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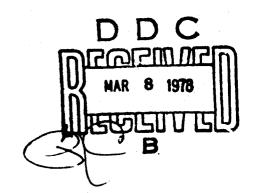
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DEVELOPMENT OF ENGINEERING DATA ON ADVANCED COMPOSITE MATERIALS

UNIVERSITY OF DAYTON RESEARCH INSTITUTE UNIVERSITY OF DAYTON DAYTON, OHIO 45469

SEPTEMBER 1977

TECHNICAL REPORT AFML-TR-77-151
Final Report for Period 1 March 1975 - 30 June 1977



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David C Watson

MR. DAVID WATSON, Engineering and Design Data Materials Integrity Branch Marta I Harmsworth

Technical Manager Engineering and Design Data

FOR THE COMMANDER:

MR. THOMAS D. COOPER, Chief Materials Integrity Branch Systems Support Division

Air Force Materials Laboratory

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19. Key Words (Concluded)

Specific Heat
Thermal Conductivity
Environmental Aging
Epoxy
Polysulfone
Polyimide
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20. Abstract (Concluded)

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shear) were measured on three fiber orientations (00, 900, and 1457 at four different temperatures (-670F, 720F, and two elevated temperatures). Tensile fatigue, creep, and stress-rupture tests were also conducted and four thermophysical properties (thermal expansion, thermal conductivity, specific heat, and glass transition temperature) were determined. Environmental agings (at 1600F and 100% R.H.) were conducted on each material and the effects of this exposure on several mechanical properties were determined.

PREFACE

This summary report covers work performed during the period from 1 March 1975 to 30 June 1977 under Air Force Contract F33615-75-C-5085. The contract was initiated under Project Number 7381, "Materials Application". The work was administered under the direction of the Systems Support Division of the Air Force Materials Laboratory, Wright-Patterson Air Force Base, Ohio. Mr. David Watson (AFML/MXA) acted as Project Engineer.

This work was conducted under the general supervision of Mr. D. Gerdeman, Project Supervisor. The Principal Investigator for this program was D. Robert Askins. Research Technicians who made major contributions to the program include: R. J. Kuhbander, F. Tittl, D. Maxwell, R. Glett, J. Graham, J. Conner, T. Green, D. Klosterman, and D. McCullum.

This report was submitted by the authors in September 1977. The contractor's report number is UDRI-TR-77-37.

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SECTION 1 INTRODUCTION

Fiber reinforced composite materials have been used in Aerospace structures for many years. The use of these materials is continually growing, and as new fiber reinforcements and matrix materials become available, the problem of selecting materials becomes an ever-growing task for aircraft builders and designers. In order to select material for a particular aircraft structure, a certain minimal amount of engineering data must be available to the aircraft designer. It was with this need in mind that a program of this nature has been undertaken. The general objective of this program is to develop engineering data on advanced composite materials. These materials are newly developed composite materials systems which are commercially available, but which at the same time are new enough that little data are available for the purpose of evaluating their potential. The purpose was to generate physical, mechanical, and thermophysical property data on a number of these advanced composite materials, which would provide an aircraft designer or builder with sufficient information to enable him to decide whether the material is a feasible candidate for his particular application. The data generated in this program are not sufficient to eliminate the need for more detailed and more comprehensive design data programs. Rather, the program provides initial data to facilitate the selection of candidate materials, and provides a basis for developing subsequent design allowable efforts on selected materials. It provides the information required to make preliminary assessments of composite materials for potential aerospace service.

SECTION 2 SELECTION OF MATERIALS

The initial portion of the program involved an identification of available candidate composite materials. This identification process consisted of several phases. One phase involved a review of the available literature on composite materials with an emphasis on the more newly developed or advanced composite materials. The second phase involved establishing both written and verbal contact with a wide cross-section of industry and qovernment representatives who are active in the area of composite materials research, development, and application. Letter questionnaires were sent to individuals representing all the services, all the major aircraft companies, and nearly all of the major material suppliers. The questionnaire was directed towards obtaining each individual's feelings as to what materials should be considered for inclusion in this program, what their assessment of the current data availability on the various materials was, and their feelings as to potential applications for which the various advanced and newly available composite material systems might be considered. In addition, these representatives were asked what they felt the most useful and most needed type of engineering data were, as well as their feeling about the effect of manufacturing processes required for a specific composite material or its potential usage by the Aerospace community. These letter-questionnaires were sent to a total of 85 individuals. A total of 23 written responses were received, representing 31% of the total mailing. In addition to the written inputs numerous telephone contacts were made to contact individuals who did not respond in writing to our questionnaires and to obtain additional information to that requested in the letter. All the verbal as well as written inputs to this phase of the program were tabulated and discussed with AFML representatives prior to the establishment of a list of tentative candidate materials for possible inclusion in the program. The criteria employed to

determine and select these candidate materials included (a) the present or imminent commercial availability of the material, (b) the degree of interest in the material expressed in the written responses and telephone contacts, (c) the material's potential to overcome specific problems of current concern to USAF, and (d) the potential value to the USAF if the material proves applicable to AF weapons systems. Table 1 lists the candidate materials which were considered during the materials selection portion of this program. The epoxy matrices are all identified with a specific reinforcement since these were the standard products of the various prepred suppliers indicated in parenthesis. All of the other materials listed in Table 1 are matrix resins and are not associated with any specific fiber, since this could vary according to the desire of the user. The companies listed in parenthesis after these latter materials produce the matrix resin and in some cases, but not all, the prepreg. This list of candidate materials was subsequently narrowed and reduced to the final five selections; SP313 (3M), AS/HME (TRW), AS/3004 (Hercules), AS/4397 (Hercules), and T300/ F178 (Hexcel).

The SP313 system (T300 fiber and PR313 resin) was selected because it represented an alternative to Narmco's 5208, a 350°F epoxy system which has found extensive application in USAF fighter aircraft structures. It was felt that two competitive systems would result in lower materials costs to aircraft builders. Other epoxy systems had been looked at previously and found wanting in one way or another, such as elevated temperature property retention after high humidity environmental aging.

The AS/HME system was developed under a previous AFML contract and was designed as a low-flow 250°F epoxy system with good resistance to property loss during high humidity environmental aging. A low-flow matrix offers considerable cost saving features from a fabrication standpoint and was of considerable interest to many aircraft builders. The enhanced moisture resistance of this matrix material also was an attractive feature of this system.

TABLE 1 PRELIMINARY CANDIDATE MATERIALS

Epoxies	Polyimides	Thermoplastics	Other
AS/HME - LOW Flow (TRW)	NR-150 (DuPont)	Polysulfone (Hercules, Whittaker)	PIQ-polyimidazoquinazoline (Whittaker)*
AS/3501-6 (Hercules)	F178 (Hexcel)	Polyethersulfone (ICI)	
T300/PR13 - SP313 (3M)	HR600 (Hughes)	PPQ-polyphenylquin- oxaline (Whittaker)	
T300/5209 (Narmco)	PMR-15 (TRW)	Polyarylsulfone (3M)	
T300/5213 (Narmco)	Kerimid 353 (Rhodia)	Polyphenylene sulfide	
Kevlar 49/E715 (U.S. Poly.)	2080 (Upjohn)		
Kevlar 49/E782 (U.S. Poly.)	4397 (Hercules)		
	5230 (Narmco)		

The Whittaker Corporation no longer exists under this name. *NOTE:

The AS/3004 material is a thermoplastic polysulfone matrix system which was of considerable interest to aircraft companies as a material with the potential for substantial cost savings in fabrication due to its very low flow and potential for formability into complex contours.

The AS/4397 polyimide system was selected because it was of interest as a potential alternative to the 350°F epoxy systems, offering better dry and wet properties at comparable temperatures. This system is considered a 450°F material and as such, offers, at equivalent cost, a larger margin of safety than the 350°F epoxies when used at comparable conditions.

The T300/F178 polyimide system is also a 450°F material which costs about the same as the 350°F epoxies but offers improved wet and dry performance at comparable temperatures as well as an overall higher temperature capability.

SECTION 3 TEST PROGRAM AND PROCEDURES

The laboratory efforts required during this program consisted of four generally sequential steps for each of the five materials characterized. These consisted of prepreg physical property characterization, laminate fabrication and specimen machining, laminate physical property characterization, and laminate mechanical and thermophysical property measurements. Each of the test methods and type of specimen used in the determination of these various properties, as well as the panel fabrication and specimen preparation procedures, are described in this section.

3.1 PREPREG PHYSICAL PROPERTY CHARACTERIZATION

The prepreg physical properties which were measured consisted of volatile content, resin content, and flow. methods used to determine these properties, for the most part, were those recommended or used by the prepreg manufacturer. Table 2 identifies the particular specification which was followed in determining these properties for each resin system. In some cases one or two of these tests were omitted for a particular prepreg. These variations are identified and explained in Table 2 and its footnotes. In the case of the AS/HME prepreg, the prepreg supplier did not recommend particular tests for resin content or flow, so the University adopted tests which it considered appropriate for this purpose. The summarized prepreg properties themselves are presented in Section 4 for each specific material. These prepred physical property characterizations were not intended primarily as a means of accepting or rejecting a particular batch of material if it deviated slightly from prespecified tolerance limits. Rather, they were conducted to provide the reader with an estimate of the normal property levels and variability encountered in purchased prepreg and also to provide a basis for the subsequent assessment of laminate properties obtainable from such prepreg.

TABLE 2
PREPREG PHYSICAL PROPERTY TEST SPECIFICATIONS

Prepreg	Test Speci	fication Identifica	tion ¹
Material	Volatile Content	Resin Content	Flow
SP313 (3M)	3M method	3M method	3M method
AS/3004 (Hercules)	HD-SG-500/232	HD-SG-2-6006C (5.2.6,F)	N.A. ²
AS/4397 (Hercules)	HD-SG-2-6006C (5.1)	HD-SG-2-6006C (5.2.6,F)	HD-SG-2-6006C (5.3.1,A)
T300/F178 (Hexcel)	N.A. ³	Hexcel method	N.A. ⁴
AS/HME (TRW)	I.l.l (TRW method)	AFML-TR-67-243 ⁵	3M method ⁶

All of the test methods specified in this table are reproduced in their entirety in Appendix A.

²No flow test was run on the AS/3004 prepreg because this thermoplastic material exhibits negligible flow during laminate consolidation.

³The F178 prepreg contains no volatiles.

⁴It was indicated by Hexcel that they did not run a flow test on this prepreg since they had found that if used within the specified shelf life period, the prepreg produced consistently good laminates if its resin content fell in the range of 42 + 3%. It was obvious during laminate preparation, however, that this is a relatively high flow system.

⁵It was found that neither hot acetone (recommended by TRW) or dimethylformamide (SP313, 3M procedure) extraction succeeded in complete resin removal. The method referenced here utilizes a hot nitric acid digestion of the resin.

No flow test procedure was recommended since this was a low-flow system. As a consequence it was arbitraily decided to use the same test as was used for the SP313 material. The comparative results, presented in Section 4, illustrate the reduced flow characteristics of the HME resin. One must keep in mind, however, that this flow test imposed 90 psi upon the sample while the actual cure schedule for the HME system goes only to 14 psi.

Samples for the prepreg physical property tests were obtained from each roll of prepreg tape and three specimens were used for each test. The complete tabulation of these prepreg test results is presented in Appendix A. All of the prepreg used in this program except for the AS/3004 and AS/HME was stored at -30°F when not in use and all of the laminates needed for the program were prepared prior to the expiration of the manufacturer's stated storage life for each specific material. In addition, a written record was maintained for each roll of prepreg which noted the cumulative total time the material was exposed to room temperature conditions during the period in which laminates were being fabricated from the tape. The AS/3004 and AS/HME materials were stored at room temperature (÷72°F) since there were no storage life limitations with these two materials.

3.2 LAMINATE PROCESSING AND SPECIMEN FABRICATION

When laminates were to be made, the roll of prepreg was removed from the freezer and allowed to warm to room temperature without opening the sealed bag in which the prepreg was con-This was done in order to eliminate the chance of moisture condensation directly on the prepreg material. After the prepreg had warmed thoroughly to room temperature, it was removed from its package and unrolled on a clean countertop. Pieces were cut from the tape in the required shape and size with a razor and after removing the release paper, carefully layed up in the desired stacking sequence for a particular laminate panel. This stack was then carefully rebagged and returned to the freezer for storage until lamination and curing. When a laminate was to be cured, it was removed from the freezer and warmed to ambient before reopening its storage bag. The prepreg was then removed from the storage bag and placed in an autoclave for curing. The detailed curing schedules for each specific prepred material are presented in Section 4. After lamination and cure, machining diagrams were sketched onto the panel surfaces and individual specimens were cut out of the panels with a diamond cut-off wheel and finish machined to the required dimensions on a Tensile-Cut belt sander. Specimens from each panel were set aside for measurement of panel physical characteristics.

Some of the mechanical test specimens required doubling tabs in the grip sections. A 1/16-inch thick glass fabric reinforced phenolic laminate material was used for this purpose. Scotchply is specified in the Design Guide for tab material but it proved unsatisfactory for the elevated temperatures. Loctite 30% adhesive was used to bond the tabs to the specimen and was cured at 275°F for 15 minutes under spring clamp pressure.

3.3 LAMINATE PHYSICAL PROPERTY CHARACTERIZATION

Four different physical properties were measured on each laminate to insure acceptable laminate quality. These were specific gravity, resin content, fiber content, and void content. Each of the procedures used for these measurements is discussed in detail in the following paragraphs and is summarized in Table 3. The summarized laminate physical properties obtained for each of the materials investigated are summarized in the tables in Section 4 and are presented in their entirety in Appendix B.

3.3.1 Specific Gravity

Three specimens from widely scattered locations on each laminate were selected for specific gravity determinations. Specimen size depended upon both panel size and the number and size of mechanical test specimens required from the panel, but in general ranged from a minimum of 1/2" x 1/2" to a maximum of 1" x 3/4". The method used was ASTM D792, a weight-in-air/weight-in-water technique.

