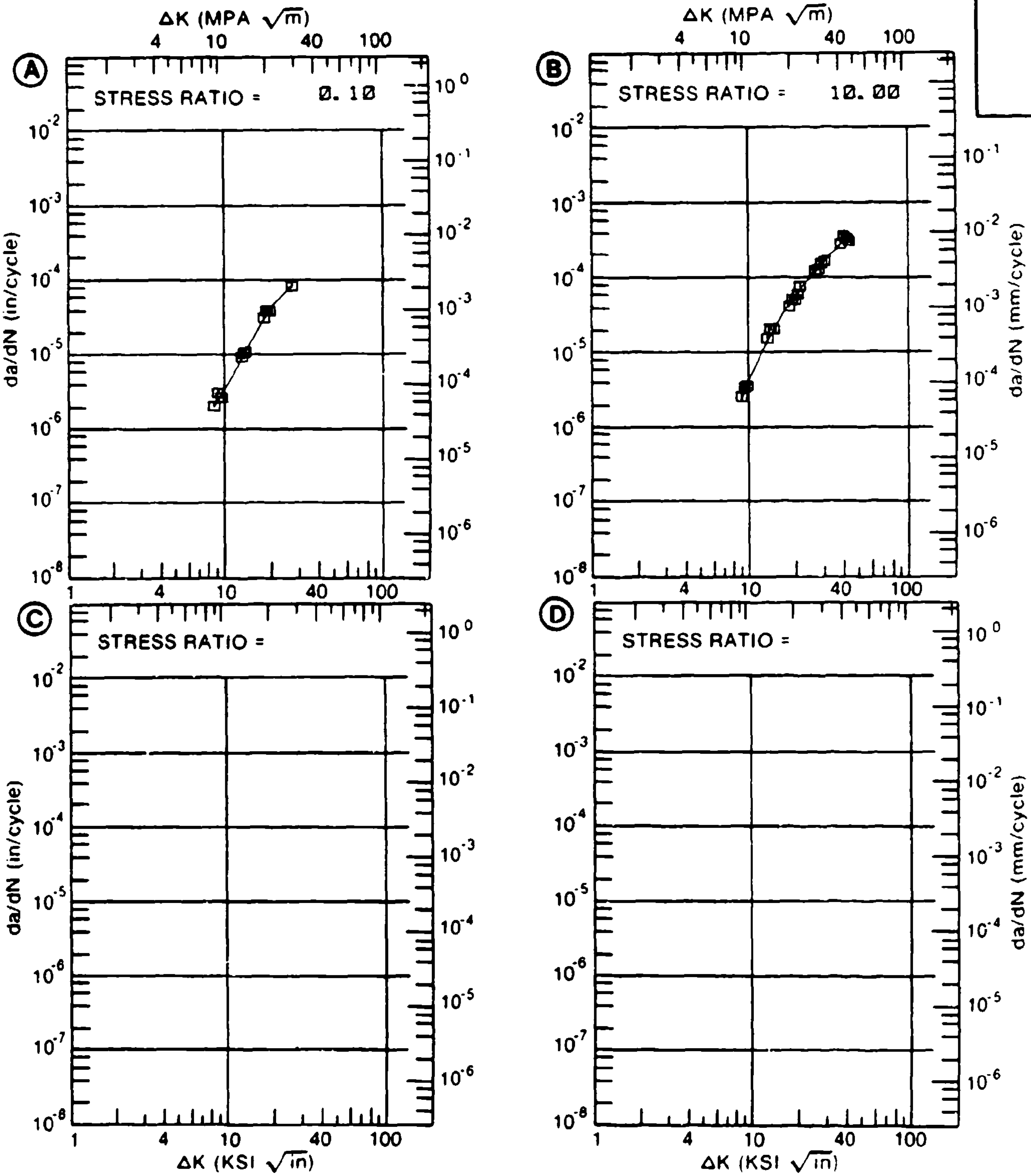

Figure 4.11.3.67

TABLE 4.11.3.68

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 4.11.3.68 INDICATING EFFECT

OF FREQUENCY

MATERIAL: TITANIUM TI-6AL-4V
CONDITION: RA
ENVIRONMENT: R.T. , HUMID AIR

DELTA K (KSI*IN**1/2)			DA/DN (10**-6 IN./CYCLE) A	B	C	D
			F(HZ)= 10.00			
	A:	8.50	.637			
DELTA K	B:					
MIN	C:					
	D:					
		9.00	.792			
		10.00	1.18			
		13.00	3.12			
		16.00	6.30			
		20.00	12.1			
		25.00	19.9			
		30.00	26.1			
		35.00	29.2			
	A:	37.14	29.6			
DELTA K	B:					
MAX	C:					
	D:					

ROOT MEAN SQUARE PERCENT ERROR 12.83

LIFE	0.0-0.5
PREDICTION	0.5-0.8
RATIO	0.8-1.25
SUMMARY	1.25-2.0
(NP/NA)	>2.0

CONDITION/HT: RA
FORM: 0.38"TH PLATE
SPECIMEN TYPE: PTSF
ORIENTATION: L-S
STRESS RATIO: +0.10
ENVIRONMENT: R.T., HUMID AIR

YIELD STRENGTH: 119.1 KSI
ULT. STRENGTH: 138.1 KSI
SPECIMEN THK: 0.376"
SPECIMEN WIDTH: 5.000"
REFERENCES: 90981

TITAN. ALLOY

TI-6AL-4V

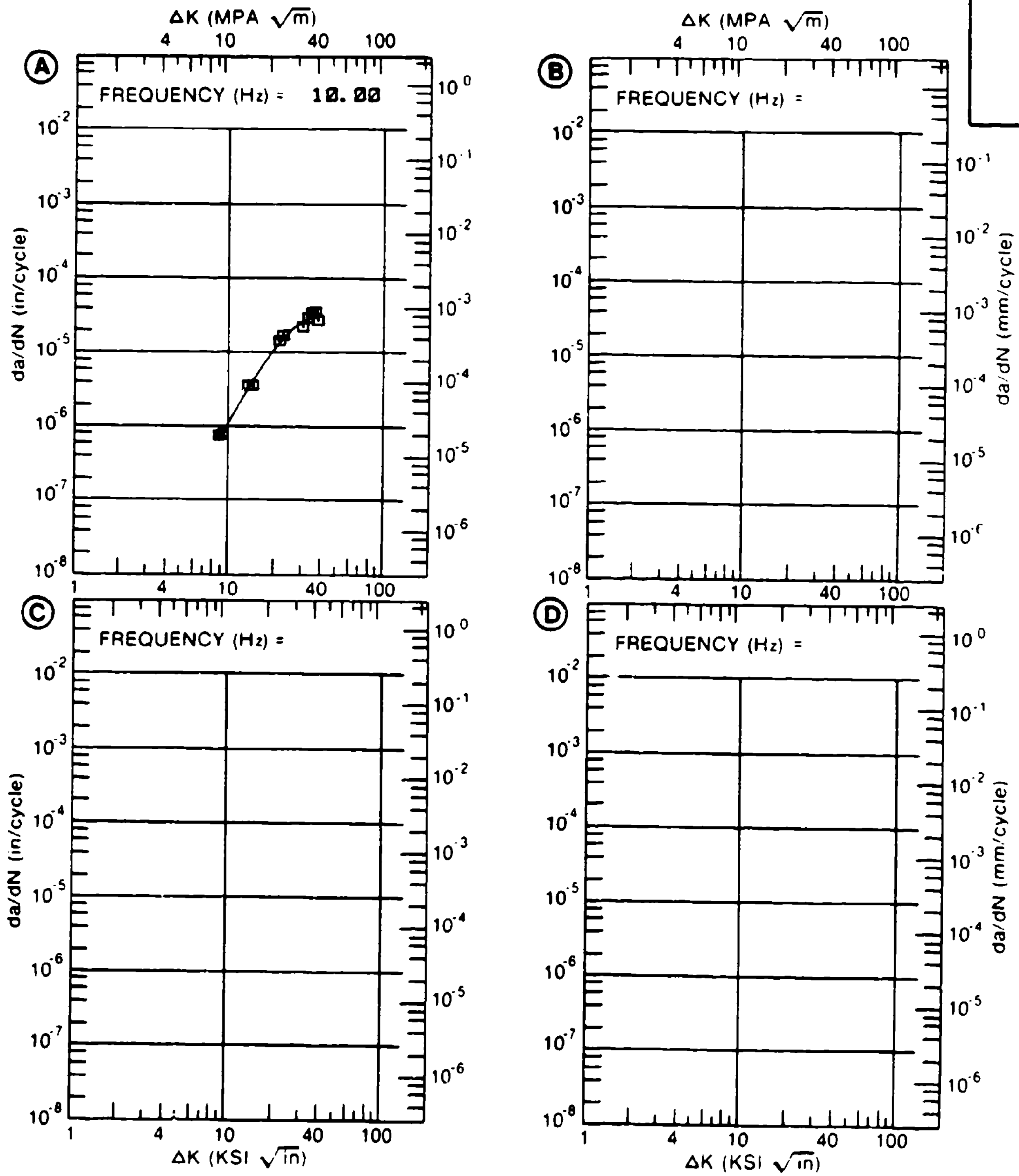

Figure 4.11.3.68

TABLE 4.11.3.69

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 4.11.3.69 INDICATING EFFECT

OF FREQUENCY

MATERIAL: TITANIUM TI-6AL-4V
CONDITION: RA
ENVIRONMENT: R. T. , 3. 5% NACL

DELTA K (KSI*IN**1/2)			DA/DN (10**-6 IN. /CYCLE) A	B	C	D
			F(HZ)= 10. 00			
	A:	15. 77	37. 3			
DELTA K MIN	B:					
	C:					
	D:					
		16. 00	37. 9			
		20. 00	49. 7			
		25. 00	67. 2			
		30. 00	84. 6			
		35. 00	99. 2			
	A:	35. 80	101.			
DELTA K MAX	B:					
	C:					
	D:					

ROOT MEAN SQUARE PERCENT ERROR 22. 70

LIFE	0. 0-0. 5
PREDICTION	0. 5-0. 8
RATIO	0. 8-1. 25
SUMMARY	1. 25-2. 0
(NP/NA)	>2. 0

CONDITION/HT: RA
FORM: 0.38"TH PLATE
SPECIMEN TYPE: PTSF
ORIENTATION: T-S
STRESS RATIO: +0.10
ENVIRONMENT: R.T., 3.5% NACL

YIELD STRENGTH: 141.7 KSI
ULT STRENGTH: 151.8 KSI
SPECIMEN THK: 0.377"
SPECIMEN WIDTH: 5.000"
REFERENCES: 90981

TITAN. ALLOY

TI-6AL-4V

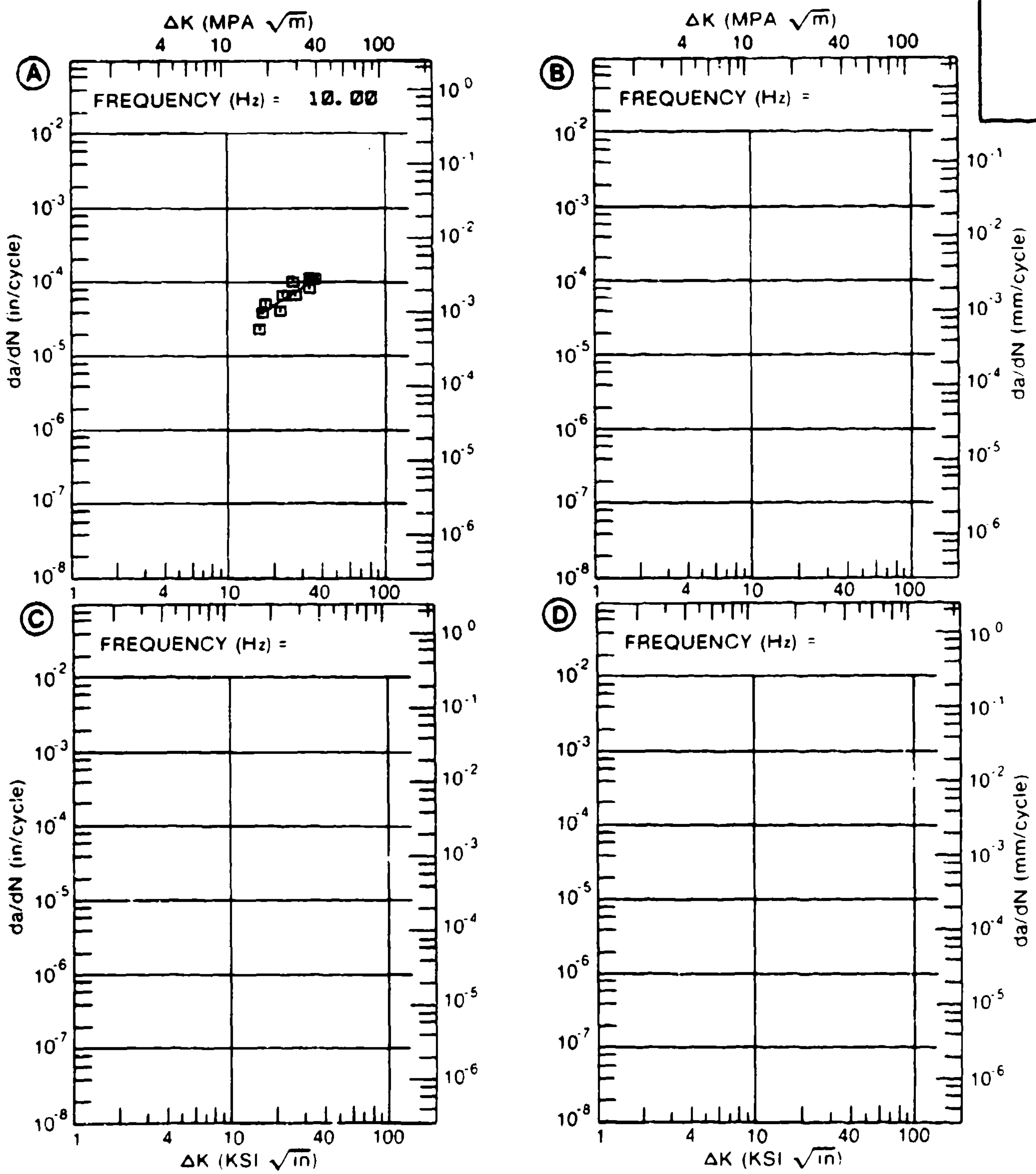

Figure 4.11.3.69

TABLE 4.11.3.70

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 4.11.3.70 INDICATING EFFECT

OF STRESS RATIO

MATERIAL: TITANIUM TI-6AL-4V
CONDITION: RA
ENVIRONMENT: R. T. , H. H. A.

DELTA K (KSI*IN**1/2)		DA/DN (10**-6 IN./CYCLE) A R=+0.10	B R=+0.50	C	D
DELTA K MIN	A: 10.10	4.77			
	B: 5.41		.99		
	C:				
	D:				
	6.00		1.54		
	7.00		2.63		
	8.00		3.84		
	9.00		5.12		
	10.00		6.45		
	13.00	6.51	10.9		
	16.00	9.27	16.7		
	20.00	14.4	26.8		
	25.00	23.2			
DELTA K MAX	A: 28.25	27.0			
	B: 23.27		33.7		
	C:				
	D:				
ROOT MEAN SQUARE PERCENT ERROR		5.20	12.89		
LIFE PREDICTION RATIO SUMMARY (NP/NA)	0.0-0.5				
	0.5-0.8				
	0.8-1.25	1	1		
	1.25-2.0				
	>2.0				

CONDITION/HT: RA
FORM: 0.38"TH PLATE
SPECIMEN TYPE: CCP
ORIENTATION: T-L
FREQUENCY: 10.00 HZ
ENVIRONMENT: R.T., H.H.A.

YIELD STRENGTH: 141.7 KSI
ULT. STRENGTH: 151.8 KSI
SPECIMEN THK: 0.370- 0.371"
SPECIMEN WIDTH: 5.000"
REFERENCES: 00081

TITAN. ALLOY
TI-6AL-4V

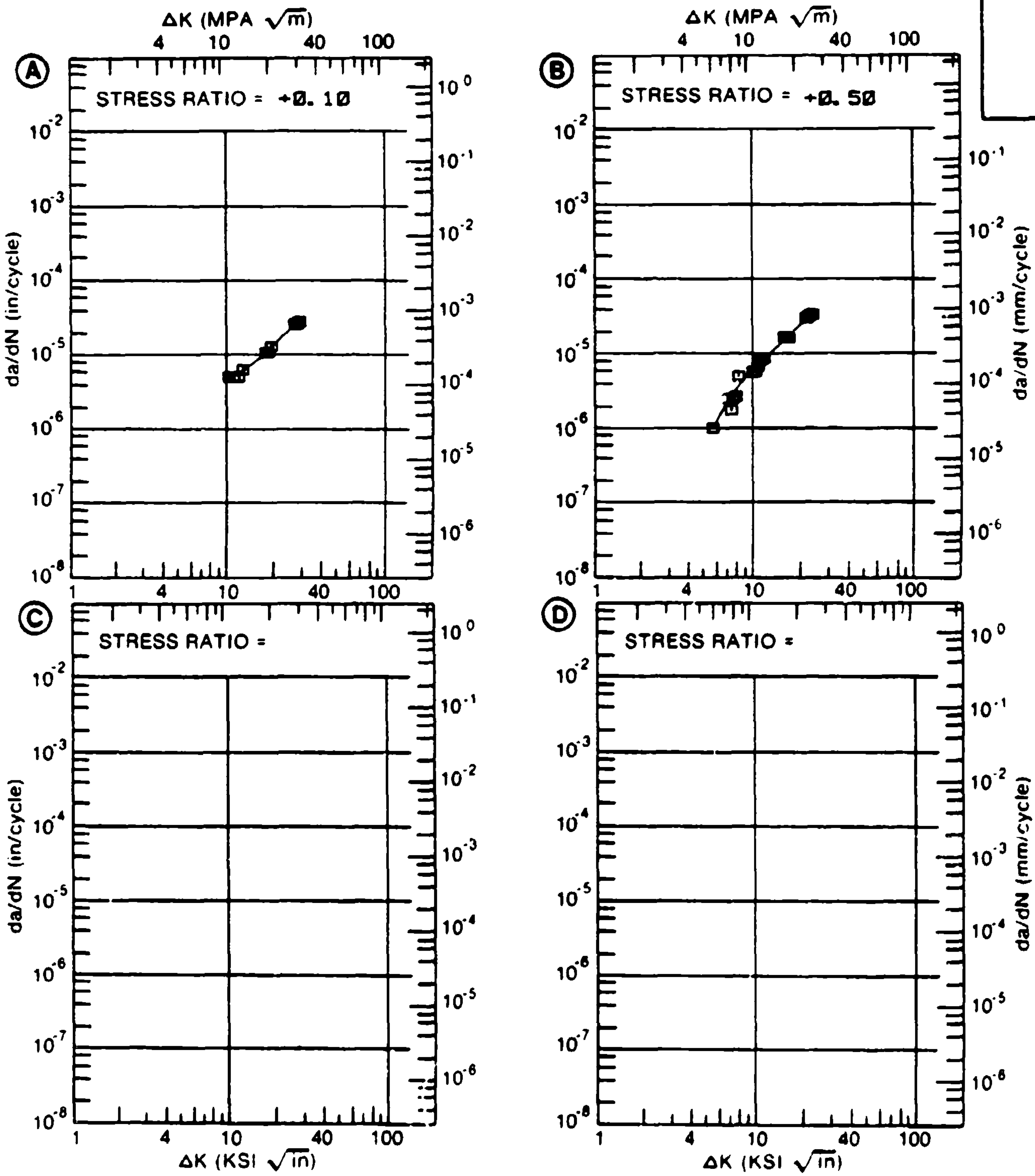

Figure 4.11.3.70

TABLE 4.11.3.71

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 4.11.3.71 INDICATING EFFECT

OF STRESS RATIO

MATERIAL: TITANIUM TI-6AL-4V
CONDITION: RA
ENVIRONMENT: R.T. , 3.5% NACL

DELTA K (KSI*IN**1/2)		DA/DN (10**-6 IN./CYCLE) A R=+0.10	B R=+0.50	C	D
DELTA K MIN	A: 17.57	35.5			
	B: 6.24		15.2		
	C:				
	D:				
	7.00		15.8		
	8.00		22.0		
	9.00		28.4		
	10.00		33.7		
	13.00		51.4		
	16.00		86.8		
	20.00	58.9	168.		
	25.00	86.0			
	30.00	132.			
	35.00	181.			
	40.00	206.			
DELTA K MAX	A: 42.87	209.			
	B: 23.07		697.		
	C:				
	D:				
ROOT MEAN SQUARE PERCENT ERROR		11.25	18.49		
LIFE PREDICTION RATIO SUMMARY (NP/NA)	0.0-0.5				
	0.5-0.8				
	0.8-1.25	1	1		
	1.25-2.0				
	>2.0				

CONDITION/HT: RA
FORM: 0.38"TH PLATE
SPECIMEN TYPE: CCP
ORIENTATION: T-L
FREQUENCY: 10.00 HZ
ENVIRONMENT: R. T., 3.5% NACL

YIELD STRENGTH: 141.7 KSI
ULT. STRENGTH: 151.8 KSI
SPECIMEN THK: 0.372"
SPECIMEN WIDTH: 5.000"
REFERENCES: 00081

TITAN. ALLOY

TI-6AL-4V

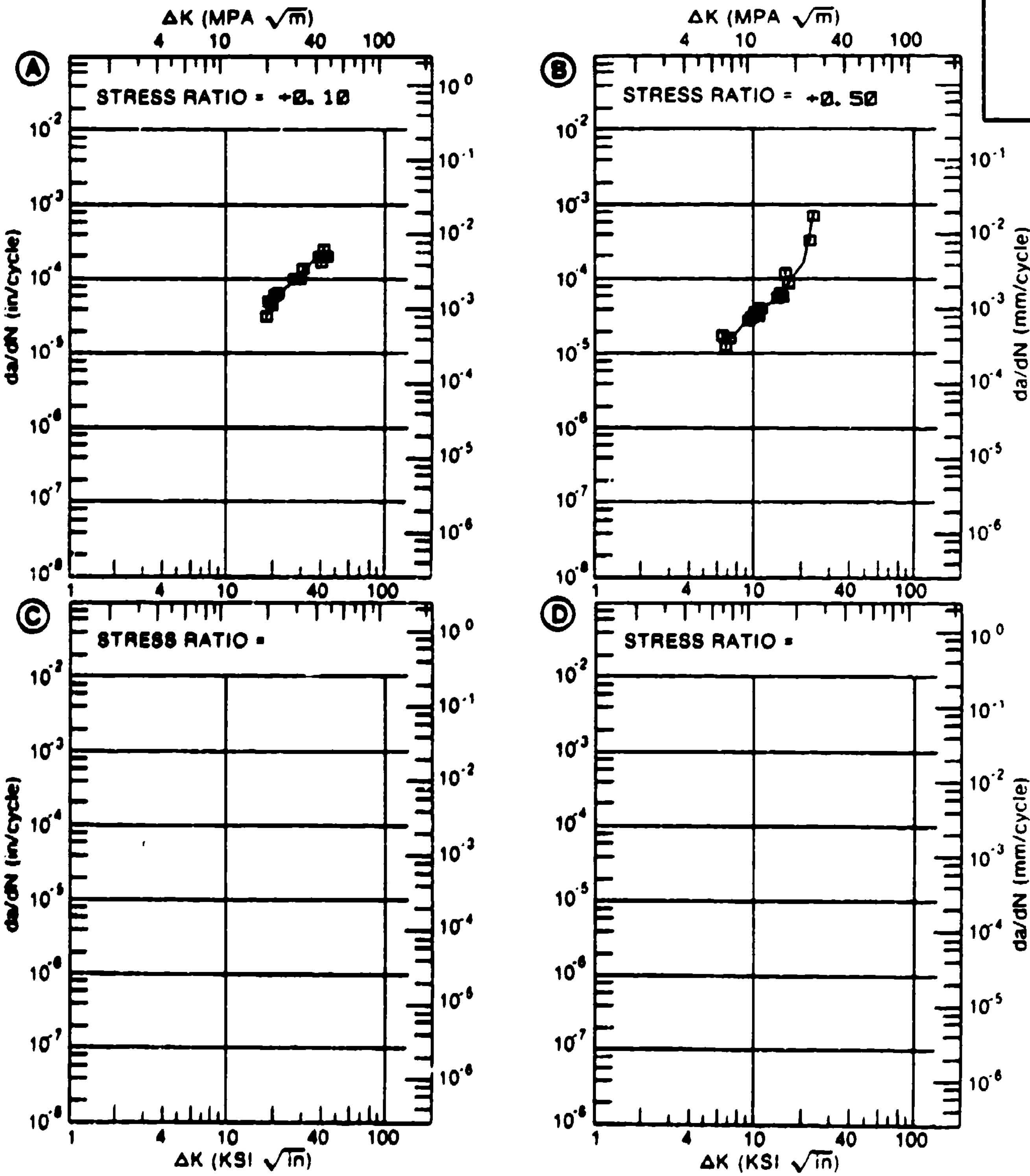

Figure 4.11.3.71

TABLE 4.11.3.72

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 4.11.3.72 INDICATING EFFECT

OF STRESS RATIO

MATERIAL: TITANIUM TI-6AL-4V
CONDITION: RA
ENVIRONMENT: R.T. , S.T.W.

DELTA K (KSI*IN**1/2)		DA/DN (10**-6 IN./CYCLE) A	B	C	D
		R=+0.08			
DELTA K MIN	A: 5.67	.224			
	B:				
	C:				
	D:				
	6.00	.262			
	7.00	.437			
	8.00	.747			
	9.00	1.26			
	10.00	2.08			
	13.00	7.51			
	16.00	19.9			
	20.00	48.7			
DELTA K MAX	A: 23.65	81.2			
	B:				
	C:				
	D:				
ROOT MEAN SQUARE PERCENT ERROR		22.66			
LIFE PREDICTION RATIO SUMMARY (NP/NA)	0.0-0.5				
	0.5-0.8				
	0.8-1.25				
	1.25-2.0	1			
	>2.0				

CONDITION/HT: RA
FORM: 0.38"TH PLATE
SPECIMEN TYPE: CT
ORIENTATION: T-L
FREQUENCY: 1.00 HZ
ENVIRONMENT: R.T., S.T.W.

YIELD STRENGTH: 128.0 KSI
ULT. STRENGTH: 140.0 KSI
SPECIMEN THK: 0.410"
SPECIMEN WIDTH: 7.400"
REFERENCES: 88578

TITAN. ALLOY

TI-6AL-4V

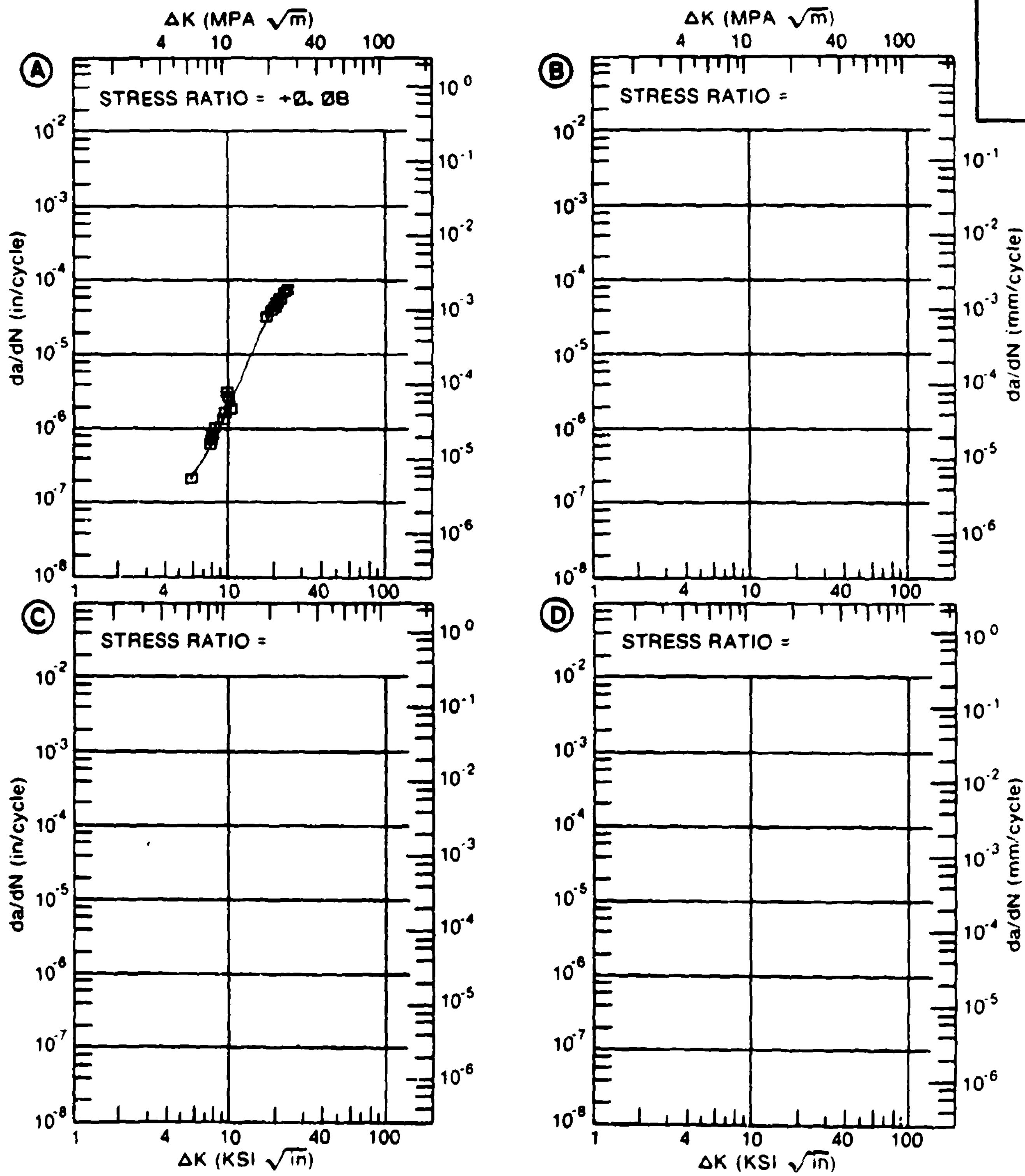

Figure 4.11.3.72

TABLE 4.11.3.73

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 4.11.3.73 INDICATING EFFECT
OF STRESS RATIO

MATERIAL: TITANIUM TI-6AL-4V
CONDITION: RA
ENVIRONMENT: R.T. ,S.T.W.

DELTA K (KSI*IN**1/2)		DA/DN (10**-6 IN./CYCLE) A	B	C	D
		R=+0.10			
DELTA K MIN A:	29.01	1405.			
B:					
C:					
D:					
	30.00	1418.			
	35.00	1800.			
	40.00	2531.			
	50.00	3951.			
DELTA K MAX A:	52.51	4043.			
B:					
C:					
D:					

ROOT MEAN SQUARE PERCENT ERROR 13.89

LIFE PREDICTION RATIO SUMMARY (NP/NA)		
	0.0-0.5	
	0.5-0.8	
	0.8-1.25	2
	1.25-2.0	
	>2.0	

CONDITION/HT: RA
FORM: 0.38"TH PLATE
SPECIMEN TYPE: CT
ORIENTATION: T-L
FREQUENCY: 0.10 HZ
ENVIRONMENT: R.T., S.T.W.

YIELD STRENGTH: 141.7 KSI
ULT. STRENGTH: 151.8 KSI
SPECIMEN THK: 0.374- 0.375"
SPECIMEN WIDTH: 2.550"
REFERENCES: 90981

TITAN. ALLOY

TI-6AL-4V

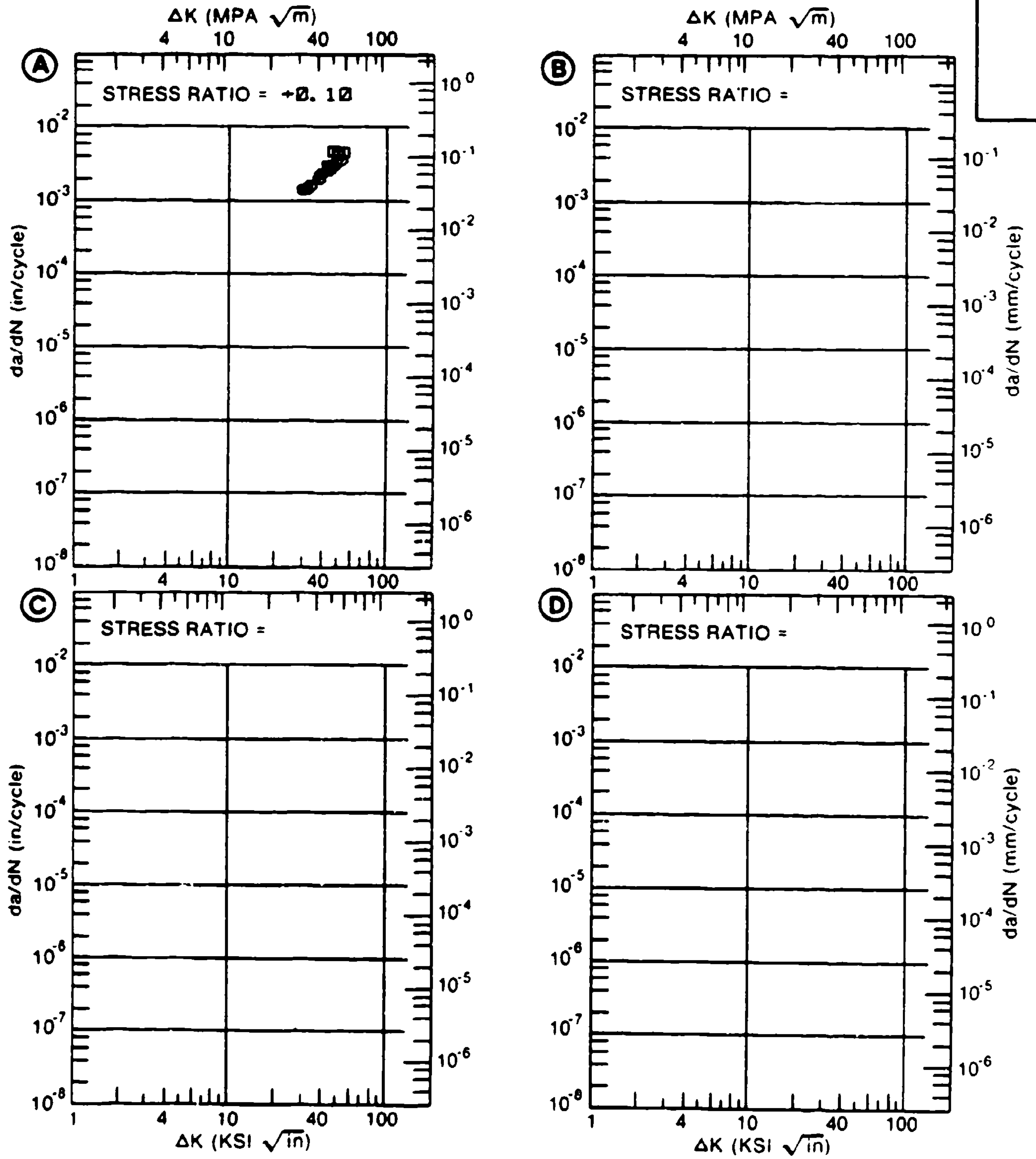

Figure 4.11.3.73

TABLE 4.11.3.74

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 4.11.3.74 INDICATING EFFECT
OF ENVIRONMENT

MATERIAL: TITANIUM TI-6AL-4V
CONDITION: RA

DELTA K (KSI*IN**1/2)		DA/DN (10**-6 IN./CYCLE) A	B	C	D
		E= R.T. LAB AIR			
DELTA K MIN	A: 13.05	4.93			
	B:				
	C:				
	D:				
	16.00	11.0			
	20.00	21.3			
	25.00	41.9			
	30.00	87.4			
	35.00	205.			
DELTA K MAX	A: 36.63	279.			
	B:				
	C:				
	D:				
ROOT MEAN SQUARE PERCENT ERROR		9.02			
LIFE PREDICTION RATIO SUMMARY (NP/NA)	0.0-0.5				
	0.5-0.8				
	0.8-1.25	1			
	1.25-2.0				
	>2.0				

CONDITION/HT: RA
FORM: 0.38"TH PLATE
SPECIMEN TYPE: CT
ORIENTATION: T-L
STRESS RATIO: +0.10
FREQUENCY: 10.00 HZ

YIELD STRENGTH: 149.2 KSI
ULT. STRENGTH: 158.2 KSI
SPECIMEN THK: 0.372"
SPECIMEN WIDTH: 2.549"
REFERENCES: 90981

TITAN. ALLOY

TI-6AL-4V

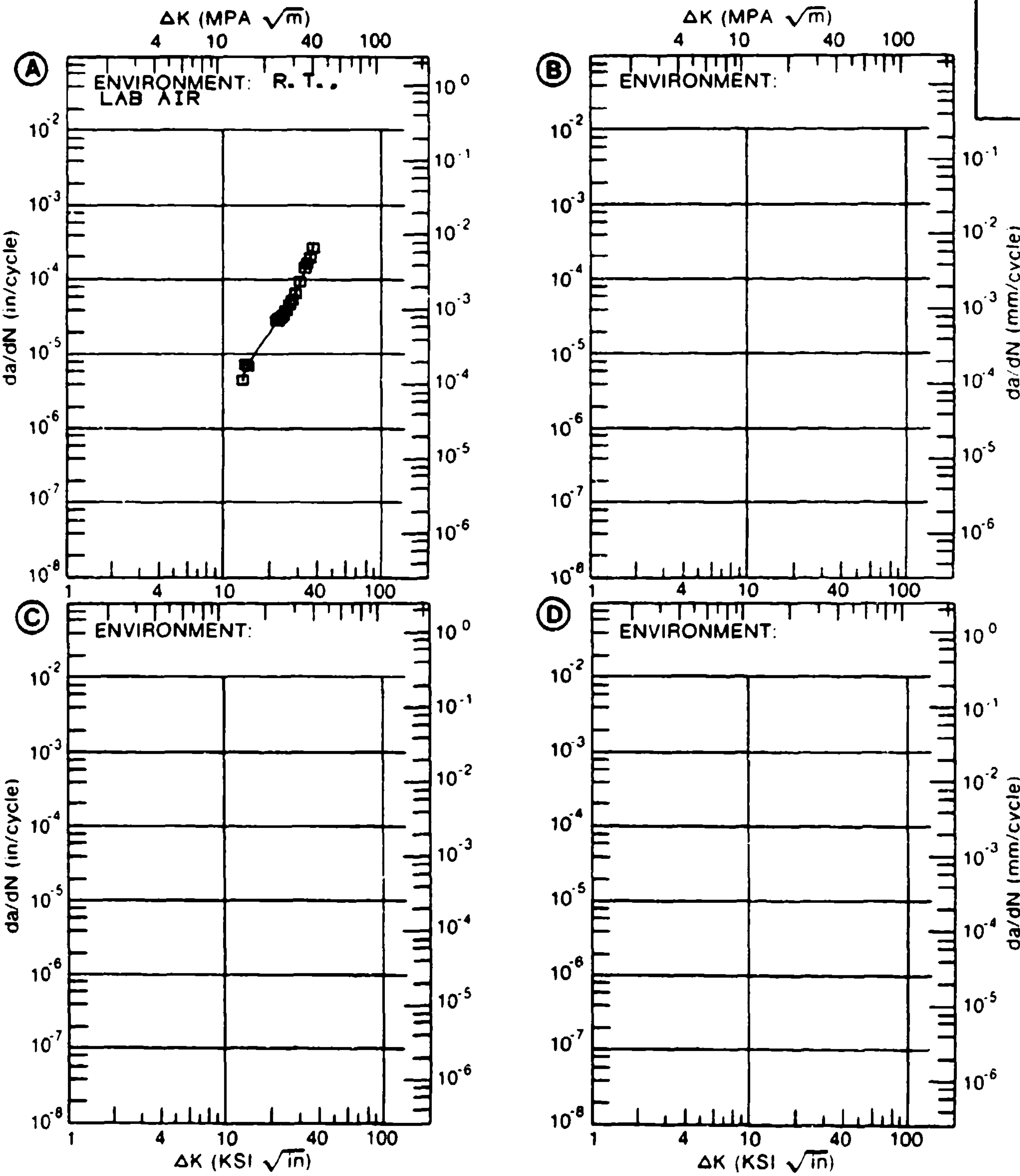

Figure 4.11.3.74

TABLE 4.11.3.75

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 4.11.3.75 INDICATING EFFECT

OF ENVIRONMENT

MATERIAL: TITANIUM TI-6AL-4V
CONDITION: RA

DELTA K (KSI*IN**1/2)			DA/DN (10**-6 IN./CYCLE) A	B	C	D
			E= R.T. DIST. WATER	E= R.T. 3.5% NACL	E= R.T. S.T.W.	
DELTA K MIN	A:	9.44	.241			
	B:	8.60		.341		
	C:	9.40			.364	
	D:					
		9.00		.405		
		10.00	.434	.646	.646	
		13.00		2.66		
DELTA K MAX	A:	11.75	1.32			
	B:	13.55		3.37		
	C:	12.61			2.09	
	D:					
ROOT MEAN SQUARE PERCENT ERROR			15.71	16.16	11.43	

LIFE PREDICTION RATIO SUMMARY (NP/NA)	
	0.0-0.5
	0.5-0.8
	0.8-1.25
	1.25-2.0
	>2.0

CONDITION/HT: RA
FORM: 1.00"TH PLATE
SPECIMEN TYPE: DCB
ORIENTATION: T-L
STRESS RATIO: +0.00
FREQUENCY: 15.00 HZ

YIELD STRENGTH:
ULT. STRENGTH:
SPECIMEN THK:
SPECIMEN WIDTH:
REFERENCES: 88140

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TI-6AL-4V

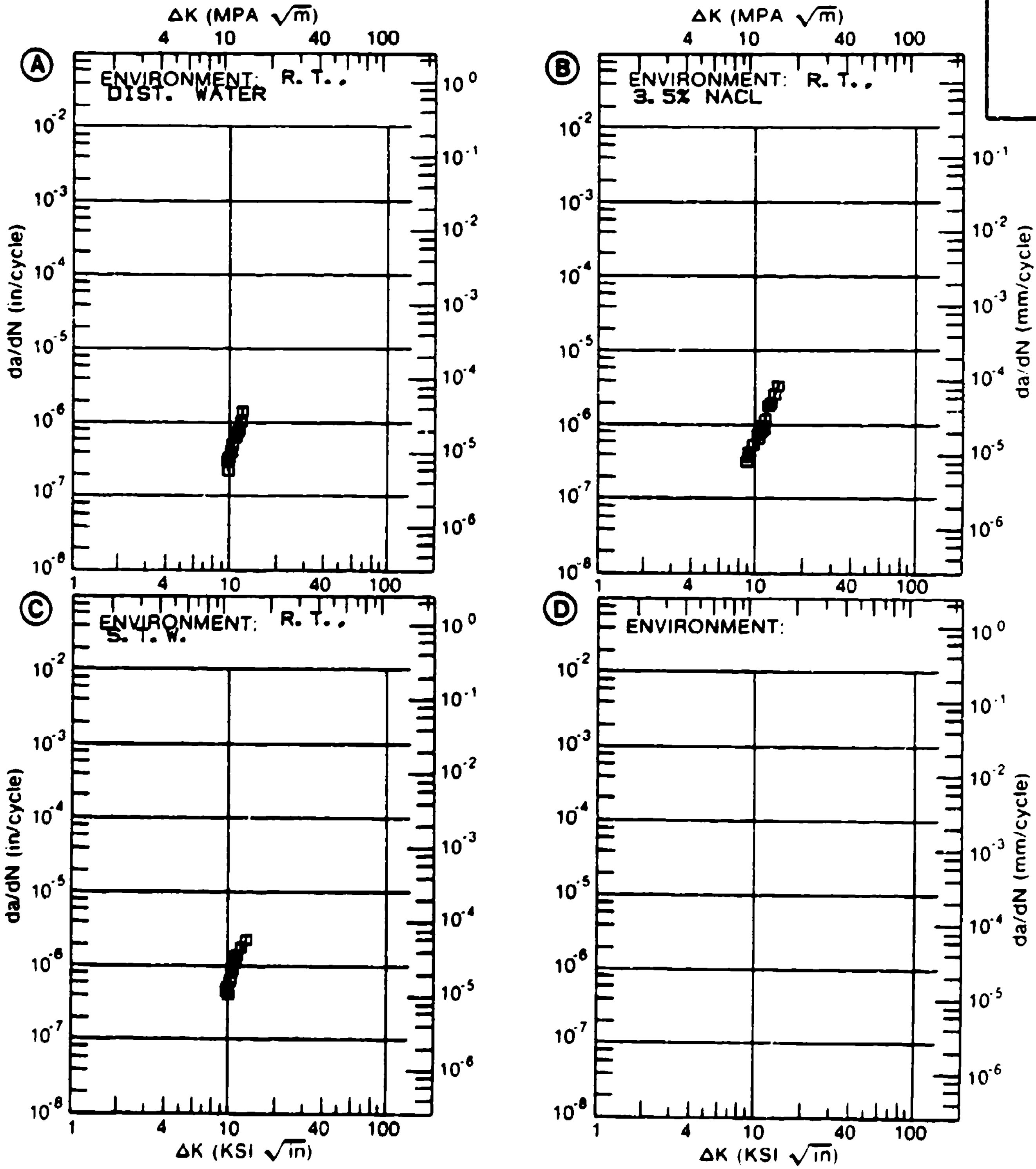

Figure 4.11.3.75

TABLE 4.11.3.76

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 4.11.3.76 INDICATING EFFECT
OF ENVIRONMENT

MATERIAL: TITANIUM TI-6AL-4V
CONDITION: RA

DELTA K (KSI*IN**1/2)		DA/DN (10**-6 IN./CYCLE) A: E= R.T. DRY AIR	B: E= R.T. H2O STAURATED JP-4 FUEL	C: E= R.T. DIST. WATER	D
DELTA K MIN	A: 12.23	1.04			
	B: 28.27		32.7		
	C: 26.64			30.5	
	D:				
	13.00	1.45			
	16.00	3.88			
	20.00	9.08			
	25.00	18.5			
	30.00	31.5	36.7	44.5	
	35.00	49.5	51.9	67.7	
	40.00	74.9	75.9	96.3	
	50.00	164.	179.	197.	
	60.00		465.	455.	
	70.00		1304.	1228.	
	80.00			3814.	
DELTA K MAX	A: 58.67	322.			
	B: 71.17		1476.		
	C: 81.31			4465.	
	D:				
ROOT MEAN SQUARE PERCENT ERROR		25.19	10.30	22.32	

LIFE PREDICTION RATIO SUMMARY (NP/NA)	
	0.0-0.5
	0.5-0.8
	0.8-1.25
	1.25-2.0
	>2.0

CONDITION/HT: RA
FORM: 1.00"TH PLATE
SPECIMEN TYPE: DCB
ORIENTATION: T-L
STRESS RATIO: +0.10
FREQUENCY: 1.00 HZ

YIELD STRENGTH:
ULT. STRENGTH:
SPECIMEN THK:
SPECIMEN WIDTH:
REFERENCES:88140

TITAN. ALLOY

TI-6AL-4V

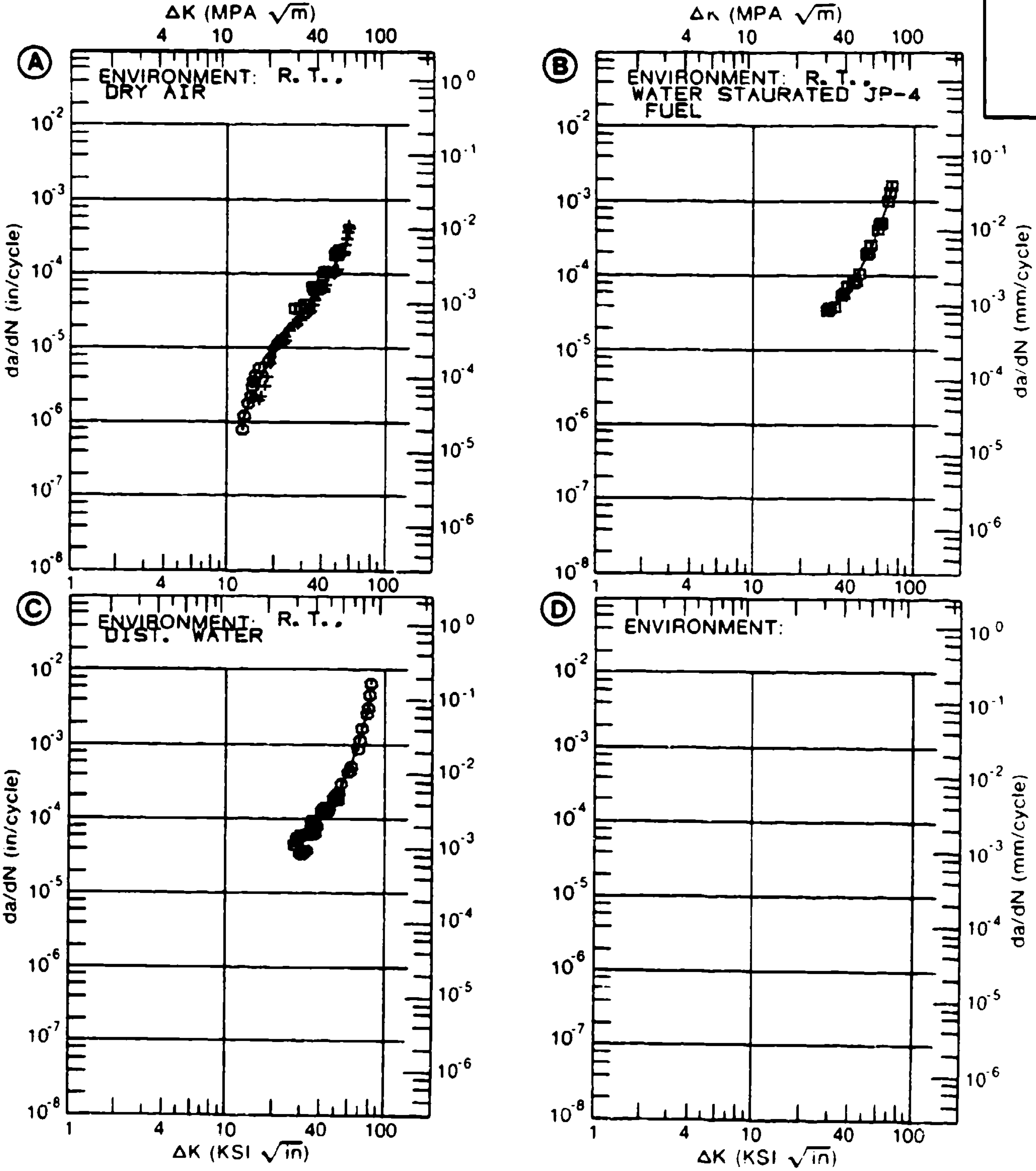

Figure 4.11.3.76

TABLE 4.11.3.77

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 4.11.3.77 INDICATING EFFECT

OF ENVIRONMENT

MATERIAL: TITANIUM TI-6AL-4V
CONDITION: RA

DELTA K (KSI*IN**1/2)		DA/DN (10**-6 IN./CYCLE) A	B	C	D
		E= R.T. 3.5% NACL	E= R.T. S.T.W.		
DELTA K MIN	A: 14.96	14.1			
	B: 28.42		84.9		
	C:				
	D:				
	16.00	16.3			
	20.00	28.6			
	25.00	54.7			
	30.00	97.2	100.		
	35.00	161.	144.		
	40.00	251.	187.		
	50.00	526.	310.		
	60.00	943.	604.		
	70.00	1504.	1456.		
	80.00		4302.		
DELTA K MAX	A: 72.43	1660.			
	B: 81.35		5050.		
	C:				
	D:				
ROOT MEAN SQUARE PERCENT ERROR		14.68	8.17		

LIFE PREDICTION RATIO SUMMARY (NP/NA)
0.0-0.5
0.5-0.8
0.8-1.25
1.25-2.0
>2.0

CONDITION/HT: RA
FORM: 1.00"TH PLATE
SPECIMEN TYPE: DCB
ORIENTATION: T-L
STRESS RATIO: +0.10
FREQUENCY: 1.00 HZ

YIELD STRENGTH:
ULT. STRENGTH:
SPECIMEN THK:
SPECIMEN WIDTH:
REFERENCES: 88140

TITAN. ALLOY

TI-6AL-4V

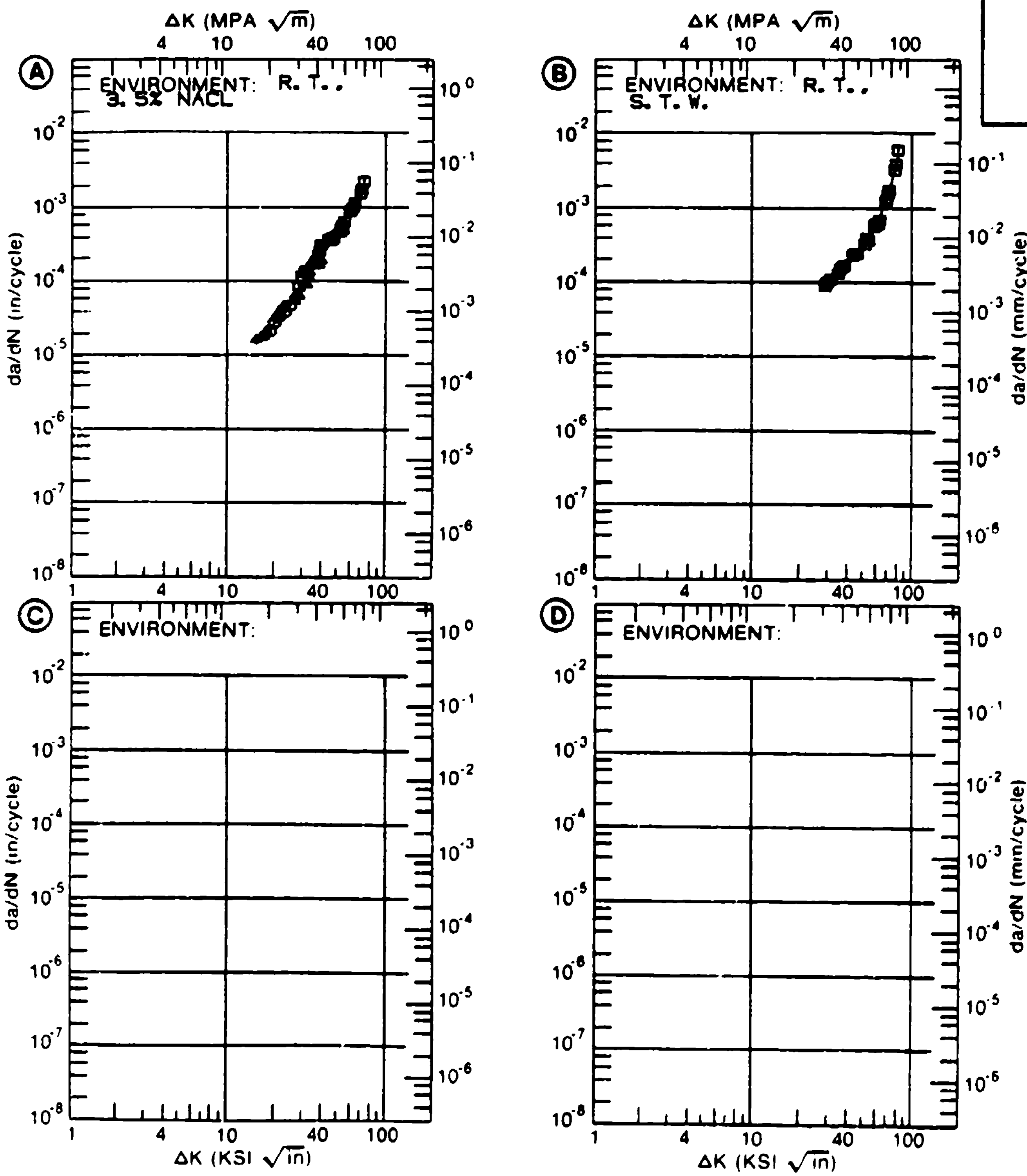

Figure 4.11.3.77

TABLE 4.11.3.78

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 4.11.3.78 INDICATING EFFECT

OF ENVIRONMENT

MATERIAL: TITANIUM TI-6AL-4V
CONDITION: RA

DELTA K (KSI*IN**1/2)		DA/DN (10**-6 IN./CYCLE) A	B	C	D
		E= R.T. DRY AIR	E= R.T. H2O SATURATED JP-4 FUEL	E= R.T. DIST. WATER	
DELTA K MIN A:	27.66	26.5			
B:	28.99		42.8		
C:	14.90			3.43	
D:					
	16.00			6.83	
	20.00			19.0	
	25.00			34.4	
	30.00	37.9	47.2	63.3	
	35.00	66.1	70.6	105.	
	40.00	101.	99.2	152.	
	50.00	224.	204.	254.	
	60.00	582.	507.	468.	
	70.00		1547.	1243.	
DELTA K MAX A:	62.76	787.			
B:	79.39		5230.		
C:	78.93			8143.	
D:					
ROOT MEAN SQUARE PERCENT ERROR		7.58	13.78	16.77	

LIFE PREDICTION RATIO SUMMARY (NP/NA)	
	0.0-0.5
	0.5-0.8
	0.8-1.25
	1.25-2.0
	>2.0

CONDITION/HT: RA
FORM: 1.00"TH PLATE
SPECIMEN TYPE: DCB
ORIENTATION: T-L
STRESS RATIO: +0.10
FREQUENCY: 0.10 HZ

YIELD STRENGTH:
ULT. STRENGTH:
SPECIMEN THK:
SPECIMEN WIDTH:
REFERENCES: 88140

TITAN. ALLOY

TI-6AL-4V

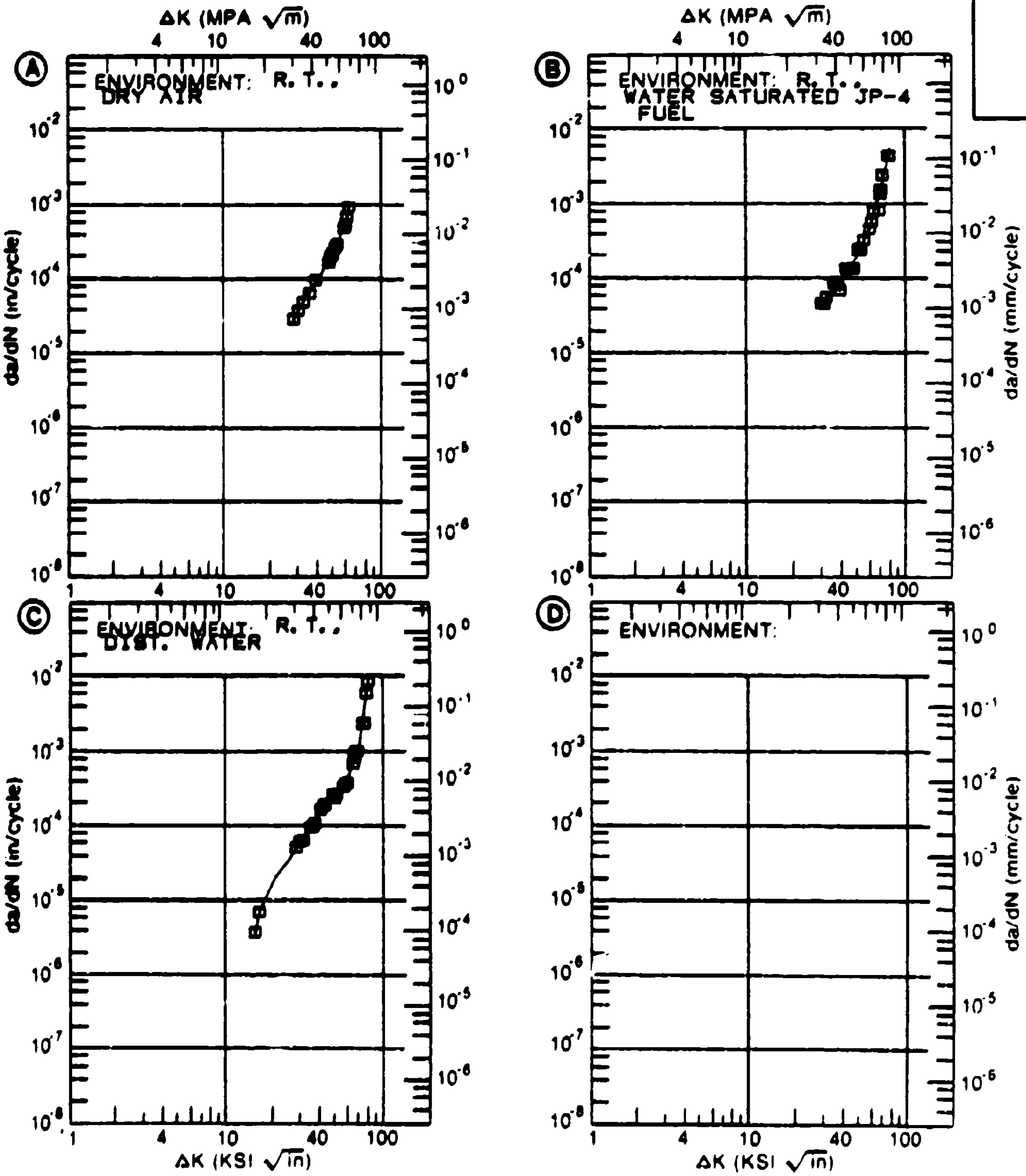

Figure 4.11.3.78

TABLE 4.11.3.79

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 4.11.3.79 INDICATING EFFECT

OF ENVIRONMENT

MATERIAL: TITANIUM TI-6AL-4V
CONDITION: RA

DELTA K (KSI*IN**1/2)		DA/DN (10**-6 IN./CYCLE) A	B	C	D
		E= R.T. 3.5% NACL	E= R.T. S.T.W.		
DELTA K MIN	A: 26.28	363.			
	B: 30.23		143.		
	C:				
	D:				
	30.00	642.			
	35.00	984.	286.		
	40.00	1262.	449.		
	50.00	1852.	905.		
	60.00	3042.	2145.		
	70.00	6176.			
DELTA K MAX	A: 75.42	9991.			
	B: 60.36		2225.		
	C:				
	D:				
ROOT MEAN SQUARE PERCENT ERROR		18.75	15.79		

LIFE PREDICTION RATIO SUMMARY (NP/NA)	
	0.0-0.5
	0.5-0.8
	0.8-1.25
	1.25-2.0
	>2.0

CONDITION/HT: RA
FORM: 1.00"TH PLATE
SPECIMEN TYPE: DCB
ORIENTATION: T-L
STRESS RATIO: +0.10
FREQUENCY: 0.10 HZ

YIELD STRENGTH:
ULT. STRENGTH:
SPECIMEN THK:
SPECIMEN WIDTH:
REFERENCES: 88140

TITAN. ALLOY

TI-6AL-4V

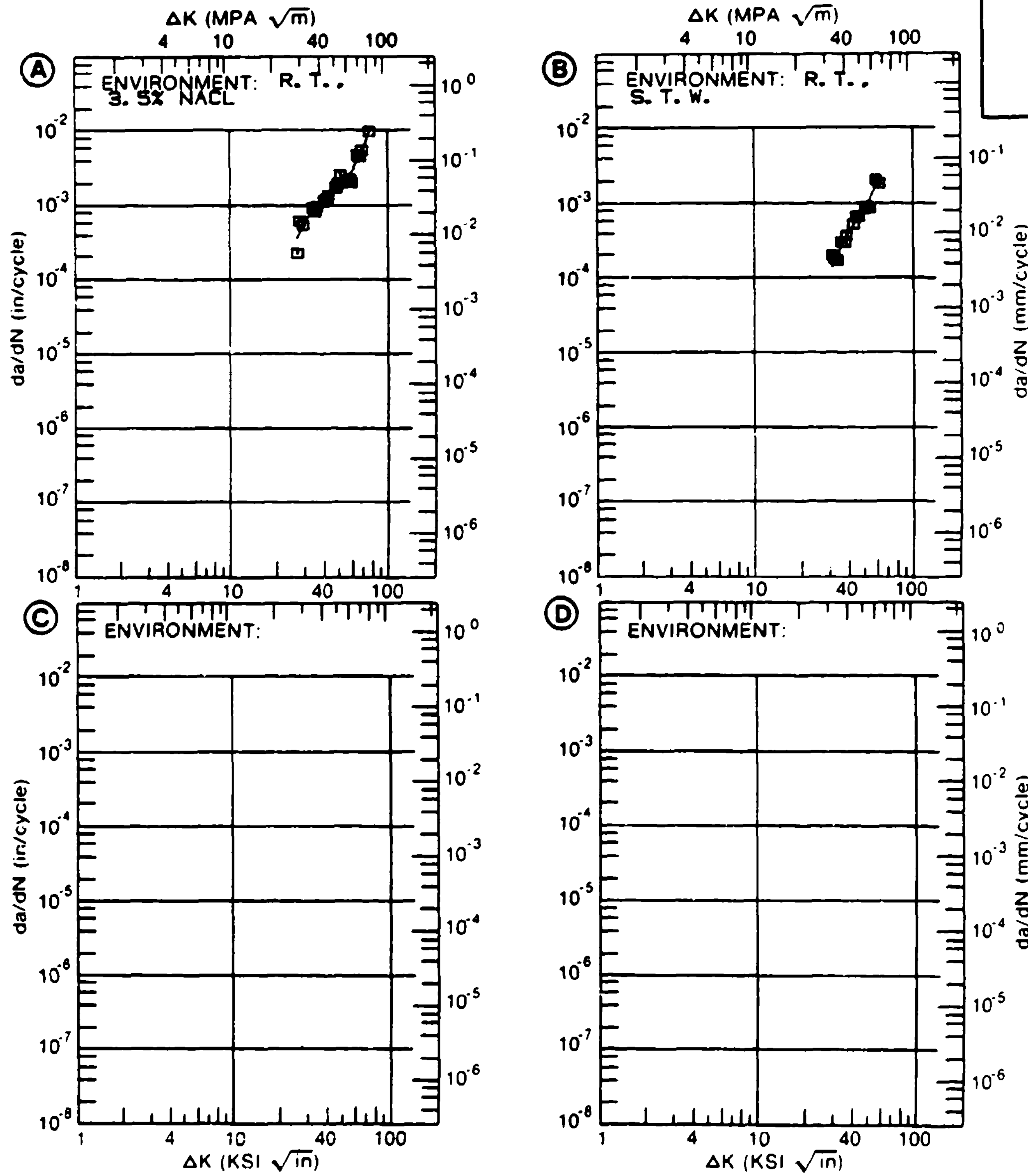

Figure 4.11.3.79

TABLE 4.11.3.80

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 4.11.3.80 INDICATING EFFECT
OF ENVIRONMENT

MATERIAL: TITANIUM TI-6AL-4V
CONDITION: RA

DELTA K (KSI*IN**1/2)		DA/DN (10**-6 IN./CYCLE) A: E= R.T. DRY AIR	B: E= R.T. H2O SATURATED JP-4 FUEL	C: E= R.T. ALT JP-4 FUEL & DIST. WATER	D
DELTA K MIN	A: 7.95	.364			
	B: 8.65		.789		
	C: 7.94			1.07	
	D:				
	8.00	.381		1.07	
	9.00	.840	.950	1.16	
	10.00	1.52	1.53	1.55	
	13.00	4.71	4.57	6.24	
	16.00	9.13	9.49	19.1	
	20.00	17.2	18.4	35.4	
	25.00	34.7	35.1	51.4	
	30.00	71.5	64.4	80.0	
	35.00	157.	120.	157.	
	40.00		278.		
DELTA K MAX	A: 37.05	220.			
	B: 45.45		2354.		
	C: 39.99			396.	
	D:				
ROOT MEAN SQUARE PERCENT ERROR		16.89	17.75	23.26	

LIFE PREDICTION RATIO SUMMARY (NP/NA)	
	0.0-0.5
	0.5-0.8
	0.8-1.25
	1.25-2.0
	>2.0

CONDITION/HT: RA
FORM: 1.00"TH PLATE
SPECIMEN TYPE: DCB
ORIENTATION: T-L
STRESS RATIO: +0.50
FREQUENCY: 1.00 HZ

YIELD STRENGTH:
ULT. STRENGTH:
SPECIMEN THK:
SPECIMEN WIDTH:
REFERENCES: 88140

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TI-6AL-4V

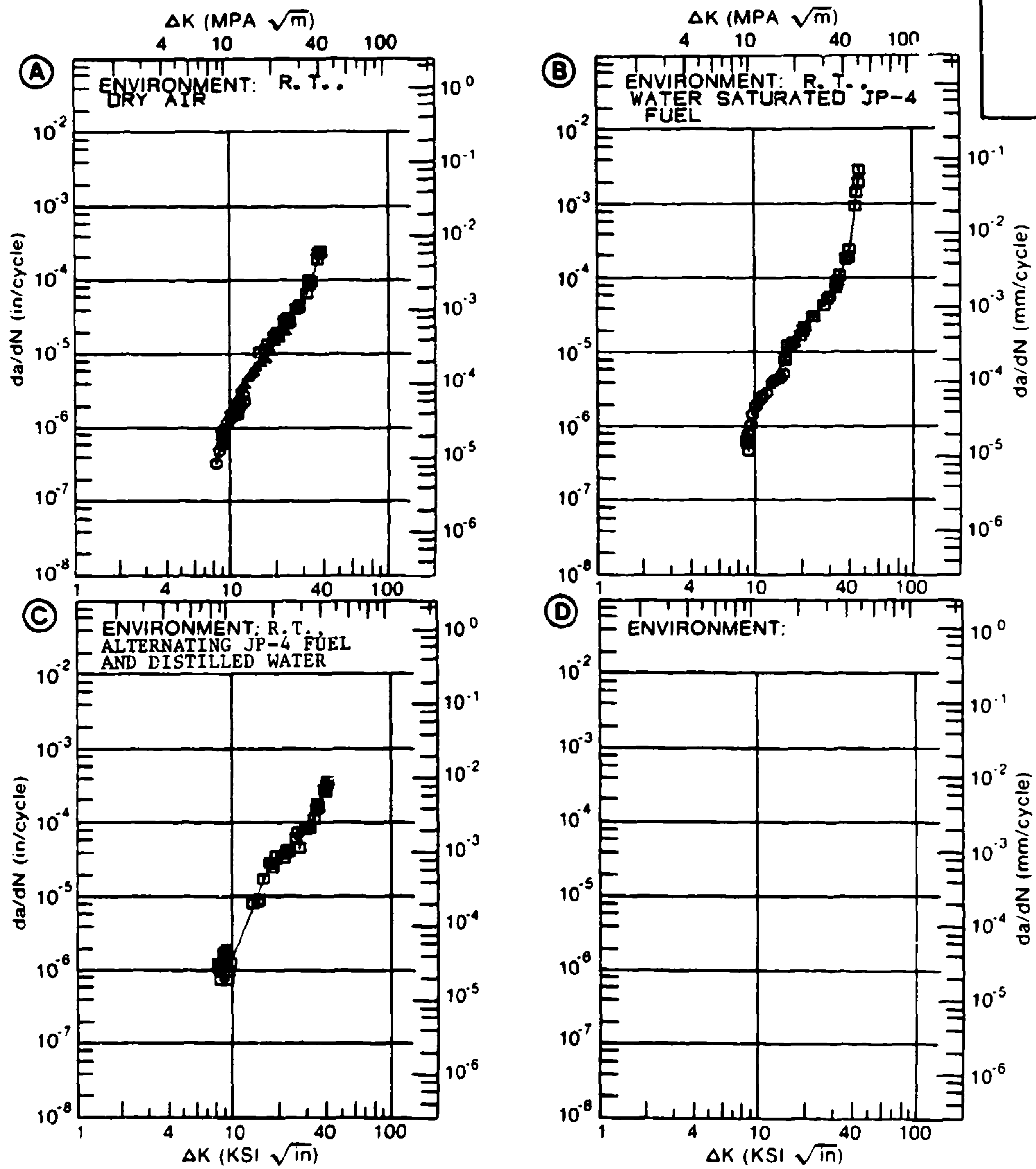

Figure 4.11.3.80

TABLE 4.11.3.81

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 4.11.3.81 INDICATING EFFECT

OF ENVIRONMENT

MATERIAL: TITANIUM TI-6AL-4V
CONDITION: RA

DELTA K (KSI*IN**1/2)		DA/DN (10**-6 IN./CYCLE) A	B	C	D
		E=+ 175F DRY AIR	E=+ 175F JP-4 FUEL	E=+ 175F DIST. WATER	E=+ 175F 3.5% NACL
DELTA K MIN	A: 15.65	6.24			
	B: 16.60		10.4		
	C: 15.44			13.0	
	D: 16.62				39.9
	16.00	6.72		15.2	
	20.00	13.3	16.9	29.6	266.
	25.00	24.8	27.0	43.6	477.
	30.00	41.7	40.7	60.8	537.
	35.00	67.2	64.2	93.6	698.
	40.00	107.	109.	166.	1277.
DELTA K MAX	A: 42.30	133.			
	B: 45.72		219.		
	C: 44.48			314.	
	D: 46.18				4629.
ROOT MEAN SQUARE PERCENT ERROR		9.95	6.80	6.53	36.25

LIFE PREDICTION RATIO SUMMARY (NP/NA)	
	0.0-0.5
	0.5-0.8
	0.8-1.25
	1.25-2.0
	>2.0

CONDITION/HT: RA
FORM: 1.00"TH PLATE
SPECIMEN TYPE: DCB
ORIENTATION: T-L
STRESS RATIO: +0.50
FREQUENCY: 1.00 HZ

YIELD STRENGTH:
ULT. STRENGTH:
SPECIMEN THK:
SPECIMEN WIDTH:
REFERENCES: 88140

TITAN. ALLOY

TI-6AL-4V

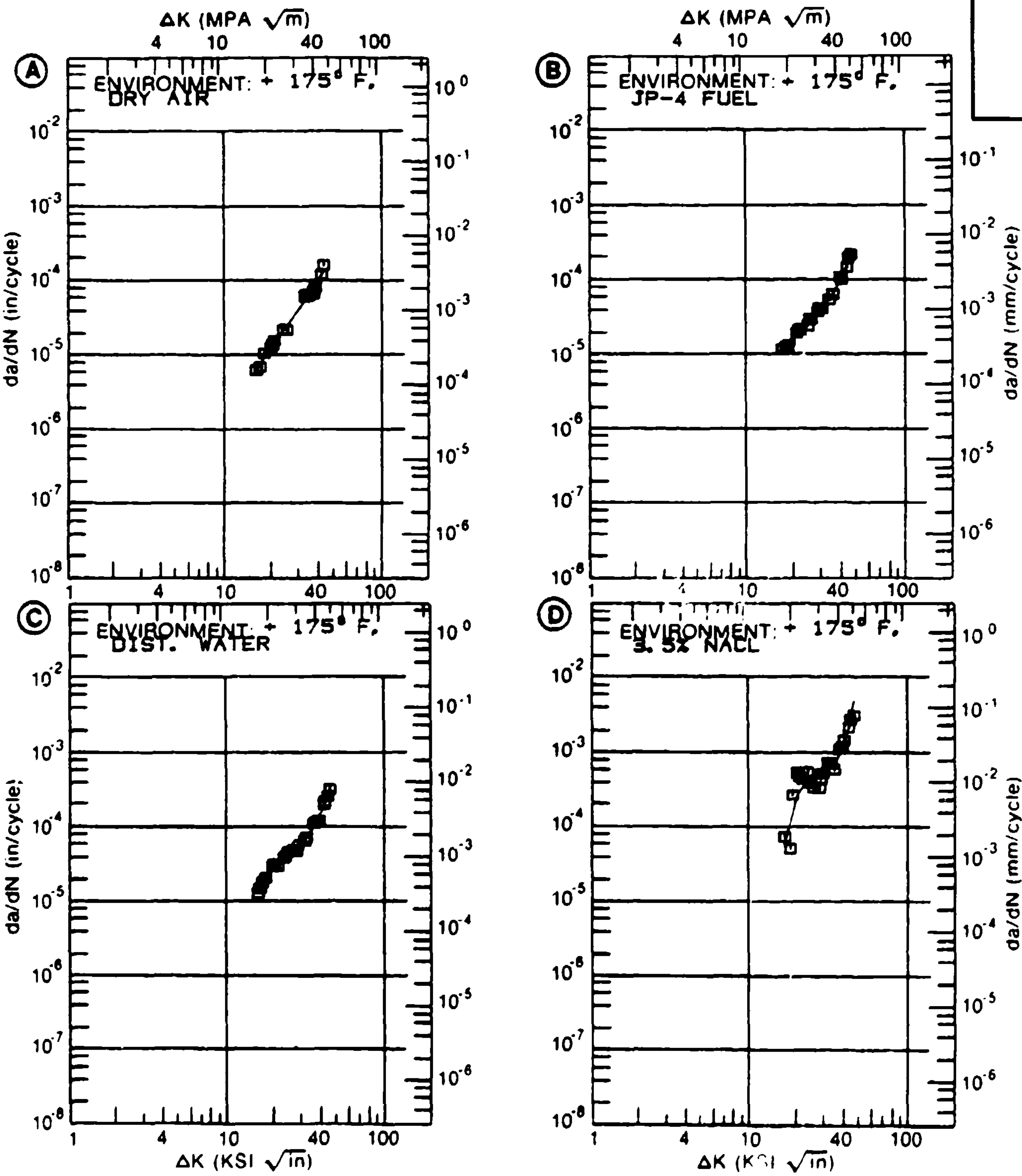

Figure 4.11.3.81

TABLE 4.11.3.82

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 4.11.3.82 INDICATING EFFECT

OF ENVIRONMENT

MATERIAL: TITANIUM TI-6AL-4V
CONDITION: RA

DELTA K (KSI*IN**1/2)		DA/DN (10**-6 IN./CYCLE) A: E= R.T. DIST. WATER	B: E= R.T. DIST. H2O CRACK SPRAYED WITH LPS-3	C: E= R.T. 3.5% NACL	D: E= R.T. S.T.W.
DELTA K MIN	A: 8.08	.507			
	B: 15.22		11.9		
	C: 8.86			1.02	
	D: 9.27				1.21
	9.00	1.26		1.15	
	10.00	2.64		2.65	2.02
	13.00	10.3		20.3	9.56
	16.00	20.9	11.1	63.4	24.9
	20.00	36.8	22.8	117.	52.5
	25.00	61.9	42.7	165.	93.6
	30.00	102.	65.0	236.	149.
	35.00	177.	121.	401.	235.
	40.00	394.	369.	838.	384.
DELTA K MAX	A: 44.55	1764.			
	B: 44.64		8433.		
	C: 44.53			1937.	
	D: 40.49				403.
ROOT MEAN SQUARE PERCENT ERROR		15.72	32.49	30.11	12.99

LIFE PREDICTION RATIO SUMMARY (NP/NA)	
	0.0-0.5
	0.5-0.8
	0.8-1.25
	1.25-2.0
	>2.0

CONDITION/HT: RA
FORM: 1.00"TH PLATE
SPECIMEN TYPE: DCB
ORIENTATION: T-L
STRESS RATIO: +0.50
FREQUENCY: 1.00 HZ

YIELD STRENGTH:
ULT. STRENGTH:
SPECIMEN THK:
SPECIMEN WIDTH:
REFERENCES: 88140

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TI-6AL-4V

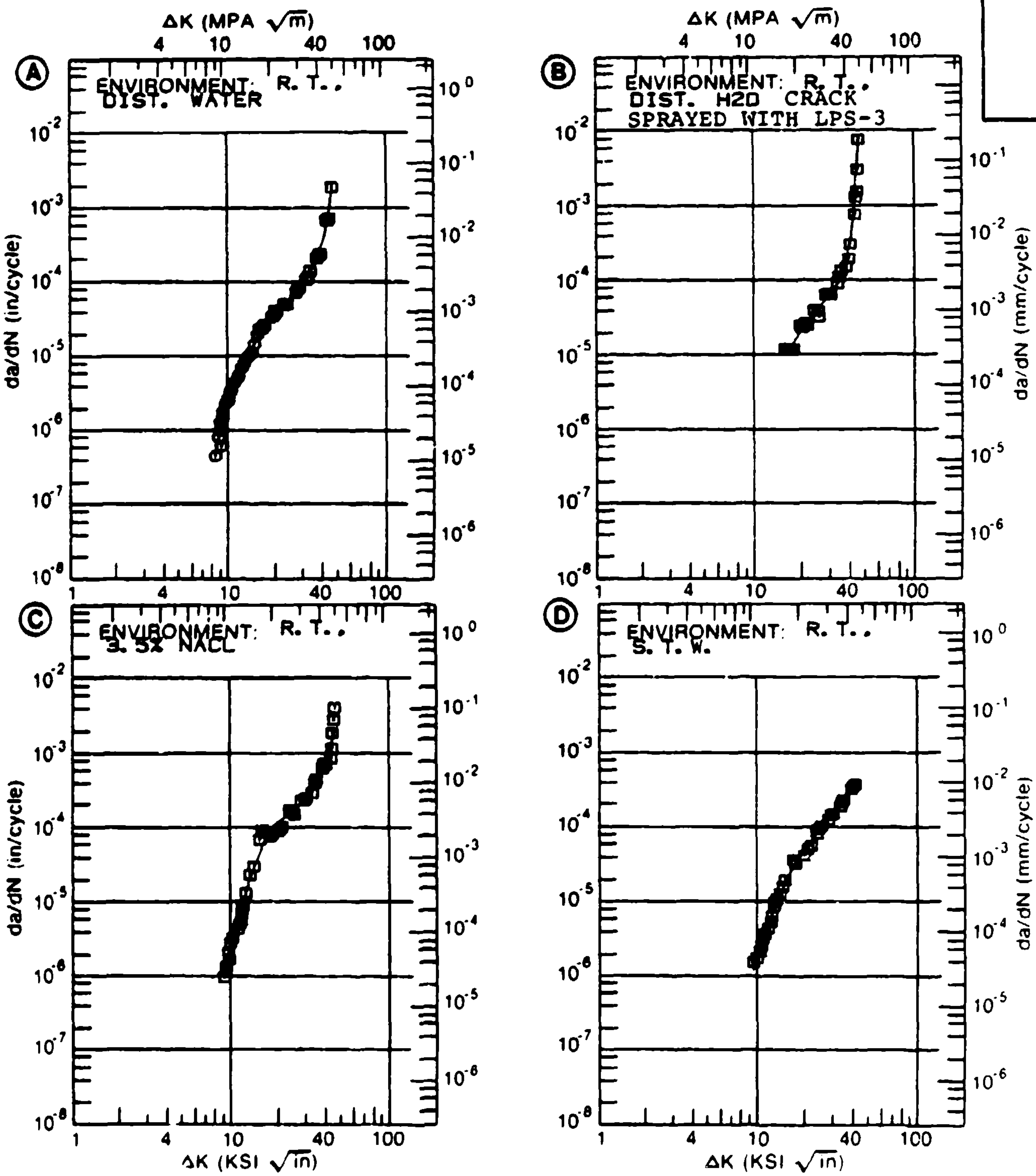

Figure 4.11.3.82

TABLE 4.11.3.83

FATIQUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 4.11.3.83 INDICATING EFFECT

OF ENVIRONMENT

MATERIAL: TITANIUM TI-6AL-4V
CONDITION: RA

DELTA K (KSI*IN**1/2)		DA/DN (10**-6 IN./CYCLE) A	B	C	D
		E=- 65F NITROGEN & AIR			
DELTA K MIN	A: 17.05	5.84			
	B:				
	C:				
	D:				
	20.00	12.2			
	25.00	21.7			
	30.00	37.0			
	35.00	83.7			
DELTA K MAX	A: 39.00	209.			
	B:				
	C:				
	D:				

ROOT MEAN SQUARE PERCENT ERROR 13.05

LIFE	0.0-0.5
PREDICTION	0.5-0.8
RATIO	0.8-1.25
SUMMARY	1.25-2.0
(NP/NA)	>2.0

CONDITION/HT: RA
FORM: 1.00"TH PLATE
SPECIMEN TYPE: DCB
ORIENTATION: T-L
STRESS RATIO: +0.50
FREQUENCY: 1.00 HZ

YIELD STRENGTH:
ULT. STRENGTH:
SPECIMEN THK:
SPECIMEN WIDTH:
REFERENCES: 88140

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TI-6AL-4V

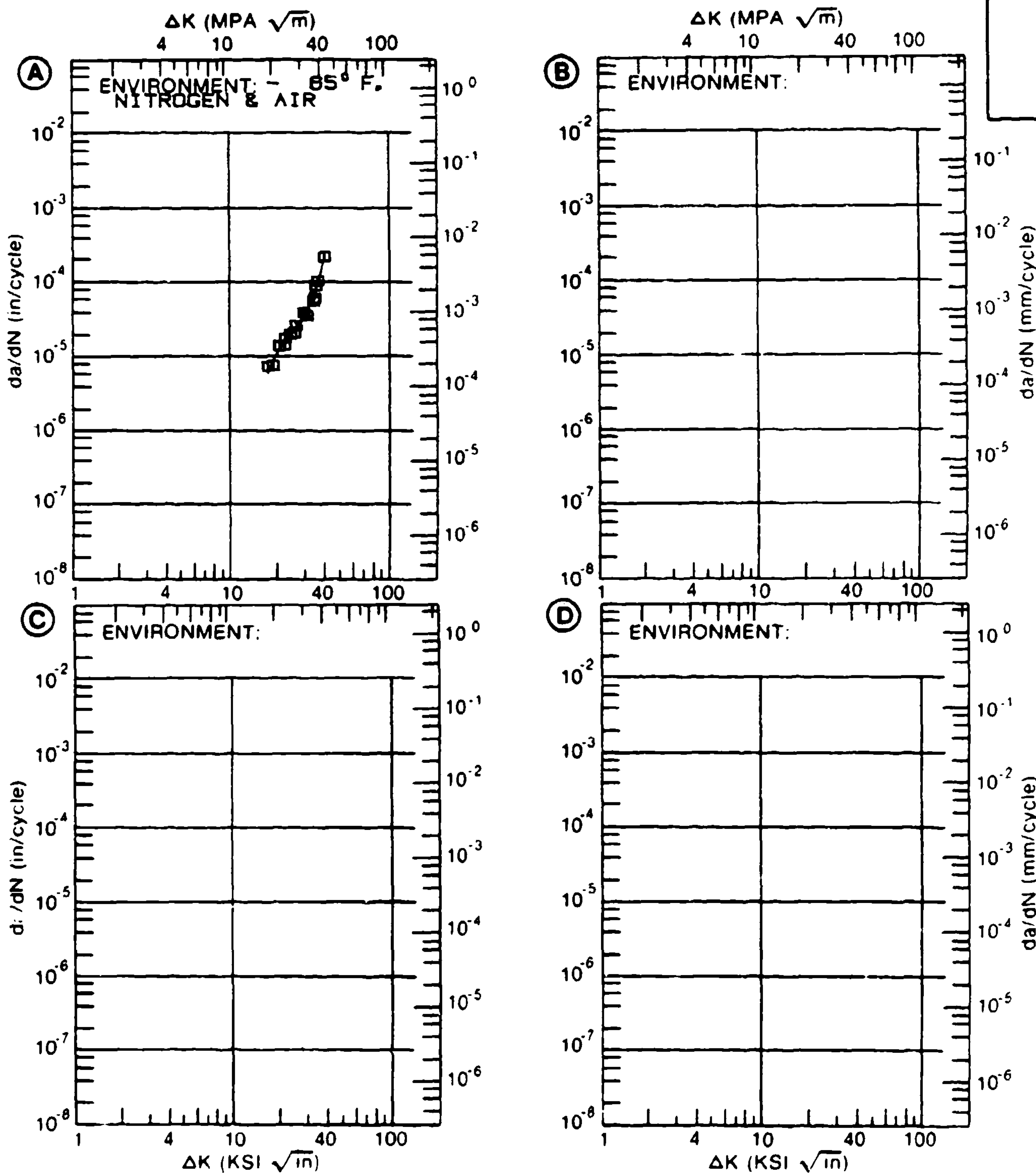

Figure 4.11.3.83

TABLE 4.11.3.84

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 4.11.3.84 INDICATING EFFECT

OF ENVIRONMENT

MATERIAL: TITANIUM TI-6AL-4V
CONDITION: RA

DELTA K (KSI*IN**1/2)		DA/DN (10**-6 IN./CYCLE) A	B	C	D
		E= R.T. DRY AIR	E= R.T. H2O SATURATED JP-4 FUEL	E= R.T. DIST. WATER	
DELTA K MIN A:	8.99	.930			
DELTA K MIN B:	15.67		12.1		
DELTA K MIN C:	14.81			9.45	
DELTA K MIN D:					
	9.00	.930			
	10.00	1.08			
	13.00	2.57			
	16.00	6.86	12.3	12.2	
	20.00	20.4	17.0	21.8	
	25.00	48.6	36.3	43.6	
	30.00	70.2	70.5	117.	
	35.00		128.	391.	
	40.00		302.	1251.	
DELTA K MAX A:	31.84	72.2			
DELTA K MAX B:	46.00		2006.		
DELTA K MAX C:	40.19			1196.	
DELTA K MAX D:					
ROOT MEAN SQUARE PERCENT ERROR		92.37	14.73	12.84	

LIFE PREDICTION RATIO SUMMARY (NP/NA)	
	0.0-0.5
	0.5-0.8
	0.8-1.25
	1.25-2.0
	>2.0

CONDITION/HT: RA
FORM: 1.00"TH PLATE
SPECIMEN TYPE: DCB
ORIENTATION: T-L
STRESS RATIO: +0.50
FREQUENCY: 0.10 HZ

YIELD STRENGTH:
ULT. STRENGTH:
SPECIMEN THK:
SPECIMEN WIDTH:
REFERENCES:00140

TITAN. ALLOY

TI-6AL-4V

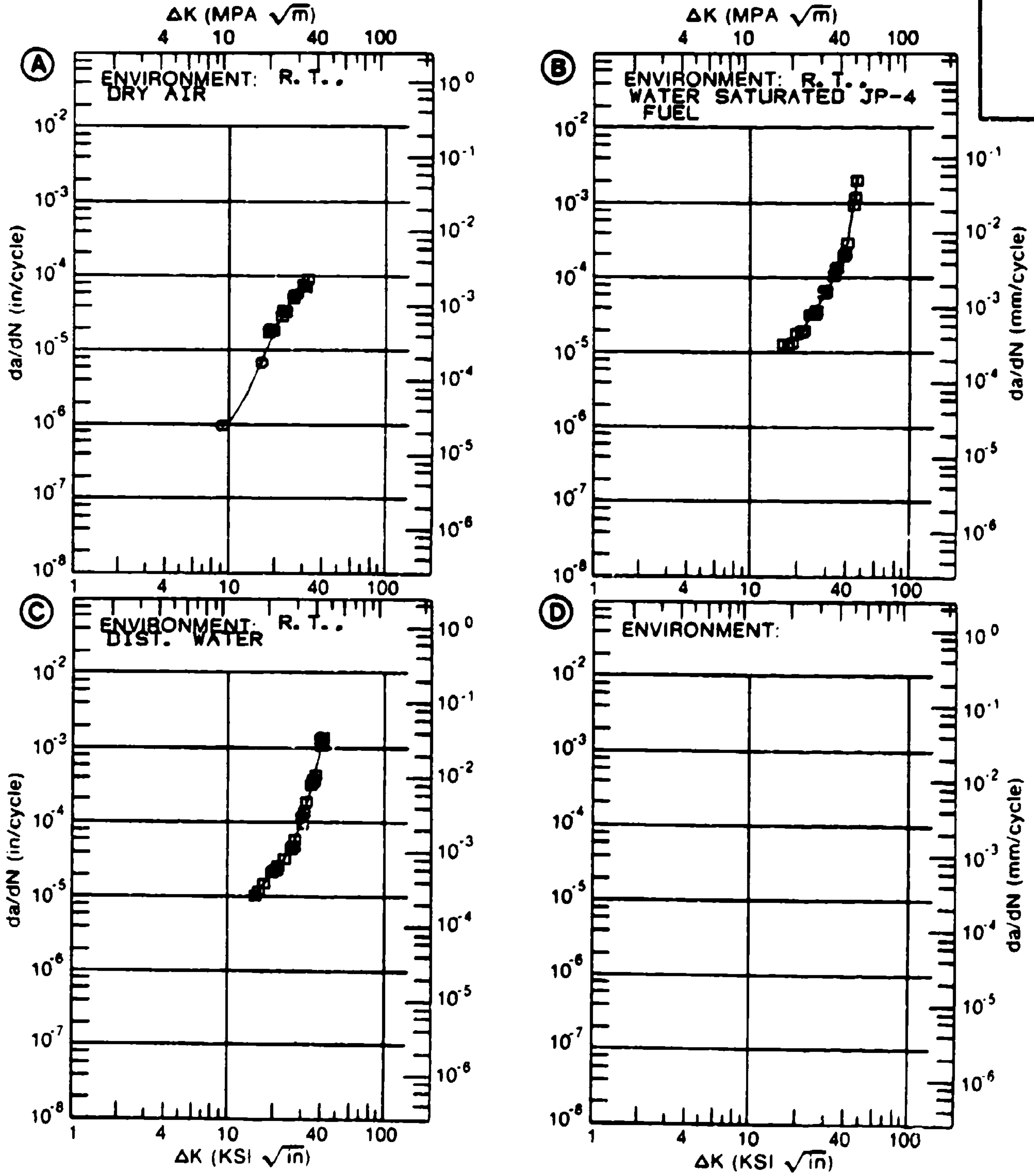

Figure 4.11.3.84

TABLE 4.11.3.85

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 4.11.3.85INDICATING EFFECT

OF ENVIRONMENT

MATERIAL: TITANIUM TI-6AL-4V
CONDITION: RA

DELTA K (KSI*IN**1/2)		DA/DN (10**-6 IN./CYCLE) A E= R.T. 3.5% NACL	B E= R.T. S.T.W.	C	D
DELTA K MIN	A: 7.97	.992			
	B: 22.18		77.7		
	C:				
	D:				
	8.00	1.02			
	9.00	1.82			
	10.00	2.55			
	13.00	5.07			
	16.00	14.8			
	20.00				
	25.00		160.		
	30.00		209.		
DELTA K MAX	A: 19.93	31.4			
	B: 34.79		262.		
	C:				
	D:				
ROOT MEAN SQUARE PERCENT ERROR		21.59	10.99		

LIFE PREDICTION RATIO SUMMARY (NP/NA)	
	0.0-0.5
	0.5-0.8
	0.8-1.25
	1.25-2.0
	>2.0

CONDITION/HT: RA
FORM: 1.00"TH PLATE
SPECIMEN TYPE: DCB
ORIENTATION: T-L
STRESS RATIO: +0.50
FREQUENCY: 0.10 HZ

YIELD STRENGTH:
ULT. STRENGTH:
SPECIMEN THK:
SPECIMEN WIDTH:
REFERENCES:88140

TITAN. ALLOY

TI-6AL-4V

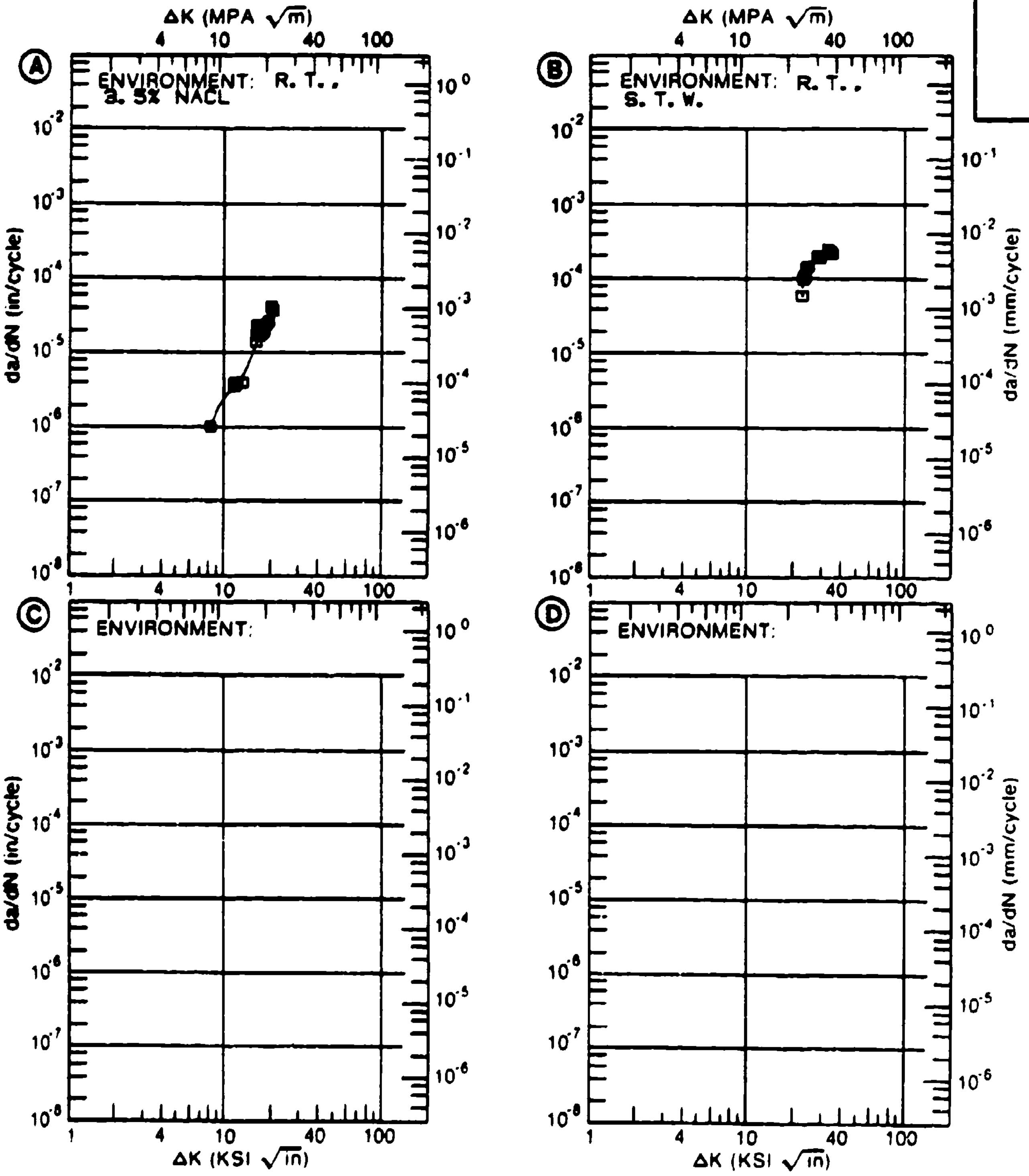

Figure 4.11.3.85

TABLE 4.11.3.86

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 4.11.3.86 INDICATING EFFECT

OF STRESS RATIO

MATERIAL: TITANIUM TI-6AL-4V
CONDITION: RA
ENVIRONMENT: R. T. , L. H. A.