3.3.2 Resin Content

The same specimens which were used for specific gravity measurements were used for resin content determinations.

TABLE 3
LAMINATE PHYSICAL PROPERTY TEST PROCEDURES

Lam inate	Procedure Identification				
Material	Specific Gravity	Resin/Fiber Content	Void Content ¹		
SP313 (3M)	ASTM D792-66	AFML-TR-67-243 (Acid digestion)	Grid point count and ASTM D2734-70(B)		
AS/3004 (Hercules)	ASTM D792-66	HD-SG-2-6006C (5.2.6,F)(Hercules Method)	Grid point count and ASTM D2734-70(B)		
AS/4397 (Hercules)	ASTM D792-66	HD-SG-2-6006C (5.2.1,A)(Hercules Method)	Grid point count and ASTM D2734-70(B)		
T300/F178 (Hexcel)	ASTM D792-66	Grid point count on photomicro- graphs ²	Grid point count		
AS/HME (TRW)	ASTM D792-66	3	3		

lvoid contents were computed as described in ASTM D2734-70(B) and also determined by a point counting technique which essentially integrates the areas on a cross sectional photomicrograph which represent resin, fiber, and voids.

²It was found impossible to digest the cured Fl,8 resin away with several different acids and solvents.

³Since evaluation of this material was terminated prematurely, no panel resin, fiber, or void contents were determined.

The methods listed in Table 3 were followed in these determinations. The grid point count method involves placing a transparent grid over a specimen photomicrograph and counting the number of grid intersections which fall on resin, fiber, or void areas. This method produces statistically accurate values if a sufficiently large sample is utilized. In this program, we have used a grid containing 1530 intersections and have used three photomicrographs (300X) per laminate.

3.3.3 Fiber Content

The fiber contents of the SP313 laminates were computed, as percent by volume, from the same data used for the resin content determinations. The computational procedure is illustrated in AFML-TR-67-243 and employed values for fiber and resin specific gravity reported by the respective manufacturers.

3.3.4 Void Content

The void contents, just as the fiber contents, of the SP313 laminates were computed, as percent by volume, from the same data obtained in the resin content determinations. The computational procedure is described in ASTM D2734-70, The result of this procedure frequently gives negative values for laminates having low void contents. This occurs because minor errors or variations in the values for resin, fiber, and composite specific gravities become significant at low void contents. This result was obtained for numerous laminates made in this program, even though photomicrographs did sometimes reveal the presence of porosity. A point counting technique using a grid superimposed over photomicrographs of laminate cross sections was consequently used in conjunction with the computed values. It is felt that the photographically obtained value is more realistic than the computed values for low porosity laminates and for this reason, these values are reported in place of the computed negative values. Figure 1 illustrates typical laminate cross sections for each of the composite materials characterized.

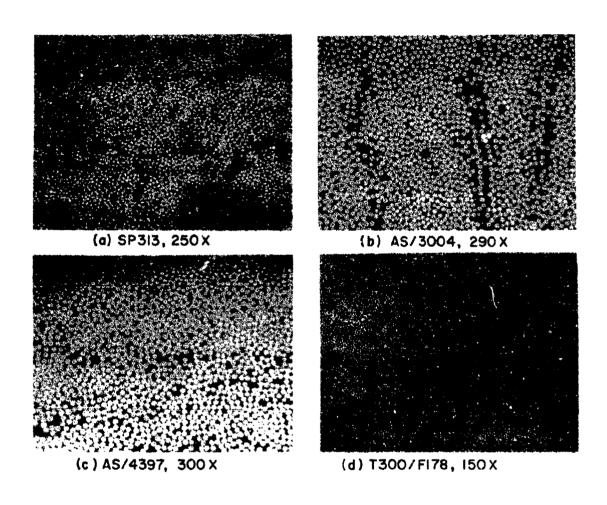


Figure 1. Typical Cross Sections of Fabricated Composites.

3.4 SPECIMEN CONDITIONING

Three different types of conditioning were involved in this program. The first was simply a dry dessicated storage of finished specimens at ambient temperature until they were to be tested. This provides a data base for the dry material to which both humidity aging data and data for other materials systems can be compared.

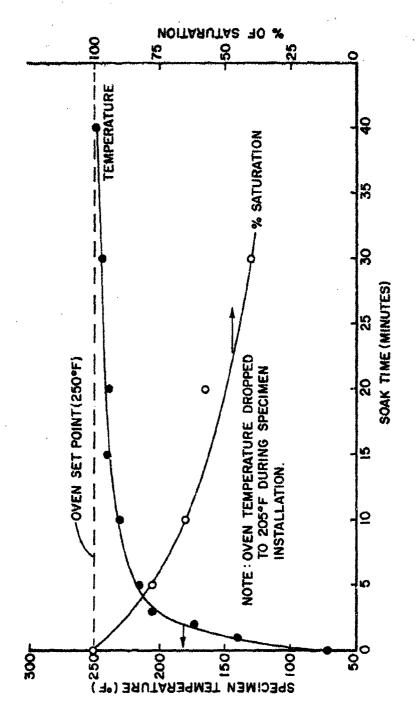
The second type of conditioning was the elevated and reduced test temperatures. In all of the mechanical testing except for specimens which were humidity aged, the specimens were soaked for one-half hour at the test temperature prior to loading. Thermal conductivity specimens were soaked at temperature for periods of up to several hours in order to provide sufficient time for the test stack to reach thermal equilibrium before readings were taken. The thermal expansion specimens were not soaked for extended periods at any one temperature. Rather, they were heated from some starting temperature to the ending temperature at a constant rate of about 2°C/min.

The third type of conditioning was an elevated temperature, high humidity exposure. The specimens involved in these tests were exposed to conditions of 160°F and 100% R.H. until they either reached saturation, as evidenced by constant weight, or about 50% of their saturated weight gain. Specimens were removed from the humidity cabinets for weighing periodically to determine weight gain. The frequency of removal varied from material to material depending upon whether the aging was being carried to saturation or half-saturation and upon the rate and extent of moisture absorption by the particular matrix system being aged. The half-saturation agings, for example, typically required less than one day, and normally two or three weighings were made during this period at intervals of from 3 to 16 hours. fully saturated agings, on the other hand, typically required from four to eight weeks to complete, during which time the specimens were removed from the aging cabinet and weighed between

four and ten times at intervals of three to seven days. After final removal from the humidity aging, the specimens were tested at both 72°P and at one of the elevated temperatures for which data on dry specimens were obtained. After removal from the humidity aging cabinet, the specimens were kept in a 72°F, 100% R.H. environment until tested (less than one-half day). During this period the specimens were exposed to ambient conditions for a maximum of about twenty minutes, during which time strain gages and gripping tabs were mounted on the specimens (interlaminar shear, short beam specimens of course, did not need this). The specimens tested at room temperature were tested as soon as they were ready. Those tested at elevated temperature were placed in a preheated test oven and tested after the same 30-minute soak used for dry specimens. The insertion of the specimens for elevated temperature testing into the grips in the test oven required less than one minute, during which time, the oven temperature fell about 50°F below its setpoint. The 30minute soak time was counted from the reclosing of the test oven door after specimen insertion. Hence, the first several minutes of this 30-minute period was required for the oven temperature to recover to the setpoint while, simultaneously, the test specimen required ten minutes or so of this 30-minute soak to approach the test temperature. This length of soak was initially used to insure complete cure of the tab adhesive prior to loading since the tabs were applied with an elevated temperature cure adhesive to insure adequate tab performance during loadup and the specimens were placed in the test oven immediately after application of the tabs so that specimen heat-up and tab adhesive cure occurred simultaneously. It is recognized that a 30-minute soak of a "wet" composite can produce a drying effect so that the test results are not actually representative of a truly "saturated" material. A compromise must be made, however, between the length of time required for a specimen to heat up to the test temperature and the rate at which a specimen dries out. Ideally, a steam test chamber would eliminate the requirement to make such a compromise. Few organizations have such a test chamber, however. The heat-up, dry-out compromise, in this case, however, was also influenced by the requirement to cure the tab adhesive prior to load application. It was found that the use of room temperature curing tab adhesives for elevated temperature tests resulted in debonding of the tabs prior to specimen failure. Consequently, elevated temperature curing tab adhesives were used to overcome this problem and, hence, the need to simultaneously cure the tab adhesive while heating the "wet" specimens up to the test temperature during the 30-minute "soak".

One experiment was conducted to measure the magnitudes of possible error introduced by the 30-minute soak before load application by measuring both the heat-up and dry-out rate of an AS/3004 polysulfone matrix specimen. This material absorbs only about 1/4-1/3 as much moisture as the other materials characterized in this program when aged to saturation and the first 50-60% of this gain occurs very rapidly (3-9 hours). An untabbed 90° tensile specimen was used for this experiment. Figure 2 illustrates the results of this experiment. It can be seen that even after 30 minutes, the specimen temperature (as indicated by a small thermocouple embedded in the center of the specimen) is not quite up to the nominal test temperature. The moisture content, however, has fallen to less than 50% of the saturated value in this period. Some investigators recommend only a threeminute soak to minimize drying. For the AS/3004 material, it can be seen that one would be testing a material with a moisture content of about 85% of the saturated value at a temperature 40°F below the nominal test temperature for this test criteria. What it boils down to is that each investigator must decide upon his own compromise.

Another experiment which was conducted, involved testing some saturated T300/F178 short beam shear specimens after a 30-minute soak and after a five-minute soak. Table 4 presents



Heat-Up and Dry-Out Behavior of Saturated AS/3004 Composite Laminates. Figure 2.

TABLE 4

COMPARISON OF THE EFFECTS OF TEST OVEN SOAK TIMES UPON RETAINED INTERLAMINAR SHEAR STRENGTH OF SATURATED T300/F178 COMPOSITE LAMINATES

A CONTRACTOR OF THE PROPERTY O

Test Condition	Test Temp.	Strength (ksi)	Std. Dev. (ksi)	No. Specimens
dry	72	14.82	0.89	5
dry	350	10.17	0.29	5
saturated	72	11.33	0.29	3
saturated	350, 30-min. soak	7.38	0.41	3
saturated	350, 5-min. soak	6.69	0.09	2

the results of this experiment. It can be seen that the fiveminute soak produced a lower strength, indicating perhaps that
the higher moisture content present after only five minutes
was more detrimental to the shear strength than the lower
specimen temperature. The difference, however, is only marginal
so it seems that the 30-minute soak data are still quite useful.
In fact, inspection of all the humidity aging data appearing in
Section 4 indicates that considerable and consistent strength
drop-offs occur for all of the materials evaluated in this
fashion.

3.5 LAMINATE MECHANICAL AND THERMOPHYSICAL PROPERTY CHARACTERIZATION

A total of eight types of mechanical property tests were performed on the composite materials evaluated during this program; tension, compression, flexure, inplane shear, interlaminar shear, tensile creep, tensile stress-rupture, and tensiletensile fatigue. In addition, four thermophysical properties were measured; specific heat, thermal conductivity, coefficient of thermal expansion, and glass transition temperature. Tables 5-8 summarize the test matrices for the static, dynamic/time dependent, thermophysical, and humidity aged static tests. It can be seen that the original test plan called for a total of 612 specimens to be tested for some sort of mechanical or thermophysical property for each material system. In addition to these specimens, however, numerous instances were encountered where extra or replacement specimens had to be tested. These situations included instances where failures occurred in the tabbed grip areas rather than in the gage section, where instrumentation failures prevented full data acquisition or aborted a test, or simply occasions when anomalous results were obtained which dictated rechecking. Another source of extra specimen testing involved the creep and fatigue tests. In these tests it was found on several occasions that the stress levels initially selected produced premature failures. Consequently, the stress levels at which these tests were conducted were lowered and extra

TABLE 5
STATIC MECHANICAL PROPERTY TEST MATRIX

Test	Test Temperature ¹					
Type	-67°F	72°F	Т3	T ₄		
0° Tension	5 .	. 5	5	- 5		
90° Tension	5	5	5	5.		
+45° Tension	5	5	5	5 .		
0° Compression	5	5	5	5		
90° Compression	5	5	5	5		
0° Flexure	5	5	5	5		
90° Flexure	5	5	5	5		
Inplane Shear ²	5	5	5	5		
Interlaminar Shear	5	5	5	5		

The two elevated temperatures varied, depending upon the matrix resin.

²Except for some rail shear tests run with the SP313 system, all of the inplane shear data were obtained from the ±45° tension data.

TABLE 6

DYNAMIC AND TIME DEPENDENT MECHANICAL PROPERTY
TEST MATRIX

<u> </u>		Test	Temperatu	ıre ^l	
	lest Type	-67°F	72°F	T3	T ₄
0°	Tensile Creep	0	9	9	9
90°	Tensile Creep	0	9	9	9
<u>+</u> 45°	Tensile Creep	0	9	9	9
0°	Tensile Stress Rupture ²	0	9	9	9
90°	Tensile Stress Rupture ²	0	9	9	9
<u>+</u> 45°	Tensile Stress Rupture ²	0	9	9	9
0°	Tensile-Tensile Fatigue	12	12	12	12
90°	Tensile-Tensile Fatigue	12	12	12	12
<u>+</u> 45°	Tensile-Tensile Fatigue	12	12	12	12

The two elevated temperatures varied, depending upon the matrix resin.

Extra Note: The 9 specimens tested in tensile-creep at each condition were subdivided into 3 groups of 3 specimens each and these groups of three were then loaded at different stress levels. The 12 specimens tested in fatigue at each condition were subdivided into 3 groups of 4 specimens each and these groups of four were then tested at different maximum cyclic stress levels.

The stress rupture lifetimes were obtained from the same specimens used for creep tests.

TABLE 7
THERMOPHYSICAL PROPERTY TEST MATRIX

	Test Temperature 1			
Test Type	-67°F	72°F	T ₃	TA
Specific Heat	32	3	3	3
Thermal Conductivity	3	3	3	3
0° Thermal Expansion	3	3	3	3
90° Thermal Expansion	3 -	3	3	3
+45° Thermal Expansion	3	3	3	3
Glass Transition Temp. (dry)3	14			
(wet) ³	1			

The two elevated temperatures varied, depending upon the matrix resin.

²In most cases a value at each test temperature was obtained from each specimen, so that, usually, three specimens provided all twelve data points.

³Dry refers to the as-fabricated composite condition, while wet refers to the condition of the specimen after it has reached an equilibrium weight gain during humidity aging at 160°F and 100% R.H.

Since these tests required access to instrumentation not under UDRI's control, only one determination could be made for each material at each condition.

TABLE 8
TEST MATRIX FOR STATIC MECHANICAL PROPERTY TESTS AFTER
ELEVATED TEMPERATURE, HIGH HUMIDITY AGINGS

	Saturation Level					
Test Type	509		100%			
	Test Temp.		Test Temp.			
	72°F	T ₃	72°F	\mathbf{T}_{3}^{1}		
90° Tension	5	5	5	5		
+45° Tension/Inplane Shear2	5	5	5	5		
Interlaminar Shear	5	5	5	5		

¹This temperature varied depending upon the specific material.

These tests were not performed on the latter materials tested in this program (AS/4397 and T300/F178) because of the relatively small effect which humidity aging has upon these properties.

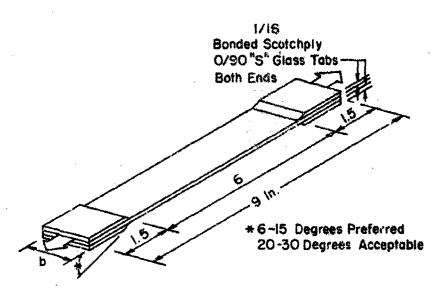
specimens tested so as to provide the full complement of results required for the test plan outlined in Tables 5-8. It will be noted in the summarized results in Section 4 that the number of specimens for which the average property values are reported varies from property to property. As discussed above, however, in some cases extra tests were conducted which raised the number of specimens above the original plan. In other cases, the behavior of the test specimen during test prevented the acquisition of one or more properties from that particular specimen. If, for example, the specimens underwent excessive elongation before failure, the strain gages were lost and ultimate elongation data were not obtained, even though strength, modulus, proportional limit, and Poisson ratio values were. In some cases, strain gage data were lost due to breaks in the lead wire-gage terminal connection.

In the succeeding sections, descriptions of the test methods used to obtain the mechanical and thermophysical properties are presented. The summarized test results for each specific material system are presented in Section 4 and a complete tabulation of all of these test results is presented in Appendices C thru M.

3.5.1 Tension

Tensile tests were conducted in accordance with the recommendations of the Advanced Composites Design Guide^[2] using the straight-sided IITRI specimen illustrated in Figure 3. The doubling tabs were a glass fabric/phenolic laminate material as discussed previously (Section 3.2). The tensile tests were conducted at an extension rate of 0.05 inch/minute on an Instron Universal Testing Machine. All of the tensile strains were monitored with strain gages. This test procedure also corresponds to ASTM method D3039-74 except for the tab materials. In the ASTM specification, the tab material called for is a non-woven 0°/90° Scotchply material 1/8 inch thick, while in this program a woven glass/pherolic material 1/16 inch thick was used satisfactorily.

TENSILE TEST SPECIMEN



SPECIAL REMARKS

LAMINATE	NO. OF PLIES(n)	SPECIMEN WIDTH b
[0] _C	n=6	1/2
[90] _C	n=15	1
[0/90] _C	n ≥ 3	1
[0/+45/90] _C	n ≥ 6	1

- (1) Specimens may be individually molded or cut (diamond tool recommended) to width required.
- (2) Inner ply of tab material should have fibers in the longitudinal direction.
- (3) Self-aligning grips should be used, completely enclosing the tab area.
- (4) The aspect ratio of the test area must be noted when testing offaxis orientations. The aspect ratio may be varied to represent a specific application.

Figure 3. IITRI Straight-Sided Tensile Specimen.

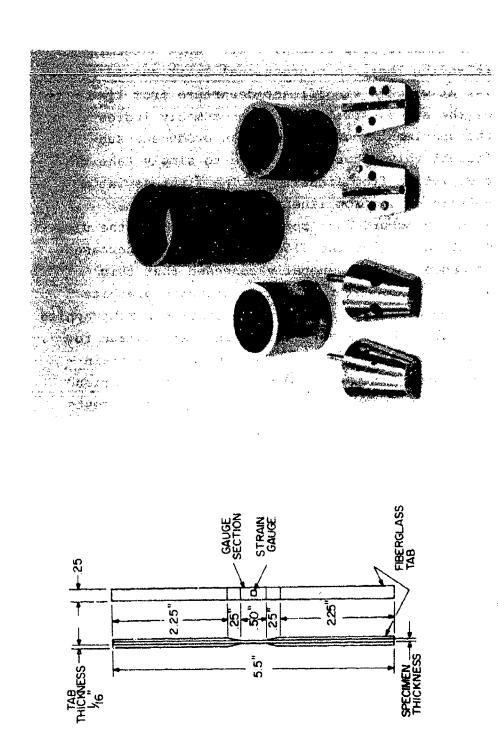
The tensile proportional limits were determined with the understanding that the proportional limit should represent the point at which a significant departure from linearity in the slope of the stress-strain curve, presumably indicative of damage to the specimen, occurs. This can produce a substantially different value than if one were to simply take the point of first deviation from linearity. The first deviation of the stress-strain curve from linearity on the 0° fiber orientations actually occurred at roughly one-third of the ultimate stress but at this point the slope of the curve increased rather than decreased. It is generally conceded that this phenomena is due to the behavior of the reinforcing graphite fiber since the same behavior is noted when testing bare graphite Consequently, this is not felt to indicate damage to the specimen. No decrease in the slope of the stress-strain curve was in fact noted for most of the 0° or 90° fiber orientations prior to failure except for the high temperature tests on the 90° fiber orientations, and for this reason the proportional limit is reported as equivalent to the ultimate strengths. On the high temperature tests with the 90° fiber orientation and on all of the +45' fiber orientations, a significant decrease in the slope of the stress-strain curves was observed below the ultimate strength. Whether this indicates the onset of real and significant damage, at least at the point of first departure, is a moot point. Perhaps the determination of the elastic limit would be of more value than the proportional limit.

The Poisson's ratio values were experimentally measured on the 0° and $\pm 45^{\circ}$ fiber orientations and computed for the 90° fiber orientation from the relationship:

$$v_{21} = v_{12} \left(\frac{E_{22}}{E_{11}} \right)$$

3.5.2 Compression

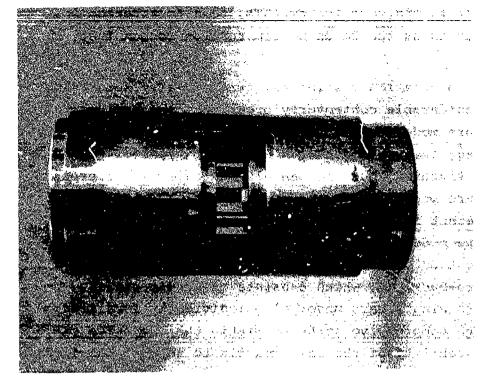
Compression tests were conducted using ASTM method D3410-75. Figures 4 and 5 illustrate the specimen and fixture

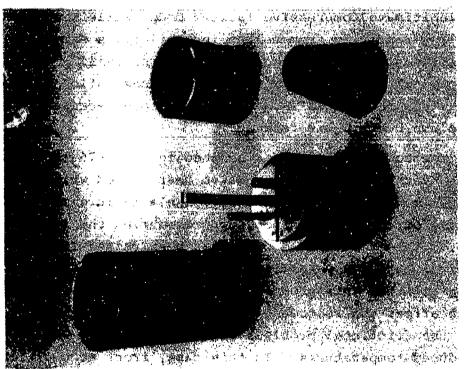


(a) CELANESE COMPRESSION COUPON SPECIMEN

(b) DISASSEMBLED CELANESE COMPRESSION FIXTURE

Celanese Compression Coupon Specimen and Disassembled Compression Fixture. Figure 4.





(a) PARTIALLY ASSEMBLED (b)

(b) FULLY ASSEMBLED WITH SPECIMEN IN PLACE

Figure 5. Celanese Compression Fixture.

details. Prior to the adoption by ASTM, this test method was widely referred to as the Celanese compression coupon test method.

Compression testing has traditionally been the subject of considerable controversy because of the various types of failure modes one can encounter. Not only can one obtain different failure modes with different types of test specimens and fixtures, but one can also experience different types of failure modes from the same type of test specimen and Inherent in the question of what is or is not a desirable failure mode is the requirement to avoid a gross specimen buckling-type of failure. This is different from what is called micro-buckling, which consists of longitudinally oriented reinforcing fibers undergoing individual, localized buckling due to compressive stresses within the composite exceeding the capability of the resin matrix to support the fiber and maintain its axial alignment. Micro-buckling is generally considered a legitimate compressive failure mode, while gross specimen buckling resulting from column instability is not. In order to eliminate the occurrence of column instability failures, specimens are designed with a slenderness ratio sufficient to insure compressive failure before the load necessary to initiate column buckling is reached.

The compression test described in D3410-75 is considered to be a very promising compressive test method which, with proper specimen design, produces acceptable failure modes without the need of lateral specimen supports during the test. One objection to this test method which has been raised is that the mated conical surfaces make line rather than surface contact during testing and that this produces frictional and alignment problems which affect the recorded results.[3] Our experience has been that the frictional problems are minimal except when testing at reduced temperatures. In this case, frost accumulates

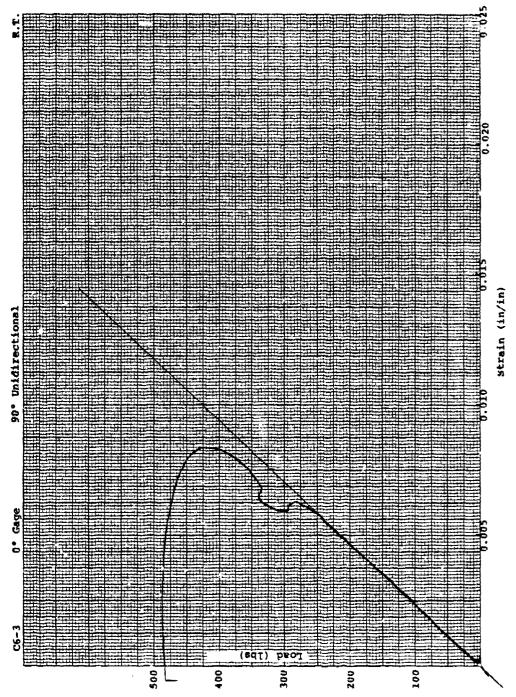
on the fixture and the sliding surfaces do not slide freely, producing some spurious load recordings. Misalignment has proven to be a problem, however. Although the specimens were designed to eliminate buckling instability, it has been found that buckling frequently occurred anyway at stresses between 75% and 100% of ultimate. This behavior is evident in the load-strain curve illustrated in Figure 6 and by the failed specimen in Figure 7. The misalignment apparently is induced by the nonuniform seating of the fixture cone in the conical socket. This nonuniform seating, in turn, results from the distortion imposed upon the split cone by the thickness of the specimen.

3.5.3 Flexure

All flexural testing, with the exception of the 0° AS/4397 specimens, was conducted using the four-point loading method described in the January, 1971, issue of the Advanced Composite Design Guide. [4] In this volume a three-point technique is recommended for 0° fiber orientations and a four-point technique for 90° fiber orientations. It has been observed, however, that one not infrequently encounters undesirable failuxe modes under the loading nose and subsequent anomalous strength values when using three-point loading on high modulus composite materials with a 0° fiber orientation. For this reason, the four-point method was used, with the one exception, for both fiber orientations in this program. The reason for this one exception is discussed in further detail in Section 4.3. All flexure tests were conducted at a testing speed of 0.05 in/min.

3.5.4 Inplane Shear

Two types of inplane shear tests were conducted. The principle technique, used for all of the different systems, utilized data obtained from a uniaxial tensile test on a ±45° crossplied laminate. This method is quite simple and is described in two articles in the Journal of Composite Materials. [5,6] The second type of inplane shear test was a double rail shear technique described as Method B in a proposed ASTM standard titled



Compressive Load-Strain Curve for Specimen Exhibiting Buckling Prior to Failure. Figure 6.



Appearance of Failed Compressive Specimen Which Buckled, Figure 7.

"Proposed Method of Test for Inplane Shear Properties of Composite Laminates." Figures 8 and 9 illustrate the specimen and fixture used in this technique. This latter method was used only with the SP313 system. The testing speed in the double rail shear test was 0.05 in/min.

All of the tabular data for inplane shear in Section 4 was obtained with the $\pm 45^{\circ}$ tensile test specimen. For comparative purposes, however, the data obtained with the rail shear method is also presented in Section 4 for the SP313 material, along with pertinent commentary.

3.5.5 Interlaminar Shear

Interlaminar shear is another property for which no simple or problem-free test exists. The two most widely used tests are the opposed double notch specimen with side supports and the short beam. A third test utilizes torsional loading of a rod but requires special fixturing. Each of these tests is subject to certain objections. The notched specimen is known to have high stress concentrations at the notch edges, the short beam specimen produces high strength values because of its short span and the compressive stresses introduced by the loading nose and supporting points, and the torsional specimen is not felt to have a straight line stress distribution at the higher stresses even though this assumption is made in computing the failure strength.

Because of the simplicity of the specimen and the test and because of the widespread use of the specimen for quality control, the short beam specimen was selected for generation of interlaminar shear properties in this evaluation. This method is described in the January 1971 issue of the Advanced Composite Design Guide and is also described by ASTM method D2344-76. The only differences between the two is that the ASTM method calls for ten replications, while only five were conducted in this program.