DELTA K (KSI*IN**1/2)		DA/DN (10**-6 IN./CYCLE) A R=+0.08	B R=+0.30	C R=+0.50	D R=+0.70
DELTA K MIN A:	5.98	.0135			
DELTA K MIN B:	6.12		.109		
DELTA K MIN C:	6.39			.226	
DELTA K MIN D:	5.11				.146
	6.00	.0139			.375
	7.00	.0485	.229	.371	.798
	8.00	.127	.464	.726	1.40
	9.00	.270	.839	1.25	2.17
	10.00	.499	1.39	1.94	3.12
	13.00	1.84	4.24	5.08	7.33
	16.00	4.30	8.75	9.54	14.9
	20.00	9.42	15.9	16.8	
	25.00	19.0	23.2		
	30.00	32.7			
	35.00	52.2			
	40.00	79.4			
	50.00	171.			
DELTA K MAX A:	52.96	213.			
DELTA K MAX B:	25.92		24.1		
DELTA K MAX C:	20.65			18.1	
DELTA K MAX D:	19.21				30.8
ROOT MEAN SQUARE PERCENT ERROR		33.97	20.34	21.38	6.79
LIFE PREDICTION RATIO SUMMARY (NP/NA)	0.0-0.5				
	0.5-0.8		1	1	
	0.8-1.25	2	1	1	1
	1.25-2.0	3			
	>2.0				

CONDITION/HT: RA
FORM: 1.50"TH PLATE
SPECIMEN TYPE: CT
ORIENTATION: L-T
FREQUENCY: 6.00 HZ
ENVIRONMENT: R.T., L.H.A.

YIELD STRENGTH: 113.0- 121.0 KSI
ULT. STRENGTH: 127.0- 135.0 KSI
SPECIMEN THK: 0.990- 1.000"
SPECIMEN WIDTH: 7.400- 7.410"
REFERENCES: 88578, 85837

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TI-6AL-4V

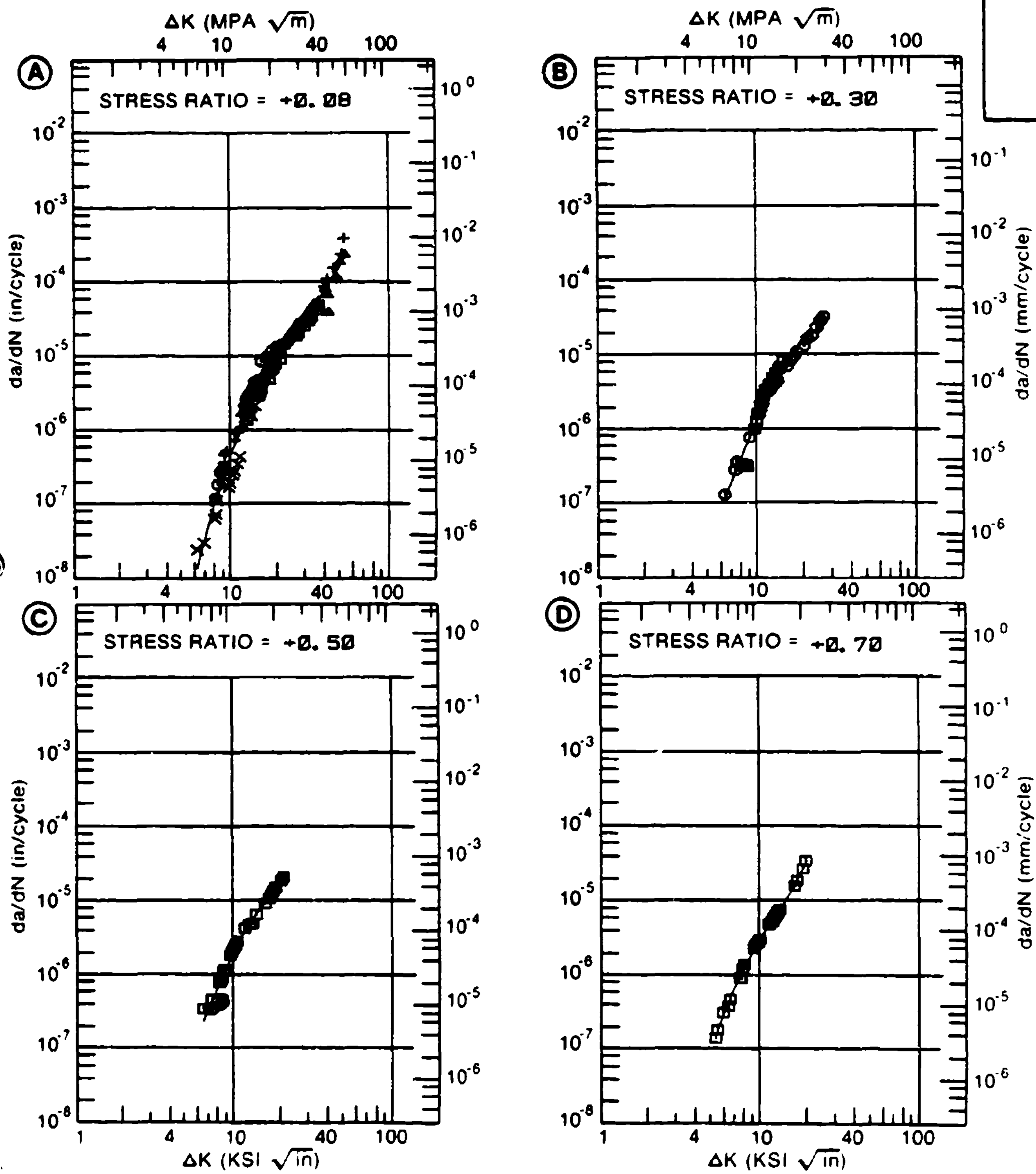

Figure 4.11.3.86

TABLE 4.11.3.87

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 4.11.3.87 INDICATING EFFECT

OF STRESS RATIO

MATERIAL: TITANIUM TI-6AL-4V
CONDITION: RA
ENVIRONMENT: R.T. ,S.T.W.

DELTA K (KSI*IN**1/2)		DA/DN (10**-6 IN./CYCLE) A R=+0.08	B R=+0.30	C R=+0.50	D
DELTA K MIN A:	8.35	.340			
B:	7.37		.385		
C:	5.97			.293	
D:					
	6.00			.300	
	7.00			.649	
	8.00		.784	1.32	
	9.00	.423	1.37	2.46	
	10.00	.590	2.27	4.23	
	13.00	1.52	7.32	13.5	
	16.00	3.49	15.3	24.6	
	20.00	8.98	24.5		
	25.00	23.4			
	30.00	50.6			
	35.00	94.6			
	40.00	158.			
	50.00	344.			
	60.00	591.			
DELTA K MAX A:	66.77	772.			
B:	22.54		26.4		
C:	17.45			28.0	
D:					
ROOT MEAN SQUARE PERCENT ERROR		58.58	11.40	10.86	
LIFE PREDICTION RATIO SUMMARY (NP/NA)	0.0-0.5				
	0.5-0.8	2			
	0.8-1.25		1	1	
	1.25-2.0	2			
	>2.0				

CONDITION/HT: RA
FORM: 1.50"TH PLATE
SPECIMEN TYPE: CT
ORIENTATION: L-T
FREQUENCY: 1.00 HZ
ENVIRONMENT: R.T., S.T.W.

YIELD STRENGTH: 118.0- 124.0 KSI
ULT. STRENGTH: 129.0- 138.0 KSI
SPECIMEN THK: 0.988- 0.998"
SPECIMEN WIDTH: 7.400"
REFERENCES: 85837, 88579

TITAN. ALLOY

TI-6AL-4V

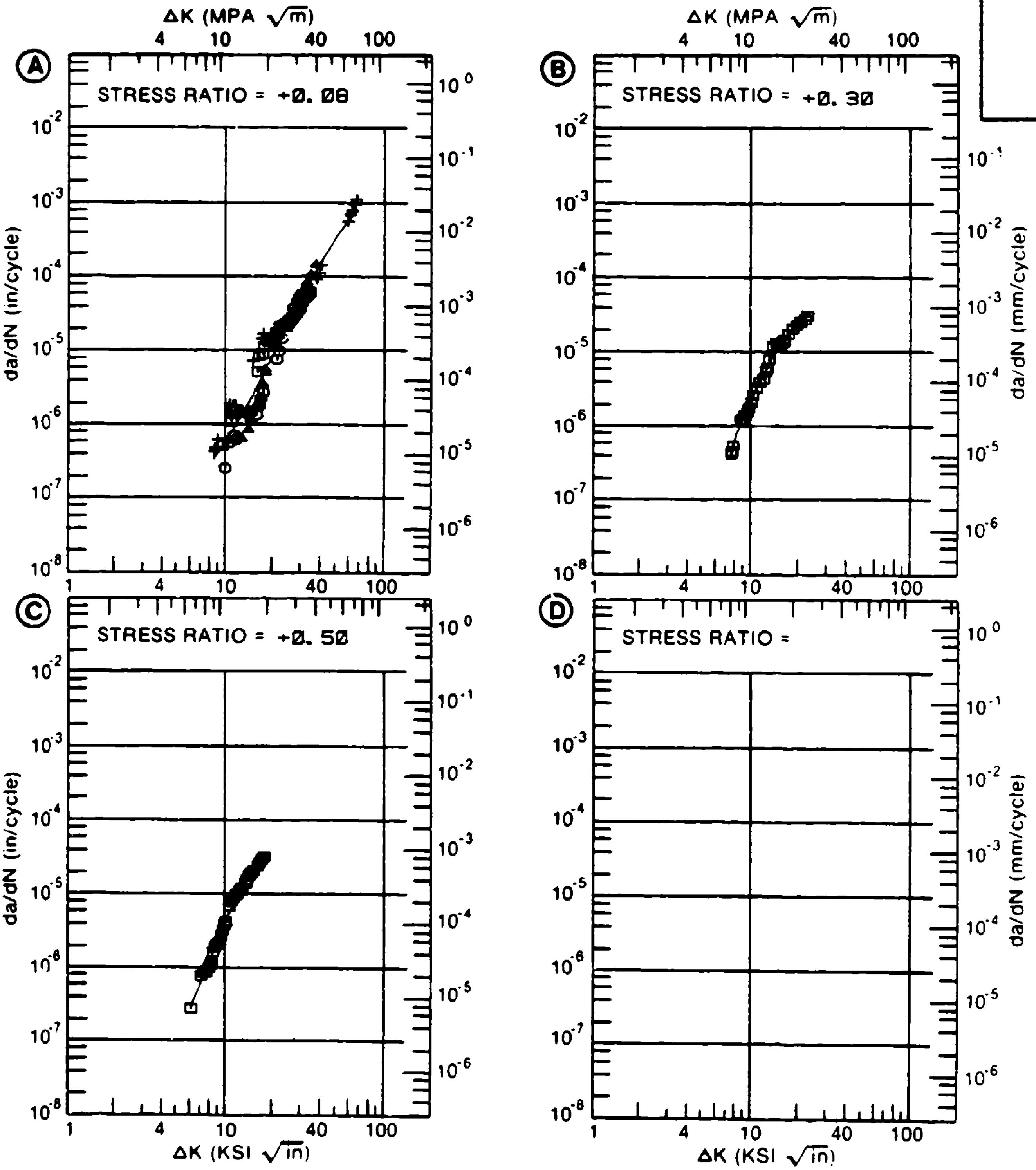

Figure 4.11.3.87

TABLE 4.11.3.88

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 4.11.3.88 INDICATING EFFECT
OF ENVIRONMENT

MATERIAL: TITANIUM TI-6AL-4V
CONDITION: RA

DELTA K (KSI*IN**1/2)		DA/DN (10**-6 IN./CYCLE) A E=- 65F L.H.A.	B E= R.T. L.H.A.	C	D
DELTA K MIN	A: 12.57	2.09			
	B: 5.98		.0135		
	C:				
	D:				
	6.00		.0139		
	7.00		.0485		
	8.00		.127		
	9.00		.270		
	10.00		.499		
	13.00	2.46	1.84		
	16.00	5.61	4.30		
	20.00	11.1	9.42		
	25.00	20.6	19.0		
	30.00	36.8	32.7		
	35.00		52.2		
	40.00		79.4		
	50.00		171.		
DELTA K MAX	A: 31.93	46.2			
	B: 52.96		213.		
	C:				
	D:				
ROOT MEAN SQUARE PERCENT ERROR		4.90	33.97		
LIFE PREDICTION RATIO SUMMARY (NP/NA)	0.0-0.5				
	0.5-0.8				
	0.8-1.25	1	2		
	1.25-2.0		3		
	>2.0				

CONDITION/HT: RA
FORM: 1.50"TH PLATE
SPECIMEN TYPE: CT
ORIENTATION: L-T
STRESS RATIO: +0.08
FREQUENCY: 6.00 HZ

YIELD STRENGTH: 113.0- 121.0 KSI
ULT. STRENGTH: 127.0- 135.0 KSI
SPECIMEN THK: 0.990- 1.000"
SPECIMEN WIDTH: 7.400- 7.410"
REFERENCES: 85837, 88579

TITAN. ALLOY

TI-6AL-4V

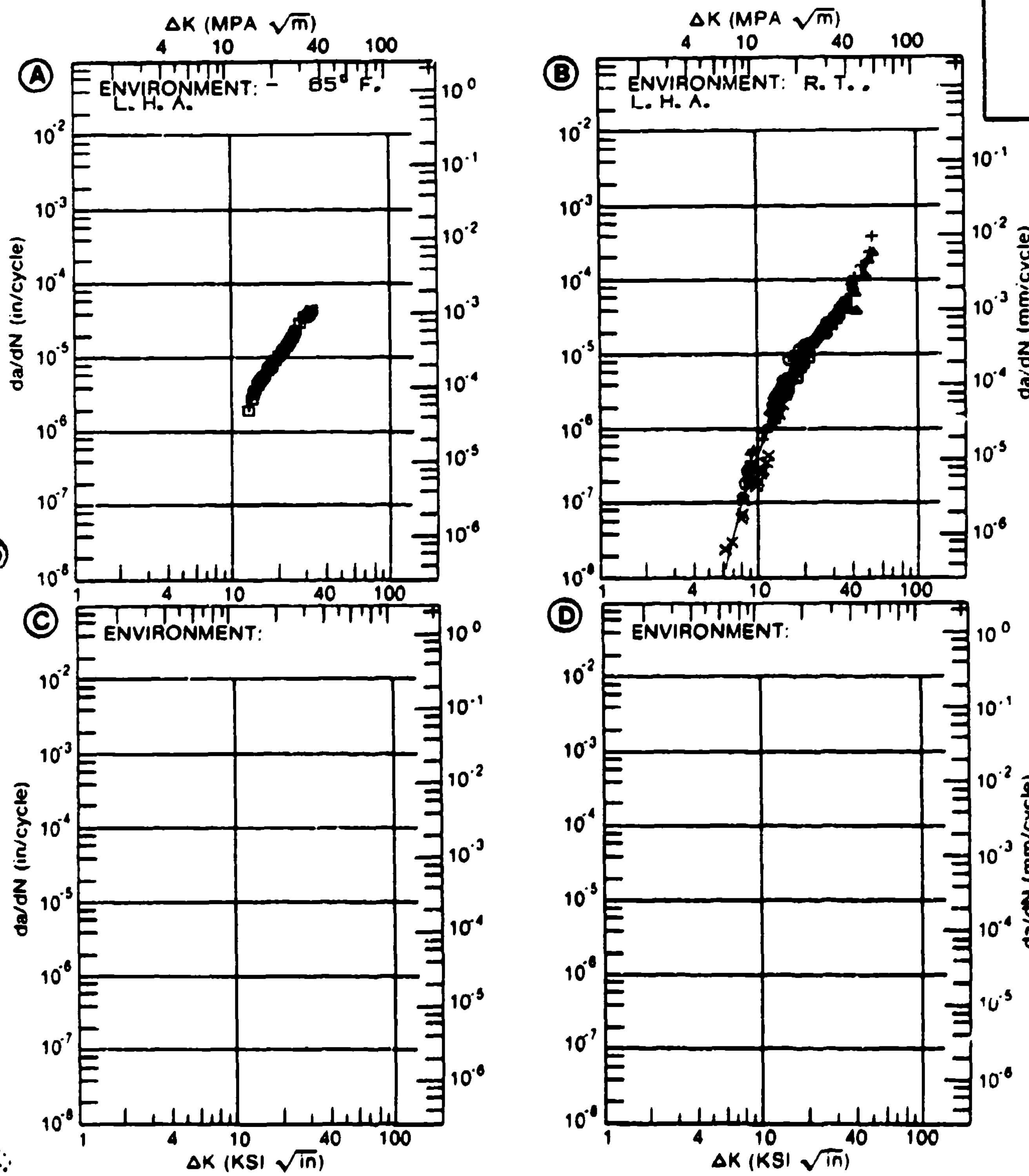

Figure 4.11.3.88

TABLE 4.11.3.89

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 4.11.3.89 INDICATING EFFECT

OF ENVIRONMENT

MATERIAL: TITANIUM TI-6AL-4V
CONDITION: RA

DELTA K (KSI*IN**1/2)		DA/DN (10**-6 IN./CYCLE) A	B	C	D
		E= R.T. L.H.A.	E=+ 265F L.H.A.		
DELTA K MIN A:	8.22	.230			
B:	14.47		3.05		
C:					
D:					
	9.00	.401			
	10.00	.728			
	13.00	2.59			
	16.00	5.76	5.05		
	20.00	11.3	11.6		
	25.00	18.6	21.8		
	30.00		36.8		
DELTA K MAX A:	28.48	23.2			
B:	32.07		45.8		
C:					
D:					
ROOT MEAN SQUARE PERCENT ERROR		13.20	8.62		
LIFE PREDICTION RATIO SUMMARY (NP/NA)	0.0-0.5				
	0.5-0.8				
	0.8-1.25	2	1		
	1.25-2.0				
	>2.0				

CONDITION/HT: RA
FORM: 1.50"TH PLATE
SPECIMEN TYPE: CT
ORIENTATION: L-T
STRESS RATIO: +0.08
FREQUENCY: 6.00 HZ

YIELD STRENGTH: 118.0- 121.0 KSI
ULT. STRENGTH: 129.0- 134.0 KSI
SPECIMEN THK: 0.254- 0.990"
SPECIMEN WIDTH: 5.000- 7.400"
REFERENCES: 85837, 88579

TITAN. ALLOY

TI-6AL-4V

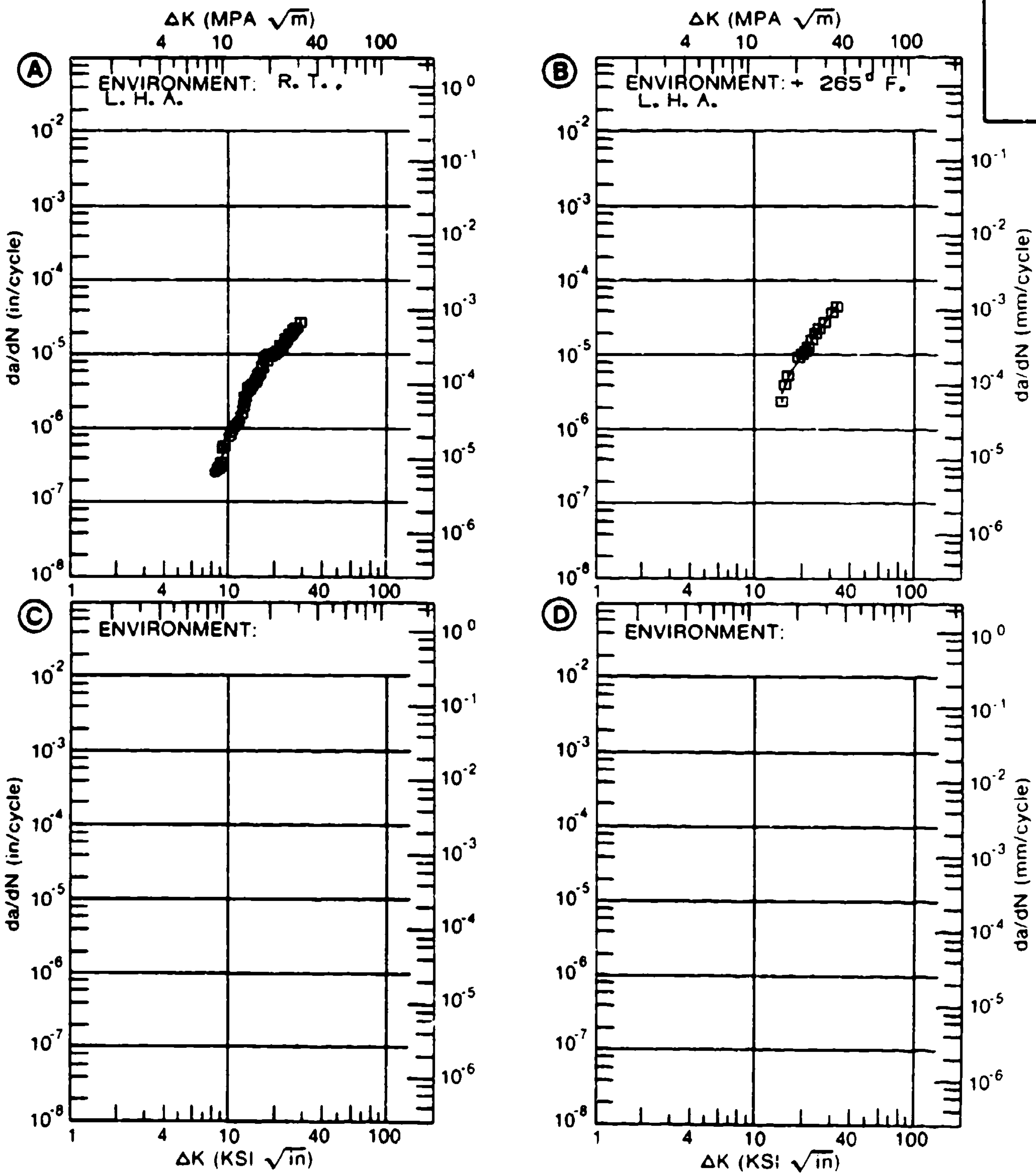

Figure 4.11.3.89

TABLE 4.11.3.90

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 4.11.3.90 INDICATING EFFECT

OF ENVIRONMENT

MATERIAL: TITANIUM TI-6AL-4V
CONDITION: RA

DELTA K (KSI*IN**1/2)		DA/DN (10**-6 IN./CYCLE) A	B	C	D
		E= R.T. L.H.A.	E= R.T. J.P.4	E=+ 150F S.T.W.	
DELTA K MIN A:	24.00	14.4			
DELTA K MIN B:	7.83		.107		
DELTA K MIN C:	12.49			2.27	
DELTA K MIN D:					
	8.00		.126		
	9.00		.308		
	10.00		.663		
	13.00		3.00	2.73	
	16.00		6.83	5.97	
	20.00		12.8	11.8	
	25.00	16.6	20.2	24.4	
	30.00	30.7		53.4	
	35.00	50.0			
	40.00	74.7			
DELTA K MAX A:	41.69	84.3			
DELTA K MAX B:	26.71		22.7		
DELTA K MAX C:	33.71			102.	
DELTA K MAX D:					
ROOT MEAN SQUARE PERCENT ERROR		4.34	20.62	16.88	
LIFE PREDICTION RATIO SUMMARY (NP/NA)	0.0-0.5				
	0.5-0.8				
	0.8-1.25	1	1	1	
	1.25-2.0				
	>2.0				

CONDITION/HT: RA
FORM: 1.50"TH PLATE
SPECIMEN TYPE: CT
ORIENTATION: L-T
STRESS RATIO: +0.08
FREQUENCY: 1.00 HZ

YIELD STRENGTH: 117.0- 121.0 KSI
ULT. STRENGTH: 129.0- 135.0 KSI
SPECIMEN THK: 0.992- 1.000"
SPECIMEN WIDTH: 7.400"
REFERENCES: 85837, 88579

TITAN. ALLOY

TI-6AL-4V

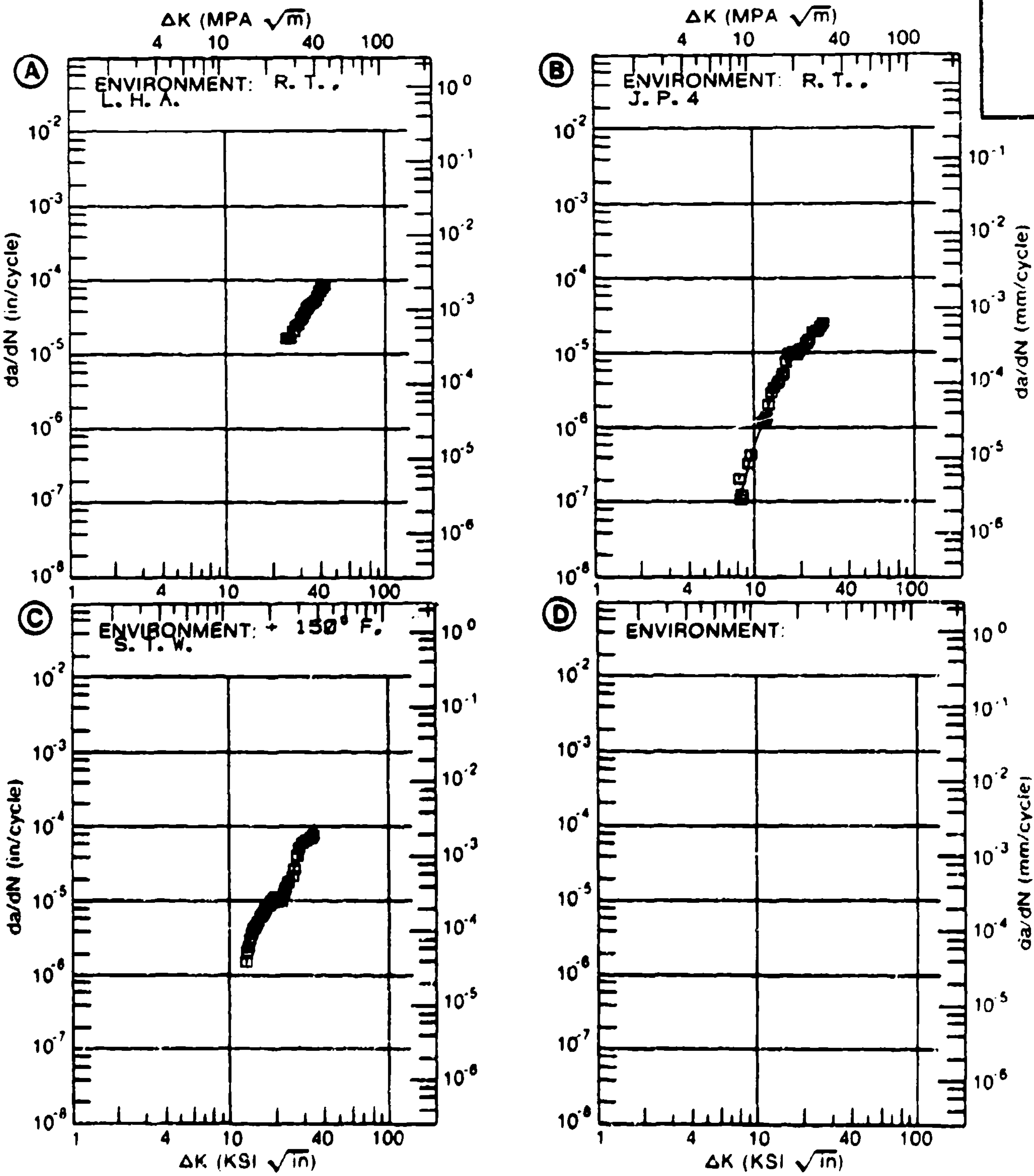

Figure 4.11.3.90

TABLE 4.11.3.91

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 4.11.3.91 INDICATING EFFECT

OF FREQUENCY

MATERIAL: TITANIUM TI-6AL-4V
CONDITION: RA
ENVIRONMENT: R.T. ,S.T.W.

DELTA K (KSI*IN**1/2)		DA/DN (10**-6 IN./CYCLE) A	B	C	D
		F(HZ)= 0.10	F(HZ)= 1.00		
DELTA K MIN A:	11.17	1.07			
DELTA K MIN B:	8.35		.340		
DELTA K MIN C:					
DELTA K MIN D:					
	9.00		.423		
	10.00		.590		
	13.00	2.24	1.52		
	16.00	4.15	3.49		
	20.00	11.0	8.98		
	25.00	21.4	23.4		
	30.00	49.0	50.6		
	35.00		94.6		
	40.00		158.		
	50.00		344.		
	60.00		591.		
DELTA K MAX A:	32.56	89.8			
DELTA K MAX B:	66.77		772.		
DELTA K MAX C:					
DELTA K MAX D:					
ROOT MEAN SQUARE PERCENT ERROR		12.74	58.58		
LIFE PREDICTION RATIO SUMMARY (NP/NA)	0.0-0.5				
	0.5-0.8		2		
	0.8-1.25	1			
	1.25-2.0		2		
	>2.0				

CONDITION/HT: RA
FORM: 1.50"TH PLATE
SPECIMEN TYPE: CT
ORIENTATION: L-T
STRESS RATIO: +0.08
ENVIRONMENT: R. T., S. T. W.

YIELD STRENGTH: 118.0- 124.0 KSI
ULT. STRENGTH: 128.0- 138.0 KSI
SPECIMEN THK: 0.988- 1.010"
SPECIMEN WIDTH: 7.380- 7.400"
REFERENCES: 88578, 85837

TITAN. ALLOY

TI-6AL-4V

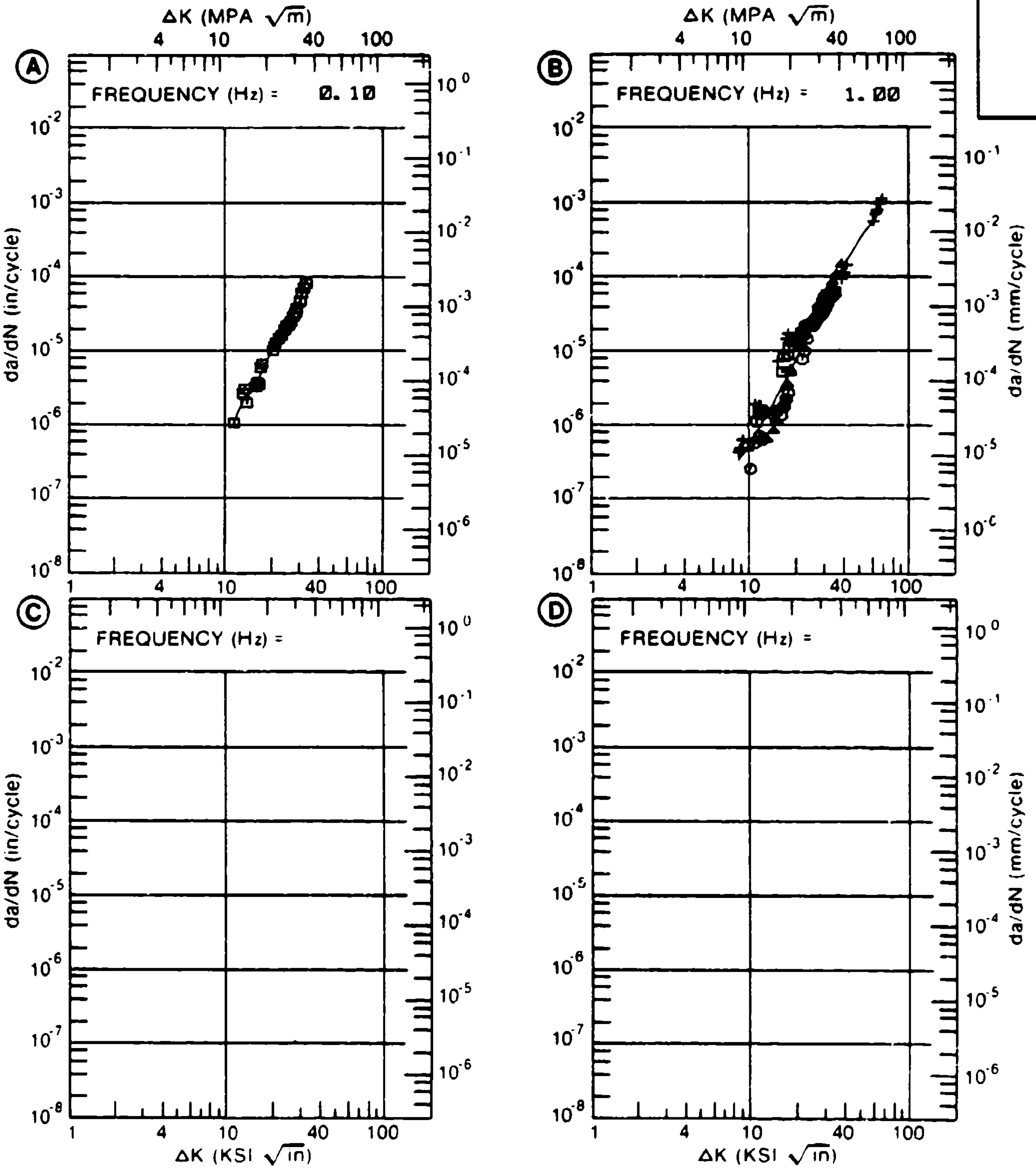

Figure 4.11.3.91

TABLE 4.11.3.92

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 4.11.3.92 INDICATING EFFECT

OF ENVIRONMENT

MATERIAL: TITANIUM TI-6AL-4V
CONDITION: RA

DELTA K (KSI*IN**1/2)		DA/DN (10**-6 IN./CYCLE) A	B	C	D
		E= R.T. L.H.A. 6HZ	E= R.T. J.P.4 1HZ	E= R.T. S.T.W. 1HZ	
DELTA K MIN A:	8.94	.231			
B:	7.99		.226		
C:	6.08			.0803	
D:					
	7.00			.175	
	8.00		.226	.346	
	9.00	.244	.375	.604	
	10.00	.537	.717	.964	
	13.00	2.45	3.58	2.78	
	16.00	5.74	7.91	5.93	
	20.00	11.4	14.2	12.7	
	25.00	20.2		26.3	
	30.00	32.0		47.6	
	35.00	49.9		79.4	
	40.00	78.5		126.	
	50.00	208.		285.	
	60.00	609.		592.	
	70.00			1160.	
DELTA K MAX A:	63.39	893.			
B:	24.76		25.7		
C:	71.06			1242.	
D:					
ROOT MEAN SQUARE PERCENT ERROR		27.79	12.87	33.61	
LIFE PREDICTION RATIO SUMMARY (NP/NA)	0.0-0.5				
	0.5-0.8	1		1	
	0.8-1.25	1	1		
	1.25-2.0	1		1	
	>2.0				

CONDITION/HT: RA
FORM: 1.50"TH PLATE
SPECIMEN TYPE: CT
ORIENTATION: T-L
STRESS RATIO: +0.08
FREQUENCY:

YIELD STRENGTH: 122.0- 125.0 KSI
ULT. STRENGTH: 134.0- 135.0 KSI
SPECIMEN THK: 0.501- 1.000"
SPECIMEN WIDTH: 7.400"
REFERENCES: 85837, 88579

TITAN. ALLOY

TI-6AL-4V

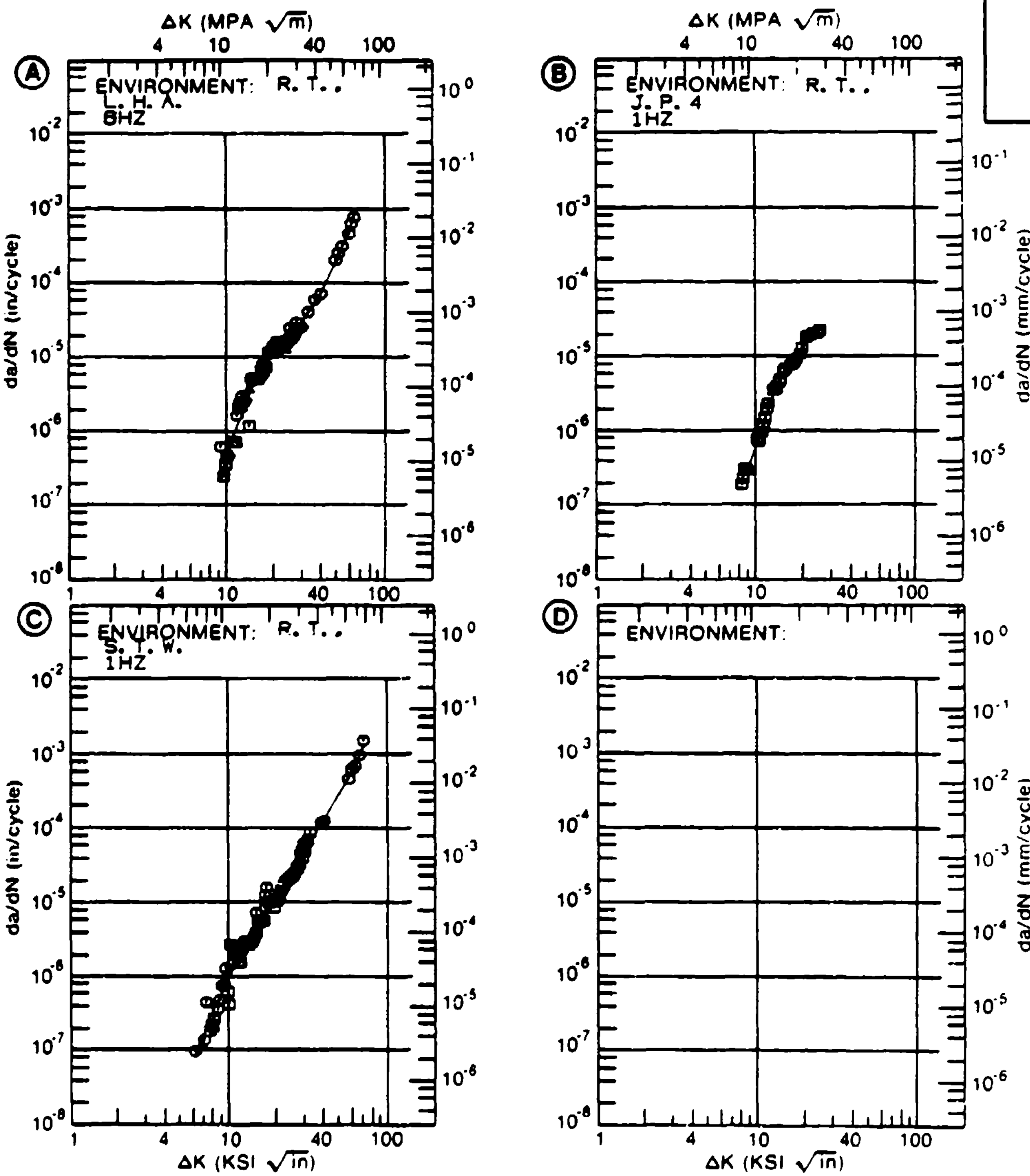

Figure 4.11.3.92

TABLE 4.11.3.93

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 4.11.3.93 INDICATING EFFECT

OF ENVIRONMENT

MATERIAL: TITANIUM TI-6AL-4V
CONDITION: RA

DELTA K (KSI*IN**1/2)		DA/DN (10**-6 IN./CYCLE) A	B	C	D
		E= R. T. F. C. S.			
DELTA K MIN A:	13. 81	3. 33			
B:					
C:					
D:					
	16. 00	4. 56			
	20. 00	8. 72			
	25. 00	16. 8			
	30. 00	24. 7			
DELTA K MAX A:	30. 21	24. 9			
B:					
C:					
D:					
ROOT MEAN SQUARE PERCENT ERROR		4. 69			

LIFE PREDICTION RATIO SUMMARY (NP/NA)		
	0. 0-0. 5	
	0. 5-0. 8	
	0. 8-1. 25	1
	1. 25-2. 0	
	>2. 0	

CONDITION/HT: RA
FORM: 1.50"TH PLATE
SPECIMEN TYPE: CT
ORIENTATION: T-L
STRESS RATIO: +0.08
FREQUENCY: 1.00 HZ

YIELD STRENGTH: 117.0 KSI
ULT. STRENGTH: 133.0 KSI
SPECIMEN THK: 1.380"
SPECIMEN WIDTH: 4.000"
REFERENCES: 88579

TITAN. ALLOY

TI-6AL-4V

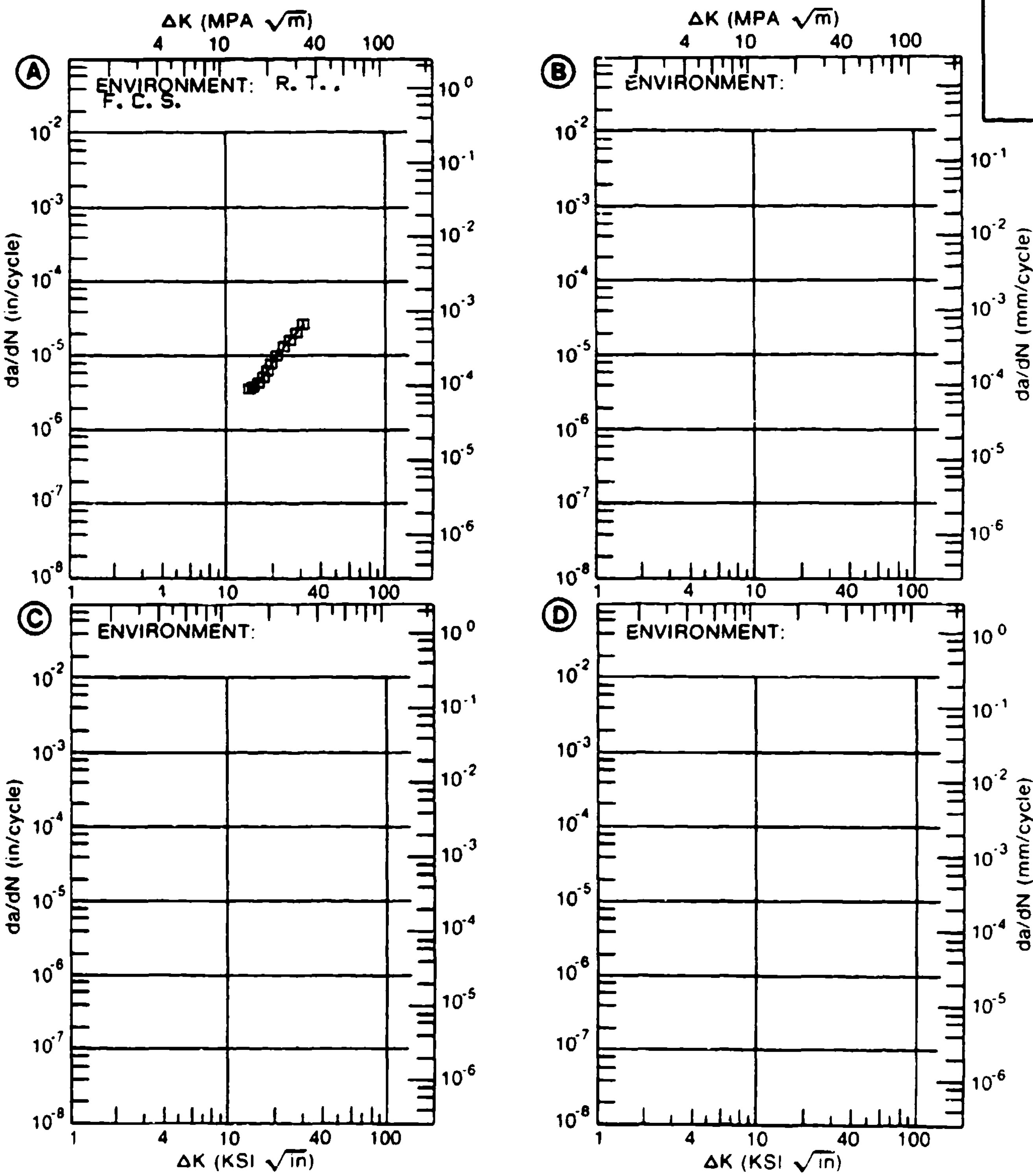

Figure 4.11.3.93

TABLE 4.11.3.94

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 4.11.3.94 INDICATING EFFECT

OF ENVIRONMENT

MATERIAL: TITANIUM TI-6AL-4V
CONDITION: RA

DELTA K (KSI*IN**1/2)			DA/DN (10**-6 IN./CYCLE) A	B	C	D
			E= R.T. L.H.A.			
DELTA K MIN	A:	11.70	1.48			
	B:					
	C:					
	D:					
		13.00	2.98			
DELTA K MAX	A:	15.81	5.79			
	B:					
	C:					
	D:					

ROOT MEAN SQUARE PERCENT ERROR	10.94

LIFE PREDICTION RATIO SUMMARY (NP/NA)		
	0.0-0.5	
	0.5-0.8	
	0.8-1.25	1
	1.25-2.0	
	>2.0	

CONDITION/HT: RA
FORM: 1.50"TH PLATE
SPECIMEN TYPE: CT
ORIENTATION: T-L
STRESS RATIO: +0.50
FREQUENCY: 6.00 HZ

YIELD STRENGTH: 121.0 KSI
ULT. STRENGTH: 135.0 KSI
SPECIMEN THK: 1.013"
SPECIMEN WIDTH: 7.380"
REFERENCES: 85837

TITAN. ALLOY

TI-6AL-4V

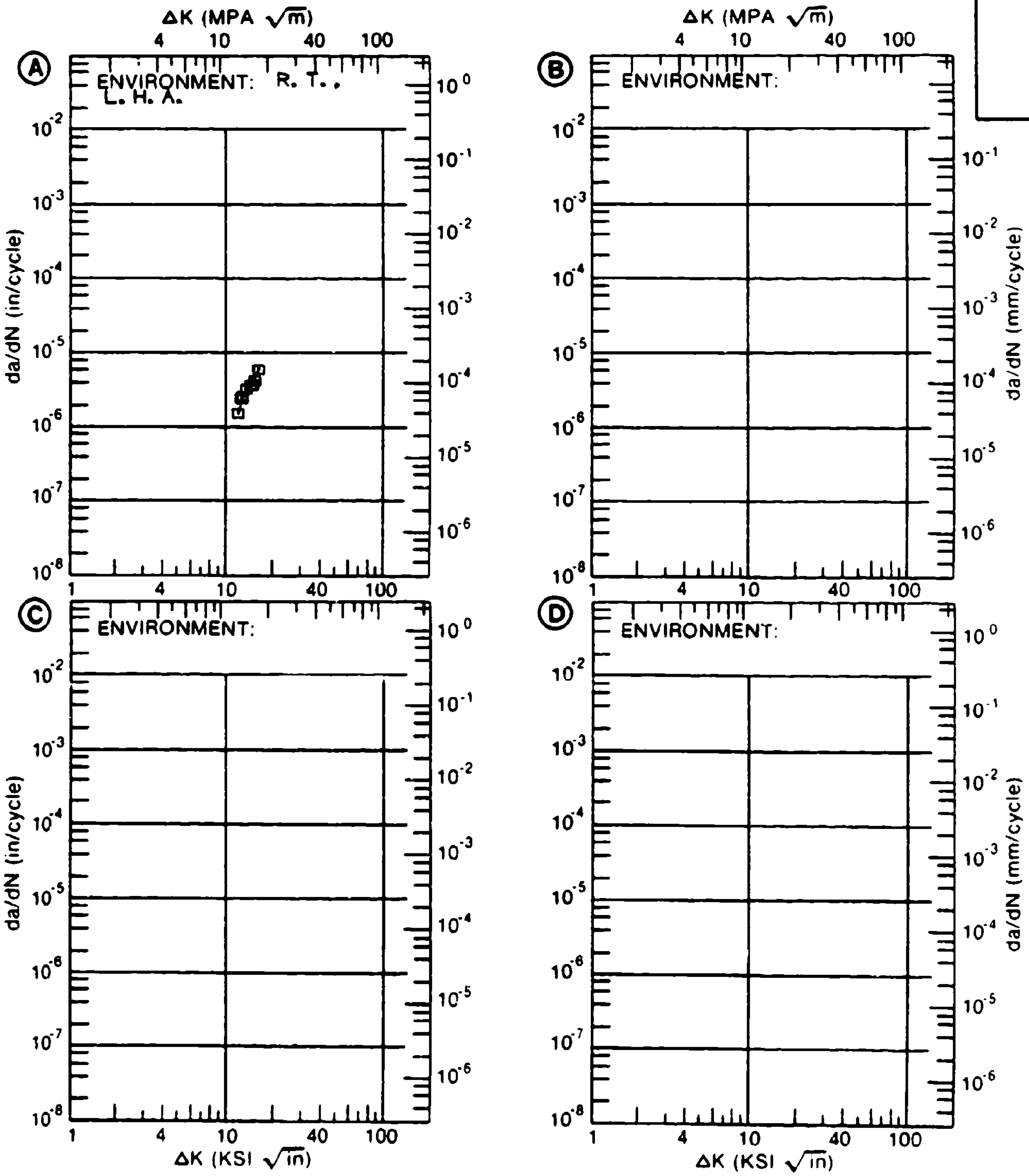

Figure 4.11.3.94

TABLE 4.11.3.95

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 4.11.3.95 INDICATING EFFECT

OF ENVIRONMENT

MATERIAL: TITANIUM TI-6AL-4V
CONDITION: RA

DELTA K (KSI*IN**1/2)		DA/DN (10**-6 IN./CYCLE) A	B	C	D
		E= R.T. L.H.A. 6HZ	E=+ 150F S.T.W. 1HZ		
DELTA K MIN A:	15.66	1.74			
DELTA K MIN B:	12.77		.99		
DELTA K MIN C:					
DELTA K MIN D:					
	13.00		1.06		
	16.00	2.12	2.71		
	20.00	7.80	9.37		
	25.00	17.5	31.9		
	30.00		67.8		
DELTA K MAX A:	29.18	45.5			
DELTA K MAX B:	34.28		93.1		
DELTA K MAX C:					
DELTA K MAX D:					
ROOT MEAN SQUARE PERCENT ERROR		12.60	11.76		
LIFE PREDICTION RATIO SUMMARY (NP/NA)	0.0-0.5				
	0.5-0.8				
	0.8-1.25	1	1		
	1.25-2.0				
	>2.0				

CONDITION/HT: RA
FORM: 2.00"TH PLATE
SPECIMEN TYPE: CT
ORIENTATION: L-T
STRESS RATIO: +0.08
FREQUENCY:

YIELD STRENGTH: 119.0- 122.0 KSI
ULT. STRENGTH: 131.0- 133.0 KSI
SPECIMEN THK: 0.998- 1.000"
SPECIMEN WIDTH: 7.400"
REFERENCES: 85837, 88579

TITAN. ALLOY

TI-6AL-4V

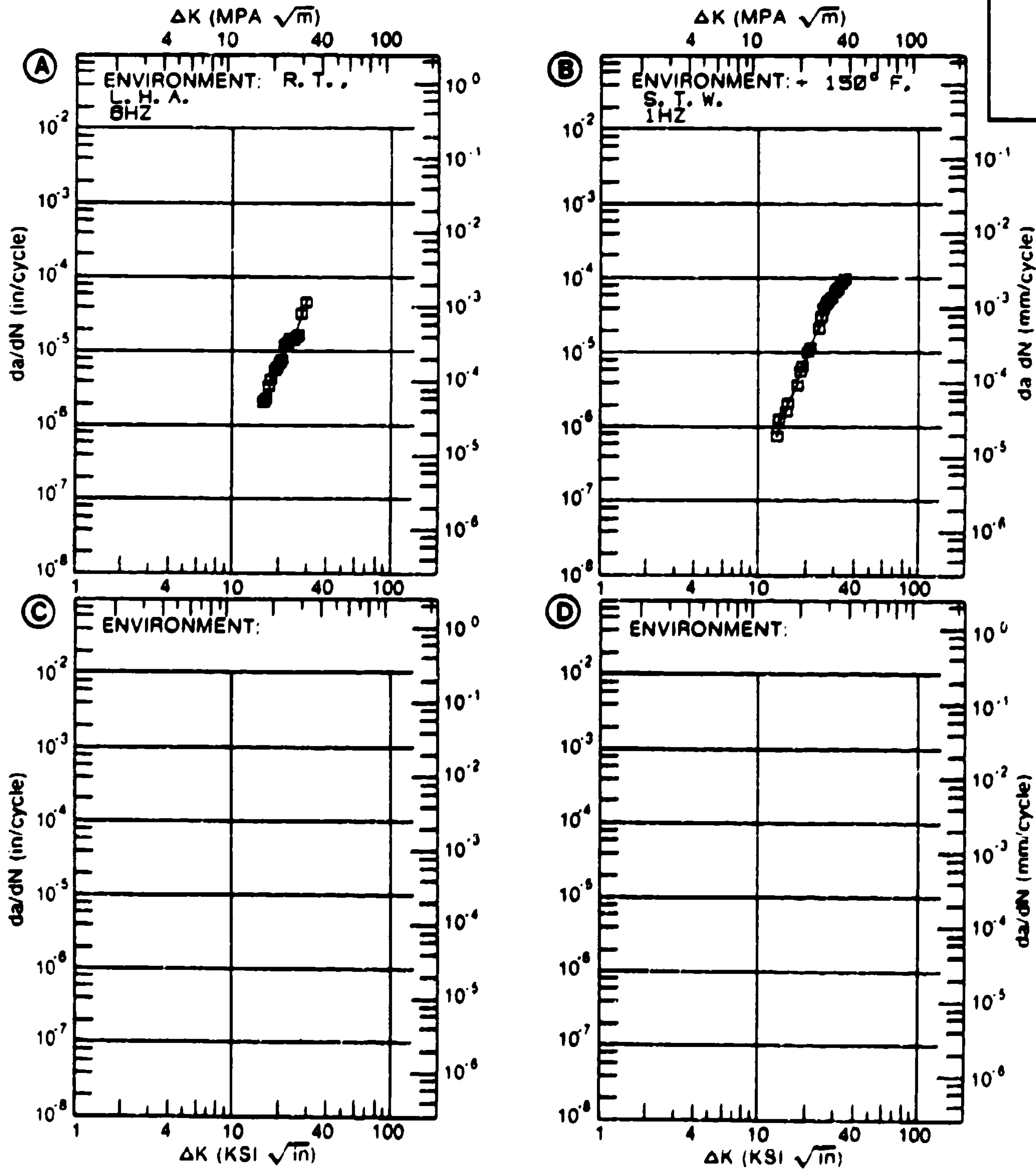

Figure 4.11.3.95

TABLE 4.11.3.96

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 4.11.3.96 INDICATING EFFECT

OF ENVIRONMENT

MATERIAL: TITANIUM TI-6AL-4V
CONDITION: RA

DELTA K (KSI*IN**1/2)			DA/DN (10**-6 IN./CYCLE) A	B	C	D
			E= R.T. S.T.W.			
DELTA K MIN	A:	13.83	.788			
	B:					
	C:					
	D:					
		16.00	2.13			
		20.00	8.98			
		25.00	27.5			
DELTA K MAX	A:	26.33	33.2			
	B:					
	C:					
	D:					

ROOT MEAN SQUARE PERCENT ERROR		10.04
LIFE PREDICTION RATIO SUMMARY (NP/NA)	0.0-0.5	
	0.5-0.8	
	0.8-1.25	1
	1.25-2.0	
	>2.0	

CONDITION/HT: RA
FORM: 2.00"TH PLATE
SPECIMEN TYPE: CT
ORIENTATION: T-L
STRESS RATIO: +0.08
FREQUENCY: 1.00 HZ

YIELD STRENGTH: 126.0 KSI
ULT. STRENGTH: 135.0 KSI
SPECIMEN THK: 0.987"
SPECIMEN WIDTH: 7.400"
REFERENCES: 85837

TITAN. ALLOY

TI-6AL-4V

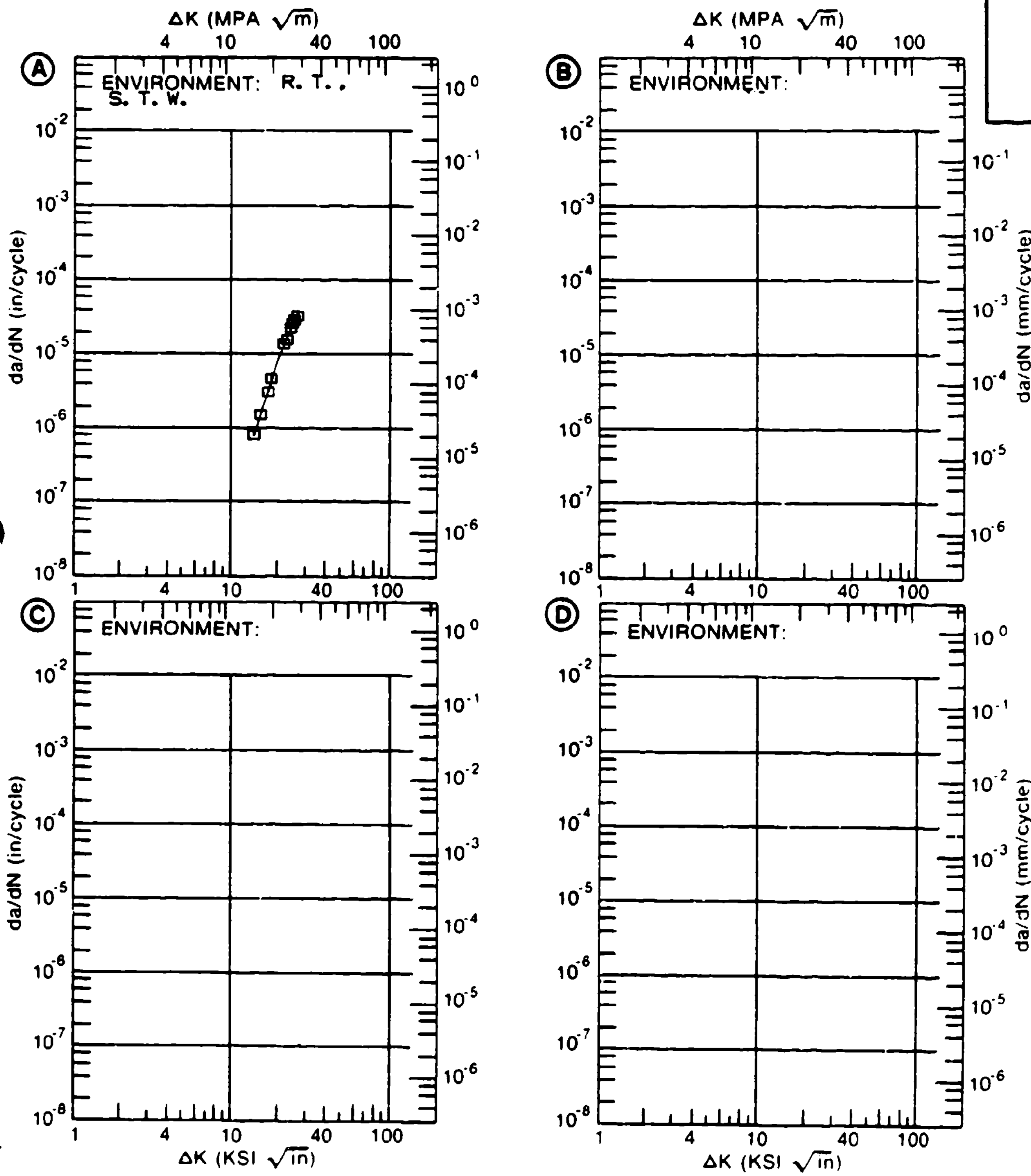

Figure 4.11.3.96

TABLE 4.11.3.97

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 4.11.3.97 INDICATING EFFECT
OF STRESS RATIO

MATERIAL: TITANIUM TI-6AL-4V
CONDITION: RA
ENVIRONMENT: R.T. ,S.T.W.

DELTA K (KSI*IN**1/2)			DA/DN (10**-6 IN./CYCLE) A	B	C	D
			R=+0.08			
	A:	7.80	.142			
DELTA K MIN	B:					
	C:					
	D:					
		8.00	.215			
		9.00	.594			
		10.00	.778			
		13.00	1.31			
		16.00	3.25			
		20.00	13.4			
		25.00	37.5			
	A:	28.44	54.6			
DELTA K MAX	B:					
	C:					
	D:					

ROOT MEAN SQUARE PERCENT ERROR 22.56

LIFE PREDICTION RATIO SUMMARY (NP/NA)		
	0.0-0.5	
	0.5-0.8	
	0.8-1.25	1
	1.25-2.0	
	>2.0	

CONDITION/HT: RA
FORM: 2.50"TH PLATE
SPECIMEN TYPE: CT
ORIENTATION: L-T
FREQUENCY: 1.00 HZ
ENVIRONMENT: R.T., S.T.W.

YIELD STRENGTH: 120.0 KSI
ULT. STRENGTH: 131.0 KSI
SPECIMEN THK: 1.000"
SPECIMEN WIDTH: 5.000"
REFERENCES: 88579

TITAN. ALLOY

TI-6AL-4V

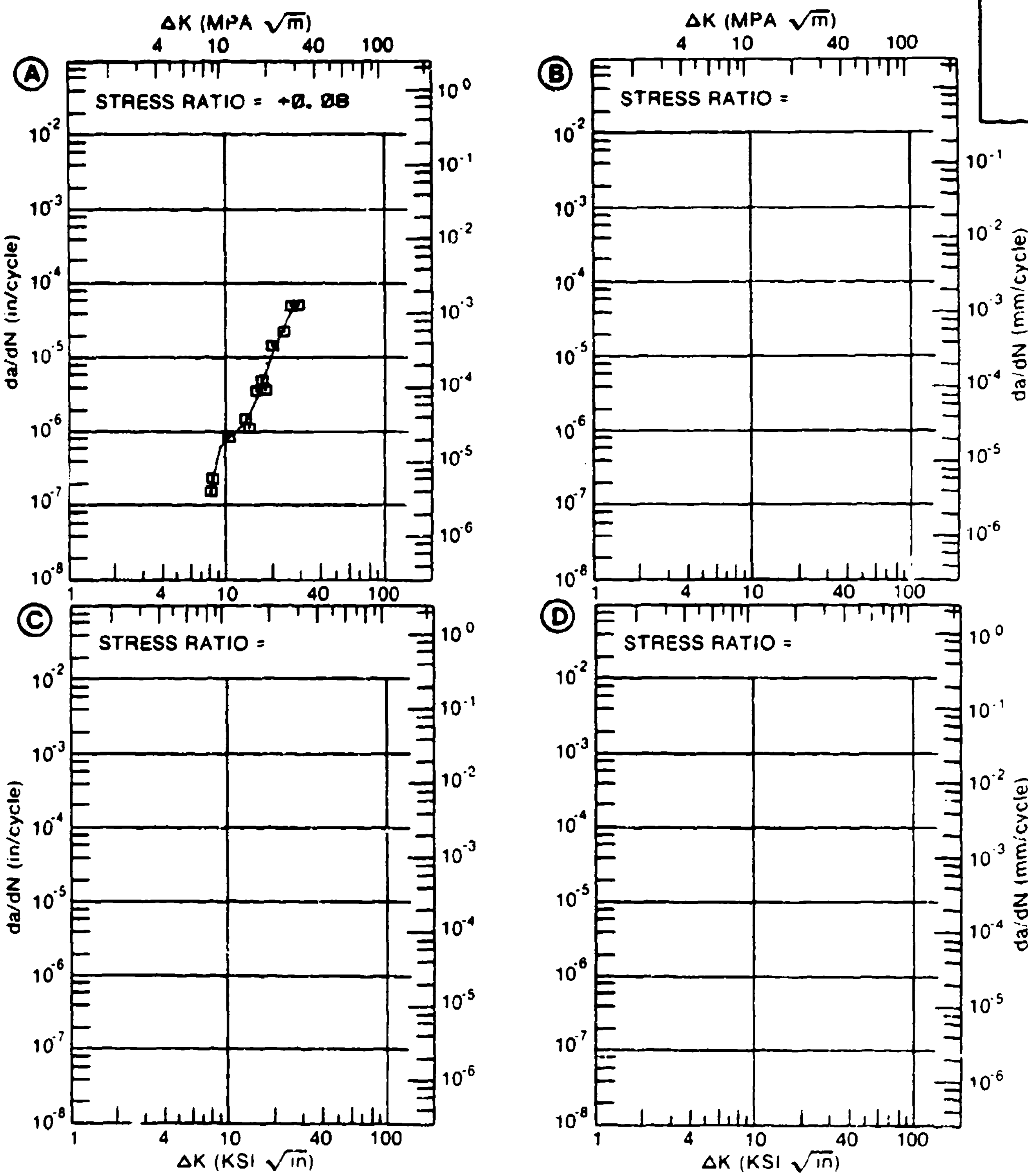

Figure 4.11.3.97

TABLE 4.11.3.98

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 4.11.3.98 INDICATING EFFECT OF ENVIRONMENT

MATERIAL: TITANIUM TI-6AL-4V
CONDITION: RA

DELTA K (KSI*IN**1/2)		DA/DN (10**-6 IN./CYCLE) A	B	C	D
		E= R.T. L.H.A. 6HZ	E= R.T. S.T.W. 1HZ		
DELTA K MIN A:	11.40	.581			
DELTA K MIN B:	11.39		.991		
DELTA K MIN C:					
DELTA K MIN D:					
	12.00	.811	1.70		
	16.00	4.76	3.96		
	20.00	10.4	9.34		
	25.00	19.9	28.1		
	30.00	34.8			
DELTA K MAX A:	32.46	42.9			
DELTA K MAX B:	27.68		34.6		
DELTA K MAX C:					
DELTA K MAX D:					
ROOT MEAN SQUARE PERCENT ERROR		13.29	15.40		
LIFE PREDICTION RATIO SUMMARY (NP/NA)	0.0-0.5				
	0.5-0.8				
	0.8-1.25	1	2		
	1.25-2.0				
	>2.0				

CONDITION/HT: RA
FORM: 2.50"TH PLATE
SPECIMEN TYPE: CT
ORIENTATION: L-T
STRESS RATIO: +0.08
FREQUENCY:

YIELD STRENGTH: 122.0 KSI
ULT. STRENGTH: 138.0 KSI
SPECIMEN THK: 0.990- 1.000"
SPECIMEN WIDTH: 7.390- 7.400"
REFERENCES: 88579

TITAN. ALLOY

TI-6AL-4V

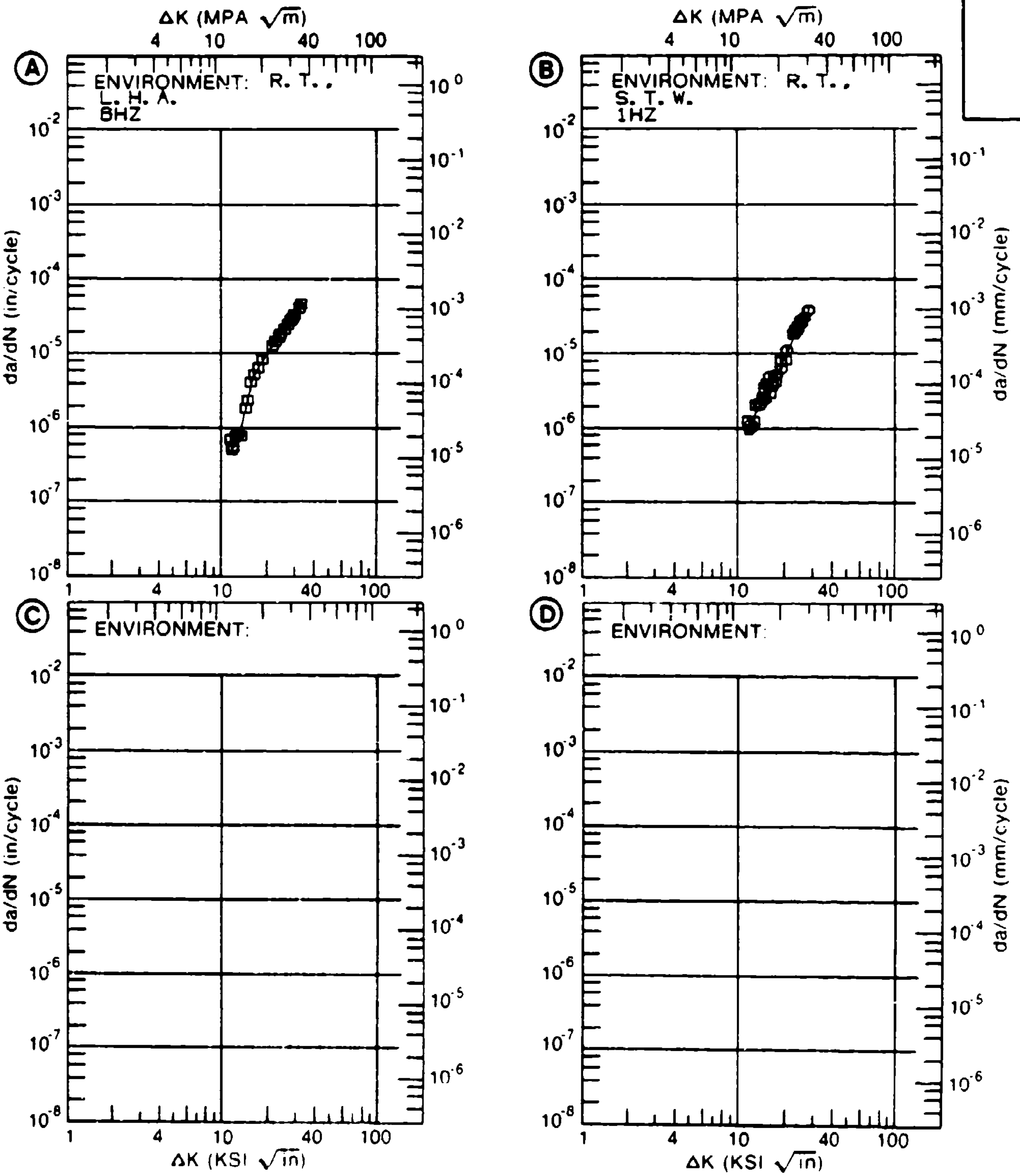

Figure 4.11.3.98

TABLE 4.11.3.99

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 4.11.3.99 INDICATING EFFECT
OF ENVIRONMENT

MATERIAL: TITANIUM TI-6AL-4V
CONDITION: RA

DELTA K (KSI*IN**1/2)			DA/DN (10**-6 IN./CYCLE) A	B	C	D
			E= R.T. L.H.A. 6HZ	E= R.T. S.T.W. 1HZ		
DELTA K MIN	A:	10.70	.357			
	B:	10.73		.743		
	C:					
	D:					
		13.00	1.12	1.37		
		16.00	3.51	3.28		
		20.00	9.89	9.12		
		25.00	20.7	23.1		
		30.00		40.6		
DELTA K MAX	A:	29.26	27.4			
	B:	31.56		45.4		
	C:					
	D:					
ROOT MEAN SQUARE PERCENT ERROR			9.23	15.54		
LIFE PREDICTION RATIO SUMMARY (NP/NA)		0.0-0.5				
		0.5-0.8		1		
		0.8-1.25	1	1		
		1.25-2.0				
		>2.0				

CONDITION/HT: RA
FORM: 2.50"TH PLATE
SPECIMEN TYPE: CT
ORIENTATION: T-L
STRESS RATIO: +0.08
FREQUENCY:

YIELD STRENGTH: 122.0 KSI
ULT. STRENGTH: 135.0 KSI
SPECIMEN THK: 0.990- 1.000"
SPECIMEN WIDTH: 7.400"
REFERENCES: 88579

TITAN. ALLOY

TI-6AL-4V

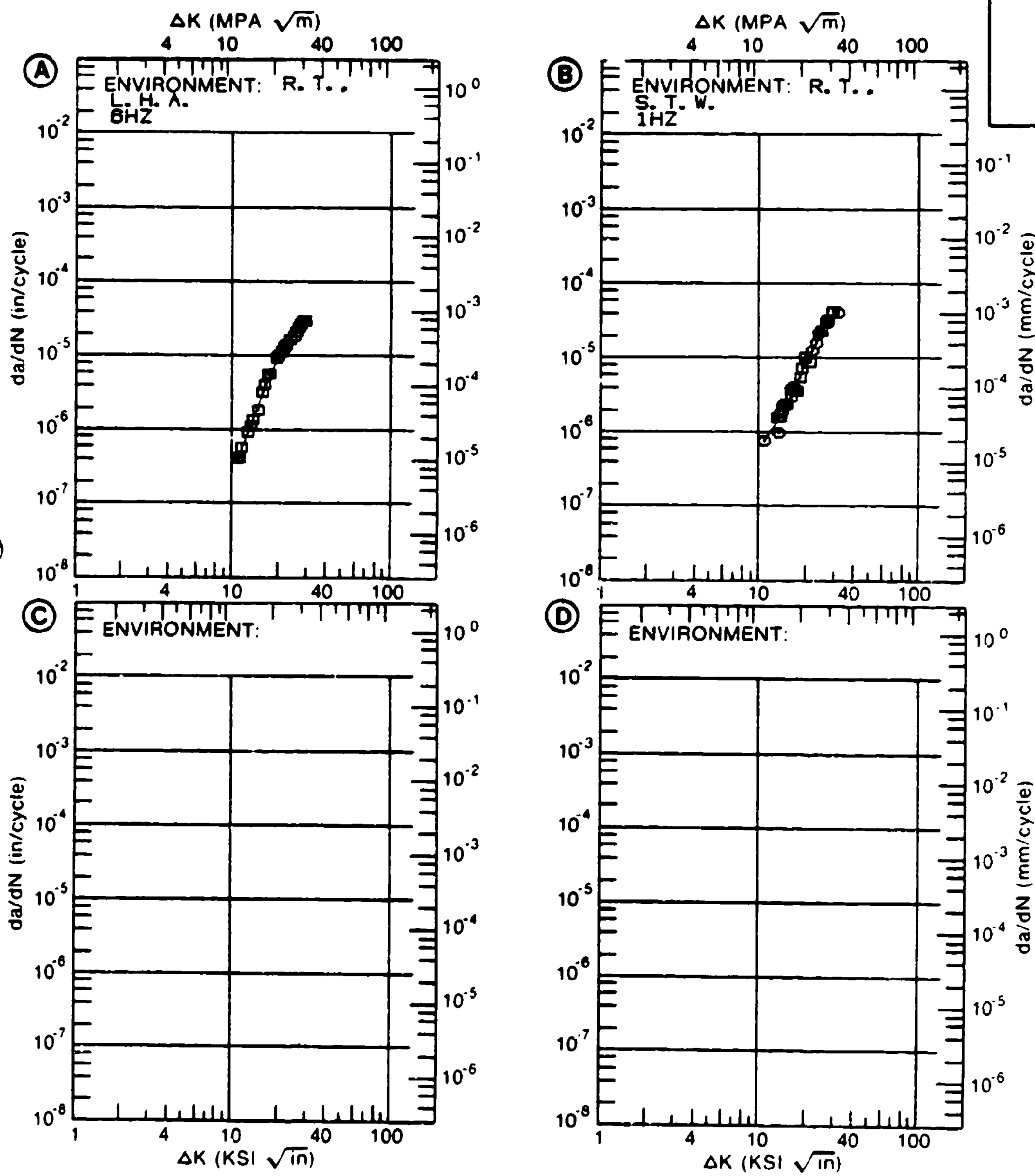

Figure 4.11.3.99

TABLE 4.11.3.100

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 4.11.3.100 INDICATING EFFECT

OF ENVIRONMENT

MATERIAL: TITANIUM TI-6AL-4V
CONDITION: RA

DELTA K (KSI*IN**1/2)			DA/DN (10**-6 IN./CYCLE) A	B	C	D
			E= R.T. L.H.A.			
DELTA K MIN	A:	18.54	2.02			
	B:					
	C:					
	D:					
		20.00	3.34			
		25.00	10.6			
		30.00	21.5			
		35.00	36.3			
		40.00	57.6			
		50.00	145.			
		60.00	405.			
DELTA K MAX	A:	62.29	521.			
	B:					
	C:					
	D:					
ROOT MEAN SQUARE PERCENT ERROR			8.69			
LIFE PREDICTION RATIO SUMMARY (NP/NA)		0.0-0.5				
		0.5-0.8				
		0.8-1.25	1			
		1.25-2.0				
		>2.0				

CONDITION/HT: RA
FORM: 3.50"TH PLATE
SPECIMEN TYPE: CT
ORIENTATION: L-T
STRESS RATIO: +0.08
FREQUENCY: 6.00 HZ

YIELD STRENGTH: 118.0 KSI
ULT. STRENGTH: 129.0 KSI
SPECIMEN THK: 1.000"
SPECIMEN WIDTH: 6.000"
REFERENCES: 88579

TITAN. ALLOY

TI-6AL-4V

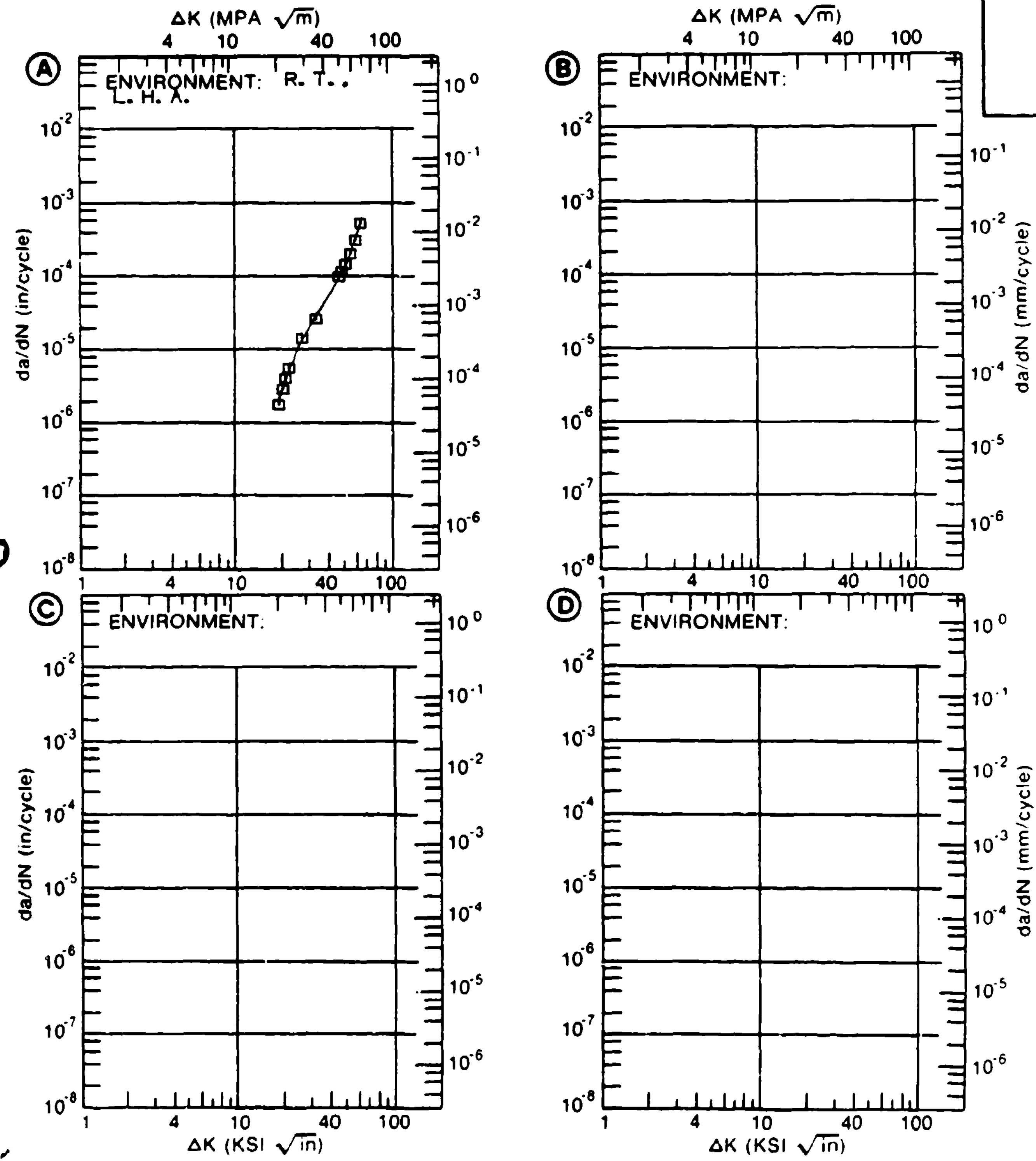

Figure 4.11.3.100

TABLE 4.11.3.101

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE4.11.3.101INDICATING EFFECT

OF STRESS RATIO

MATERIAL: TITANIUM TI-6AL-4V
CONDITION: RA
ENVIRONMENT: R. T. , S. T. W.

DELTA K (KSI*IN**1/2)			DA/DN (10**-6 IN./CYCLE) A	B	C	D
			R=+0.08			
	A:	6.72	.356			
DELTA K MIN	B:					
	C:					
	D:					
		7.00	.384			
		8.00	.573			
		9.00	.957			
		10.00	1.65			
		13.00	7.24			
		16.00	20.0			
		20.00	36.8			
	A:	21.08	38.2			
DELTA K MAX	B:					
	C:					
	D:					
ROOT MEAN SQUARE PERCENT ERROR			9.22			

LIFE PREDICTION RATIO SUMMARY (NP/NA)		
	0.0-0.5	
	0.5-0.8	
	0.8-1.25	1
	1.25-2.0	
	>2.0	

CONDITION/HT: RA
FORM: FORGING
SPECIMEN TYPE: CT
ORIENTATION: L-T
FREQUENCY: 1.00 HZ
ENVIRONMENT: R.T., S.T.W.