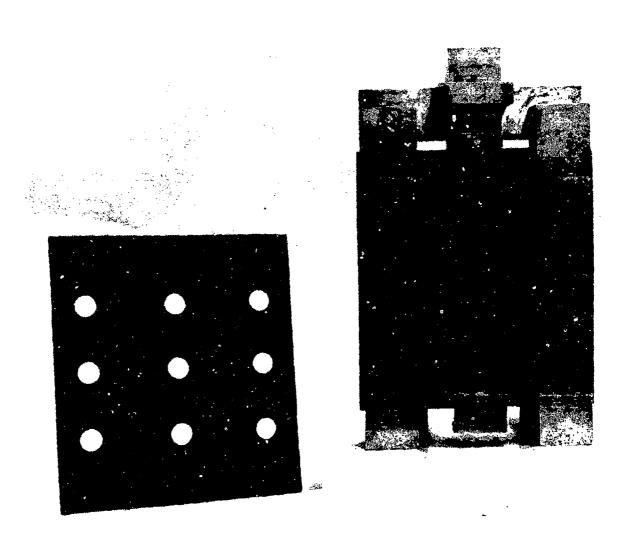
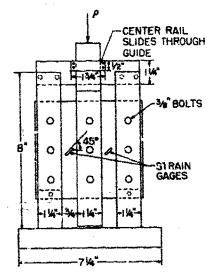
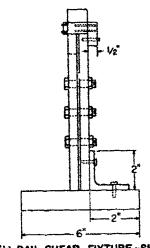




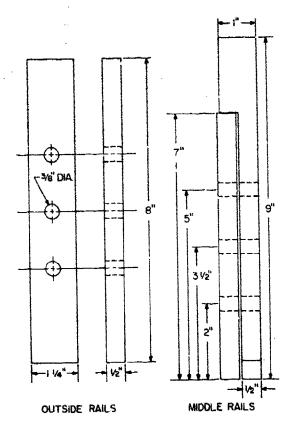
Figure 8. Double Rail Shear Specimen and Fully Assembled Test Fixture.



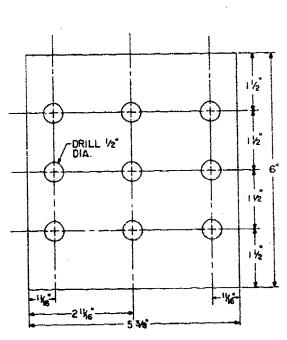
(a) RAIL SHEAR FIXTURE-FRONT



(b) RAIL SHEAR FIXTURE-SIDE



(c) RAIL DETAIL



(d) RAIL SHEAR SPECIMEN

Figure 9. Schematic Illustration of Rail Shear Specimen and Fixture.

3.5.6 Tensile Fatigue

Fatigue tests were conducted on all three fiber orientations at all four test temperatures and at three different levels of maximum stress. At least four replications were run for each condition. The same type of specimen was used for fatigue as was used for tensile tests. All of the tests were constant load amplitude at a frequency of 30 Hz with the minimum stress equal to one-tenth the maximum stress. The specimens were cycled to a maximum of 107 cycles, at which time, if no failure had occurred, they were removed and tested for residual tensile properties. All residual property tests were conducted at 72°F, regardless of the temperature at which the specimens were fatigue loaded.

The fatigue tests were carried out on MTS, closed-loop, electrohydraulic, servo-actuated testing machines. Specimen gripping was by means of wedge-type Instron and Templin grips. The grips are locked into place on the loading ram and load cell to insure constant alignment. Axial and concentric alignment of the ram and load cell was verified with a dial gage to within 0.001 inch and grip alignment was insured by the use of a specially machined straight aluminum bar in place of a specimen. Spacers were utilized to center the one-half-inch wide specimens in the one-inch wide jaws and periodically, a specially strained gaged specimen was placed in the grips and the strains on opposite sides and edges monitored during loading to insure that eccentric loading was held below 1%.

Both reduced and elevated temperature tests (except for the 0° orientations at 450°F) were conducted in Instron circulating air environmental test cabinets (Figure 10). Extra styrofoam insulation was placed along the interior walls of the Instron chambers during reduced temperature tests (-67°F) in order to reduce coolant (liquid nitrogen) consumption. Temperature control in both elevated and reduced temperature tests was maintained with Instron oven proportional temperature controllers

with the chromel/alumel control thermocouples positioned directly adjacent to the specimen gage section. Two additional thermocouples were mounted one inch above and one inch below the control thermocouple and monitored separately to verify that the temperature of the entire gage section was constant and that transient temperature fluctuations were less than $\pm 2^{\circ}F$ around the setpoint during elevated temperature tests and $\pm 5^{\circ}F$ during reduced temperature tests. Figure 11 illustrates the position of the control and two extra monitoring thermocouples along the gage section of a fatigue specimen.

The 450°F tests on the 0° specimens of the two polyimide systems utilized a short tube furnace (Figure 12) in place of the Instron environmental cabinets. This arrangement was necessitated by the inability of the tab adhesive to withstand the 450° temperature for an extended time period (up to 93 hours) at the high stress levels required for the 0° specimens. With these short furnaces (four inches long and one and one-half inches diameter tube), only the gage section of the specimen was in the heated zone. Temperature control on these tube furnaces was maintained with a thermistor actuated, timeproportioning controller employing a zero crossover switching triac, and transient fluctuations were less than +3°F around the setpoint. The temperature controlling thermistor was mounted on the side of the one-half-inch wide test specimens and the specimen centered in the uniform temperature region of the furnaces. Additionally, two thermocouples were attached to the specimen at a distance of one-half inch on either side of the thermistor to insure that the thermistor was at the optimum location. Figure 13 presents a typical temperature profile of the tube furnaces used for these 450°F tests. It can be seen that the central two-inch portion of this type tube furnace maintains a relatively "flat" temperature profile which is within +5°F of the setpoint.

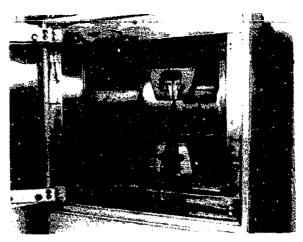


Figure 10. Fatigue Specimen Mounted in Instron Grips and Environmental Cabinet.

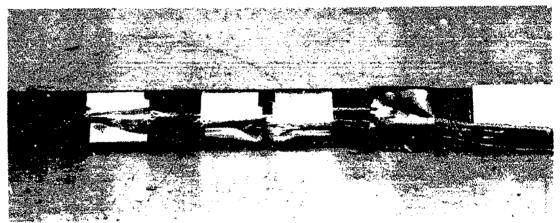
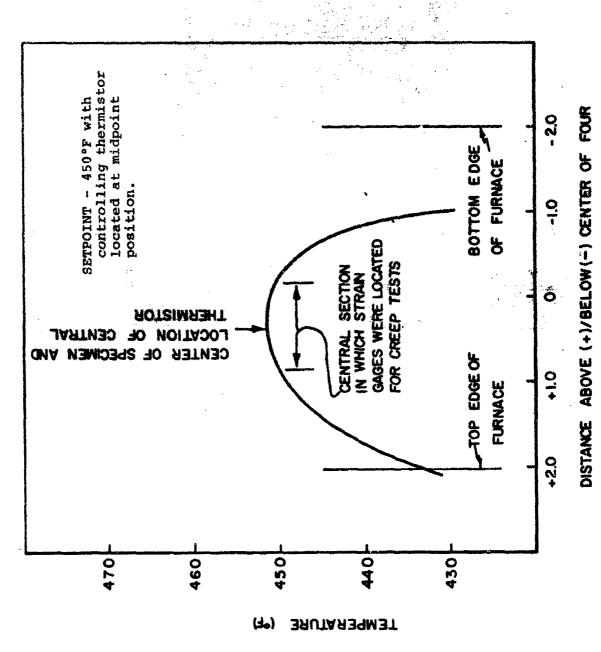


Figure 11. Location of Temperature Controlling and Monitoring Thermocouples on Fatigue Specimen.



Figure 12. Short Tube-Furnace Used in 450°F Fatigue Tests on 0° Fiber Orientation and in Elevated Temperature Creep Tests.



Typical Temperature Profile of Four-Inch Tube Furnaces. INCH TUBE FURNACE (INCHES) Figure 13.

3.5.7 Tensile Creep

Creep tests were conducted on all three fiber orientations at three temperatures and at least three stress levels. No creep tests were conducted at -67°F because of the low levels of creep exhibited at 72°F and because of the large refrigerant expense for long term tests. The same specimen design used in tensile testing was used for the creep tests. Creep strain measurements were recorded using one-inch long strain gages and were carried out to a maximum of 500 hours, at which time, if a specimen had not fractured, it was unloaded and creep recovery measurements recorded for a period of three hours. Each of these surviving specimens was then tested for residual tensile properties at 72°F. It will be noted that the creep recovery data are not included in the tabulated summaries of Section 4. The recovery data are presented, however, in Appendix I.

The creep tests were carried out on Arcweld creep frames. Each frame has the capacity, through a 20:1 counter-balanced lever arm, of putting loads of up to 12,000 lbs. on the test specimen. Each frame is also equipped with an electric timer and automatic shutoff switch, which monitors the total creep time as well as time to failure. Each frame also has an electrically driven load weight elevator and self-aligning couplings.

Two types of specimen gripping were employed. All of the 0° fiber orientations were gripped with wedge-type jaw grips as illustrated in Figure 14. The 90° and ±45° fiber orientations were drilled in their doubling tab areas to accept three 3/16-inch loading pins, as illustrated in Figure 15. These holes were carefully aligned axially to insure that no eccentric loading was introduced.

Elevated temperature tests were conducted in the short tube-furnaces described in the preceding section. The furnaces were controlled with a thermistor, as previously

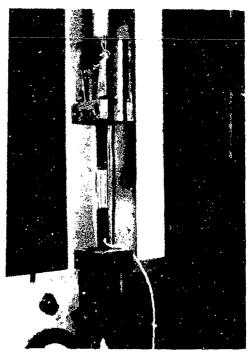


Figure 14. Wedge-Type Jaw Grips Used in Creep Tests.

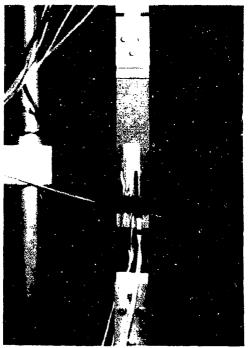


Figure 15. Pin-Type Grips Used in Creep Tests.

described, and temperature uniformity along the gage section was monitored with two thermocouples mounted one-half inch above and below the thermistor bead (Figure 15) to insure a "flat" temperature distribution across this section. As in the fatigue tests, transient fluctuations were +3°F around the setpoint. Specimens were stabilized at the test temperature for at least two hours before the load was applied.

Strain measurements were obtained from one-inch long strain gages mounted on the specimen surfaces and feeding into a Vishay model P-350A digital strain indicator through a Vishay model SB-1 ten-channel switch and balance unit. Figure 16 illustrates the strain indicator and switch and balance located on a table in front of the creep frames. Also illustrated here is a portable temperature monitoring instrument and a 24-channel switching unit for thermocouple input. Compensation for thermal expansion during elevated temperature tests was achieved by utilizing a compensating gage on a short (about three-inch) section of unstressed specimen material taped to the gage section of the actual test specimen (Figure 17). The output from this compensating gage was fed into an adjacent leg of a half-bridge circuit.

Many of the creep specimens were stacked in a series loading arrangement of up to three specimens in order to increase the rate of data acquisition. Figure 18 illustrates such an arrangement, with one oven moved aside for greater clarity. In cases where one of the specimens in a series broke prior to the 500-hour termination point, the remaining specimens were replaced and new tests conducted.

It will be noted in the tables in the text, as well as in Appendix I, that many creep specimens failed on loading even though the applied stress was less than the strength obtained in the static test at the same temperature. The only factor to which this can be attributed is that the creep load was applied at a considerably more rapid (though not instantaneous) rate than the load applied during the static test. The

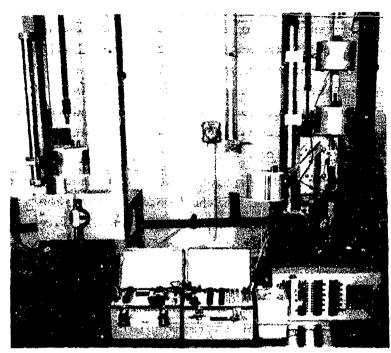


Figure 16. Strain Indicator and Switch-and-Balance Unit Used for Strain Measurements During Creep Tests.

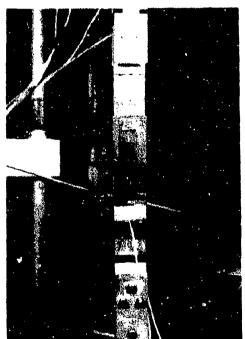


Figure 17. Compensating Gage for Thermal Expansion Compensation During Creep Tests.

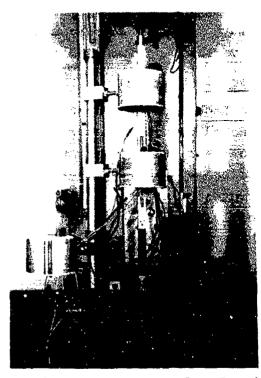


Figure 18. Stacking Arrangement for Testing Three Creep Specimens Simultaneously.

reason for this is that the load pans on the creep frames are raised and lowered by a motor driven elevator, which operates much more rapidly than the 0.05 inch/minute rate utilized during static testing.

3.5.8 Tensile Stress Rupture

Stress rupture data were obtained from the same specimens used for the creep tests, the only difference being that time-to-failure rather than strain as a function of time was the measured variable of interest.

3.5.9 Specific Heat

Two techniques were used to determine specific heat of the laminated composite materials. On the SP313 material, a drop calorimetry technique was employed. This is a relatively simple procedure in which a sample is brought to thermal equilibrium at a desired temperature and then transferred adiabatically to a receiver at room temperature. A measure of the heat content of the sample is then obtained as a function of the corresponding temperature change of the receiver as it comes to thermal equilibrium with the sample. The receiver consists of a circular copper plate housed in a quartz cylinder and has three thermocouples, connected in series, embedded in it. These thermocouples are connected in series to magnify the change in temperature of the receiver after the drop, as well as to insure a good average temperature indication over the entire area of the receiver plate. The sample is also a disc shape, only slightly smaller in diameter than the receiver plate, so that upon dropping, a large contacting surface area exists to promote rapid heat transfer and thermal equilibrium. The receiver cup has been calibrated with standards of known specific heat to obtain a relationship between the receiver cup temperature and its heat content. The tests with the SP313 consisted of heating the samples to the desired temperatures and dropping them onto the receiver plate. The values so obtained actually represent specific heat values at the average temperature between the initial and final sample temperatures. These data were all obtained from unidirectionally reinforced samples and represent averages of three tests each.

Cn all of the other materials, specific heat was determined with a differential scanning calorimeter (DSC) technique. This technique compares the rate of heat input required to maintain a constant rate of temperature rise in an unknown sample to that required to maintain the same rate of temperature rise in a known reference material and is considerably simpler and less time-consuming to run than the drop calorimetry tests. A Perkin-Elmer, model DSCl-B, instrument was used for these determinations.

3.5.10 Coefficient of Thermal Expansion

Thermal expansion was measured using a quartz tube dilatometer. Both the apparatus and the experimental procedure are described in ASTM D696-70. Low temperature measurements were performed by cooling the specimen to -67°F in an insulated chamber and then allowing the system to warm to room temperature at a rate controlled by an electric resistance heater. Elevated temperature measurements are achieved by slowly heating the specimen with a wire wound resistance furnace. In each case, expansion is measured continuously throughout the temperature range. Measurement of the thermal expansion of unidirectionally reinforced specimens in the direction of the fiber axis (0°) proved most tedious because the expansions were so minute. For this reason, the values obtained for this orientation are reported as approximately zero. An optical interferometric technique would probably prove more useful for measurements with this orientation.

3.5.11 Thermal Conductivity

Thermal conductivity was measured in the direction normal to the laminate surface for both unidirectional and <u>445°</u> fiber orientations. A comparative technique was employed in

which the sample is sandwiched between two identical reference materials of known conductivity. These, in turn, are held firmly between a heater and a heat sink. The heat flux through this stack establishes a temperature gradient which is measured with thermocouples placed on the upper and lower surfaces of both reference plates and the specimen plate in small precisely machined grooves. Radial heat flow to and from the test stack is minimized with a cylindrical guard heater in which a linear temperature gradient, closely matching that of the test stack, is maintained. A Dynatech model TCFCM-N20 thermal conductivity instrument was used for these measurements. Data points were taken at approximately equal temperature intervals over the range of interest and a "best-fit" curve (or straight-line) plotted through these data points. The reported values in Section 4 were taken from these plotted curves at the specific temperatures. The maximum scatter of the individual data points on either side of the plotted curves was about +15% of the reported values.

3.5.12 Glass Transition Temperature

Glass transition temperatures were determined with a Perkin-Elmer Thermomechanical Analyzer, model TMS-1. This measurement simply consists of noting the temperature at which a relatively abrupt change in the thermal expansion characteristics of the sample occurs. Specimens were run both "dry" and "wet", the "wet" condition implying that the sample was humidity aged at 160°F and 100% R.H. to an equilibrium weight gain prior to the determination. Unfortunately, there was no way to prevent the "wet" specimen from drying somewhat during the test. Hence, the specimen was no doubt at some moisture content less than saturation when the indicated Tg was observed. Nonetheless, the "wet" values were lower than the "dry" values in every case, indicating a definite softening due to whatever moisture level still remained in the samples.

SECTION 4 SUMMARIZED COMPOSITE DATA

This section presents tabulated summaries of all the data generated for each composite system evaluated during the program. Also presented are the averaged stress-strain, creep, and fatigue S-N curves for each of the systems.

In addition to the summarized data and averaged mechanical property curves, pertinent observations made during the characterization of each material are discussed.

Of the five materials systems specified in Section 2 as having been selected for characterization in this program, only four were finally characterized. Testing of the fifth, the AS/HME (low flow) graphite/epoxy, was terminated early because of difficulty in fabricating high quality laminates with the prepreg supplied. The principle problem was a large variability in resin content from point to point in the prepreg, due to nonuniform resin distribution when the prepreg was fabricated. A comprehensive study of this resin content variability showed. that prepred resin contents varied from as low as 22% in visibly resin-starved areas to as high as 46% in visibly resin-rich areas. The resin-starved areas of prepreg contributed to the development of large unbonded areas in the laminate interiors since the low flow characteristic prevented the resin from the resin-rich areas from flowing into the resin-starved areas. Four panels were prepared and it was found that one-half of the specimens were unusable because of grossly visible interior defects. Test results from the remainder of the specimens produced low strength values for properties sensitive to porosity, such as 90° tension. Since replacement of the prepreg proved impossible, and also since further development work with this resin was anticipated (which might even alter slightly the basic chemistry of the resin), it was decided to terminate work on this matrix system. No data are consequently presented in this Section for the AS/HME graphite/epoxy material.

4.1 SP313

Tables 9-22 present the data generated for this graphite/epoxy composite system. Figures 19-40 illustrate the stress-strain, fatigue, and creep behavior of this material, as well as the effects of humidity aging upon the composite material.

As indicated in Section 3.5.4, a comparison of the inplane shear data obtained from both the ±45° tensile coupon
and the double rail shear technique is presented here. Table
16 presents the double rail shear data and Figure 25 illustrates
the stress-strain data obtained from the two different test
procedures.

It is readily apparent that good agreement exists between the two different test methods except for the case in which a ±45° fiber orientation was used in the rail shear fixture. In this case, however, considerable tensile stresses are developed in the fibers of the rail shear specimens and the loads necessary to deform and fracture the specimen are considerably higher than in the other three orientations.

It is interesting to note that the strength obtained for the 0°/90° orientation with the rail shear test is almost exactly equal to the sum of strengths obtained with the 0° and the 90° orientations. The large differences encountered with these different fiber orientations is traceable to the different failure modes and stresses developed in the specimens. The 0° specimens, with the fibers running parallel to the load direction, experienced splitting in the fiber direction at locations very near the edge of the gripping rails. For the type of failure, only resin and/or resin-fiber interfacial bonds had to be fractured. Since the panel is clamped in a relatively rigid fixture, no lateral contraction is permitted during the test. This constraint serves to develop internal tensile stresses acting perpendicular to the load direction. In a 0° orientation this is easily the weakest direction and failure probably is

caused by these internally developed tensile stresses rather than the shear stresses. The 90° specimens, with fibers running perpendicular to the load direction and across the width of the loaded section, sustained considerably higher loads. When they did fail, they experienced numerous splits again the fiber direction, but now at 90° to the direction of splitting in the 0° specimens. The tensile stresses which develop because of the rigid fixture constraints are more readily bourne by the 90° orientation because the fibers can carry the load and consequently, a substantially higher strength is obtained. The behavior of the 0°/90° specimen is essentially a composite of the separate 0° and 90° behaviors with the 0° plies splitting longitudinally to cause failure but the 90° plies carrying sufficient load to reduce the internally developed tensile strain and postpone failure to a markedly higher stress than is obtained with J° orientations alone. No damage was visible on the +45° rail shear specimen. The higher apparent shear modulus values obtained with the 0° or 90° orientations can probably be attributed to the mixed mode stresses induced in this specimen.

TABLE 9 PROCESSING DATA FOR SP313 SYSTEM

Composite Processing Information

Material System - SP313

Fiber - T300 Matrix - PR313

Graphite/Epoxy SP313

Maximum Rated Temperature - 350°F

Prepreg by - 3M

Laminate Processing Schedule

Layup Procedure: Prepreg warmed to R.T. in closed wrapper. Prepreg removed from package and plies cut to desired size using razor blade. Plies stacked in desired sequence (release paper removed from each ply). Stack placed in Mini-Clave on sheet of non-porous Teslon and surrounded with cork dam to restrict siber slow. Sheet of porous Teslon placed on top of stack and one ply of bleeder paper placed on top of this. One ply of style 112 glass fabric is layed over the bleeder paper and this is capped with another sheet of non-porous Teslon and a pressure plate. Three plies of bleeder paper large enough to extend over the cork dam are then placed over the pressure plate and a silicone rubber bladder then placed over the Mini-Clave. The Mini-Clave was placed in an unheated press and a nominal I psi platen pressure applied to keep the Mini-Clave closed during cure.

Cure Schedule: Temperature was increased from R.T. at a rate of 3 to 5°F per minute under 28-29 in. Hg vacuum. When the temperature reached 250°F, 80 psi air pressure was applied above the bladder. At 260°F, the vacuum under the bladder was vented to the atmosphere. At 350°F, the temperature was held for four hours. The panel was then cooled under pressure to below 150°F at a rate of 3-5°F per minute.

Postcure Schedule: None

TABLE 10
PREPREG AND COMPOSITE PHYSICAL PROPERTIES: SP313

Material System - SP313	DD 2.12		Graphite/Epoxy	
Fiber - T300 Matrix - PR313 Maximum Rated Temperature - 350°F		Prepreg by - 3M		
Prep	reg Physical	Properties		
-		-	(Test Method) (Ref.)	
Volatile Content-0.23% by w Resin Content-39.1% by wt. Resin Flow-15.9% by wt. No. of Rolls Involved-5 No. of Batches Involved -2	0.4 0.5	38.4-39.4	7 3M methods as describe 1 in spec. sheets provided 3 by 3M	
Lam	inate Physic	al Properties	1	
	•	-	(Test Method) (Ref.)	
	Stnd. Dev.) 1. 3.2 2.6 0.03 As report	(Range) 57.4-65.9 27.2-33.9 1.46-1.62 rted by manuf	(Test Method) (Ref Acid AFML-TI Digestion 67-243 Point count	

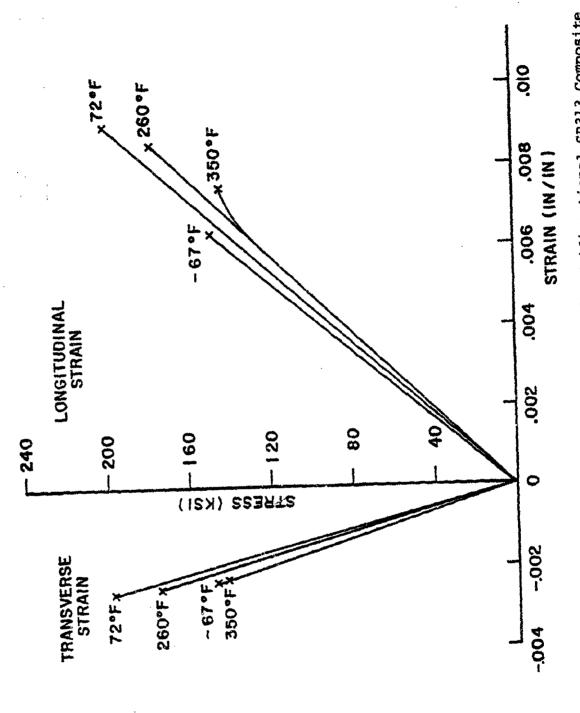
¹The properties reported here represent averages for all panels of this material used throughout the program.

TABLE 11

TENSILE PROPERTIES OF SP313 COMPOSITE LAMINATES

COMPOSITE MATERIAL PROPERTIES					
Material System - \$P313 Fiber - T300 Matrix - PR313 Maximum Rated Temperature - 350°F Resin Content - 29, 1% by wt. Prepreg by - 3M Graphite/Epox Laminate Sp. Gr 1.47 Average Ply Thickness - 0.0052 in.					
Fiber Content - 64, 7% by vol. Void Content - 2, 4% by vol. No. of panels from which specimens were tested in this table - 12 Thickness of each type specimen 0°-6 ply, 90°-15 ply					
TENSION: 0°					
	-67° y	72°¥	260°F	350°F	
F ^{tu} (kai)	146.2	198.7	176.6	141.7	
etud. dev. (ksi) Range (ksi) No. of Specimens	7. 9 133.2-153. 6 5	14.9 182.0-218.2 6	8.6 162.3-184.5 5	15.0 117.2-156.3	
F ^{tpl} (ksi)	146. 2	198.7	176.6	130.8	
stad. dev. No. of Specimens	2	14.9 7	8. 6 5	26.5 5	
Ex (Msi)	20.7	20.3	19.3	19.5	
sind. dev. No. of Specimens	1.2	1.1	0 . 6 5	0.3 5·	
stu (min/in)	7050	9000	8600	7460	
stnd. dev. No. of Specimens	71 2	449 5	600 5	316 4	
t "xy	0.36	0.32	0,32	0.34	
atnd. dev. No. of Specimens	0.06	0.03	0,02 5	0.02 3	
Test Method Reference		Straight-a Design (ided tension Juide		
	TENS	ION: 90°	,		
F ^{fu} (ksi)	5.2	4.9	4,8	3.7	
stnd. dev. (ksi) Range (ksi) No. of Specimens	0.7 4.1-5.8 5	0.3 4.6-5.4 5	0.6 4.0-5.4 5	0.4 3.3-4/2 5	
Fy (kai)	5.2	4.9	4-1	1.6	
stnd. dev. No. of Specimens	0.7 5	0.3 5	0.6 5	0.7 S	
Ey (Mai)	1.4	1.3	1.1	1.05	
stnd. dev. No. of Specimens	0.1 5	0.03	0.05 5	0,01	
etu (#in/in) stnd. dev.	3700 540	3800 250	4400 640	4100 410	
No. of Specimens t yx	0.024 ¹	0.0201	0.0151	0.014 ¹	
Test Mothod Reference		Straight-eided tension Design Guide			

Computed using elastic modulii and longitudinal Poisson's ratio.