YIELD STRENGTH: 123.0 KSI
ULT. STRENGTH: 136.0 KSI
SPECIMEN THK: 0.900"
SPECIMEN WIDTH: 6.000"
REFERENCES: 88579

TITAN. ALLOY

TI-6AL-4V

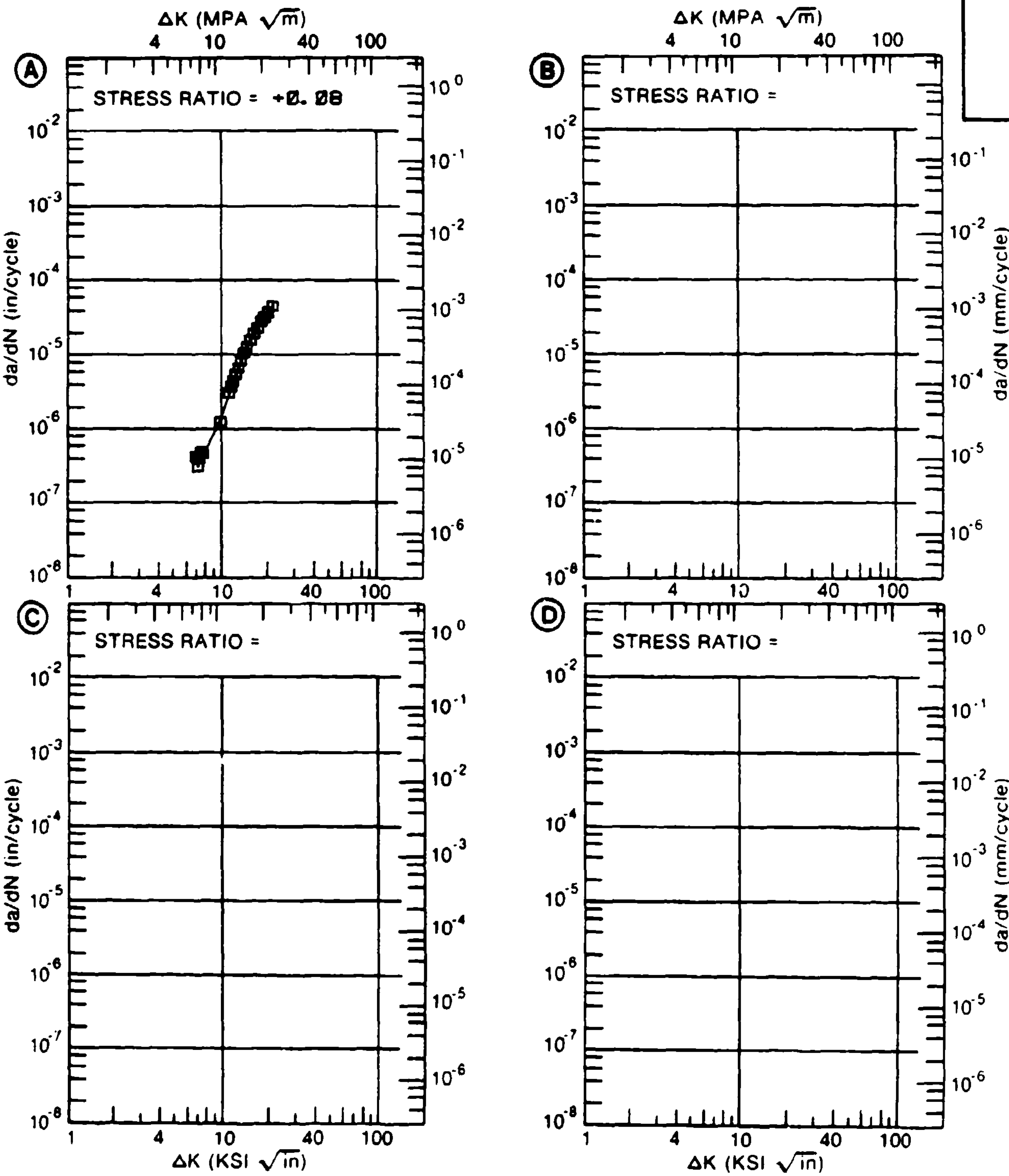

Figure 4.11.3.101

TABLE 4.11.3.102

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE4.11.3.102INDICATING EFFECT

OF STRESS RATIO

MATERIAL: TITANIUM TI-6AL-4V
CONDITION: RA
ENVIRONMENT: R.T. ,S.T.W.

DELTA K (KSI*IN**1/2)			DA/DN (10**-6 IN./CYCLE) A	B	C	D
			R=+0.08			
DELTA K MIN	A:	10.96	1.07			
	B:					
	C:					
	D:					
		13.00	2.50			
		16.00	6.47			
		20.00	16.1			
		25.00	36.1			
		30.00	64.4			
		35.00	99.4			
		40.00	139.			
		50.00	225.			
DELTA K MAX	A:	54.52	264.			
	B:					
	C:					
	D:					

ROOT MEAN SQUARE PERCENT ERROR		22.85
LIFE PREDICTION RATIO SUMMARY (NP/NA)	0.0-0.5	
	0.5-0.8	
	0.8-1.25	1
	1.25-2.0	1
	>2.0	

CONDITION/HT: RA
FORM: FORGING
SPECIMEN TYPE: CT
ORIENTATION: T-L
FREQUENCY: 1.00 HZ
ENVIRONMENT: R.T., S.T.W.

YIELD STRENGTH: 119.0- 124.0 KSI
ULT. STRENGTH: 132.0- 136.0 KSI
SPECIMEN THK: 0.910- 1.010"
SPECIMEN WIDTH: 5.000"
REFERENCES 88579

TITAN. ALLOY

TI-6AL-4V

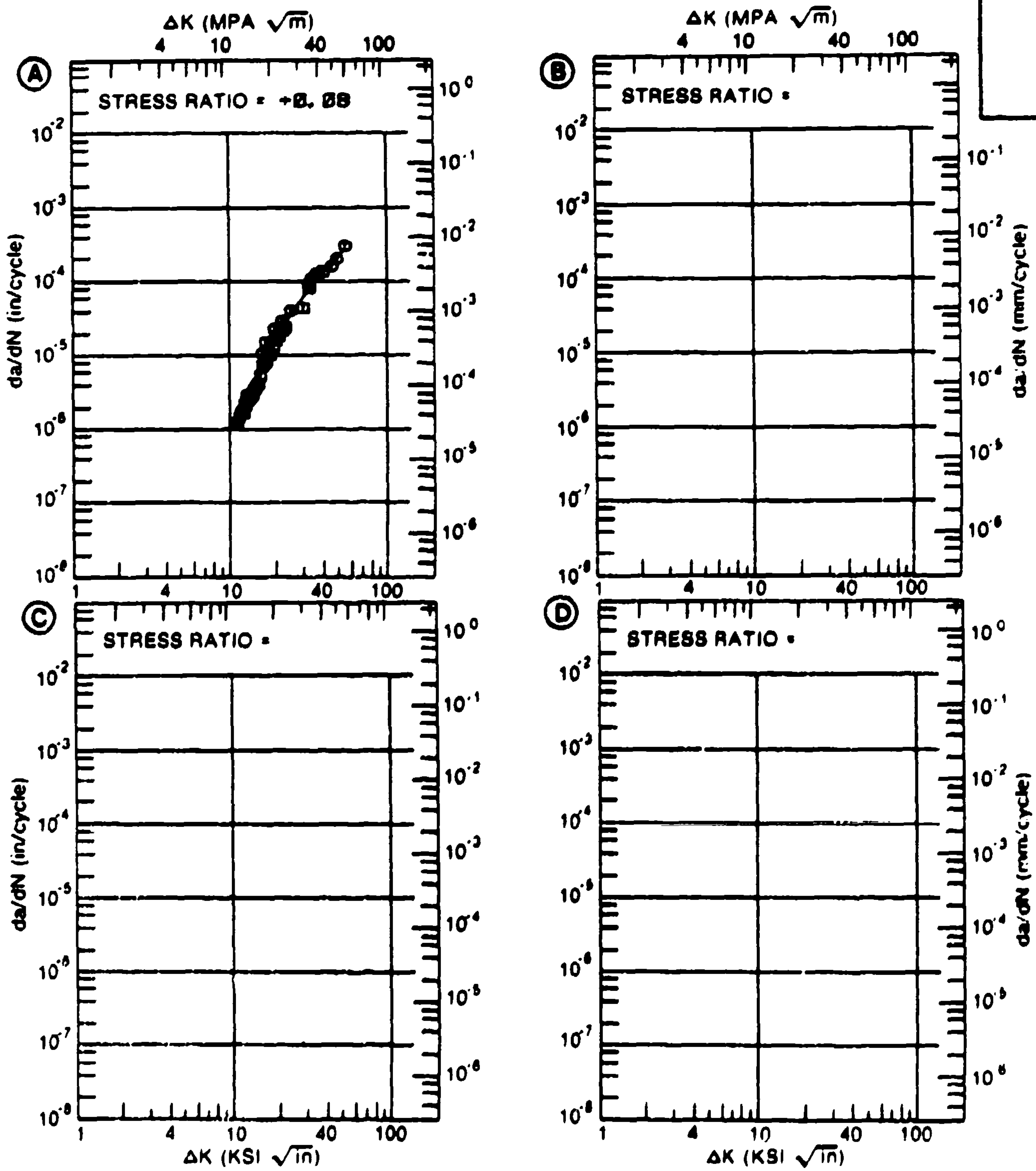

Figure 4.11.3.102

TABLE 4.11.3.103

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE4.11.3.103INDICATING EFFECT

OF STRESS RATIO

MATERIAL: TITANIUM TI-6AL-4V
CONDITION: RA
ENVIRONMENT: R. T. ,L. H. A.

DELTA K (KSI*IN**1/2)		DA/DN (10**-6 IN./CYCLE) A	B	C	D
		R=+0.08	R=+0.30		
DELTA K MIN	A: 10.40	.132			
	B: 9.44		.866		
	C:				
	D:				
	10.00		1.22		
	13.00	.618	4.26		
	16.00	1.93	8.77		
	20.00	6.76	16.2		
	25.00	13.9	28.2		
	30.00	23.3	45.4		
	35.00		72.4		
	40.00		117.		
	50.00		324.		
DELTA K MAX	A: 34.94	36.0			
	B: 57.20		710.		
	C:				
	D:				
ROOT MEAN SQUARE PERCENT ERROR		12.27	8.17		
LIFE PREDICTION RATIO SUMMARY (NP/NA)	0.0-0.5				
	0.5-0.8				
	0.8-1.25		1		
	1.25-2.0	1			
	>2.0				

CONDITION/HT: RA
FORM: 4.00"TH FORGING
SPECIMEN TYPE: CT
ORIENTATION: L-T
FREQUENCY: 6.00 HZ
ENVIRONMENT: R.T., L.H.A.

YIELD STRENGTH: 121.0 KSI
ULT. STRENGTH: 132.0 KSI
SPECIMEN THK: 1.000"
SPECIMEN WIDTH: 7.400"
REFERENCES: 88578

TITAN. ALLOY

TI-6AL-4V

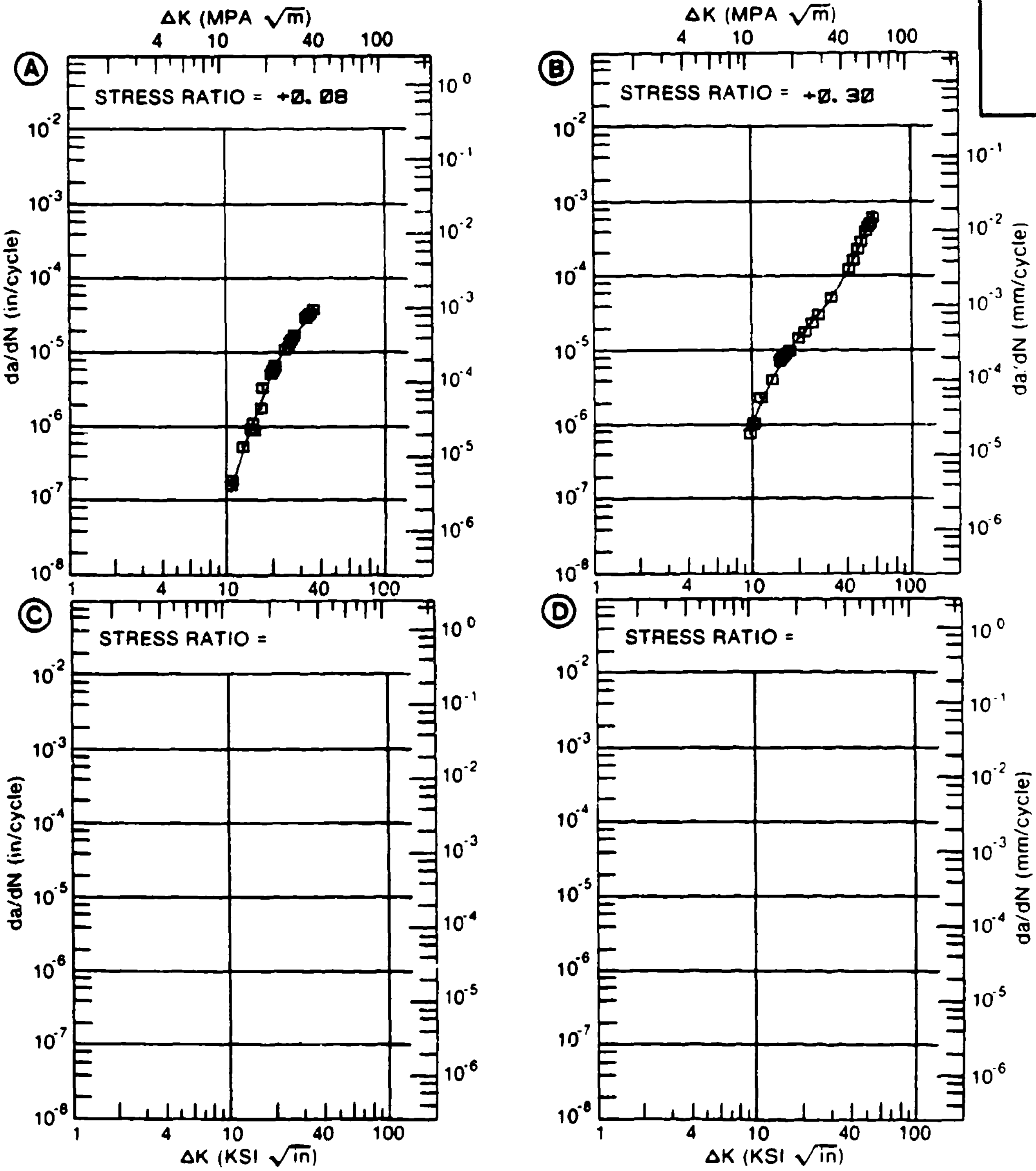

Figure 4.11.3.103

TABLE 4.11.3.104

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE4.11.3.104INDICATING EFFECT

OF ENVIRONMENT

MATERIAL: TITANIUM TI-6AL-4V
CONDITION: RA

DELTA K (KSI*IN**1/2)			DA/DN (10**-6 IN./CYCLE) A E= R.T. L.H.A.	B E= R.T. J.P.4	C	D
	A:	9.37	.349			
DELTA K MIN	B:	12.53		.933		
	C:					
	D:					
		10.00	.388			
		13.00	.844	.812		
		16.00	2.04	1.38		
		20.00	5.78	5.54		
		25.00	15.9	14.2		
		30.00	34.1	26.6		
		35.00	60.1			
		40.00	91.3			
		50.00	166.			
	A:	58.69	341.			
DELTA K MAX	B:	32.23		34.8		
	C:					
	D:					
ROOT MEAN SQUARE PERCENT ERROR			25.76	17.89		
LIFE PREDICTION RATIO SUMMARY (NP/NA)		0.0-0.5				
		0.5-0.8				
		0.8-1.25	2	1		
		1.25-2.0				
		>2.0				

CONDITION/HT: RA
FORM: 4.00"TH FORGING
SPECIMEN TYPE: CT
ORIENTATION: L-T
STRESS RATIO: +0.08
FREQUENCY: 1.00 HZ

YIELD STRENGTH: 121.0 KSI
ULT. STRENGTH: 132.0 KSI
SPECIMEN THK: 0.950- 1.000"
SPECIMEN WIDTH: 7.400"
REFERENCES: 88579

TITAN. ALLOY

TI-6AL-4V

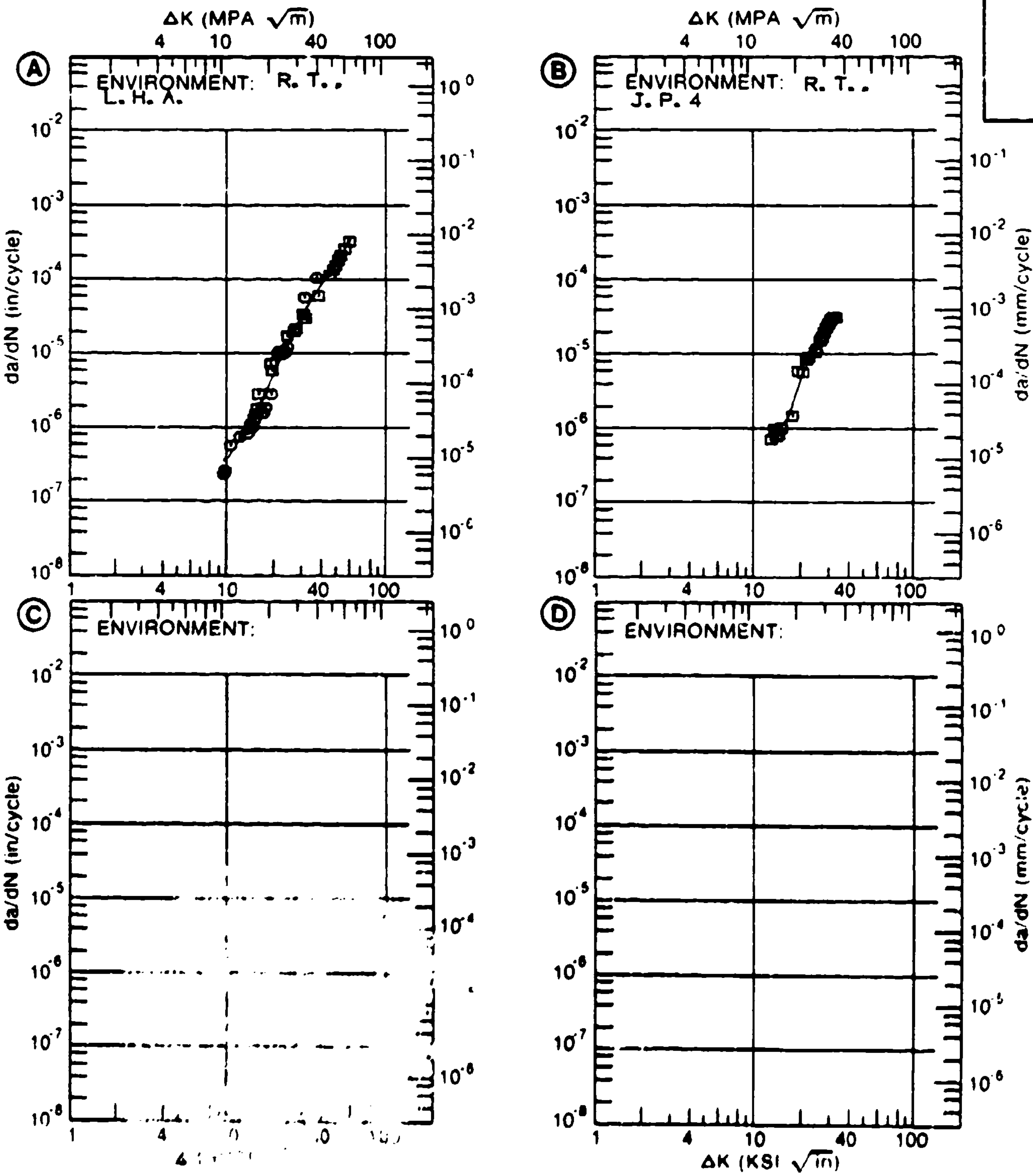

Figure 4.11.3.104

TABLE 4.11.3.105

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE4.11.3.105INDICATING EFFECT

OF STRESS RATIO

MATERIAL: TITANIUM TI-6AL-4V
CONDITION: RA
ENVIRONMENT: R.T. , L.H.A.

DELTA K (KSI*IN**1/2)			DA/DN (10**-6 IN./CYCLE) A R=+0.08	B R=+0.50	C	D
DELTA K MIN	A:	12.73	.837			
	B:	9.49		2.14		
	C:					
	D:					
		10.00		2.68		
		13.00	.920	6.78		
		16.00	2.53	11.9		
		20.00	7.65	19.8		
		25.00	19.1	32.7		
		30.00	32.8	51.6		
		35.00	48.1	71.3		
		40.00	67.2			
		50.00	135.			
		60.00	327.			
DELTA K MAX	A:	68.69	885.			
	B:	37.30		101.		
	C:					
	D:					
ROOT MEAN SQUARE PERCENT ERROR			13.63	7.38		
LIFE PREDICTION RATIO SUMMARY (NP/NA)		0.0-0.5				
		0.5-0.8				
		0.8-1.25	1	1		
		1.25-2.0				
		>2.0				

CONDITION/HT: RA
FORM: 4.00"TH FORGING
SPECIMEN TYPE: CT
ORIENTATION: T-L
FREQUENCY: 6.00 HZ
ENVIRONMENT: R. T., L. H. A.

YIELD STRENGTH: 119.0- 128.0 KSI
ULT. STRENGTH: 127.0- 136.0 KSI
SPECIMEN THK: 1.000"
SPECIMEN WIDTH: 7.400"
REFERENCES: 88579

TITAN. ALLOY

TI-6AL-4V

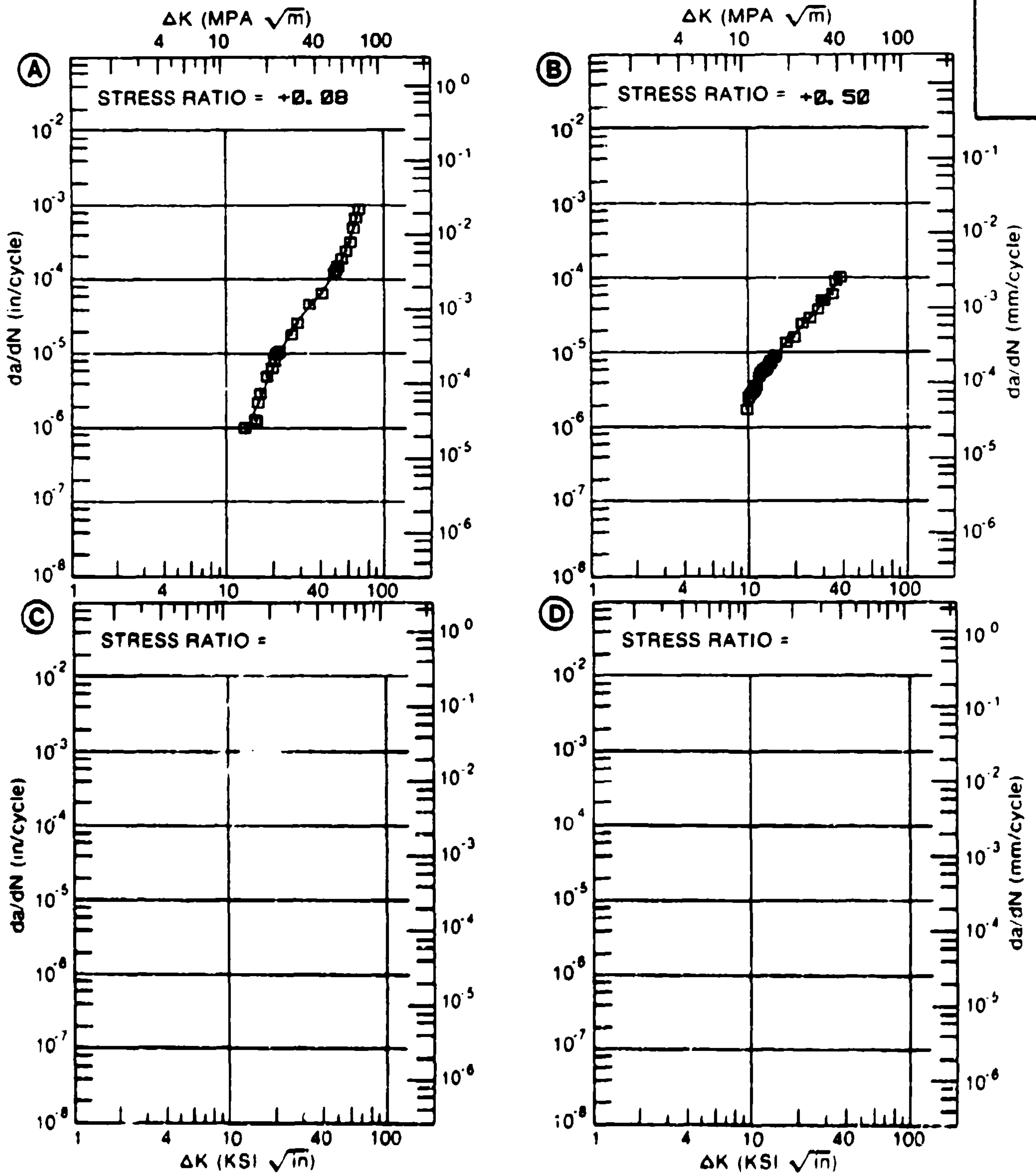

Figure 4.11.3.105

TABLE 4.11.3.106

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 4.11.3.106 INDICATING EFFECT

OF STRESS RATIO

MATERIAL: TITANIUM TI-6AL-4V
CONDITION: RA
ENVIRONMENT: R.T. ,S.T.W.

DELTA K (KSI*IN**1/2)			DA/DN (10**-6 IN./CYCLE) A	B	C	D
			R=+0.50			
DELTA K MIN	A:	7.69	1.88			
	B:					
	C:					
	D:					
		8.00	1.81			
		9.00	2.18			
		10.00	3.39			
		13.00	14.7			
		16.00	33.8			
		20.00	61.3			
		25.00	103.			
		30.00	171.			
		35.00	277.			
		40.00	426.			
DELTA K MAX	A:	40.43	440.			
	B:					
	C:					
	D:					
ROOT MEAN SQUARE PERCENT ERROR			15.31			

LIFE PREDICTION RATIO SUMMARY (NP/NA)		
	0.0-0.5	
	0.5-0.8	
	0.8-1.25	1
	1.25-2.0	
	>2.0	

CONDITION/HT: RA
FORM: 4.00"TH FORGING
SPECIMEN TYPE: CT
ORIENTATION: T-L
FREQUENCY: 1.00 HZ
ENVIRONMENT: R.T., S.T.W.

YIELD STRENGTH: 128.0 KSI
ULT. STRENGTH: 136.0 KSI
SPECIMEN THK: 0.660"
SPECIMEN WIDTH: 7.400"
REFERENCES 88579

TITAN. ALLOY

TI-6AL-4V

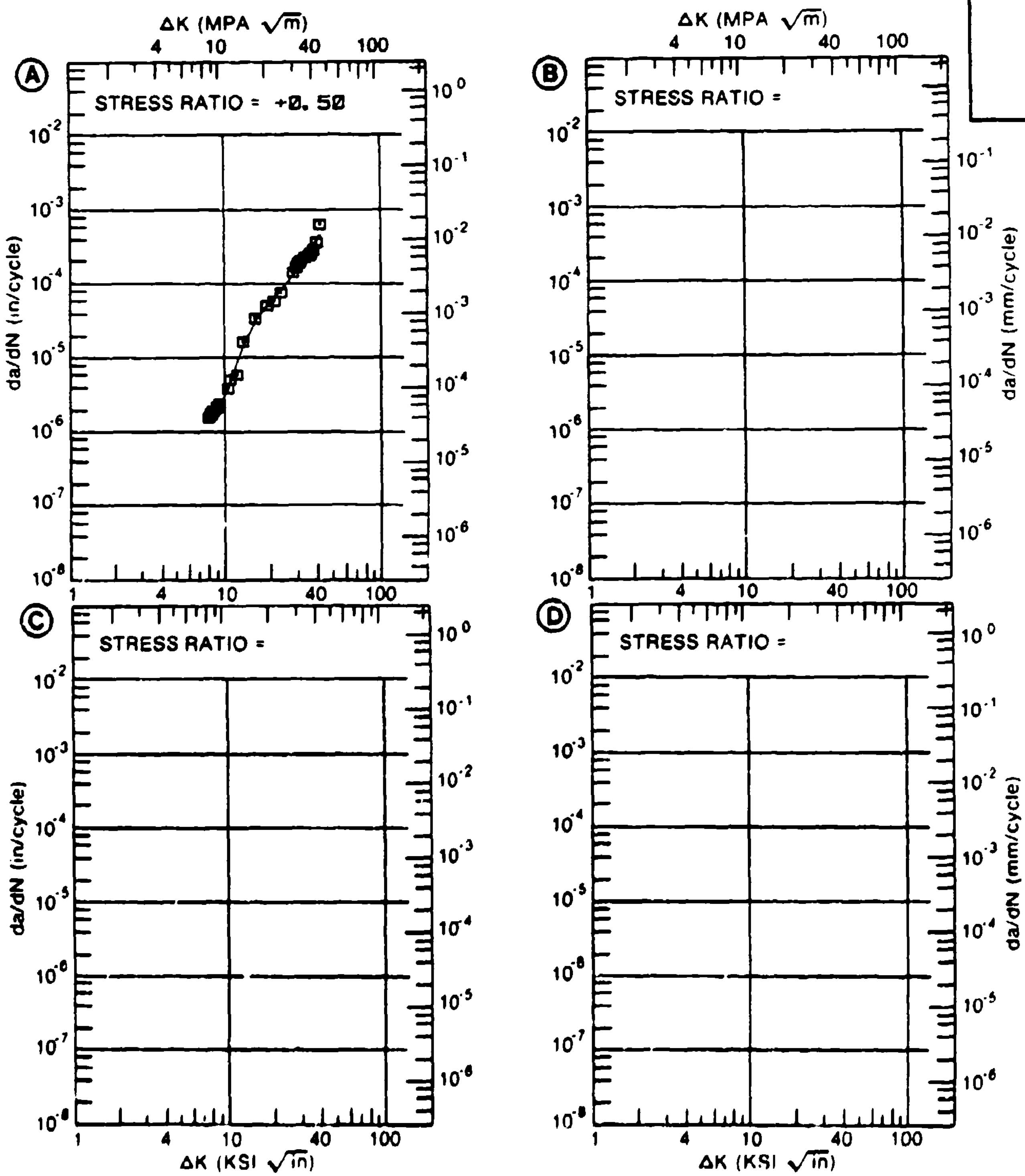

Figure 4.11.3.106

TABLE 4.11.3.107

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 4.11.3.107 INDICATING EFFECT

OF ENVIRONMENT

MATERIAL: TITANIUM TI-6AL-4V
CONDITION: RA

DELTA K (KSI*IN**1/2)		DA/DN (10**-6 IN./CYCLE) A	B	C	D
		E= R.T. S.T.W. SP. THK.=.77"	E= R.T. S.T.W. SP. THK.=1.04"		
DELTA K MIN A:	9.95	.707			
B:	8.02		.186		
C:					
D:					
	9.00		.398		
	10.00	.694	.742		
	13.00	1.60	2.75		
	16.00	5.77	6.48		
	20.00	14.0	14.9		
	25.00	29.9	33.5		
	30.00	51.9			
	35.00	79.6			
	40.00	112.			
	50.00	192.			
DELTA K MAX A:	58.05	270.			
B:	28.61		56.2		
C:					
D:					
ROOT MEAN SQUARE PERCENT ERROR		10.30	25.37		
LIFE PREDICTION RATIO SUMMARY (NP/NA)	0.0-0.5				
	0.5-0.8				
	0.8-1.25	1			
	1.25-2.0		1		
	>2.0				

CONDITION/HT: RA
FORM: 4.00"TH FORGING
SPECIMEN TYPE: CT
ORIENTATION: T-L
STRESS RATIO: +0.08
FREQUENCY: 1.00 HZ

YIELD STRENGTH: 119.0- 128.0 KSI
ULT. STRENGTH: 127.0- 136.0 KSI
SPECIMEN THK:
SPECIMEN WIDTH: 7.400"
REFERENCES:88579

TITAN. ALLOY

TI-6AL-4V

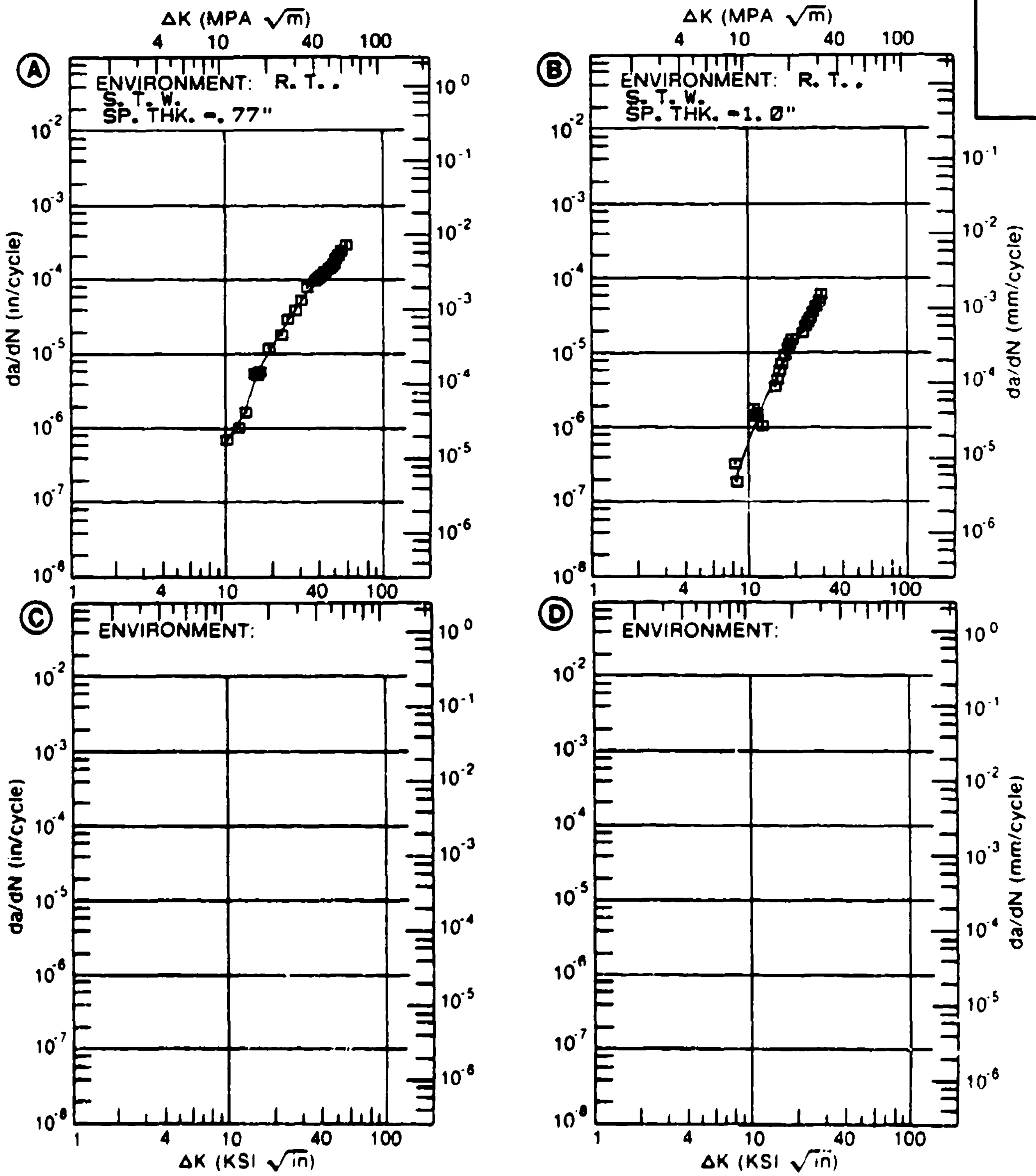

Figure 4.11.3.107

TABLE 4.11.3.108

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE4.11.3.108INDICATING EFFECT

OF ENVIRONMENT

MATERIAL: TITANIUM TI-6AL-4V
CONDITION: STOA

DELTA K (KSI*IN**1/2)		DA/DN (10**-6 IN./CYCLE) A	B	C	D
		E= R. T. L. H. A.			
DELTA K MIN	A: 11.82	9.43			
	B:				
	C:				
	D:				
	13.00	9.10			
	16.00	20.2			
DELTA K MAX	A: 18.56	37.1			
	B:				
	C:				
	D:				

ROOT MEAN SQUARE PERCENT ERROR		10.90
LIFE PREDICTION RATIO SUMMARY (NP/NA)	0.0-0.5	
	0.5-0.8	
	0.8-1.25	1
	1.25-2.0	
	>2.0	

CONDITION/HT: STOA
FORM: 0.82"TH PLATE
SPECIMEN TYPE: CT
ORIENTATION: L-T
STRESS RATIO: +0.30
FREQUENCY: 1.00 HZ

YIELD STRENGTH: 140.0 KSI
ULT. STRENGTH: 150.0 KSI
SPECIMEN THK: 0.491"
SPECIMEN WIDTH: 6.000"
REFERENCES: 85837

TITAN. ALLOY

TI-6AL-4V

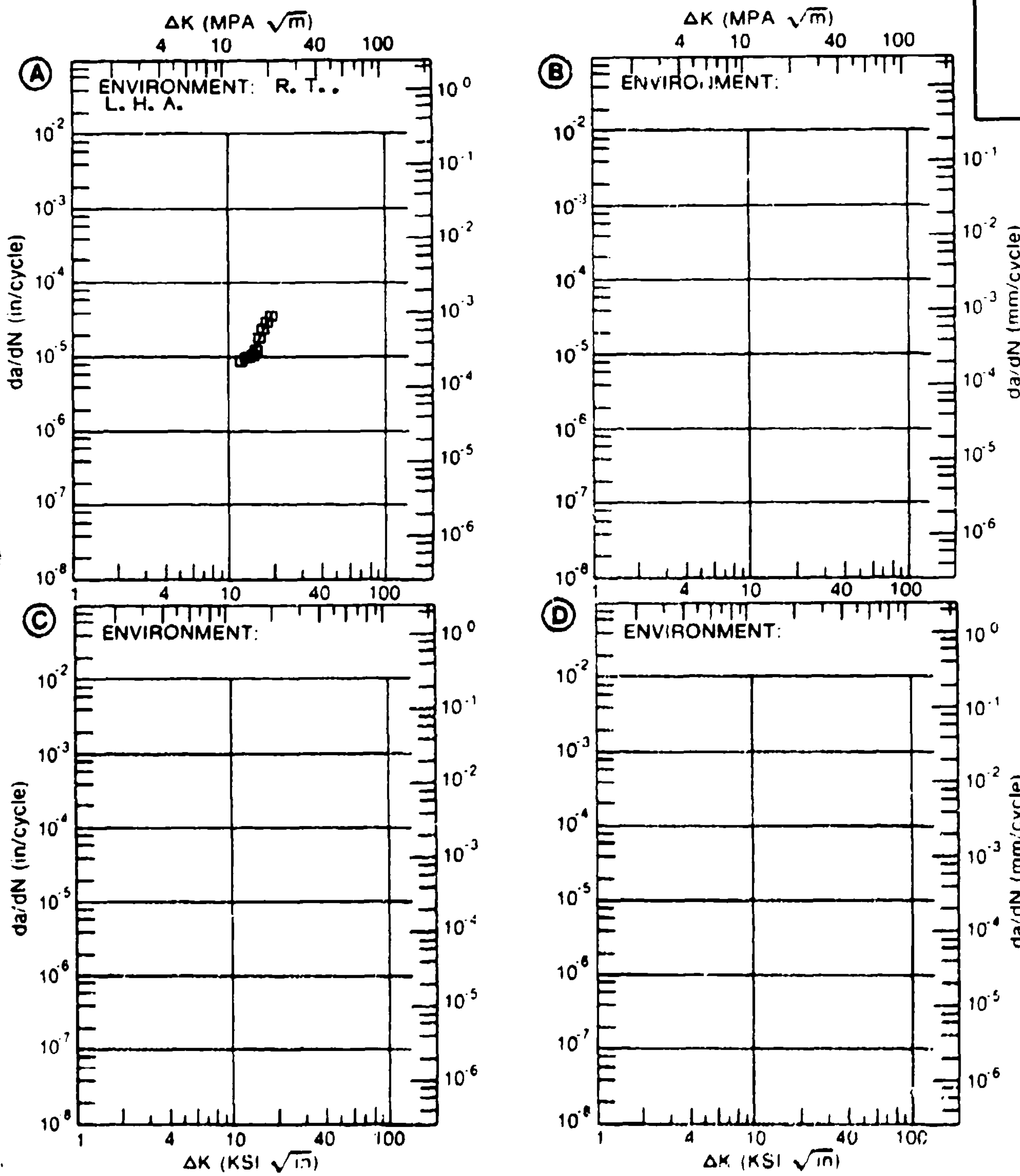

Figure 4.11.3.108

TABLE 4.11.3.109

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 4.11.8.109 INDICATING EFFECT

OF ENVIRONMENT

MATERIAL: TITANIUM TI-6AL-4V
CONDITION: STRESS RELIEVED E.B. WELDMENT (WELD ZONE)

DELTA K (KSI*IN**1/2)		DA/DN (10**-6 IN./CYCLE) A	B	C	D
		E= R.T. LAB AIR	E= R.T. DIST. WATER		
DELTA K MIN A:	15.48	2.20			
DELTA K MIN B:	25.76		5.22		
DELTA K MIN C:					
DELTA K MIN D:					
	16.00	4.77			
	20.00	10.1			
	25.00	24.6			
	30.00	63.5	19.2		
	35.00	175.	78.6		
	40.00	1080.	273.		
	50.00		2053.		
	60.00		9009.		
DELTA K MAX A:	40.52	1462.			
DELTA K MAX B:	68.14		21786.		
DELTA K MAX C:					
DELTA K MAX D:					
ROOT MEAN SQUARE PERCENT ERROR		39.26	111.76		

LIFE PREDICTION RATIO SUMMARY (NP/NA)	
0.0-0.5	
0.5-0.8	
0.8-1.25	
1.25-2.0	
>2.0	

CONDITION/HT: STRESS RELIEVED E.B. WELDMENT (WELD ZONE)
FORM: 1.00"TH WELDMENT
SPECIMEN TYPE: CT
ORIENTATION: T-L
STRESS RATIO: +0.10
FREQUENCY: 0.10- 10.00 HZ

YIELD STRENGTH:
ULT. STRENGTH:
SPECIMEN THK: 1.000"
SPECIMEN WIDTH: 2.000"
REFERENCES:88144

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TI-6AL-4V

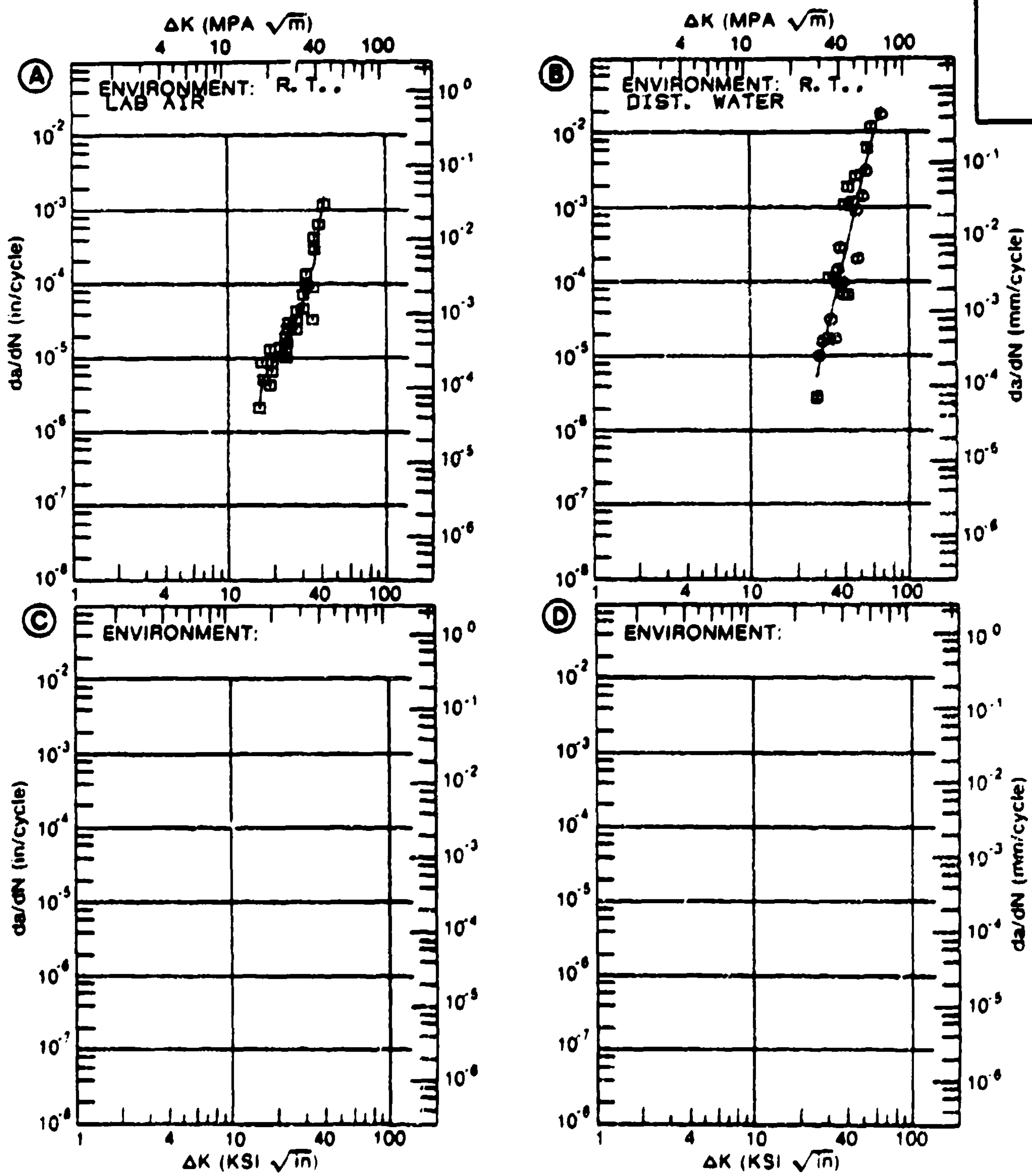

Figure 4.11.3.109

TABLE 4.11.3.110

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE4.11.3.110INDICATING EFFECT

OF ENVIRONMENT

MATERIAL: TITANIUM TI-6AL-4V
CONDITION: STRESS RELIEVED E. B. WELDMENT (WELD ZONE)

DELTA K (KSI*IN**1/2)		DA/DN (10**-6 IN./CYCLE) A: E= R.T. 3.5% NACL	B: E=+ 175F 3.5% NACL	C	D
DELTA K MIN A:	21.95	17.8			
DELTA K MIN B:	28.50		31.1		
DELTA K MIN C:					
DELTA K MIN D:					
	25.00	120.			
	30.00	854.	53.6		
	35.00	2746.	179.		
	40.00	5987.	895.		
	50.00	18134.			
DELTA K MAX A:	51.09	20210.			
DELTA K MAX B:	46.69		8328.		
DELTA K MAX C:					
DELTA K MAX D:					
ROOT MEAN SQUARE PERCENT ERROR		74.94	39.82		

LIFE PREDICTION RATIO SUMMARY (NP/NA)	
0.0-0.5	
0.5-0.8	
0.8-1.25	
1.25-2.0	
>2.0	

CONDITION/HT: STRESS RELIEVED E. B. WELDMENT (WELD ZONE)
FORM: 1.00"TH WELDMENT
SPECIMEN TYPE: CT
ORIENTATION: T-L
STRESS RATIO: +0.10
FREQUENCY: 0.10- 10.00 HZ

YIELD STRENGTH:
ULT. STRENGTH:
SPECIMEN THK: 1.000"
SPECIMEN WIDTH: 2.550"
REFERENCES: 88144

TITAN. ALLOY

TI-6AL-4V

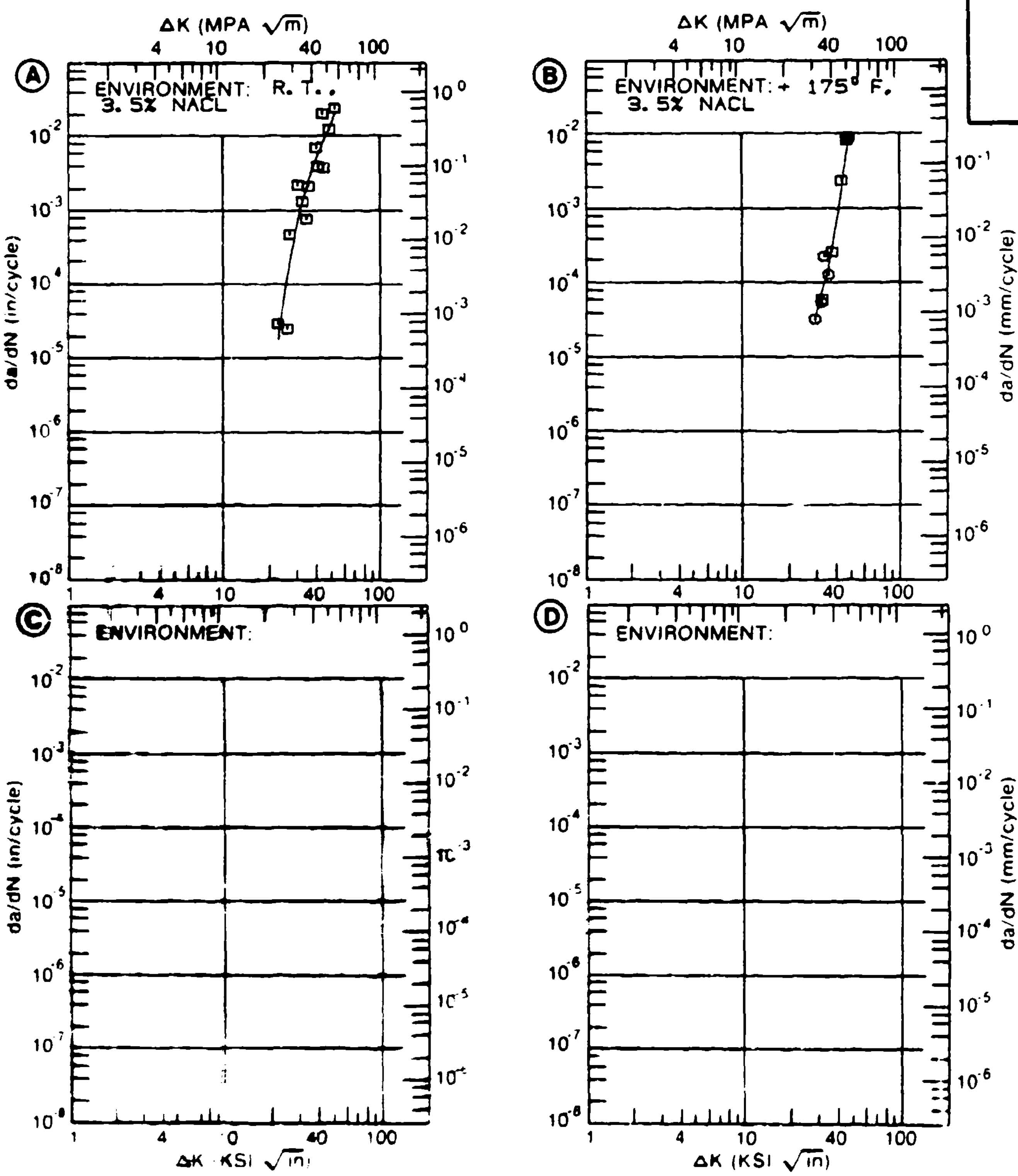

Figure 4.11.3.110

TABLE 4.11.3.111

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE4.11.3.111INDICATING EFFECT

OF ENVIRONMENT

MATERIAL: TITANIUM TI-6AL-4V
CONDITION: STRESS RELIEVED E. B. WELDMENT (HEAT
AFFECTED ZONE)

DELTA K (KSI*IN**1/2)		DA/DN (10**-6 IN./CYCLE) A	B	C	D
		E= R. T. 3. 5% NACL . 1-10HZ	E=+ 175F 3. 5% NACL 10HZ	E=+ 175F 3. 5% NACL . 1HZ	
DELTA K MIN A:	19. 78	14. 6			
DELTA K MIN B:					
DELTA K MIN C:					
DELTA K MIN D:					
	20. 00	13. 9			
	25. 00	17. 7			
	30. 00	84. 5			
	35. 00	626.			
	40. 00	4908.			
DELTA K MAX A:	49. 52	172725.			
DELTA K MAX B:					
DELTA K MAX C:					
DELTA K MAX D:					
ROOT MEAN SQUARE PERCENT ERROR		113. 68	0. 00	0. 00	

LIFE PREDICTION RATIO SUMMARY (NP/NA)
0. 0-0. 5
0. 5-0. 8
0. 8-1. 25
1. 25-2. 0
>2. 0

CONDITION/HT: STRESS RELIEVED E. B. WELDMENT (HEAT AFFECTED ZONE)	
FORM: 1.00"TH WELDMENT	YIELD STRENGTH:
SPECIMEN TYPE: CT	ULT. STRENGTH:
ORIENTATION: T-L	SPECIMEN THK: 1.000"
STRESS RATIO: +0.10	SPECIMEN WIDTH: 2.550"
FREQUENCY:	REFERENCES: 88144

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TI-6AL-4V

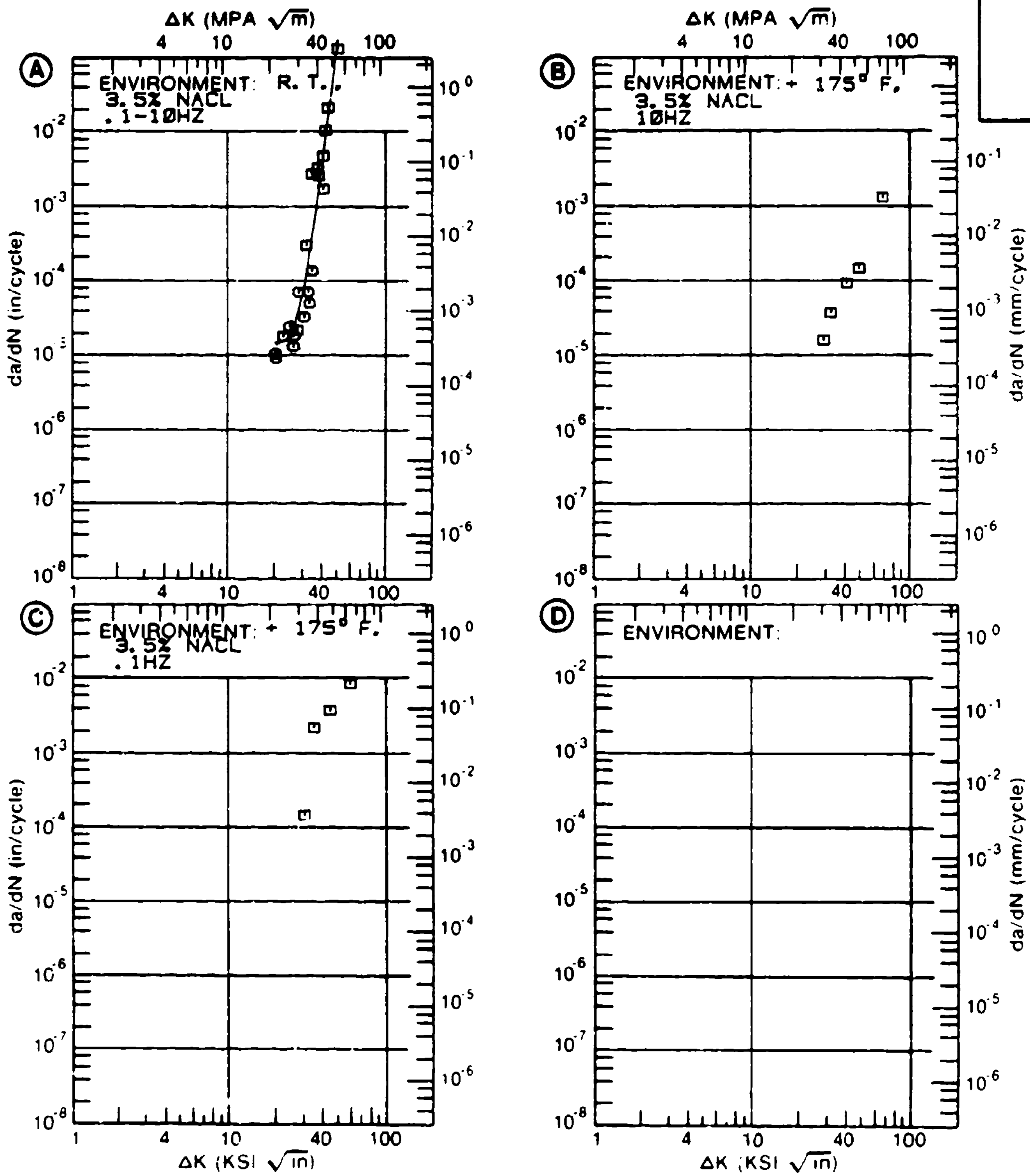

Figure 4.11.3.111

TABLE 4.11.3.112

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE4.11.3.112INDICATING EFFECT

OF ENVIRONMENT

MATERIAL: TITANIUM TI-6AL-4V
CONDITION: STRESS RELIEVED E.B. WELDMENT (HEAT AFFECTED ZONE)

DELTA K (KSI*IN**1/2)		DA/DN (10**-6 IN./CYCLE) A E= R.T. LAB AIR	B	C	D
DELTA K MIN	A: 15.64	3.64			
	B:				
	C:				
	D:				
	16.00	4.27			
	20.00	14.2			
	25.00	29.9			
	30.00	47.5			
	35.00	71.9			
	40.00	113.			
	50.00	344.			
DELTA K MAX	A: 52.34	1326.			
	B:				
	C:				
	D:				

ROOT MEAN SQUARE PERCENT ERROR 34.88

LIFE PREDICTION RATIO SUMMARY (NP/NA)	
0.0-0.5	
0.5-0.8	
0.8-1.25	
1.25-2.0	
>2.0	

CONDITION/HT: STRESS RELIEVED E.B. WELDMENT (HEAT AFFECTED ZONE)		TITAN. ALLOY
FORM: 1.00"TH WELDMENT	YIELD STRENGTH:	
SPECIMEN TYPE: CT	ULT. STRENGTH:	
ORIENTATION: T-L	SPECIMEN THK: 1.000"	
STRESS RATIO: +0.10	SPECIMEN WIDTH: 2.000"	TI-6AL-4V
FREQUENCY: 0.10- 10.00 HZ	REFERENCES:88144	

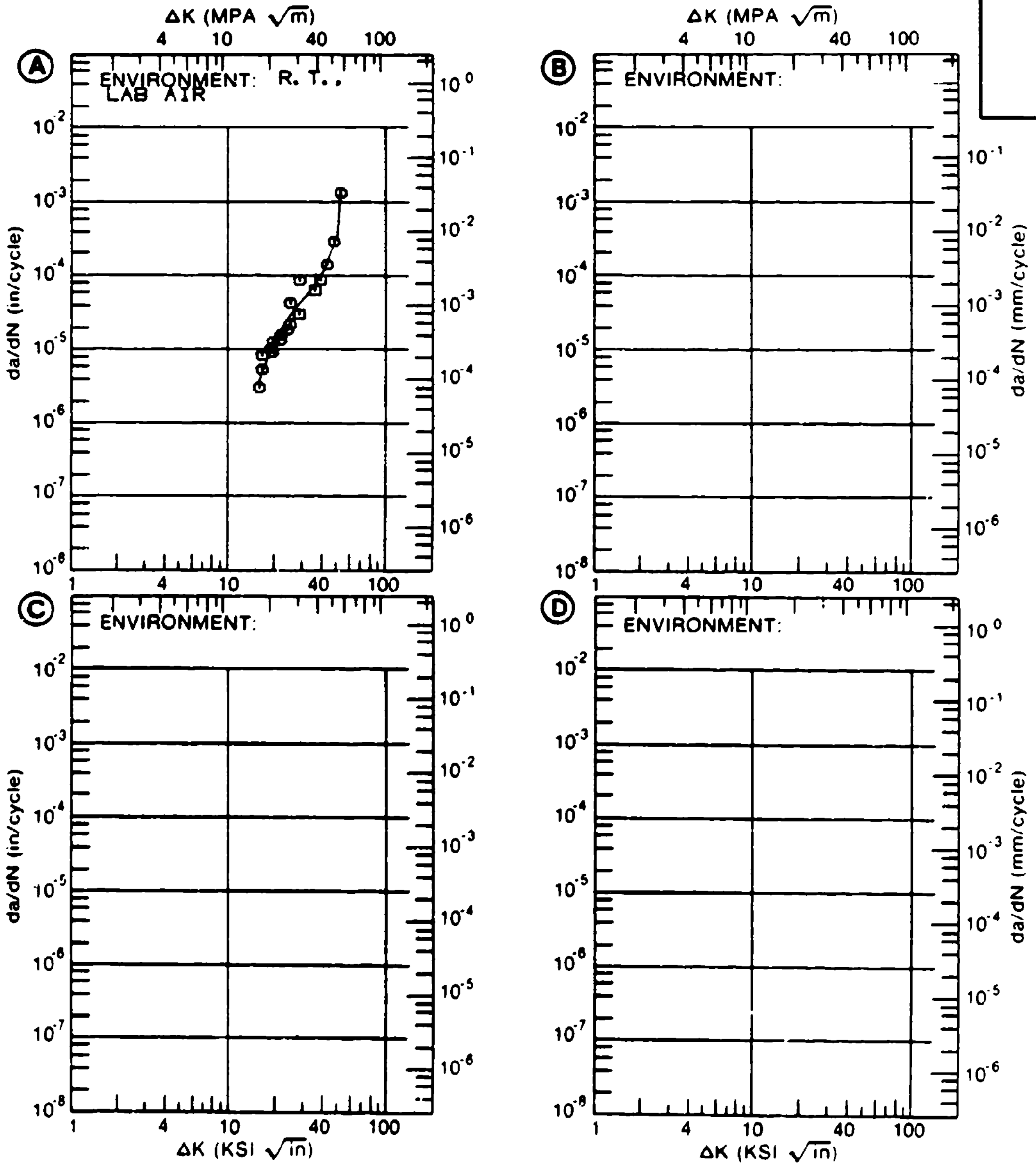

Figure 4.11.3.112

TABLE 4.11.3.113

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE4.11.3.113INDICATING EFFECT

OF ENVIRONMENT

MATERIAL: TITANIUM TI-6AL-4V
CONDITION: STRESS RELIEVED E. B. WELDMENT (HEAT
AFFECTED ZONE)

DELTA K (KSI*IN**1/2)		DA/DN (10**-6 IN./CYCLE) A E=- 65F AIR	B E=+ 175F AIR	C E= R. T. JP-4 FUEL	D E=+ 175F DIST. WATER
DELTA K MIN A:	29.03	59.9			
B:	16.93		4.81		
C:	18.23			5.47	
D:	29.99				46.8
	20.00		8.82	9.65	
	25.00		15.2	16.8	
	30.00	56.6	22.0	22.4	46.9
	35.00	143.	32.1	43.5	85.6
	40.00	461.	49.8	145.	192.
	50.00		150.	1561.	952.
	60.00		1058.		3157.
DELTA K MAX A:	43.08	585.			
B:	61.62		2449.		
C:	56.28			2318.	
D:	67.44				5530.
ROOT MEAN SQUARE PERCENT ERROR		54.47	24.73	75.15	53.19

LIFE PREDICTION RATIO SUMMARY (NP/NA)
0.0-0.5
0.5-0.8
0 8-1.25
1.25-2.0
>2.0

CONDITION/HT: STRESS RELIEVED E. B. WELDMENT (HEAT AFFECTED ZONE)
FORM: 1.00"TH WELDMENT
SPECIMEN TYPE: CT
ORIENTATION: T-L
STRESS RATIO: +0.10
FREQUENCY: 0.10- 10.00 HZ

YIELD STRENGTH:
ULT. STRENGTH:
SPECIMEN THK: 1.000"
SPECIMEN WIDTH: 2.550"
REFERENCES: 88144

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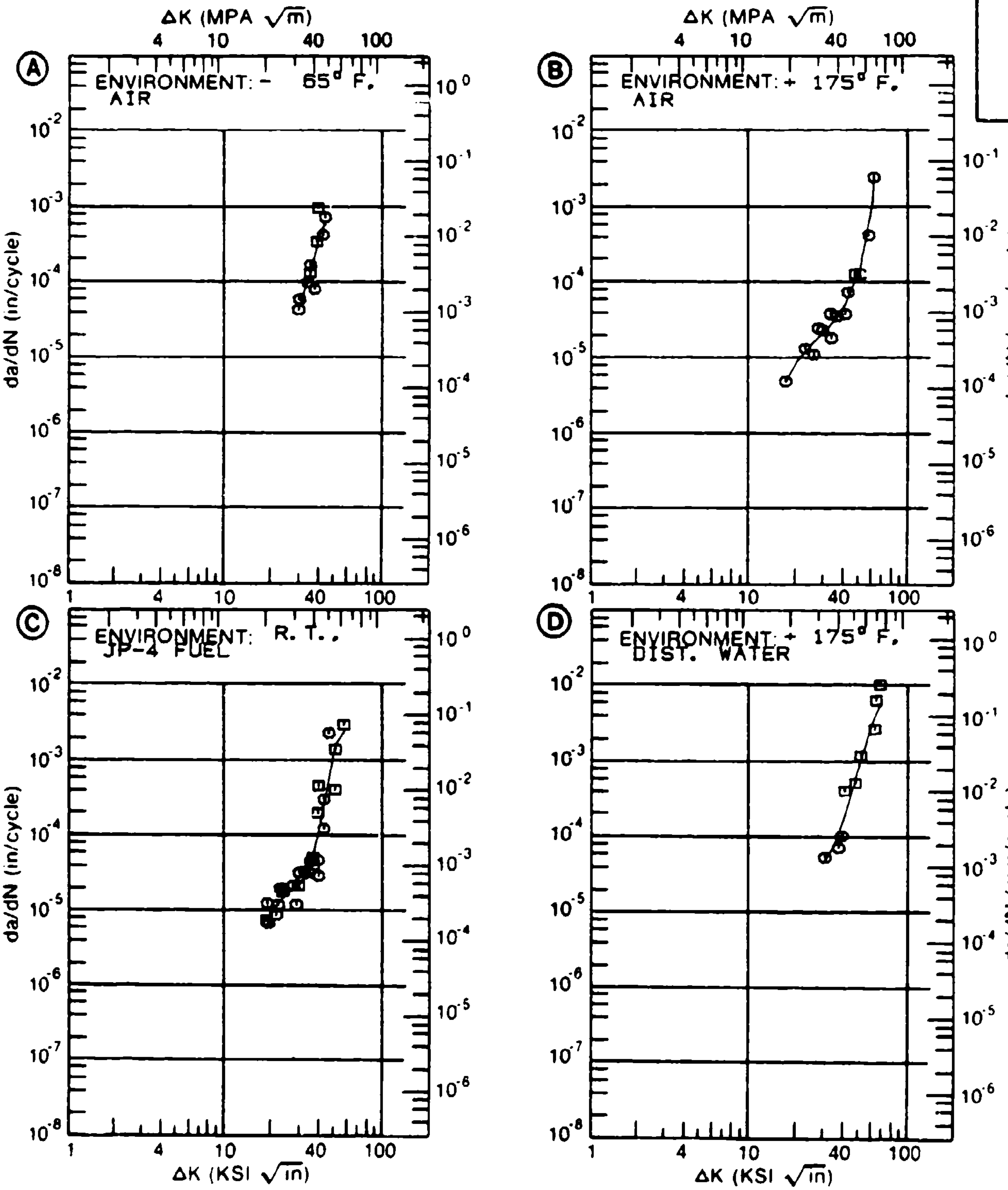

Figure 4.11.3.113

TABLE 4.11.3.114

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 4.11.3.114 INDICATING EFFECT

OF ENVIRONMENT

MATERIAL: TITANIUM TI-6AL-4V
CONDITION: AS WELDED E. B. WELDMENT (WELD ZONE)

DELTA K (KSI*IN**1/2)			DA/DN (10**-6 IN./CYCLE) A	B	C	D
			E= R. T. LAB AIR			
DELTA K MIN	A:	16.39	.700			
	B:					
	C:					
	D:					
		20.00	5.94			
		25.00	18.0			
DELTA K MAX	A:	25.00	18.0			
	B:					
	C:					
	D:					
ROOT MEAN SQUARE PERCENT ERROR			37.12			

LIFE	0.0-0.5
PREDICTION	0.5-0.8
RATIO	0.8-1.25
SUMMARY	1.25-2.0
(NP/NA)	>2.0

CONDITION/HT: AS WELDED
FORM: 1.00"TH WELDMENT
SPECIMEN TYPE: CT
ORIENTATION: T-L
STRESS RATIO: +0.10
FREQUENCY: 10.00 HZ

E. B. WELDMENT (WELD ZONE)
YIELD STRENGTH:
ULT. STRENGTH:
SPECIMEN THK: 1.000"
SPECIMEN WIDTH: 2.000"
REFERENCES:88144

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TI-6AL-4V

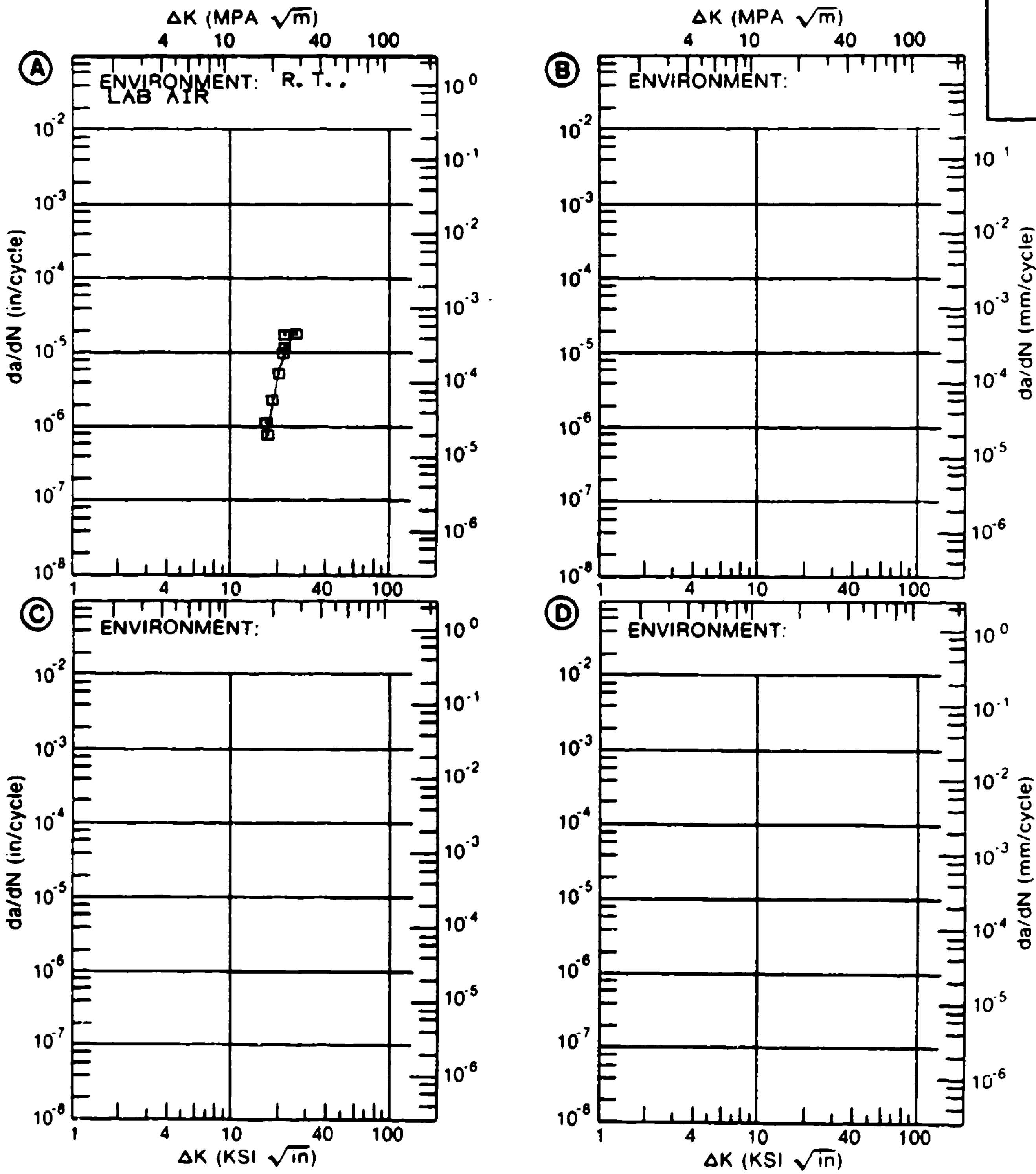

Figure 4.11.3.114

TABLE 4.11.3.115

FATIQUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE4.11.3.115INDICATING EFFECT

OF ENVIRONMENT

MATERIAL: TITANIUM TI-6AL-4V
CONDITION: AS WELDED E. B. WELDMENT (HEAT AFFECTED ZONE)

DELTA K (KSI*IN**1/2)		DA/DN (10**-6 IN./CYCLE) A E= R. T. LAB AIR	B	C	D
DELTA K MIN A:	15.35	1.98			
B:					
C:					
D:					
	16.00	2.50			
	20.00	6.52			
	25.00	13.2			
	30.00	24.7			
	35.00	50.2			
DELTA K MAX A:	35.34	52.9			
B:					
C:					
D:					
ROOT MEAN SQUARE PERCENT ERROR		7.47			

LIFE PREDICTION RATIO SUMMARY (NP/NA)	
	0.0-0.5
	0.5-0.8
	0.8-1.25
	1.25-2.0
	>2.0

CONDITION/HT: AS WELDED E. B. WELDMENT (HEAT AFFECTED ZONE)
FORM: 1. 00"TH WELDMENT
SPECIMEN TYPE: CT
ORIENTATION: T-L
STRESS RATIO: +0. 10
FREQUENCY: 10. 00 HZ

YIELD STRENGTH:
ULT. STRENGTH:
SPECIMEN THK: 1. 000"
SPECIMEN WIDTH: 2. 000"
REFERENCES:88144

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TI-6AL-4V

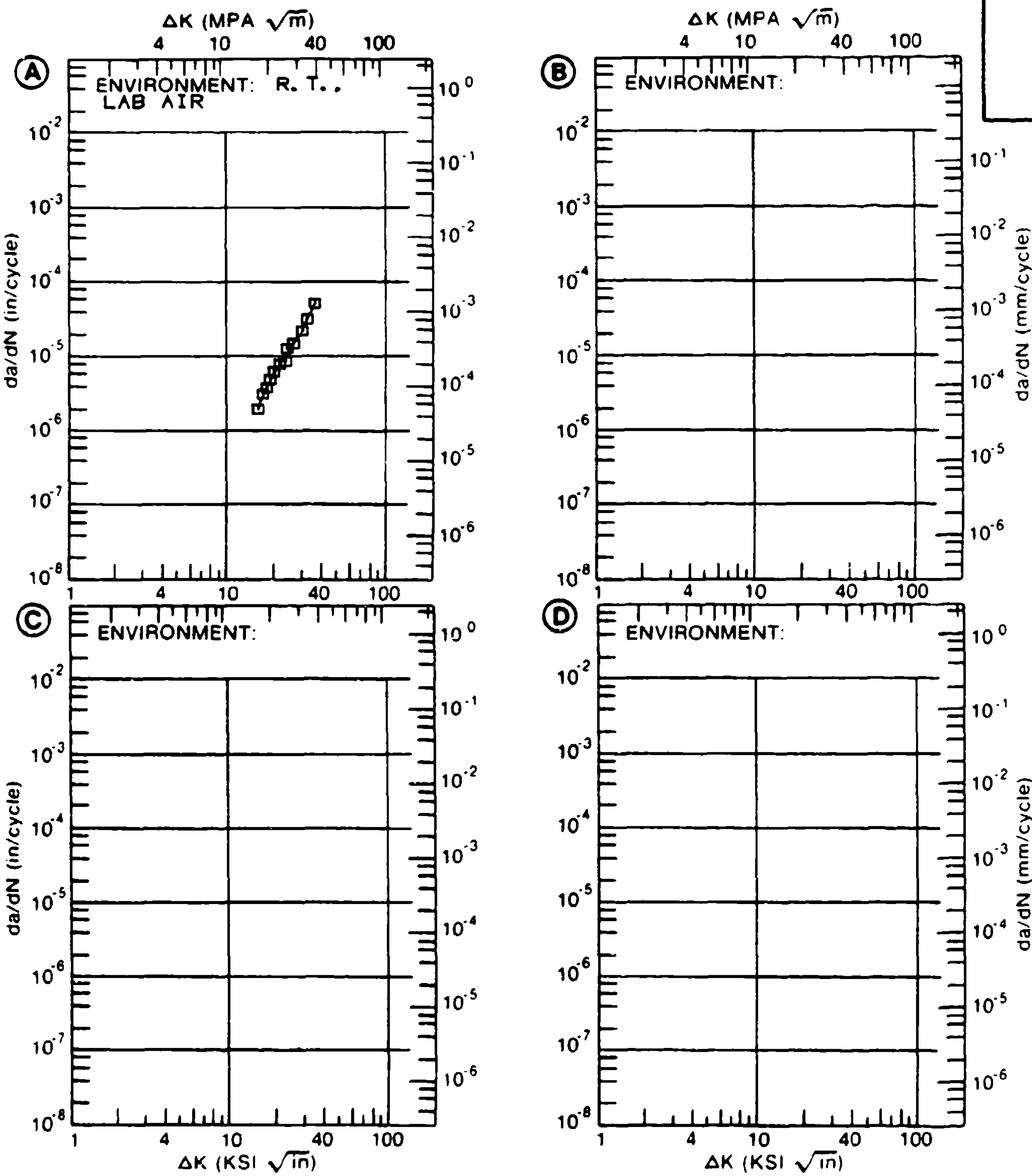

Figure 4.11.3.115

TABLE 4.11.3.116

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE4.11.3.116INDICATING EFFECT

OF ENVIRONMENT

MATERIAL: TITANIUM TI-6AL-4V
CONDITION: WELDED & STRESS RELIEVED 1100F 2HRS (HAZ)

DELTA K (KSI*IN**1/2)	DA/DN (10**-6 IN./CYCLE)			
	A	B	C	D
	E= R.T. L.H.A.	E= R.T. S.T.W.		
DELTA K MIN A:				
B:				
C:				
D:				
200.00				
DELTA K MAX A:				
B:				
C:				
D:				
ROOT MEAN SQUARE PERCENT ERROR	0.00	0.00		

LIFE PREDICTION RATIO SUMMARY (NP/NA)	
	0.0-0.5
	0.5-0.8
	0.8-1.25
	1.25-2.0
	>2.0

CONDITION/HT: WELDED & STRESS RELIEVED 1100F 2HRS (HAZ)
FORM: WELDMENT
SPECIMEN TYPE: CCP
ORIENTATION: L-T
STRESS RATIO: +0.08
FREQUENCY: 1.00 HZ

YIELD STRENGTH: 131.0 KSI
ULT. STRENGTH: 139.0 KSI
SPECIMEN THK: 0.088- 0.100"
SPECIMEN WIDTH: 24.000"
REFERENCES: 88575

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TI-6AL-4V

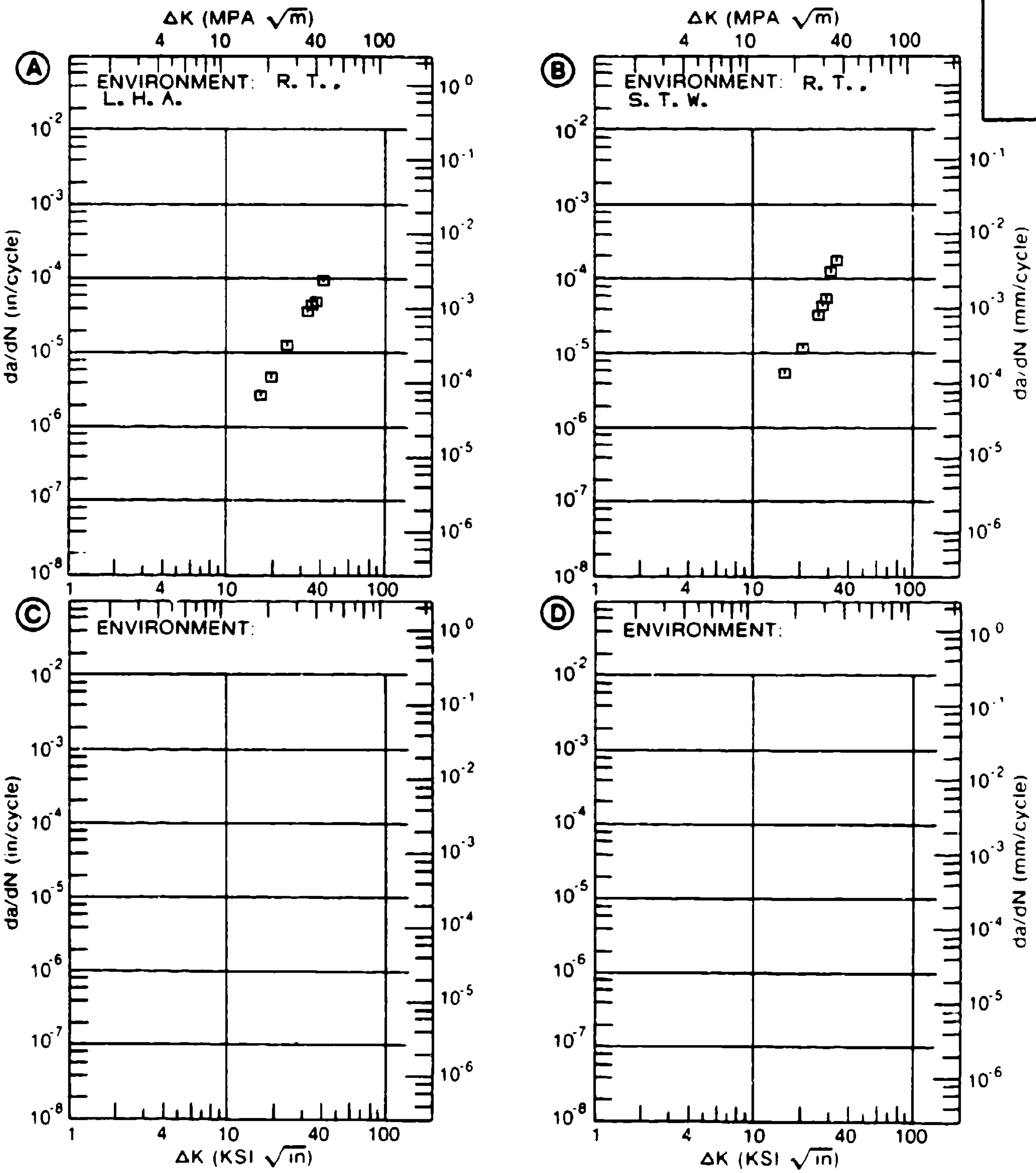

Figure 4.11.3.116

TABLE 4.11.3.117

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 4.11.3.117 INDICATING EFFECT

OF ENVIRONMENT

MATERIAL: TITANIUM TI-6AL-4V
CONDITION: 1550F 4HRS FC, 1000F 4HRS, ARGON COOLED

DELTA K (KSI*IN**1/2)		DA/DN (10**-6 IN./CYCLE) A E= R.T. ARGON	B E= R.T. ARGON	C	D
DELTA K MIN A:	9.68	.15			
DELTA K MIN B:	10.56		.26		
DELTA K MIN C:					
DELTA K MIN D:					
	10.00	.195			
	13.00	.886	.854		
	16.00	1.94	1.96		
	20.00	3.81	4.08		
	25.00	7.97	9.01		
	30.00	18.1	21.0		
	35.00	46.8	54.5		
	40.00	137.	158.		
DELTA K MAX A:	44.83	434.			
DELTA K MAX B:	41.26		209.		
DELTA K MAX C:					
DELTA K MAX D:					
ROOT MEAN SQUARE PERCENT ERROR		29.57	28.88		

LIFE PREDICTION RATIO SUMMARY (NP/NA)	
0.0-0.5	
0.5-0.8	
0.8-1.25	
1.25-2.0	
>2.0	

CONDITION/HT: 1550F 4HRS FC. 1000F 4HRS. ARGON COOLED
FORM: FORGING
SPECIMEN TYPE: WOL
ORIENTATION: R-C
STRESS RATIO: +0.10
FREQUENCY: 10.00 HZ
YIELD STRENGTH: 140.9 KSI
ULT. STRENGTH: 150.1 KSI
SPECIMEN THK: 0.800"
SPECIMEN WIDTH: 2.550"
REFERENCES: UM001

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TI-6AL-4V

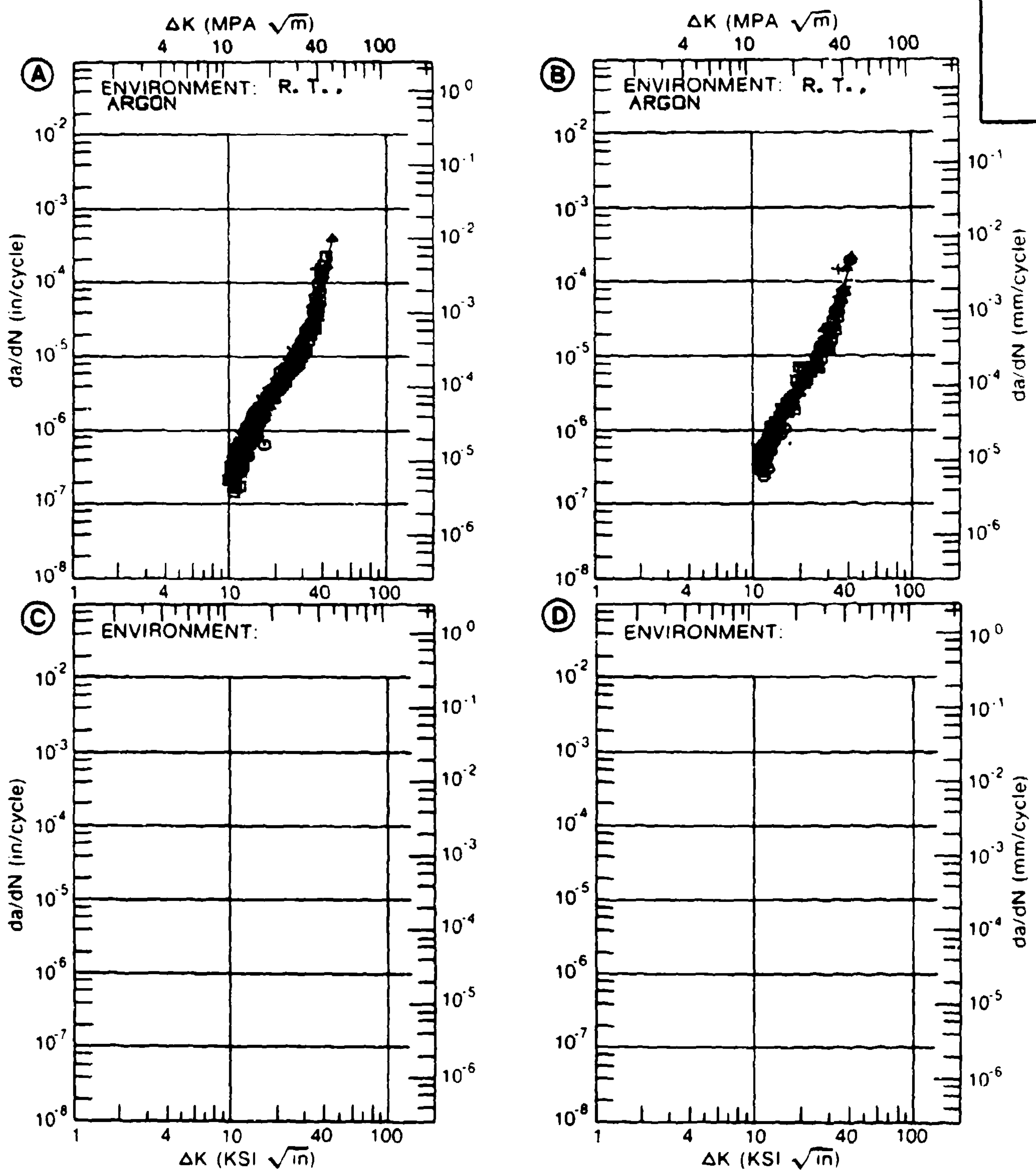

Figure 4.11.3.117

TABLE 4.11.3.118

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE4.11.3.118INDICATING EFFECT

OF ENVIRONMENT

MATERIAL: TITANIUM TI-6AL-4V
CONDITION: 1750F 4HRS ARGON COOLED, 1000F 4HRS, ARGON COOLED

DELTA K (KSI*IN**1/2)		DA/DN (10**-6 IN./CYCLE) A	B	C	D
		E= R.T. ARGON	E= R.T. ARGON		
DELTA K MIN A:	10.46	.20			
DELTA K MIN B:	10.57		.15		
DELTA K MIN C:					
DELTA K MIN D:					
	13.00	.850	.539		
	16.00	2.04	1.54		
	20.00	4.05	4.13		
	25.00	8.51	10.5		
	30.00	20.4	23.1		
	35.00	59.1	48.0		
	40.00	207.	97.7		
DELTA K MAX A:	42.45	407.			
DELTA K MAX B:	43.64		163.		
DELTA K MAX C:					
DELTA K MAX D:					
ROOT MEAN SQUARE PERCENT ERROR		31.31	41.13		

LIFE PREDICTION RATIO SUMMARY (NP/NA)	
0.0-0.5	
0.5-0.8	
0.8-1.25	
1.25-2.0	
>2.0	

CONDITION/HT: 1750F 4HRS ARGON COOLED, 1000F 4HRS, ARGON COOLED
FORM: FORGING
SPECIMEN TYPE: WOL
ORIENTATION: R-C
STRESS RATIO: +0.10
FREQUENCY: 10.00 HZ

YIELD STRENGTH: 135.7 KSI
ULT. STRENGTH: 144.9 KSI
SPECIMEN THK: 0.800"
SPECIMEN WIDTH: 2.550"
REFERENCES: UM001

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TI-6AL-4V

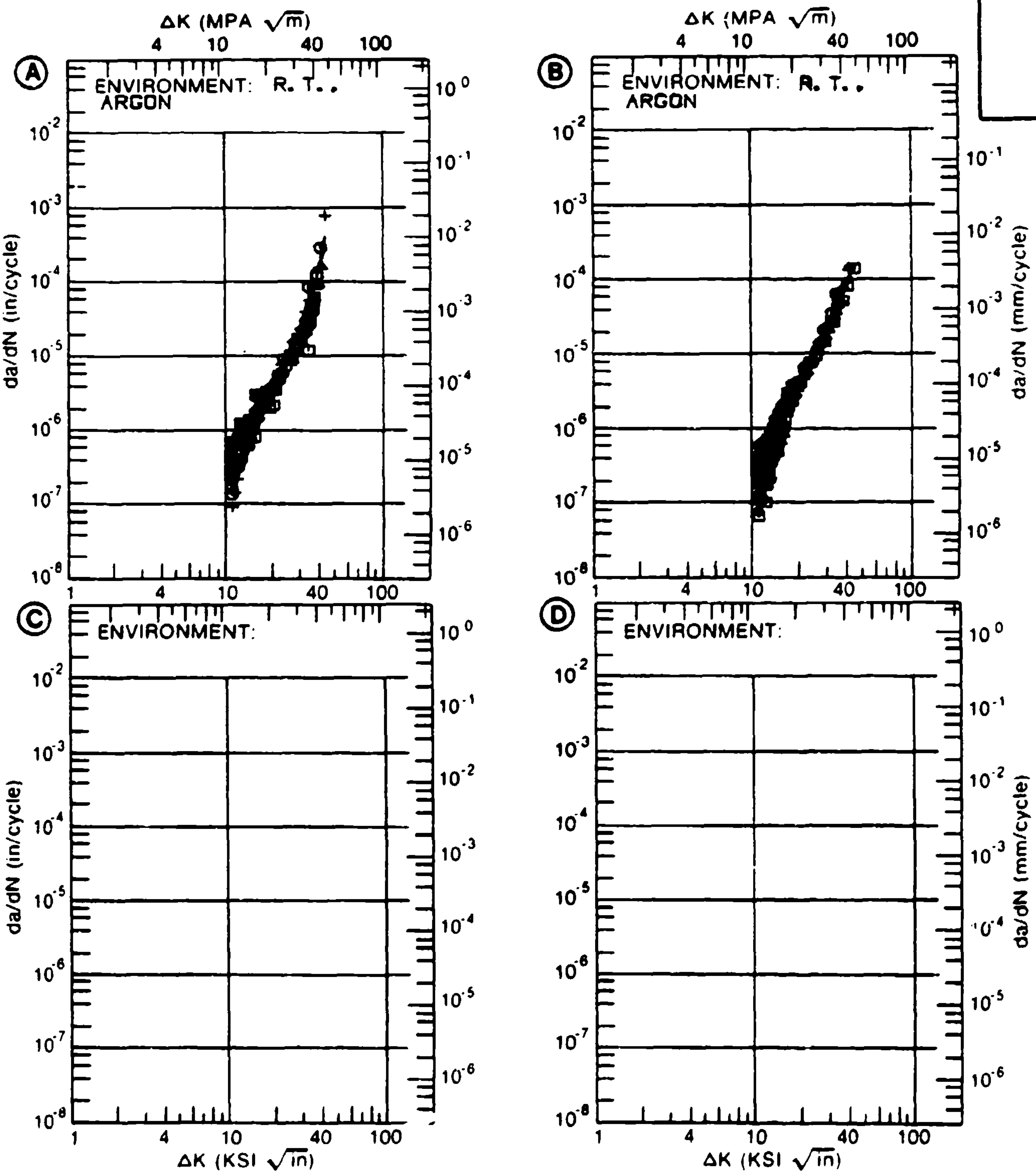

Figure 4.11.3.118

TABLE 4.11.3.119

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE4.11.3.119INDICATING EFFECT