Tensile Stress-Strain Curves for Unidirectional SP313 Composite Laminates: 0° Fiber Orientation. Figure 19.

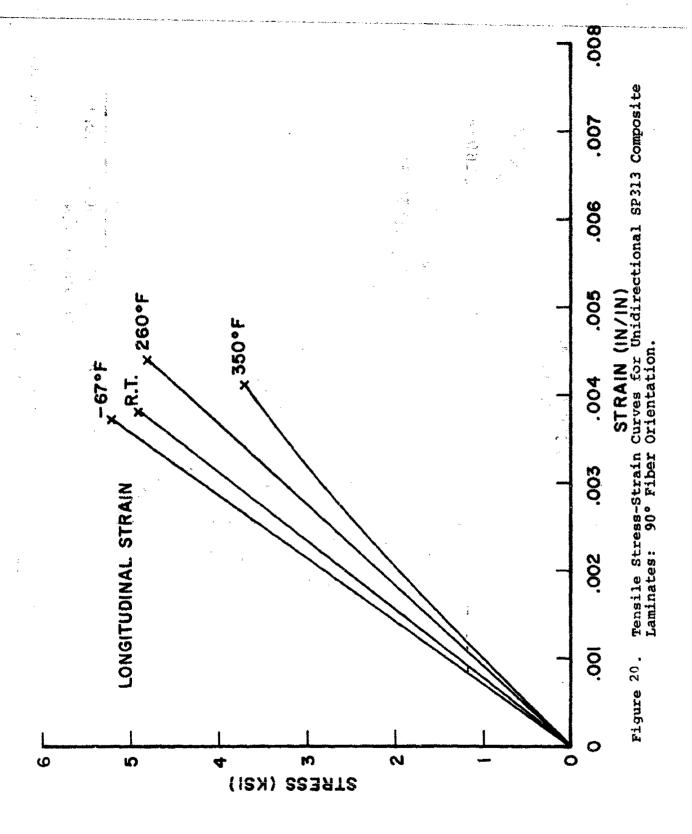


TABLE 12
TENSILE PROPERTIES OF SP313 COMPOSITE LAMINATES

COMPOSITE MATERIAL PROPERTIES Material System - SP313 Prepreg by - 3M Graphite/Epoxy								
Material System - S Fiber - T300 Maximum Rated Ten Resin Content - 32. Fiber Content - 59. Void Content - 2%	Matrix - Inperature - 3 5% by wt. 5% by vol.	PR313 Lami 350°F Aver: No. o	nate Sp. Gr. age Ply Thick If panels from re tested in t	- 1.55 mess - 0.0055 inch m which specimens				
	TENȘIC	N: + 45°						
	-67°F	72°F	260°F	350°F				
F _x (ksi)	24.50 0.36	20.99	15.02	10.94				
stnd. dev. (ksi) Range (ksi) No. of Specimens		0.39 20.67-21.58 5	0,38 14,52-15.56 5	1.04 10.33-12.73 5				
F _x ^{tpl} (ksi)	8. 28	5.86	3.86	2.63				
stnd. dev. (ksi) No. of Specimens	0,78 5	0. 72 5	0, 43 5	0.37 5				
E ^t (Msi)	3.01	2.70	2. 12	1. 92				
stnd. dev. No. of Specimens	0,16 5	0.17 5	0.10 5	0.10 5				
e ^{tu} (#in/in)	11,200	14, 200	27, 000	28,000				
stnd. dev. No. of Specimens	894 5	2, 150 5	5, 440 5	4,500 5				
t ×y	0.66	0, 73	0.74	0.83				
stnd. dev. No. of Specimens	0.04 5	0.05 5	0. 04 5	0.02 5				
Test Method Reference		Straight-si Design	ded tension Guide					

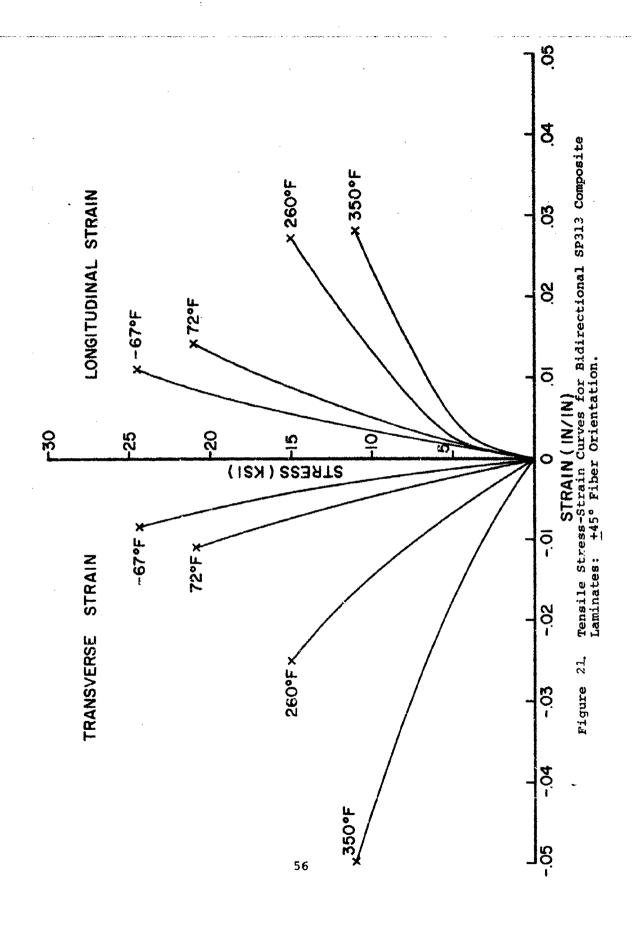


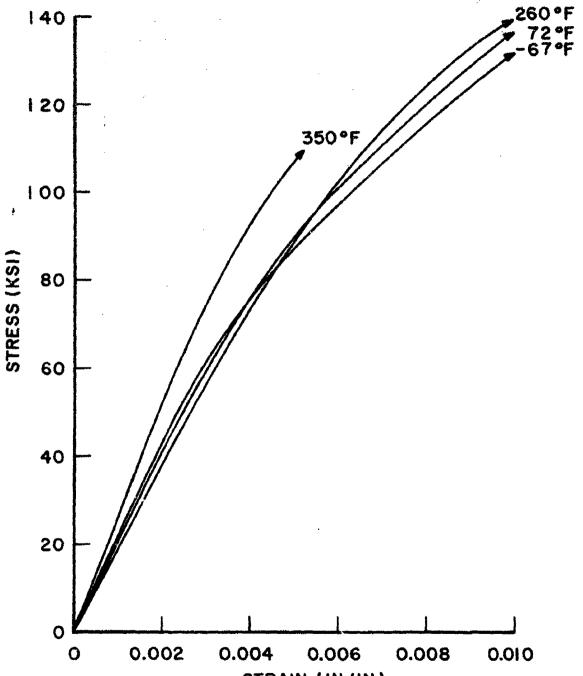
TABLE 13

COMPRESSIVE PROPERTIES OF SP313 COMPOSITE LAMINATES

COMPOSITE MATERIAL PROPERTIES Material System - 5P313 Graphite/Zpoxy								
			_	G	aphite/Epoxy			
Fiber - T3		trix - PR31		epreg by -3M				
Regin Cont	Rated Temper ent - 31.3%	hours - 350		aminate Sp. G	 - 1.55 ickness - 0.0055 ir. 			
	ent : 60.5%				om which specimens			
	nt - 1,7% by		W(era tested in t	his table - 3			
{			T?	hickmess of ea	ch type specimen:			
			O ^c	5-14 plies; 90	-14 plies			
		сом	PRESSION : C	مر				
		-67°F	72°F	5600æ	350°F			
Çu F	(ksi)	166.3	157.4	147.9	148.1			
stad, dev.	(ksi)	35.0	12.1	25.6	6.8			
Range	(ksi)	123.1-225.4	143.6-172.8	119. 8-194. 6	141, 3-159, 1			
No. of Specim	ens .	7	5	6	5			
F _∞	(ksi)	53.0	35,8	63.5	53.0			
stnd. dev.		23.0	7.9	19.5	23.8			
No. of Specim	ens	5	5	6	5			
_e	(Moi)	21, 15	19.8	19.34	25.0 ²			
×	fwrat!			}	1			
eind, dev.		4. 36	0.9	1.91	1.9			
No. of Specim	1672		5	1 °	5			
cn	(u in/in)	20, 2001	12,600 ¹	11,400	7, 300 ¹			
x stad. dev.		13, 200	6, 400	6,000	4,100			
No. of Specim	ens	7	5	7	5			
Test Method			elanase coupo	n and test fixt	ire			
Reference			AFML-TR-7					
cu		COMPRESSION: 90°						
L _{cr}	(ksi)	42.4 26.4 19.9 16.6						
atnd. dev.	(ksi)	7.1	3.33	1.9	2.2			
Range	(ksi)		22, 9-32, 3	18.4-22.8	13.8-19.7			
No. of Specim	ens	5	6	} 5	5			
r _y	(ksi)	18.0	3.93	4,5	4, 3			
stnd. dev.		12.8	1.7	1.9	1.1			
No. of Specim	retra	4	4	5	5			
E,	(Msi)	1.85	1.72	1.49	1.56			
stad. dev.	- ·	0.32	0, 20	0.11	0.3			
No. of Specim	tens	5	6	5	5			
cu	(4 in/in)	33,500 ¹	17, 200 ¹	20.5001	34, 700			
y	M. cart cash	1 1	i .	1	1			
stnd. dev. No. of Specim	ens	12,300 5	10, 900 6	12,500	18,400 5			
Test Method Reference			Celanese coup AFML-TR-7	en and test fin 2-205, pt. i	ture			

Ultimate strain values represent maximum observed strain rather than ultimate values. Buckling was observed in majority of tests.

 $^{^2\}mathrm{R}$ is recognized that this value appears abnormally high, but it nevertheless was obtained in the same manner as the other values and there was very little scatter in the five values.



STRAIN (IN/IN)
Figure 22 Compressive Stress-Strain Curves for Unidirectional SP313 Composite Laminates: 0° Fiber Orientation.

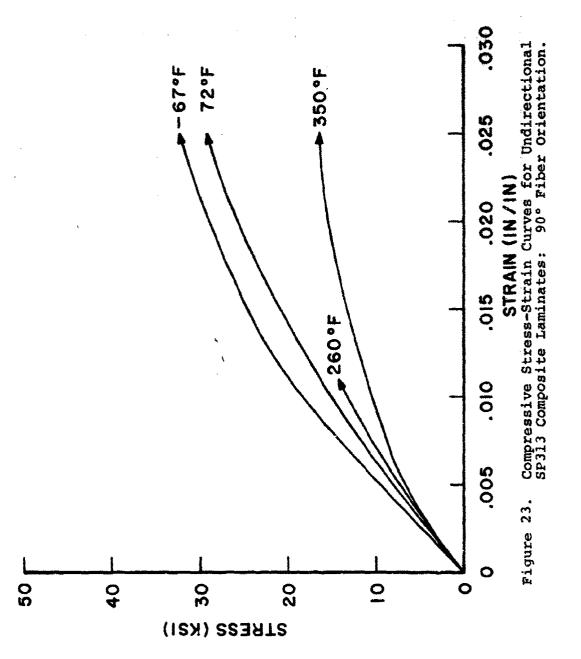
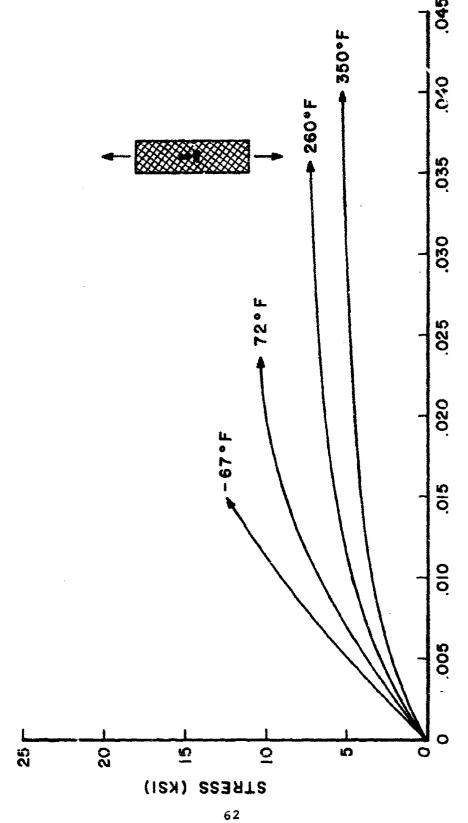


TABLE 14
FLEXURE PROPERTIES OF SP313 COMPOSITE LAMINATES

C	OMPOSITE MATE	HAL PROPE	RTIES	
Material System -	SP313 Matrix - PR3		cg by - 3M	Graphite/Epoxy
Fiber - T300 Maximum Rated T Resin Content - 32 Fiber Content - 59 Void Content - 6	emperature – 350° 2.6% by wt. 3.3% by vol	F Lamin Avera No. of were t		ess - 0.0053 inch which specimens able - 2 pe specimen:
	FLEX	URE : 00		
	-67°F.	72°F	260°F	350 ⁰ F
F _x (ksi)	190.0	200,7 26.6	135.7 19.0	96. 4 12. 5
stnd. dev. (ksi) Range (ksi) No. of Specimens	23.0 156.4-209.8 5		19.0 113.8-159.6 5	87.0-117.9 5
f E _x (Msi)	17.63	17.77 0.76	17.33 0.65	16, 29 0, 63
stnd. dev. No. of Specimens	0.52 5	5	5	5
Test Method Reference		Design Jan.,	flexure n Guide , 1971	
	FLEX	UR E: 90°		
Fy (ksi)	11.24 0.60	10,66 0,77	6.50 0.75	4. 82 0. 23
stnd. dev. (ksi) Range (ksi) No. of Specimens	10.46-11.89 5	9. 47-11. 34 5	1	4. 46-5. 06 5
E _y (Msi)	1.46	1.36	1,12	0.95
stnd. dev.	0, 05	0.06	0.07	0.05
No. of Specimens	5	5	5	5
Test Method Reference		4 pt. fl Design Jan.,	Guide	