OF ENVIRONMENT

MATERIAL: TITANIUM TI-6AL-4V
CONDITION: 1750F 4HRS ARGON COOLED, 1000F 4HRS
ARGON COOLED

DELTA K (KSI*IN**1/2)		DA/DN (10**-6 IN./CYCLE) A	B	C	D
		E= R.T. ARGON			
DELTA K MIN A:	10.71	.231			
DELTA K MIN B:					
DELTA K MIN C:					
DELTA K MIN D:					
	13.00	.681			
	16.00	1.81			
	20.00	4.61			
	25.00	11.7			
	30.00	27.1			
	35.00	60.7			
	40.00	229.			
DELTA K MAX A:	40.42	360.			
DELTA K MAX B:					
DELTA K MAX C:					
DELTA K MAX D:					
ROOT MEAN SQUARE PERCENT ERROR		23.92			

LIFE PREDICTION RATIO SUMMARY (NP/NA)	
	0.0-0.5
	0.5-0.8
	0.8-1.25
	1.25-2.0
	>2.0

CONDITION/HT: 1750F 4HRS ARGON COOLED, 1000F 4HRS ARGON COOLED	
FORM: FORGING	YIELD STRENGTH: 135.7 KSI
SPECIMEN TYPE: WOL	ULT. STRENGTH: 144.9 KSI
ORIENTATION: C-R	SPECIMEN THK: 0.800"
STRESS RATIO: +0.10	SPECIMEN WIDTH: 2.550"
FREQUENCY: 10.00 HZ	REFERENCES: UM001

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TI-6AL-4V

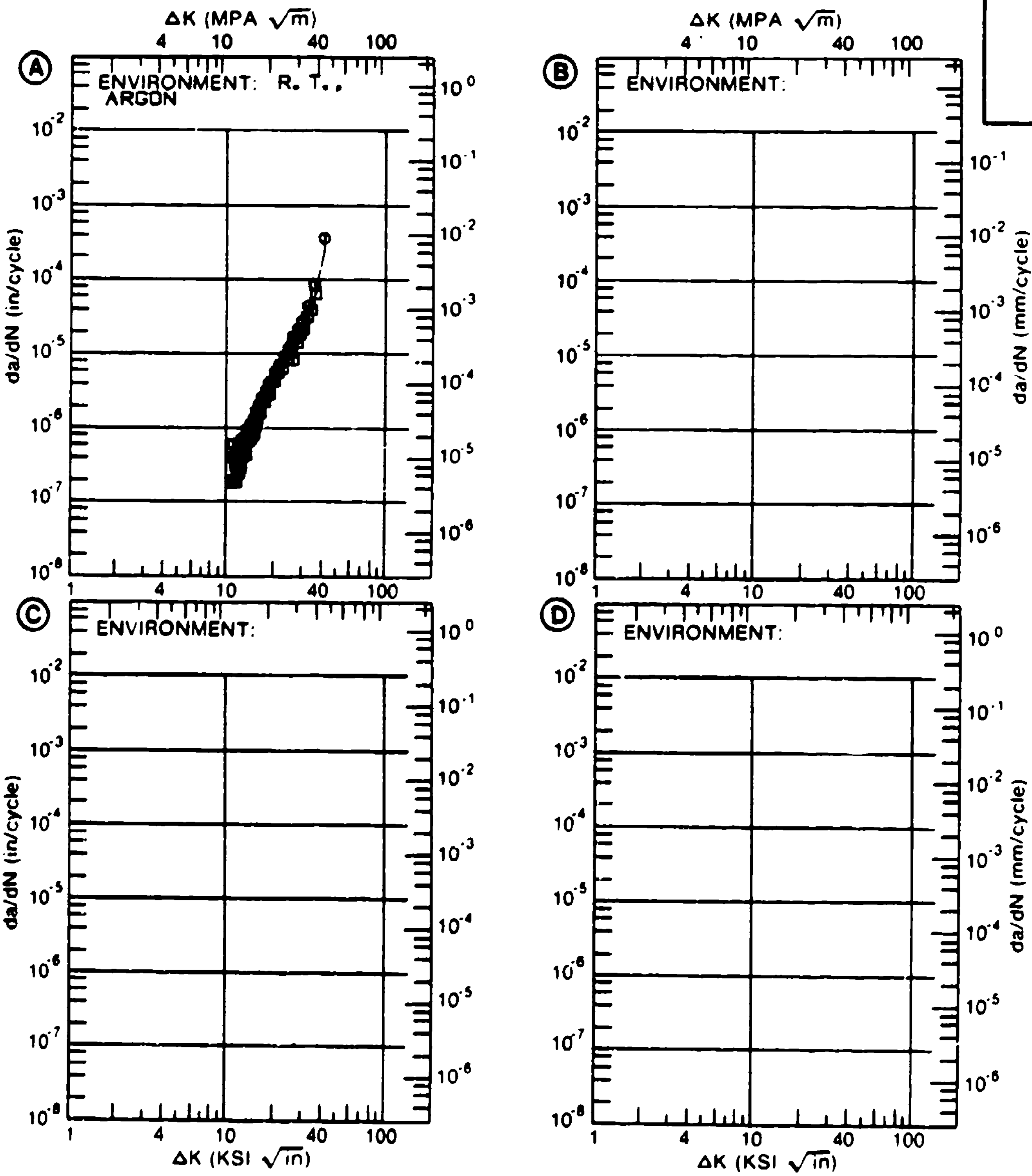

Figure 4.11.3.119

TABLE 4.11.3.120

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE4.11.3.120INDICATING EFFECT

OF ENVIRONMENT

MATERIAL: TITANIUM TI-6AL-4V
CONDITION: 1775F 1HR WQ, 1675F 1HR WQ, 1000F 4HRS
AC, 900F 5HR AC

DELTA K (KSI*IN**1/2)		DA/DN (10**-6 IN./CYCLE) A	B	C	D
		E= R.T. LAB AIR	E=+ 200F AIR		
DELTA K MIN	A: 30.47	37.2			
	B: 30.79		48.5		
	C:				
	D:				
	35.00	58.5	96.8		
	40.00	83.9	167.		
	50.00	152.	356.		
	60.00	290.	745.		
	70.00	625.	1817.		
	80.00	1545.			
DELTA K MAX	A: 80.58	1635.			
	B: 74.44		2874.		
	C:				
	D:				
ROOT MEAN SQUARE PERCENT ERROR		7.07	7.10		
LIFE PREDICTION RATIO SUMMARY (NP/NA)	0.0-0.5				
	0.5-0.8		1		
	0.8-1.25	1			
	1.25-2.0				
	>2.0				

CONDITION/HT: 1775F 1HR WQ, 1875F 1HR WQ, 1000F 4HRS AC, 900F 5HR AC
FORM: 0.50"TH DISK
SPECIMEN TYPE: CCP
ORIENTATION: C-R
STRESS RATIO: +0.05
FREQUENCY: 0.33- 10.00 HZ

YIELD STRENGTH: 120.0 KSI
ULT. STRENGTH: 130.0 KSI
SPECIMEN THK: 0.120"
SPECIMEN WIDTH: 1.980"
REFERENCES: GE003

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TI-6AL-4V

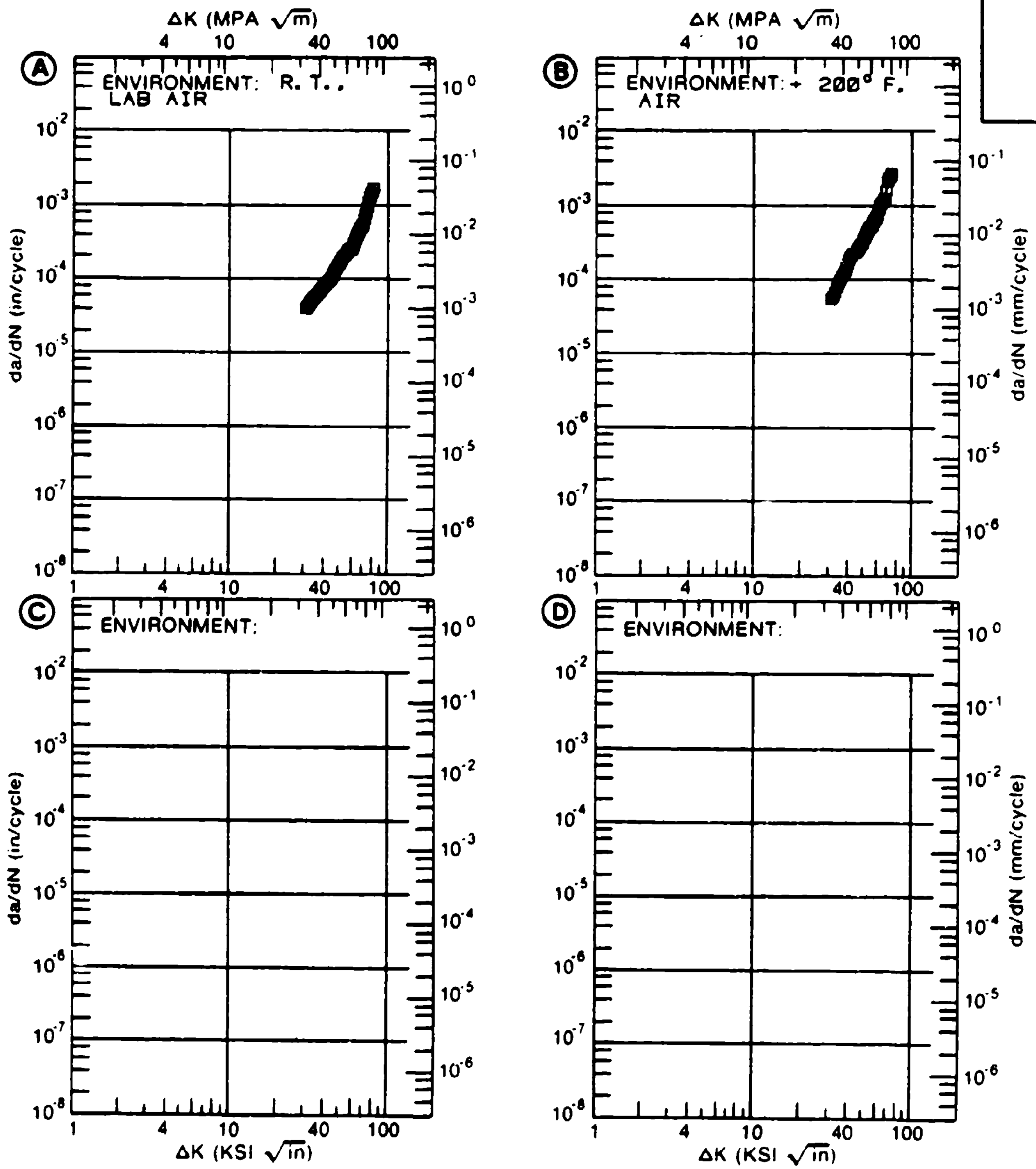

Figure 4.11.3.120

TABLE 4.11.3.121

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE4.11.3.121INDICATING EFFECT

OF STRESS RATIO

MATERIAL: TITANIUM TI-6AL-4V
CONDITION: 1775F 1HR WQ, 1675F 1HR WQ, 1000F-1200F
2-8HRS AC
ENVIRONMENT: R.T. ,LAB AIR

DELTA K (KSI*IN**1/2)		DA/DN (10**-6 IN./CYCLE) A R=+0.03	B R=+0.25	C R=+0.54	D
DELTA K MIN	A: 9.85	.788			
	B: 10.87		2.71		
	C: 10.48			3.11	
	D:				
	10.00	.865			
	13.00	3.13	4.91	6.16	
	16.00	6.22	9.51	11.5	
	20.00	11.0	18.9		
	25.00	18.9	37.5		
	30.00	32.1	66.2		
	35.00	57.0			
	40.00	107.			
DELTA K MAX	A: 44.18	191.			
	B: 30.68		71.1		
	C: 19.06			15.7	
	D:				
ROOT MEAN SQUARE PERCENT ERROR		15.97	10.81	14.72	

LIFE PREDICTION RATIO SUMMARY (NP/NA)	
	0.0-0.5
	0.5-0.8
	0.8-1.25
	1.25-2.0
	>2.0

CONDITION/HT: 1775F 1HR WQ, 1675F 1HR WQ, 1000F-1200F 2-8HRS AC
FORM: 0.94"TH DISK
SPECIMEN TYPE: KB BAR
ORIENTATION: C-R
FREQUENCY: 0.33- 0.56 HZ
ENVIRONMENT: R.T., LAB AIR

YIELD STRENGTH: 150.0 KSI
ULT. STRENGTH:
SPECIMEN THK: 0.251- 0.252"
SPECIMEN WIDTH: 0.989- 1.000"
REFERENCES: GE007

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TI-6AL-4V

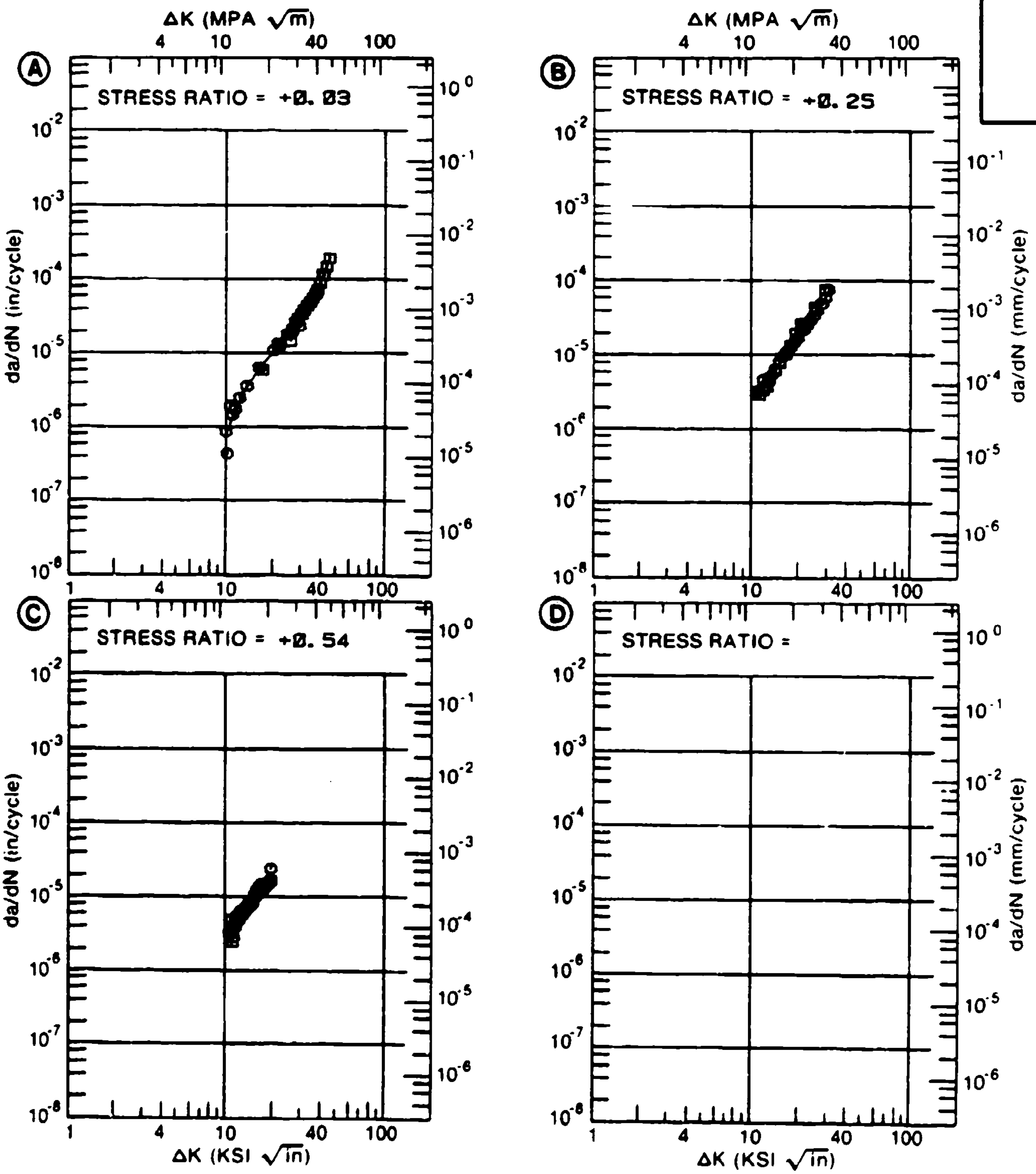

Figure 4.11.3.121

TABLE 4.11.3.122

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 4.11.3.122 INDICATING EFFECT

OF STRESS RATIO

MATERIAL: TITANIUM TI-6AL-4V
CONDITION: 1775F 1HR WQ, 1675F 1HR WQ, 1000F-1200F
2-8HRS AC
ENVIRONMENT: + 300F, AIR

DELTA K (KSI*IN**1/2)			DA/DN (10**-6 IN./CYCLE) A R=+0.03	B R=+0.25	C R=+0.54	D
	A:	9.83	.687			
DELTA K	B:	10.90		1.46		
MIN	C:	11.42			3.45	
	D:					
		10.00	.746			
		13.00	2.32	3.46	5.10	
		16.00	4.94	6.88	8.22	
		20.00	10.1	11.9		
		25.00	19.7	20.9		
		30.00	33.4	39.8		
		35.00	52.7			
		40.00	79.8			
	A:	41.12	87.2			
DELTA K	B:	32.83		60.4		
MAX	C:	18.98			11.5	
	D:					
ROOT MEAN SQUARE PERCENT ERROR			15.61	21.04	6.65	

LIFE	0.0-0.5
PREDICTION	0.5-0.8
RATIO	0.8-1.25
SUMMARY	1.25-2.0
(NP/NA)	>2.0

CONDITION/HT: 1775F 1HR WQ. 1675F 1HR WQ. 1000F-1200F 2-8HRS AC
FORM: 0.94"TH DISK
SPECIMEN TYPE: KB BAR
ORIENTATION: C-R
FREQUENCY: 0.33 HZ
ENVIRONMENT: + 300° F. AIR

YIELD STRENGTH: 150.0 KSI
ULT. STRENGTH:
SPECIMEN THK: 0.252"
SPECIMEN WIDTH: 0.991- 0.999"
REFERENCES: GE007

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TI-6AL-4V

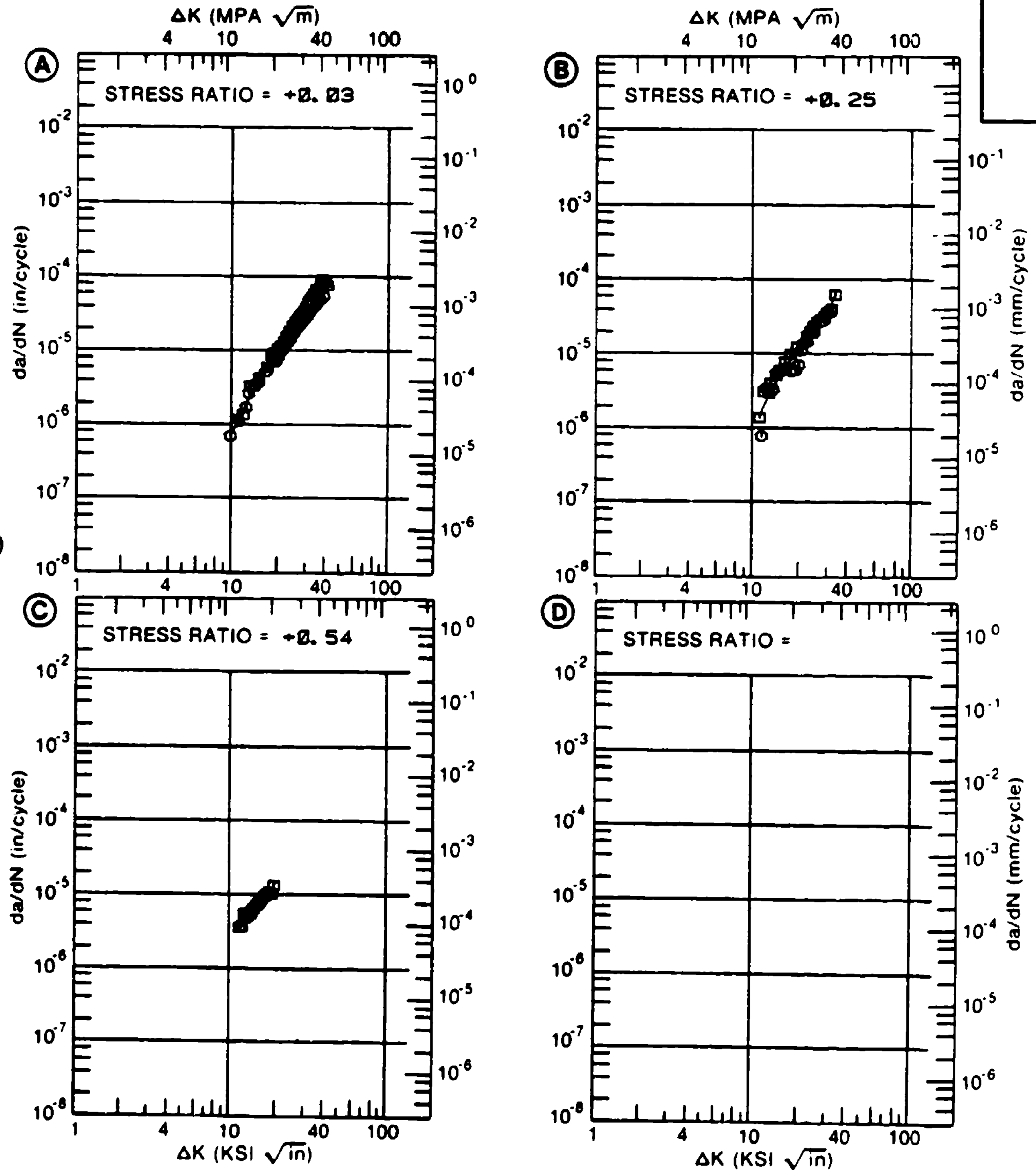

Figure 4.11.3.122

TABLE 4.11.3.123

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 4.11.3.123 INDICATING EFFECT OF STRESS RATIO

MATERIAL: TITANIUM TI-6AL-4V
CONDITION: 1775F 1HR WQ, 1675F 1HR WQ, 1000F-1200F 2-8HRS AC
ENVIRONMENT: + 600F, AIR

DELTA K (KSI*IN**1/2)		DA/DN (10**-6 IN./CYCLE) A R=+0.03	B R=+0.25	C R=+0.54	D
DELTA K MIN A:	8.19	.501			
DELTA K MIN B:	9.28		1.84		
DELTA K MIN C:	8.94			1.96	
DELTA K MIN D:					
	9.00	.715		1.96	
	10.00	1.05	2.04	2.12	
	13.00	2.57	3.70	4.38	
	16.00	4.99	6.86	8.94	
	20.00	9.87	13.3		
	25.00	19.2	22.6		
	30.00	32.9	28.3		
	35.00	52.0			
	40.00	77.8			
DELTA K MAX A:	42.82	95.8			
DELTA K MAX B:	30.82		28.7		
DELTA K MAX C:	19.48			13.6	
DELTA K MAX D:					
ROOT MEAN SQUARE PERCENT ERROR		11.62	14.03	14.72	

LIFE PREDICTION RATIO SUMMARY (NP/NA)	
	0.0-0.5
	0.5-0.8
	0.8-1.25
	1.25-2.0
	>2.0

CONDITION/HT: 1775F 1HR WQ. 1675F 1HR WQ. 1000F-1200F 2-8HRS AC
FORM: 0.94"TH DISK
SPECIMEN TYPE: KB BAR
ORIENTATION: C-R
FREQUENCY: 0.33 HZ
ENVIRONMENT: + 600° F. AIR

YIELD STRENGTH: 150.0 KSI
ULT. STRENGTH:
SPECIMEN THK: 0.251- 0.253"
SPECIMEN WIDTH: 0.995- 1.002"
REFERENCES: GE007

TITAN. ALLOY

TI-6AL-4V

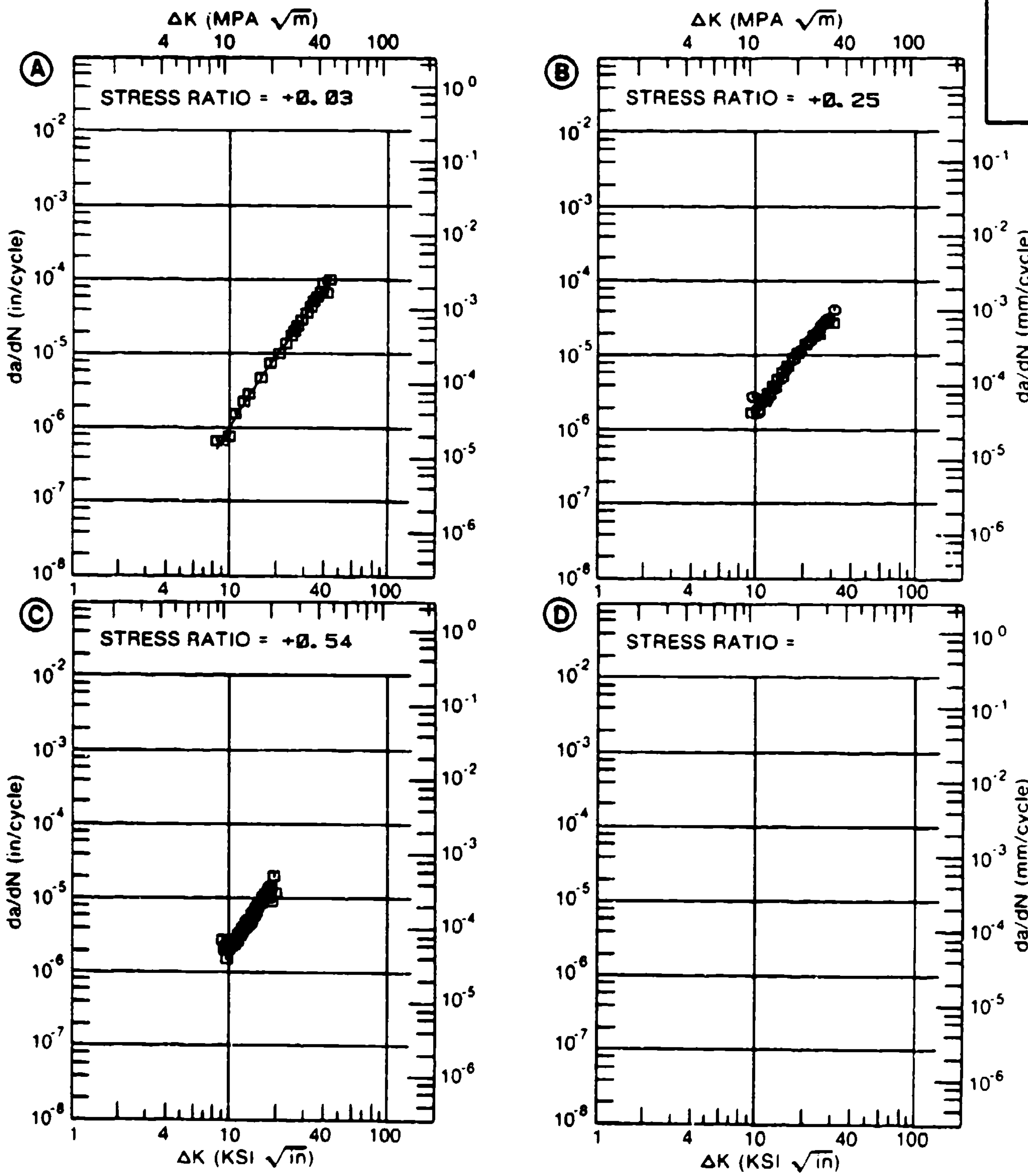

Figure 4.11.3.123

TABLE 4.11.3.124

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE4.11.3.124INDICATING EFFECT

OF STRESS RATIO

MATERIAL: TITANIUM TI-6AL-4V
CONDITION: 1775F 1HR WQ, 1675F 1HR WQ, 1000F-1200F
2-8HRS AC
ENVIRONMENT: + 600F, AIR

DELTA K (KSI*IN**1/2)		DA/DN (10**-6 IN./CYCLE) A	B	C	D
		R=+0.03			
DELTA K MIN A:	8.01	.906			
B:					
C:					
D:					
	9.00	1.29			
	10.00	1.77			
	13.00	3.85			
	16.00	6.94			
	20.00	12.6			
	25.00	21.6			
	30.00	32.2			
	35.00	43.5			
	40.00	54.6			
DELTA K MAX A:	42.55	60.1			
B:					
C:					
D:					
ROOT MEAN SQUARE PERCENT ERROR		7.35			

LIFE PREDICTION RATIO SUMMARY (NP/NA)	
	0.0-0.5
	0.5-0.8
	0.8-1.25
	1.25-2.0
	>2.0

CONDITION/HT: 1775F 1HR WQ. 1675F 1HR WQ. 1000F-1200F 2-8HRS AC
FORM: 1.15"TH DISK
SPECIMEN TYPE: KB BAR
ORIENTATION: C-R
FREQUENCY: 0.33 HZ
ENVIRONMENT: + 800° F. AIR

YIELD STRENGTH: 145.0 KSI
ULT. STRENGTH:
SPECIMEN THK: 0.251"
SPECIMEN WIDTH: 1.000"
REFERENCES: GE007

TITAN. ALLOY

TI-6AL-4V

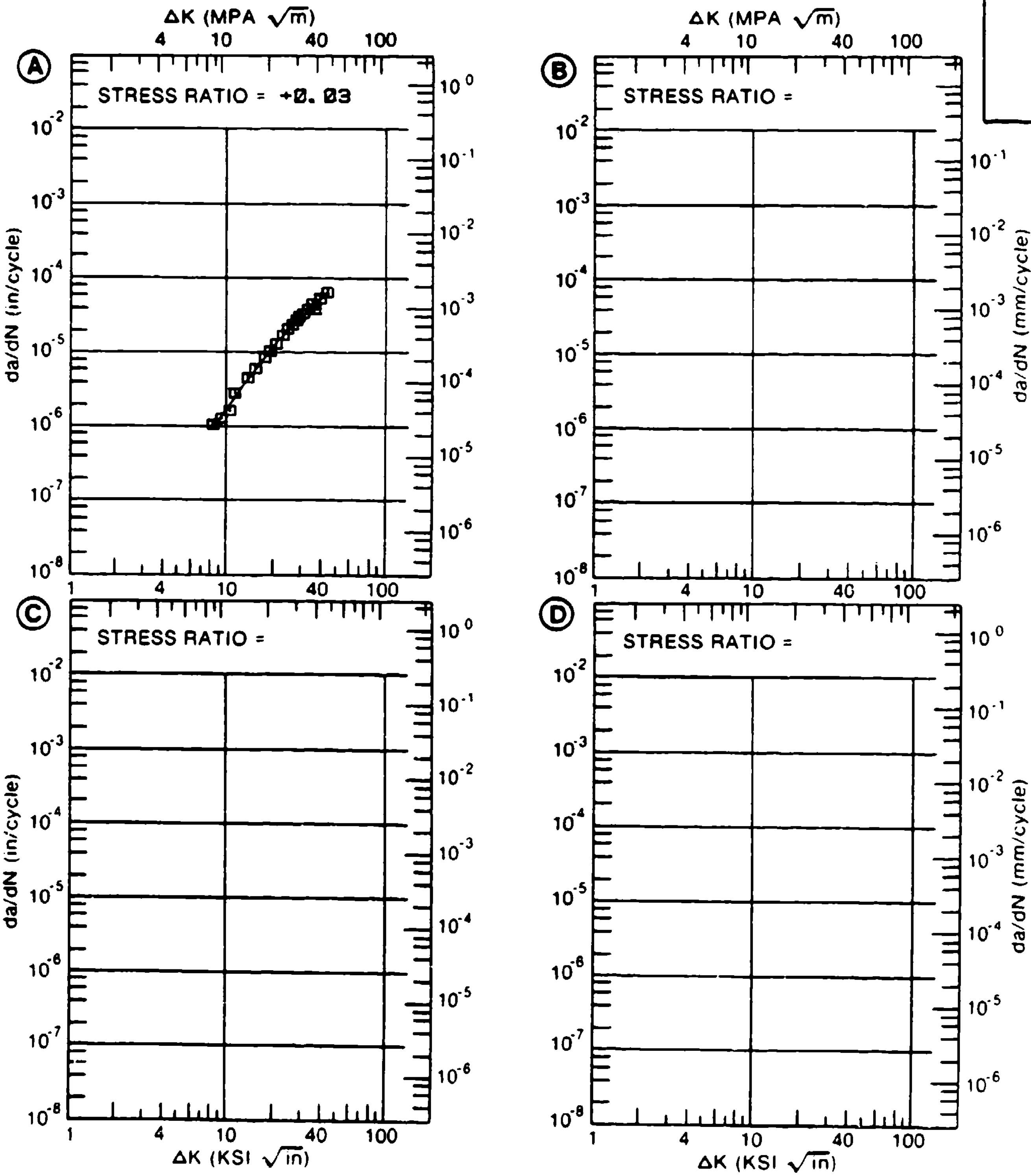

Figure 4.11.3.124

TABLE 4.11.3.125

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE4.11.3.125INDICATING EFFECT

OF ENVIRONMENT

MATERIAL: TITANIUM TI-6AL-4V
CONDITION: 1950F 4HRS WQ, 1000F 4HRS ARGON COOLED

DELTA K (KSI*IN**1/2)		DA/DN (10**-6 IN./CYCLE) A	B	C	D
		E= R. T. ARGON			
DELTA K MIN A:	10.04	.179			
DELTA K MIN B:					
DELTA K MIN C:					
DELTA K MIN D:					
	13.00	.508			
	16.00	1.08			
	20.00	2.38			
	25.00	5.58			
	30.00	12.3			
	35.00	26.6			
	40.00	56.9			
	50.00	257.			
DELTA K MAX A:	50.06	260.			
DELTA K MAX B:					
DELTA K MAX C:					
DELTA K MAX D:					
ROOT MEAN SQUARE PERCENT ERROR		57.10			

LIFE PREDICTION RATIO SUMMARY (NP/NA)	
	0.0-0.5
	0.5-0.8
	0.8-1.25
	1.25-2.0
	>2.0

CONDITION/HT: 1950F 4HRS WQ, 1000F 4HRS ARGON COOLED
FORM: FORGING
SPECIMEN TYPE: WOL
ORIENTATION: R-C
STRESS RATIO: +0.10
FREQUENCY: 10.00 HZ

YIELD STRENGTH: 136.4 KSI
ULT. STRENGTH: 147.8 KSI
SPECIMEN THK: 0.800"
SPECIMEN WIDTH: 2.550"
REFERENCES: UM001

TITAN. ALLOY

TI-6AL-4V

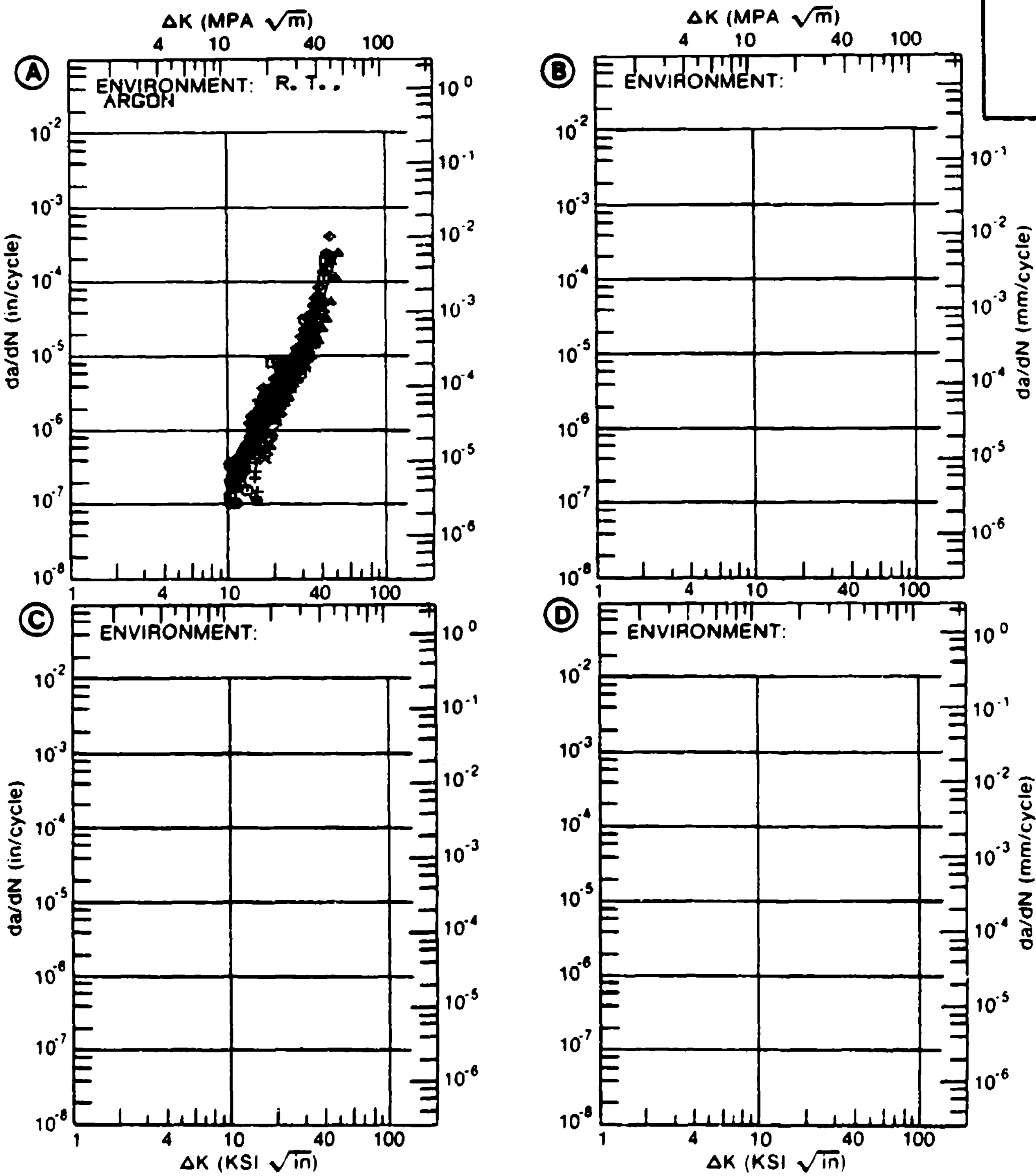

Figure 4.11.3.125

TABLE 4.11.3.126

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE4.11.3.126 INDICATING EFFECT

OF ENVIRONMENT

MATERIAL: TITANIUM TI-6AL-4V
CONDITION: 1950F 4HRS WQ, 1000F 4HRS ARGON COOLED

DELTA K (KSI*IN**1/2)			DA/DN (10**-6 IN./CYCLE) A	B	C	D
			E= R.T. ARGON			
DELTA K MIN	A:	11.18	.159			
	B:					
	C:					
	D:					
		13.00	.442			
		16.00	1.31			
		20.00	3.37			
		25.00	8.42			
		30.00	20.3			
		35.00	51.3			
DELTA K MAX	A:	35.49	56.4			
	B:					
	C:					
	D:					

ROOT MEAN SQUARE PERCENT ERROR 39.65

LIFE PREDICTION RATIO SUMMARY (NP/NA)	
	0.0-0.5
	0.5-0.8
	0.8-1.25
	1.25-2.0
	>2.0

CONDITION/HT: 1950F 4HRS WQ, 1000F 4HRS ARGON COOLED
FORM: FORGING
SPECIMEN TYPE: WOL
ORIENTATION: C-R
STRESS RATIO: +0.10
FREQUENCY: 10.00 HZ

YIELD STRENGTH: 138.4 KSI
ULT. STRENGTH: 147.8 KSI
SPECIMEN THK: 0.800"
SPECIMEN WIDTH: 2.550"
REFERENCES: UM001

TITAN. ALLOY

TI-6AL-4V

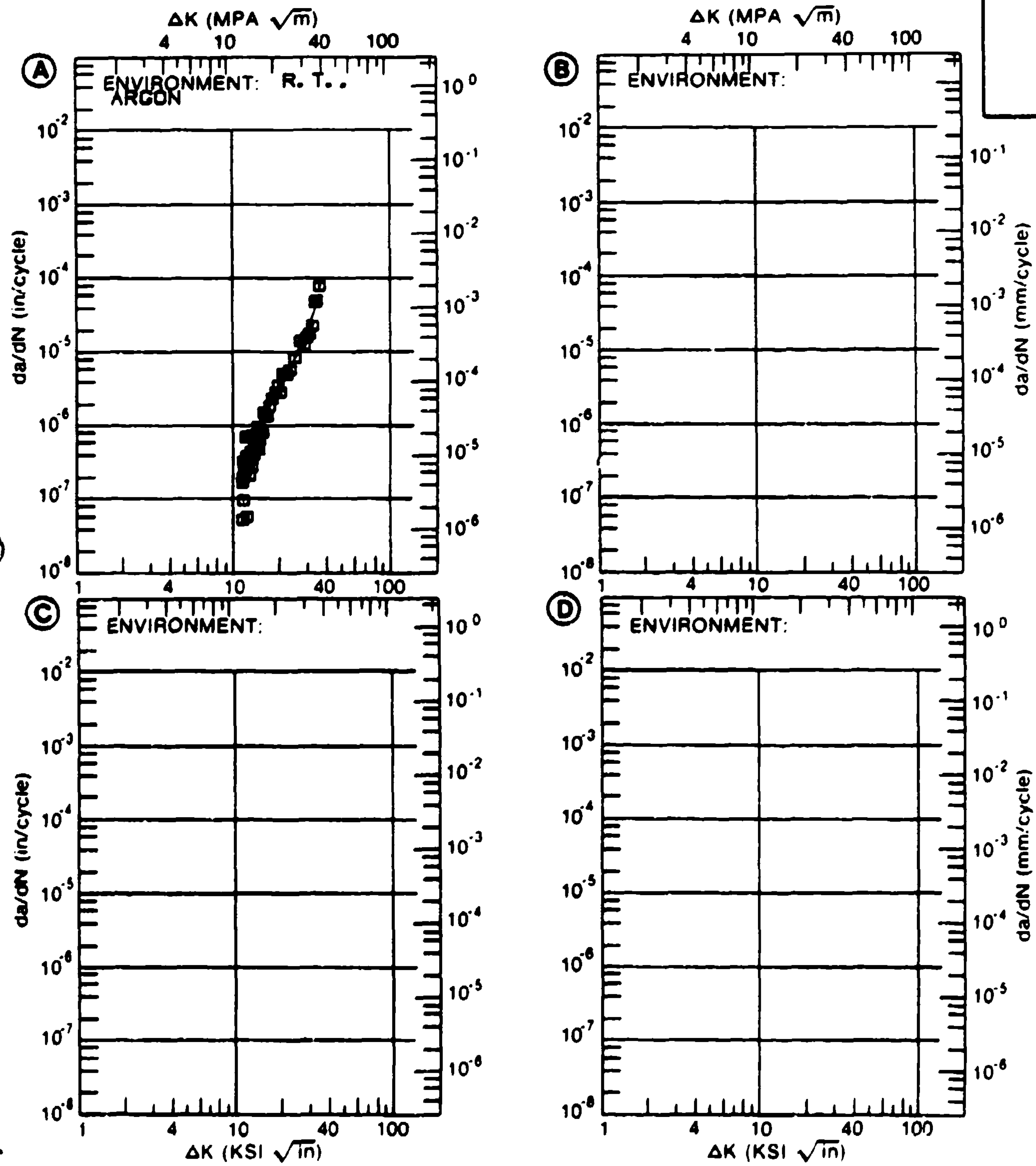

Figure 4.11.3.126

TABLE 4.11.3.127

SUSTAINED CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE4.11.3.127INDICATING EFFECT

OF ENVIRONMENT

MATERIAL: TITANIUM TI-6AL-4V
CONDITION: EB WELD, STRESS RELIEVED (HEAT AFFECTED ZONE)

K MAX (KSI*IN**1/2)	DA/DT (10**-6 IN/HOUR) A	B	C	D
	E= 3.5% NACL; 75F	E= AIR; 175F		
K MAX MIN A:				
B:				
C:				
D:				
200.00				
K MAX MAX A:				
B:				
C:				
D:				
ROOT MEAN SQUARE PERCENT ERROR	0.00	0.00		

CONDITION/HT: EB WELD, STRESS RELIEVED (HEAT AFFECTED ZONE)
FORM: 1.0"TH WELDMENT
SPECIMEN TYPE: CT
ORIENTATION: T-L
YIELD STRENGTH: 132.0 KSI
ULT. STRENGTH:
SPECIMEN THK: 1.000"
SPECIMEN WIDTH: 2.550"
CRACK LENGTH (A_0):
K_{ISCC}: 33.00 KSI (SQRT IN)
REFERENCES: 88144

TITAN. ALLOY

TI-6AL-4V

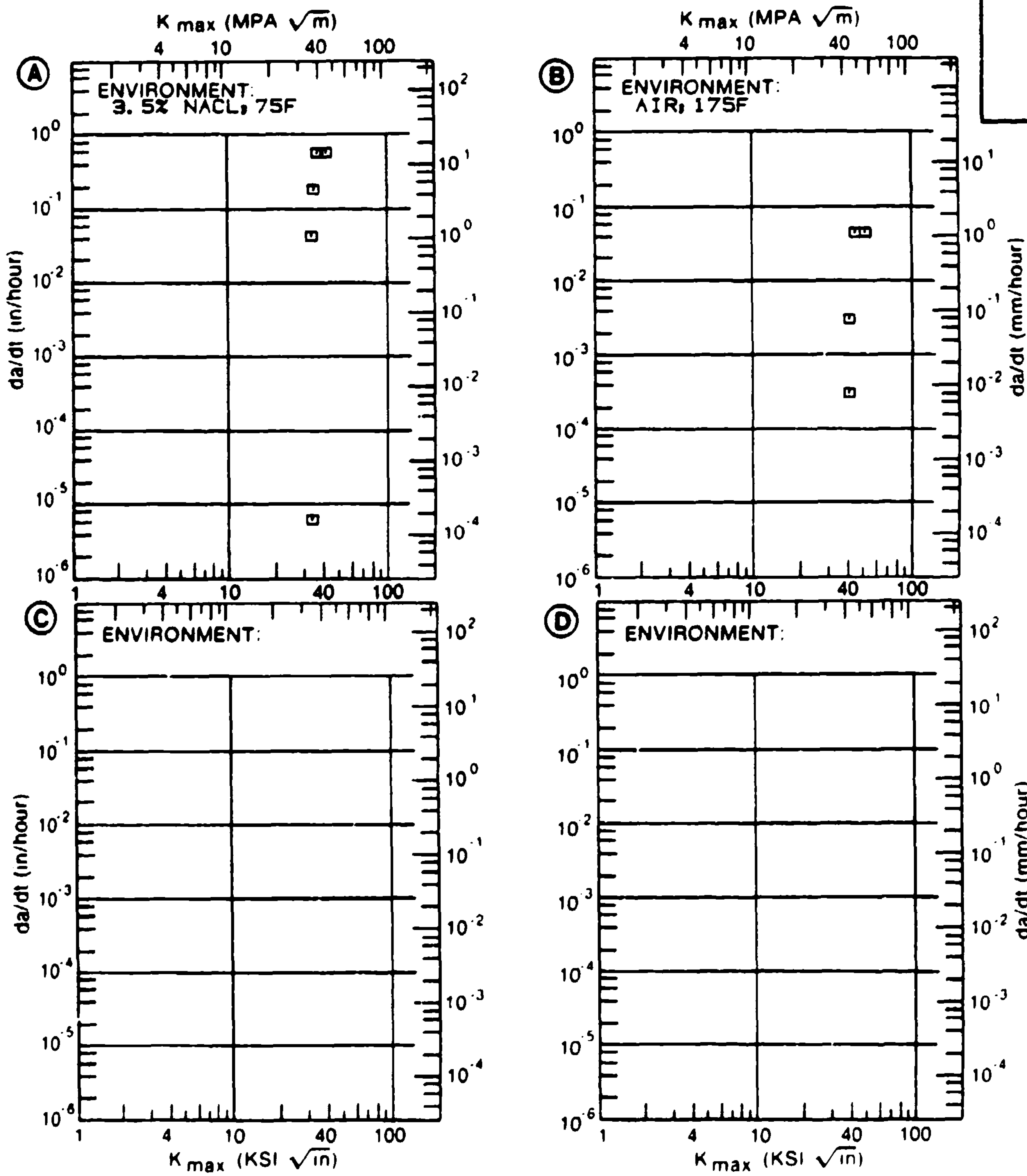

Figure 4.11.3.127

TABLE 4.11.3.128

SUSTAINED CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE4.11.3.128INDICATING EFFECT

OF ENVIRONMENT

MATERIAL: TITANIUM TI-6AL-4V
CONDITION: EB WELD, STRESS RELIEVED (WELD ZONE)

K MAX (KSI*IN**1/2)			DA/DT (10**-6 IN/HOUR) A	B	C	D
			E= 3.5% NACL; 75F	E= AIR; 175F		
K MAX MIN	A:	36.00	171.			
	B:					
	C:					
	D:					
		40.00	724548.			
K MAX MAX	A:	44.00	964781.			
	B:					
	C:					
	D:					
ROOT MEAN SQUARE PERCENT ERROR			48.35	0.00		

CONDITION/HT: EB WELD. STRESS RELIEVED (WELD ZONE)
FORM: 1.0"TH WELDMENT
SPECIMEN TYPE: CT
ORIENTATION: T-L
YIELD STRENGTH: 132.0 KSI
ULT. STRENGTH:

SPECIMEN THK: 1.000"
SPECIMEN WIDTH: 2.550"
CRACK LENGTH (A_0):
K_{ISCC}: 36.00 KSI (SQRT IN)
REFERENCES: 88144

TITAN. ALLOY

TI-6AL-4V

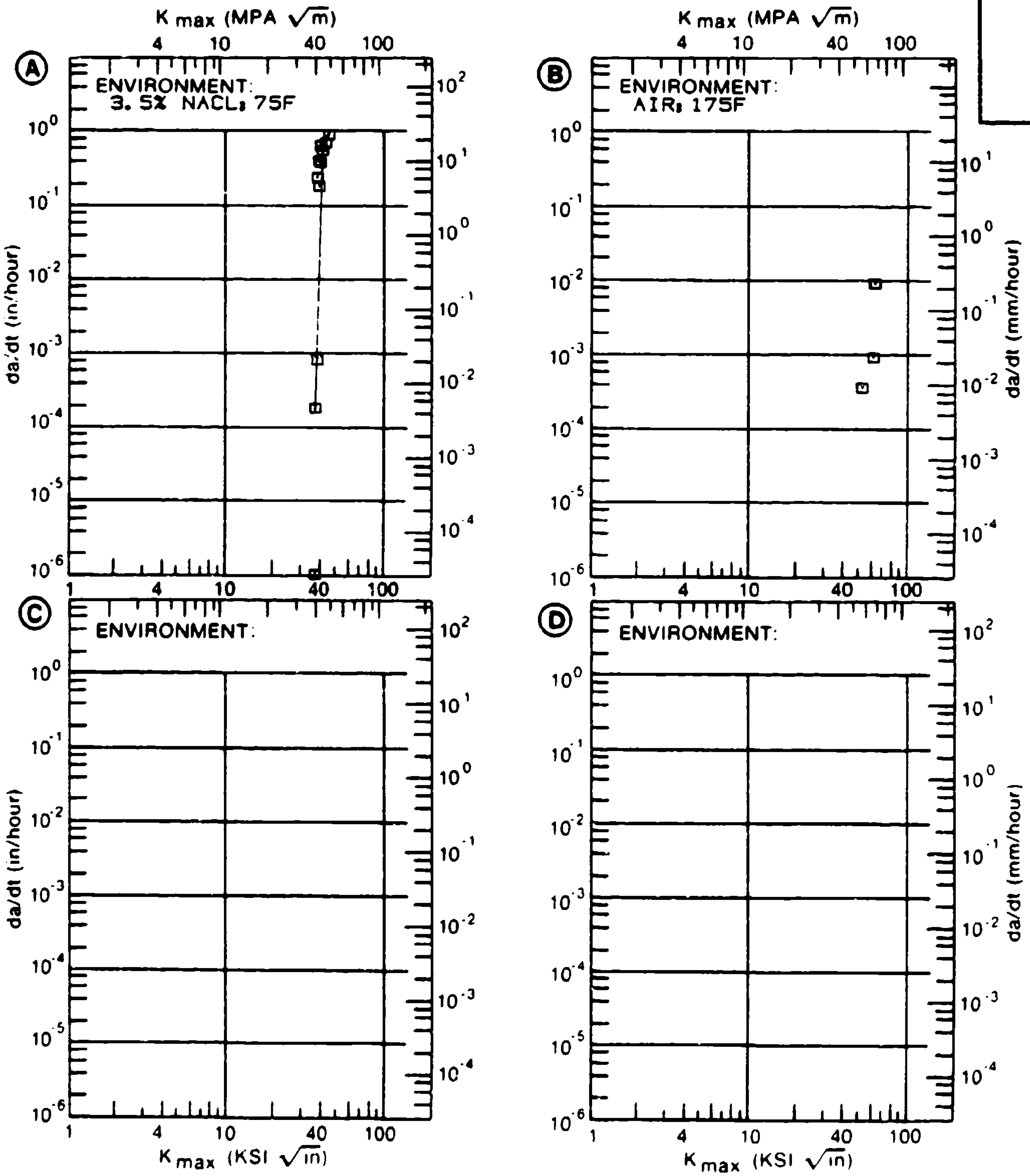

Figure 4.11.3.128

TABLE 4.11.3.129

SUSTAINED CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE4.11.3.129INDICATING EFFECT

OF ENVIRONMENT

MATERIAL: TITANIUM TI-6AL-4V
CONDITION: MA

K MAX (KSI*IN**1/2)			DA/DT (10**-3 IN/HOUR)			
			A	B	C	D
			E= R. T. 0. 6M KCL -500 MV	E= R. T. 0. 6M KCL -1000 MV		
	A:	22. 00	240.			
K MAX MIN	B:	23. 00		232.		
	C:					
	D:					
		25. 00	542.	266.		
		30. 00	854.	299.		
		35. 00	933.	341.		
		40. 00	1059.	474.		
	A:	45. 20	1499.			
K MAX MAX	B:	45. 20		867.		
	C:					
	D:					
ROOT MEAN SQUARE PERCENT ERROR			13. 23	13. 95		

CONDITION/HT: MA
FORM: 0.2"TH SHEET
SPECIMEN TYPE: DCB
ORIENTATION: T-L
YIELD STRENGTH:
ULT. STRENGTH:

SPECIMEN THK: 0.200"
SPECIMEN WIDTH:
CRACK LENGTH (A_0):
K_{ISCC}:
REFERENCES: 81221

TITAN. ALLOY

TI-6AL-4V

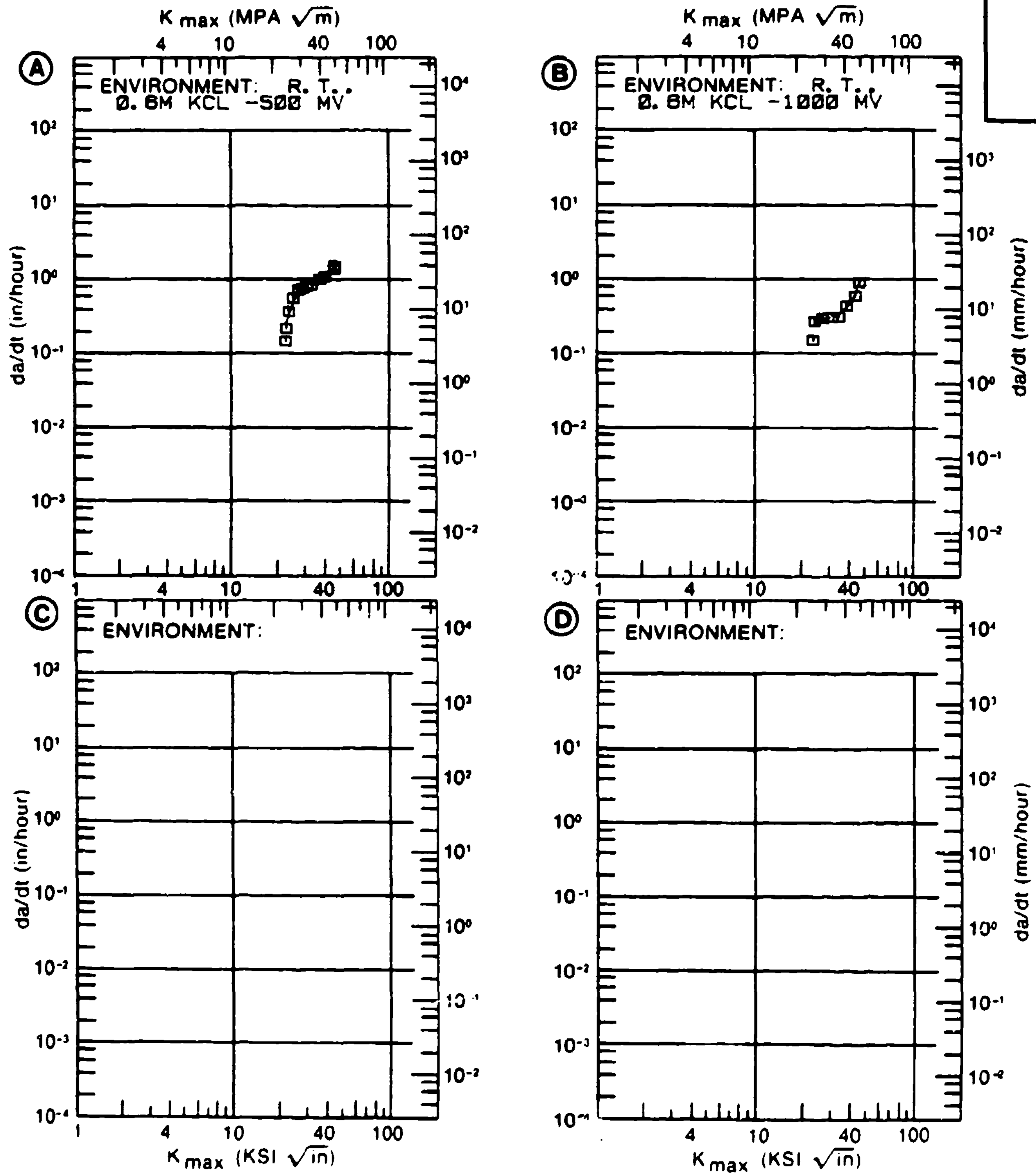

Figure 4.11.3.129

TABLE 4.11.3.130

SUSTAINED CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE4.11.3.130INDICATING EFFECT

OF ENVIRONMENT

MATERIAL: TITANIUM TI-6AL-4V
CONDITION: MA

K MAX (KSI*IN**1/2)			DA/DT (10**-3 IN/HOUR) A E= R.T. 5M KI +1000 MV	B E= R.T. 5M KI +500 MV	C E= R.T. 5M KI 0 MV	D E= R.T. 5M KI -500 MV
	A:					
K MAX	B:	17.50		970.		
MIN	C:	18.50			1202.	
	D:	19.20				1271.
		20.00		17493.	6645.	3216.
		25.00		26009.	15774.	9982.
		30.00		38482.	27636.	15327.
		35.00			42504.	21875.
		40.00			56727.	30115.
	A:					
K MAX	B:	34.00		52976.		
MAX	C:	44.80			65998.	
	D:	44.70				40011.
ROOT MEAN SQUARE PERCENT ERROR			0.00	29.55	12.77	12.68

CONDITION/HT: MA
FORM: 0.2"TH SHEET
SPECIMEN TYPE: DCB
ORIENTATION: T-L
YIELD STRENGTH:
ULT. STRENGTH:

SPECIMEN THK: 0.200"
SPECIMEN WIDTH:
CRACK LENGTH (A_0):
K_{ISCC}:
REFERENCES: 81221

TITAN. ALLOY

TI-6AL-4V

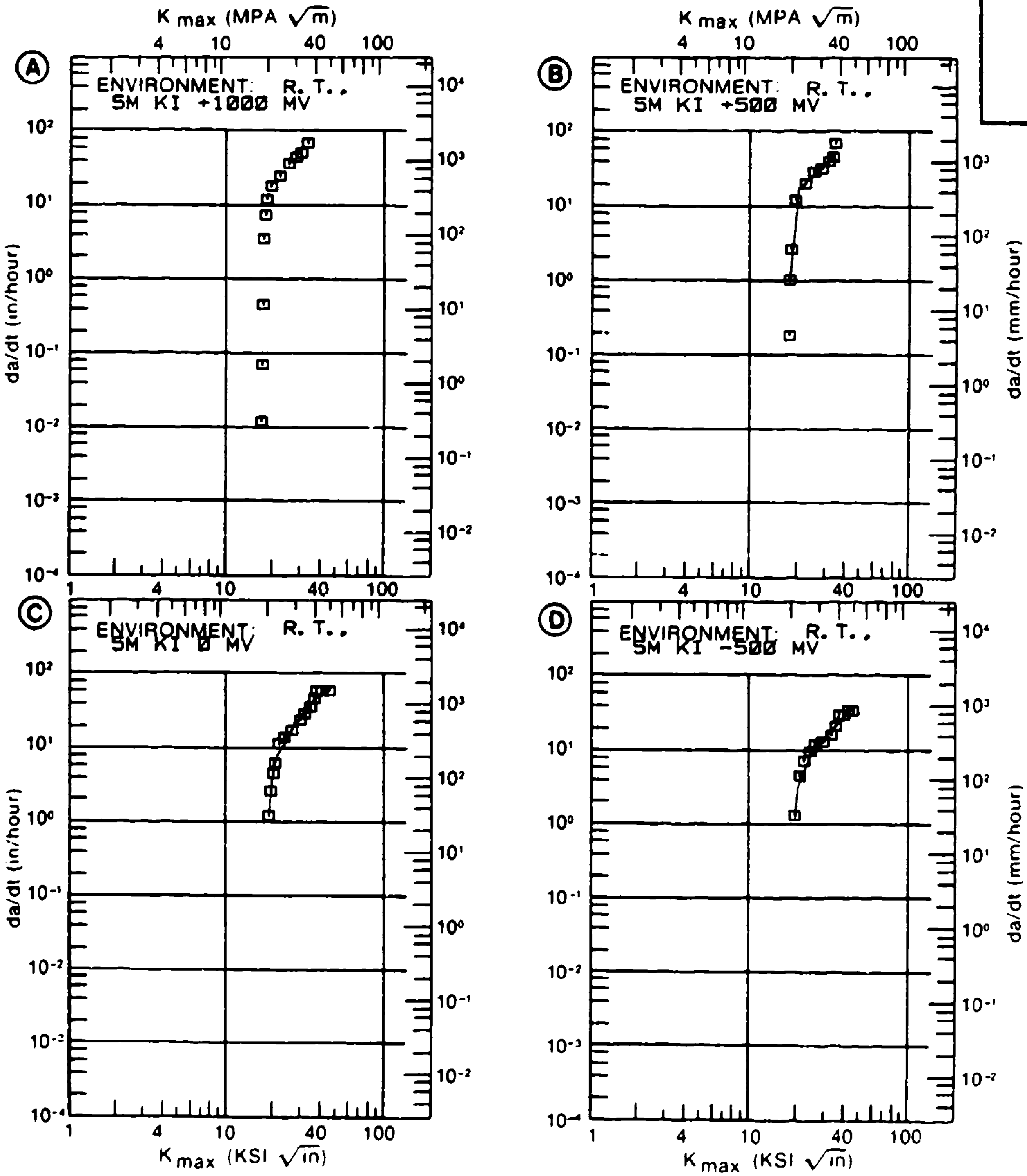

Figure 4.11.3.130

TABLE 4.11.3.131

SUSTAINED CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE4.11.3.131INDICATING EFFECT

OF ENVIRONMENT

MATERIAL: TITANIUM TI-6AL-4V
CONDITION: MA

K MAX (KSI*IN**1/2)			DA/DT (10**-3 IN/HOUR) A E= R. T. 5M KI -1000 MV	B E= R. T. 5M KI -1500 MV	C	D
K MAX MIN	A:	30.00	1328.			
	B:					
	C:					
	D:					
		35.00	2562.			
		40.00	9680.			
K MAX MAX	A:	44.00	10010.			
	B:					
	C:					
	D:					
ROOT MEAN SQUARE PERCENT ERROR			11.47	0.00		

CONDITION/HT: MA
FORM: 0.2"TH SHEET
SPECIMEN TYPE: DCB
ORIENTATION: T-L
YIELD STRENGTH:
ULT. STRENGTH:

SPECIMEN THK: 0.200"
SPECIMEN WIDTH:
CRACK LENGTH (A_c):
K_{ISCC}:
REFERENCES: 81221

TITAN. ALLOY

TI-6AL-4V

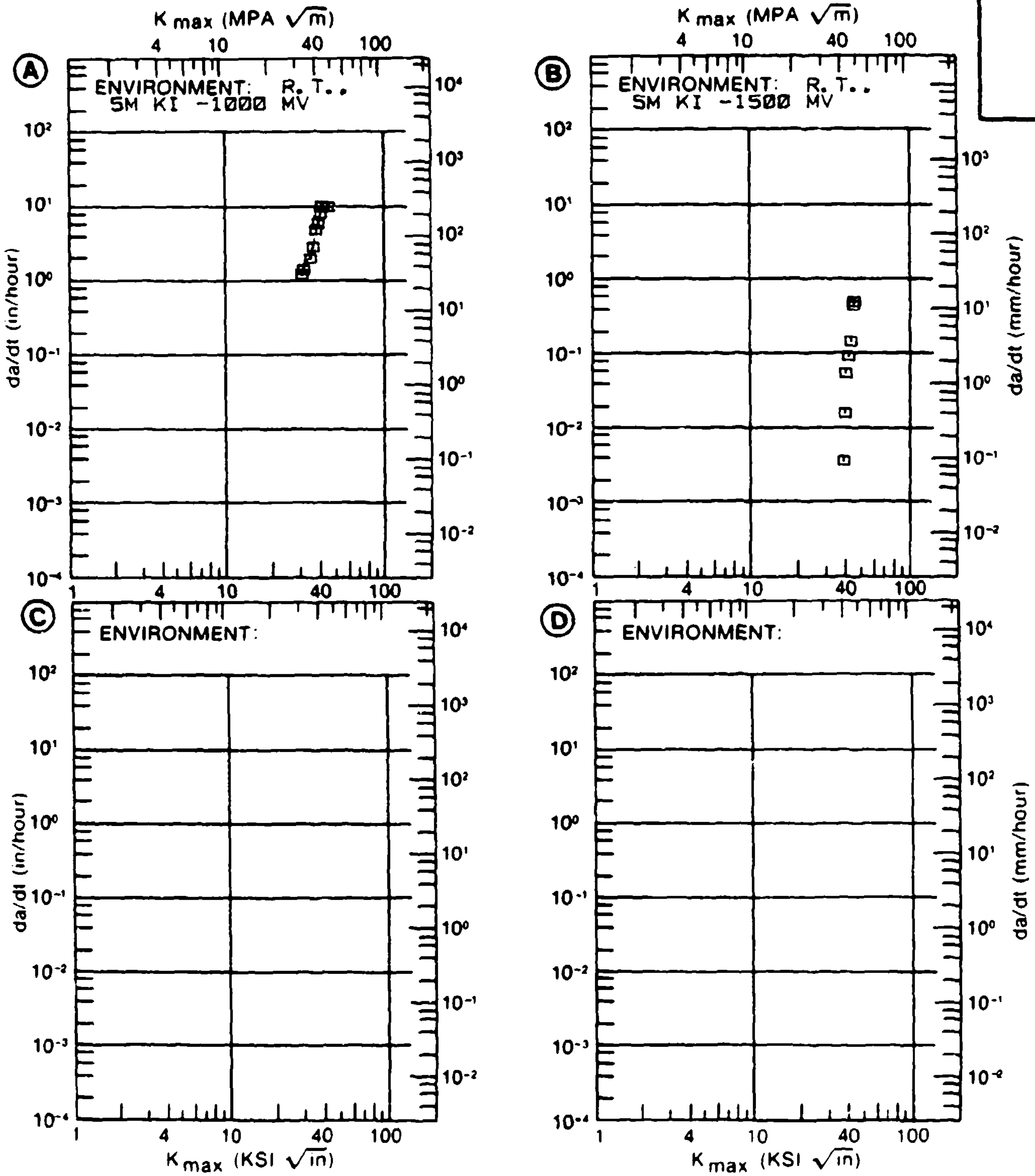

Figure 4.11.3.131

TABLE 4.11.3.132

SUSTAINED CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE4.11.3.132INDICATING EFFECT

OF ENVIRONMENT

MATERIAL: TITANIUM TI-6AL-4V
CONDITION: MA

K MAX (KSI*IN**1/2)			DA/DT (10**-3 IN/HOUR) A E= R.T. 6M KF	B E= R.T. 3M KF	C E= R.T. 1M KF	D E= R.T. DIST. WATER
K MAX MIN	A:	30.00	461.			
	B:					
	C:	35.00			30.0	
	D:	31.40				196.
		35.00	1075.			381.
		40.00	2121.		207.	485.
K MAX MAX	A:	44.50	3590.			
	B:					
	C:	44.20			529.	
	D:	45.00				522.
ROOT MEAN SQUARE PERCENT ERROR			11.57	0.00	11.33	2.17

CONDITION/HT: MA
FORM: Ø. 2"TH SHEET
SPECIMEN TYPE: DCB
ORIENTATION: T-L
YIELD STRENGTH:
ULT. STRENGTH:

SPECIMEN THK: Ø. 2ØØ"
SPECIMEN WIDTH:
CRACK LENGTH (A_0):
K_{ISCC}: 35. ØØ KSI (SQRT IN)
REFERENCES: 81221

TITAN. ALLOY

TI-6AL-4V

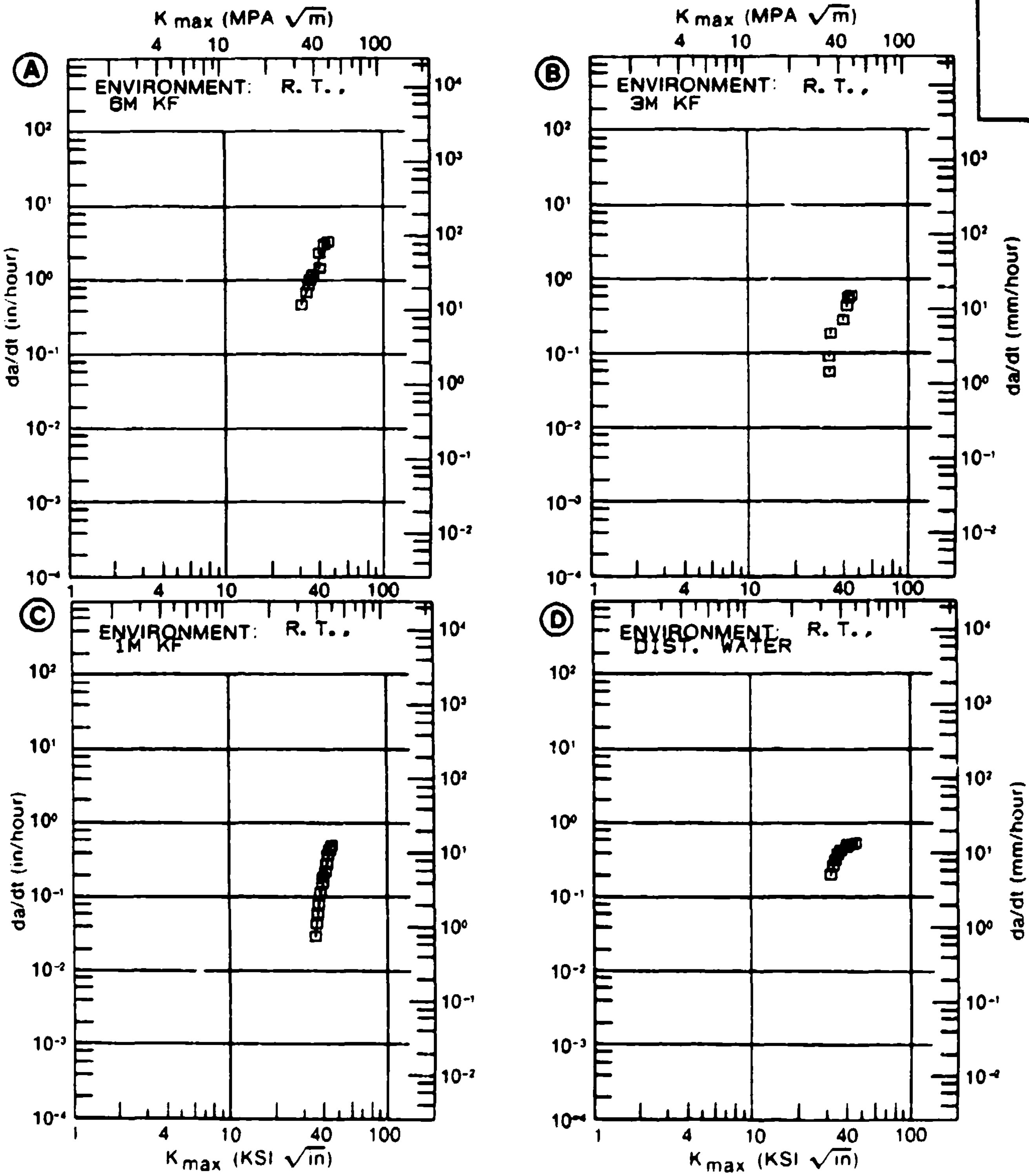

Figure 4.11.3.132

TABLE 4.11.3.133

SUSTAINED CRACK GROWTH RATES AT DEFINED LEVELS OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE4.11.3.133INDICATING EFFECT

OF ENVIRONMENT

MATERIAL: TITANIUM TI-6AL-4V
CONDITION: MA

K MAX (KSI*IN**1/2)			DA/DT (10**-3 IN/HOUR) A	B	C	D
			E= R. T. 0. 6M KCL +2000 MV	E= R. T. 0. 6M KCL +1000 MV	E= R. T. 0. 6M KCL +500 MV	E= R. T. 0. 6M KCL 0 MV
	A:					
K MAX	B:	23. 50		363.		
MIN	C:	23. 00			882.	
	D:	21. 50				576.
		25. 00		1708.	1236.	869.
		30. 00		2448.	1823.	1303.
		35. 00		3586.	2242.	1789.
		40. 00		5102.	3027.	2398.
	A:					
K MAX	B:	45. 00		6844.		
MAX	C:	45. 20			5110.	
	D:	45. 00				3230.
ROOT MEAN SQUARE PERCENT ERROR			0. 00	8. 77	7. 97	9. 38

CONDITION/HT: MA
FORM: 0.2"TH SHEET
SPECIMEN TYPE: DCB
ORIENTATION: T-L
YIELD STRENGTH:
ULT. STRENGTH:

SPECIMEN THK: 0.200"
SPECIMEN WIDTH:
CRACK LENGTH (A_0):
K_{ISCC}:
REFERENCES: 81221

TITAN. ALLOY

TI-6AL-4V

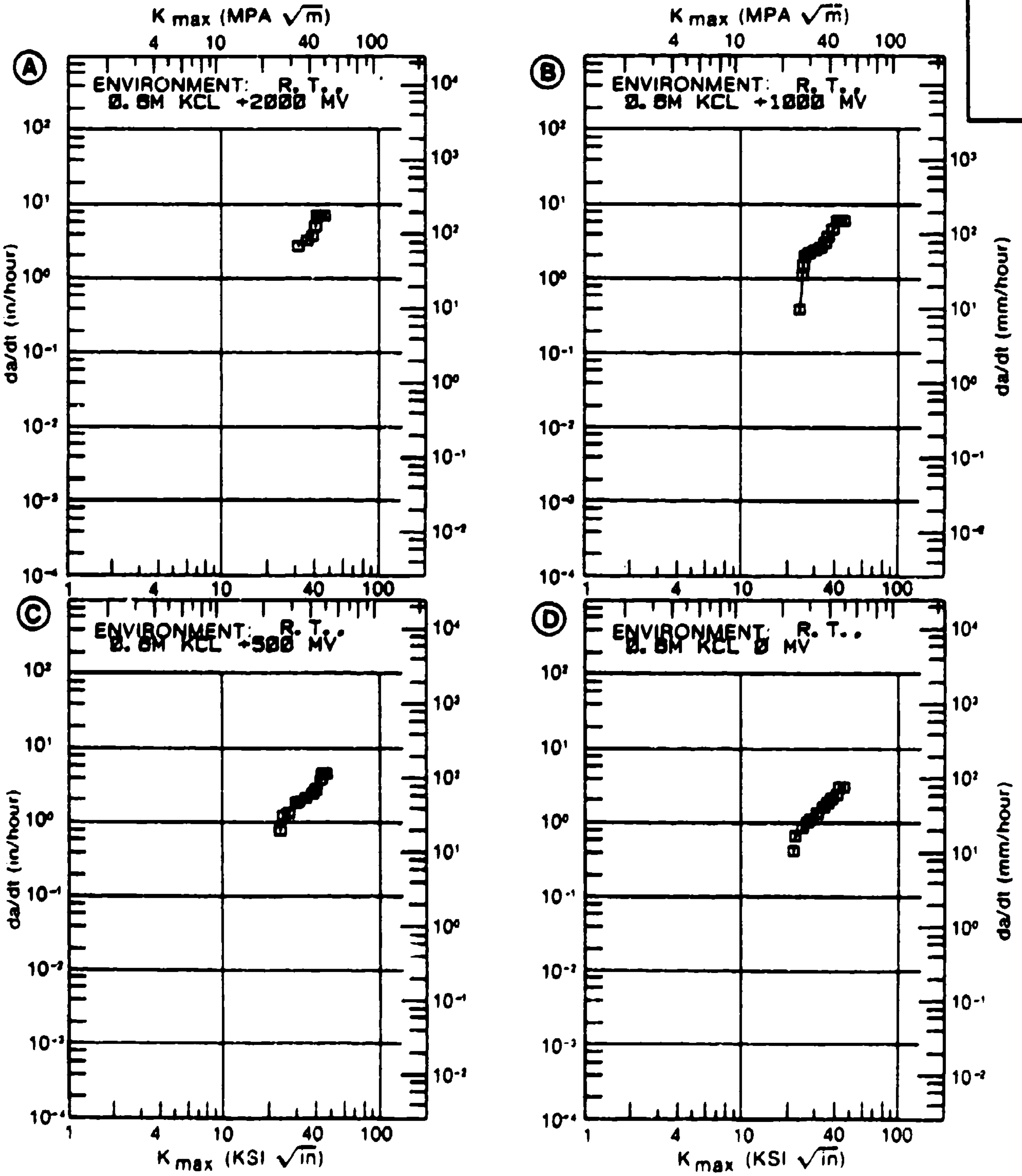

Figure 4.11.3.133

TABLE 4.11.3.134

SUSTAINED CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE4.11.3.134INDICATING EFFECT

OF ENVIRONMENT

MATERIAL: TITANIUM TI-6AL-4V
CONDITION: MA

K MAX (KSI*IN**1/2)			DA/DT (10**-3 IN/HOUR) A	B	C	D
			E= R.T. 3.5% NACL	E= R.T. JP-4 FUEL		
K MAX MIN	A:	30.00	.693			
	B:					
	C:					
	D:					
		35.00	1879.			
		40.00	2253.			
K MAX MAX	A:	45.00	4520.			
	B:					
	C:					
	D:					
ROOT MEAN SQUARE PERCENT ERROR			27.43	0.00		

CONDITION/HT: MA
FORM: 1.0"TH PLATE
SPECIMEN TYPE: CT
ORIENTATION: T-L
YIELD STRENGTH: 132.0 KSI
ULT. STRENGTH:

SPECIMEN THK: 1.000"
SPECIMEN WIDTH: 2.550"
CRACK LENGTH (A_0):
K_{ISCC}: 30.0; 49.0 KSI
REFERENCES: 88144

TITAN. ALLOY

TI-6AL-4V

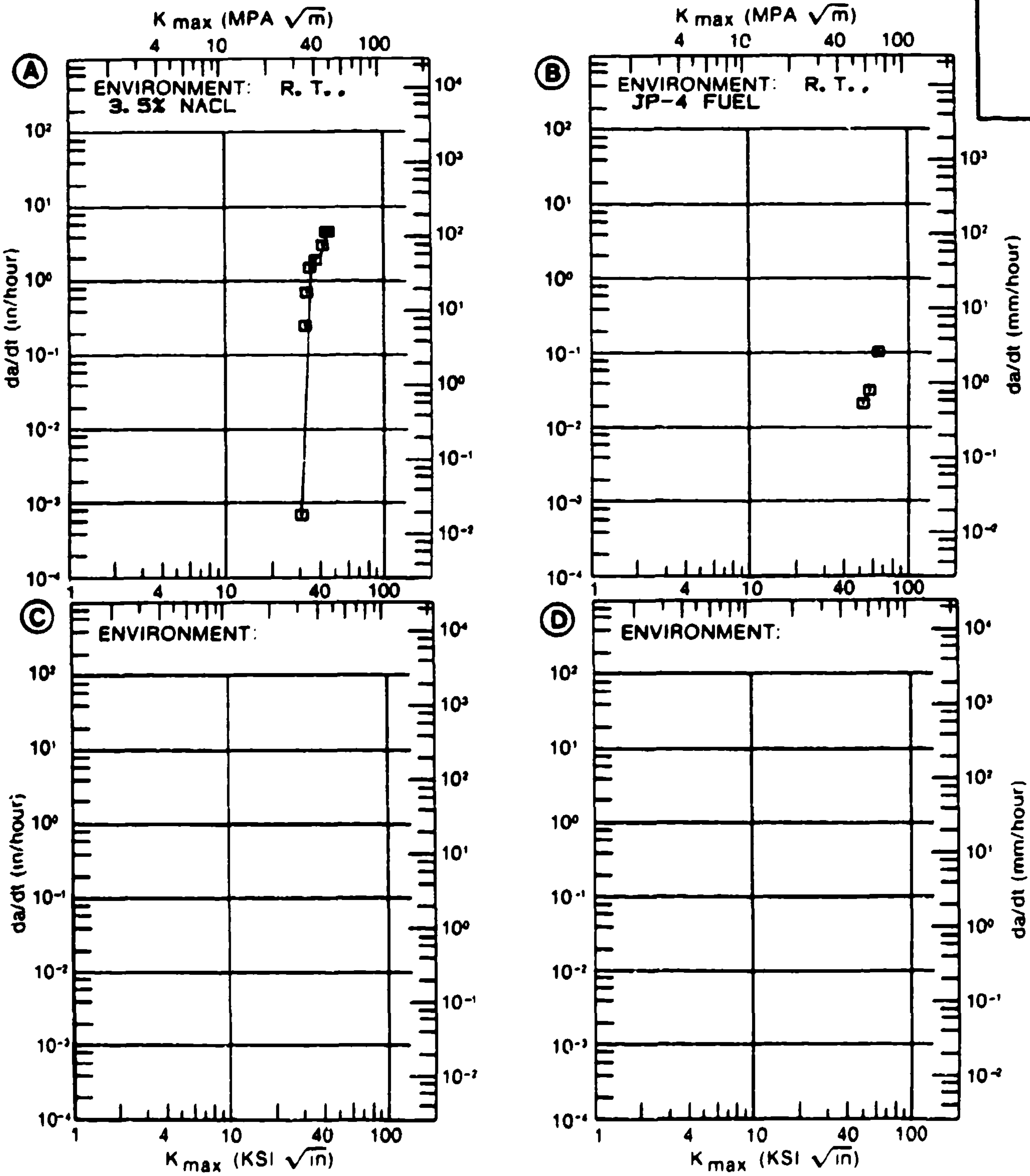

Figure 4.11.3.134

TABLE 4.11.3.135

SUSTAINED CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 4.11.3.135 INDICATING EFFECT

OF ENVIRONMENT

MATERIAL: TITANIUM TI-6AL-4V
CONDITION: 1000F 2HR

K MAX (KSI*IN**1/2)			DA/DT (10**-3 IN/HOUR) A	B	C	D
			E= R. T. 3. 5% NACL	E= R. T. JP-4 FUEL		
	A:	35. 60	222.			
K MAX MIN	B:					
	C:					
	D:					
		40. 00	3703.			
	A:	47. 00	28832.			
K MAX MAX	B:					
	C:					
	D:					
ROOT MEAN SQUARE PERCENT ERROR			46. 58	0. 00		

CONDITION/HT: 1000F 2HR
FORM: 2.0"TH FORGING
SPECIMEN TYPE: TDCB
ORIENTATION: L-T
YIELD STRENGTH: 145.0 KSI
ULT. STRENGTH:

SPECIMEN THK: 1.250"
SPECIMEN WIDTH: 5.500"
CRACK LENGTH (A_0):
K_{ISCC}: 31.0; 43.0 KSI (SORT IN)
REFERENCES: 84380

TITAN. ALLOY

TI-6AL-4V

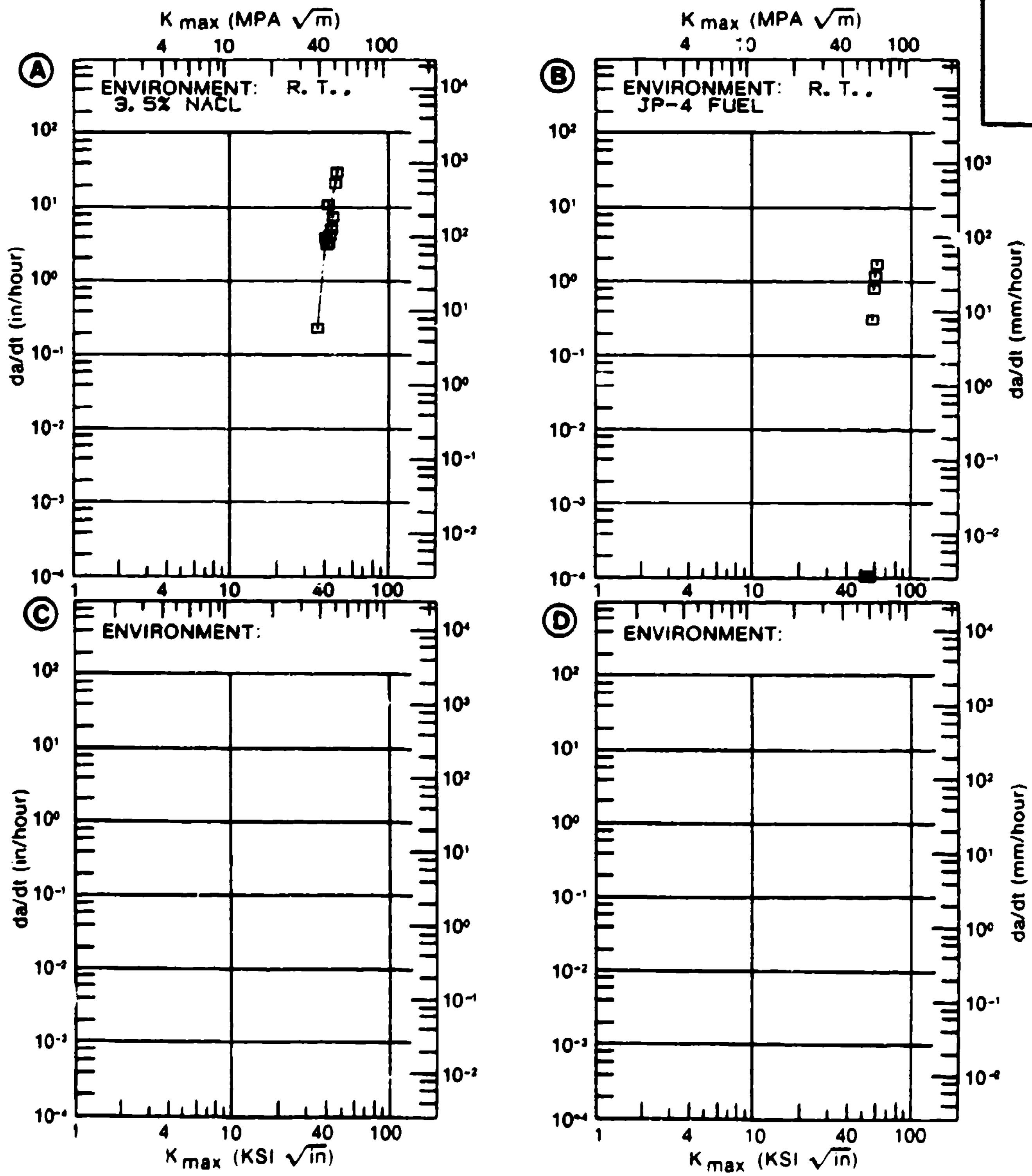

Figure 4.11.3.135

TABLE 4.11.3.136

TITANIUM TI-6AL-4V K(ISCC)