TABLE 15
SHEAR PROPERTIES OF SP313 COMPOSITE LAMINATES

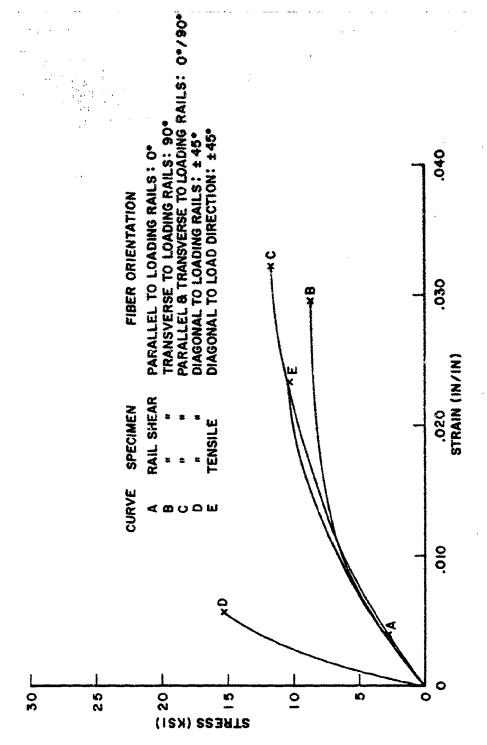
COL	POSITE MATI	PDIAT DOODS	en mine	
CON	IPOSITE MATT	ERIAL PROPE	ERTIES	
Material System - SP Fiber - T300 M Maximum Rated Temp Resin Content - 32.88 Fiber Content - 59.28 Void Content - 28 h	Matrix - PR313 erature - 350°1 by wt. by vol.	E Laminate Nominal No. of pa were te	by - 3M Sp. Gr 1 Ply Thicknes anels from wh sted in this to	s - 0.0054 in. ich specimens
	INPLAN	E SHEAR: 0°	or opecia	ens - o pry
	-67°F	72°F	260°F	350°F
Fxy (ksi) Stnd. Dev. (ksi) Range (ksi) No. of Specimens Gxy (Msi) Stnd. Dev. (Msi) No. of Specimens Test Method Reference	J. Comp. Mtls.		5 0.61 0.02 5 -sided tens 2 & Vol. 7, p	
	INTERLAM	INAR SHEAR:	. 0°	
F ^{isu} (ksi) Stnd. Dev. (ksi) Range (ksi) No. of Specimens	14.49 0.51 13.76-15.00 5	12.69 0.48 11.88-13.04 5	8.76 0.30 8.39-9.11 5	7.18 0.19 6.98-7.44 5
Test Method Reference		Short Beam Design Gui Jan., 197	de	



STRAIN (IN / IN)
Inplane Shear Stress-Strain Curves for SP313
Composite Laminates. Figure 24 .

TABLE 16
INPLANE SHEAR PROPERTIES OF SP313 COMPOSITE LAMINATES

COMPOSITE MATERIAL PROPERTIES										
Material System - SP313 Prepreg by - 3M Graphite/Epoxy										
Fiber - T300 M	fatrix - PR31			te Sp. Gr 1.						
Maximum Rated Te					s - 0.0054 inch					
	27.86% by wt.			panels from wh tested in this t	ich specimens					
	65.45% by vol ≟2% by vol.	•	were	tested in this t	able - 7					
Yold Content -										
<u></u>	Inplane Shea	r: 0° (fiber pa								
		-67°F	72°F	260°F	350°F					
T _{xy} (ksi)			2.85							
stnd. dev. (ksi)			0.34							
No. of Specimens			6							
G _{xy} (Msi)			0.97							
stnd. dev. (Msi)			0.24							
No. of Specimens			6							
	90° (fib	er perpendicula	r to lead direc	ction)						
T ^u (ksi)			8.73	6.65	5. 24					
			0.37	0.17	0,25					
stnd. dev. (ksi) No. of Specimens			6	6	6					
140. or obecutiens			· ·	_						
G _{xy} (Msi)			0.87	0.72	0. 58					
stnd. dev. (Msi)			0.11	0.08	0.04					
No. of Specimens			6	6	3					
±45°										
T ^u xy (ksi)			15.26							
stnd. dev. (ksi)										
No. of Specimens			2							
G _{xy} (Msi)			5.41							
stnd. dev. (Msi)			***							
No. of Specimens			2	<u> </u>	<u> </u>					
		2º/90º		· · · · · · · · · · · · · · · · · · ·						
T ^u (ksi)			11.80							
stnd, dev, (ksi)			0.32							
No. of Specimens			8							
G _{xy} (Msi)		•••	0.78							
stnd. dev. (Msi)			0.09							
No. of Specimens			8							
Test Method		Rail She	ar (3 rail)							
Reference			d ASTM test,	Method B						
		L ,								



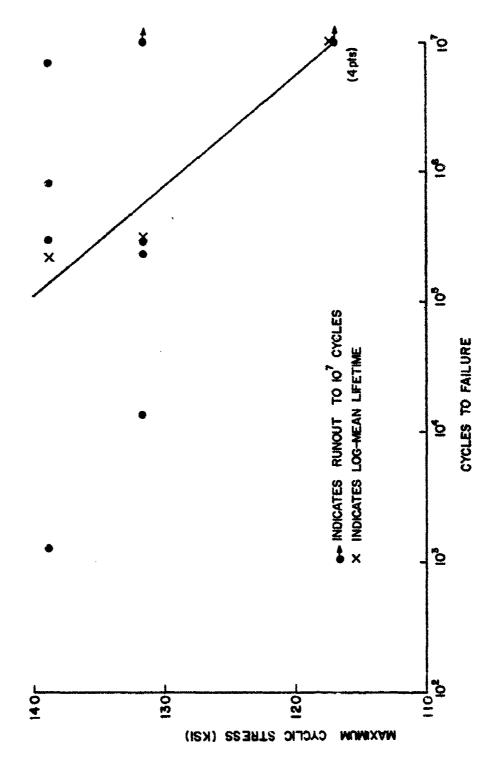
Inplane Shear Stress-Strain Curves for SP313 Composite Laminates from +45° Tensile Coupon and Double Rail Shear Panels of 0°, 90°, 0°/90°, and +45° Fiber Orientations at 72°F. Figure 25.

TABLE 17

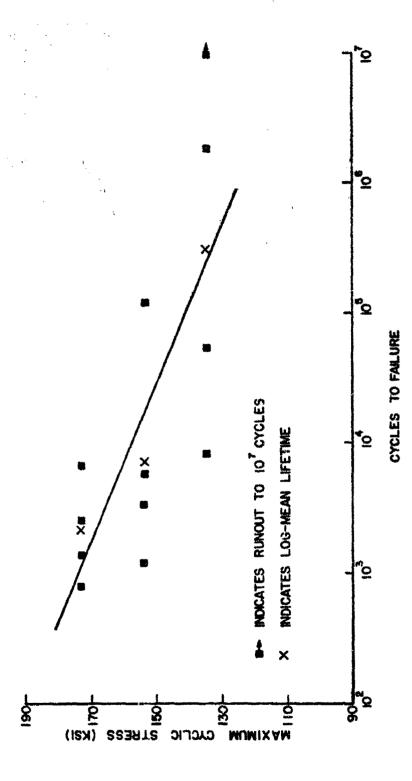
FATIGUE PROPERTIES OF SP313 COMPOSITE LAMINATES

			COX	POSITE MA	COMPOSITE MATERIAL PROPERTIES	erties			
Material System -	SP313	Prepreg by						Oresh	Grephite/Epoxy
Fiber - T300	Fiber - T300 Matrix - PR313 Maximum Temperature Raifag - 350°F	í	A	aminate Sp.	Laminate Sp. Gr 1.54				
Resin Content	Resin Content 31.17% by wt.		₹Ž	rerage Ply	Average Ply Thickness - 0.0053 inch No. of manels from which specimens	Average Ply Thickness - 0.0053 inch No. of ranels from which specimens were tested is this table -	is table - 30	•	
Figer Content -	= 52% by vol.		F	nicka se of	Thickn se of each type specimen	men 6 plice			
Test Method -	Tension	Reference -		Design Guide		+450 B plica			
				TENSILE	TENSILE FATIGUE, R=0.1	į.			
Temperature	Fiber Orientations	စ္ပ	006	±45°	Temperature	Fiber Orlegiations	o	006	+450
2067	May Street (kg))	138.9	4,68	18,38	30092	Max. Stress (ksi)	157.2	4,29	12.01
• •	Lifetime (cycles)	216,660	190	8,610		Lifetime (cycles)	870	260	5,670
	No. of Specimens	*	•	4		No. of Specimens	₹	*	•
	Residual Strength (kel)	•	:	; <		Residual Strength (kel)		: 0	; 0
	No. of Specimens	•	>	>		, or open		, ,	· ;
	Max, Stress (kei)	131.6	4.16	17.15		Max. Stress (ksf.)	139.8	3.81	10.51
	Lifetime (cycles)	309,350	5,530	48,088		Lifetime (cycles)	6,915	2 .	040',41
	No. of Specimens		•	•		No. of Speciment	• }	•	- :
	Residual Strength (kal)	190.2	:	! <		ticestanal Strength (Ket)	٥	0	0
	No. of Specimens	-	>	,		No. of Specimens	• •	. :	
	Max. Stress (ksi)	1120	3,640	14,70		Max. Stress (ksl)	122.3	3.55	576
	Lifetime (cycles)	20.	42,070	902, 634		Lifetime (cycles)	366, 330	13,030	-
	No. of Specimens		•	•		Designation of the state of the	• 1	. :	20,39
	Residual Strength (kel)	171.6	; <	; 0		No. of Specimens	0	0	
	No, of Specimens	•	>	,					
104	Max. Strees (ks)	173.1	4,42	16.79	320 ₀ E	Max. Stress (ksi)	127.5	3, 32	8.75
!		2,110	2,200	9, 770		Lifetime (cycles)	10,850	1,450	0+9*91
	No. of Specimens	*		*		No. of Specimens	\$	*	•
	Residual Strength (ksi)	;	:	į		Residual Strength (kel)	: (:	•
	No. of Specimens	•	0	0		No. of Speciment	5	>	•
	Max. Stress (ks)	153.8	3.93	14.69		Max. Stress (ksl)	113.4	2.95	8.20
	Lifetime (cycles)	7,375	3, 390	162,030		Lifetime (cycles)	122,870	2,790	3, 18x10
	No. of Specimens	*	*	*		No. of Specimens	•	•	* :
	Residual Strangth (kel)	: •	; <	•		Residual Strength (Kel)	: 0		-
•	No. of Specimens		>	>		No. of Specimens	,	•	,
	Max. Stress (kail	134.6	3.44	12.59		Max. Stress (xxl)	2.50	2.59	7.66
	Lifetime (cycles)	307,140	1 56.770	2.87×10°		Lifetime (cycles)	660,440	32,290	7, 73×10
	t.c. of Specimens			*		No. of Specimens	•	•	, ,
	Residual Strength (kel)	9.061	5.010	; <		Residual Strongth (KBI)		; c	
	No. of Specimens		J	>		No. of opecutions	7	,	1

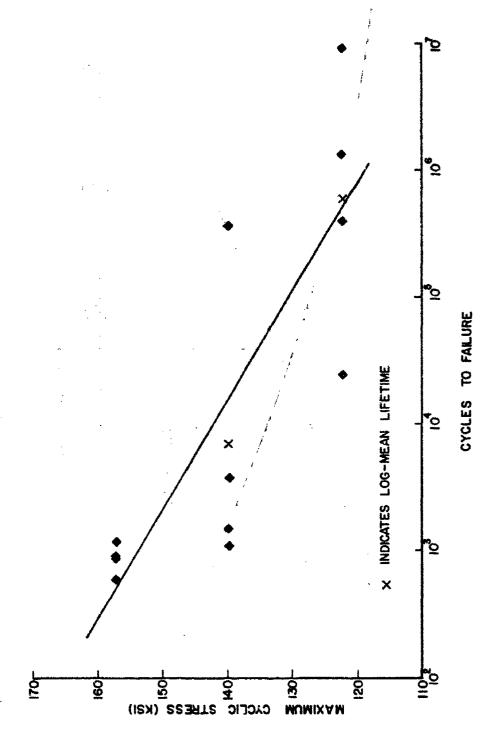
Note: Fatigue ilfatimes are log mean values. All residual strengths determined by tunsila tust at 72°F.



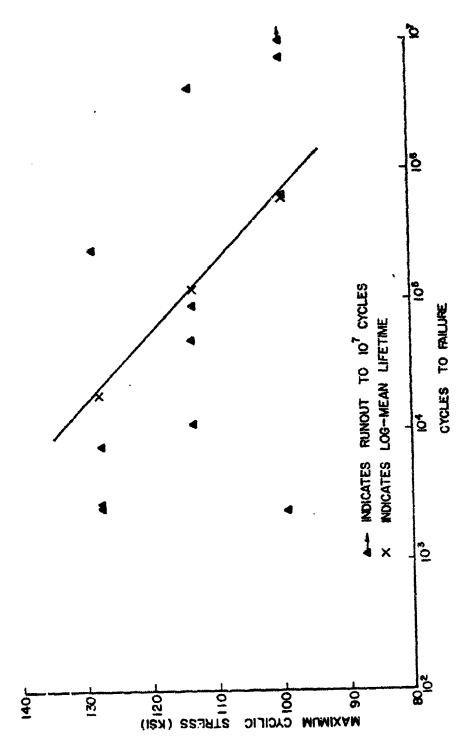
Tensile-Tensile Fatigue Behavior of Unidirectional SP313 Composite Laminates at -67°F: 0° Fiber Orientation, R=0.10, 30 Hz. Figure 26.