CONDITION	PRODUCT FORM	PRODUCT THICK (IN)	TEST TEMP (F)	SPEC OR	YIELD STR (KSI)	ENVIRONMENT	SPECIMEN WIDTH (IN) W	SPECIMEN THICK (IN) B	SPECIMEN DESIGN (**SG)	CRACK LENGTH (IN) A	K(Q) (KSI*SQRT IN)	K(ISCC) (KSI*SQRT IN)	MEAN	STAN DEV	TEST TIME (MIN)	DATE	REFER
--------------	-	----	R.T.	L-T	116.0	3.5 PCT NACL	----	----	CANT	----	115.00	95.00*			----	1967	70887
--------------	F	----	R.T.	---	105.0	METHANOL	1.100	0.750	CANT	----	98.00	60.00*			----	1968	84328
--------------	F	----	R.T.	---	105.0	N-HEXANE	1.100	0.750	CANT	----	98.00	80.00*			----	1968	84328
--------------	F	----	R.T.	---	105.0	3.5 PCT NACL	1.100	0.750	CANT	----	98.00	80.00*			----	1968	84328
--------------	F	1.25	R.T.	S-T	106.0	JP-4 FUEL	3.075	1.249	BWOL	1.365	-------	> 66.50			>133920	1977	MA005
		1.25			106.0		3.073	1.251	BWOL	1.355	-------	> 66.60			>133920	1977	MA005
		1.25			108.0		3.078	1.251	BWOL	1.384	-------	> 69.00			>133920	1977	MA005
		1.25			108.0		3.078	1.252	BWOL	1.363	-------	> 68.00			>133920	1977	MA005
--------------	F	1.25	R.T.	S-T	106.0	SIM. SEA WATER	3.077	1.249	BWOL	1.619	-------	> 69.60			>133920	1977	MA005
		1.25			106.0		3.077	1.250	BWOL	1.369	-------	> 69.30			>133920	1977	MA005
		1.25			108.0		3.077	1.251	BWOL	1.364	-------	> 67.70			>133920	1977	MA005
		1.25			108.0		3.073	1.253	BWOL	1.355	-------	> 68.50			>133920	1977	MA005
ALPHA-BETA FORGED	F	2.25	R.T.	T-L	144.9	INDUSTRIAL ATM	2.000	1.000	CT	----	36.50	27.00			----	1973	86688
ALPHA-BETA FORGED	F	2.25	R.T.	T-L	144.9	SEACOAST ATM	2.000	1.000	CT	----	36.50	18.00			----	1973	86688
ALPHA-BETA FORGED	F	2.25	R.T.	T-L	144.9	3.5 PCT NACL	2.000	1.000	CT	----	36.50	27.00			----	1973	86688
AS RECEIVED PROBABLY MA	P	----	R.T.	T-S	125.0	3.5 PCT NACL	----	----	CANT*	----	120.00	105.00*			----	1968	74355
BETA FORGED	F	2.25	R.T.	T-L	134.9	INDUSTRIAL ATM	2.000	1.000	CT	----	44.20	42.00			----	1973	86688

*NOTE-DATA WHICH DO NOT MEET MINIMUM SPECIMEN THICKNESS REQUIREMENTS OF 2.5(KISCC/TYS)SQUARED

TABLE 4.11.3.136 (Con't)

TITANIUM TI-6AL-4V K(ISCC)

CONDITION	--PRODUCT-- FORM	THICK (IN)	TEST TEMP (F)	SPEC OR	YIELD STR (KSI)	ENVIRONMENT	------SPECIMEN-------- WIDTH (IN) W	THICK (IN) B	DESIGN (*=SQ)	CRACK LENGTH (IN) A	K(Q) (KSI*SQRT IN)	K(ISCC) (KSI*SQRT IN)	MEAN	STAN DEV	TEST TIME (MIN)	DATE	REFER
BETA FORGED	F	2.25	R.T.	T-L	134.9	SEACOAST ATM	2.000	1.000	CT	----	44.20	42.00			----	1973	86685
BETA FORGED	F	2.25	R.T.	T-L	134.9	3.5 PCT NACL	2.000	1.000	CT	----	44.20	34.00			----	1973	86680
FINISH ROLLED 1440F	P	3.00	R.T.	T-S	114.0	3.5 PCT NACL	2.000	0.750	NB *	1.166	116.00	90.10*			----	1972	84036
		3.00			114.0		2.000	0.750	NB *	1.215	116.00	95.00*			----	1972	84036
		3.00			114.0		2.000	0.750	NB *	0.303	116.00	96.00*			----	1972	84036
		3.00			114.0		2.000	0.750	NB *	1.153	116.00	94.60*			----	1972	84036
		3.00			114.0		3.000	1.500	NB *	1.105	------	79.60			----	1972	84036
		3.00			114.0		3.000	1.500	NB *	1.051	------	74.50			----	1972	84036
		3.00			114.0		3.000	1.500	NB *	1.163	------	87.20			----	1972	84036
		3.00			114.0		3.000	1.500	NB *	1.043	------	78.60			----	1972	84036
		3.00			114.0		3.000	2.000	NB *	0.920	------	61.50			----	1972	84036
		3.00			114.0		3.000	2.000	NB *	1.005	------	78.00			----	1972	84036
		3.00			114.0		3.000	2.000	NB *	0.959	------	73.70			----	1972	84036
													76.2/	7.8			
GTA - WELD POSTWELD 1100F 2HR (HEAT AFFECTED ZONE)	P	1.25	R.T.	L-T	----	FIELD CLEANING SOLVENT	5.500	0.500	DCB	----	------	> 48.00			----	1974	89004
GTA - WELD POSTWELD 1100F 2HR (HEAT AFFECTED ZONE)	P	1.25	R.T.	L-T	----	S.T.W.	5.500	0.500	DCB	----	------	> 89.00*			----	1974	89004
		1.25			----		5.500	0.750	DCB	----	------	76.00*			----	1974	89004
		1.25			----		5.500	1.000	DCB	----	------	58.00			----	1974	89004
GTA - WELD POSTWELD 1100F 2HR (HEAT AFFECTED ZONE)	P	1.25	R.T.	L-T	----	SHOP CLEANING SOLVENT	5.500	0.500	DCB	----	------	> 64.00*			----	1974	89004
GTA WELD POSTWELD 1200F 1HR (HEAT AFFECTED ZONE)	P	1.25	R.T.	L-T	----	S.T.W.	5.500	0.125	DCB	----	------	> 67.00*			----	1974	89004

*NOTE-DATA WHICH DO NOT MEET MINIMUM SPECIMEN THICKNESS REQUIREMENTS OF 2.5(KISCC/TYS)SQUARED

TABLE 4.11.3.136 (Con't)

TITANIUM TI-6AL-4V K(ISCC)

CONDITION	PRODUCT FORM	PRODUCT THICK (IN)	TEST TEMP (F)	SPEC OR	YIELD STR (KSI)	ENVIRONMENT	SPECIMEN WIDTH (IN) W	SPECIMEN THICK (IN) B	SPECIMEN DESIGN (*=SC)	CRACK LENGTH (IN) A	K(Q) (KSI*SQRT IN)	K(ISCC) MEAN (KSI*SQRT IN)	STAN DEV	TEST TIME (MIN)	DATE	REFER
GTA WELD POSTWELD 1400F 1HR (HEAT AFFECTED ZONE)	P	1.25	R.T.	L-T	----	S.T.W.	5.500	0.125	DCB	----	------	> 62.00*		----	1974	89004
GTA WELD POSTWELD 1200F 1HR (HEAT AFFECTED ZONE)	P	1.25	R.T.	L-T	----	S.T.W.	5.500	0.250	DCB	----	------	> 66.00*		----	1974	89004
GTA WELD POSTWELD 1400F 5HR (HEAT AFFECTED ZONE)	P	1.25	R.T.	L-T	----	S.T.W.	5.500	0.250	DCB	----	------	> 70.00*		----	1974	89004
GTA WELD POSTWELD 1100F 2HR (WELD ZONE)	P	1.25	R.T.	L-T	----	S.T.W.	5.500	0.500	DCB	----	------	93.00*		----	1974	89004
MILL ANNEALED	S	0.13	R.T.	---	----	A-50	1.300	0.125	WOL	----	------	68.00*		----	1974	88700
MILL ANNEALED	S	0.13	R.T.	---	----	MCB	1.300	0.125	WOL	----	------	38.60*		----	1974	88700
MILL ANNEALED	S	0.13	R.T.	---	----	MCB/1PCT CO2	1.300	0.125	WOL	----	------	40.80*		----	1974	88700
MILL ANNEALED	S	0.20	R.T.	T-L	----	DIST WATER	----	0.200	DCB	----	------	33.00*		----	1971	81221
MILL ANNEALED	S	0.20	R.T.	T-L	----	1 M KF	----	0.200	DCB	----	------	35.00*		----	1971	81221
MILL ANNEALED	S	0.20	R.T.	T-L	----	3 M KF	----	0.200	DCB	----	------	37.00*		----	1971	81221
MILL ANNEALED	S	0.20	R.T.	T-L	----	6 M KF	----	0.200	DCB	----	------	31.00*		----	1971	81221
MILL ANNEALED	S	0.20	R.T.	T-L	----	6M KF, 0 MV	----	0.200	DCB	----	------	19.00*		----	1971	81221
MILL ANNEALED	S	0.20	R.T.	T-L	----	6M KF,+1000MV	----	0.200	DCB	----	------	16.00*		----	1971	81221
MILL ANNEALED	S	0.20	R.T.	T-L	----	6M KF,+500MV	----	0.200	DCB	----	------	17.00*		----	1971	81221

*NOTE-DATA WHICH DO NOT MEET MINIMUM SPECIMEN THICKNESS REQUIREMENTS OF 2.5(KISCC/TYS)SQUARED

TABLE 4.11.3.136 (Con't)

TITANIUM TI-6AL-4V K(ISCC)

CONDITION	--PRODUCT-- FORM	THICK (IN)	TEST TEMP (F)	SPEC OR	YIELD STR (KSI)	ENVIRONMENT	-------SPECIMEN-------- WIDTH (IN) W	THICK (IN) B	DESIGN (*=SO)	CRACK LENGTH (IN) A	K(Q)	K(ISCC) (KSI*SQRT IN)	MEAN	STAN DEV	TEST TIME (MIN)	DATE	REFER
MILL ANNEALED	S	0.20	R.T.	T-L	----	6M KF, -1000MV	----	0.200	DCB	----	------	31.00*			----	1971	81221
MILL ANNEALED	S	0.20	R.T.	T-L	----	6M KF, -1500MV	----	0.200	DCB	----	------	38.00*			----	1971	81221
MILL ANNEALED	S	0.20	R.T.	T-L	----	6M KF, -500MV	----	0.200	DCB	----	------	20.00*			----	1971	81221
MILL ANNEALED	P	0.50	R.T.	L-S	----	3.5 PCT NACL	----	----	NB	----	61.00	32.00			----	1969	75386
MILL ANNEALED	P	1.00	R.T.	T-S	120.0	3.5 PCT NACL	1.000	0.750	CANT*	----	88.00	67.00*			----	1967	70931
MINUTEMAN CASING	P	----	R.T.	T-S	165.0	3.5 PCT NACL	0.750	0.100	CANT	----	64.00	55.00*			----	1967	70931
RA	P	1.50	R.T.	L-T	117.0	S.T.W.	5.500	1.000	DCB	----	74.00	60.00*			60300	1976	R1006
		1.50			117.0		5.500	1.000	DCB	----	74.00	> 69.00*			60300	1976	R1006
		1.50			117.0		5.500	1.000	DCB	----	74.00	60.00*			60300	1976	R1006
		1.50			117.0		5.500	1.000	DCB	----	74.00	55.00			54360	1976	R1006
		1.50			121.0		5.500	1.000	DCB	----	76.00	63.00			54360	1976	R1006
		1.50			121.0		5.500	1.000	DCB	----	76.00	62.00			51720	1976	R1006
		1.50			121.0		5.500	1.000	DCB	----	76.00	> 67.00			54360	1976	R1006
		1.50			121.0		5.500	1.000	DCB	----	76.00	> 69.00			54360	1976	R1006
		2.50			122.0		5.500	1.000	DCB	----	77.00	56.00			70140	1976	R1006
		2.50			122.0		5.500	1.000	DCB	----	77.00	59.00			70140	1976	R1006
		2.50			122.0		5.500	1.000	DCB	----	77.00	60.00			54360	1976	R1006
		2.50			122.0		5.500	1.000	DCB	----	77.00	60.00			54360	1976	R1006
													59.3/	2.9			
RA	P	1.50	R.T.	T-L	122.0	F.C.S.	5.500	1.000	DCB	----	77.00	70.00			119100	1976	R1006
RA	P	1.50	R.T.	T-L	122.0	B.C.S.	5.500	1.000	DCB	----	77.00	75.00			59100	1976	R1006
		1.50			122.0		5.500	1.000	DCB	----	77.00	63.00			112200	1976	R1006
													69.0/	8.5			
RA	P	1.50	R.T.	T-L	122.0	S.T.W.	5.500	1.000	DCB	----	77.00	61.00			60300	1976	R1006
		1.50			122.0		5.500	1.000	DCB	----	77.00	62.00			54360	1976	R1006
		1.50			122.0		5.500	1.000	DCB	----	77.00	58.00			60300	1976	R1006

*NOTE-DATA WHICH DO NOT MEET MINIMUM SPECIMEN THICKNESS REQUIREMENTS OF 2.5(KISCC/TYS)SQUARED

TABLE 4.11.3.136 (Con't)

TITANIUM TI-6AL-4V K(ISCC)

CONDITION	PRODUCT FORM	PRODUCT THICK (IN)	TEST TEMP (F)	SPEC OR	YIELD STR (KSI)	ENVIRONMENT	SPECIMEN WIDTH (IN) W	SPECIMEN THICK (IN) B	SPECIMEN DESIGN (*=SC)	CRACK LENGTH (IN) A	K(Q) (KSI*SQRT IN)	K(ISCC) (KSI*SQRT IN)	MEAN	STAN DEV	TEST TIME (MIN)	DATE	REFER
RA	P	1.50	R.T.	T-L	122.0	S.T.W.	5.500	1.000	DCB	----	77.00	62.00			60300	1976	R1006
		2.00			126.0		5.500	1.000	DCB	----	80.00	61.00			61980	1976	R1006
		2.00			126.0		5.500	1.000	DCB	----	80.00	59.00			61980	1976	R1006
													59.8/	2.0			
RA	F	4.00	R.T.	T-L	119.0	S.T.W.	5.500	1.000	DCB	----	75.00	55.00			60360	1976	R1006
		4.00			117.0		5.500	1.000	DCB	----	75.00	51.00			60360	1976	R1006
													53.0/	2.8			
RA	F	----	R.T.	S-L	----	S.T.W.	5.500	1.000	DCB	----	78.00	> 57.00			64920	1976	R1006
		----			----		5.500	1.000	DCB	----	75.00	56.00			60180	1976	R1006
		----			----		5.500	1.000	DCB	----	75.00	56.00			60660	1976	R1006
		----			----		5.500	1.000	DCB	----	78.00	> 71.00			60660	1976	R1006
		4.00			125.0		5.500	1.000	DCB	----	79.00	55.00			64920	1976	R1006
		4.00			125.0		5.500	1.000	DCB	----	79.00	57.00			61680	1976	R1006
													56.0/	0.8			
SOL TREATED 1050F 4HR. WELDED 1050F 4HR	F	----	85	---	133.0	N2O4 315PSIG	1.500	0.062	PTSC	0.026	47.00	32.00*			----	1969	78535
		----		---	138.0		1.500	0.062	PTSC	0.026	47.00	31.00*			----	1969	78535
SOL TREATED 1050F 4+4 HR	F	----	85	---	160.0	N2O4 315PSIG	1.000	0.052	PTSC	0.018	45.00	28.00*			----	1969	78535
		----		---	161.0		1.000	0.052	PTSC	0.018	45.00	30.00*			----	1969	78535
1300F 2HR AC	E	0.50	R.T.	L-S	121.2	3.5 PCT NACL	1.500	0.480	NB	----	94.70	65.00*			----	1972	84282
1300F 2HR AC	E	0.50	R.T.	L-T	128.9	3.5 PCT NACL	1.500	0.480	NB	----	83.30	73.00*			----	1972	84282
1700F 4HR FC TO 1400F AC. DIFFUSION BOND THERMAL CYCLE	P	1.50	R.T.	L-T	----	S.T.W.	5.500	1.000	DCB	----	------	66.00			----	1974	89004
1700F 4HR FC TO 1400F AC. DIFFUSION BOND THERMAL CYCLE	P	1.50	R.T.	T-L	----	FIELD CLEANING SOLVENT	5.500	1.000	DCB	----	94.00	70.00			----	1974	89004

*NOTE-DATA WHICH DO NOT MEET MINIMUM SPECIMEN THICKNESS REQUIREMENTS OF 2.5(KISCC/TYS)SQUARED

TABLE 4.11.3.136 (Con't)

TITANIUM TI-6AL-4V K(ISCC)

CONDITION	PRODUCT FORM	PRODUCT THICK (IN)	TEST TEMP (F)	SPEC OR	YIELD STR (KSI)	ENVIRONMENT	SPECIMEN WIDTH (IN) W	SPECIMEN THICK (IN) B	SPECIMEN DESIGN (*=SQ)	CRACK LENGTH (IN) A	K(Q) (KSI*SQRT IN)	K(ISCC) (KSI*SQRT IN)	MEAN	STAN DEV	TEST TIME (MIN)	DATE	REFER
1700F 4HR FC	P	1.50	R.T	T-L	----	S.T.W.	5.500	1.000	DCB	----	------	60.00			----	1974	87004
TO 1400F AC,		1.50			----		5.500	1.000	DCB	----	92.00	44.00			----	1974	87004
DIFFUSION BOND		1.50			----		5.500	1.000	DCB	----	94.00	61.00			----	1974	89004
THERMAL CYCLE		2.00			----		5.500	1.000	DCB	----	92.00	53.00			----	1974	87004
		2.00			----		5.500	1.000	DCB	----	92.00	58.00			----	1974	89004
													55.2/	7.0			
1700F 4HR FC TO 1400F AC, DIFFUSION BOND THERMAL CYCLE	P	1.50	R.T.	T-L	----	SHOP CLEANING SOLVENT	5.500	1.000	DCB	----	94.00	69.00			----	1974	89004
1725F 1HR WQ	E	0.50	R.T.	L-S	139.4	3.5 PCT NACL	1.500	0.480	NB	----	77.80	60.00			----	1972	84282
1250F 4HR AC (STOA)		0.50			140.3		1.500	0.480	NB	----	74.90	70.00*			----	1972	84282
1725F 1HR WQ,	E	0.50	R.T.	L-S	145.7	3.5 PCT NACL	1.500	0.480	NB	----	67.20	51.00			----	1972	84282
1000F 1HR AC (STA)		0.50			146.9		1.500	0.480	NB	----	65.80	46.00			----	1972	84282
													48.5/	3.5			
1750F WQ 1000F 8HR 1000F (ALPHA+BETA)	F	0.50	R.T.	---	160.0	DIST WATER +50	1.000	0.030	PTSC	----	43.50	40.00*			> 1080	1968	77290
1750F WQ 1000F	F	0.50	R.T.	---	160.0	METHANOL	1.000	0.030	PTSC	----	43.50	< 26.00*			180	1968	77290
8HR 1000F (ALPHA+BETA)		0.50		---	160.0		1.000	0.060	PTSC	----	45.90	> 26.00*			180	1968	77290
1750F WQ 1000F 8HR 1000F (ALPHA+BETA)	F	0.50	R.T.	---	160.0	PPM NA2CR207	1.000	0.060	PTSC	----	45.90	43.00*			> 1080	1968	77290
1750F 1.5HR WQ	F	----	R.T.	---	160.9	AEROZINE 50	0.800	0.095	PTSC	----	52.20	37.00*			----	1969	75528
1050F-1100F 8HR, 950F 8HR		----		---	161.4		0.800	0.095	PTSC	----	51.50	38.00*			----	1969	75528

*NOTE-DATA WHICH DO NOT MEET MINIMUM SPECIMEN THICKNESS REQUIREMENTS OF 2.5(KISCC/TYS)SQUARED

TABLE 4.11.3.136 (Con't)

TITANIUM TI-6AL-4V K(ISCC)

CONDITION	--PRODUCT-- FORM	THICK (IN)	TEST TEMP (F)	SPEC OR	YIELD STR (KSI)	ENVIRONMENT	------SPECIMEN-------- WIDTH (IN) W	THICK (IN) B	DESIGN (*=SG)	CRACK LENGTH (IN) A	K(Q) (KSI*SQRT IN)	K(ISCC)	MEAN	STAN DEV	TEST TIME (MIN)	DATE	REFER
1750F 1.5HR WQ 1050F-1100F 8HR, 950F 8HR	F	----	R.T.	---	161.4	FREON TF	0.800	0.095	PTSC	----	51.50	42.00*			----	1969	75528
		----		---	160.9		0.800	0.095	PTSC	----	52.20	39.00*			----	1969	75528
1750F 1.5HR WQ 1050F-1100F 8HR, 950F 8HR	F	----	R.T.	---	160.9	N2O4	0.800	0.095	PTSC	----	52.20	40.00*			----	1969	75528
		----		---	161.4		0.800	0.095	PTSC	----	51.50	41.00*			----	1969	75528
1750F 1000F 2HR AC	F	2.30	R.T.	L-T	144.9	JP-4 FUEL	5.000	1.250	TDCB	----	50.90	43.30			----	1971	84360
1750F 1000F 2HR AC	F	2.30	R.T.	L-T	144.9	3.5 PCT NACL	5.000	1.250	TDCB	----	50.90	31.00			----	1971	84360
1790F 1.5HR WQ 1160F 8HR + 1025F 8HR AC	S	1.25	R.T.	---	----	MARTIN MARIETTA REFINED GRADE HYDRAZINE	1.300	0.125	WOL	----	------	46.20*			----	1974	88700
1790F 1.5HR WQ 1160F 8HR + 1025F 8HR AC	S	1.25	R.T.	---	----	PROPELLANT GRADE HYDRAZINE	1.300	0.125	WOL	----	------	64.30*			----	1974	88700

*NOTE-DATA WHICH DO NOT MEET MINIMUM SPECIMEN THICKNESS REQUIREMENTS OF 2.5(KISCC/TYS)SQUARED

TABLE 4.12.1.1

MEAN PLANE STRAIN FRACTURE TOUGHNESS DATA OF
TITANIUM ALLOY TI-6AL-4V(ELI) AT ROOM TEMPERATURE

CONDITION/HT	MEAN KIC ± STANDARD (KSI SQRT(IN)) DEVIATION	(NUMBER OF SPECIMENS)	
	PLATE		
CONDITION/HT	L-T	T-L	S-L
RECRYSTALLIZE ANNEAL	76.1 ± 4.0 (3)	76.8 ± 0.7 (3)	------
	FORGING		
CONDITION/HT	L-T	T-L	S-L
ANNEALED	83.5 ± 1.3 (3)	84.3 ± 0.4 (3)	------

TABLE 4.12.1.2

FATIGUE CRACK GROWTH RATE AT DEFINED LEVELS OF THE STRESS-INTENSITY FACTOR

TITANIUM TI 6AL-4V(ELI)

TEST CONDITIONS

SPECIMEN ORIENTATION L-T

ENVIRONMENT LAB AIR AT R.T

CONDITION/HT	PRODUCT FORM	STRESS RATIO	FREQ (HZ)	DELTA K LEVELS (KSI SQRT(IN))	2.5	5	10	20	50	100
				FATIGUE CRACK GROWTH RATES (MICRO IN/CYCLE)						
ANNEALED	FORGING	0.10	1.00-10.00					12.9	206	
RA	PLATE	0.10						10.8		

TABLE 4.12.1.3

FATIGUE CRACK GROWTH RATE AT DEFINED LEVELS OF THE STRESS-INTENSITY FACTOR

TITANIUM TI-6AL-4V (ELI)

TEST CONDITIONS

SPECIMEN ORIENTATION: T-L

ENVIRONMENT: DRY AIR AT R.T.

CONDITION/HT	PRODUCT FORM	STRESS RATIO	FREQ (HZ)	FATIGUE CRACK GROWTH RATES (MICRO IN/CYCLE)					
			DELTA K LEVELS: (KSI SQRT(IN))	2.5	5	10	20	50	100
BA	PLATE	0.00	15.00				4.02		
BA	PLATE	0.10	1.00					128	
BA	PLATE	0.50	0.10- 1.00				12.8		
BA	PLATE	0.80	1.00			1.12			

TABLE 4.12.1.4

FATIGUE CRACK GROWTH RATE AT DEFINED LEVELS OF THE STRESS-INTENSITY FACTOR

TITANIUM TI-6AL-4V(ELI)

TEST CONDITIONS

SPECIMEN ORIENTATION: T-L

ENVIRONMENT: LAB AIR AT R T

CONDITION/HT	PRODUCT FORM	STRESS RATIO	FREQ. (HZ)	DELTA K LEVELS: (KSI SQRT(IN)) 2 5	5	10	20	50	100
				FATIGUE CRACK GROWTH RATES (MICRO IN/CYCLE)					
ANNEALED	FORGING	0 10	1 00-20 00				11 9	171	
RA	PLATE	0 10	1 00-10 00				7 75	240	

TABLE 4.12.1.5

FATIGUE CRACK GROWTH RATE AT DEFINED LEVELS OF THE STRESS-INTENSITY FACTOR

TITANIUM TI-6AL-4V (ELI)

TEST CONDITIONS

SPECIMEN ORIENTATION T-L

ENVIRONMENT: H2O SATURATED JP-4 FUEL AT R.T.

CONDITION/HT	PRODUCT FORM	STRESS RATIO	FREQ. (HZ)	DELTA K LEVELS (KSI SQRT(IN)) → FATIGUE CRACK GROWTH RATES (MICRO IN/CYCLE) 2.5	5	10	20	50	100
BA	PLATE	0.00	15.00				5.14		
BA	PLATE	0.10	0.10					123.	
BA	PLATE	0.10	1.00					106.	
BA	PLATE	0.50	1.00				13.8		
BA	PLATE	0.50	0.10				13.9		

TABLE 4.12.1.6

FATIGUE CRACK GROWTH RATE AT DEFINED LEVELS OF THE STRESS-INTENSITY FACTOR

TITANIUM TI-6AL-4V (ELI)

TEST CONDITIONS

SPECIMEN ORIENTATION T-L

ENVIRONMENT: DIST. WATER AT R. T.

CONDITION/HT	PRODUCT FORM	STRESS RATIO	FREQ. (HZ)	DELTA K LEVELS: (KSI SQRT(IN)) 2.5	5	10	20	50	100
				FATIGUE CRACK GROWTH RATES (MICRO IN/CYCLE)					
BA	PLATE	0.00	15.00				5.20		
BA	PLATE	0.10	1.00					141	
BA	PLATE	0.50	1.00			0.27	13.7		

TABLE 4.12.1.7

FATIGUE CRACK GROWTH RATE AT DEFINED LEVELS OF THE STRESS-INTENSITY FACTOR

TITANIUM TI-6AL-4V (ELI)

TEST CONDITIONS

SPECIMEN ORIENTATION: T-L

ENVIRONMENT: 3.5% NACL AT R.T.

CONDITION/HT	PRODUCT FORM	STRESS RATIO	FREQ. (HZ)	DELTA K LEVELS (KSI SQRT(IN)) 2.5	5	10	20	50	100
				FATIGUE CRACK GROWTH RATES (MICRO IN/CYCLE)					
BA	PLATE	0.00	15.00				14.5		
BA	PLATE	0.10	0.10					393	
BA	PLATE	0.10	1.00					214	
BA	PLATE	0.50	1.00				31.3		
BA	PLATE	0.50	0.10				15.0		

TABLE 4.12.1.8

FATIGUE CRACK GROWTH RATE AT DEFINED LEVELS OF THE STRESS-INTENSITY FACTOR

TITANIUM TI-6AL-4V (ELI)

TEST CONDITIONS

SPECIMEN ORIENTATION T-L

ENVIRONMENT S.T.W. AT R.T.

CONDITION/HT	PRODUCT FORM	STRESS RATIO	FREQ. (HZ)	DELTA K LEVELS: (KSI SQRT(IN)) 2.5	5	10	20	50	100
				FATIGUE CRACK GROWTH RATES (MICRO IN/CYCLE)					
BA	PLATE	0.10	1.00					214	
BA	PLATE	0.50	0.10				12.7		
BA	PLATE	0.50	1.00			1.13	28.2		

TABLE 4.12.2.1

TITANIUM TI-6AL-4V(ELI) K(IC)

CONDITION	PRODUCT FORM	PRODUCT THICK (IN)	TEST TEMP (F)	SPECIMEN ORIENT	YIELD STRENGTH (KSI)	SPECIMEN WIDTH (IN) W	SPECIMEN THICK (IN) B	SPECIMEN DESIGN	CRACK LENGTH (IN) A	2.5*(K(IC)/TYS)**2 (IN)	K(IC) (KSI*SQRT IN)	K(IC) MEAN	STAN DEV	DATE	REFER
ANNEALED	F	3.00	R.T	L-T	117.0	4.000	2.005	CT	2.130	1.24	82.42			1976	NC001
		3.00			117.0	3.776	2.001	CT	2.136	1.31	84.91			1976	NC001
		3.00			117.0	3.996	2.005	CT	2.143	1.26	83.21	83.5/	1.3	1976	NC001
ANNEALED	F	3.00	R.T	T-L	117.0	3.997	2.023	CT	2.157	1.31	84.71			1976	NC001
		3.00			117.0	3.991	2.005	CT	2.126	1.29	84.23			1976	NC001
		3.00			117.0	3.995	2.020	CT	2.146	1.28	83.89	84.3/	0.4	1976	NC001
RECRYSTALLIZE ANNEAL	P	3.00	R.T	L-T	119.0	4.000	2.000	CT	2.072	0.94	73.32			1976	NC001
		3.00			119.0	4.000	2.000	CT	2.088	1.14	80.66			1976	NC001
		3.00			119.0	4.000	1.999	CT	2.117	0.97	74.26	76.1/	4.0	1976	NC001
RECRYSTALLIZE ANNEAL	P	3.00	R.T	T-L	122.0	4.000	2.000	CT	2.059	0.97	76.19			1976	NC001
		3.00			122.0	4.000	2.000	CT	2.034	1.01	77.61			1976	NC001
		3.00			122.0	4.000	2.000	CT	2.102	0.98	76.61	76.8/	0.7	1976	NC001

TABLE 4.12.2.2

TITANIUM TI-6AL-4V (ELI) K(C)

CONDITION	PRODUCT FORM	PRODUCT THICK (IN)	TEST TEMP (F)	SPEC OR	YIELD STR (KSI)	SPECIMEN WIDTH (IN) W	SPECIMEN THICK (IN) B	CRACK LENGTH INIT (IN) 2A(O)	CRACK LENGTH FINAL (IN) 2A(F)	GROSS STRESS ONSET (KSI) S(O)	GROSS STRESS MAX (KSI) S(MAX)	K(APP) (KSI*SQRT IN)	K(APP) MEAN	K(APP) STAN DEV	K(C) (KSI*SQRT IN)	K(C) MEAN	K(C) STAN DEV	DATE	REFER
BUCKLING OF CRACK EDGES RESTRAINED																			
ANNEALED	S	0.03	R.T.	L-T	136.0	2.000	0.025	0.490	0.780	---	104.00	94.77*			127.27*			1964	60578
		0.03			136.0	2.000	0.025	0.480	0.800	---	104.00	93.65*			129.62*			1964	60578
		0.03			136.0	2.000	0.025	0.470	0.750	---	107.00	95.20*			127.37*			1964	60578
		0.03			136.0	2.000	0.025	0.480	0.750	---	104.00	93.65*			123.79*			1964	60578
		0.03			136.0	2.000	0.025	0.480	0.700	---	105.00	94.55*			119.24*			1964	60578
ANNEALED	S	0.03	R.T.	L-T	136.0	4.000	0.025	1.270	1.600	---	71.80	108.22			126.55*			1964	60578
		0.03			136.0	4.000	0.025	1.280	1.700	---	68.50	103.76			126.31*			1964	60578
		0.03			136.0	4.000	0.025	1.260	1.650	---	70.60	105.88			127.29*			1964	60578
		0.03			136.0	4.030	0.025	1.270	1.530	---	73.60	110.82			125.44*			1964	60578
		0.03			136.0	4.040	0.025	1.270	1.650	---	74.90	112.74*	107.2/	3.0	134.72*	----/	---	1964	60578
ANNEALED	S	0.03	R.T.	L-T	136.0	17.980	0.025	5.490	6.190	---	49.50	154.33			166.70			1964	60578
		0.03			136.0	17.980	0.025	5.490	7.610	---	42.10	131.26			164.08			1964	60578
		0.03			136.0	17.990	0.024	5.480	7.350	---	44.10	137.33			167.42			1964	60578
		0.03			136.0	18.000	0.025	5.500	6.980	---	41.60	129.83			152.10			1964	60578
		0.03			136.0	18.000	0.025	5.490	7.350	---	41.60	129.68	136.5/	10.5	157.91	161.6/	6.5	1964	60578

*NOTE- NET SECTION STRESS EXCEEDS 80% OF YIELD STRENGTH. VALUE NOT INCLUDED IN MEAN OR STD. DEV.

TABLE 4.12.3.1

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 4.12.3.1 INDICATING EFFECT

OF ENVIRONMENT

MATERIAL: TITANIUM TI-6AL-4V (ELI)
CONDITION: ANNEALED

DELTA K (KSI*IN**1/2)		DA/DN (10**-6 IN./CYCLE) A	B	C	D
		E= R.T. LAB AIR			
DELTA K MIN	A: 12.87	2.61			
	B:				
	C:				
	D:				
	13.00	2.73			
	16.00	6.36			
	20.00	12.9			
	25.00	23.5			
	30.00	37.6			
	35.00	57.6			
	40.00	87.5			
	50.00	206.			
	60.00	506.			
DELTA K MAX	A: 67.30	1005.			
	B:				
	C:				
	D:				
ROOT MEAN SQUARE PERCENT ERROR		6.38			
LIFE PREDICTION RATIO SUMMARY (NP/NA)	0.0-0.5				
	0.5-0.8				
	0.8-1.25	2			
	1.25-2.0				
	>2.0				

CONDITION/HT: ANNEALED
FORM: 3.00"TH FORGING
SPECIMEN TYPE: CT
ORIENTATION: L-T
STRESS RATIO: +0.10
FREQUENCY: 1.00- 10.00 HZ

YIELD STRENGTH: 116.8 KSI
ULT. STRENGTH: 126.7 KSI
SPECIMEN THK: 0.881- 1.014"
SPECIMEN WIDTH: 7.400"
REFERENCES: NC002

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TI-6AL-4V (ELI)

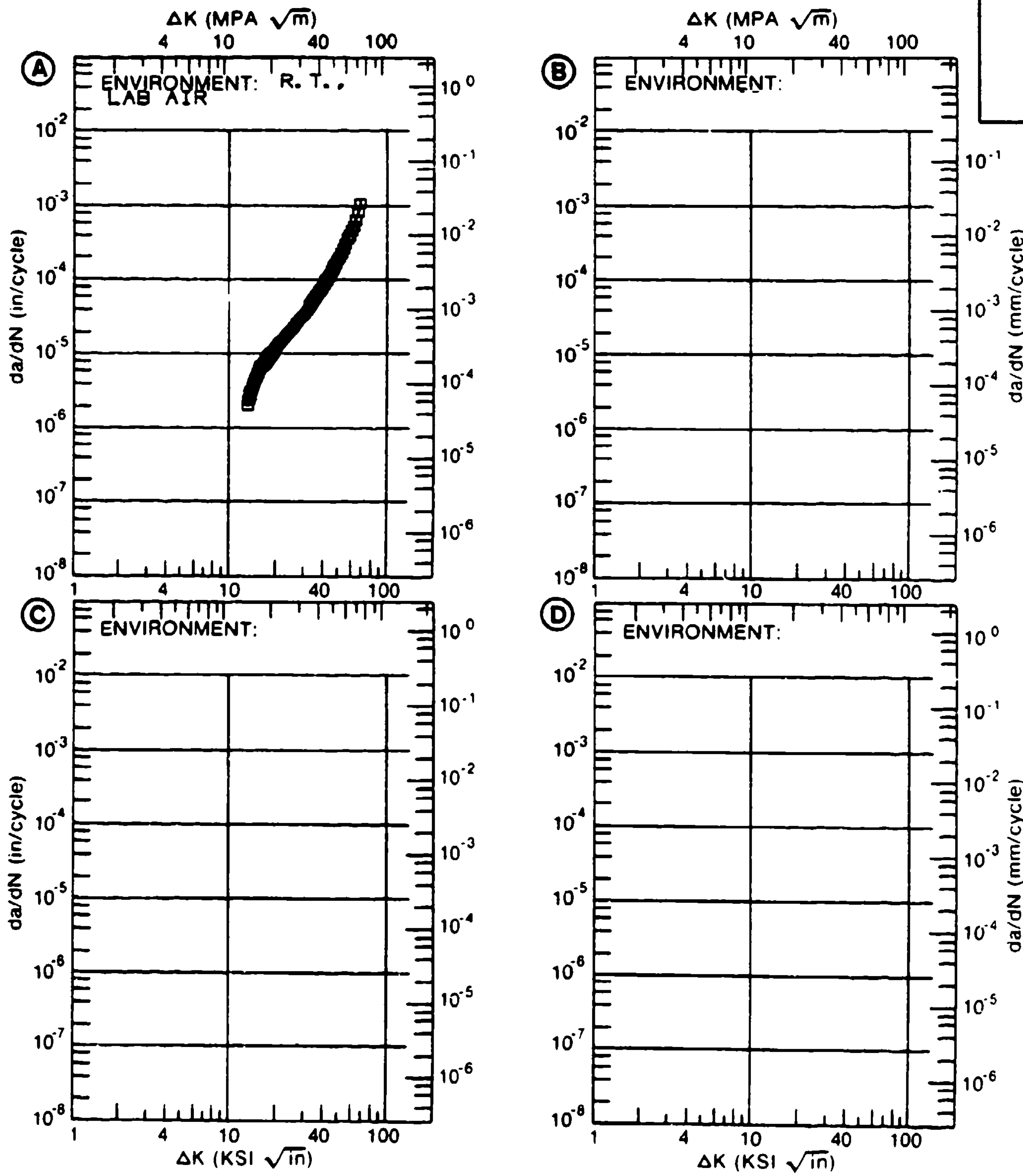

Figure 4.12.3.1

TABLE 4.12.3.2

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 4.12.3.2 INDICATING EFFECT

OF ENVIRONMENT

MATERIAL: TITANIUM TI-6AL-4V (ELI)
CONDITION: ANNEALED

DELTA K (KSI*IN**1/2)		DA/DN (10**-6 IN./CYCLE) A	B	C	D
		E= R.T. LAB AIR			
DELTA K MIN	A: 12.55	.717			
	B:				
	C:				
	D:				
	13.00	.974			
	16.00	4.18			
	20.00	11.9			
	25.00	23.6			
	30.00	36.4			
	35.00	52.3			
	40.00	75.1			
	50.00	171.			
	60.00	461.			
DELTA K MAX	A: 63.28	662.			
	B:				
	C:				
	D:				
ROOT MEAN SQUARE PERCENT ERROR		26.42			
LIFE PREDICTION RATIO SUMMARY (NP/NA)	0.0-0.5				
	0.5-0.8				
	0.8-1.25	2			
	1.25-2.0	1			
	>2.0				

CONDITION/HT: ANNEALED
FORM: 3.00"TH FORGING
SPECIMEN TYPE: CT
ORIENTATION: T-L
STRESS RATIO: +0.10
FREQUENCY: 1.00- 20.00 HZ

YIELD STRENGTH: 116.9 KSI
ULT. STRENGTH: 127.0 KSI
SPECIMEN THK: 0.999- 1.002"
SPECIMEN WIDTH: 7.400"
REFERENCES: NC002

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TI-6AL-4V(ELI)

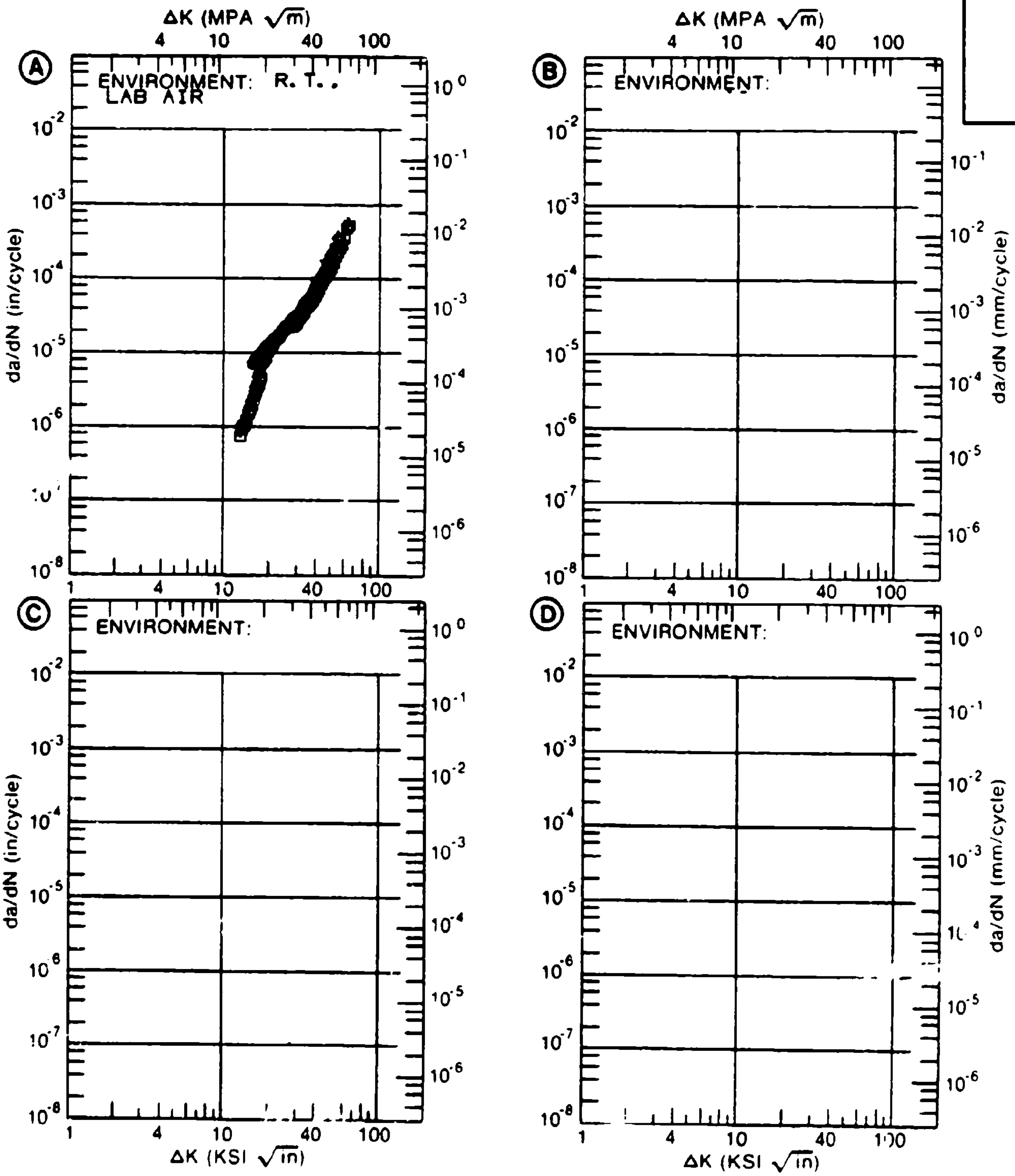

Figure 4.12.3.2

TABLE 4.12.3.3

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 4.12.3.3 INDICATING EFFECT
OF STRESS RATIO

MATERIAL: TITANIUM TI-6AL-4V (ELI)
CONDITION: BA
ENVIRONMENT: R.T. , DRY AIR

DELTA K (KSI*IN**1/2)		DA/DN (10**-6 IN./CYCLE) A	B	C	D
		R=+0.10	R=+0.80		
DELTA K MIN A:	40.32	58.0			
B:	7.50		.190		
C:					
D:					
	8.00		.286		
	9.00		.597		
	10.00		1.12		
	13.00		4.50		
	16.00				
	20.00				
	25.00				
	30.00				
	35.00				
	40.00				
	50.00	128.			
	60.00	229.			
	70.00	401.			
DELTA K MAX A:	71.02	426.			
B:	13.61		5.54		
C:					
D:					
ROOT MEAN SQUARE PERCENT ERROR		4.60	10.38		

LIFE PREDICTION RATIO SUMMARY (NP/NA)	
	0.0-0.5
	0.5-0.8
	0.8-1.25
	1.25-2.0
	>2.0

CONDITION/HT: BA
FORM: 1.00"TH PLATE
SPECIMEN TYPE: DCB
ORIENTATION: T-L
FREQUENCY: 1.00 HZ
ENVIRONMENT: R.T., DRY AIR

YIELD STRENGTH:
ULT. STRENGTH:
SPECIMEN THK:
SPECIMEN WIDTH:
REFERENCES: 88140

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TI-6AL-4V (ELI)

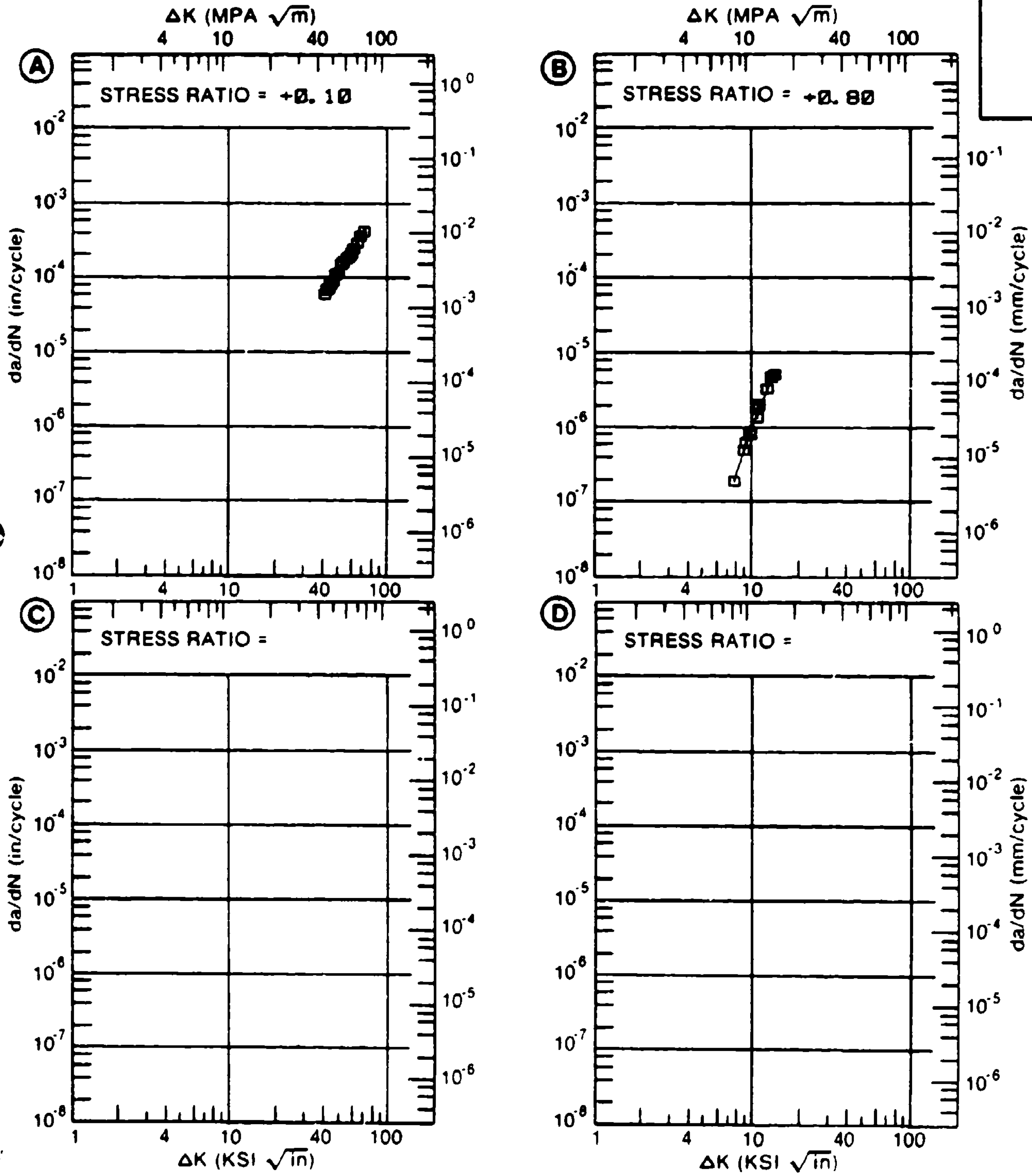

Figure 4.12.3.3

TABLE 4.12.3.4

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 4.12.3.4 INDICATING EFFECT
OF STRESS RATIO

MATERIAL: TITANIUM TI-6AL-4V (ELI)
CONDITION: BA
ENVIRONMENT: R.T. ,3.5% NACL

DELTA K (KSI*IN**1/2)	DA/DN (10**-6 IN./CYCLE) A	B	C	D
	R=+0.80			
DELTA K MIN A:				
B:				
C:				
D:				
200.00				
DELTA K MAX A:				
B:				
C:				
D:				

ROOT MEAN SQUARE PERCENT ERROR 0.00

LIFE PREDICTION RATIO SUMMARY (NP/NA)	
	0.0-0.5
	0.5-0.8
	0.8-1.25
	1.25-2.0
	>2.0

CONDITION/HT: BA
FORM: 1.00"TH PLATE
SPECIMEN TYPE: DCB
ORIENTATION: T--L
FREQUENCY: 1.00 HZ
ENVIRONMENT: R. T., 3.5% NACL

YIELD STRENGTH:
ULT. STRENGTH:
SPECIMEN THK:
SPECIMEN WIDTH:
REFERENCES: 88140

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TI-6AL-4V (ELI)

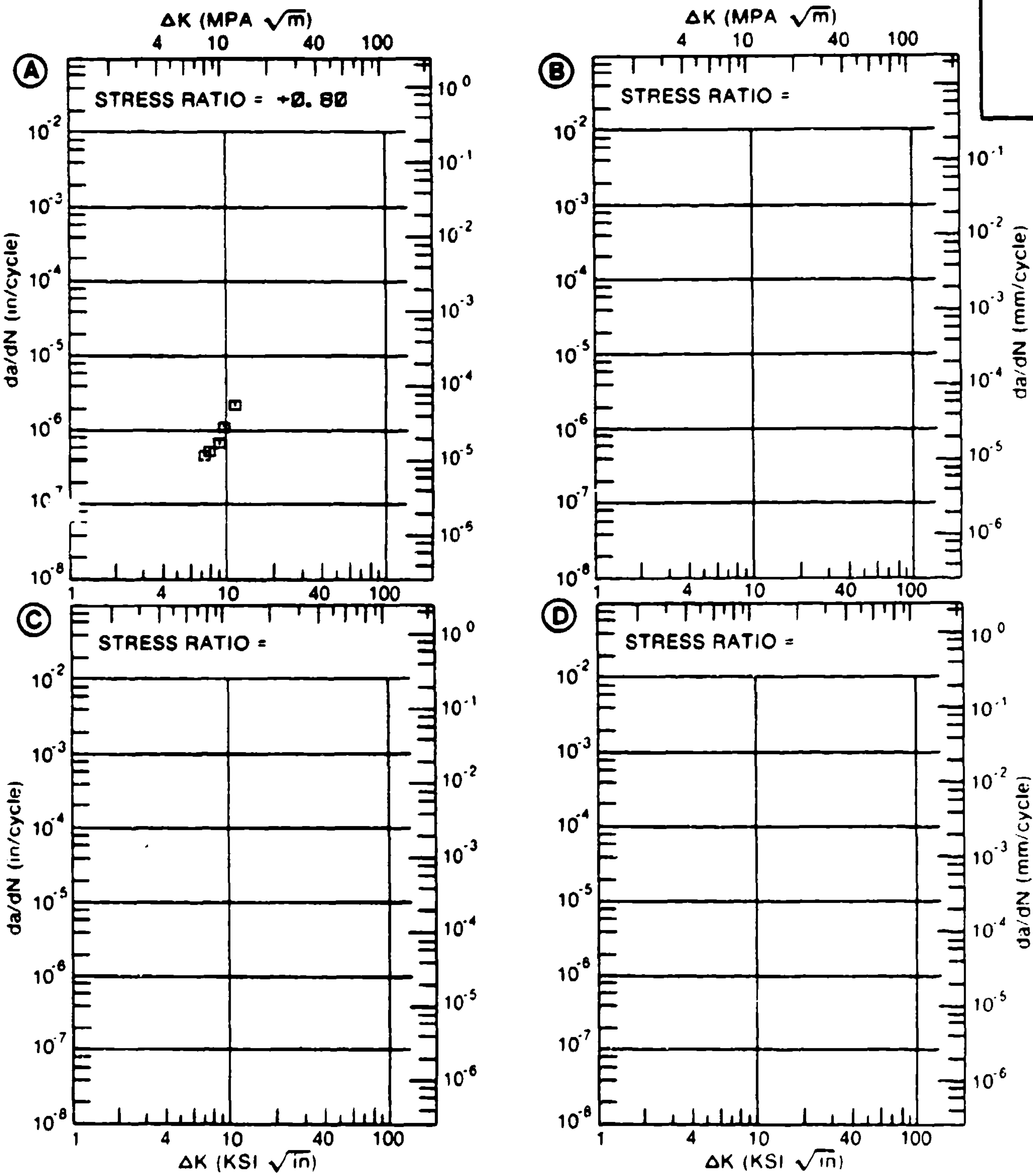

Figure 4.12.3.4

TABLE 4.12.3.5

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 4.12.3.5 INDICATING EFFECT

OF ENVIRONMENT

MATERIAL: TITANIUM TI-6AL-4V (ELI)
CONDITION: BA

DELTA K (KSI*IN**1/2)		DA/DN (10**-6 IN./CYCLE) A	B	C	D
		E= R.T. DRY AIR			
DELTA K MIN A:	11.53	.0879			
DELTA K MIN B:					
DELTA K MIN C:					
DELTA K MIN D:					
	13.00	.227			
	16.00	1.01			
	20.00	4.02			
	25.00	11.9			
	30.00	22.4			
	35.00	31.3			
DELTA K MAX A:	37.95	34.5			
DELTA K MAX B:					
DELTA K MAX C:					
DELTA K MAX D:					
ROOT MEAN SQUARE PERCENT ERROR		24.63			

LIFE PREDICTION RATIO SUMMARY (NP/NA)	
	0.0-0.5
	0.5-0.8
	0.8-1.25
	1.25-2.0
	>2.0

CONDITION/HT: BA
FORM: 1.00"TH PLATE
SPECIMEN TYPE: DCB
ORIENTATION: T-L
STRESS RATIO: +0.00
FREQUENCY: 15.00 HZ

YIELD STRENGTH:
ULT. STRENGTH:
SPECIMEN THK:
SPECIMEN WIDTH:
REFERENCES: 88140

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TI-6AL-4V (ELI)

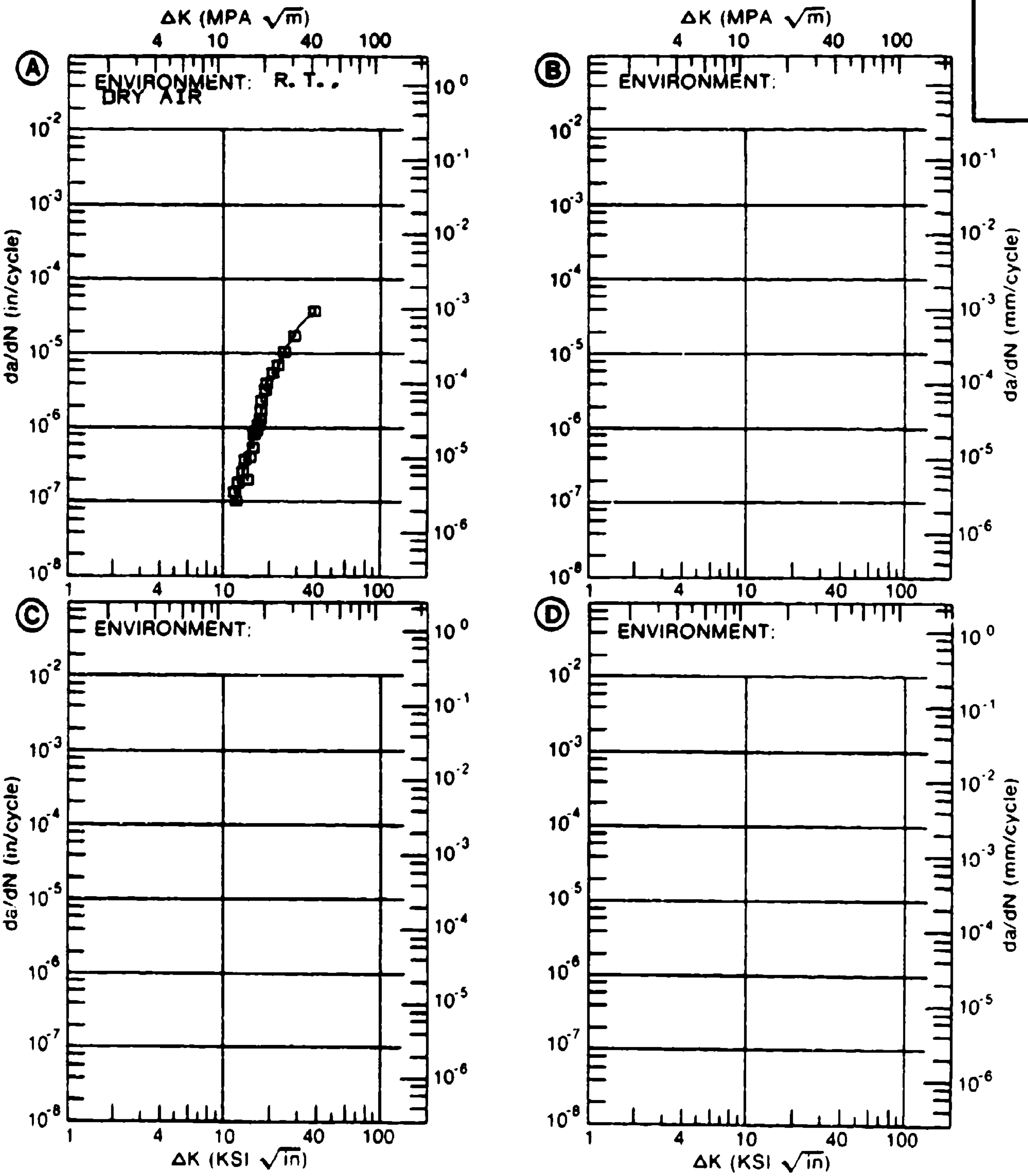

Figure 4.12.3.5

TABLE 4.12.3.6

FATIQUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 4.12.3.6 INDICATING EFFECT

OF ENVIRONMENT

MATERIAL: TITANIUM TI-6AL-4V (ELI)
CONDITION: BA

DELTA K (KSI*IN**1/2)		DA/DN (10**-6 IN./CYCLE) A	B	C	D
		E= R.T. H2O SATURATED JP-4 FUEL	E= R.T. DIST. WATER	E= R.T. 3.5% NACL	E= R.T. S.T.W.
DELTA K MIN	A: 14.45	.387			
	B: 15.47		.968		
	C: 10.07			.117	
	D: 13.53				.400
	13.00			1.36	
	16.00	1.06	1.27	2.99	1.64
	20.00	5.14	5.20	14.5	
	25.00	13.4	13.0		
	30.00	22.4	22.8		
	35.00	32.4	35.7		
	40.00	45.9	55.4		
DELTA K MAX	A: 43.49	59.6			
	B: 40.10		55.9		
	C: 24.47			24.0	
	D: 16.98				3.23
ROOT MEAN SQUARE PERCENT ERROR		11.94	19.22	22.82	17.58

LIFE PREDICTION RATIO SUMMARY (NP/NA)	
	0.0-0.5
	0.5-0.8
	0.8-1.25
	1.25-2.0
	>2.0

CONDITION/HT: BA
FORM: 1.00"TH PLATE
SPECIMEN TYPE: DCB
ORIENTATION: T-L
STRESS RATIO: +0.00
FREQUENCY: 15.00 HZ

YIELD STRENGTH:
ULT. STRENGTH:
SPECIMEN THK:
SPECIMEN WIDTH:
REFERENCES: 88140

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TI-6AL-4V (ELI)

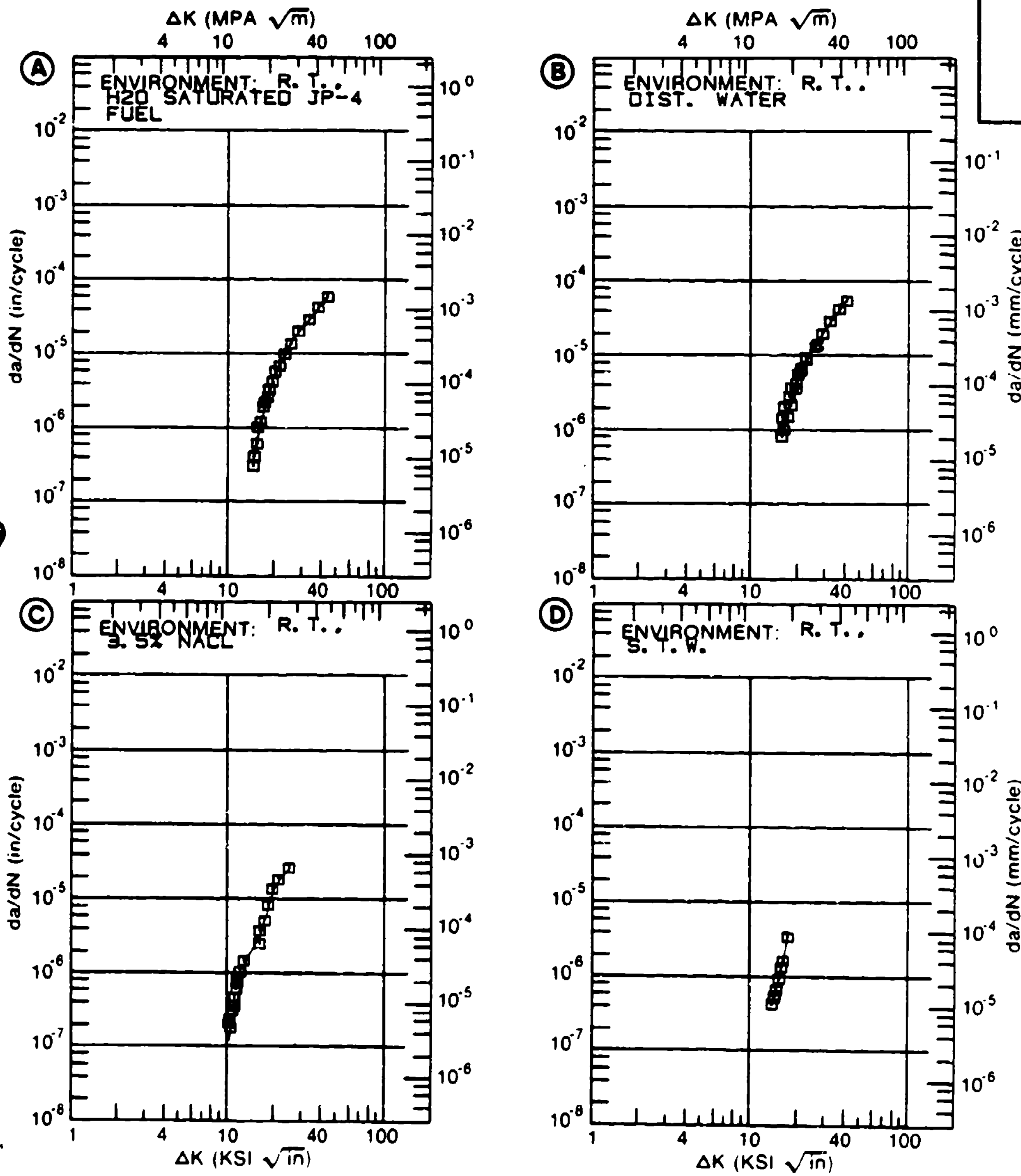

Figure 4.12.3.6

TABLE 4.12.3.7

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 4.12.3.7 INDICATING EFFECT

OF ENVIRONMENT

MATERIAL: TITANIUM TI-6AL-4V (ELI)
CONDITION: BA

DELTA K (KSI*IN**1/2)		DA/DN (10**-6 IN./CYCLE) A	B	C	D
		E= R.T. H2O SATURATED JP-4 FUEL	E= R.T. ALT JP4-FUEL & DIST. WATER	E= R.T. DIST. WATER	
DELTA K MIN	A: 27.33	19.4			
	B: 26.24		19.2		
	C: 42.57			63.1	
	D:				
	30.00	26.4	31.1		
	35.00	40.8	48.9		
	40.00	57.7	69.0		
	50.00	106.	122.	141.	
	60.00	200.	212.	210.	
	70.00	402.	388.	383.	
DELTA K MAX	A: 72.48	483.			
	B: 73.62		489.		
	C: 74.51			607.	
	D:				
ROOT MEAN SQUARE PERCENT ERROR		10.21	12.84	5.17	

LIFE PREDICTION RATIO SUMMARY (NP/NA)	
	0.0-0.5
	0.5-0.8
	0.8-1.25
	1.25-2.0
	>2.0

CONDITION/HT: BA
FORM: 1.00"TH PLATE
SPECIMEN TYPE: DCB
ORIENTATION: T-L
STRESS RATIO: +0.10
FREQUENCY: 1.00 HZ

YIELD STRENGTH:
ULT. STRENGTH:
SPECIMEN THK:
SPECIMEN WIDTH:
REFERENCES: 88140

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TI-6AL-4V (ELI)

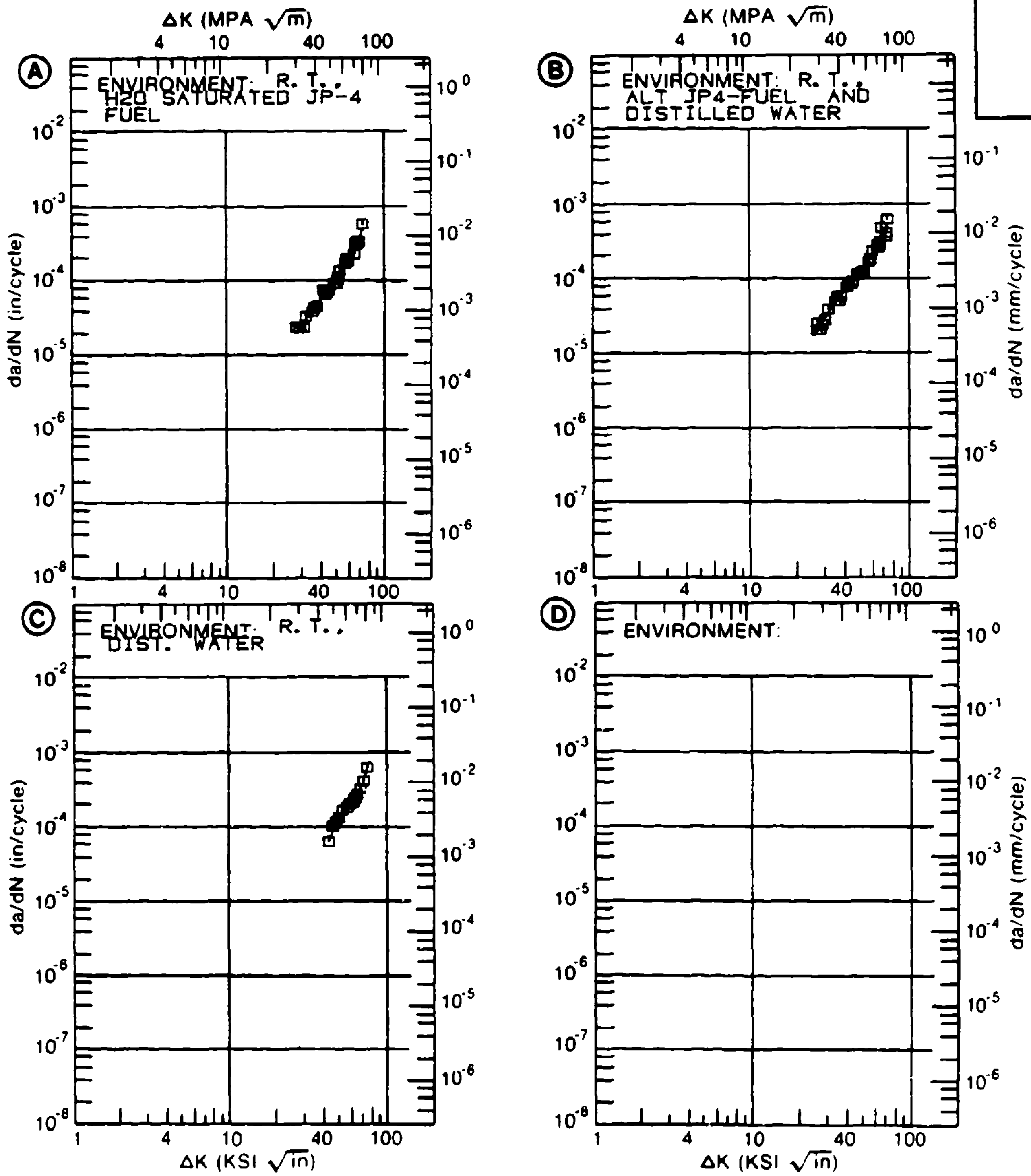

Figure 4.12.3.7

TABLE 4.12.3.8

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 4.12.3.8 INDICATING EFFECT

OF ENVIRONMENT

MATERIAL: TITANIUM TI-6AL-4V (ELI)
CONDITION: BA

DELTA K (KSI*IN**1/2)			DA/DN (10**-6 IN./CYCLE) A	B	C	D
			E= R.T. 3.5% NACL	E= R.T. S.T.W.		
	A:	26.53	51.6			
DELTA K	B:	27.01		37.8		
MIN	C:					
	D:					
		30.00	74.9	53.2		
		35.00	107.	70.8		
		40.00	138.	89.5		
		50.00	214.	214.		
		60.00	355.	616.		
		70.00	657.			
	A:	73.43	833.			
DELTA K	B:	64.60		757.		
MAX	C:					
	D:					
ROOT MEAN SQUARE PERCENT ERROR			7.81	10.86		

LIFE	0.0-0.5
PREDICTION	0.5-0.8
RATIO	0.8-1.25
SUMMARY	1.25-2.0
(NP/NA)	>2.0

CONDITION/HT: 8A
FORM: 1.00"TH PLATE
SPECIMEN TYPE: DCB
ORIENTATION: T-L
STRESS RATIO: +0.10
FREQUENCY: 1.00 HZ

YIELD STRENGTH:
ULT. STRENGTH:
SPECIMEN THK:
SPECIMEN WIDTH:
REFERENCES:88140

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TI-6AL-4V (ELI)

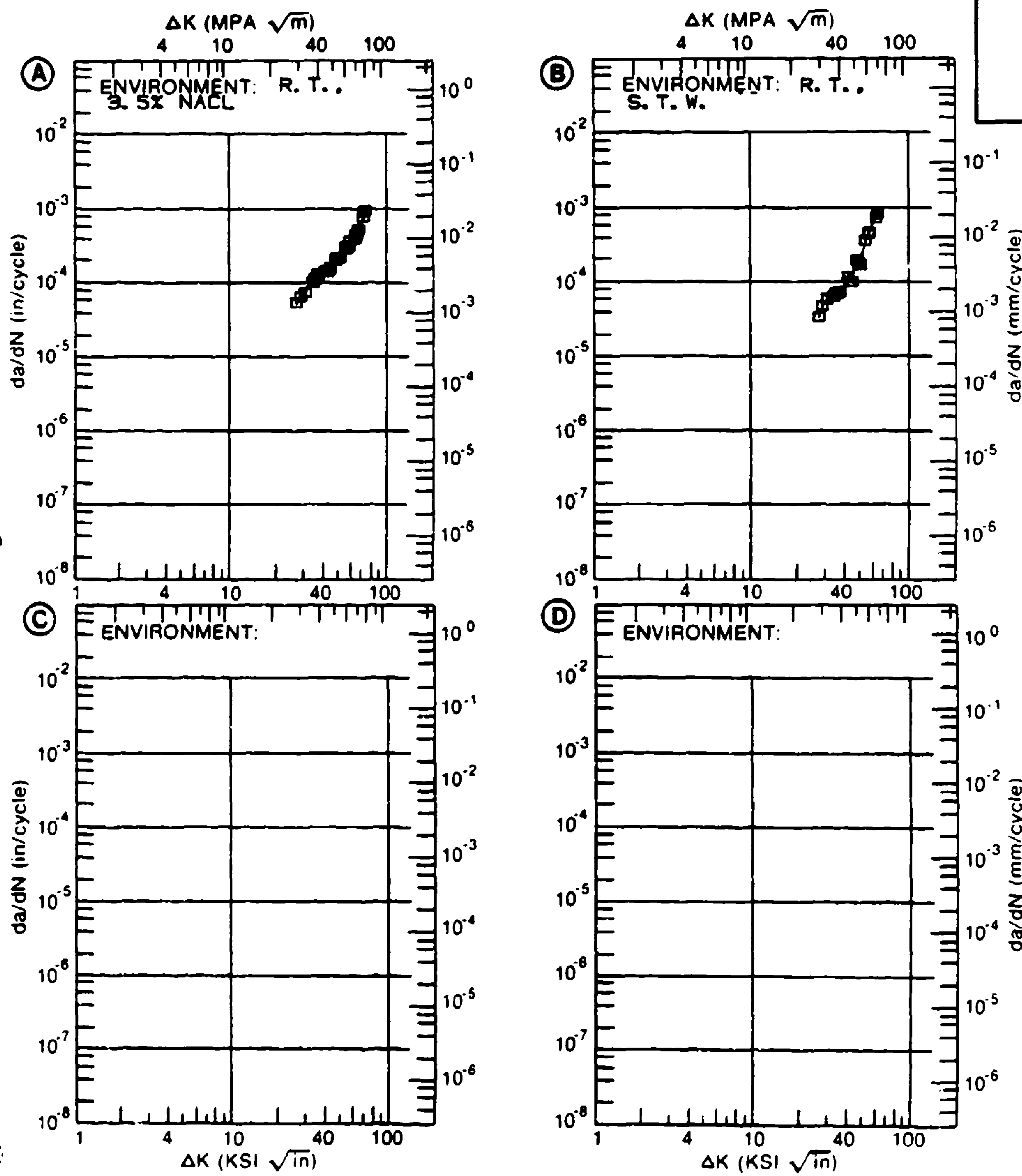

Figure 4.12.3.8

TABLE 4.12.3.9

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 4.12.3.9 INDICATING EFFECT

OF ENVIRONMENT

MATERIAL: TITANIUM TI-6AL-4V (ELI)
CONDITION: BA

DELTA K (KSI*IN**1/2)			DA/DN (10**-6 IN./CYCLE) A	B	C	D
			E= R.T. H2O SATURATED JP-4 FUEL	E= R.T. 3.5% NACL		
DELTA K MIN	A:	26.50	15.3			
	B:	26.86		11.0		
	C:					
	D:					
		30.00	28.0	36.5		
		35.00	47.5	110.		
		40.00	67.9	194.		
		50.00	123.	353.		
		60.00	230.	624.		
		70.00	501.	1449.		
DELTA K MAX	A:	76.78	1014.			
	B:	75.41		2636.		
	C:					
	D:					
ROOT MEAN SQUARE PERCENT ERROR			10.69	18.13		

[illegible] 0.0-0.5
[illegible] [illegible]5-0.8
[illegible] [illegible]-1.25
[illegible] 1.[illegible]2.0
([illegible]) [illegible]

CONDITION/HT: BA
FORM: 1.00" TH PLATE
SPECIMEN TYPE: DCB
ORIENTATION: T-L
STRESS RATIO: +0.10
FREQUENCY: 0.10 HZ

YIELD STRENGTH:
ULT. STRENGTH:
SPECIMEN THK:
SPECIMEN WIDTH:
REFERENCES: 88140

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TI-6AL-4V (ELI)

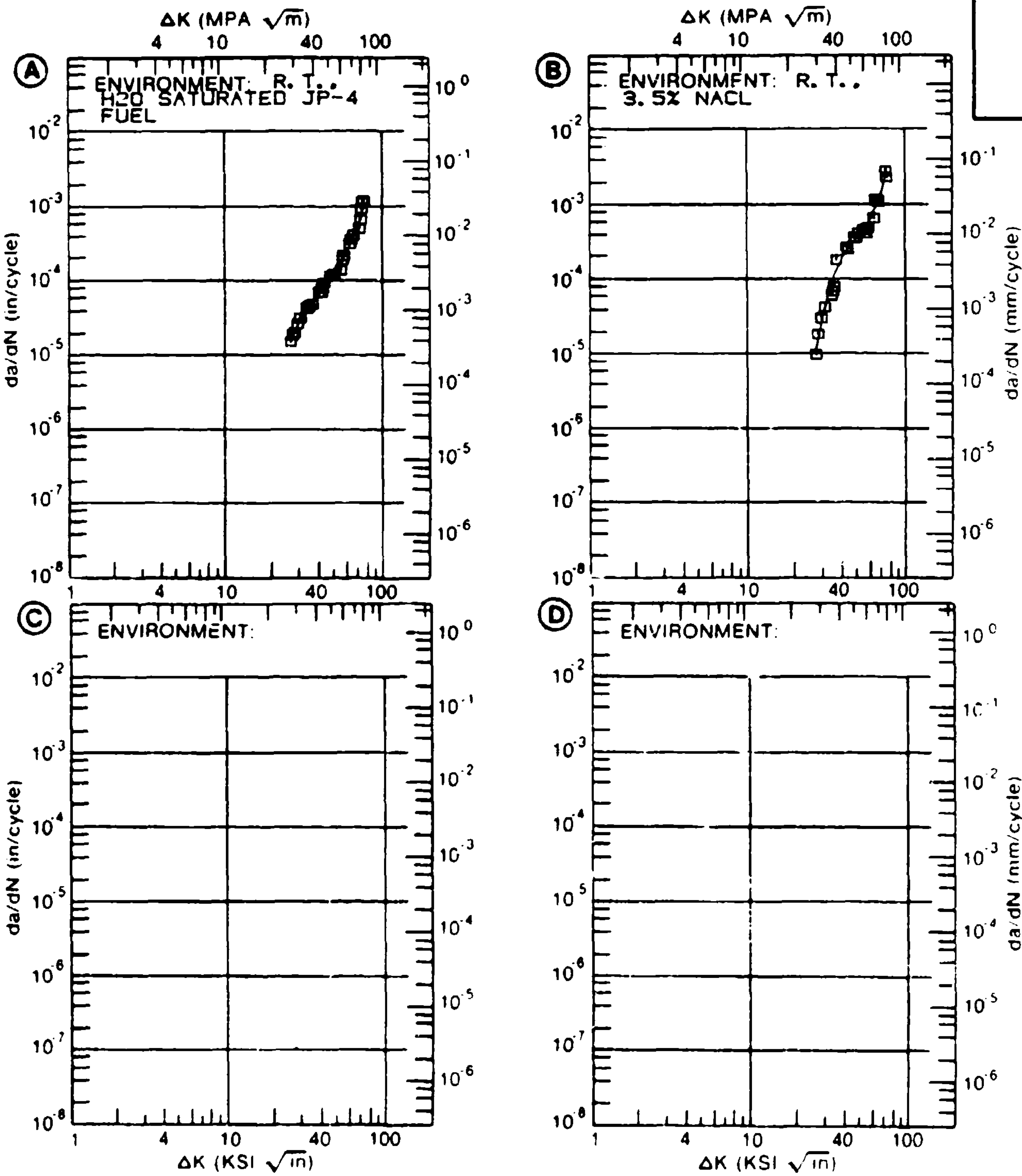

Figure 4.12.3.9

TABLE 4.12.3.10

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 4.12.3.10 INDICATING EFFECT

OF ENVIRONMENT

MATERIAL: TITANIUM TI-6AL-4V (ELI)
CONDITION: BA

DELTA K (KSI*IN**1/2)		DA/DN (10**-6 IN./CYCLE) A	B	C	D
		E=- 65F NITROGEN & AIR			
DELTA K MIN	A: 15.30	2.20			
	B:				
	C:				
	D:				
	16.00	2.69			
	20.00	9.07			
	25.00	15.4			
	30.00	22.0			
	35.00	33.1			
	40.00	53.4			
DELTA K MAX	A: 42.13	66.9			
	B:				
	C:				
	D:				
ROOT MEAN SQUARE PERCENT ERROR		11.19			

LIFE PREDICTION RATIO SUMMARY (NP/NA)	
	0.0-0.5
	0.5-0.8
	0.8-1.25
	1.25-2.0
	>2.0

CONDITION/HT: BA
FORM: 1.00"TH PLATE
SPECIMEN TYPE: DCB
ORIENTATION: T-L
STRESS RATIO: +0.50
FREQUENCY: 1.00 HZ

YIELD STRENGTH:
ULT. STRENGTH:
SPECIMEN THK:
SPECIMEN WIDTH:
REFERENCES: 88140

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TI-6AL-4V (ELI)

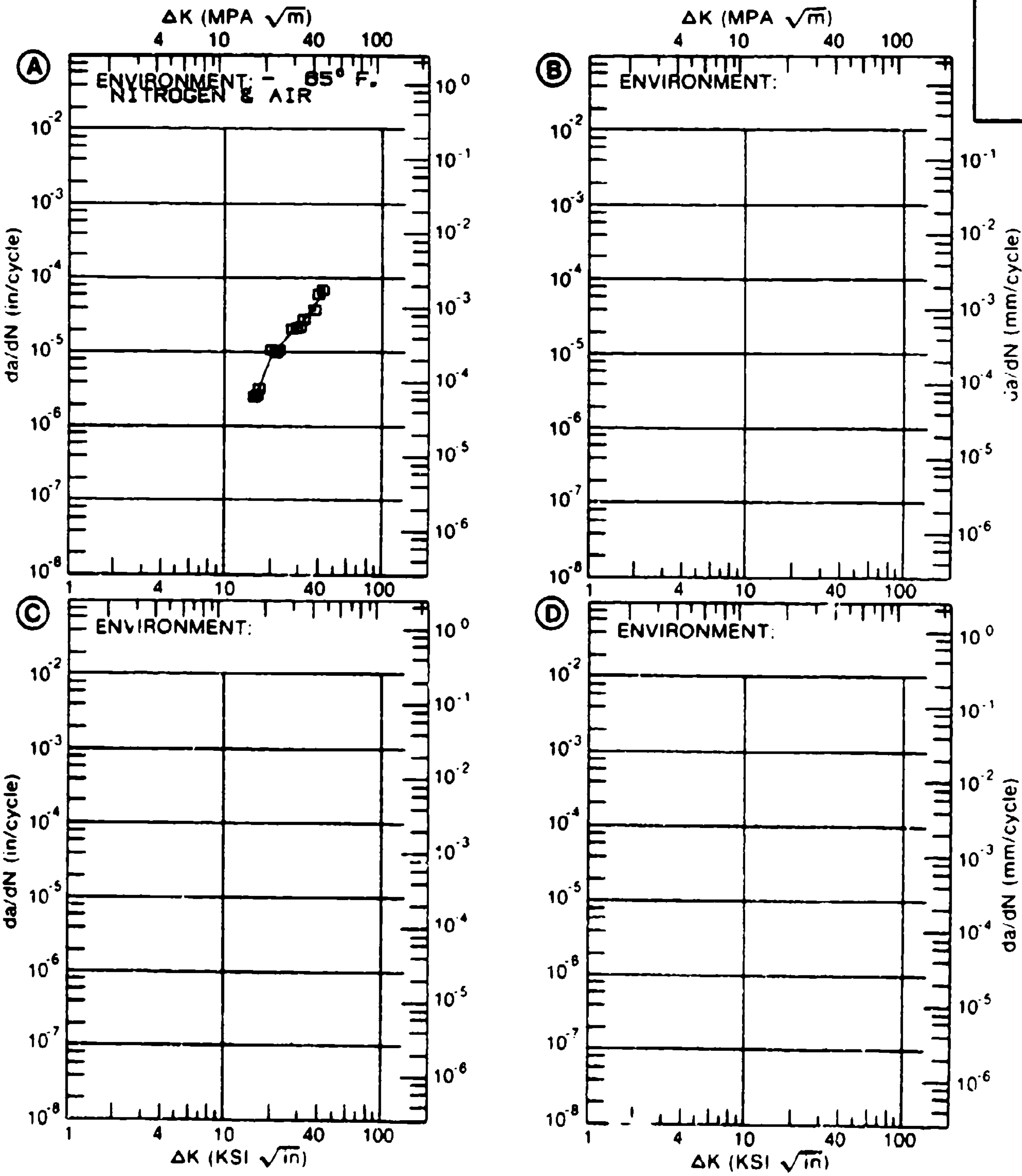

Figure 4.12.3.10

TABLE 4.12.3.11

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 4.12.3.11 INDICATING EFFECT

OF ENVIRONMENT

MATERIAL: TITANIUM TI-6AL-4V (ELI)
CONDITION: BA

DELTA K (KSI*IN**1/2)			DA/DN (10**-6 IN./CYCLE) A	B	C	D
			E=+ 175F DRY AIR	E=+ 175F JP-4 FUEL	E=+ 175F DIST. WATER	E=+ 175F 3.5% NACL
	A:	15.15	4.42			
DELTA K	B:	14.71		3.87		
MIN	C:	21.49			19.1	
	D:	15.01				5.51
		16.00	5.69	5.02		6.93
		20.00	12.1	13.3		17.8
		25.00	20.7	24.0	29.8	48.6
		30.00	33.5	36.9	50.4	100.
		35.00	56.1	59.6	73.3	159.
		40.00	78.0	99.0	91.9	
	A:	40.96	80.3			
DELTA K	B:	42.28		101.		
MAX	C:	41.36			95.5	
	D:	35.56				165.
ROOT MEAN SQUARE PERCENT ERROR			9.05	14.61	7.92	12.39

LIFE PREDICTION RATIO SUMMARY (NP/NA)	
	0.0-0.5
	0.5-0.8
	0.8-1.25
	1.25-2.0
	>2.0

CONDITION/HT: BA
FORM: 1.00"TH PLATE
SPECIMEN TYPE: DCB
ORIENTATION: T-L
STRESS RATIO: +0.50
FREQUENCY: 1.00 HZ

YIELD STRENGTH:
ULT. STRENGTH:
SPECIMEN THK:
SPECIMEN WIDTH:
REFERENCES:88140

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TI-6AL-4V (ELI)

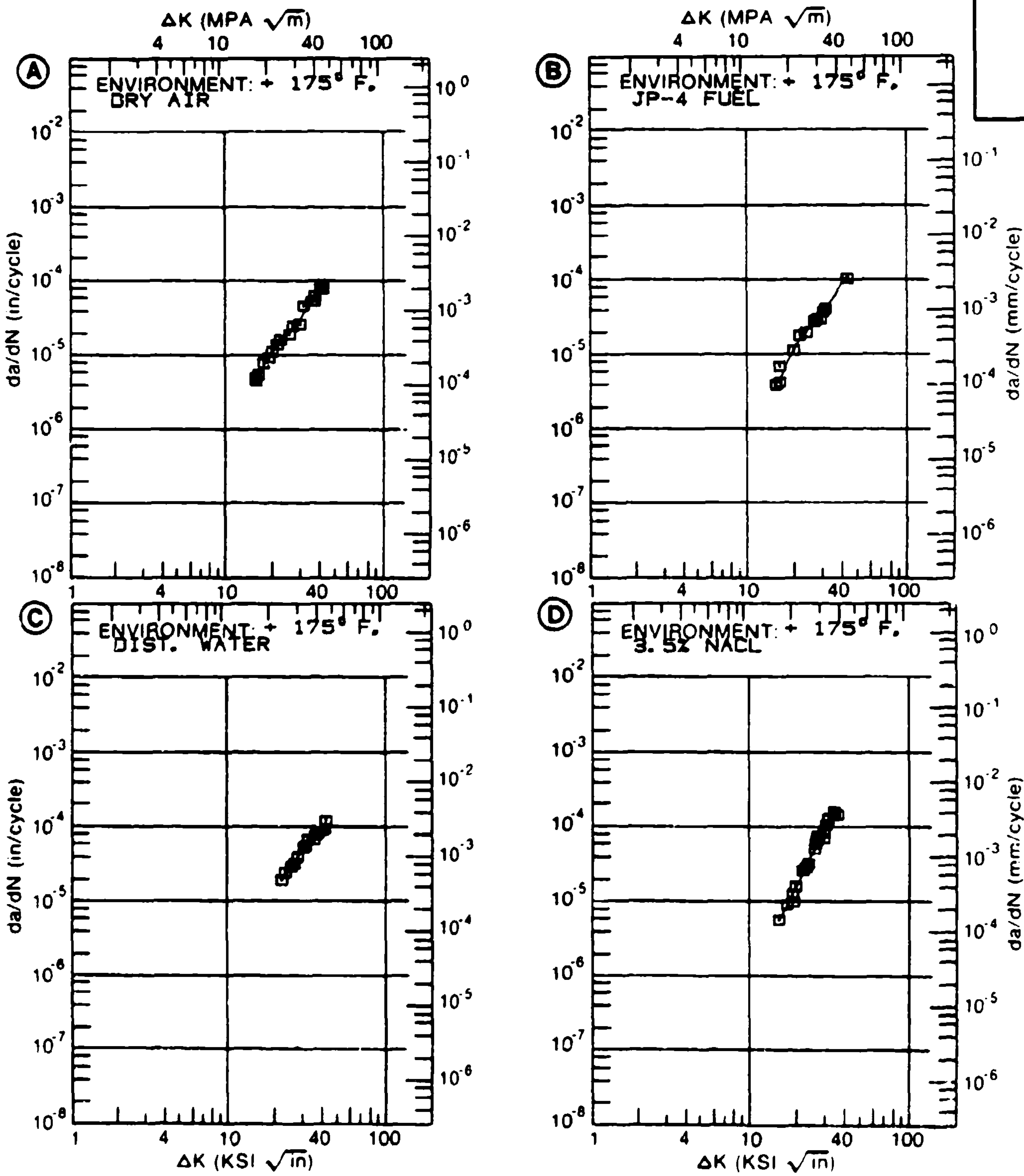

Figure 4.12.3.11

TABLE 4.12.3.12

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 4.12.3.12 INDICATING EFFECT

OF ENVIRONMENT

MATERIAL: TITANIUM TI-6AL-4V (ELI)
CONDITION: BA

DELTA K (KSI*IN**1/2)		DA/DN (10**-6 IN./CYCLE) A E= R.T. H2O SATURATED JP-4 FUEL	B E= R.T. ALT JP4-FUEL & DIST. WATER	C E= R.T. DIST. WATER	D
DELTA K MIN A:	10.91	.61			
DELTA K MIN B:	10.34		.50		
DELTA K MIN C:	9.85			.23	
DELTA K MIN D:					
	10.00			.273	
	13.00	2.24	2.19	2.03	
	16.00	6.47	5.87	6.01	
	20.00	13.8	12.9	13.7	
	25.00	24.6	23.5	25.5	
	30.00	39.7	35.5	40.7	
	35.00	66.0	50.1	63.0	
	40.00	117.		98.7	
DELTA K MAX A:	41.26	137.			
DELTA K MAX B:	36.59		55.4		
DELTA K MAX C:	44.21			148.	
DELTA K MAX D:					
ROOT MEAN SQUARE PERCENT ERROR		22.06	20.98	16.08	

LIFE PREDICTION RATIO SUMMARY (NP/NA)	
	0.0-0.5
	0.5-0.8
	0.8-1.25
	1.25-2.0
	>2.0

CONDITION/HT: BA
FORM: 1.00"TH PLATE
SPECIMEN TYPE: DCB
ORIENTATION: T-L
STRESS RATIO: +0.50
FREQUENCY: 1.00 HZ

YIELD STRENGTH:
ULT. STRENGTH:
SPECIMEN THK:
SPECIMEN WIDTH:
REFERENCES:88140

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TI-6AL-4V (ELI)

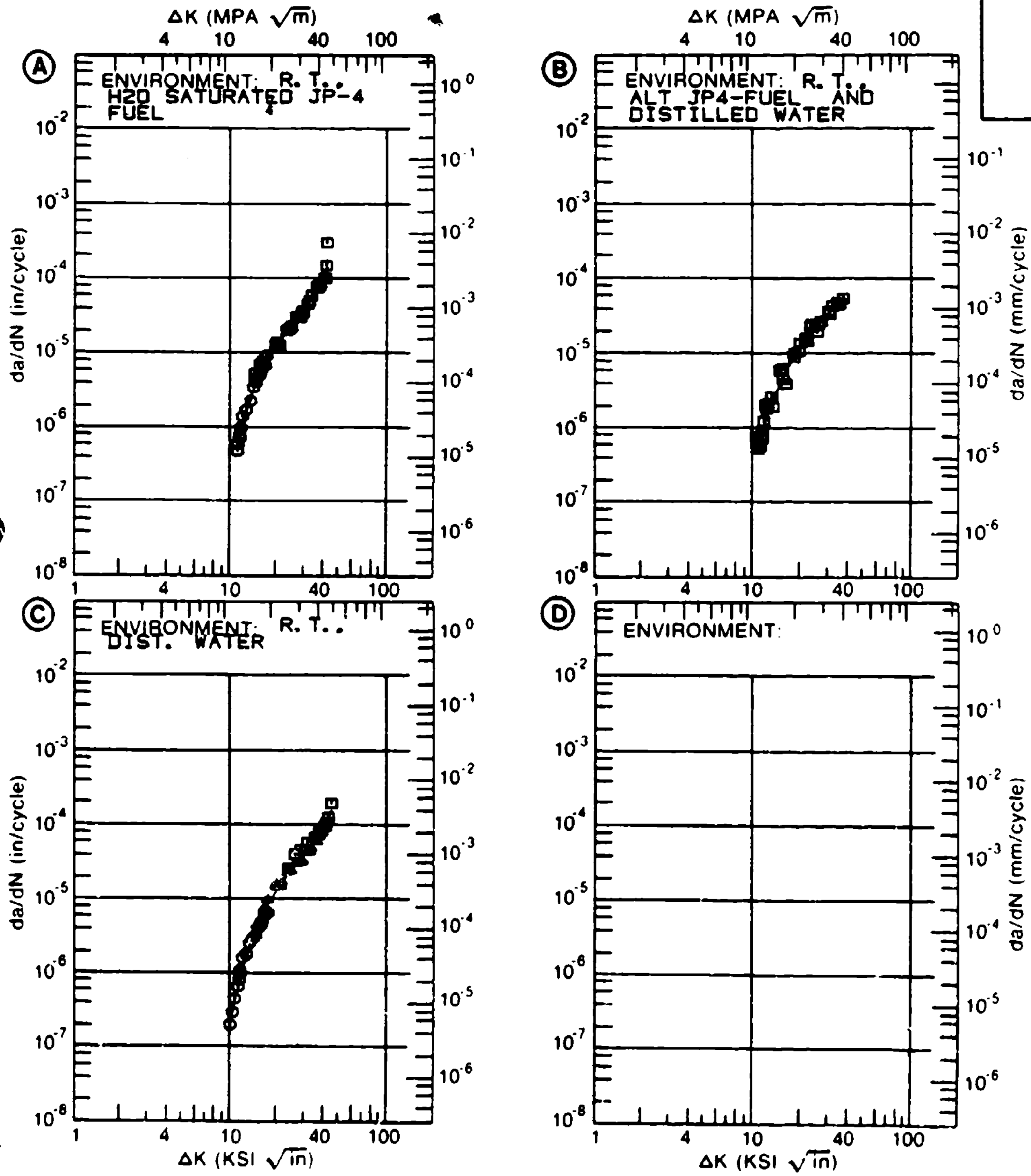

Figure 4.12.3.12

TABLE 4.12.3.13

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 4.12.3.13INDICATING EFFECT
OF ENVIRONMENT

MATERIAL: TITANIUM TI-6AL-4V (ELI)
CONDITION: BA

DELTA K (KSI*IN**1/2)		DA/DN (10**-6 IN./CYCLE) A E= R.T. 3.5% NACL	B E= R.T. S.T.W.	C	D
DELTA K MIN A:	10.16	.980			
DELTA K MIN B:	9.76		.991		
DELTA K MIN C:					
DELTA K MIN D:					
	10.00		1.13		
	13.00	2.61	3.77		
	16.00	9.36	9.26		
	20.00	31.3	28.2		
	25.00	69.0	62.3		
	30.00	115.	86.9		
	35.00	184.	120.		
	40.00	308.	196.		
DELTA K MAX A:	40.69	333.			
DELTA K MAX B:	42.18		258.		
DELTA K MAX C:					
DELTA K MAX D:					
ROOT MEAN SQUARE PERCENT ERROR		18.54	15.96		

LIFE PREDICTION RATIO SUMMARY (NP/NA)	
0.0-0.5	
0.5-0.8	
0.8-1.25	
1.25-2.0	
>2.0	

CONDITION/HT: BA
FORM: 1.00"TH PLATE
SPECIMEN TYPE: DCB
ORIENTATION: T-L
STRESS RATIO: +0.50
FREQUENCY: 1.00 HZ

YIELD STRENGTH:
ULT. STRENGTH:
SPECIMEN THK:
SPECIMEN WIDTH:
REFERENCES: 88140

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TI-6AL-4V (ELI)

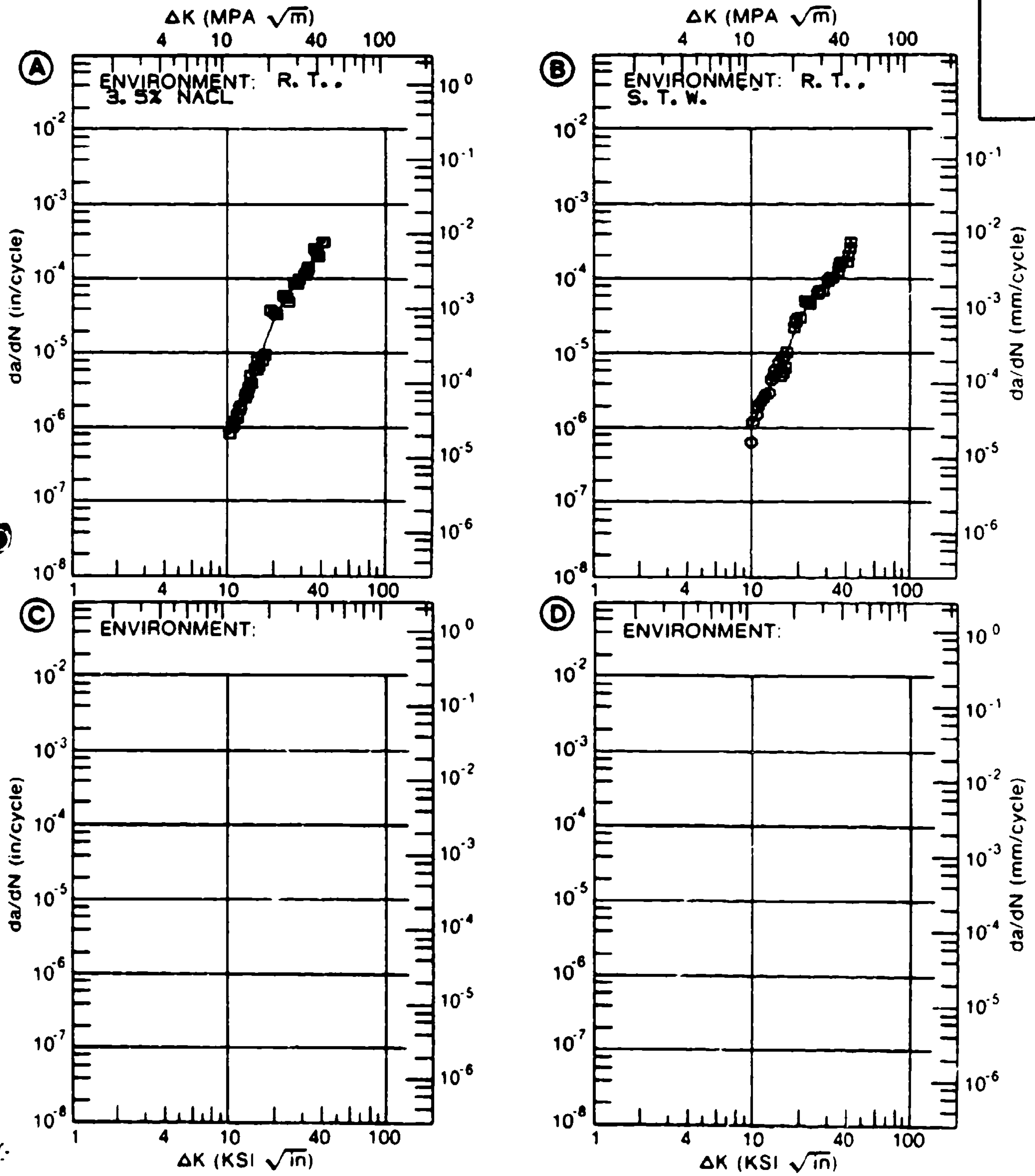

Figure 4.12.3.13

TABLE 4.12.3.14

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 4.12.3.14 INDICATING EFFECT

OF ENVIRONMENT

MATERIAL: TITANIUM TI-6AL-4V (ELI)
CONDITION: BA

DELTA K (KSI*IN**1/2)		DA/DN (10**-6 IN./CYCLE) A E= R.T. DRY AIR	B	C	D
DELTA K MIN A:	10.10	.424			
DELTA K MIN B:					
DELTA K MIN C:					
DELTA K MIN D:					
	13.00	2.46			
	16.00	6.34			
	20.00	12.8			
	25.00	22.4			
	30.00	36.2			
	35.00	60.4			
	40.00	107.			
DELTA K MAX A:	40.48	113.			
DELTA K MAX B:					
DELTA K MAX C:					
DELTA K MAX D:					
ROOT MEAN SQUARE PERCENT ERROR		20.59			

LIFE PREDICTION RATIO SUMMARY (NP/NA)	
	0.0-0.5
	0.5-0.8
	0.8-1.25
	1.25-2.0
	>2.0

CONDITION/HT: BA
FORM: 1.00"TH PLATE
SPECIMEN TYPE: DCB
ORIENTATION: T-L
STRESS RATIO: +0.50
FREQUENCY: 0.10- 1.00 HZ

YIELD STRENGTH:
ULT. STRENGTH:
SPECIMEN THK:
SPECIMEN WIDTH:
REFERENCES:88140

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TI-6AL-4V (ELI)

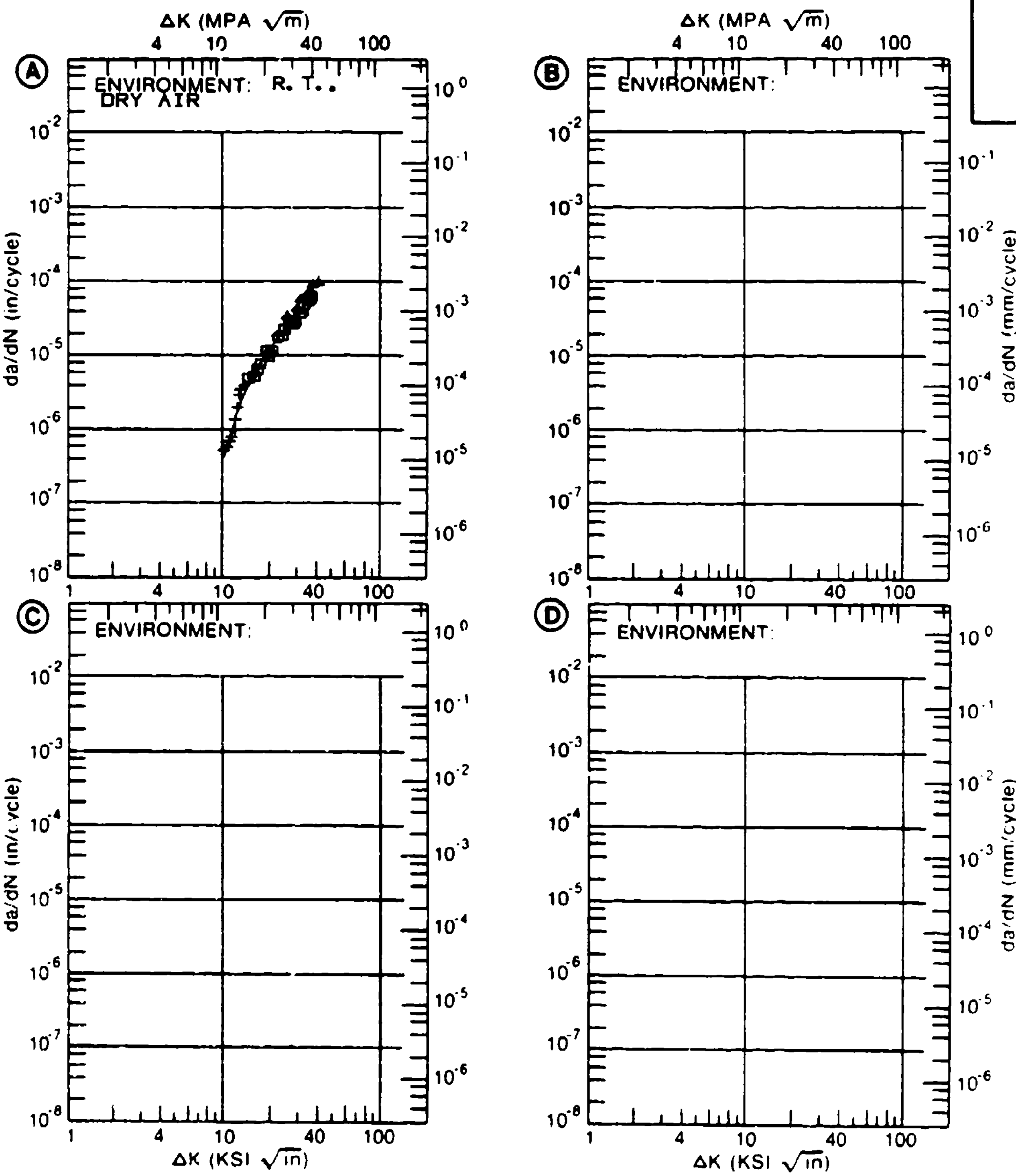

Figure 4.12.3.14

TABLE 4.12.3.15

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 4.12.3.15 INDICATING EFFECT OF ENVIRONMENT

MATERIAL: TITANIUM TI-6AL-4V (ELI)
CONDITION: BA

DELTA K (KSI*IN**1/2)		DA/DN (10**-6 IN./CYCLE) A	B	C	D
		E= R.T. H2O SATURATED JP-4 FUEL	E= R.T. 3.5% NACL	E= R.T. S.T.W.	
DELTA K MIN A:	14.08	3.65			
DELTA K MIN B:	15.54		5.62		
DELTA K MIN C:	15.38			4.56	
DELTA K MIN D:					
	16.00	6.63	6.80	5.42	
	20.00	13.9	15.0	12.7	
	25.00	25.0	37.8	27.2	
	30.00	42.8	178.	54.1	
	35.00	78.6	264.	110.	
	40.00			233.	
DELTA K MAX A:	37.10	105.			
DELTA K MAX B:	35.28		264.		
DELTA K MAX C:	42.70			357.	
DELTA K MAX D:					
ROOT MEAN SQUARE PERCENT ERROR		7.84	21.27	9.49	

LIFE PREDICTION RATIO SUMMARY (NP/NA)	
	0.0-0.5
	0.5-0.8
	0.8-1.25
	1.25-2.0
	>2.0

CONDITION/HT: BA
FORM: 1.00"TH PLATE
SPECIMEN TYPE: DCB
ORIENTATION: T-L
STRESS RATIO: +0.50
FREQUENCY: 0.10 HZ

YIELD STRENGTH:
ULT. STRENGTH:
SPECIMEN THK:
SPECIMEN WIDTH:
REFERENCES: 88140

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TI-6AL-4V (ELI)

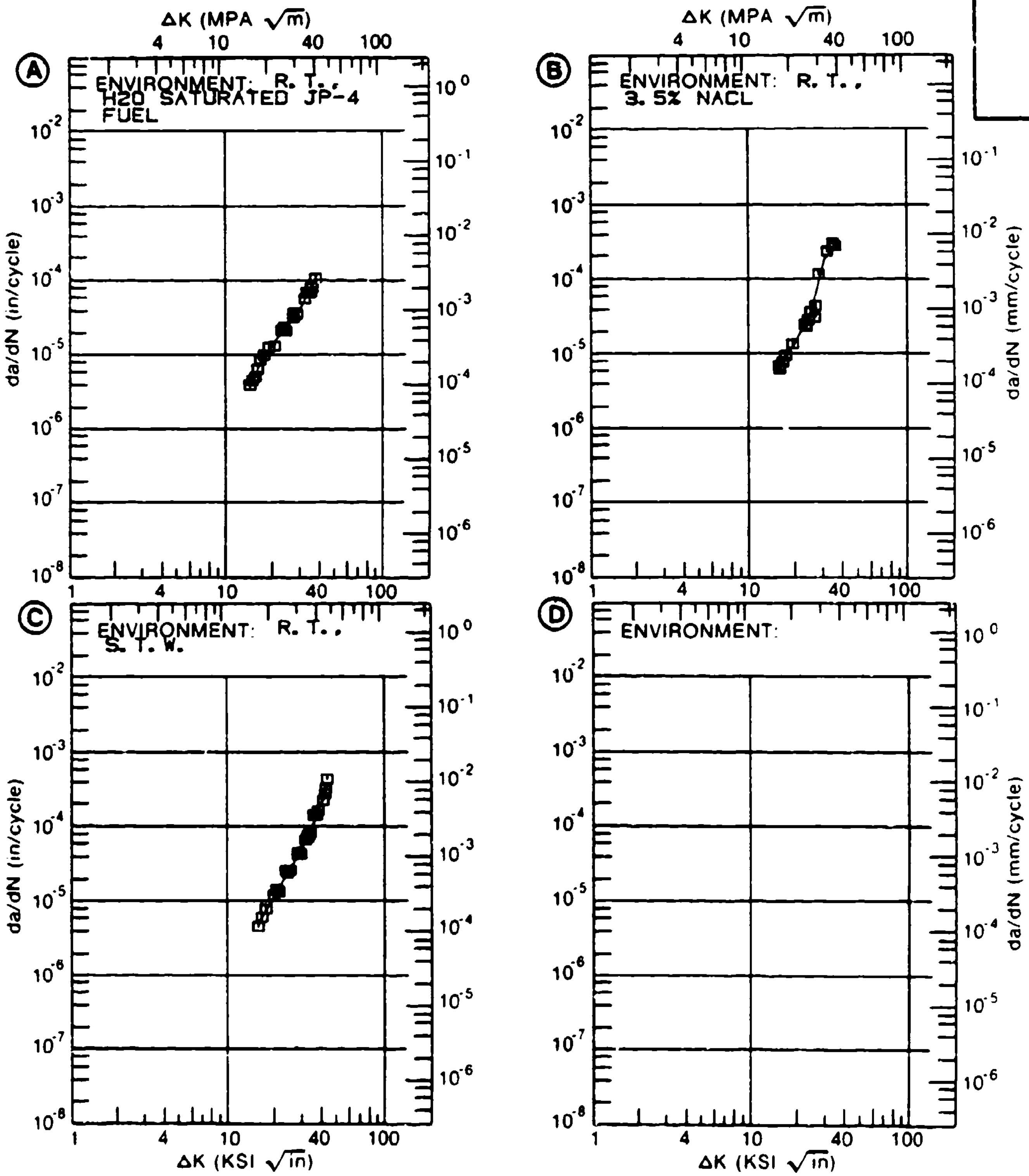

Figure 4.12.3.15

TABLE 4.12.3.16

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 4.12.3.16INDICATING EFFECT

OF ENVIRONMENT

MATERIAL: TITANIUM TI-6AL-4V (ELI)
CONDITION: RA

DELTA K (KSI*IN**1/2)			DA/DN (10**-6 IN./CYCLE) A E= R.T. LAB AIR 10HZ	B E= R.T. SIM. SEA WATER 1-10HZ	C	D
DELTA K MIN	A:	12.94	.519			
	B:	10.88		3.44		
	C:					
	D:					
		13.00	.565	3.90		
		16.00	4.94	7.39		
		20.00	10.8	15.0		
		25.00	19.4	32.1		
		30.00	30.8	64.3		
		35.00	50.6	121.		
		40.00	91.5	204.		
		50.00		393.		
DELTA K MAX	A:	47.16	202.			
	B:	50.76		404.		
	C:					
	D:					
ROOT MEAN SQUARE PERCENT ERROR			33.80	20.45		
LIFE PREDICTION RATIO SUMMARY (NP/NA)		0.0-0.5				
		0.5-0.8	1			
		0.8-1.25		2		
		1.25-2.0	1			
		>2.0				

CONDITION/HT: RA
FORM: 3.00"TH PLATE
SPECIMEN TYPE: CT
ORIENTATION: L-T
STRESS RATIO: +0.10
FREQUENCY:

YIELD STRENGTH: 119.4 KSI
ULT. STRENGTH: 127.8 KSI
SPECIMEN THK: 1.003- 1.040"
SPECIMEN WIDTH: 7.400"
REFERENCES: NC002

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TI-6AL-4V (ELI)

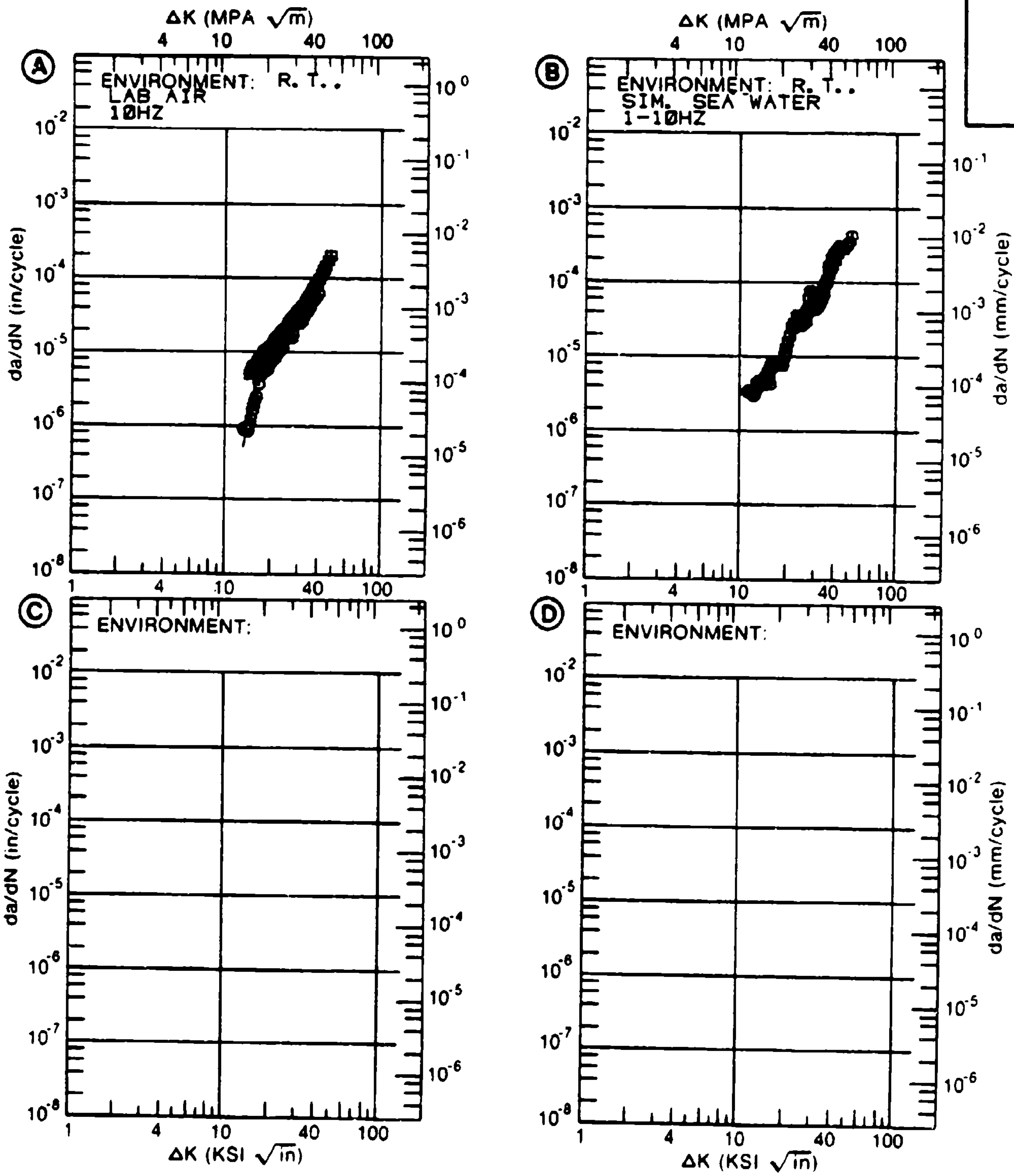

Figure 4.12.3.16

TABLE 4.12.3.17

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 4.12.3.17INDICATING EFFECT

OF ENVIRONMENT

MATERIAL: TITANIUM TI-6AL-4V (ELI)
CONDITION: RA

DELTA K (KSI*IN**1/2)		DA/DN (10**-6 IN./CYCLE) A	B	C	D
		E= R.T. LAB AIR	E= R.T. SIM. SEA WATER		
DELTA K MIN A:	12.57	1.50			
DELTA K MIN B:	13.17		2.76		
DELTA K MIN C:					
DELTA K MIN D:					
	13.00	1.71			
	16.00	3.68	3.88		
	20.00	7.75	7.96		
	25.00	16.0	20.1		
	30.00	29.4	45.1		
	35.00	51.4	87.4		
	40.00	87.2	146.		
	50.00	240.			
	60.00	638.			
DELTA K MAX A:	67.29	1287.			
DELTA K MAX B:	45.43		221.		
DELTA K MAX C:					
DELTA K MAX D:					
ROOT MEAN SQUARE PERCENT ERROR		16.76	30.38		
LIFE PREDICTION RATIO SUMMARY (NP/NA)	0.0-0.5				
	0.5-0.8	1	1		
	0.8-1.25	2	1		
	1.25-2.0				
	>2.0				

CONDITION/HT: RA	
FORM: 3.00"TH PLATE	YIELD STRENGTH: 122.0 KSI
SPECIMEN TYPE: CT	ULT. STRENGTH: 130.2 KSI
ORIENTATION: T-L	SPECIMEN THK: 0.923- 1.010"
STRESS RATIO: +0.10	SPECIMEN WIDTH: 7.400"
FREQUENCY: 1.00- 10.00 HZ	REFERENCES:NC002

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TI-6AL-4V (ELI)

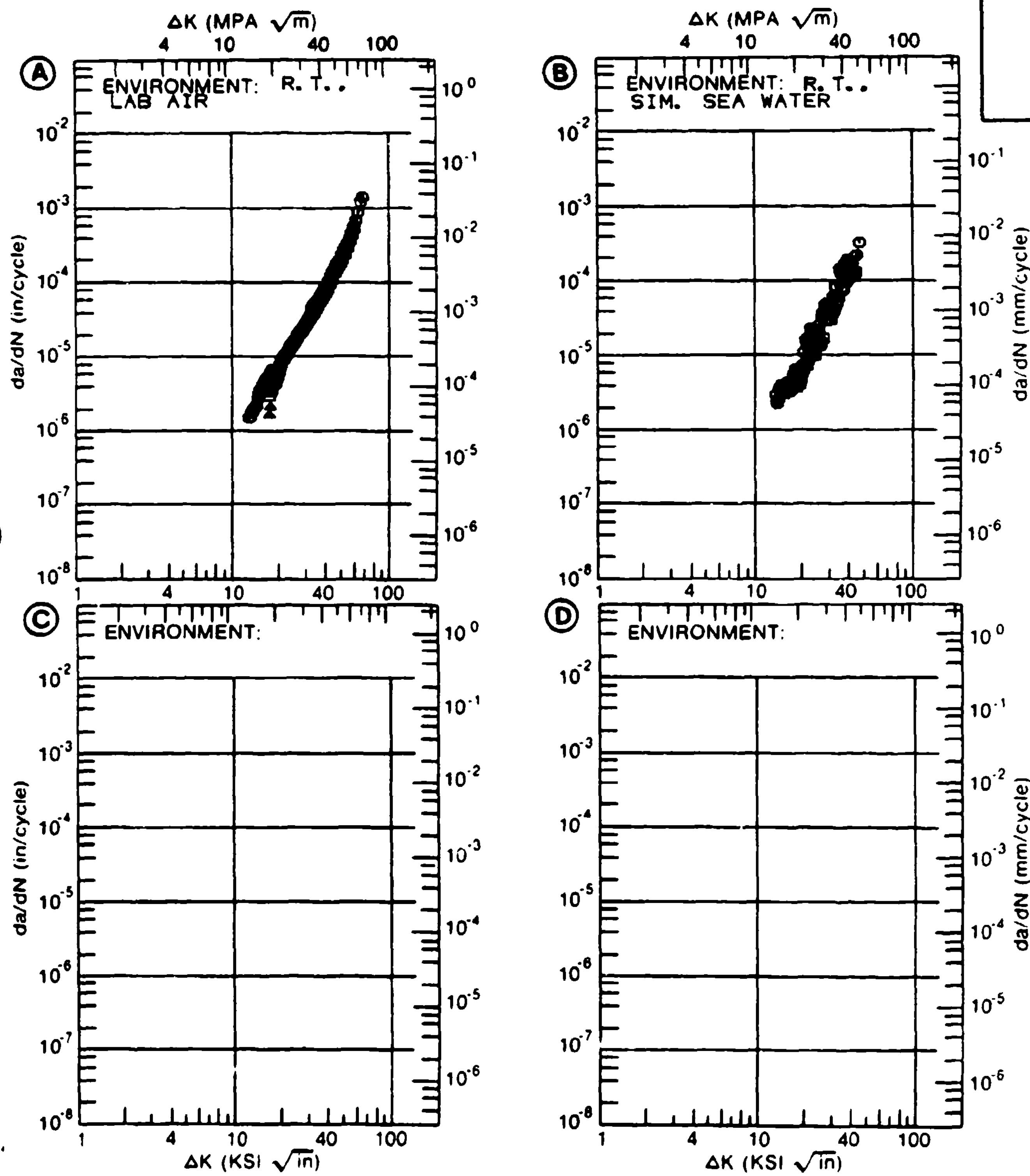

Figure 4.12.3.17

TABLE 4.12.3.18

TITANIUM TI-6AL-4V(ELI) K(ISCC)

CONDITION	--PRODUCT-- FORM	--PRODUCT-- THICK (IN)	TEST TEMP (F)	SPEC OR	YIELD STR (KSI)	ENVIRONMENT	------SPECIMEN-------- WIDTH (IN) W	THICK (IN) B	DESIGN (*=SG)	CRACK LENGTH (IN) A	K(Q) (KSI*SQRT IN)	K(ISCC) (KSI*SQRT IN)	MEAN	STAN DEV	TEST TIME (MIN)	DATE	REFER
1000F 1HR HELIUM COOL	P	1.00	R.T	T-S	115.2	3.5 PCT NACL	1.000	0.500	CANT*	----	112.00	84.00*			----	1967	70931

*NOTE--DATA WHICH DO NOT MEET MINIMUM SPECIMEN THICKNESS REQUIREMENTS OF 2.5(KISCC/TYS)SQUARED

TABLE 4.13.1.1

MEAN PLANE STRAIN FRACTURE TOUGHNESS DATA OF
TITANIUM ALLOY TI-6AL-6V-2SN AT ROOM TEMPERATURE

CONDITION/HT — MEAN KIC ± STANDARD DEVIATION (KSI SQRT(IN)) (NUMBER OF SPECIMENS)

PLATE

CONDITION/HT	L-T	T-L	S-L
BETA ANNEAL 1810F 1 HR. ARGON COOL	-----	54.3 ± 2.0 (3)	-----
BETA ANNEAL & STOA-1800F 0.5HR.AC.1575F 0.5HR.WQ.1050F 8 HR.AC	50.1 ± 1.8 (2)	-----	-----
DUPLEX ANNEAL	-----	65.1 ± 2.0 (3)	-----
MILL ANNEALED	-----	35.0 ± 5.2 (4)	-----
STA-1675F 0.25 HR.WQ. '100F 4 HR	-----	34.1 ± 3.8 (3)	-----
STOA-1700F 1 HR.WQ.1400F 1 HR.AC	42.9 ± 1.2 (3)	46.1 ± 3.1 (4)	-----

FORGING

CONDITION/HT	L-T	T-L	S-L
MILL ANNEALED	38.6 ± 2.7 (3)	-----	-----
STA-1600F 0.5HR.WQ.1000F 6 HR.AC	30.8 ± 0.7 (3)	-----	-----

TABLE 4.13.1.1 (Con't)

MEAN PLANE STRAIN FRACTURE TOUGHNESS DATA OF
TITANIUM ALLOY TI-6AL-6V-2SN AT ROOM TEMPERATURE

CONDITION/HT	MEAN KIC ± STANDARD (KSI SQRT(IN)) DEVIATION	(NUMBER OF SPECIMENS)	
	BILLET		
CONDITION/HT	L-T	T-L	S-L
MILL ANNEALED	52.3 ± 6.4 (4)	-----	-----
MILL ANNEALED 1000F 2 HR. AC	57.1 ± 2.2 (2)	-----	-----
STOA-1700F 1 HR. WQ. 1400F 1 HR. AC	62.8 ± 6.9 (4)	57.0 ± 3.7 (4)	-----

TABLE 4.13.1.2

FATIGUE CRACK GROWTH RATE AT DEFINED LEVELS OF THE STRESS-INTENSITY FACTOR

TITANIUM TI-6AL-6V-2SN

TEST CONDITIONS

SPECIMEN ORIENTATION L-S

ENVIRONMENT H H A AT R T

CONDITION/HT	PRODUCT FORM	STRESS RATIO	FREQ (HZ)	DELTA K LEVELS (KSI SQRT(IN))	FATIGUE CRACK GROWTH RATES (MICRO IN/CYCLE) 2 5	5	10	20	50	100
STOA	PLATE	0 10	0. 10				1 73	10. 2		
STOA	PLATE	0 10	10. 00				2 58	9 03		

TABLE 4.13.1.3

FATIGUE CRACK GROWTH RATE AT DEFINED LEVELS OF THE STRESS-INTENSITY FACTOR

TITANIUM TI-6AL-6V-2SN

TEST CONDITIONS

SPECIMEN ORIENTATION L-T

ENVIRONMENT H H A AT R T

CONDITION/HT	PRODUCT FORM	STRESS RATIO	FREQ (HZ)	DELTA K LEVELS (KSI SQRT(IN))	FATIGUE CRACK GROWTH RATES (MICRO IN/CYCLE)					
					2 5	5	10	20	50	100
STOA	PLATE	0 10	1 00				1 64	15 1	396	
STOA	PLATE	0 10	20 00			0 11	1 76	13 4		

TABLE 4.13.1.4

FATIGUE CRACK GROWTH RATE AT DEFINED LEVELS OF THE STRESS-INTENSITY FACTOR

TITANIUM TI-6AL-6V-2SN

TEST CONDITIONS

SPECIMEN ORIENTATION L-T

ENVIRONMENT. 3.5% NACL AT R.T.

CONDITION/HT	PRODUCT FORM	STRESS RATIO	FREQ. (HZ)	DELTA K LEVELS: (KSI SQRT(IN))	FATIGUE CRACK GROWTH RATES (MICRO IN/CYCLE)					
					2.5	5	10	20	50	100
STOA	PLATE	0.10	1.00				2.35	38.4	2560	
STOA	PLATE	0.10	20.00			0.23	3.13	19.3		

TABLE 4.13.1.5

FATIGUE CRACK GROWTH RATE AT DEFINED LEVELS OF THE STRESS-INTENSITY FACTOR

TITANIUM TI-6AL-6V-2SN

TEST CONDITIONS

SPECIMEN ORIENTATION T-S

ENVIRONMENT H.H.A. AT R.T.

CONDITION/HT	PRODUCT FORM	STRESS RATIO	FREQ. (HZ)	DELTA K LEVELS: (KSI SQRT(IN))	FATIGUE CRACK GROWTH RATES (MICRO IN/CYCLE) 2.5	5	10	20	50	100
STOA	PLATE	0.10	0.10				1.15	41.6		
STOA	PLATE	0.50	0.10				2.67	63.9		

TABLE 4.13.1.6

FATIGUE CRACK GROWTH RATE AT DEFINED LEVELS OF THE STRESS-INTENSITY FACTOR

TITANIUM TI-6AL-6V-2SN

TEST CONDITIONS

SPECIMEN ORIENTATION: T-S

ENVIRONMENT: 3.5% NACL AT R.T

CONDITION/HT	PRODUCT FORM	STRESS RATIO	FREQ. (HZ)	DELTA K LEVELS: (KSI SQRT(IN))	2.5	5	10	20	50	100
					FATIGUE CRACK GROWTH RATES (MICRO IN/CYCLE)					
BA	PLATE	0.10	0.10-10.00				1.51			
STOA	PLATE	0.10	1.00				1.49	92.1		

TABLE 4.13.1.7

FATIGUE CRACK GROWTH RATE AT DEFINED LEVELS OF THE STRESS-INTENSITY FACTOR

TITANIUM TI-6AL-6V-2SN

TEST CONDITIONS

SPECIMEN ORIENTATION T-L

ENVIRONMENT HUMID AIR AT R. T

CONDITION/HT	PRODUCT FORM	STRESS RATIO	FREQ (HZ)	DELTA K LEVELS: (KSI SQRT(IN))	FATIGUE CRACK GROWTH RATES (MICRO IN/CYCLE)					
					2 5	5	10	20	50	100
STOA	PLATE	0 10	10 00				2 16	12 4		
STOA	PLATE	0 10	10 00				0 73	5 98	42 3	
STOA	PLATE	0 50	10 00			0 33	2 38	49 5		

TABLE 4.13.2.1

TITANIUM TI-6AL-6V-2SN K(IC)

CONDITION	--PRODUCT-- FORM	THICK (IN)	TEST TEMP (F)	SPECIMEN ORIENT	YIELD STRENGTH (KSI)	------SPECIMEN------ WIDTH (IN) W	THICK (IN) B	DESIGN	CRACK LENGTH (IN) A	2.5*(K(IC)/TYS)**2 (IN)	K(IC) (KSI*SQRT IN)	K(IC) MEAN	STAN DEV	DATE	REFER
ANNEAL-COARSE	F	1.00	R.T.	--	143.0	2.000	1.000	CT	1.000	0.70	75.60			1974	88962
GRAIN-1350F		1.00			143.0	2.000	1.000	CT	1.000	0.52	65.00			1974	88962
2 HR.AC		1.00			143.0	2.000	1.000	CT	1.000	0.48	62.80			1974	88962
		1.00			143.0	2.000	1.000	CT	1.000	0.52	65.00			1974	88962
		1.00			143.0	2.000	1.000	CT	1.000	0.65	73.20			1974	88962
		1.00			143.0	2.000	1.000	CT	1.000	0.76	78.80	70.1/	6.6	1974	88962
ANNEAL-FINE	F	6.00	R.T.	--	148.0	2.000	1.000	CT	1.000	0.34	54.40			1974	88962
GRAIN-1350F		6.00			148.0	2.000	1.000	CT	1.000	0.36	56.60			1974	88962
2 HR.AC		6.00			148.0	2.000	1.000	CT	1.000	0.33	53.80			1974	88962
		6.00			148.0	2.000	1.000	CT	1.000	0.34	54.60			1974	88962
		6.00			148.0	2.000	1.000	CT	1.000	0.29	50.30			1974	88962
		6.00			148.0	2.000	1.000	CT	1.000	0.34	54.40	54.0/	2.1	1974	88962
ANNEALED 10-20	F	2.50	R.T.	--	145.0	2.000	1.000	CT	1.000	0.30	50.40			1974	88962
10-20% PRIMARY		2.50			145.0	2.000	1.000	CT	1.000	0.31	51.30			1974	88962
ALPHA ANNEALED 1350F 2 HR.AC												50.9/	0.6		
ANNEALED 40-50	F	2.50	R.T.	--	149.0	2.000	1.000	CT	1.000	0.26	48.10			1974	88962
40-50% PRIMARY		2.50			149.0	2.000	1.000	CT	1.000	0.28	49.40			1974	88962
ALPHA ANNEALED 1350F 2 HR.AC												48.8/	0.9		
BB.AB FIN-10	F	2.50	R.T.	--	148.0	2.000	1.000	CT	1.000	0.54	68.70			1974	88962
BETA BLOCKED.		2.50			148.0	2.000	1.000	CT	1.000	0.67	76.60			1974	88962
ALPHA-BETA FINISHED.10% REDUCTION. SOLUTION TREATED & OVERAGED.1650F 1 HR.WQ.1300F 2 HR.AC												72.7/	5.6		
BB.AB FIN-10MA	F	2.50	R.T.	---	147.0	2.000	1.000	CT	1.000	0.83	84.70			1974	88962
BETA BLOCKED.		2.50			147.0	2.000	1.000	CT	1.000	0.60	71.80			1974	88962
ALPHA-BETA FINISHED 10% REDUCTION.MILL ANNEALED 1350F 2 HR.AC															

TABLE 4.13.2.1 (Con't)

TITANIUM TI-6AL-6V-2SN K(IC)

CONDITION	--PRODUCT-- FORM	THICK (IN)	TEST TEMP (F)	SPECIMEN ORIENT	YIELD STRENGTH (KSI)	-------SPECIMEN------ WIDTH (IN) W	THICK (IN) B	DESIGN	CRACK LENGTH (IN) A	2.5*(K(IC)/TYS)**2 (IN)	K(IC) (KSI*SQRT IN)	K(IC) MEAN	STAN DEV	DATE	REFER
BB.AB FIN-10MA	F	2.50	R.T.	--	147.0	2.000	1.000	CT	1.000	0.64	74.60			1974	88962
BETA BLOCKED, ALPHA-BETA FINISHED 10% REDUCTION, MILL ANNEALED 1350F 2 HR. AC												77.0/	6.8		
BB.AB FIN-30	F	2.50	R.T.	--	148.0	2.000	1.000	CT	1.000	0.47	64.30			1974	88962
BETA BLOCKED,		2.50			148.0	2.000	1.000	CT	1.000	0.40	59.60			1974	88962
ALPHA-BETA		2.50			148.0	2.000	1.000	CT	1.000	0.42	60.80			1974	88962
FINISHED. 30% REDUCTION, SOLUTION TREATED & OVERAGED. 1650F 1 HR. WQ. 1300F 2 HR. AC												61.6/	2.4		
BB.AB FIN-30MA	F	2.50	R.T.	--	145.0	2.000	1.000	CT	1.000	0.49	64.40			1974	88962
BETA BLOCKED,		2.50			145.0	2.000	1.000	CT	1.000	0.51	65.40			1974	88962
ALPHA-BETA		2.50			145.0	2.000	1.000	CT	1.000	0.49	64.20			1974	88962
FINISHED. 30%REDUCTION, MILL ANNEALED 1350F 2 HR. AC												64.7/	0.6		
BB.B FIN-10	F	2.50	R.T.	--	140.0	2.000	1.000	CT	1.000	0.69	73.60			1974	88962
BETA BLOCKED,		2.50			140.0	2.000	1.000	CT	1.000	0.64	70.70			1974	88962
BETA FINISHED. 10%REDUCTION, SOLUTION TREATED & OVERAGED. 1650F 1 HR. WQ. 1300F 2 HR. AC												72.2/	2.1		
BB.B FIN-10MA	F	2.50	R.T.	--	136.0	2.000	1.000	CT	1.000	0.69	71.70			1974	88962
BETA BLOCKED,		2.50			136.0	2.000	1.000	CT	1.000	0.66	69.70			1974	88962
BETA FINISHED.		2.50			136.0	2.000	1.000	CT	1.000	0.66	70.20			1974	88962
10% REDUCTION, MILL ANNEALED 1350F 2 HR. AC												70.5/	1.0		
BETA ANNEAL	P	1.00	R.T.	T-L	138.4	2.550	1.000	WOL	----	0.73	74.60			1977	JEM01
BETA ANNEAL	P	0.50	R.T.	T-L	139.8	1.000	0.447	CT	0.568	0.36	53.20			1971	83222
1810F 1 HR.		0.50			139.8	1.000	0.447	CT	0.513	0.41	56.60			1971	83222
ARGON COOL		0.50			139.8	1.000	0.446	CT	0.558	0.36	53.00	54.3/	2.0	1971	83222

TABLE 4.13.2.1 (Con't)

TITANIUM TI 6AL-6V-2SN K(IC)

CONDITION	--PRODUCT-- FORM	THICK (IN)	TEST TEMP (F)	SPECIMEN ORIENT	YIELD STRENGTH (KSI)	--SPECIMEN-- WIDTH (IN) W	THICK (IN) B	DESIGN	CRACK LENGTH (IN) A	2.5*(K(IC)/TYS)**2 (IN)	K(IC) (KSI*SQRT IN)	K(IC) MEAN	STAN DEV	DATE	REFER
BETA ANNEAL &	P	0.62	R.T.	L-T	156.0	2.000	0.626	CT	1.000	0.27	51.30			1974	88186
STOA-1800F		0.62			156.0	2.000	0.626	CT	1.000	0.24	48.80			1974	88186
0.5HR.AC.1575F 0.5HR.WQ.1050F 8 HR.AC												50.1/	1.8		
BF.AB FOR-ANN	F	2.50	R.T.	---	138.0	2.000	1.000	CT	1.000	0.73	74.50			1974	88962
BETA FLECTED.		2.50			138.0	2.000	1.000	CT	1.000	0.82	79.30			1974	88962
ALPHA-BETA		2.50			138.0	2.000	1.000	CT	1.000	0.68	72.10			1974	88962
FORGED.ANNEALED.1350F 2 HR.AC												75.3/	3.7		
BF.B FOR-ANN	F	2.50	R.T.	--	136.0	2.000	1.000	CT	1.000	0.74	73.90			1974	88962
BETA FLECTED.		2.50			136.0	2.000	1.000	CT	1.000	0.74	73.80			1974	88962
BETA FORGED.		2.50			136.0	2.000	1.000	CT	1.000	0.75	74.70			1974	88962
ANNEALED 1350F 2 HR.AC												74.1/	0.5		
BF.LAB FOR-ANN	F	2.50	R.T.	--	141.0	2.000	1.000	CT	1.000	0.42	58.10			1974	88962
BETA FLECTED.		2.50			141.0	2.000	1.000	CT	1.000	0.38	55.20			1974	88962
LOW ALPHA-BETA		2.50			141.0	2.000	1.000	CT	1.000	0.39	55.70			1974	88962
FORGED(1500F).ANNEALED.1350F 2 HR.AC												56.3/	1.6		
DUPLEX ANNEAL	P	0.50	R.T.	T-L	150.5	2.000	0.500	CT	0.988	0.46	64.50			1971	83222 (1)
		0.50			150.5	2.000	0.500	CT	1.078	0.44	63.50			1971	83222 (1)
		0.50			150.5	2.000	0.495	CT	1.056	0.50	67.40			1971	83222 (1)
												65.1/	2.0		
MILL ANNEALED	P	2.00	R.T.	--	157.0	2.500	1.250	CT	1.250	0.18	42.30			1973	90584 (2)
		2.00			157.0	2.500	1.250	CT	1.250	0.18	42.30			1973	90584 (2)
												42.3/	0.0		
MILL ANNEALED	P	1.00	R.T.	T-L	151.3	2.550	1.000	WOL	----	0.20	42.80			1977	JEM01
		0.50			163.3	1.000	0.495	CT	0.522	0.09	32.00			1971	83222
		0.50			163.3	1.000	0.494	CT	0.537	0.09	32.10			1971	83222

NOTES
(1) 1700F 1 HR. ARGON COOL.1400F 1 HR.ARGON COOL
(2) COMPOSITION(WT PERCENT) 5.6AL.5.4V.2.0SN.0.026C.0.57FE.0.014N.0.084H.0.180.0.50CU

TABLE 4.13.2.1 (Con't)

TITANIUM TI-6AL-6V-2SN K(IC)

CONDITION	PRODUCT FORM	PRODUCT THICK (IN)	TEST TEMP (F)	SPECIMEN ORIENT	YIELD STRENGTH (KSI)	SPECIMEN WIDTH (IN) W	SPECIMEN THICK (IN) B	SPECIMEN DESIGN	CRACK LENGTH (IN) A	2.5*(K(IC)/TYS)**2 (IN)	K(IC) (KSI*SQRT IN)	K(IC) MEAN	STAN DEV	DATE	REFER
MILL ANNEALED	P	0.50	R.T.	T-L	163.3	1.000	0.495	CT	0.517	0.10	33.20	35.0/	5.2	1971	83222
MILL ANNEALED	F	----	R.T.	—	144.0	2.500	1.250	CT	1.250	0.37	55.70			1973	90584
		----			144.0	2.500	1.250	CT	1.250	0.37	55.60	55.7/	0.1	1973	90584
MILL ANNEALED	F	3.80	-65	L-T	169.0	2.502	1.007	CT	1.312	0.19	47.70			1973	90589
		3.80			169.0	2.498	1.008	CT	1.299	0.19	47.20			1973	90589
		3.80			169.0	2.503	1.003	CT	1.297	0.12	37.60	44.2/	5.7	1973	90589
MILL ANNEALED	F	3.80	R.T.	L-T	149.0	2.499	0.999	CT	1.299	0.43	61.70			1973	90589
		3.80			149.0	2.501	1.006	CT	1.300	0.36	56.90			1973	90589
		3.80			149.0	2.495	0.995	CT	1.301	0.37	57.30	58.6/	2.7	1973	90589
MILL ANNEALED	FB	1.50	R.T.	—	153.0	2.500	1.250	CT	1.250	0.20	43.10			1973	90584
MILL ANNEALED	BT	2.20	R.T.	L-T	144.0	2.500	1.251	CT	1.332	0.37	55.60			1971	84360
		2.20			144.0	2.507	1.243	CT	1.262	0.42	58.90			1971	84360
		2.20			146.0	2.500	1.245	CT	1.216	0.30	50.40			1971	84360
		2.20			146.0	2.495	1.253	CT	1.297	0.23	44.30	52.3/	6.4	1971	84360
MILL ANNEALED 1000F 2 HR, AC	BT	2.20	R.T.	L-T	155.0	2.495	1.255	CT	1.295	0.32	55.50			1971	84360
		2.20			155.0	2.500	1.254	CT	1.254	0.36	58.60	57.1/	2.2	1971	84360
RECRYSTALLIZE ANNEAL	P	1.00	R.T.	T-L	150.0	2.550	1.000	WOL	----	0.45	63.70			1977	JEM01
STA-1600F 0.5HR, WQ, 1000F 6 HR, AC	F	3.80	-65	L-T	209.0	2.494	1.010	CT	1.326	0.05	20.70			1973	90589
		3.80			209.0	2.499	1.005	CT	1.267	0.05	28.80			1973	90589
		3.80			209.0	2.496	1.007	CT	1.283	0.04	27.80	28.4/	0.6	1973	90589
STA-1600F 0.5HR, WQ, 1000F 6 HR, AC	F	3.80	R.T.	L-T	184.0	2.498	1.005	CT	1.290	0.07	31.60			1973	90589
		3.80			184.0	2.502	1.006	CT	1.296	0.07	30.20			1973	90589
		3.80			184.0	2.501	1.007	CT	1.278	0.07	30.60	30.8/	0.7	1973	90589
STA-1600F 0.5HR, WQ, 1000F 6 HR, AC	F	3.80	300	L-T	165.0	2.501	1.001	CT	1.292	0.28	55.50			1973	90589

TABLE 4.13.2.1 (Con't)

TITANIUM TI-6AL-6V-2SN K(IC)

CONDITION	--PRODUCT-- FORM	THICK (IN)	TEST TEMP (F)	SPECIMEN ORIENT	YIELD STRENGTH (KSI)	------SPECIMEN----- WIDTH (IN) W	THICK (IN) B	DESIGN	CRACK LENGTH (IN) A	2.5*(K(IC)/TYS)**2 (IN)	K(IC) (KSI*SQRT IN)	K(IC) MEAN	STAN DEV	DATE	REFER
STA-1600F	F	3.00	300	L-T	165.0	2.497	1.015	CT	1.278	0.27	54.20			1973	90589
0.5HR. WQ. 1000F		3.00			165.0	2.499	1.009	CT	1.272	0.22	49.40			1973	90589
6 HR. AC												53.0/	3.2		
STA-1650F	F	----	R.T.	L-C	188.0	0.998	0.500	CT	0.508	0.04	24.60			1972	86494 (1)
0.5HR. WQ. 1050F		----			188.0	0.994	0.500	CT	0.507	0.04	24.90			1972	86494 (1)
24 HR. AC		----			188.0	0.997	0.498	CT	0.532	0.05	25.50			1972	86494 (1)
		----			188.0	1.000	0.499	CT	0.556	0.05	25.60			1972	86494 (1)
												25.1/	0.6		
STA-1650F	F	----	R.T.	C-L	188.0	1.005	0.500	CT	0.517	0.06	29.10			1972	86494 (1)
0.5HR. WQ. 1050F		----			188.0	1.001	0.500	CT	0.523	0.05	25.60			1972	86494 (1)
24 HR. AC		----			188.0	1.001	0.500	CT	0.505	0.05	25.30			1972	86494 (1)
												26.7/	2.1		
STA-1675F	P	1.25	R.T.	T-L	173.3	2.000	0.499	CT	1.080	0.11	37.00			1971	83222
0.25 HR. WQ.		1.25			173.3	2.000	0.499	CT	1.138	0.07	29.80			1971	83222
1100F 4 HR		1.25			173.3	2.000	0.499	CT	1.046	0.10	35.50	34.1/	3.8	1971	83222
STOA-1600F	E	3.00	R.T.	C-R	143.0	1.476	0.750	CT	0.779	0.36	54.20			1973	87230 (2)
1 .5HR. WQ. 1250F		3.00			143.0	1.480	0.750	CT	0.808	0.33	52.00			1973	87230 (2)
6 HR. AC		3.00			143.0	1.479	0.749	CT	0.783	0.36	54.50			1973	87230 (2)
												53.6/	1.4		
STOA-1650F	F	2.50	R.T.	--	154.0	2.000	1.000	CT	1.000	0.18	41.60			1974	88962
1 HR. WQ. 1300F		2.50			154.0	2.000	1.000	CT	1.000	0.17	40.40			1974	88962
2 HR. AC												41.0/	0.8		
STOA-1700F	P	0.38	R.T.	L-T	156.0	1.000	0.375	CT	----	0.20	44.30			1974	90981
1 HR. WQ. 1400F		0.38			156.0	1.000	0.375	CT	----	0.18	41.90			1974	90981
1 HR. AC		0.38			156.0	1.000	0.375	CT	----	0.18	42.50	42.9/	1.2	1974	90981

NOTES
(1) ISOTHERMAL FORGING FOR AIRCRAFT NOSE WHEEL
(2) ALPHA PRECIPITATE IN BETA MATRIX
STRAIGHTNESS OF CRACK FRONT MAY NOT MEET ASTM E399-72 REQUIREMENTS

TABLE 4.13.2.1 (Con't)

TITANIUM   TI-6AL-6V-2SN   K(IC)

CONDITION	PRODUCT FORM	PRODUCT THICK (IN)	TEST TEMP (F)	SPECIMEN ORIENT	YIELD STRENGTH (KSI)	SPECIMEN WIDTH (IN) W	SPECIMEN THICK (IN) B	SPECIMEN DESIGN	CRACK LENGTH (IN) A	2.5*(K(IC)/TYS)**2 (IN)	K(IC) (KSI*SQRT IN)	K(IC) MEAN	STAN DEV	DATE	REFER
STOA-1700F	P	0.38	R.T.	T-L	160.0	1.000	0.375	CT	----	0.19	44.00			1974	90981
1 HR.WQ.1400F		0.38			160.0	1.000	0.375	CT	----	0.23	48.30			1974	90981
1 HR.AC		0.38			160.0	1.000	0.375	CT	----	0.18	42.90			1974	90981
		0.38			160.0	1.000	0.375	CT	----	0.24	49.10	46.1/	3.1	1974	90981
STOA-1700F	BT	12.00	R.T.	L-T	147.0	2.000	1.020	NB	----	0.33	53.60			1974	90981
1 HR.WQ.1400F		12.00			147.0	2.000	1.020	NB	----	0.57	70.40			1974	90981
1 HR.AC		12.00			148.0	2.000	1.020	NB	----	0.46	63.70			1974	90981
		12.00			148.0	2.000	1.020	NB	----	0.46	63.40	62.8/	6.9	1974	90981
STOA-1700F	BT	12.00	R.T.	T-L	144.0	2.000	1.020	NB	----	0.42	58.80			1974	90981
1 HR.WQ.1400F		12.00			144.0	2.000	1.020	NB	----	0.40	58.00			1974	90981
1 HR.AC		12.00			145.0	2.000	1.020	NB	----	0.32	51.50			1974	90981
		12.00			145.0	2.000	1.020	NB	----	0.42	59.60	57.0/	3.7	1974	90981
1650F 1 HR.WQ.	F	4.50	-320	L-C	270.0	0.501	0.250	NB	0.122	0.02	22.60			1965	84316
1050F 1 HR.AC		4.50			270.0	0.998	0.501	NB	0.193	0.02	24.50	23.6/	1.3	1965	84316
1650F 1 HR.WQ.	F	4.50	R.T.	L-C	184.0	0.998	0.501	NB	0.191	0.06	27.80			1965	84316
1050F 1 HR.AC		4.50			184.0	0.998	0.501	NB	0.301	0.07	31.40			1965	84316
		4.50			184.0	0.501	0.251	NB	0.177	0.07	30.40			1965	84316
		4.50			184.0	0.990	0.502	NB	0.274	0.08	32.40			1965	84316
		4.50			184.0	0.501	0.250	NB	0.139	0.09	34.30			1965	84316
		4.50			184.0	0.501	0.250	NB	0.132	0.07	30.90	31.2/	2.2	1965	84316
1675F 2 HR.AC	P	2.00	R.T.	--	150.0	2.500	1.250	CT	1.250	0.34	55.00			1973	90584 (1)
1600F 1 HR.FC		2.00			150.0	2.500	1.250	CT	1.250	0.30	52.50			1973	90584 (1)
												53.8/	1.8		
1675F 2 HR.AC	F	----	R.T.	--	138.0	2.500	1.250	CT	1.250	0.36	52.70			1973	90584
1600F 1 HR.FC		----			138.0	2.500	1.250	CT	1.250	0.46	58.90	55.8/	4.4	1973	90584
1675F 2 HR.AC	FB	1.50	R.T.	--	150.0	2.500	1.250	CT	1.250	0.43	62.20			1973	90584
1600F 1 HR.FC		1.50			150.0	2.500	1.250	CT	1.250	0.38	58.20	60.2/	2.8	1973	90584

NOTES
(1) COMPOSITION(WT PERCENT) 5.6AL,5.4V,2.0SN,0.026C,0.57FE,0.014N,0.004H,0.180,0.50CU

TABLE 4.13.3.1

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 4.13.3.1 INDICATING EFFECT

OF STRESS RATIO

MATERIAL: TITANIUM TI-6AL-6V-2SN
CONDITION: BA
ENVIRONMENT: R. T. , HUMID AIR

DELTA K (KSI*IN**1/2)	DA/DN (10**-6 IN. /CYCLE) A	B	C	D
	R=+0. 10			
DELTA K MIN A:				
B:				
C:				
D:				
200. 00				
DELTA K MAX A:				
B:				
C:				
D:				

ROOT MEAN SQUARE PERCENT ERROR 0. 00

LIFE PREDICTION RATIO SUMMARY (NP/NA)	
0. 0-0. 5	
0. 5-0. 8	
0. 8-1. 25	
1. 25-2. 0	
>2. 0	

CONDITION/HT: BA
FORM: 0.38"TH PLATE
SPECIMEN TYPE: PTSF
ORIENTATION: T-S
FREQUENCY: 10.00 HZ
ENVIRONMENT: R.T., HUMID AIR

YIELD STRENGTH: 130.0 KSI
ULT. STRENGTH:
SPECIMEN THK: 0.375"
SPECIMEN WIDTH: 5.000"
REFERENCES: 00081

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TI-6AL-6V-2SN

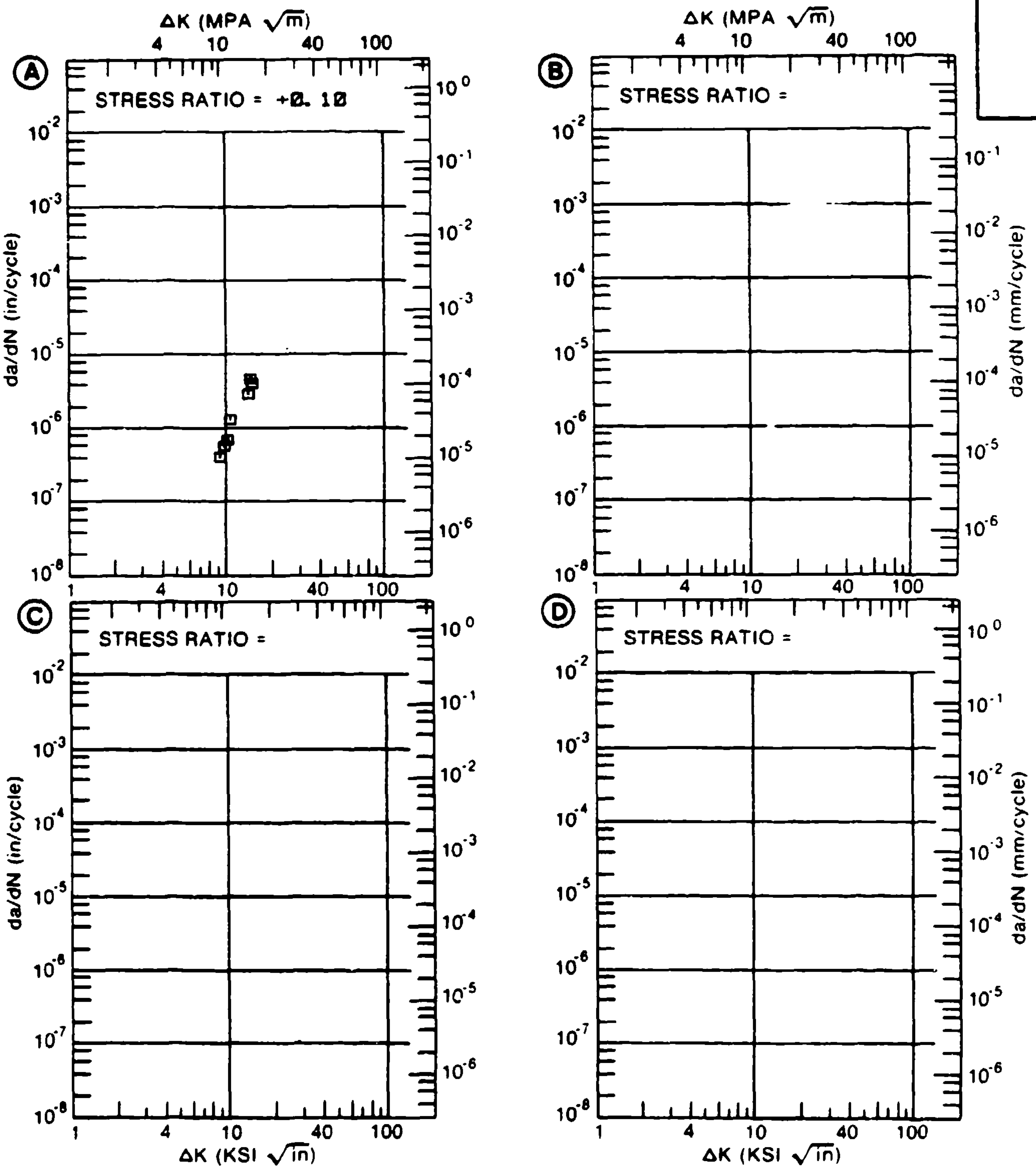

Figure 4.13.3.1

TABLE 4.13.3.2

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 4.13.3.2 INDICATING EFFECT

OF ENVIRONMENT

MATERIAL: TITANIUM TI-6AL-6V-2SN
CONDITION: BA

DELTA K (KSI*IN**1/2)		DA/DN (10**-6 IN./CYCLE) A	B	C	D
		E= R.T. 3.5% NACL			
DELTA K MIN A:	8.91	1.38			
B:					
C:					
D:					
	9.00	1.36			
	10.00	1.51			
	13.00	5.40			
	16.00	12.5			
DELTA K MAX A:	17.76	12.0			
B:					
C:					
D:					

ROOT MEAN SQUARE PERCENT ERROR 27.07

LIFE PREDICTION RATIO SUMMARY (NP/NA)	
	0.0-0.5
	0.5-0.8
	0.8-1.25
	1.25-2.0
	>2.0

CONDITION/HT: BA
FORM: 0.38"TH PLATE
SPECIMEN TYPE: PTSF
ORIENTATION: T-S
STRESS RATIO: +0.10
FREQUENCY: 0.10- 10.00 HZ

YIELD STRENGTH: 160.0 KSI
ULT. STRENGTH: 168.0 KSI
SPECIMEN THK: 0.375"
SPECIMEN WIDTH: 5.000"
REFERENCES: 90981

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TI-6AL-6V-2SN

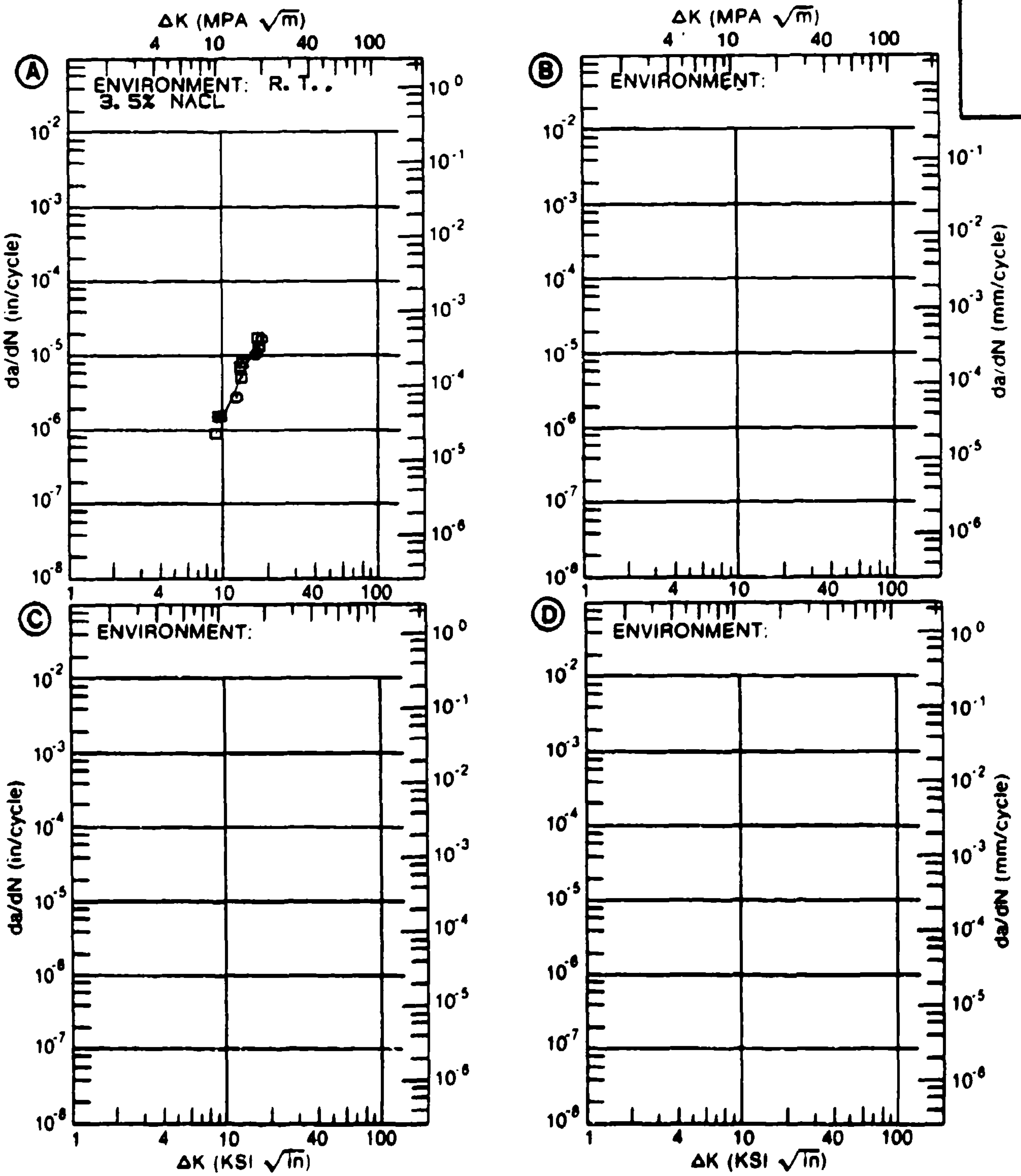

Figure 4.13.3.2

TABLE 4.13.3.3

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 4.13.3.3 INDICATING EFFECT

OF ENVIRONMENT

MATERIAL: TITANIUM TI-6AL-6V-2SN
CONDITION: MA

DELTA K (KSI*IN**1/2)			DA/DN (10**-6 IN./CYCLE) A E= R.T. INTERSTITIAL OXYGEN=0.08%	B E= R.T. INTERSTITIAL OXYGEN=0.16%	C	D
DELTA K MIN	A:	16.07	3.37			
	B:	18.53		8.57		
	C:					
	D:					
		20.00	9.21	11.7		
		25.00	17.8	30.7		
		30.00	26.7	66.7		
		35.00	37.7			
		40.00	53.5			
DELTA K MAX	A:	49.10	112.			
	B:	31.63		171.		
	C:					
	D:					
ROOT MEAN SQUARE PERCENT ERROR			5.19	12.71		

LIFE PREDICTION RATIO SUMMARY (NP/NA)	
	0.0-0.5
	0.5-0.8
	0.8-1.25
	1.25-2.0
	>2.0

CONDITION/HT: MA
FORM:
SPECIMEN TYPE:
ORIENTATION:
STRESS RATIO:
FREQUENCY:

YIELD STRENGTH:
ULT. STRENGTH:
SPECIMEN THK:
SPECIMEN WIDTH:
REFERENCES: 91945

TITAN. ALLOY

TI-6AL-6V-2SN

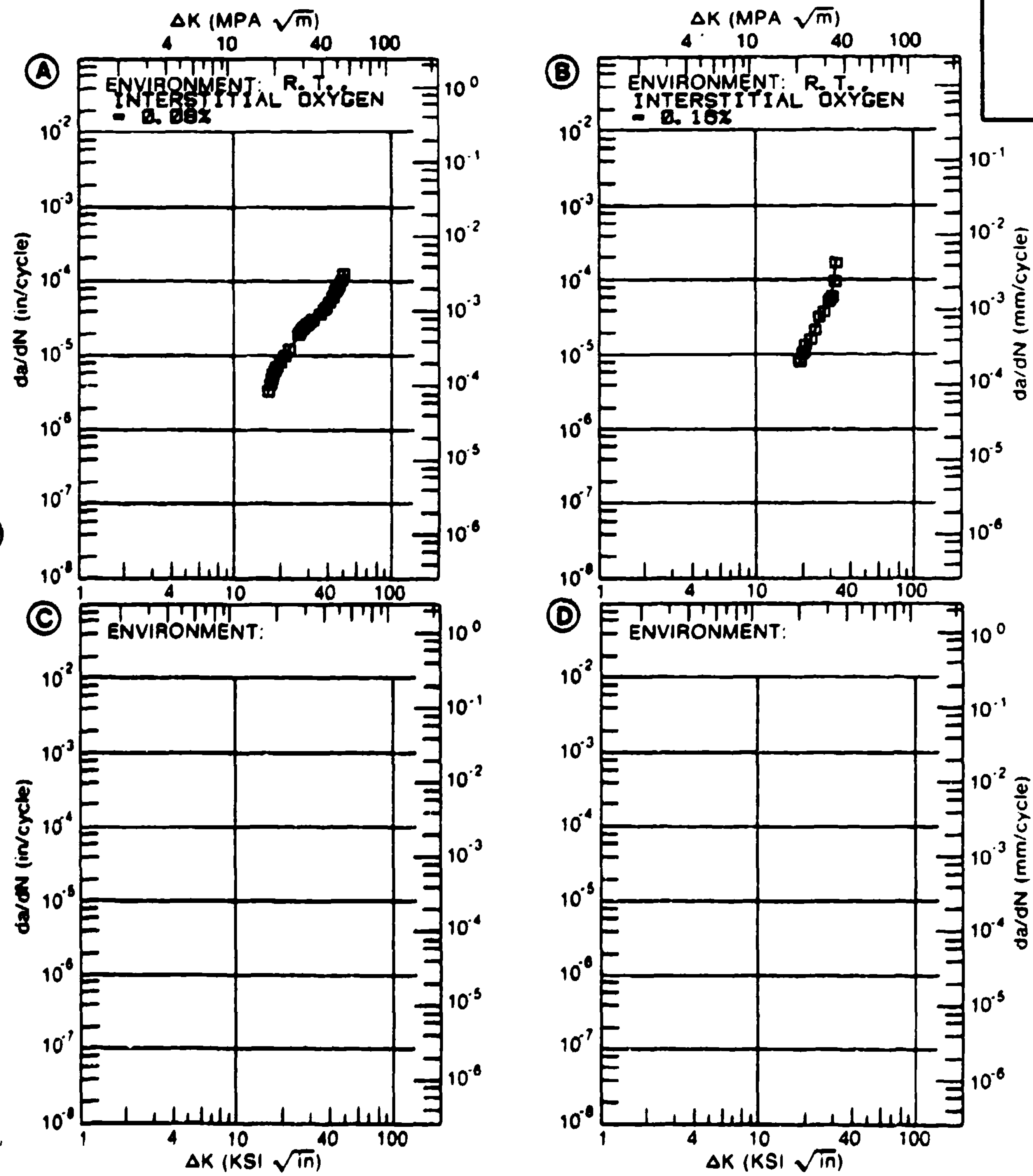

Figure 4.13.3.3

TABLE 4.13.3.4

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 4.13.3.4 INDICATING EFFECT

OF ENVIRONMENT

MATERIAL: TITANIUM TI-6AL-6V-2SN
CONDITION: MA

DELTA K (KSI*IN**1/2)		DA/DN (10**-6 IN./CYCLE) A	B	C	D
		E= R.T. LAB AIR			
DELTA K MIN A:	4.16	.0207			
B:					
C:					
D:					
	5.00	.0440			
	6.00	.0905			
	7.00	.164			
	8.00	.271			
	9.00	.420			
	10.00	.620			
	13.00	1.61			
	16.00	3.43			
	20.00	7.73			
	25.00	17.7			
	30.00	35.2			
	35.00	64.0			
	40.00	109.			
DELTA K MAX A:	41.81	130.			
B:					
C:					
D:					

ROOT MEAN SQUARE PERCENT ERROR		19.73
LIFE PREDICTION RATIO SUMMARY (NP/NA)	0.0-0.5	
	0.5-0.8	1
	0.8-1.25	1
	1.25-2.0	
	>2.0	

CONDITION/HT: MA
FORM: EXTRUSION
SPECIMEN TYPE: CCP
ORIENTATION: L-T
STRESS RATIO: +0.02
FREQUENCY: 0.10- 20.00 HZ

YIELD STRENGTH: 143.0 KSI
ULT. STRENGTH: 157.0 KSI
SPECIMEN THK: 0.081- 0.082"
SPECIMEN WIDTH: 3.509- 3.519"
REFERENCES: MA002

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TI-6AL-6V-2SN

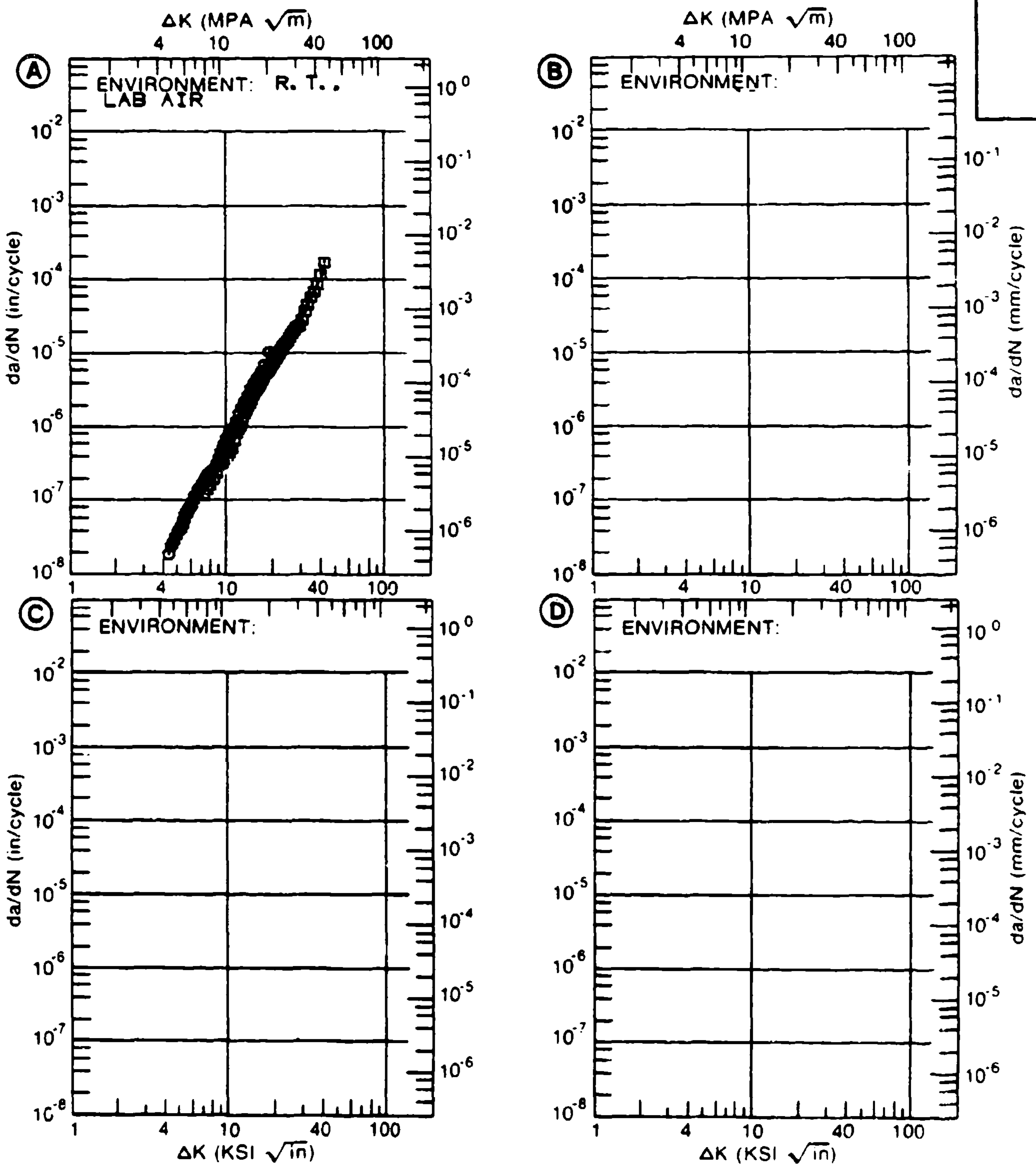

Figure 4.13.3.4

TABLE 4.13.3.5

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 4.13.3.5 INDICATING EFFECT OF ENVIRONMENT

MATERIAL: TITANIUM TI-6AL-6V-2SN
CONDITION: MA

DELTA K (KSI*IN**1/2)		DA/DN (10**-6 IN./CYCLE) A	B	C	D
		E= R.T. DRY ARGON	E= R.T. DRY AIR	E= R.T. JP-4 FUEL	E= R.T. DIST. WATER
DELTA K MIN A:	13.02	4.85			
DELTA K MIN B:	10.24		1.28		
DELTA K MIN C:	10.06			2.41	
DELTA K MIN D:	10.25				.93
	13.00		3.53	5.70	2.36
	16.00	6.20	7.54	10.9	4.79
	20.00	10.3	11.1	22.4	9.77
	25.00	21.0	19.1	51.6	17.9
	30.00	40.9	48.9	118.	36.9
	35.00	72.9	107.	271.	65.4
	40.00	120.	164.	632.	113.
	50.00	633.	391.		322.
DELTA K MAX A:	55.28	911.			
DELTA K MAX B:	58.24		1749.		
DELTA K MAX C:	42.78			1015.	
DELTA K MAX D:	58.29				747.
ROOT MEAN SQUARE PERCENT ERROR		23.61	29.90	21.93	25.52

LIFE PREDICTION RATIO SUMMARY (NP/NA)	
	0.0-0.5
	0.5-0.8
	0.8-1.25
	1.25-2.0
	>2.0

CONDITION/HT: MA
FORM: 2.00"TH FORGING
SPECIMEN TYPE: DCB
ORIENTATION: L-T
STRESS RATIO: +0.02
FREQUENCY: 0.08- 10.00 HZ

YIELD STRENGTH: 144.0- 155.0 KSI
ULT. STRENGTH: 151.0- 164.0 KSI
SPECIMEN THK: 0.750"
SPECIMEN WIDTH: 5.500"
REFERENCES: 84360

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TI-6AL-6V-2SN

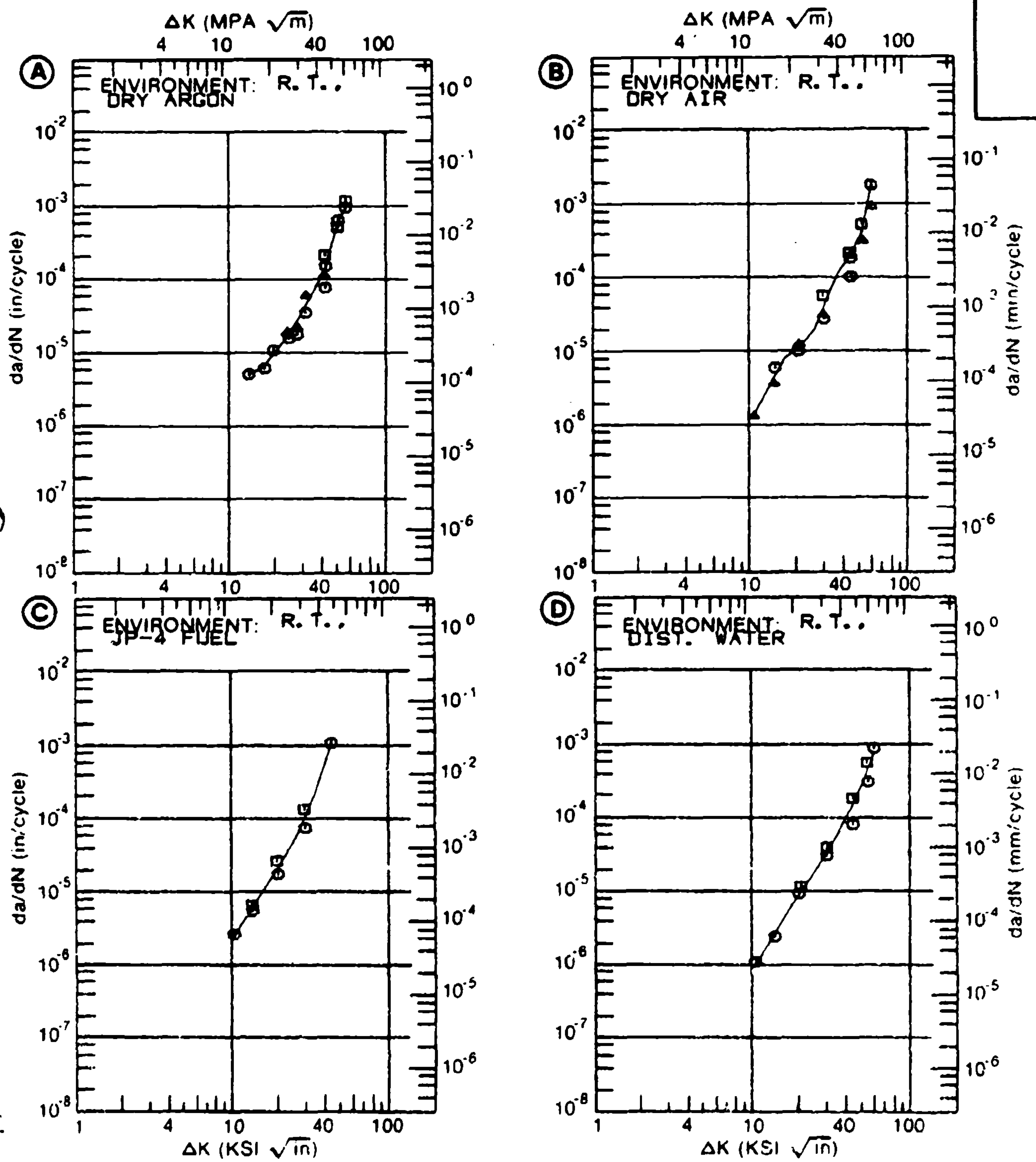

Figure 4.13.3.5

TABLE 4.13.3.6

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 4.13.3.6 INDICATING EFFECT

OF ENVIRONMENT

MATERIAL: TITANIUM TI-6AL-6V-2SN
CONDITION: RA

DELTA K (KSI*IN**1/2)		DA/DN (10**-6 IN./CYCLE) A	B	C	D
		E= R.T. INTERSTITIAL OXYGEN=0.08%	E= R.T. INTERSTITIAL OXYGEN=0.16%		
DELTA K MIN A:	18.44	4.64			
B:	21.24		10.6		
C:					
D:					
	20.00	6.36			
	25.00	13.6	23.7		
	30.00	23.0	47.1		
	35.00	34.8	72.4		
	40.00	49.3	96.3		
	50.00	86.0			
	60.00	125.			
	70.00	154.			
	80.00	176.			
	90.00	195.			
DELTA K MAX A:	91.66	199.			
B:	48.09		129.		
C:					
D:					
ROOT MEAN SQUARE PERCENT ERROR		10.65	7.01		

LIFE PREDICTION RATIO SUMMARY (NP/NA)	
0.0-0.5	
0.5-0.8	
0.8-1.25	
1.25-2.0	
>2.0	

CONDITION/HT: RA
FORM:
SPECIMEN TYPE:
ORIENTATION:
STRESS RATIO:
FREQUENCY:

YIELD STRENGTH:
ULT. STRENGTH:
SPECIMEN THK:
SPECIMEN WIDTH:
REFERENCES: 91945

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TI-6AL-6V-2SN

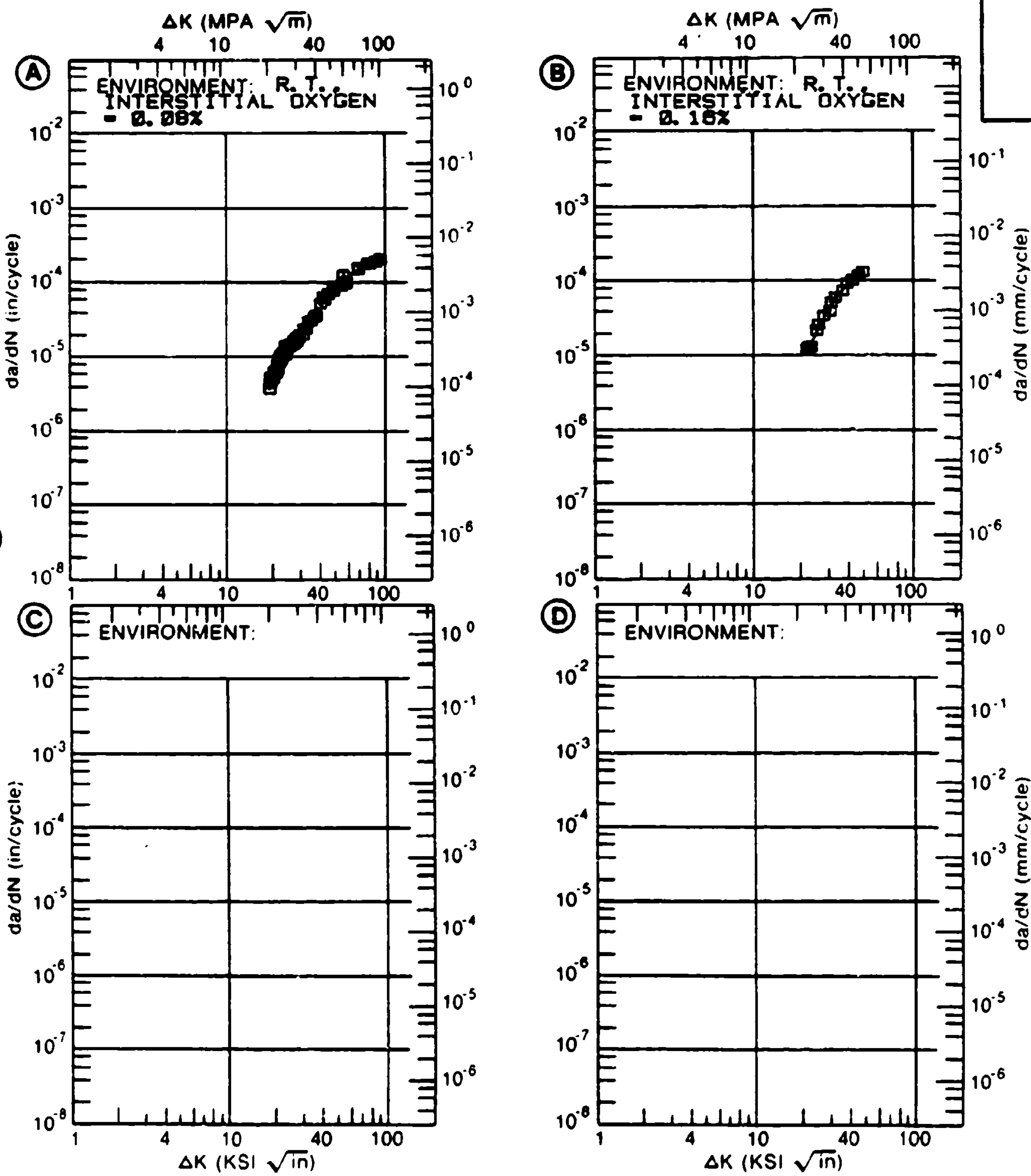

Figure 4.13.3.6

TABLE 4.13.3.7

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 4.13.3.7INDICATING EFFECT

OF STRESS RATIO

MATERIAL: TITANIUM TI-6AL-6V-2SN
CONDITION: STOA
ENVIRONMENT: R.T. ,HUMID AIR

DELTA K (KSI*IN**1/2)			DA/DN (10**-6 IN./CYCLE) A	B	C	D
			R=+0.10			
DELTA K MIN	A:	8.20	.39			
	B:					
	C:					
	D:					
		9.00	.525			
		10.00	.734			
		13.00	1.67			
		16.00	3.15			
		20.00	5.98			
		25.00	10.8			
		30.00	16.7			
		35.00	23.2			
		40.00	29.9			
		50.00	42.3			
DELTA K MAX	A:	54.31	46.9			
	B:					
	C:					
	D:					

ROOT MEAN SQUARE PERCENT ERROR 33.44

LIFE PREDICTION RATIO SUMMARY (NP/NA)	
0.0-0.5	
0.5-0.8	
0.8-1.25	1
1.25-2.0	
>2.0	

CONDITION/HT: STOA
FORM: 0.13"TH PLATE
SPECIMEN TYPE: CCP
ORIENTATION: T-L
FREQUENCY: 10.00 HZ
ENVIRONMENT: R.T., HUMID AIR

YIELD STRENGTH: 137.4 KSI
ULT. STRENGTH: 143.0 KSI
SPECIMEN THK: 0.125"
SPECIMEN WIDTH: 5.000"
REFERENCES: 80981

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TI-8AL-8V-2SN

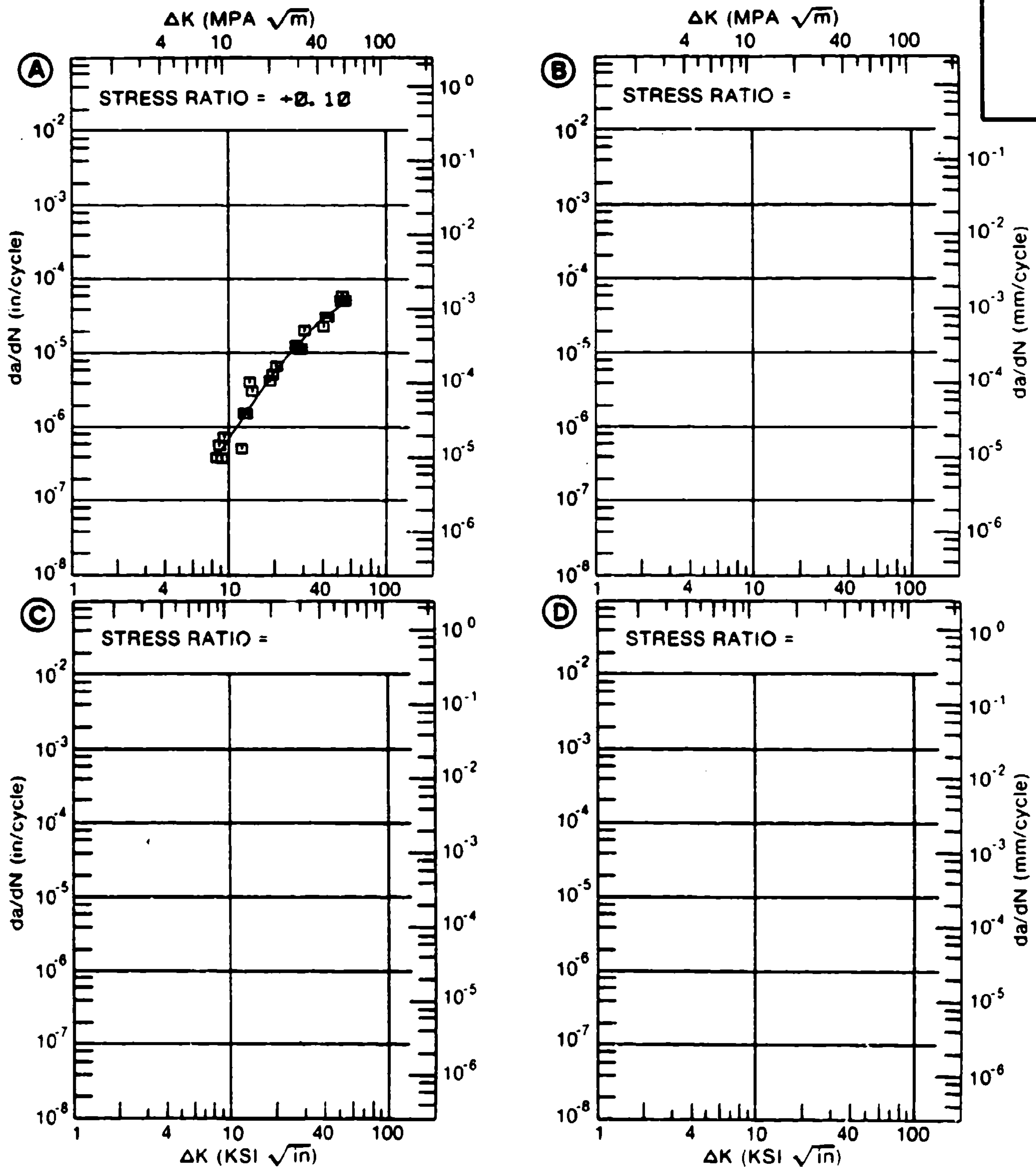

Figure 4.13.3.7

TABLE 4.13.3.8

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 4.13.3.8 INDICATING EFFECT

OF ENVIRONMENT

MATERIAL: TITANIUM TI-6AL-6V-2SN
CONDITION: STOA

DELTA K (KSI*IN**1/2)		DA/DN (10**-6 IN./CYCLE) A	B	C	D
		E= R.T. H.H.A.	E= R.T. 3.5% NACL		
DELTA K MIN	A: 9.04	.526			
	B: 8.98		2.50		
	C:				
	D:				
	9.00		2.48		
	10.00	2.58	3.14		
	13.00	4.48	15.0		
	16.00	5.34	20.8		
	20.00	9.03	29.2		
	25.00	20.5	53.7		
	30.00	47.9	61.1		
	35.00	104.			
DELTA K MAX	A: 39.96	140.			
	B: 30.00		61.1		
	C:				
	D:				
ROOT MEAN SQUARE PERCENT ERROR		12.68	8.44		

LIFE PREDICTION RATIO SUMMARY (NP/NA)	
	0.0-0.5
	0.5-0.8
	0.8-1.25
	1.25-2.0
	>2.0

CONDITION/HT: STOA
FORM: 0.38"TH PLATE
SPECIMEN TYPE: PTSF
ORIENTATION: L-S
STRESS RATIO: +0.10
FREQUENCY: 10.00 HZ

YIELD STRENGTH: 130.0 KSI
ULT. STRENGTH: 167.2 KSI
SPECIMEN THK: 0.373- 0.374"
SPECIMEN WIDTH: 5.000"
REFERENCES: 90981

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TI-6AL-6V-2SN

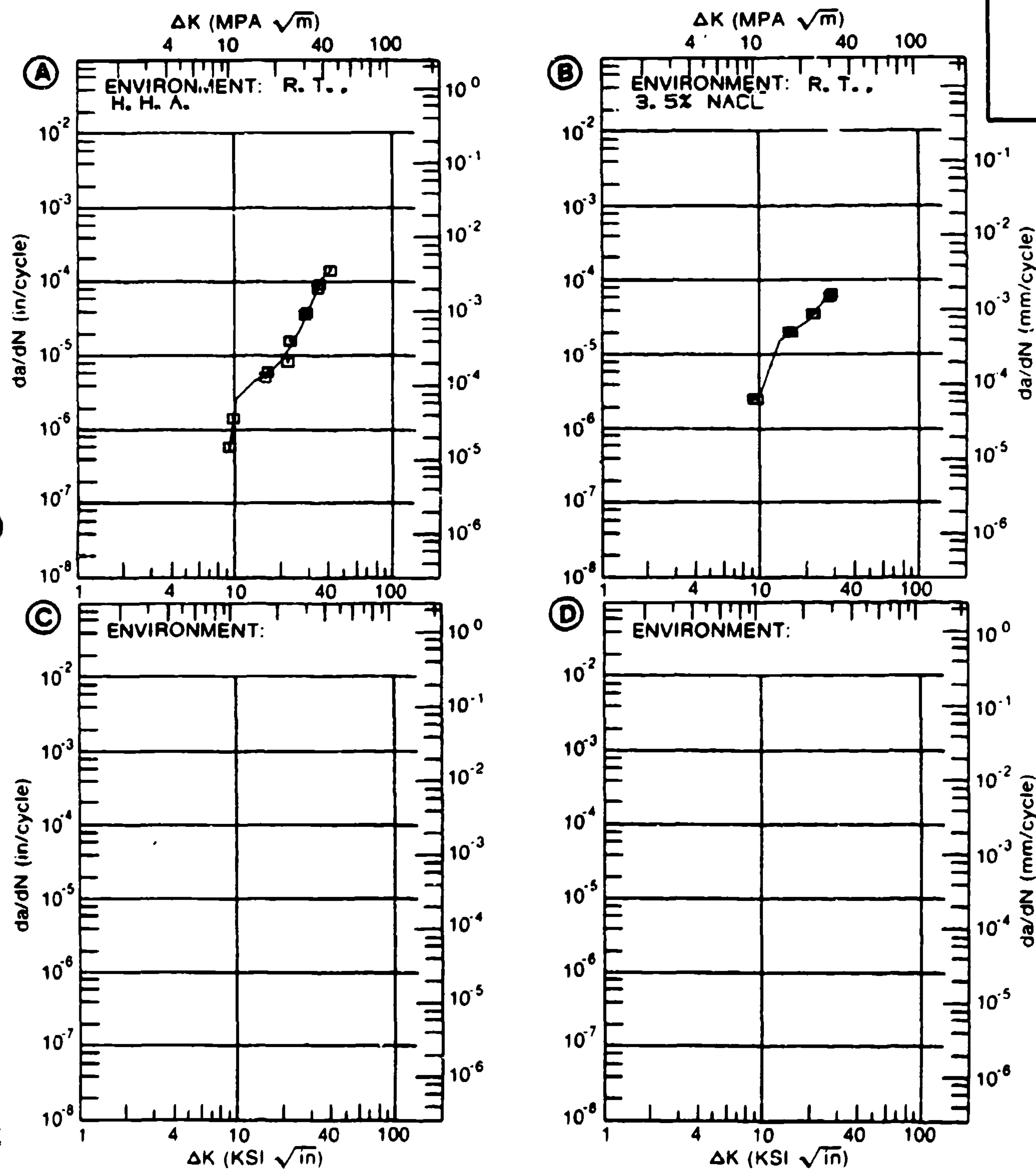

Figure 4.13.3.8

TABLE 4.13.3.9

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 4.13.3.9 INDICATING EFFECT

OF ENVIRONMENT

MATERIAL: TITANIUM TI-6AL-6V-2SN
CONDITION: STOA

DELTA K (KSI*IN**1/2)		DA/DN (10**-6 IN./CYCLE) A	B	C	D
		E= R.T. H.H.A.			
DELTA K MIN	A: 8.70	.824			
	B:				
	C:				
	D:				
	9.00	1.01			
	10.00	1.73			
	13.00	4.16			
	16.00	6.42			
	20.00	10.2			
	25.00	20.7			
	30.00	53.0			
DELTA K MAX	A: 34.23	139.			
	B:				
	C:				
	D:				

ROOT MEAN SQUARE PERCENT ERROR 16.00

LIFE PREDICTION RATIO SUMMARY (NP/NA)
0.0-0.5
0.5-0.8
0.8-1.25
1.25-2.0
>2.0

CONDITION/HT: STOA
FORM: 0.38"TH PLATE
SPECIMEN TYPE: PTSF
ORIENTATION: L-S
STRESS RATIO: +0.10
FREQUENCY: 0.10 HZ

YIELD STRENGTH: 130.0 KSI
ULT. STRENGTH: 167.2 KSI
SPECIMEN THK: 0.372"
SPECIMEN WIDTH: 5.000"
REFERENCES: 00081

TITAN. ALLOY

TI-6AL-6V-2SN

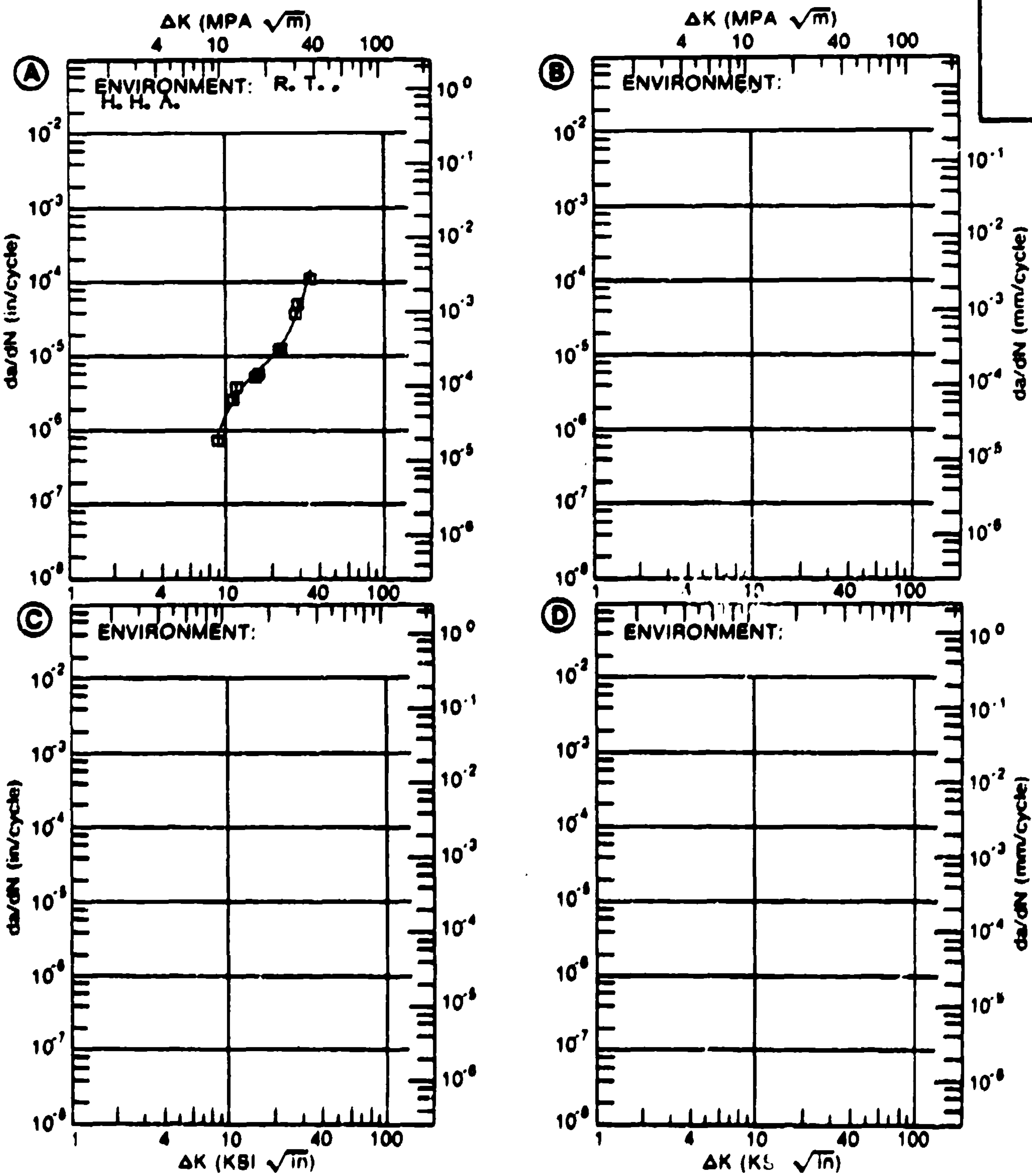

Figure 4.13.3.9

TABLE 4.13.3.10

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 4.13.3.10 INDICATING EFFECT

OF STRESS RATIO

MATERIAL: TITANIUM TI-6AL-6V-2SN
CONDITION: STOA
ENVIRONMENT: R.T. ,H.H.A.

DELTA K (KSI*IN**1/2)			DA/DN (10**-6 IN./CYCLE) A	B	C	D
			R=+0.10	R=+0.50		
	A:	8.60	.537			
DELTA K	B:	8.90		1.35		
MIN	C:					
	D:					
		9.00	.670	1.45		
		10.00	1.15	2.67		
		13.00	4.83	11.7		
		16.00	14.7	31.4		
		20.00	41.6	63.5		
		25.00	88.0			
		30.00	119.			
	A:	33.13	122.			
DELTA K	B:	22.70		75.8		
MAX	C:					
	D:					
ROOT MEAN SQUARE PERCENT ERROR			45.83	36.15		

LIFE PREDICTION RATIO SUMMARY (NP/NA)	
	0.0-0.5
	0.5-0.8
	0.8-1.25
	1.25-2.0
	>2.0

CONDITION/HT: STOA
FORM: 0.38"TH PLATE
SPECIMEN TYPE: PTSF
ORIENTATION: T-S
FREQUENCY: 0.10 HZ
ENVIRONMENT: R.T., H.H.A.

YIELD STRENGTH: 130.0 KSI
ULT. STRENGTH: 167.2 KSI
SPECIMEN THK: 0.373- 0.374"
SPECIMEN WIDTH: 5.000"
REFERENCES: 90981

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TI-6AL-6V-2SN

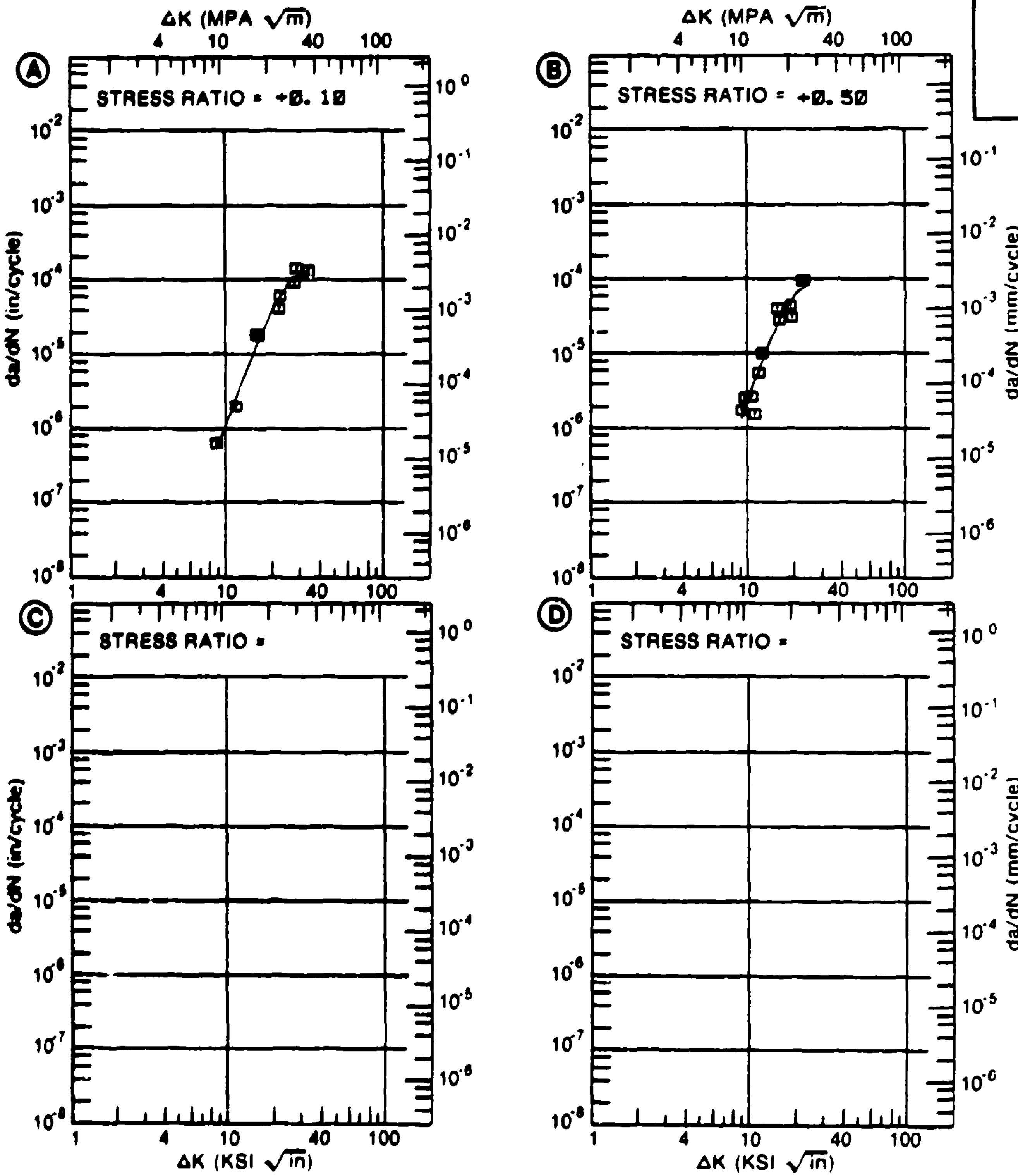

Figure 4.13.3.10

TABLE 4.13.3.11

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 4.13.3.11INDICATING EFFECT

OF ENVIRONMENT

MATERIAL: TITANIUM TI-6AL-6V-2SN
CONDITION: STOA

DELTA K (KSI*IN**1/2)			DA/DN (10**-6 IN./CYCLE) A	B	C	D
			E= R.T. 3.5% NACL			
DELTA K MIN	A:	9.26	1.28			
	B:					
	C:					
	D:					
		10.00	1.49			
		13.00	6.18			
		16.00	27.2			
		20.00	92.1			
		25.00	185.			
		30.00	282.			
		35.00	423.			
		40.00	685.			
DELTA K MAX	A:	45.85	2081.			
	B:					
	C:					
	D:					

ROOT MEAN SQUARE PERCENT ERROR 32.03

LIFE PREDICTION RATIO SUMMARY (NP/NA)	
	0.0-0.5
	0.5-0.8
	0.8-1.25
	1.25-2.0
	>2.0

CONDITION/HT: STOA
FORM: 0.38"TH PLATE
SPECIMEN TYPE: PTSF
ORIENTATION: T-S
STRESS RATIO: +0.10
FREQUENCY: 1.00 HZ

YIELD STRENGTH: 156.5 KSI
ULT. STRENGTH: 167.8 KSI
SPECIMEN THK: 0.375"
SPECIMEN WIDTH: 5.000"
REFERENCES: 90981

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TI-6AL-6V-2SN

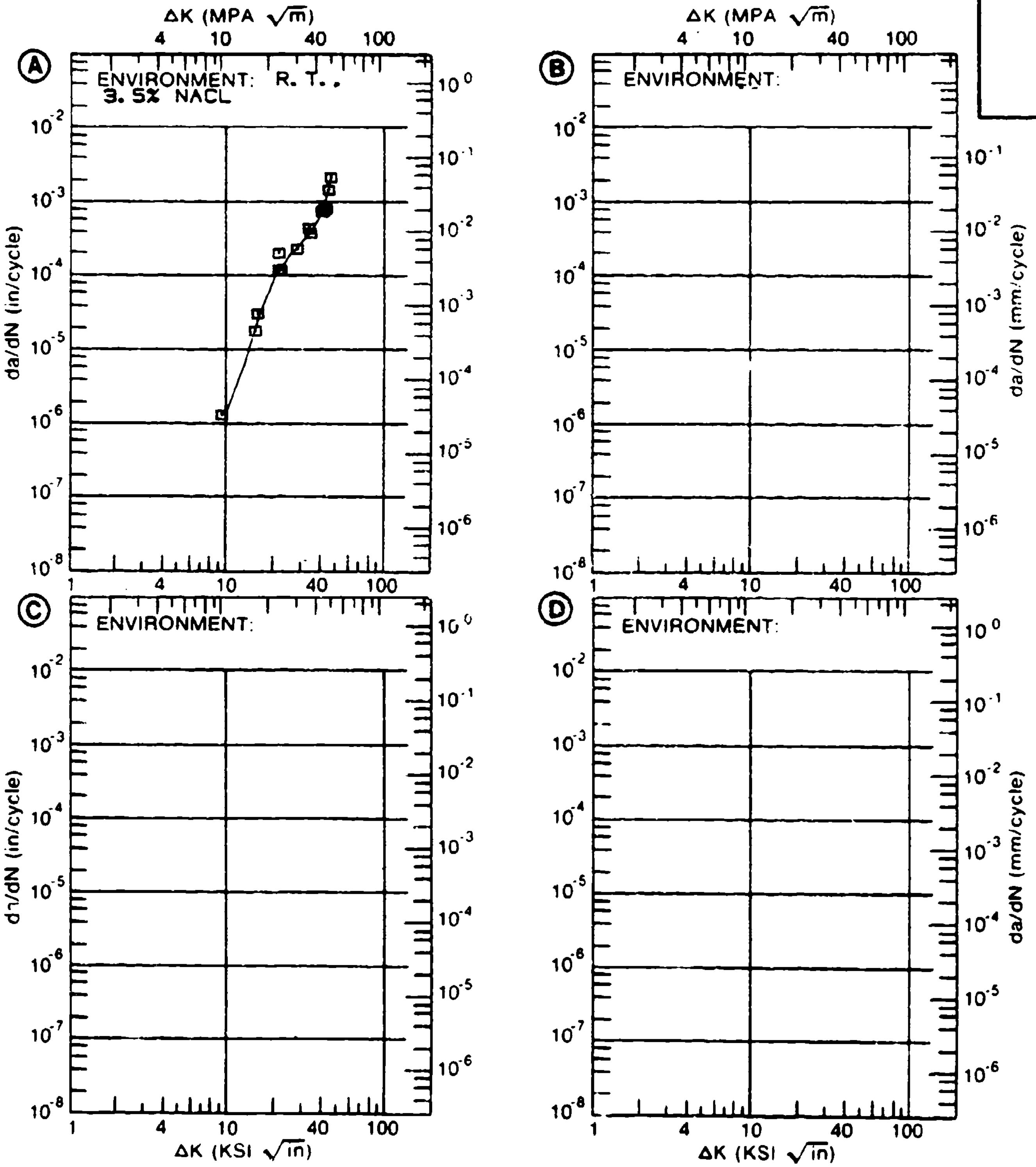

Figure 4.13.3.11

TABLE 4.13.3.12

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 4.13.3.12 INDICATING EFFECT OF STRESS RATIO

MATERIAL: TITANIUM TI-6AL-6V-2SN
CONDITION: STOA
ENVIRONMENT: R.T. ,HUMID AIR

DELTA K (KSI*IN**1/2)			DA/DN (10**-6 IN./CYCLE) A	B	C	D
			R=+0.10	R=+0.50		
	A:	7.71	.61			
DELTA K MIN	B:	4.54		.23		
	C:					
	D:					
		5.00		.334		
		6.00		.592		
		7.00		.907		
		8.00	.764	1.29		
		9.00	1.40	1.77		
		10.00	2.16	2.38		
		13.00	4.71	5.66		
		16.00	7.45	13.9		
		20.00	12.4	49.5		
		25.00	24.7			
		30.00	56.3			
		35.00	146.			
		40.00	421.			
	A:	41.04	531.			
DELTA K MAX	B:	22.27		105.		
	C:					
	D:					
ROOT MEAN SQUARE PERCENT ERROR			16.17	19.45		
LIFE PREDICTION RATIO SUMMARY (NP/NA)		0.0-0.5				
		0.5-0.8				
		0.8-1.25	1	1		
		1.25-2.0				
		>2.0				

CONDITION/HT: STOA
FORM: 0.38"TH PLATE
SPECIMEN TYPE: CCP
ORIENTATION: T-L
FREQUENCY: 10.00 HZ
ENVIRONMENT: R.T., HUMID AIR

YIELD STRENGTH: 180.3 KSI
ULT. STRENGTH: 187.8 KSI
SPECIMEN THK: 0.375"
SPECIMEN WIDTH: 5.000"
REFERENCES: 90981

TITAN. ALLOY

TI-6AL-6V-2SN

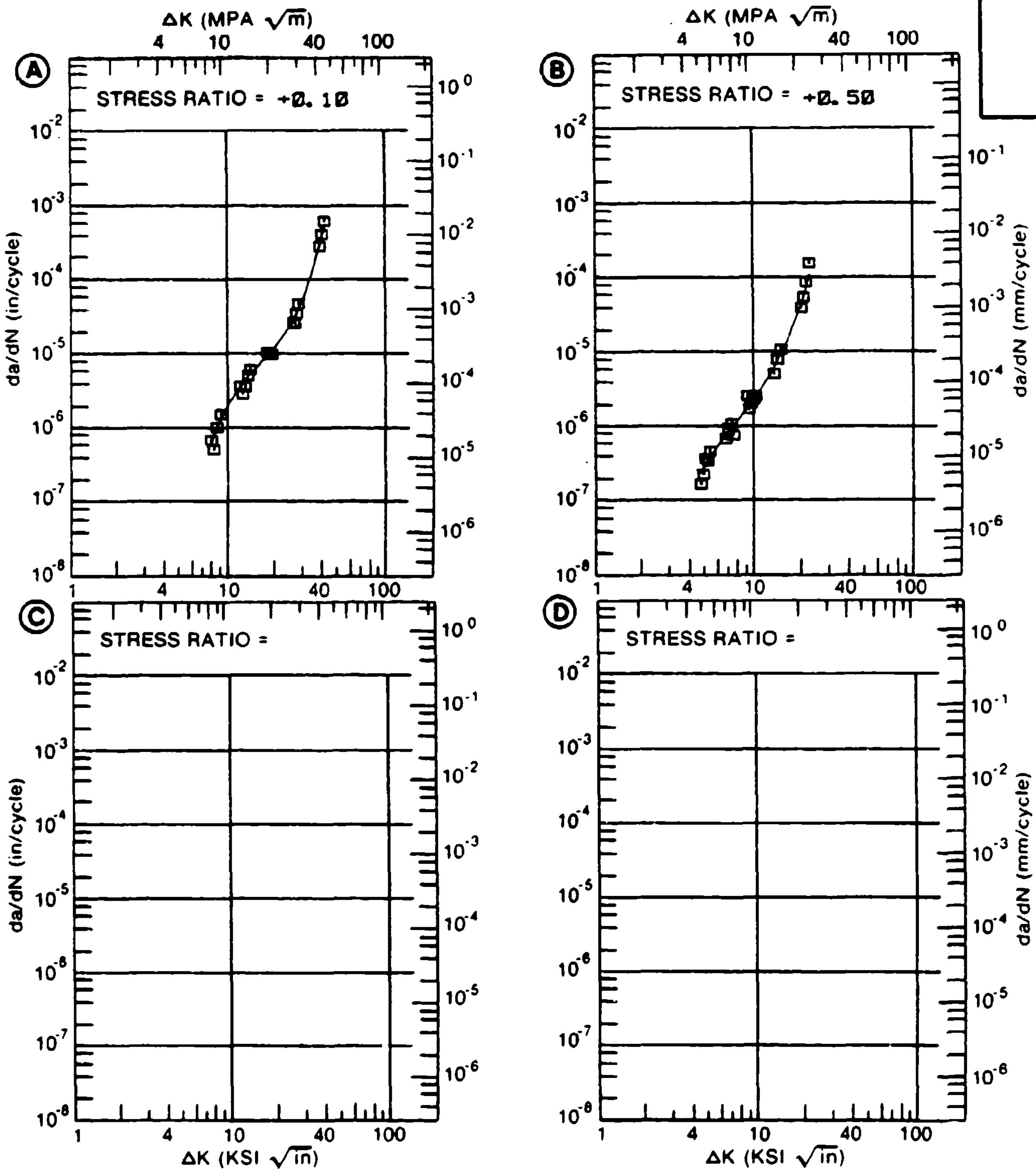

Figure 4.13.3.12

TABLE 4.13.3.13

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 4.13.3.13 INDICATING EFFECT

OF ENVIRONMENT

MATERIAL: TITANIUM TI-6AL-6V-2SN
CONDITION: STOA

DELTA K (KSI*IN**1/2)			DA/DN (10**-6 IN./CYCLE) A	B	C	D
			E= R.T. 3.5% NACL			
DELTA K MIN	A:	8.30	1.38			
	B:					
	C:					
	D:					
		9.00	1.71			
		10.00	2.35			
		13.00	6.07			
		16.00	13.5			
		20.00	30.1			
DELTA K MAX	A:	23.43	48.2			
	B:					
	C:					
	D:					
ROOT MEAN SQUARE PERCENT ERROR			15.51			
LIFE PREDICTION RATIO SUMMARY (NP/NA)		0.0-0.5				
		0.5-0.8				
		0.8-1.25	1			
		1.25-2.0				
		>2.0				

CONDITION/HT: STOA
FORM: 0.38"TH PLATE
SPECIMEN TYPE: CCP
ORIENTATION: T-L
STRESS RATIO: +0.10
FREQUENCY: 0.10 HZ

YIELD STRENGTH: 180.3 KSI
ULT. STRENGTH: 187.8 KSI
SPECIMEN THK: 0.375"
SPECIMEN WIDTH: 5.000"
REFERENCES: 90081

TITAN. ALLOY

TI-6AL-6V-2SN

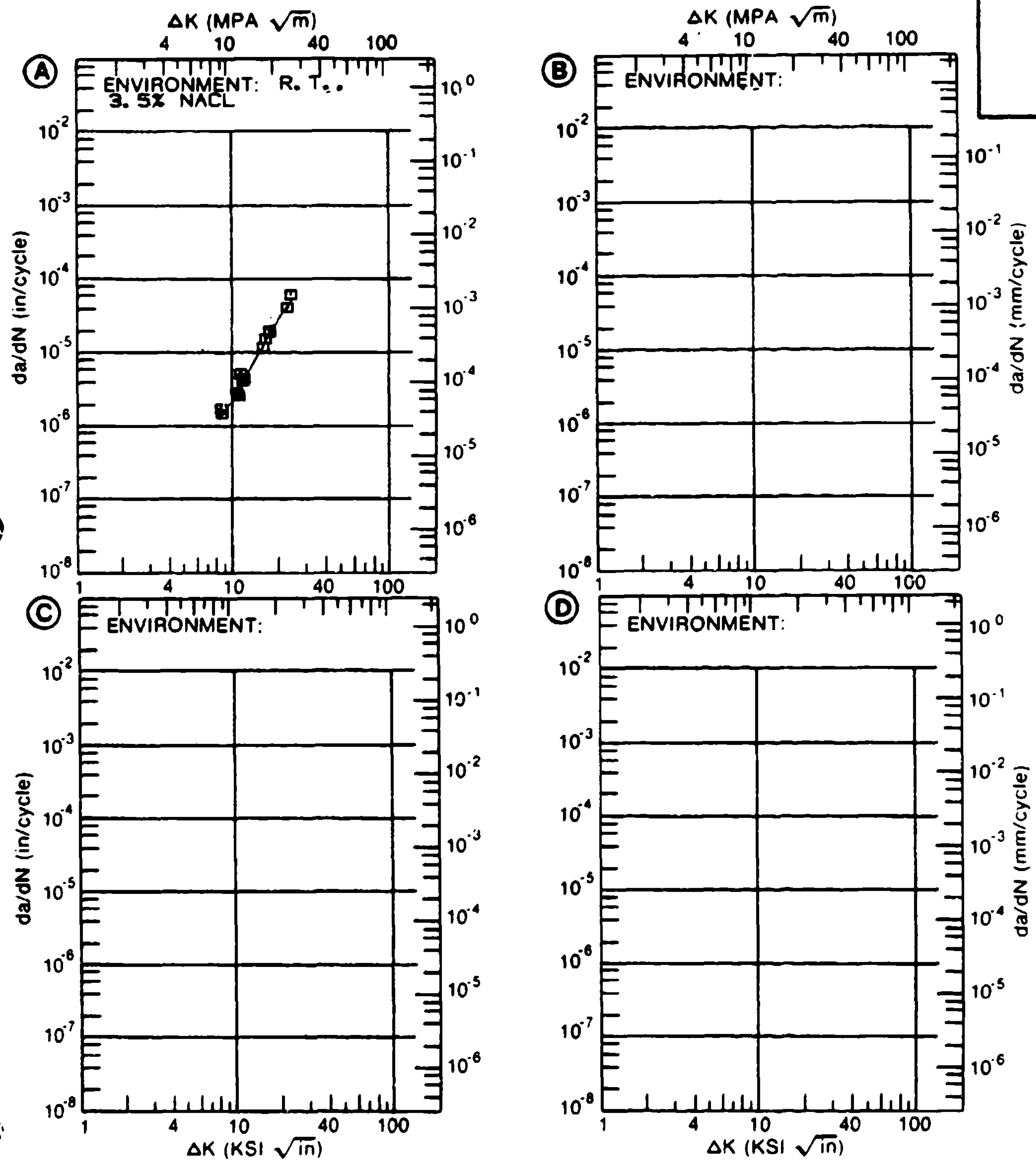

Figure 4.13.3.13

TABLE 4.13.3.14

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 4.13.3.14 INDICATING EFFECT OF ENVIRONMENT

MATERIAL: TITANIUM TI-6AL-6V-2SN
CONDITION: STOA

DELTA K (KSI*IN**1/2)		DA/DN (10**-6 IN./CYCLE) A E= R.T. H.H.A. 1HZ	B E= R.T. 3.5% NACL 1HZ	C E= R.T. H.H.A. 20HZ	D E= R.T. 3.5% NACL 20HZ
DELTA K MIN A:	7.86	.602			
DELTA K MIN B:	6.57		.540		
DELTA K MIN C:	4.47			.0681	
DELTA K MIN D:	4.61				.174
	5.00			.118	.231
	6.00			.240	.469
	7.00		.634	.419	.869
	8.00	.652	1.01	.715	1.45
	9.00	1.08	1.60	1.17	2.21
	10.00	1.64	2.35	1.76	3.13
	13.00	4.12	5.51	4.20	6.72
	16.00	7.84	12.8	7.53	11.4
	20.00	15.1	38.4	13.4	19.3
	25.00	29.4	85.1	24.3	32.8
	30.00	52.4	150.	41.2	51.9
	35.00	89.5	264.	68.5	79.2
	40.00	149.	505.	113.	
	50.00	396.	2561.		
	60.00	1011.			
DELTA K MAX A:	63.06	1341.			
DELTA K MAX B:	54.97		6717.		
DELTA K MAX C:	45.10			187.	
DELTA K MAX D:	39.72				116.
ROOT MEAN SQUARE PERCENT ERROR		14.47	19.12	9.46	12.48
LIFE PREDICTION RATIO SUMMARY (NP/NA)	0.0-0.5				
	0.5-0.8				
	0.8-1.25	1	1	1	1
	1.25-2.0				
	>2.0				

CONDITION/HT: STOA
FORM: 0.63"TH PLATE
SPECIMEN TYPE: CT
ORIENTATION: L-T
STRESS RATIO: +0.10
FREQUENCY:

YIELD STRENGTH: 160.0 KSI
ULT. STRENGTH: 170.0 KSI
SPECIMEN THK: 0.148- 0.151"
SPECIMEN WIDTH: 3.000"
REFERENCES: 88844

TITAN. ALLOY

TI-6AL-6V-2SN

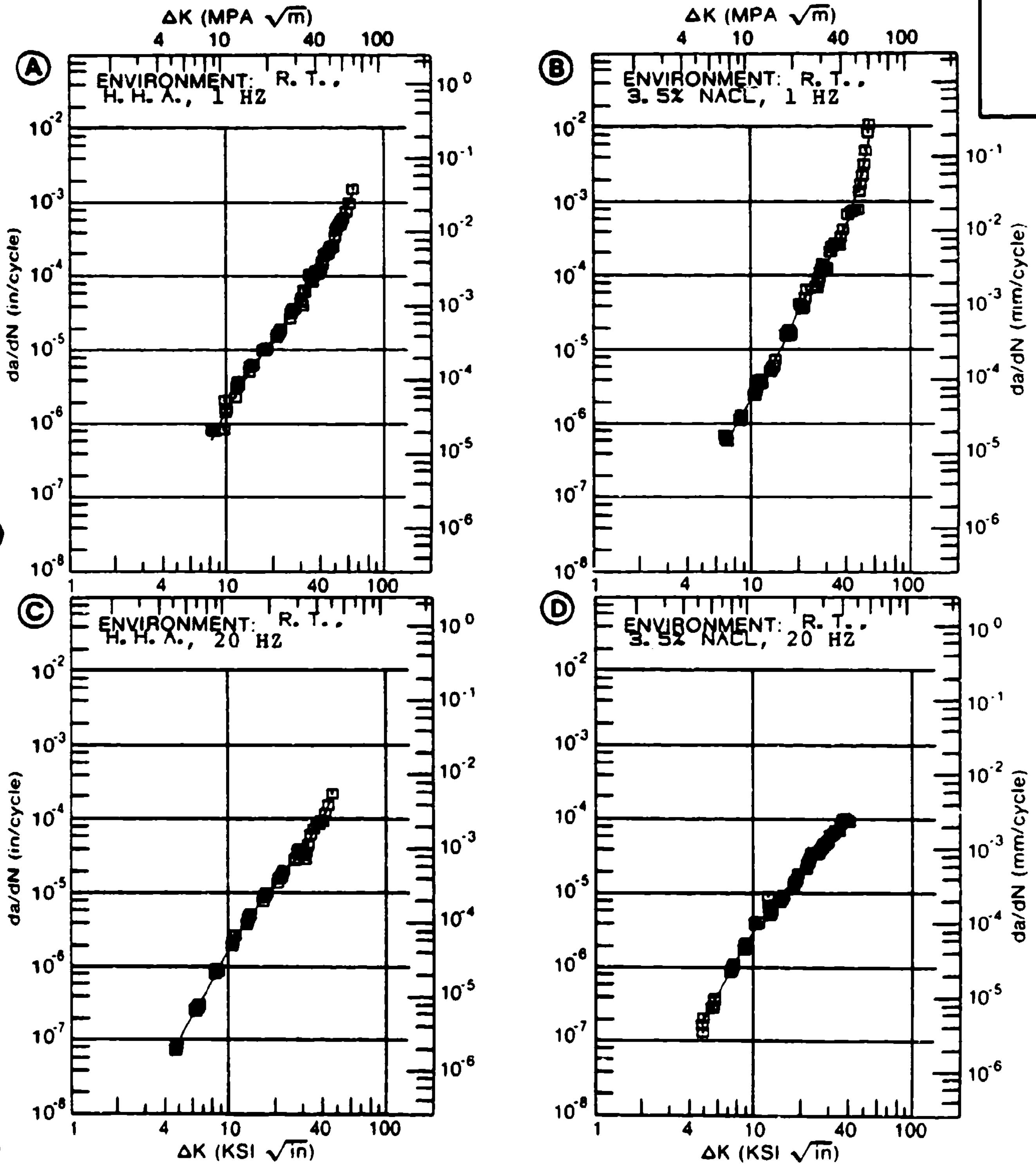

Figure 4.13.3.14

TABLE 4.13.3.15

SUSTAINED CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 4.13.3.15 INDICATING EFFECT

OF ENVIRONMENT

MATERIAL: TITANIUM TI-6AL-6V-2SN
CONDITION: 1300F 2HR

K MAX (KSI*IN**1/2)		DA/DT (10**-3 IN/HOUR) A	B	C	D
		E= R. T. 3.5% NACL	E= R. T. JP-4 FUEL		
K MAX MIN	A:				
	B:				
	C:				
	D:				
200.00					
K MAX MAX	A:				
	B:				
	C:				
	D:				
ROOT MEAN SQUARE PERCENT ERROR		0.00	0.00		

CONDITION/HT: 1300F 2HR
FORM: 2.0"TH FORGING
SPECIMEN TYPE: TDCB
ORIENTATION: L-T
YIELD STRENGTH: 140.0 KSI
ULT. STRENGTH:

SPECIMEN THK: 1.250"
SPECIMEN WIDTH: 5.500"
CRACK LENGTH (A_0):
K_{ISCC}: 32.00 KSI (SQRT IN)
REFERENCES: 84380

TITAN. ALLOY

TI-8AL-8V-2SN

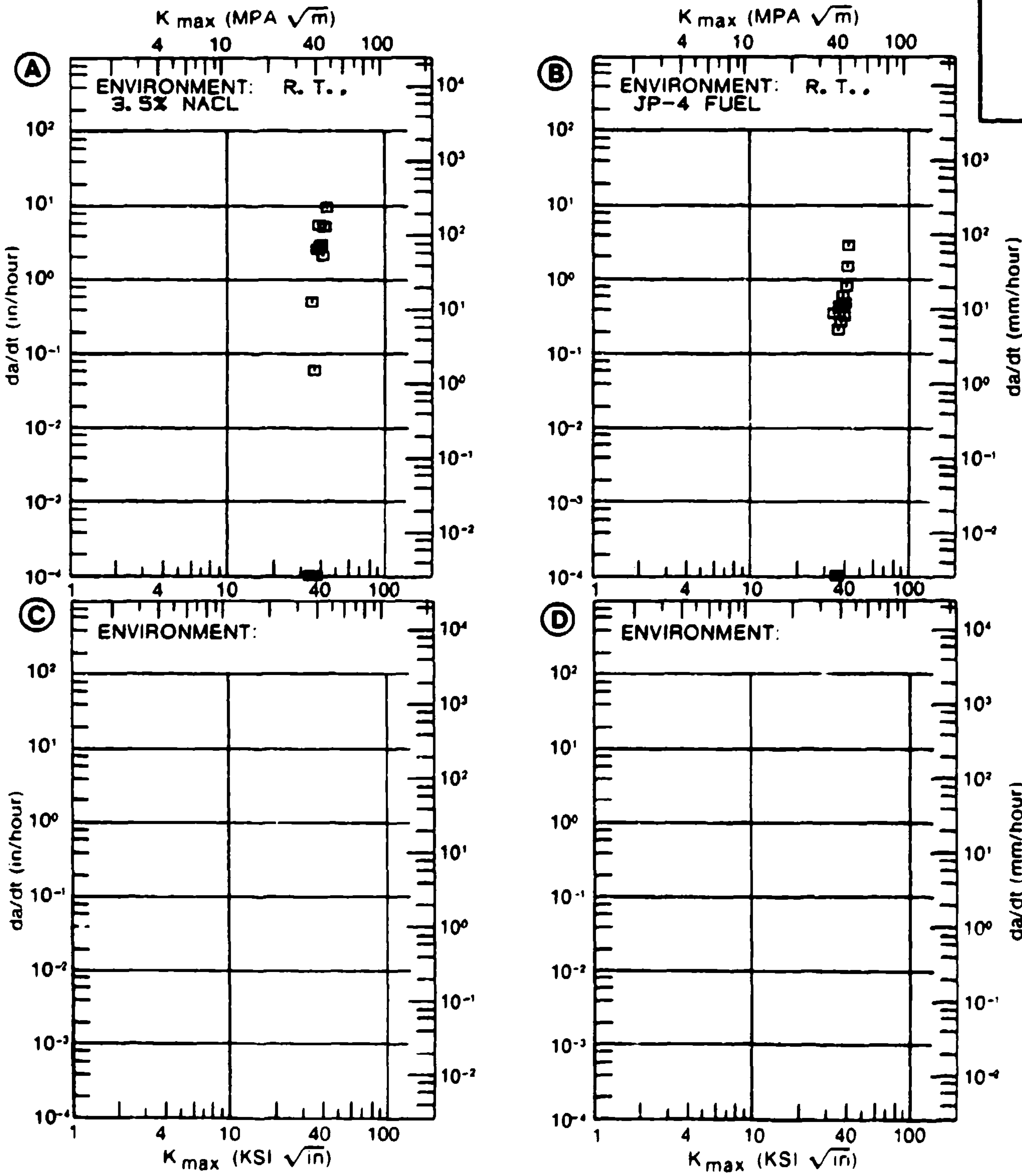

Figure 4.13.3.15

TABLE 4.14.3.1

TITANIUM TI-6AL-6V-2.5SN K(ISCC)

CONDITION	PRODUCT FORM	PRODUCT THICK (IN)	TEST TEMP (F)	SPEC OR	YIELD STR (KSI)	ENVIRONMENT	SPECIMEN WIDTH (IN) W	SPECIMEN THICK (IN) B	SPECIMEN DESIGN (*=SG)	CRACK LENGTH (IN) A	K(Q) (KSI*SQRT IN)	K(ISCC) (KSI*SQRT IN)	MEAN	STAN DEV	TEST TIME (MIN)	DATE	REFER
------------	P	----	R.T.	---	106.0	3.5 PCT NACL	----	----	CANT	----	55.00	21.00			----	1967	70887
1000F 2HR AC	F	2.20	R.T.	L-T	155.1	JP-4 FUEL	5.000	1.250	TDCB	----	57.10	30.50			----	1971	84360
1300F 2HR AC	F	2.20	R.T.	L-T	146.2	3.5 PCT NACL	5.000	1.250	TDCB	----	47.30	32.40			----	1971	84360
1550F 1HR WQ [illegible] 4HR AC	P	1.00	R.T.	T-S	179.6	3.5 PCT NACL	1.000	0.750	CANT*	----	55.00	21.00			----	1967	70931

TABLE 4.15.2.1

TITANIUM TI-6AL2SN4ZR6MO K(IC)

CONDITION	--PRODUCT-- FORM	THICK (IN)	TEST TEMP (F)	SPECIMEN ORIENT	YIELD STRENGTH (KSI)	------SPECIMEN------ WIDTH (IN) W	THICK (IN) B	DESIGN	CRACK LENGTH (IN) A	2.5* (K(IC)/TYS)**2 (IN)	K(IC) (KSI*SQRT IN)	K(IC) MEAN	STAN DEV	DATE	REFER
BETA PROCESSED	F	2.00	R.T	—	156.6	——	2.000	—	----	0.52	71.44			----	R1005
BU.D FRG-10MA	F	2.75	R.T		148.0	2.000	1.000	CT	1.000	0.09	28.50			1974	88762 (1)
BETA UPSET.		2.75			148.0	2.000	1.000	CT	1.000	0.[illegible]	26.70			1974	88762 (1)
BETA FINISHED.		2.75			148.0	2.000	1.000	CT	1.000	0.09	28.50			1974	88762 (1)
10% PRIMARY ALPHA.MILL ANNEALED 1300F 1 HR.AC												27.9/	1.0		
BU.D FRG-10STA	F	2.75	R.T.	—	162.0	2.000	1.000	CT	1.000	0.10	31.60			1974	88762 (1)
BETA UPSET.		2.75			162.0	2.000	1.000	CT	1.000	0.09	30.40			1974	88762 (1)
BETA FINISHED.		2.75			162.0	2.000	1.000	CT	1.000	0.10	31.30			1974	88762 (1)
10% PRIMARY ALPHA.SOLUTION TREATED & AGED 1625F 1 HR.AC.1100F 8 HR.AC												31.1/	0.6		
BU.D FRG-10STO	F	2.75	R.T	—	148.0	2.000	1.000	CT	1.000	0.[illegible]	27.10			1974	88762 (1)
BETA UPSET.		2.75			148.0	2.000	1.000	CT	1.000	0.10	29.70			1974	88762 (1)
BETA FINISHED. 10%PRIMARY ALPHA SOLUTION TREATED&OVERAGED 1625F 1 HR.AC.1300F 1 HR.AC												28.4/	1.8		
BU.D FRG-50MA	F	2.75	R.T	—	154.0	2.000	1.000	CT	1.000	0.05	22.70			1974	88762 (1)
BETA UPSET.		2.75			154.0	2.000	1.000	CT	1.000	0.06	24.90			1974	88762 (1)
BETA FINISHED.50% PRIMARY ALPHA.MILL ANNEALED 1300F 1 HR.AC												23.8/	1.6		
BU.D FRG-50STA	F	2.75	R.T	—	167.0	2.000	1.000	CT	1.000	0.05	24.00			1974	88762 (1)
BETA UPSET.		2.75			167.0	2.000	1.000	CT	1.000	0.05	24.80			1974	88762 (1)
BETA FINISHED 50% PRIMARY ALPHA.SOLUTION TREATED & AGED.1625F 1 HR.AC.1100F 8 HR.AC												24.4/	0.6		
BU.HARFORGBETA	F	2.75	R.T	--	159.0	2.000	1.000	CT	1.000	0.16	40.30			1974	88762 (1)
BETA UPSET.		2.75			159.0	2.000	1.000	CT	1.000	0.18	42.30			1974	88762 (1)
HI ALPHA-BETA FINISHED.15% REDUCTION. SOLUTION TREATED & AGED.1625F 1 HR.AC.1100F 8 HR.AC															

NOTES
(1) CORP DATA

TABLE 4.15.2.1 (con't)

TITANIUM   TI-6AL2SN4ZR6MO K(IC)

CONDITION	--PRODUCT-- FTUN	THICK (IN)	TEST TEMP (F)	SPECIMEN ORIENT	YIELD STRENGTH (KSI)	------SPECIMEN------ WIDTH (IN) W	THICK (IN) B	DES'GN	CRACK LENGTH (IN) A	2.5* (K(IC)/TYS)**2 (IN)	K(IC) (KSI*SQRT IN)	K(IC) MEAN (KSI*SQRT IN)	STAN DEV	DATE	REFER
BU.HAMFINIOSIA	F	2.75	R.T.	—	157.0	2.000	1.000	CT	1.000	0.17	41.50			1974	BB962 (1)
BETA UPSET. 1U ALPHA-BETA FINISHED.10% REDUCTION. SOLUTION TREATED & AGED.1625F 1 HR.AC.1100F 8 HR(1)COF												41.4/	0.9		
BU.HAMFINIOSIA	F	2.75	R.T.	—	161.0	2.000	1.000	CT	1.000	0.13	36.90			1974	BB962 (1)
BETA UPSET.HI		2.75			161.0	2.000	1.000	CT	1.000	0.15	38.90			1974	BB962 (1)
ALPHA-BETA FIN		2.75			161.0	2.000	1.000	CT	1.000	0.13	36.40			1974	BB962 (1)
ISHED.30% REDUCTION.SOLUTION TREATED & AGED.1625F 1 HR.1100F 8 HR.AC												37.4/	1.3		
BU.LARFINIOSIA	F	2.75	R.T.	—	155.0	2.000	1.000	CT	1.000	0.22	45.80			1974	BB962 (1)
BETA UPSET.LO		2.75			155.0	2.000	1.000	CT	1.000	0.20	43.60			1974	BB962 (1)
ALPHA-BETA		2.75			155.0	2.000	1.000	CT	1.000	0.21	44.80			1974	BB962 (1)
FINISHED.10% REDUCTION.SOLUTION TREATED & AGED 1650F 1 HR.AC.1100F 8 HR.AC												44.7/	1.1		
STA-1625F	F	----	R.T.	--	163.0	2.000	1.000	CT	1.000	0.10	32.40			1974	BB962 (2)
1 HR.AC.1100F		----			163.0	2.000	1.000	CT	1.000	0.10	32.70			1974	BB962 (2)
8 HR.AC		----			163.0	2.000	1.000	CT	1.000	0.09	31.60			1974	BB962 (2)
		----			166.0	2.000	1.000	CT	1.000	0.08	29.30			1974	BB962 (3)
		----			166.0	2.000	1.000	CT	1.000	0.08	30.20			1974	BB962 (3)
		----			166.0	2.000	1.000	CT	1.000	0.09	31.30			1974	BB962 (3)
												31.2/	1.3		
50% PRIMARY ALPHA	F	2.00	R.T.	—	150.0	----	2.000	—	----	0.21	43.96			----	R1003

NOTES
(1) COMP DISK
(2) COMP DISK COARSE GRAIN SIZE
(3) COMP DISK FINE GRAIN SIZE

TABLE 4.16.1.1

FATIGUE CRACK GROWTH RATE AT DEFINED LEVELS OF THE STRESS-INTENSITY FACTOR

TITANIUM TI-8AL-1MO-1V

TEST CONDITIONS

SPECIMEN ORIENTATION L-T

ENVIRONMENT: LAB AIR AT R.T.

CONDITION/HT	PRODUCT FORM	STRESS RATIO	FREQ (HZ)	DELTA K LEVELS: (KSI SQRT(IN))	FATIGUE CRACK GROWTH RATES (MICRO IN/CYCLE) 2.5	5	10	20	50	100
	SHEET	0.02	0.10-12.00				2.28	13.5	144	1243
DA	SHEET	0.00	1.00-30.00						67.2	
DA	SHEET	0.10	43.00					7.58	246	
DA	SHEET	0.25	1.00-30.00						162	
DA	SHEET	0.43	1.00-30.00					13.3		
DA	SHEET	0.67	1.00-30.00				2.22			
MA	SHEET	0.10	43.00					7.47		

TABLE 4.16.2.1

TITANIUM TI-8AL-1MO-1V K(IC)

CONDITION	--PRODUCT-- FORM	THICK (IN)	TEST TEMP (F)	SPECIMEN ORIENT	YIELD STRENGTH (KSI)	------SPECIMEN------ WIDTH (IN) W	THICK (IN) B	DESIGN	CRACK LENGTH (IN) A	2.5*(K(IC)/TYS)**2 (IN)	K(IC) (KSI*SQRT IN)	K(IC) MEAN	STAN DEV	DATE	REFER
1850F 1HR WQ, 1100F 8HRS AC	F	----	R.T.	C-R	142.0	2.500	0.500	--	----	0.18	38.22			1977	FW002

TABLE 4.16.2.2

TITANIUM TI-6AL-1MO-1V K(C)

CONDITION	PRODUCT FORM	PRODUCT THICK (IN)	TEST TEMP (F)	SPEC OR	YIELD STR (KSI)	SPECIMEN WIDTH (IN) W	SPECIMEN THICK (IN) B	CRACK LENGTH INIT (IN) 2A(O)	CRACK LENGTH FINAL (IN) 2A(F)	GROSS STRESS ONSET (KSI) S(O)	GROSS STRESS MAX (KSI) S(MAX)	K(APP) (KSI*SQRT IN)	K(APP) MEAN / STAN DEV	K(C) (KSI*SQRT IN)	K(C) MEAN / STAN DEV	DATE	REFER
								BUCKLING OF CRACK EDGES RESTRAINED									
DA	S	0.02	R.T.	L-T	135.5	9.000	0.020	2.110	7.630	62.20	73.30	138.16		157.35		1966	67821
DA	S	0.02	R.T.	L-T	135.5	12.000	0.020	0.580	0.700	99.00	110.20	105.34*		115.80*		1966	67821
		0.02			135.5	12.000	0.020	2.120	2.800	42.50	55.90	104.02		121.33		1966	67821
		0.02			135.5	12.000	0.020	2.020	2.360	41.60	47.90	86.85		94.49		1966	67821
		0.02			135.5	12.000	0.020	0.950	1.240	75.00	85.00	104.24	98.4/10.0	119.42	111.7/15.0	1966	67821
DA	S	0.04	R.T.	L-T	132.6	9.000	0.045	2.100	2.970	45.90	66.10	124.25		153.19		1966	67821
DA	S	0.05	R.T.	L-T	133.6	8.000	0.050	1.500	3.050	62.00	87.50	137.30*		210.73*		1968	71709
		0.05			133.6	8.000	0.050	3.500	4.790	27.00	79.90	213.08*		285.48*		1968	71709
		0.05			133.6	8.000	0.050	1.020	2.100	75.20	105.00	134.26*		199.24*		1968	71709
		0.05			133.6	8.000	0.050	1.970	3.390	52.90	79.20	145.62		206.08*		1968	71709
		0.05			133.6	8.000	0.050	5.010	5.700	19.00	33.70	127.02	136.3/13.2	152.64*	----/ ---	1968	71709
DA	S	0.05	R.T.	L-T	133.6	20.000	0.050	2.060	5.000	62.40	85.90	155.54		250.46*		1968	71709
		0.05			133.6	20.000	0.050	2.020	4.000	29.10	77.40	138.75		198.94		1968	71709
		0.05			133.6	20.000	0.050	8.020	14.500	26.50	42.70	168.60		314.95*		1968	71709
		0.05			133.6	20.000	0.050	9.940	15.000	22.80	36.40	170.65		285.62*		1968	71709
		0.05			133.6	20.000	0.050	6.040	10.000	26.80	47.60	155.45		224.35		1968	71709
		0.05			133.6	20.000	0.050	9.980	15.600	19.30	30.50	143.50		259.41*		1968	71709
		0.05			133.6	20.000	0.050	6.800	11.080	36.40	45.60	160.64		236.94		1968	71709
		0.05			133.6	20.000	0.050	4.260	7.500	36.90	58.90	156.77		221.71		1968	71709
		0.05			133.6	20.000	0.050	3.760	7.520	48.60	69.80	173.43	158.1/11.8	263.23*	220.5/15.8	1968	71709
DA	S	0.05	R.T.	T-L	135.3	8.000	0.050	4.910	5.700	26.90	37.80	139.02		171.22*		1968	71709
		0.05			135.3	8.000	0.050	1.000	2.250	65.00	103.00	132.88*		207.62*		1968	71709
		0.05			135.3	8.000	0.050	2.940	4.250	39.40	62.00	145.55		195.48*		1968	71709
		0.05			135.3	8.000	0.050	2.020	3.650	42.90	80.10	148.56		220.88*		1968	71709
		0.05			135.3	8.000	0.050	1.520	3.100	51.70	91.80	145.09*	144.4/ 4.9	223.65*	----/ ---	1968	71709

*NOTE- NET SECTION STRESS EXCEEDS 80% OF YIELD STRENGTH. VALUE NOT INCLUDED IN MEAN OR STD. DEV.

TABLE 4.16.3.1

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 4.16.3.1 INDICATING EFFECT
OF STRESS RATIO

MATERIAL: TITANIUM TI-6AL-1MO-1V
CONDITION:
ENVIRONMENT: R.T. ,LAB AIR

DELTA K (KSI*IN**1/2)		DA/DN (10**-6 IN./CYCLE) A	B	C	D
		R=+0.02			
DELTA K MIN	A: 6.38	.621			
	B:				
	C:				
	D:				
	7.00	.824			
	8.00	1.22			
	9.00	1.70			
	10.00	2.28			
	13.00	4.56			
	16.00	7.75			
	20.00	13.5			
	25.00	23.6			
	30.00	37.3			
	35.00	55.4			
	40.00	78.7			
	50.00	144.			
	60.00	243.			
	70.00	387.			
	80.00	589.			
	90.00	867.			
	100.00	1243.			
DELTA K MAX	A: 118.36	2281.			
	B:				
	C:				
	D:				

ROOT MEAN SQUARE PERCENT ERROR 34.16

LIFE PREDICTION RATIO SUMMARY (NP/NA)	
0.0-0.5	
0.5-0.8	
0.8-1.25	
1.25-2.0	
>2.0	

CONDITION/HT:
FORM: Ø.Ø5"TH SHEET
SPECIMEN TYPE: CCP
ORIENTATION: L-T
FREQUENCY: Ø.1Ø- 12.ØØ HZ
ENVIRONMENT: R.T., LAB AIR

YIELD STRENGTH: 119.5 KSI
ULT. STRENGTH: 134.Ø KSI
SPECIMEN THK: Ø.Ø5Ø"
SPECIMEN WIDTH: 6.ØØØ"
REFERENCES: MAØ11

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TI-8AL-1MO-1V

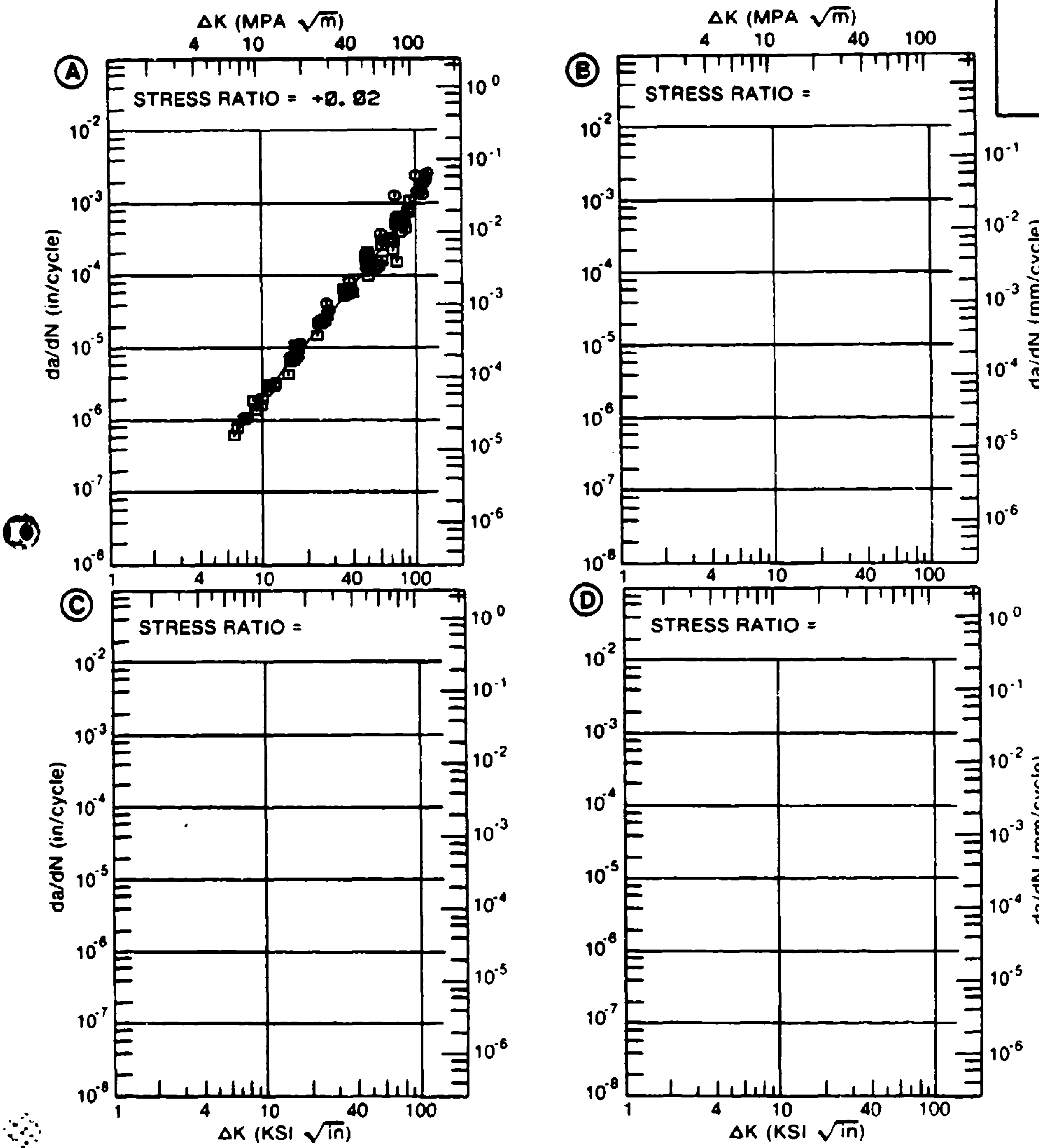

Figure 4.16.3.1

TABLE 4.16.3.2

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 4.16.3.2 INDICATING EFFECT

OF STRESS RATIO

MATERIAL: TITANIUM TI-6AL-1MO-1V
CONDITION: DA
ENVIRONMENT: R.T. ,LAB AIR

DELTA K (KSI*IN**1/2)			DA/DN (10**-6 IN./CYCLE) A	B	C	D
			R=+0.10			
DELTA K MIN	A:	17.97	5.41			
	B:					
	C:					
	D:					
		20.00	7.58			
		25.00	10.5			
		30.00	14.1			
		35.00	24.9			
		40.00	60.4			
		50.00	246.			
		60.00	787.			
DELTA K MAX	A:	62.14	1256.			
	B:					
	C:					
	D:					

ROOT MEAN SQUARE PERCENT ERROR 12.44

LIFE PREDICTION RATIO SUMMARY (NP/NA)		
	0.0-0.5	
	0.5-0.8	
	0.8-1.25	2
	1.25-2.0	
	>2.0	

CONDITION/HT: DA
FORM: 0.05"TH SHEET
SPECIMEN TYPE: CCP
ORIENTATION: L-T
FREQUENCY: 43.00 HZ
ENVIRONMENT: R.T., LAB AIR

YIELD STRENGTH: 140.0 KSI
ULT. STRENGTH: 149.2 KSI
SPECIMEN THK: 0.064"
SPECIMEN WIDTH: 3.000"
REFERENCES: 86089

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TI-8AL-1MO-1V

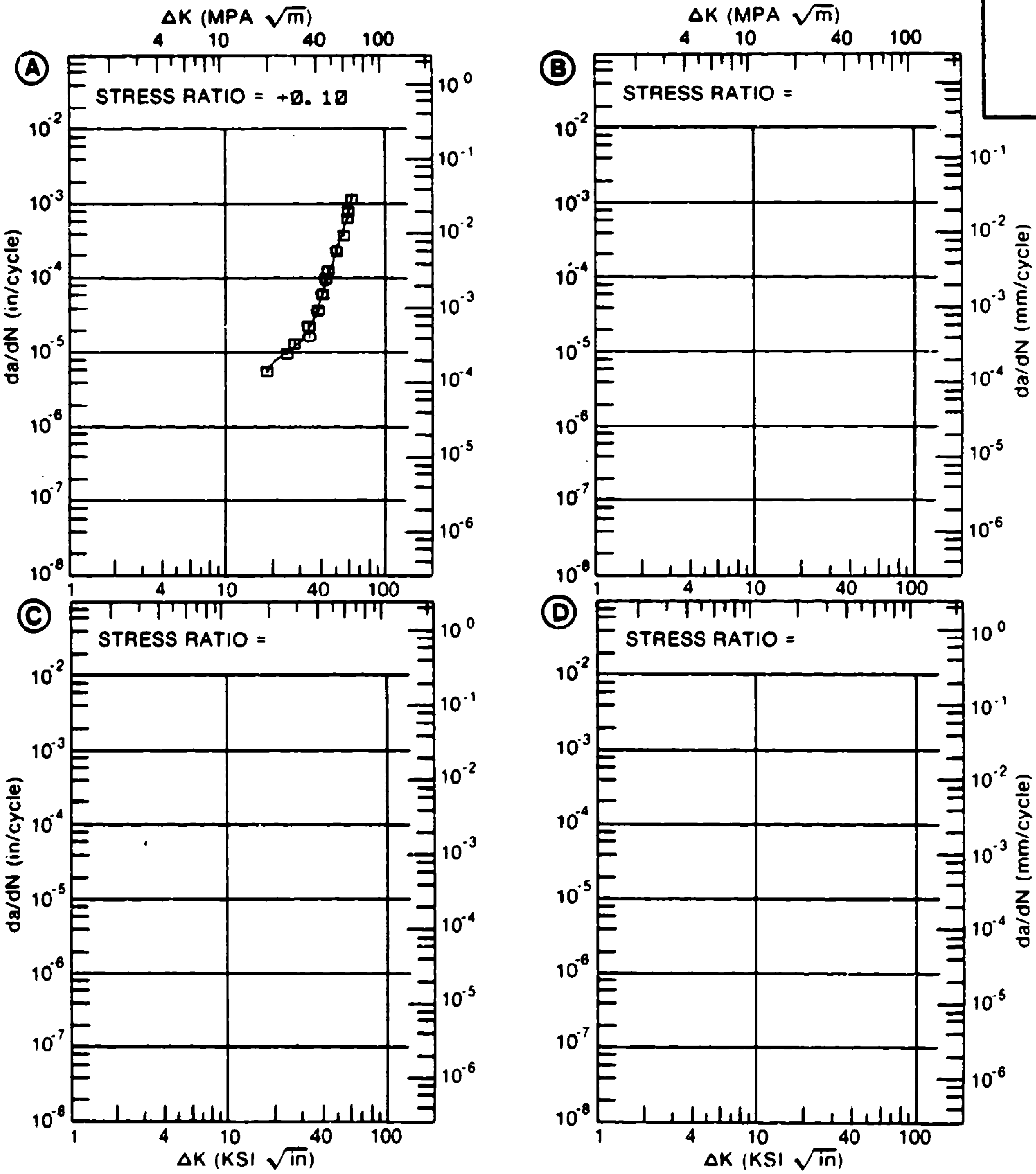

Figure 4.16.3.2

TABLE 4.16.3.3

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 4.16.3.3 INDICATING EFFECT OF STRESS RATIO

MATERIAL: TITANIUM TI-8AL-1MO-1V
CONDITION: DA
ENVIRONMENT: R.T. ,LAB AIR

DELTA K (KSI*IN**1/2)		DA/DN (10**-6 IN./CYCLE) A R=+0.00	B R=+0.25	C R=+0.43	D R=+0.67
DELTA K MIN	A:				
	B: 29.33		33.3		
	C:				
	D:				
	30.00		35.3		
	35.00		51.0		
	40.00		71.5		
	50.00		162.		
DELTA K MAX	A:				
	B: 59.13		439.		
	C:				
	D:				
ROOT MEAN SQUARE PERCENT ERROR		0.00	6.87	0.00	0.00
LIFE PREDICTION RATIO SUMMARY (NP/NA)	0.0-0.5				
	0.5-0.8				
	0.8-1.25		1		
	1.25-2.0				
	>2.0				

CONDITION/HT: DA
FORM: Ø.Ø5"TH SHEET
SPECIMEN TYPE: CCP
ORIENTATION: L-T
FREQUENCY: 1.ØØ- 3Ø.ØØ HZ
ENVIRONMENT: R.T., LAB AIR

YIELD STRENGTH: 138.3 KSI
ULT. STRENGTH: 15Ø.7 KSI
SPECIMEN THK: Ø.Ø5Ø"
SPECIMEN WIDTH: 2Ø.ØØØ"
REFERENCES: 86Ø99

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TI-8AL-1MO-1V

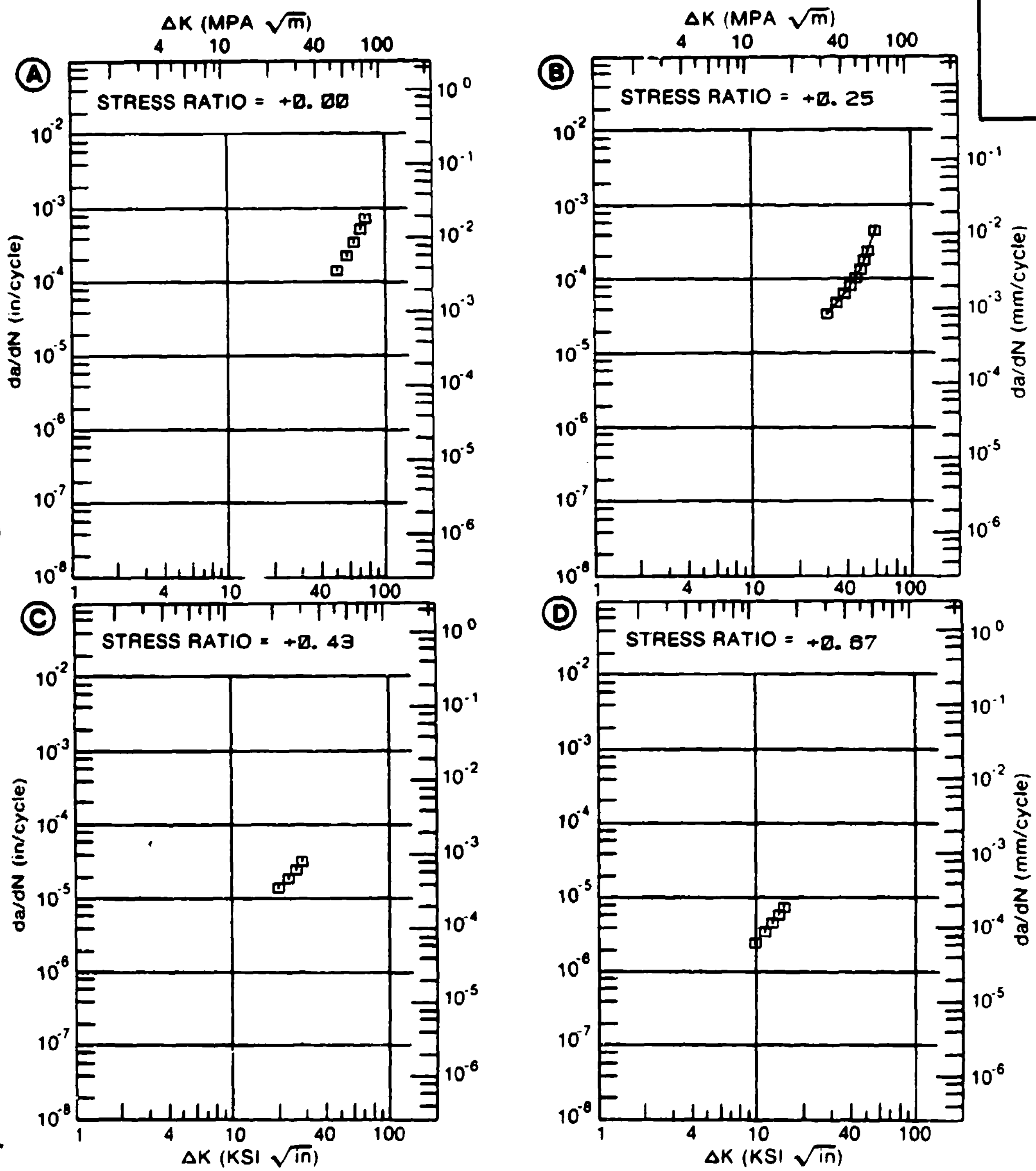

Figure 4.16.3.3

TABLE 4.16.3.4

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 4.16.3.4 INDICATING EFFECT

OF STRESS RATIO

MATERIAL: TITANIUM TI-8AL-1MO-1V
CONDITION: DA
ENVIRONMENT: R.T. ,LAB AIR

DELTA K (KSI*IN**1/2)		DA/DN (10**-6 IN./CYCLE) A R=+0.00	B R=+0.25	C R=+0.43	D R=+0.67
DELTA K MIN	A: 37.15	28.2			
	B: 22.28		13.3		
	C: 14.82			6.14	
	D: 7.48				.598
	8.00				.860
	9.00				1.48
	10.00				2.22
	13.00				5.13
	16.00			7.88	10.2
	20.00			13.3	
	25.00		15.6	21.1	
	30.00		24.6		
	35.00		39.8		
	40.00	32.8	60.8		
	50.00	67.2			
DELTA K MAX	A: 56.83	95.6			
	B: 41.40		67.5		
	C: 28.99			32.5	
	D: 18.26				17.6
ROOT MEAN SQUARE PERCENT ERROR		16.65	12.77	9.57	19.18
LIFE PREDICTION RATIO SUMMARY (NP/NA)	0.0-0.5				
	0.5-0.8				
	0.8-1.25	3	4	4	3
	1.25-2.0	1			1
	>2.0				

CONDITION/HT: DA
FORM: 0.05"TH SHEET
SPECIMEN TYPE: CCP
ORIENTATION: L-T
FREQUENCY: 1.00- 30.00 HZ
ENVIRONMENT: R.T., LAB AIR

YIELD STRENGTH: 133.7- 138.3 KSI
ULT. STRENGTH: 150.7- 152.1 KSI
SPECIMEN THK: 0.050"
SPECIMEN WIDTH: 2.000- 7.992"
REFERENCES: 86098

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TI-8AL-1MO-1V

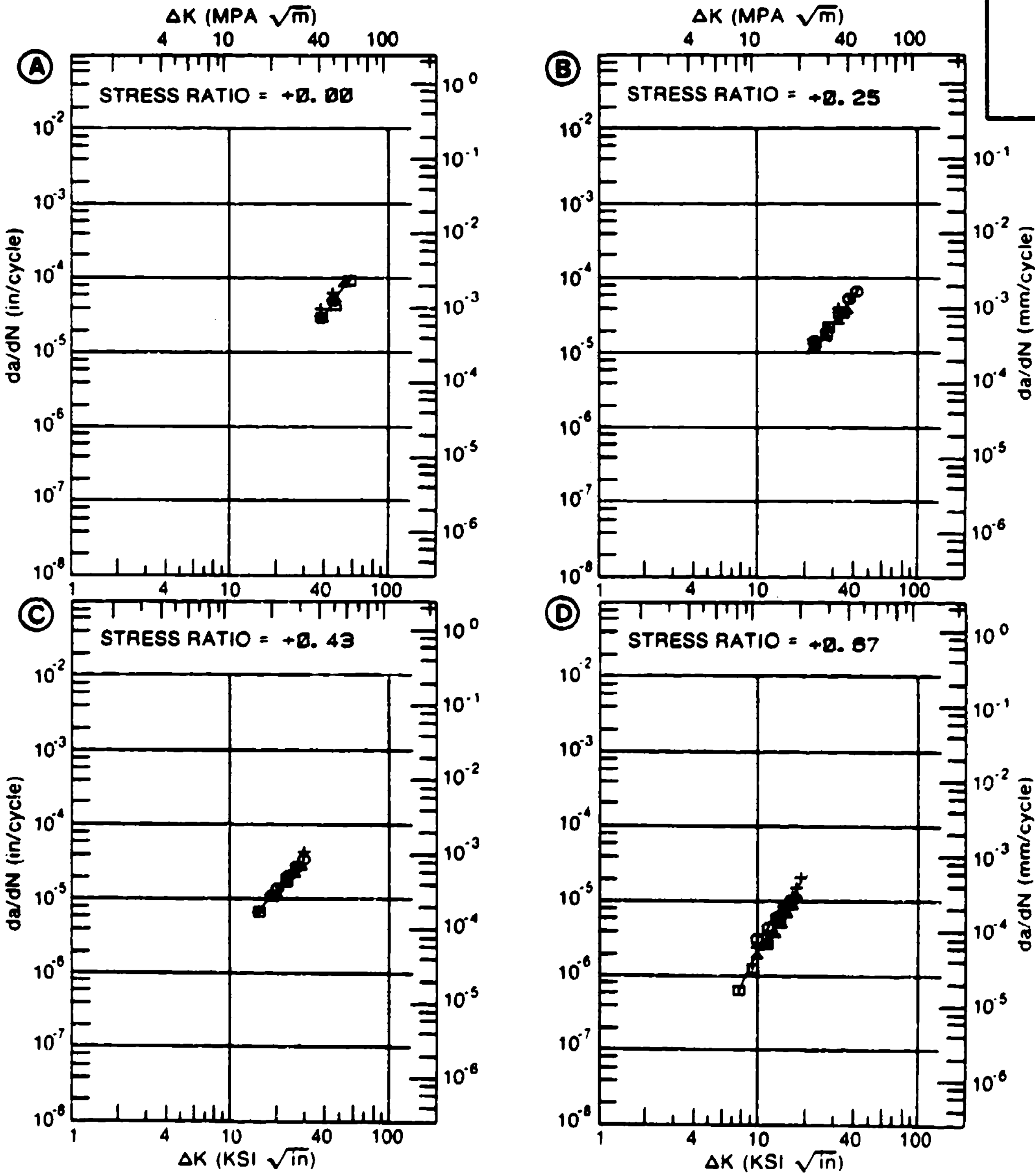

Figure 4.16.3.4

TABLE 4.16.3.5

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 4.16.3.5 INDICATING EFFECT

OF STRESS RATIO

MATERIAL: TITANIUM TI-8AL-1MO-1V
CONDITION: MA
ENVIRONMENT: R.T. ,LAB AIR

DELTA K (KSI*IN**1/2)		DA/DN (10**-6 IN./CYCLE) A	B	C	D
		R=+0.10			
DELTA K MIN A:	19.10	6.63			
B:					
C:					
D:					
	20.00	7.47			
	25.00	10.2			
	30.00	24.4			
	35.00	54.3			
DELTA K MAX A:	39.05	87.0			
B:					
C:					
D:					
ROOT MEAN SQUARE PERCENT ERROR		28.77			
LIFE PREDICTION RATIO SUMMARY (NP/NA)	0.0-0.5				
	0.5-0.8	1			
	0.8-1.25	1			
	1.25-2.0				
	>2.0				

CONDITION/HT: MA
FORM: 0.02"TH SHEET
SPECIMEN TYPE: CCP
ORIENTATION: L-T
FREQUENCY: 43.00 HZ
ENVIRONMENT: R.T., LAB AIR

YIELD STRENGTH: 154.9 KSI
ULT. STRENGTH: 159.2 KSI
SPECIMEN THK: 0.019"
SPECIMEN WIDTH: 3.000"
REFERENCES 00000

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TI-8AL-1MO-1V

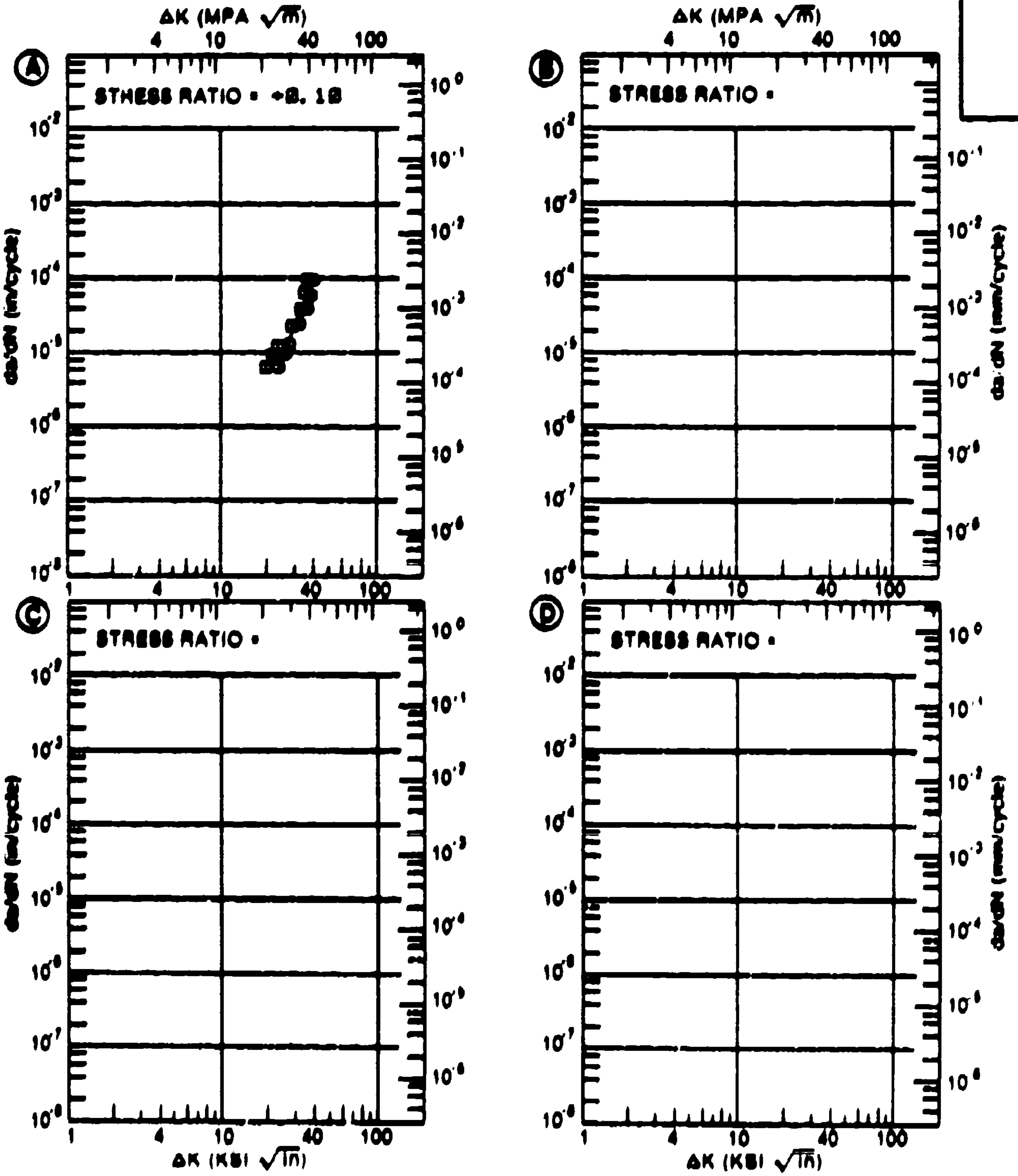

Figure 4.10.1.5

TABLE 4.16.3.6

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 4.16.3.6 INDICATING EFFECT

OF STRESS RATIO

MATERIAL: TITANIUM TI-8AL-1MO-1V
CONDITION: 1825F 1HR AC, 1350F 2HRS AC
ENVIRONMENT: R.T. ,LAB AIR

DELTA K (KSI*IN**1/2)		DA/DN (10**-6 IN./CYCLE) A R=+0.00	B R=+0.04	C R=+0.54	D
DELTA K MIN A:	13.50	2.16			
B:	6.37		.0417		
C:	10.39			2.48	
D:					
	7.00		.0911		
	8.00		.214		
	9.00		.379		
	10.00		.581		
	13.00		1.60	6.62	
	16.00	2.86	4.92	19.0	
	20.00	10.6			
	25.00	23.3			
	30.00	75.2			
DELTA K MAX A:	31.31	107.			
B:	19.64		28.6		
C:	16.74			21.9	
D:					
ROOT MEAN SQUARE PERCENT ERROR		17.10	20.60	11.15	

LIFE PREDICTION RATIO SUMMARY (NP/NA)	
	0.0-0.5
	0.5-0.8
	0.8-1.25
	1.25-2.0
	>2.0

CONDITION/HT: 1825F 1HR AC, 1350F 2HRS AC
FORM: 2.50"TH FAN BLADES
SPECIMEN TYPE: KB BAR
ORIENTATION: L-T
FREQUENCY: 0.33 HZ
ENVIRONMENT: R.T., LAB AIR

YIELD STRENGTH: 120.0 KSI
ULT. STRENGTH:
SPECIMEN THK: 0.251- 0.253"
SPECIMEN WIDTH: 0.750"
REFERENCES: GE006

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TI-6AL-1MO-1V

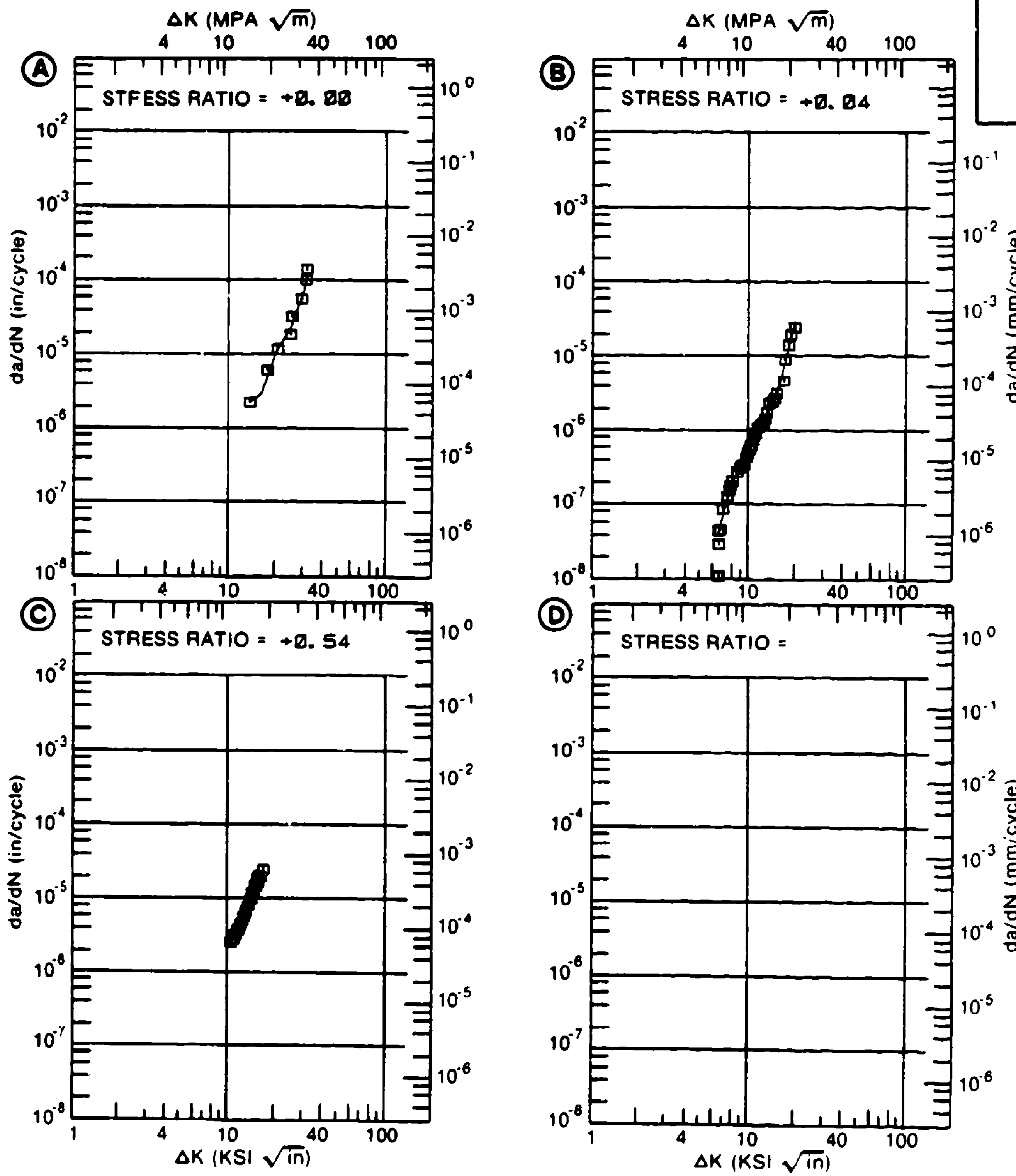

Figure 4.16.3.6

TABLE 4.16.3.7

FATIGUE CRACK GROWTH RATES AT DEFINED LEVELS OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 4.16.3.7 INDICATING EFFECT

OF ENVIRONMENT

MATERIAL: TITANIUM TI-8AL-1MO-1V
CONDITION: 1830F 1HR WQ, 1100F 8HRS AC

DELTA K (KSI*IN**1/2)			DA/DN (10**-6 IN./CYCLE) A	B	C	D
			E= R.T. LAB AIR	E=+ 800F AIR		
	A:	4.09	.0338			
DELTA K MIN	B:	5.78		.455		
	C:					
	D:					
		5.00	.107			
		6.00	.200	.450		
		7.00	.355	.484		
		8.00	.598	.591		
		9.00	.967	.769		
		10.00	1.50	1.03		
		13.00	4.70	2.51		
		16.00		5.52		
	A:	15.89	11.5			
DELTA K MAX	B:	19.11		10.7		
	C:					
	D:					
ROOT MEAN SQUARE PERCENT ERROR			10.00	8.96		

LIFE PREDICTION RATIO SUMMARY (NP/NA)	
	0.0-0.5
	0.5-0.8
	0.8-1.25
	1.25-2.0
	>2.0

CONDITION/HT: 1830F 1HR WQ. 1100F 8HRS AC
FORM: 1.00"TH FORGING
SPECIMEN TYPE: CCP
ORIENTATION: C-R
STRESS RATIO: +0.10
FREQUENCY: 30.00 HZ

YIELD STRENGTH: 135.5- 145.8 KSI
ULT. STRENGTH: 148.5- 159.3 KSI
SPECIMEN THK: 0.078- 0.080"
SPECIMEN WIDTH: 1.750"
REFERENCES: PW002

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TI-8AL-1MO-1V

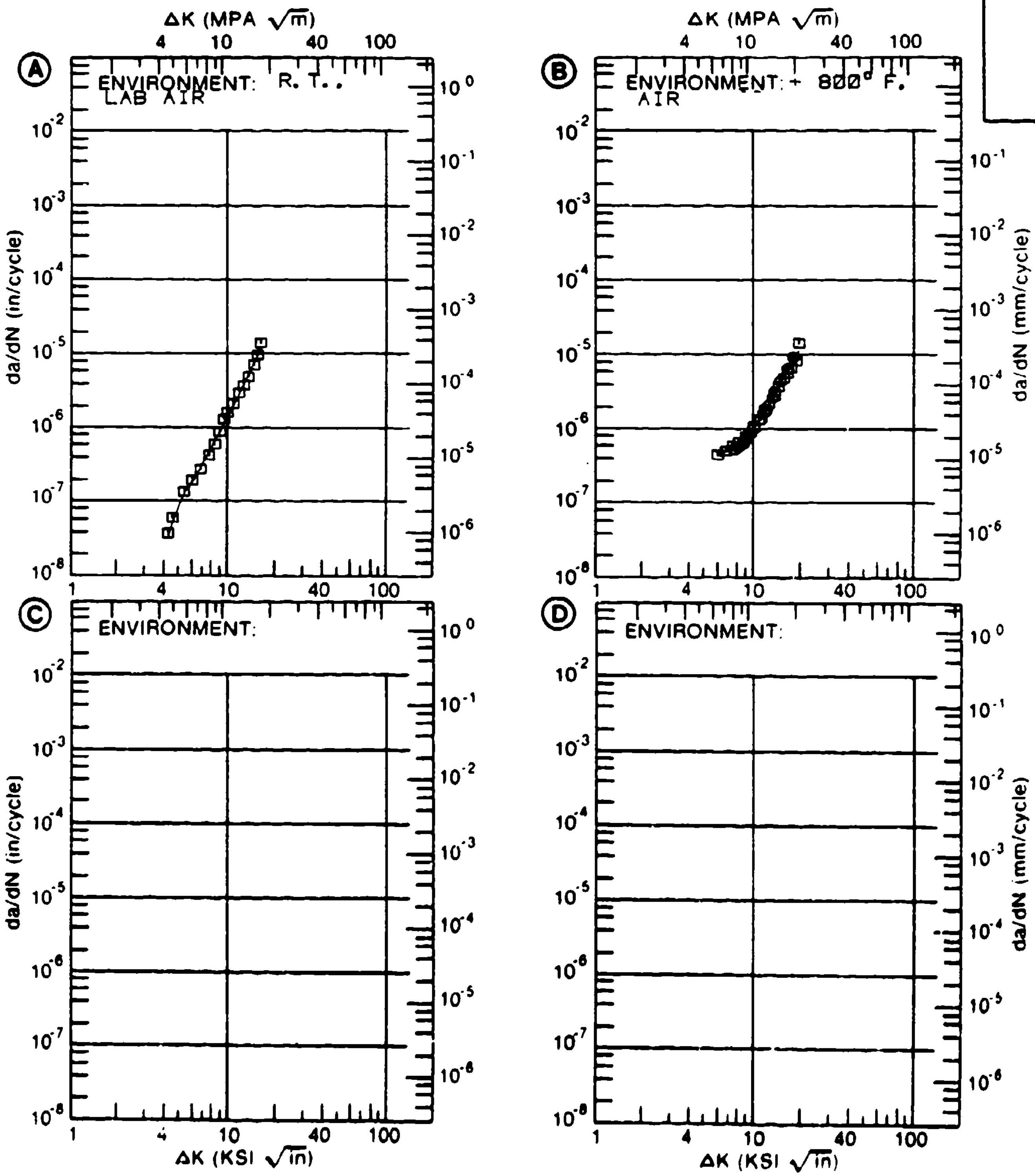

Figure 4.16.3.7

TABLE 4.16.3.8

SUSTAINED CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 4.16.3.8 INDICATING EFFECT

OF ENVIRONMENT

MATERIAL: TITANIUM TI-8AL-1MO-1V
CONDITION:

K MAX (KSI*IN**1/2)			DA/DT (10**-3 IN/HOUR) A	B	C	D
			E= DRY CCL4	E= WATER SAT CCL4		
K MAX MIN	A:	28.00	581.			
	B:	29.50		855.		
	C:					
	D:					
		30.00	751.	896.		
		35.00	1259.	1149.		
		40.00	1854.	1358.		
		50.00	3149.	2767.		
		60.00	4395.	5272.		
		70.00	5470.			
K MAX MAX	A:	74.50	5887.			
	B:	67.50		6317.		
	C:					
	D:					
ROOT MEAN SQUARE PERCENT ERROR			19.95	19.48		

CONDITION/HT:
FORM:
SPECIMEN TYPE: SENT
ORIENTATION:
YIELD STRENGTH:
ULT. STRENGTH:

SPECIMEN THK:
SPECIMEN WIDTH:
CRACK LENGTH (A_0):
K_{ISCC}:
REFERENCES:82851

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TI-8AL-1MO-1V

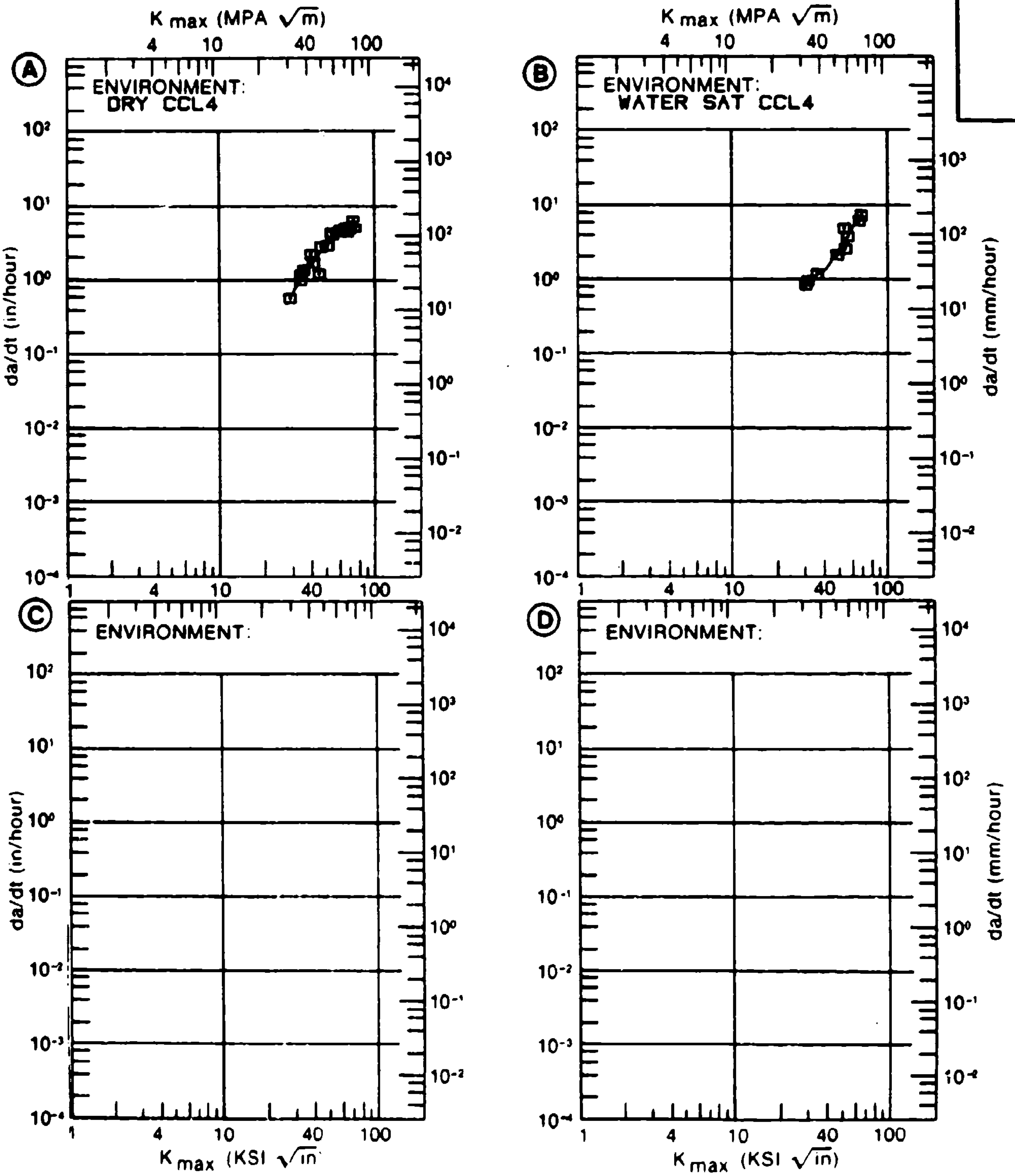

Figure 4.16.3.8

TABLE 4.16.3.9

SUSTAINED CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 4.16.3.9 INDICATING EFFECT

OF ENVIRONMENT

MATERIAL: TITANIUM TI-8AL-1MO-1V
CONDITION:

K MAX (KSI*IN**1/2)			DA/DT (10**-3 IN/HOUR) A	B	C	D
			E= DRY CH2CL2	E= WATER SAT CH2CL2	E= DRY CH2I2	
K MAX MIN	A:					
	B:					
	C:	28.50			1394.	
	D:					
		30.00			1601.	
		35.00			2163.	
		40.00			2507.	
		50.00			2739.	
		60.00			2740.	
K MAX MAX	A:					
	B:					
	C:	70.00			2753.	
	D:					
ROOT MEAN SQUARE PERCENT ERROR			0.00	0.00	1.14	

CONDITION/HT:
FORM:
SPECIMEN TYPE: SENT
ORIENTATION:
YIELD STRENGTH:
ULT. STRENGTH:

SPECIMEN THK:
SPECIMEN WIDTH:
CRACK LENGTH (A_0):
K_{ISCC}:
REFERENCES:82851

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TI-8AL-1MO-1V

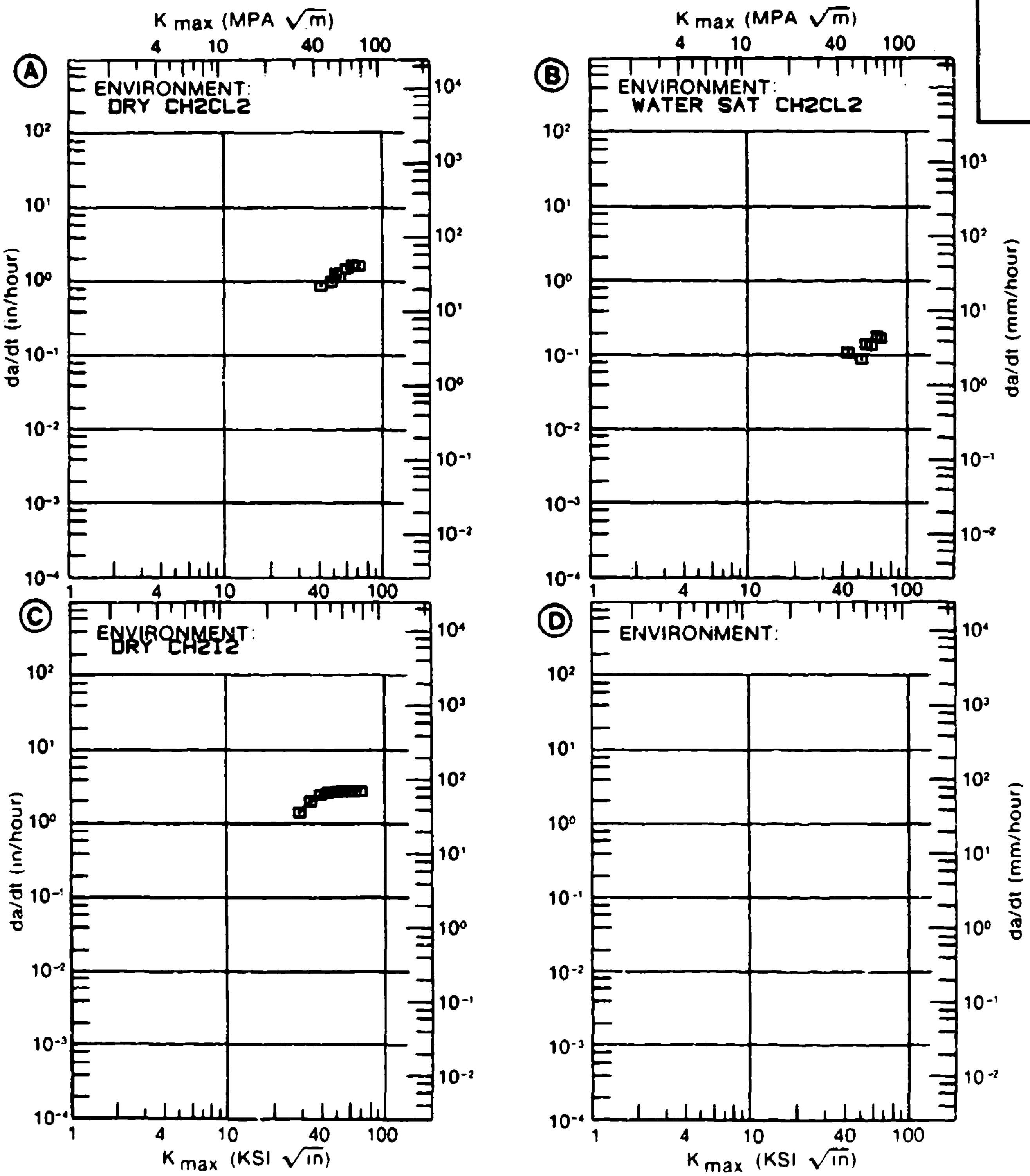

Figure 4.16.3.9

TABLE 4.16.3.10

SUSTAINED CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 4.16.3.10 INDICATING EFFECT

OF ENVIRONMENT

MATERIAL: TITANIUM TI-8AL-1MO-1V
CONDITION:

K MAX (KSI*IN**1/2)	DA/DT (10**-3 IN/HOUR) A	B	C	D
	E= 3.5% NACL			
K MAX MIN A:				
B:				
C:				
D:				
200.00				
K MAX MAX A:				
B:				
C:				
D:				
ROOT MEAN SQUARE PERCENT ERROR	0.00			

CONDITION/HT:
FORM: 0.1"TH SHEET
SPECIMEN TYPE: SENT
ORIENTATION:
YIELD STRENGTH: 150.0 KSI
ULT. STRENGTH:

SPECIMEN THK: 0.125"
SPECIMEN WIDTH: 3.000"
CRACK LENGTH (A_0):
K_{ISCC}: 22.00 KSI (SQRT IN)
REFERENCES:77456

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TI-8AL-1MO-1V

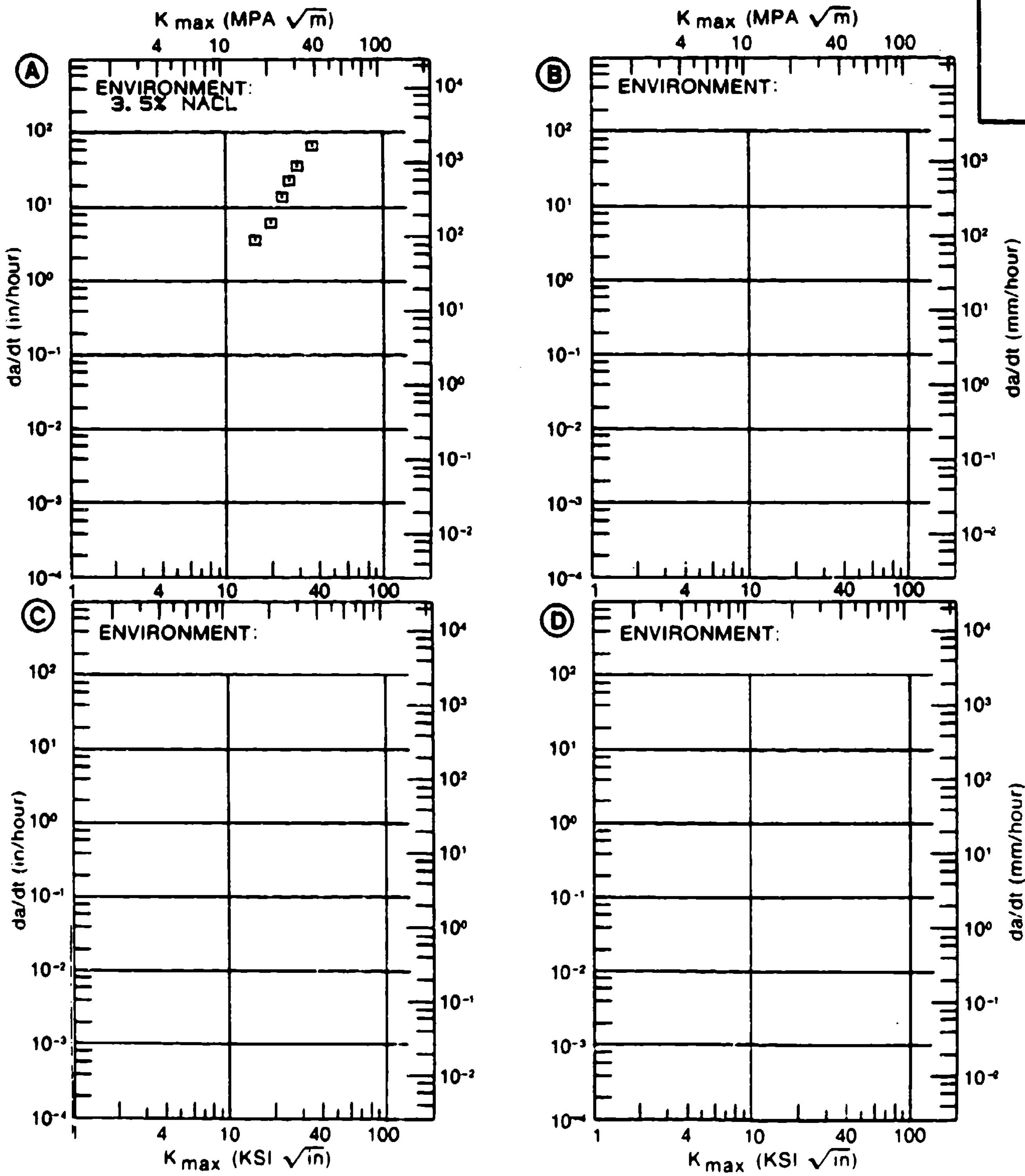

Figure 4.16.3.10

TABLE 4.16.3.11

SUSTAINED CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 4.16.3.11 INDICATING EFFECT

OF ENVIRONMENT

MATERIAL: TITANIUM TI-8AL-1MO-1V
CONDITION: MA

K MAX (KSI*IN**1/2)			DA/DT (10**-3 IN/HOUR) A	B	C	D
			E= 3.5% NACL			
K MAX MIN	A:	20.80	59.2			
	B:					
	C:					
	D:					
		25.00	11168.			
K MAX MAX	A:	29.50	29280.			
	B:					
	C:					
	D:					

ROOT MEAN SQUARE PERCENT ERROR 59.14

CONDITION/HT: MA
FORM: 0.1"TH SHEET
SPECIMEN TYPE:
ORIENTATION:
YIELD STRENGTH: 145.0 KSI
ULT. STRENGTH:

SPECIMEN THK: 0.180"
SPECIMEN WIDTH: 8.000"
CRACK LENGTH (A_0):
K_{ISCC}: 21.00 KSI (SQRT IN)
REFERENCES:84290

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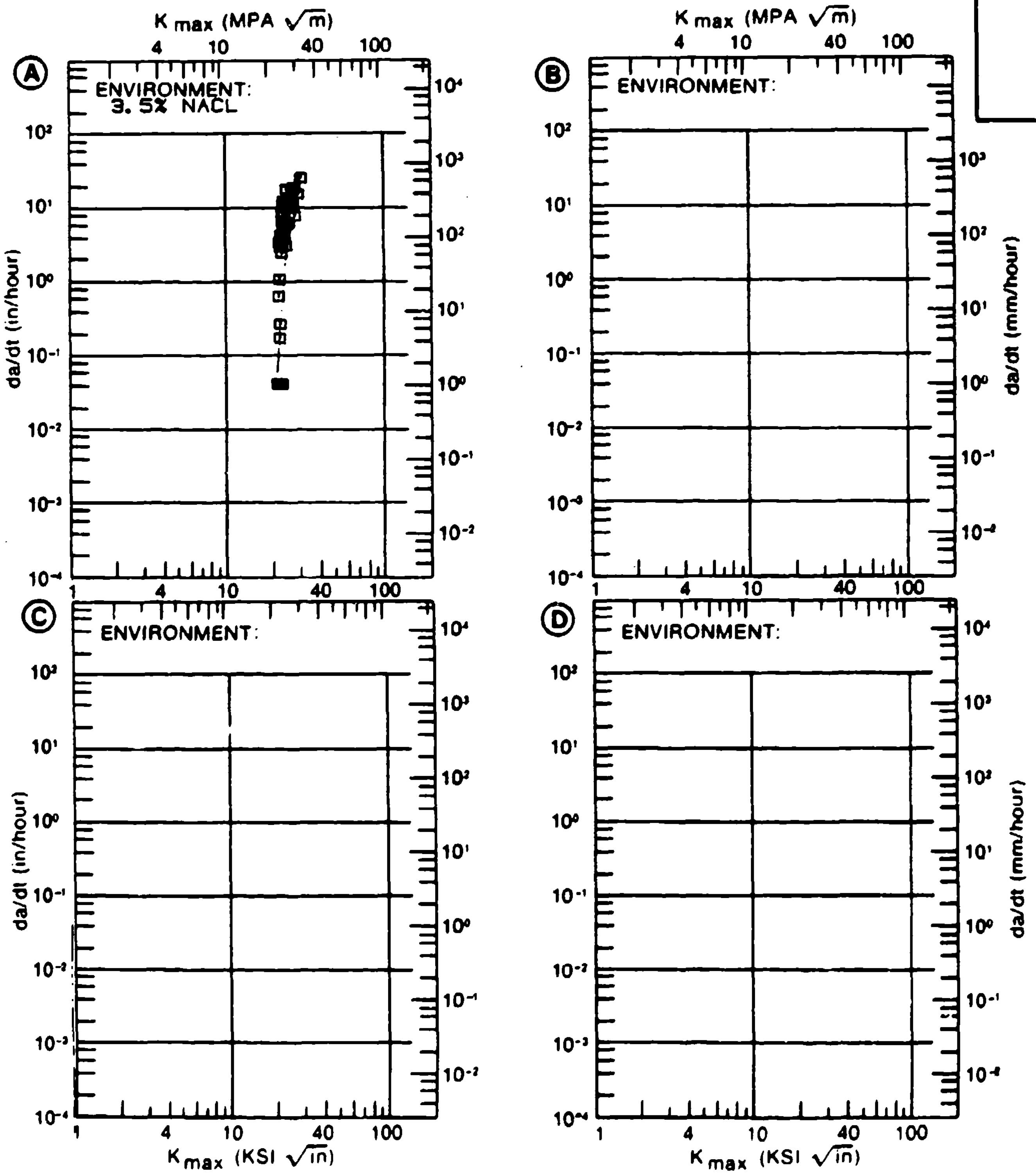

Figure 4.16.3.11

TABLE 4.16.3.12

SUSTAINED CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 4.16.3.12 INDICATING EFFECT

OF ENVIRONMENT

MATERIAL: TITANIUM TI-8AL-1MO-1V
CONDITION: MA

K MAX (KSI*IN**1/2)			DA/DT (10**-3 IN/HOUR) A	B	C	D
			E- DIST. WATER			
K MAX MIN	A:	20.00	10.0			
	B:					
	C:					
	D:					
		25.00	118.			
		30.00	601.			
		35.00	1289.			
		40.00	1533.			
K MAX MAX	A:	49.00	1610.			
	B:					
	C:					
	D:					

ROOT MEAN SQUARE PERCENT ERROR 25.16

CONDITION/HT: MA
FORM: 0.2"TH PLATE
SPECIMEN TYPE: SENT
ORIENTATION:
YIELD STRENGTH:
ULT. STRENGTH:

SPECIMEN THK: 0.200"
SPECIMEN WIDTH: 2.000"
CRACK LENGTH (A_0):
K_{Iscc}:
REFERENCES:81741

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TI-8AL-1MO-1V

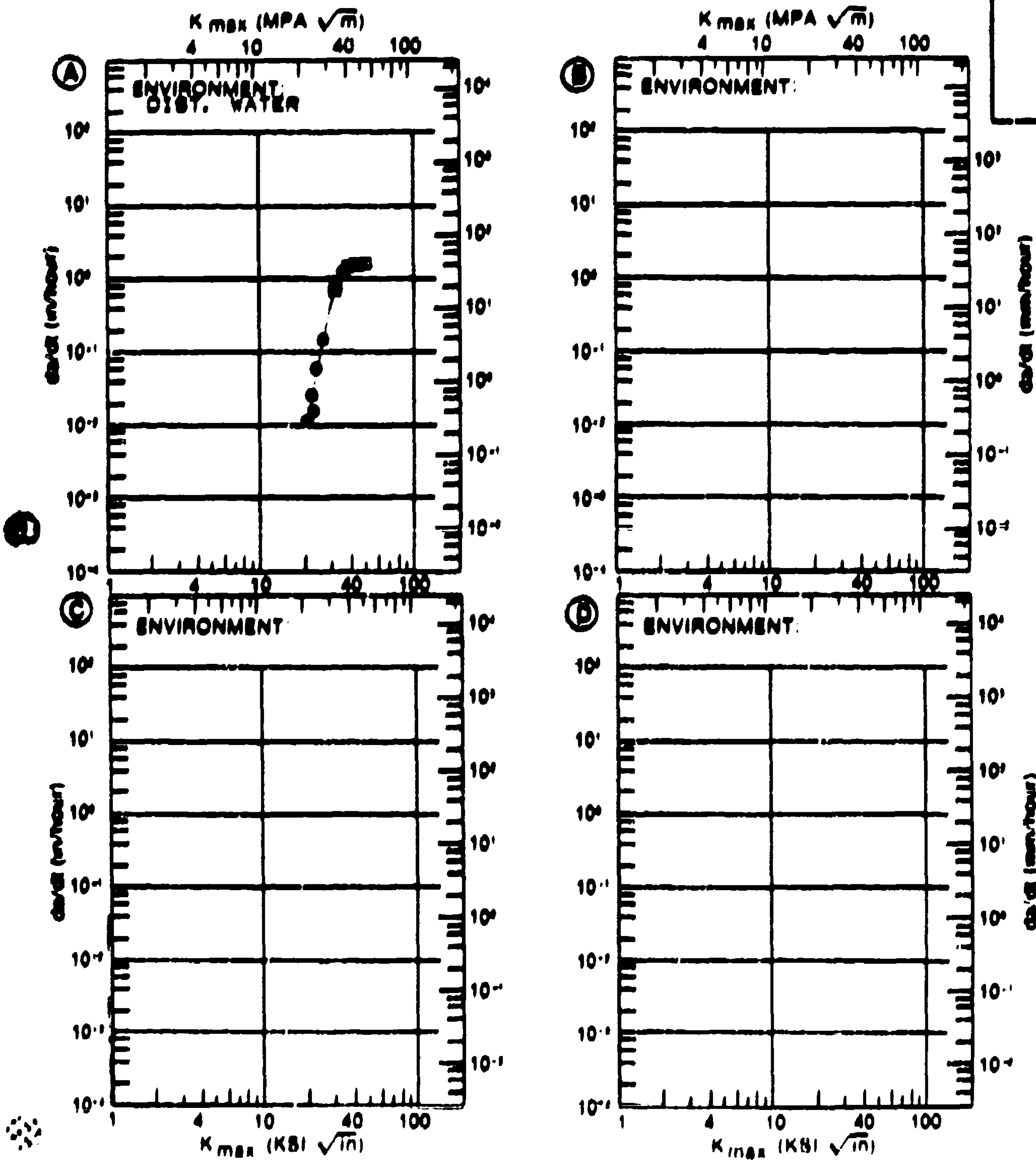

Figure 4.16.1.17

TABLE 4.16.3.13

SUSTAINED CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 4.16.3.13 INDICATING EFFECT
OF ENVIRONMENT

MATERIAL: TITANIUM TI-8AL-1MO-1V
CONDITION: 1520F 1HR WQ

K MAX (KSI*IN**1/2)			DA/DT (10**-3 IN/HOUR) A: E= R.T. 9MHCL TICL3	B: E= R.T. DIST. WATER	C: E= R.T. METHANOL	D
K MAX MIN	A:	16.00	430.			
	B:	26.00		93.3		
	C:	12.00			1.98	
	D:					
		13.00			5.76	
		16.00			42.1	
		20.00	1875.		129.	
		25.00	3467.		172.	
		30.00	4989.	182.	197.	
		35.00	6257.	330.	188.	
		40.00	7222.	498.	189.	
		50.00	8360.	672.	256.	
K MAX MAX	A:	60.00	8778.			
	B:	60.00		604.		
	C:	60.00			527.	
	D:					
ROOT MEAN SQUARE PERCENT ERROR			18.81	10.02	26.51	

CONDITION/HT: 1520F 1HR WQ
FORM: 0.2"TH PLATE
SPECIMEN TYPE: DCB
ORIENTATION:
YIELD STRENGTH: 124.0 KSI
ULT. STRENGTH:

SPECIMEN THK: 0.250"
SPECIMEN WIDTH:
CRACK LENGTH (A_0):
K_{ISCC}:
REFERENCES: 83689

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TI-8AL-1MO-1V

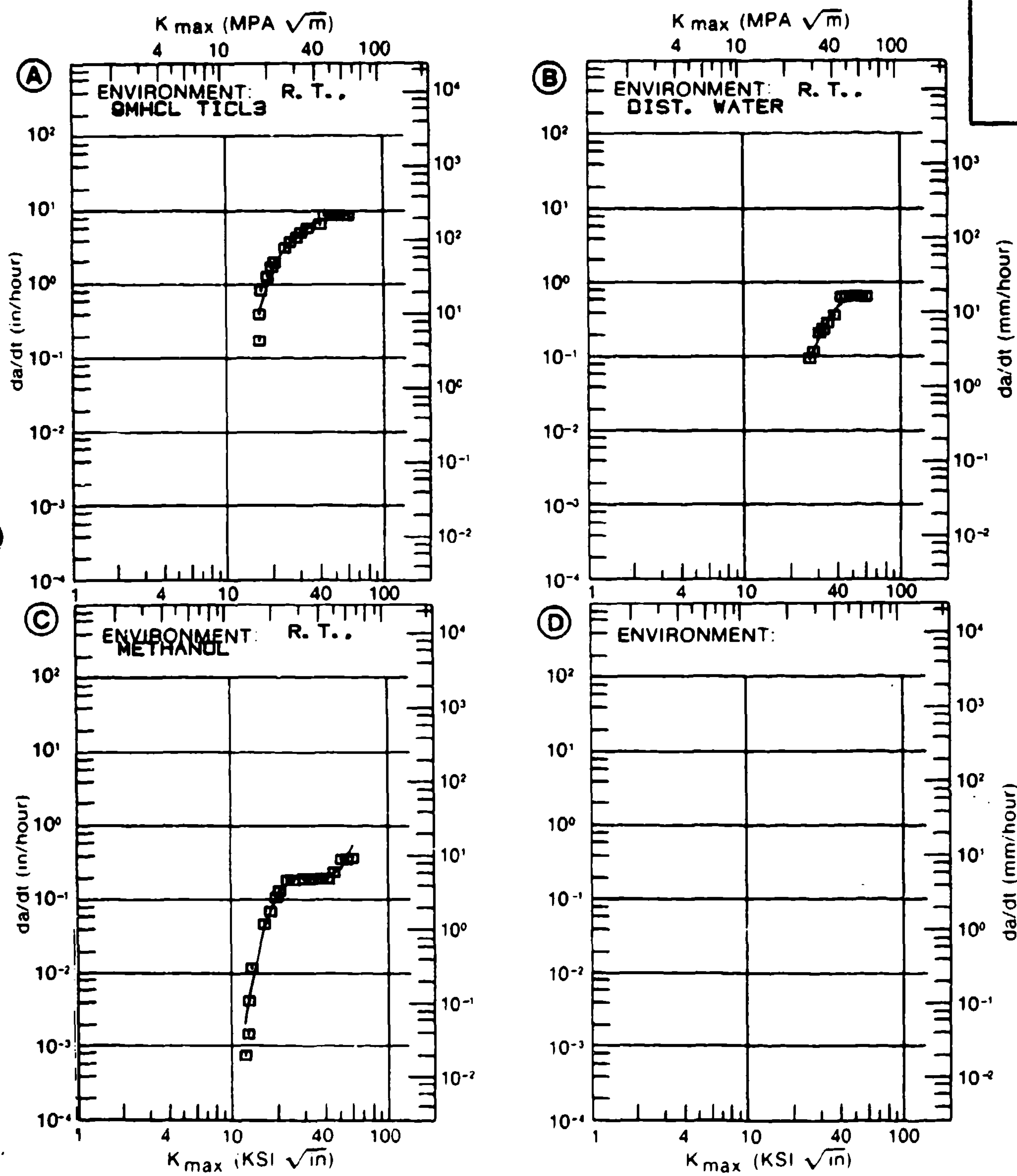

Figure 4.16.3.13

TABLE 4.16.3.14

SUSTAINED CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 4.16.3.14 INDICATING EFFECT

OF ENVIRONMENT

MATERIAL: TITANIUM TI-6AL-1MO-1V
CONDITION: 1520F 1HR WQ

K MAX (KSI*IN**1/2)			DA/DT (10**-3 IN/HOUR) A	B	C	D
			E= R.T. TI CL4	E= R.T. GLYCERINE	E= R.T. HNO3	
K MAX MIN	A:	16.80	15.2			
	B:	26.00		1.64		
	C:	33.80			1.35	
	D:					
		20.00	23.4			
		25.00	32.1			
		30.00	37.0	1.92		
		35.00	40.3	3.14	1.46	
		40.00	44.0	5.32	2.44	
		50.00	56.3	10.2	6.40	
K MAX MAX	A:	60.00	81.2			
	B:	60.00		9.11		
	C:	60.00			7.20	
	D:					
ROOT MEAN SQUARE PERCENT ERROR			19.57	18.00	16.69	

CONDITION/HT: 1520F 1HR, WQ
FORM: 0.2"TH PLATE
SPECIMEN TYPE: DCB
ORIENTATION:
YIELD STRENGTH: 124.0 KSI
ULT. STRENGTH:

SPECIMEN THK: 0.250"
SPECIMEN WIDTH:
CRACK LENGTH (A_0):
K_{Iscc}:
REFERENCES: 83089

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TI-8AL-1MO-1V

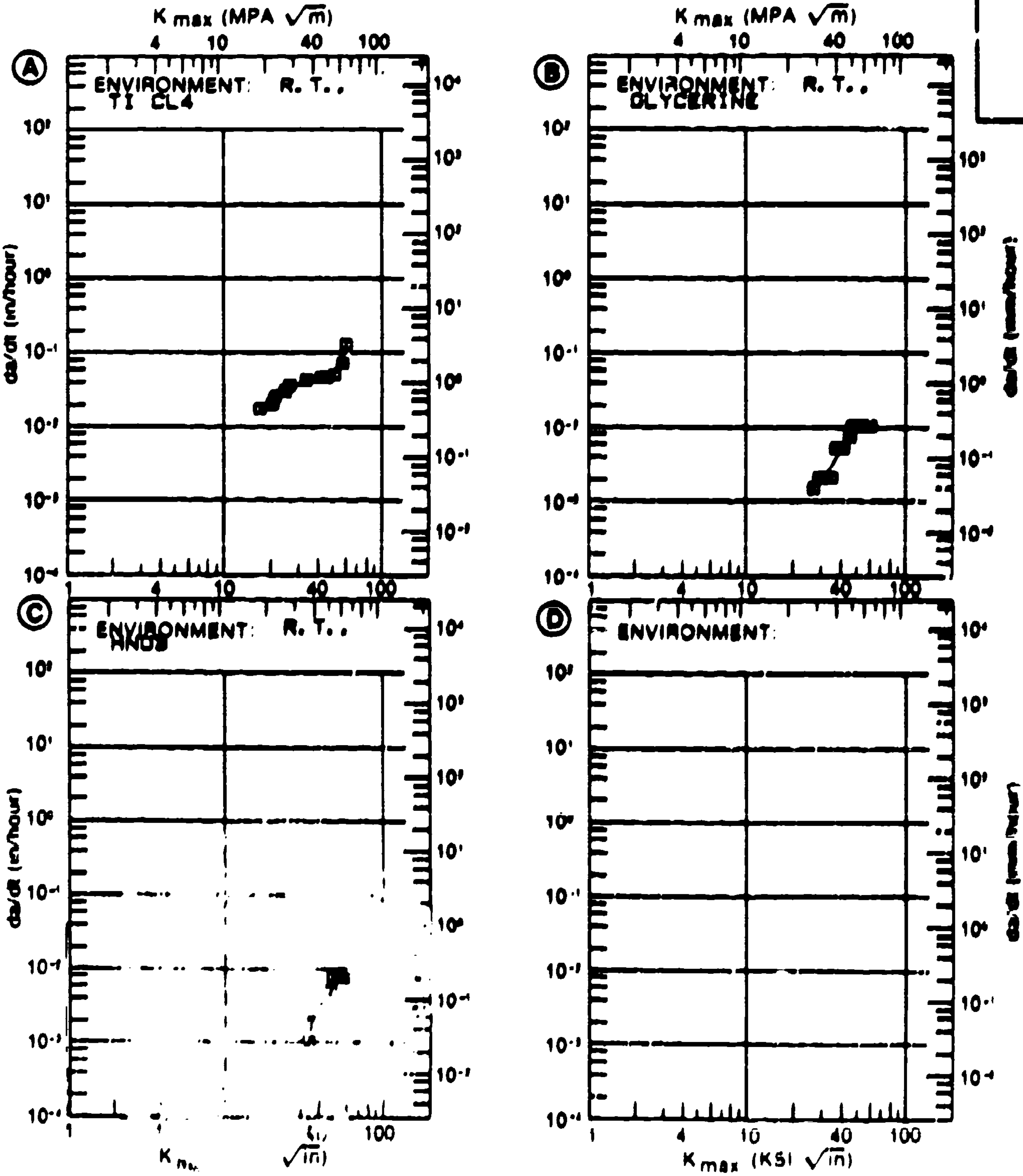

Figure 4.16.3.14

TABLE 4.16.3.15

SUSTAINED CRACK GROWTH RATES AT DEFINED LEVELS OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 4.16.3.15 INDICATING EFFECT OF ENVIRONMENT

MATERIAL: TITANIUM TI-8AL-1MO-1V
CONDITION: 1520F 1HR WQ

K MAX (KSI*IN**1/2)			DA/DT (10**-3 IN/HOUR) A: E= R.T. 5H2O/1HCL, -1000 MV	B: E= R.T. 5H2O/1HCL, -400 MV	C: E= R.T. 5H2O/1HCL, -200 MV	D
K MAX MIN	A:	17.00	12.6			
	B:	15.70		29.0		
	C:	49.50			5910.	
	D:					
		16.00		35.1		
		20.00	1621.	1310.		
		25.00	2968.	2062.		
		30.00	4042.	2828.		
		35.00	4890.	3618.		
		40.00	5667.	4463.		
		50.00	7553.	6450	5861.	
		60.00	10704.	9081.	15121.	
K MAX MAX	A	70.00	16458.			
	B	68.00		11888.		
	C	70.00			19986.	
	D					
ROOT MEAN SQUARE PERCENT ERROR			19.71	20.45	8.15	

CONDITION/HT: 1520F 1HR WQ
FORM: 0.2"TH PLATE
SPECIMEN TYPE: DCB
ORIENTATION: T-L
YIELD STRENGTH: 124.0 KSI
ULT. STRENGTH:

SPECIMEN THK: 0.250"
SPECIMEN WIDTH: 1.000"
CRACK LENGTH (A_0): 0.985"
K_{ISCC}:
REFERENCES: 83689

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TI-8AL-1MO-1V

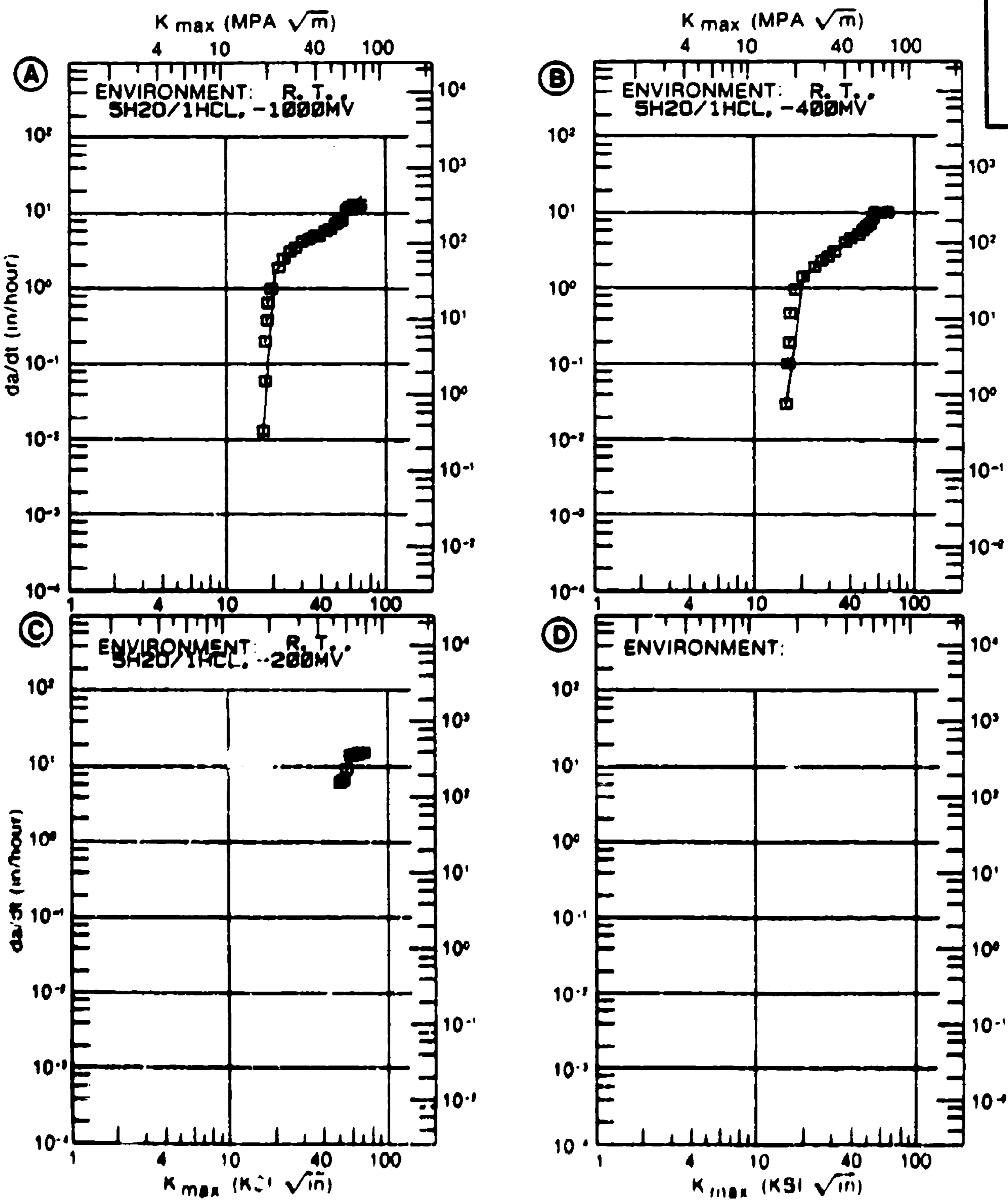

Figure 4.10.3.15

TABLE 4.16.3.16

SUSTAINED CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 4.16.3.16 INDICATING EFFECT
OF ENVIRONMENT

MATERIAL: TITANIUM TI-8AL-1MO-1V
CONDITION: 1520F 1HR WQ

K MAX (KSI*IN**1/2)			DA/DT (10**-3 IN/HOUR) A	B	C	D
			E= R.T. 5H2O/1HCL, +500 MV	E= R.T. 5H2O/1HCL, +1000 MV	E= R.T. 5H2O/1HCL, -1.9 TO -1.5	
	A:					
K MAX	B:					
MIN	C:	46.50			4942.	
	D:					
		50.00			5303.	
		60.00			5814.	
	A:					
K MAX	B:					
MAX	C:	70.00			5752.	
	D:					
ROOT MEAN SQUARE PERCENT ERROR			0.00	0.00	1.65	

CONDITION/HT: 1520F 1HR WQ
FORM: 0.2"TH PLATE
SPECIMEN TYPE: DCB
ORIENTATION: T-L
YIELD STRENGTH: 124.0 KSI
ULT. STRENGTH:

SPECIMEN THK: 0.250"
SPECIMEN WIDTH: 1.000"
CRACK LENGTH (A_0): 0.985"
K_{ISCC}:
REFERENCES: 83688

TITAN. ALLOY

TI-8AL-1MO-1V

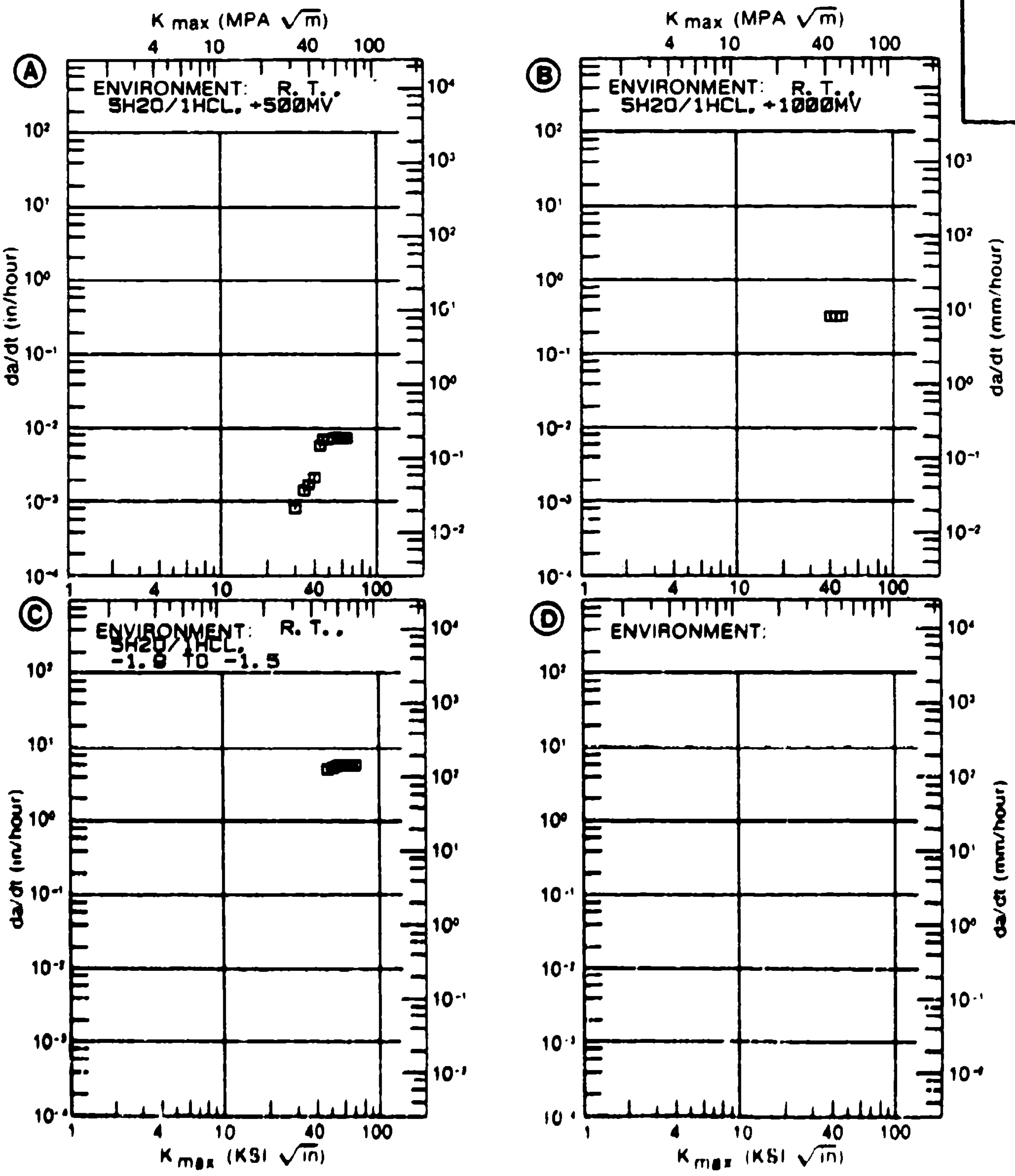

Figure 4.10.3.10

TABLE 4.16.3.17

SUSTAINED CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 4.16.3.17 INDICATING EFFECT
OF ENVIRONMENT

MATERIAL: TITANIUM TI-8AL-1MO-1V
CONDITION: 1725F FC, 1200F 3HR WQ

K MAX (KSI*IN**1/2)			DA/DT (10**-3 IN/HOUR) A E= 21000PPM CL 32F	B E= 21000PPM CL 72F	C E= 21000PPM CL 140F	D E= 121000PPM CL 200F
K MAX MIN	A:	21.00	3113.			
	B:	17.00		5014.		
	C:					
	D:					
		20.00		7759.		
		25.00	4963.	11801.		
		30.00	6674.	14738.		
		35.00	7737.	16734.		
		40.00	8432.	18121.		
		50.00	9637.	20090.		
		60.00	11481.			
K MAX MAX	A:	61.00	11729.			
	B:	57.00		21366.		
	C:					
	D:					
ROOT MEAN SQUARE PERCENT ERROR			6.18	3.03	0.00	0.00

CONDITION/HT: 1725F FC. 1200F 3HR WQ
FORM: 0.2"TH PLATE
SPECIMEN TYPE: CANT
ORIENTATION: T-L
YIELD STRENGTH:
ULT. STRENGTH:

SPECIMEN THK: 0.250"
SPECIMEN WIDTH: 2.000"
CRACK LENGTH (A_O): 0.250"
K_{ISCC}:
REFERENCES: 85855

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TI-8AL-1MO-1V

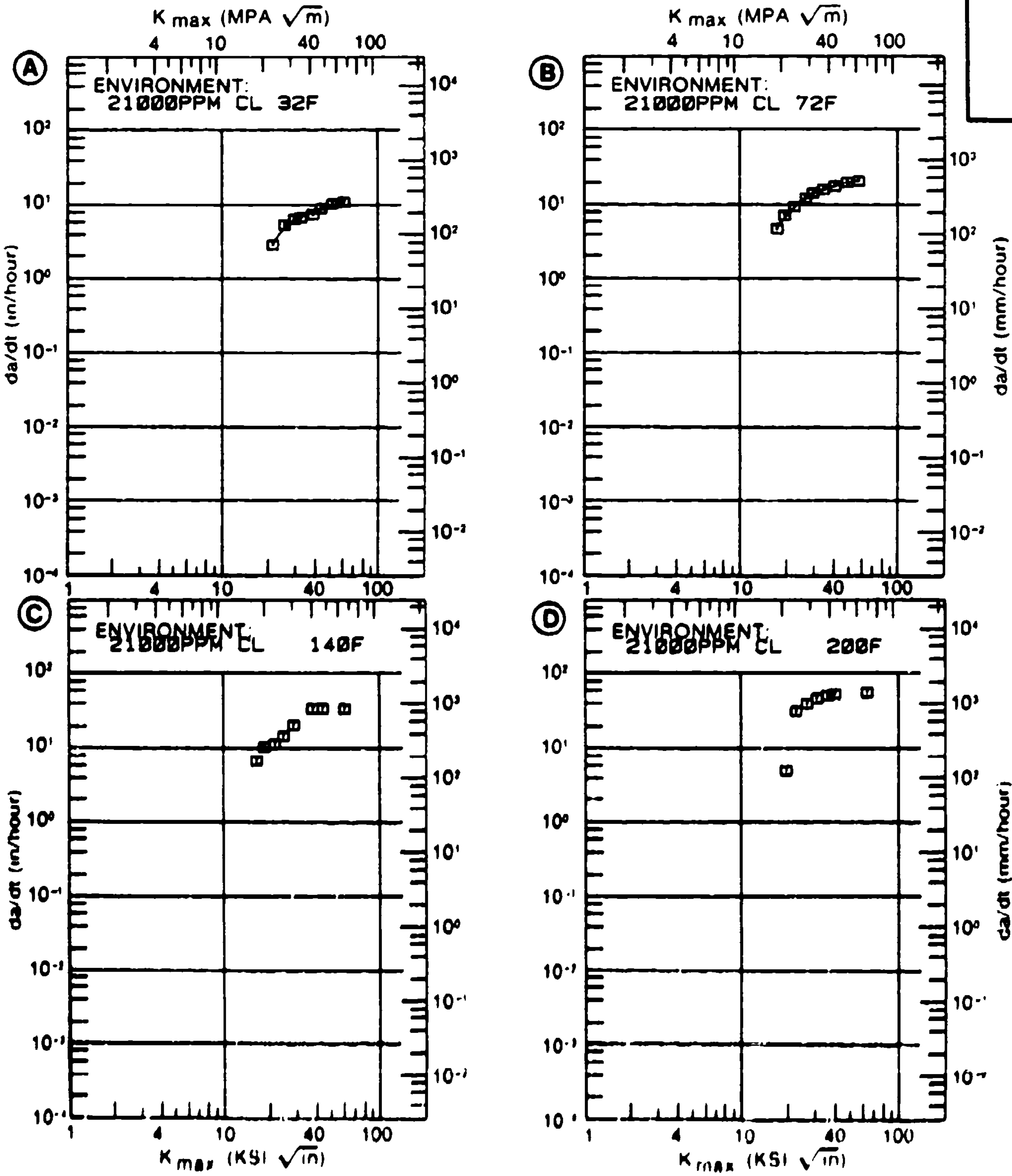

Figure 4.16.3.17

TABLE 4.16.3.18

SUSTAINED CRACK GROWTH RATES AT DEFINED LEVELS
OF STRESS INTENSITY FACTOR

DATA ASSOCIATED WITH FIGURE 4.16.3.18 INDICATING EFFECT

OF ENVIRONMENT

MATERIAL: TITANIUM TI-6AL-1MO-1V
CONDITION: 1725F FC, 1200F 3HR WQ

K MAX (KSI*IN**1/2)			DA/DT (10**-3 IN/HOUR) A: E=+ 32F WATER, 0. 1PPM CL	B: E=+ 32F WATER, 100PPM CL	C: E=+ 32F WATER, 6000PPM CL	D: E=+ 32F WATER, 21000PPM CL
K MAX MIN	A:					
	B:					
	C:	22.00			4288.	
	D:	16.00				4246.
		20.00				6986.
		25.00			7535.	12536.
		30.00			11710.	15437.
		35.00			13591.	16541.
		40.00			14216.	17074.
		50.00			15481.	19061.
K MAX MAX	A:					
	B:					
	C:	58.00			18718.	
	D:	58.00				23086.
ROOT MEAN SQUARE PERCENT ERROR			0.00	0.00	7.67	13.28

CONDITION/HT: 1725F FC, 1200F 3HR WQ
FORM: 0.2"TH PLATE
SPECIMEN TYPE: CANT
ORIENTATION: T-L
YIELD STRENGTH: 150.0 KSI
ULT. STRENGTH:

SPECIMEN THK: 0.250"
SPECIMEN WIDTH: 2.000"
CRACK LENGTH (A_0): 0.250"
K_{ISCC}:
REFERENCES: 85055

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TI-8AL-1MO-1V

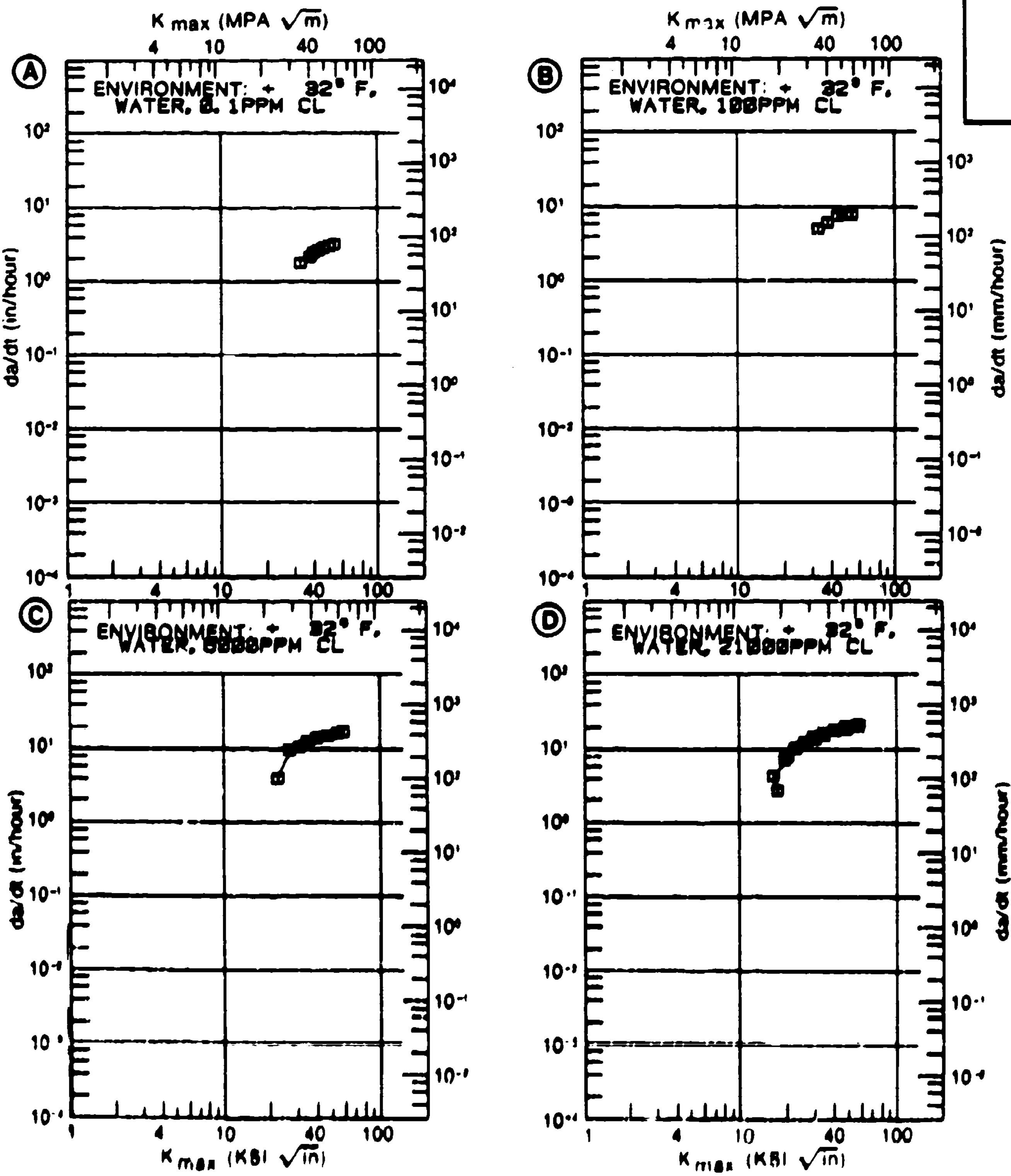

Figure 4.10.1.1H

TABLE 4.16.3.19

TITANIUM   TI-8AL-1MO-1V   K(ISCC)

CONDITION	PRODUCT FORM	PRODUCT THICK (IN)	TEST TEMP (F)	SPEC OR	YIELD STR (KSI)	ENVIRONMENT	SPECIMEN WIDTH (IN) W	SPECIMEN THICK (IN) B	SPECIMEN DESIGN (*=SC)	CRACK LENGTH (IN) A	K(Q) (KSI*SQRT IN)	K(ISCC) (KSI*SQRT IN)	MEAN	STAN DEV	TEST TIME (MIN)	DATE	REFER
------------	S	0.13	R T	T-S	130.0	3.5 PCT NACL	1.000	0.125	CANT	----	54.00	18.00			----	1967	70931
------------	P	---	R T	---	----	3.5 PCT NACL	----	----	CANT	----	100.00	38.00			----	1967	70887
MILL ANNEALED	P	0.50	R T	L-S	----	3.5 PCT NACL	----	----	NB	----	43.00	20.00			----	1969	73386
MILL ANNEALED	P	1.00	R T	T-S	123.0	3.5 PCT NACL	1.000	0.150	CANT*	----	73.00	46.00*			----	1967	84327
		1.00			123.0		1.000	0.250	CANT*	----	73.00	38.00			----	1967	84327
		1.00			123.0		1.000	0.250	CANT	----	73.00	61.00*			----	1967	84327
		1.00			123.0		1.000	0.500	CANT	----	83.00	41.00			----	1967	84327
		1.00			123.0		1.000	0.500	CANT*	----	83.00	41.00			----	1967	84327
		1.00			123.0		1.000	1.000	CANT*	----	83.00	38.00			----	1967	84327
		1.06			123.0		1.000	1.000	CANT	----	83.00	39.00			----	1967	84327
													39.4/	1.5			
MILL ANNEALED	S	0.13	R T	T-S	130.0	3.5 PCT NACL	3.000	0.125	SENT	----	33.50	32.00*			> 60	1969	77456
1475F 8HR FC		0.16			143.0		8.000	0.160	CNT	0.800	39.00	21.00			----	1967	70733
[illegible] ANNEALED	P	----	R T	T-L	135.0	HEXANE	1.000	0.270	CANT*	----	65.00	34.00			----	1968	84326
		----			135.0		1.000	0.270	CANT*	----	44.00	34.00			----	1968	84326
													34.0/	0.0			
[illegible] ANNEALED	P	----	R T	T-L	135.0	METHANOL	1.000	0.270	CANT*	----	44.00	23.00			----	1968	84326
		----			135.0		1.000	0.270	CANT*	----	102.00	22.00			----	1968	84326
		----			135.0		1.000	0.270	CANT*	----	65.00	23.00			----	1968	84326
													22.7/	0.6			
[illegible] ANNEALED	P	----	R T	T-L	135.0	3.5 PCT NACL	1.000	0.270	CANT*	----	102.00	27.00			----	1968	84326
		----			135.0		1.000	0.270	CANT*	----	44.00	23.00			----	1968	84326
		----			135.0		1.000	0.270	CANT*	----	65.00	23.00			----	1968	84326
													24.3/	2.3			
1550F 1HR WQ	P	0.25	-31	T-L	124.0	5 TO 1 SOLVENT TO SOLUTE RATIO	1.000	0.250	BCB	0.985	93.00	20.00			----	1962	83489
1[illegible] 1HR WQ	P	0.25	-15	T-L	124.0	WATER LICL	1.000	0.250	BCB	0.985	93.00	22.70			----	1962	83489

NOTE DATA WHICH DO NOT MEET MINIMUM SPECIMEN THICKNESS REQUIREMENTS OF 2.5(KISCC/TYS)SQUARED

TABLE 4.16.3.19 (Con't)

TITANIUM TI-6AL-6V-2SN? K(ISCC)

CONDITION	PRODUCT FORM	PRODUCT THICK (IN)	TEST TEMP (F)	SPEC OR	YIELD STR (KSI)	ENVIRONMENT	SPECIMEN WIDTH (IN) W	SPECIMEN THICK (IN) B	SPECIMEN DESIGN (C=DB)	CRACK LENGTH (IN) A	K(Q)	K(ISCC) (KSI-SQRT IN)	MEAN	STAN DEV	TEST TIME (HOUR)	DATE	REFER
[illegible]	P	0.25	72	T-L	124.0	CCL4	1.000	0.250	DCB	0.900	72.00	19.40			----	1962	[illegible]
[illegible]	P	0.25	27	T-L	124.0	WATER LIQ.	1.000	0.250	DCB	0.900	73.00	20.30			----	1962	[illegible]
[illegible]	P	0.25	36	T-L	124.0	WATER LIQ.	1.000	0.250	DCB	0.900	73.40	17.00			----	1962	[illegible]
[illegible]	P	0.25	36	T-L	124.0	WATER LIQ. @ [illegible]	1.000	0.250	DCB	0.900	72.00	23.10			----	1962	[illegible]
[illegible]	P	0.25	R T	T-L	124.0	AIR	1.000	0.250	DCB	0.900	73.00	36.00			----	1962	[illegible]
[illegible]	P	0.25	R T	T-L	124.0	CCL4	1.000	0.250	DCB	0.900	73.00	20.00			----	1962	[illegible]
[illegible]	P	0.25	R T	T-L	124.0	CHLOROFORM	1.000	0.250	DCB	0.900	73.00	21.00			----	1962	[illegible]
[illegible]	P	0.25	R T	T-L	124.0	[illegible] LIQ.	1.000	0.250	DCB	0.900	73.00	19.00			----	1962	[illegible]
[illegible]	P	0.25	R T	T-L	124.0	GLYCERIN	1.000	0.250	DCB	0.900	73.00	36.00			----	1962	[illegible]
[illegible]	P	0.25	R T	T-L	124.0	GLYCERINE LIQ.	1.000	0.250	DCB	0.900	73.00	19.00			----	1962	[illegible]
[illegible]	P	0.25	R T	T-L	124.0	HEXAMETHYL-PHOSPHORIC TRIAMIDE	1.000	0.250	DCB	0.900	73.00	27.00			----	1962	[illegible]
[illegible]	P	0.25	R T	T-L	124.0	METHANOL	1.000	0.250	DCB	0.900	73.00	13.00			----	1962	[illegible]
[illegible]	P	0.25	R T	T-L	124.0	METHANOL LIQ.	1.000	0.250	DCB	0.900	73.00	13.00			----	1962	[illegible]
[illegible]	P	0.25	R T	T-L	124.0	MIXED SOLVENTS 3 TO 1 SOLVENT TO SOLUTE RATIO FORMIC ACID	1.000	0.250	DCB	0.900	73.00	23.00			----	1962	[illegible]
[illegible]	P	0.25	R T	T-L	124.0	N,N-DIMETHYL-ACETAMIDE	1.000	0.250	DCB	0.900	73.00	30.60			----	1962	[illegible]
[illegible]	P	0.25	R T	T-L	124.0	WATER	1.000	0.250	DCB	0.900	73.00	36.00			----	1962	[illegible]
[illegible]	P	0.25	R T	T-L	124.0	WATER 3.5% NACL	1.000	0.250	DCB	0.900	73.00	21.40			----	1962	[illegible]

*NOTE DATA WHICH DO NOT MEET MINIMUM SPECIMEN THICKNESS REQUIREMENTS OF 2.5(K(ISCC)/TYS)SQUARED

TABLE 4.16.3.19 (Con't)

TITANIUM TI-8AL-1MO-1V K(ISCC)

CONDITION	PRODUCT FORM	PRODUCT THICK (IN)	TEST TEMP (F)	SPEC OR	YIELD STR (KSI)	ENVIRONMENT	SPECIMEN WIDTH (IN) W	SPECIMEN THICK (IN) B	SPECIMEN DESIGN (ASTM)	CRACK LENGTH (IN) A	K(Q) (KSI*SQRT IN)	K(ISCC) (KSI*SQRT IN)	MEAN	STAN DEV	TEST TIME (MIN)	DATE	REFER
1550F 100 HR	P	0.25	R T	T-L	124.0	WATER HCL IN TICL3	1.000	0.250 DCB		0.985	95.00	16.30			----	1962	83689
1550F 100 HR	P	0.25	R T	T-L	124.0	WATER LIBR	1.000	0.250 DCB		0.985	95.00	19.30			----	1962	83689
1550F 100 HR	P	0.25	R T	T-L	124.0	WATER LICL	1.000	0.250 DCB		0.985	95.00	14.70			----	1962	83689
1550F 100 HR	P	0.25	R T	T-L	124.0	WATER LICL -300MV	1.000	0.250 DCB		0.985	95.00	15.30			----	1962	83689
1550F 100 HR	P	0.25	R T	T-L	124.0	WATER LICL -1000MV	1.000	0.250 DCB		0.985	95.00	17.00			----	1962	83689
1550F 100 HR	P	0.25	R T	T-L	124.0	WATER LICL +200MV	1.000	0.250 DCB		0.985	95.00	20.80			----	1962	83689
1550F 100 HR	P	0.25	R T	T-L	124.0	WATER LICL +500MV	1.000	0.250 DCB		0.985	95.00	27.70			----	1962	83689
1550F 100 HR	P	0.25	R T	T-L	124.0	WATER LICL 0.6M NACL -500MV	1.000	0.250 DCB		0.985	95.00	20.00			----	1962	83689
1550F 100 HR	P	0.25	R T	T-L	124.0	WATER LICL -200MV	1.000	0.250 DCB		0.985	95.00	19.90			----	1962	83689
1550F 100 HR	P	0.25	R T	T-L	124.0	WATER LICL +2000MV	1.000	0.250 DCB		0.985	95.00	20.00			----	1962	83689
1550F 100 HR	P	0.25	R T	T-L	124.0	WATER 0.1M LICL	1.000	0.250 DCB		0.985	95.00	24.80			----	1962	83689
1550F 100 HR	P	0.25	R T	T-L	124.0	WATER 9M LICL 9M LINO3	1.000	0.250 DCB		0.985	95.00	23.20			----	1962	83689
1550F 100 HR	P	0.25	R T	T-L	124.0	WATER(1) GLYCERINE(4) LICL	1.000	0.250 DCB		0.985	95.00	24.90			----	1962	83689
1550F 100 HR	P	0.25	R T	T-L	124.0	WATER(2.5) GLYCERINE(2.5)LICL	1.000	0.250 DCB		0.985	95.00	18.00			----	1962	83689

TABLE 4.16.3.19 (Con't)

TITANIUM   TI-6AL-1MO-1V   K(ISCC)

[illegible]	[illegible]	PRODUCT FORM	PRODUCT THICK (IN)	TEST TEMP (F)	SPEC OR	YIELD STR (KSI)	ENVIRONMENT	SPECIMEN WIDTH (IN) W	SPECIMEN THICK (IN) B	SPECIMEN DESIGN (+=BG)	CRACK LENGTH (IN) A	K(O) (KSI*SQRT IN)	K(ISCC) (KSI*SQRT IN)	MEAN	STAN DEV	TEST TIME (MIN)	DATE	REFER
[illegible]	1HR WQ	P	0.25	R T	T-L	124.0	WATER(3.4) DMSO(1) AILICL	1.000	0.250	DCB	0.985	95.00	19.50			----	1962	83689
1500F	1HR WQ	P	0.25	R T	T-L	124.0	WATER(4) GLYCERINE(1) LICL	1.000	0.250	DCB	0.985	95.00	19.00			----	1962	83689
[illegible]	1HR WQ	P	0.25	R T	T-L	124.0	5 TO 1 SOLVENT TO SOLUTE RATIO WATER LICL, -1000MV	1.000	0.[illegible]	DCB	0.985	95.00	23.20			----	1962	83689
1500F	1HR WQ	P	0.25	122	T-L	124.0	CCL4	1.000	0.250	DCB	0.985	95.00	19.50			----	1962	83689
1500F	1HR WQ	P	0.25	131	T-L	124.0	DMSO LICL	1.000	0.250	DCB	0.985	95.00	25.00			----	1962	83689
1500F	1HR WQ	P	0.25	136	T-L	124.0	METHANOL LICL	1.000	0.250	DCB	0.985	95.00	13.00			----	1962	83689
1500F	1HR WQ	P	0.25	140	T-L	124.0	WATER LICL	1.000	0.250	DCB	0.985	95.00	21.80			----	1962	83689
1500F	1HR WQ	P	0.25	151	T-L	124.0	ACETONE LIBR	1.000	0.250	DCB	0.985	95.00	30.00			----	1962	83689
1500F	1HR WQ	P	0.25	151	T-L	124.0	WATER AMMONIUM CHLORIDE	1.000	0.250	DCB	0.985	95.00	26.00			----	1962	83689
1500F	1HR WQ	P	0.25	194	T-L	124.0	WATER 0.1M LICL	1.000	0.250	DCB	0.985	95.00	30.20			----	1962	83689
1500F	1HR WQ	P	0.25	203	T-L	124.0	WATER LICL +10000MV	1.000	0.250	DCB	0.985	95.00	21.30			----	1962	83689
1500F	1HR WQ	P	0.25	203	T-L	124.0	WATER LICL 0MV	1.000	0.250	DCB	0.985	95.00	22.20			----	1962	83689
1500F	1HR WQ	P	0.25	203	T-L	124.0	WATER LICL +2000MV	1.000	0.250	DCB	0.985	95.00	23.90			----	1962	83689
1500F	1HR WQ	P	0.25	203	T-L	124.0	WATER LICL -1000MV	1.000	0.250	DCB	0.985	95.00	29.00			----	1962	83689
1500F	1HR WQ	P	0.25	205	T-L	124.0	GLYCERINE LICL	1.000	0.250	DCB	0.985	95.00	26.00			----	1962	83689

TABLE 4.16.3.19 (Con't)

TITANIUM TI-8AL-1MO-1V K(ISCC)

CONDITION	PRODUCT FORM	PRODUCT THICK (IN)	TEST TEMP (F)	SPEC OR	YIELD STR (KSI)	ENVIRONMENT	SPECIMEN WIDTH (IN) H	SPECIMEN THICK (IN) B	SPECIMEN DESIGN (*=SQ)	CRACK LENGTH (IN) A	K(Q) (KSI*SQRT IN)	K(ISCC) MEAN (KSI*SQRT IN)	STAN DEV	TEST TIME (MIN)	DATE	REFER
15[illegible]0F 1HR WQ	P	0.25	205	T-L	124.0	WATER	1.000	0.250	DCB	0.985	95.00	42.00*		----	1962	83689
[illegible] 1HR WQ	P	0.25	205	T-L	124.0	WATER LICL	1.000	0.250	DCB	0.985	95.00	20.80		----	1962	83689
15[illegible]0F 1HR WQ	P	0.25	212	T-L	124.0	SILICONE OIL	1.000	0.250	DCB	0.985	95.00	65.00*		----	1962	83689
15[illegible]0F 1HR WQ	P	0.25	2[illegible]5	T-L	124.0	WATER LICL	1.000	0.250	DCB	0.985	95.00	22.70		----	1962	83689
15[illegible]0F 1HR WQ	P	0.25	412	T-L	124.0	GLYCERINE LICL	1.000	0.250	DCB	0.985	95.00	26.00		----	1962	83689
1[illegible]5F, 1HR, AC 1[illegible]5F, 8HR, AC 1000F, 2HR, AC	P	1.00	R.T	T-L	138.9	3.5% NACL	----	0.866	CANT	----	------	26.40		----	1981	NR001
1[illegible]0F 1HR AC, 1[illegible]0F 2HR WQ	P	1.00	R.T	T-S	107.9	3.5 PCT NACL	1.000	0.500	CANT*	----	112.00	28.00		----	1967	70931
17[illegible]5F 0.5HR FC TO 1200F, 1200F 0.5HR AC, 1200F 3HR ARGON QUENCH	P	0.25	32	T-L	130.0	WATER 21000PPM CHLORIDE	2.000	0.250	CANT	0.200	65.40	17.70		----	1973	85855
1775F 0.5HR FC TO 1200F, 1200F 0.5HR AC, 1200F 3HR ARGON QUENCH	P	0.25	R.T	T-L	150.0	WATER 0.1PPM CHLORIDE	2.000	0.250	CANT	0.200	59.50	24.20		----	1973	85855
1775F 0.5HR FC TO 1200F, 1200F 0.5HR AC, 1200F 3HR ARGON QUENCH	P	0.25	R.T	T-L	150.0	WATER 100PPM CHLORIDE	2.000	0.250	CANT	0.200	58.70	20.80		----	1973	85855
1775F 0.5HR FC TO 1200F, 1200F 0.5HR AC, 1200F 3HR ARGON QUENCH	P	0.25	R.T	T-L	150.0	WATER 21000PPM CHLORIDE	2.000	0.250	CANT	0.200	67.40	14.00		----	1973	85855

*NOTE: DATA WHICH DO NOT MEET MINIMUM SPECIMEN THICKNESS REQUIREMENTS OF 2.5(KISCC/TYS)SQUARED

TABLE 4.16.3.19 (Con't)

TITANIUM TI-6AL-1MO-1V K(ISCC)

CONDITION	PRODUCT FORM	PRODUCT THICK (IN)	TEST TEMP (F)	SPEC OR	YIELD STR (KSI)	ENVIRONMENT	SPECIMEN WIDTH (IN) W	SPECIMEN THICK (IN) B	SPECIMEN DESIGN (*=SQ)	CRACK LENGTH (IN) A	K(Q) (KSI*SQRT IN)	K(ISCC) (KSI*SQRT IN)	MEAN	STAN DEV	TEST TIME (MIN)	DATE	REFER
1725F 0.5HR FC TO 1200F, 1200F 0.5HR AC, 1200F 3HR ARGON QUENCH	P	0.25	R.T.	T-L	150.0	WATER 6000PPM CHLORIDE	2.000	0.250	CANT	0.200	60.30	18.40			----	1973	85855
1735F 0.5HR FC TO 1200F, 1200F 0.5HR AC, 1200F 3HR ARGON QUENCH	P	0.25	140	T-L	150.0	WATER 21000PPM CHLORIDE	2.000	0.250	CANT	0.200	62.10	14.70			----	1973	85855
1775F 0.5HR FC TO 1200F, 1200F 0.5HR AC, 1200F 3HR ARGON QUENCH	P	0.25	200	T-L	150.0	WATER 21000PPM CHLORIDE	2.000	0.250	CANT	0.200	66.30	18.40			----	1973	85855
1805F 1HR AC	P	1.00	R.T.	T-S	120.4	3.5 PCT NACL	1.000	0.500	CANT*	----	88.00	23.00			----	1967	70931
2000F,0.5HR,AC	P	1.30	R.T.	T-L	115.1	3.5% NACL	----	0.866	CANT	----	------	47.30			----	1981	NR001

TABLE 4.17.1.1

MEAN PLANE STRAIN FRACTURE TOUGHNESS DATA OF
TITANIUM ALLOY TI-8MO8V2FE3AL AT ROOM TEMPERATURE

CONDITION/HT	MEAN KIC ± STANDARD (KSI SQRT(IN)) DEVIATION	(NUMBER OF SPECIMENS)	
		PLATE	
CONDITION/HT	L-T	T-L	S-L
STA, REAGED AT 1100F 6HR	54.0 ± 1.0 (3)	53.9 ± 1.0 (3)	-----

TABLE 4.17.2.1

TITANIUM TI-8MO8V2FE3AL K(IC)

CONDITION	--PRODUCT-- FORM	THICK (IN)	TEST TEMP (F)	SPECIMEN ORIENT	YIELD STRENGTH (KSI)	------SPECIMEN------ WIDTH (IN) W	THICK (IN) B	DESIGN	CRACK LENGTH (IN) A	2.5*(K(IC)/TYS)**2 (IN)	K(IC) (KSI*SQRT IN)	K(IC) MEAN	STAN DEV	DATE	REFER
STA, REAGED AT 1100F 6HR	P	1.00	R.T.	L-T	170.0	1.989	0.998	CT	1.001	0.26	55.00			----	86429
		1.00			170.0	1.990	1.002	CT	0.994	0.24	53.10			----	86429
		1.00			170.0	1.975	1.005	CT	0.995	0.25	53.90	54.0/	1.0	----	86429
STA, REAGED AT 1100F 6HR	P	1.00	R.T.	T-L	177.0	1.991	0.991	CT	0.987	0.23	53.40			----	86429
		1.00			177.0	1.975	0.998	CT	1.008	0.24	55.00			----	86429
		1.00			177.0	1.993	0.996	CT	1.014	0.23	53.20	53.9/	1.0	----	86429
1475F 1.5 HR, WQ, 1000F 8 HR, AC	E	3.00	R.T.	---	155.0	1.498	0.750	CT	0.747	0.12	34.10			1973	87230 (1)
		3.00			155.0	1.500	0.750	CT	0.776	0.14	36.30			1973	87230 (1)
		3.00			155.0	1.498	0.750	CT	0.766	0.12	34.30			1973	87230 (1)
												34.9/	1.2		

NOTES:
(1) COMPOSITION(WT PERCENT) 2.26AL, 7.99V, 8.17MO, 0.022C, 0.018N, 0.0070H, 0.160, 0.006CU
ALPHA PRECIPITATE IN BETA MATRIX
STRAIGHTNESS OF CRACK FRONT MAY NOT MEET ASTM E399-72 REQUIREMENTS

TABLE 4.18.2.1

TITANIUM TI5AL2.5SN(ELI) K(IC)

CONDITION	PRODUCT FORM	PRODUCT THICK (IN)	TEST TEMP (F)	SPECIMEN ORIENT	YIELD STRENGTH (KSI)	SPECIMEN WIDTH (IN) W	SPECIMEN THICK (IN) B	SPECIMEN DESIGN	CRACK LENGTH (IN) A	2.5*(K(IC)/TYS)**2 (IN)	K(IC) (KSI*SQRT IN)	K(IC) MEAN	STAN DEV	DATE	REFER
ANNEALED	F	----	-423	--	186.0	2.000	1.006	CT	1.010	0.32	66.30			1970	88439
		----			186.0	2.000	1.005	CT	1.060	0.32	66.60			1970	88439
		----			186.0	2.000	1.006	CT	1.040	0.27	61.10			1970	88439
		----			187.0	2.000	1.000	CT	0.950	0.40	74.50			1970	88439
		----			187.0	2.000	1.004	CT	1.020	0.32	67.00			1970	88439
		----			187.0	2.000	1.000	CT	0.930	0.34	69.30	67.5/	4.4	1970	88439
ANNEALED	F	17.00	-423	R-L	189.0	2.000	1.000	CT	0.950	0.39	74.50			1970	88439
		17.00			189.0	2.000	1.000	CT	0.910	0.32	67.90			1970	88439
		17.00			189.0	2.000	1.000	CT	0.930	0.34	69.30			1970	88439
		17.00			189.0	2.000	1.000	CT	0.950	0.36	71.50	70.8/	2.9	1970	88439
ANNEALED	F	17.00	-423	R-C	189.0	2.000	1.000	CT	1.040	0.17	49.80			1970	88439
		17.00			189.0	2.000	1.000	CT	1.020	0.19	52.40			1970	88439
		17.00			189.0	2.000	1.000	CT	1.000	0.23	57.30	53.2/	3.8	1970	88439
ANNEALED (ES)	F	----	-423	--	186.0	2.000	1.004	CT	1.020	0.36	71.20			1970	88439 (1)
		----			186.0	2.000	1.002	CT	1.020	0.35	69.80			1970	88439 (1)
		----			186.0	2.000	1.001	CT	1.050	0.35	70.00			1970	88439 (1)
		----			186.0	2.000	1.003	CT	1.000	0.35	70.00			1970	88439 (1)
		----			186.0	2.000	1.002	CT	1.010	0.36	70.80			1970	88439 (1)
		----			186.0	2.000	1.001	CT	1.010	0.35	69.80			1970	88439 (1)
												70.3/	0.6		
ANNEALED (IS)	F	----	-423	--	186.0	2.000	1.000	CT	1.010	0.56	88.20			1970	88439 (2)
		----			186.0	2.000	1.002	CT	1.060	0.44	77.60			1970	88439 (2)
		----			186.0	2.000	1.001	CT	1.020	0.50	83.30			1970	88439 (2)
		----			186.0	2.000	1.002	CT	1.020	0.37	71.70			1970	88439 (2)
		----			186.0	2.000	1.001	CT	0.990	0.41	75.20			1970	88439 (2)
												77.2/	6.6		

NOTES
1) EQUIAXED STRUCTURE
2) INTERMEDIATE STRUCTURE BETWEEN PLATELET ALPHA AND FINE EQUIAXED GRAINS

TABLE 4.19.1.1

MEAN PLANE STRAIN FRACTURE TOUGHNESS DATA OF
TITANIUM ALLOY TI6AL6V2SN(ELI) AT ROOM TEMPERATURE

CONDITION/HT — MEAN KIC ± STANDARD DEVIATION (KSI SQRT(IN)) (NUMBER OF SPECIMENS)

PLATE

CONDITION/HT	L-T	T-L	S-L
1600F 1 HR.WQ. 1050F 4 HR.AC	29.6 ± 0.6 (2)	-----	-----
1650F 1 HR.WQ. 1125F 4 HR.AC	34.0 ± 3.5 (2)	-----	-----

TABLE 4.19.2.1

TITANIUM   TI6AL6V2SN(ELI) K(IC)

CONDITION	--PRODUCT-- FORM	THICK (IN)	TEST TEMP (F)	SPECIMEN ORIENT	YIELD STRENGTH (KSI)	------SPECIMEN------ WIDTH (IN) W	THICK (IN) B	DESIGN	CRACK LENGTH (IN) A	2.5*(K(IC)/TYS)**2 (IN)	K(IC) (KSI*SQRT IN)	K(IC) MEAN	STAN DEV	DATE	REFER
1600F 1 HR, WQ,	P	1.00	R.T.	L-S	179.0	0.499	0.251	NB	0.215	0.10	35.10			1965	04316
1050F 4 HR, AC		1.00			179.0	0.499	0.250	NB	0.184	0.07	30.10			1965	84316
		1.00			179.0	0.499	0.250	NB	0.222	0.08	32.10	32.4/	2.5	1965	84316
1600F 1 HR, WQ,	P	1.00	R.T.	L-T	179.0	0.499	0.250	NB	0.177	0.07	30.20			1965	84316
1050F 4 HR, AC		1.00			179.0	0.499	0.247	NB	0.223	0.07	29.20			1965	84316
		1.00			179.0	0.499	0.255	NB	0.200	0.07	30.00	29.8/	0.5	1965	84316
1650F 1 HR, WQ,	P	1.00	-320	L-S	258.0	0.499	0.250	NB	0.221	0.02	24.70			1965	84316
1125F 4 HR, AC		1.00			258.0	0.499	0.250	NB	0.206	0.02	22.60	23.7/	1.5	1965	84316
1650F 1 HR, WQ,	P	1.00	R.T.	L-S	170.0	0.499	0.250	NB	0.205	0.13	38.60			1965	84316
1125F 4 HR, AC		1.00			170.0	0.499	0.250	NB	0.191	0.12	37.50	38.1/	0.8	1965	84316
1650F 1 HR, WQ,	P	1.00	R.T.	L-T	170.0	0.499	0.248	NB	0.191	0.09	31.50			1965	84316
1125F 4 HR, AC		1.00			170.0	0.499	0.251	NB	0.219	0.11	36.50	34.0/	3.5	1965	84316

TABLE 4.20

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TABLE 4.20 (continued)

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TABLE 4.20 (continued)

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