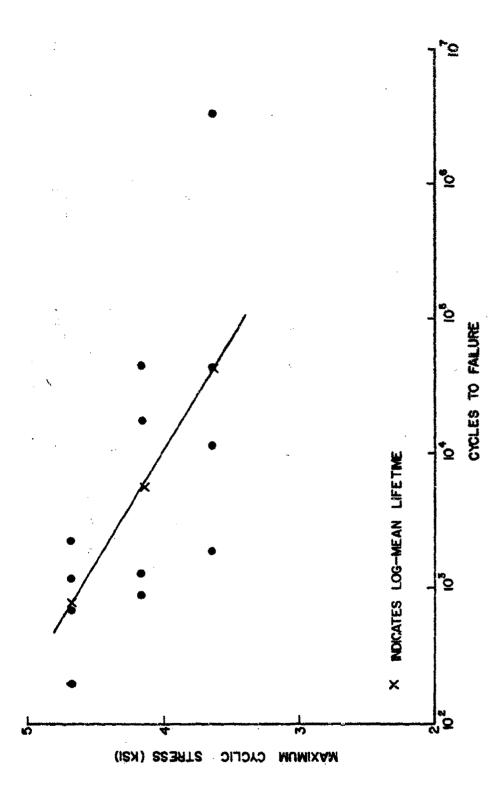
Tensile-Tensile Fatigue Behavior of Unidirectional SP313 Composite Laminates at 72°F: 0° Fiber Orientation, R=0.10, 30 Hz. Figure 27.



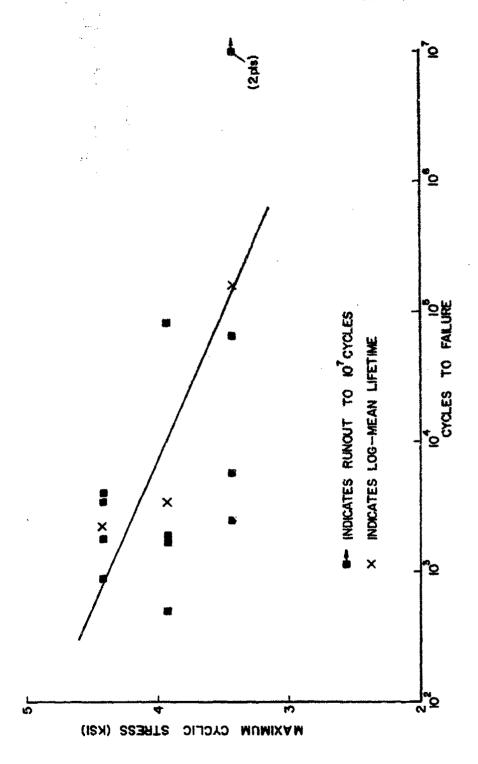
Tensile-Tensile Fatigue Behavior of Unidirectional SP313 Composite Laminates at 260°F: 0° Fiber Orientation, R=0.10, 30 Hz. Figure 28.



Tensile-Tensile Fatigue Behavior of Unidirectional SP313 Composite Laminates at 350°F: 0° Fiber Orientation, R=0.10, 30 Hz. Figure 29.

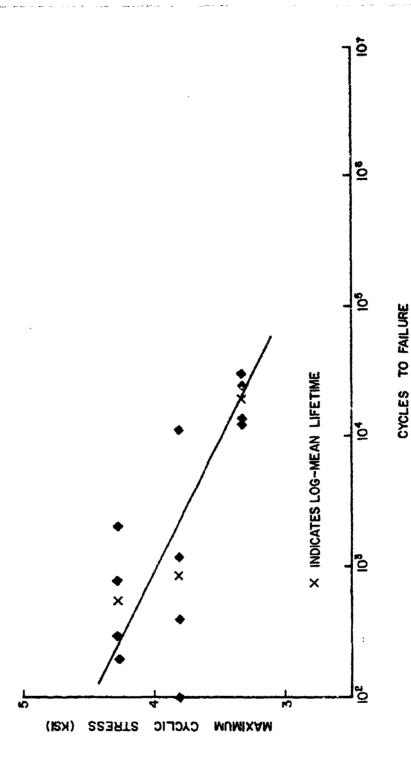


Tensile-Tensile Fatigue Behavior of Unidirectional SP313 Composite Laminates at -67°F: 90° Fiber Orientation, R=0.10, 30 Hz. Figure 30.

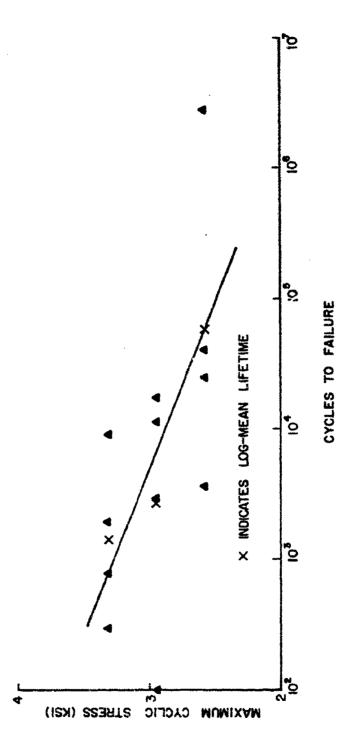


Tensile-Tensile Fatigue Behavior of Unidirectional SP313 Composite Laminates at 72°F: 90° Fiber Orientation, R=0.10, 30 Hz. Figure 31.

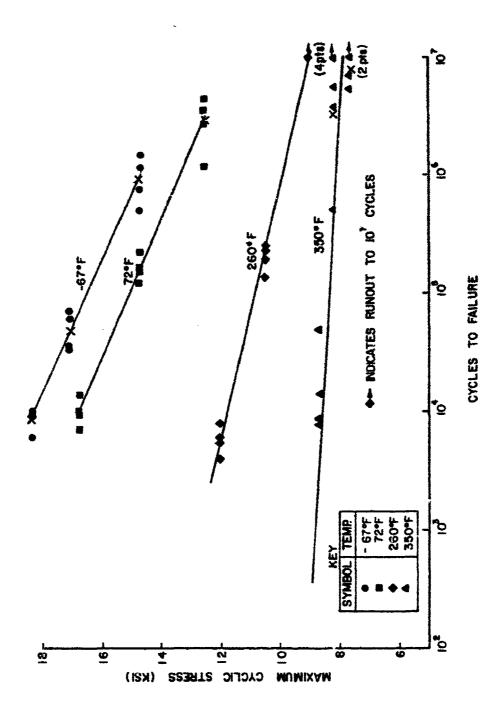
With the second of the second



Tensile-Tensile Fatigue Behavior of Unidirectional SP313 Composite Laminates at 260°F: 90° Fiber Orientation, R=0.10, 30 Hz. Figure 32.



Tensile-Tensile Fatigue Behavior of Unidirectional SP313 Composite Laminates at 350°F: 90° Fiber Orientation, R=0.10, 30 Hz. Figure 33.



Tensile-Tensile Fatigue Behavior of Bidirectional SP313 Composite Laminates: ±45° Fiber Orientation, R=0.10, 30 Hz. Figure 34.

TABLE 18

CREEP PROPERTIES OF SP313 COMPOSITE LAMINATES

			COMPOSITI	MATERIA	COMPOSITE MATERIAL PROPERTIES	T.S.			
Material System	- \$P313	Prepres by	3M				<u> </u>	Graphite/Epoxy	Posty
Maximum Temp Resin Content - Fiber Content - Void Content -	21. 21.		Laminate Average No. of pa Thickness	Laminate Sp. Cr 1, 55 Average Ply Thickness - C No. of panels from which : Thickness of each type spe	Laminate Sp. Gr 1,55 Average Ph Thickness - 0,0054 inch No. of panels from which specimens Thickness of each type specimes -	Laminate Sp. Gr 1, 55 Average Fly Thickness - 0,0054 inch No, of panels from which specimens were tested in this table - 23 Thickness of each type specimes - 00 6 plass	8		
Test Method -	Tension	Reference -	Design Cuide			+450 8 plies			
				CREEP	•				
Temperature	Fiber Orientation:	O.	906	7.650	Temperature	Fiber Orienistion:	90	906	-45c
£019~	Stress Level (ks!) Creep Strain, 500 kr(µ in/in) No. of Specimens Residual Strength (ks!) No. of Specimens				. 260 ⁰ F	Stress Level (ks)) Creep Strain, 800 hr(p. in/in) No. of Speckmens Residual Strength (ks!) No. of Specimens	1.721 225 1.25 208.4		13.5 >20,300 ⁵ 3 21.1
	Stress Level (ksi) Cresp Strein, 500 hr (ti ln/ta) No. of Specimens Residual Strength (ksi) No. of Specimens					Stress Level (km) Cresp Strein, 500 hr (µ in/in) No. of Specimens Residusi Strength (km!) No. of Specimens	139.7 100 12 195.7	07 7 0	12.0 9092 3 27.2
	Stress Level (ks!) Creep Strein, 500 hr (μ in/is) No. of Specimens Residual Strength (ks!) No. of Specimens					Stress Level (kal) Creep Strain, 500 hr(µ in/in) No. of Specimens Residual Strength (kal) No. of Specimens	22. 1 204 3 168. 1	2.86 553 24 5.16	10. 5 7377 8 8 20. 9
12 ⁰ F	Stress Level (ksi) Creep Strain, 500 hr(p.in/in) No. of Specimens Residual Strongth (kei) No. of Specimens	175,1	3, 93 366 12 12 5, 41	9.0	£058	Stress Level (kei) Creep Strain, 500 hr(µ in/in) No. of Specimens Residual Strength (kei) No. of Specimens	127.5 1331 139.0 159.0	2. 55 5 5	7. 66 >16, 700 ⁵ 3 20. 0
	Stress Level (ksi) Cores Strein, SOO hr(p. in/in) No. of Specimens Residual Strength (kei) No. of Specimens	155.8 66 194.6	3. 5. 5. 5. 5. 5. 5. 5. 5. 5. 5. 5. 5. 5.	16.8 5796 2.0 2.0.6		Strees Layel (kel) Creep Strein, 500 hr (p. la/in) No. of Specimens Residual Streegth (kel) No. of Specimens	1253 1253 2 2 5 84.6	77.7	21.30 de 21.25 de 21.
	Stress Level (knt) Creep Straid, 500 br(µ in/in) No. of Specimens Residual Strength (kat) No. of Specimens	134.6 25 3 190,1	3, 47	21.5 21.5 21.5 21.5		Strass Lavel (kel) Creep Strain, 500 brip la/la) No. of Specimens Residual Strength (kal) No. of Specimens	99.2 611 162.3	1,85 3647 12 12 1.5.51	2.19 7163 18.2

Notes

All values represent arithmetic average. All residual strengthe determined by tearlie test at 72°F.

1. Four specimens falled on loading or during test.

2. Two specimens falled on loading or during test.

3. Three specimens falled on loading or during test.

1. Three specimens falled on loading or during test.

2. Three specimens falled on loading or during test.

3. Three specimens falled in large in strains of about 20,000 in/in.

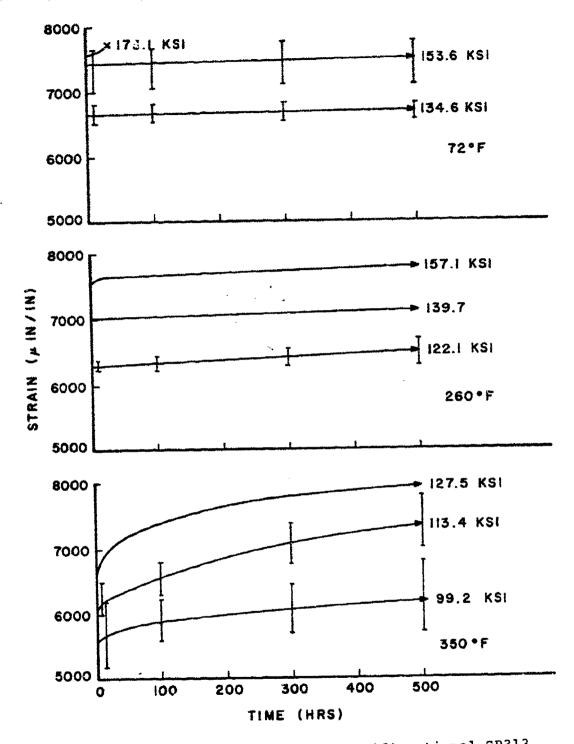


Figure 35. Tensile Creep Behavior of Unidirectional SP313 Composite Laminates: 0° Fiber Orientation.

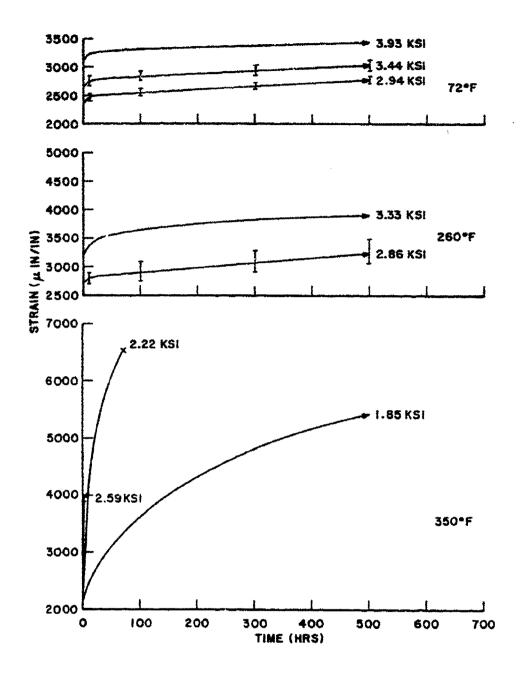


Figure 36. Tensile Creep Behavior of Unidirectional SP313 Composite Laminates: 90° Fiber Orientation.

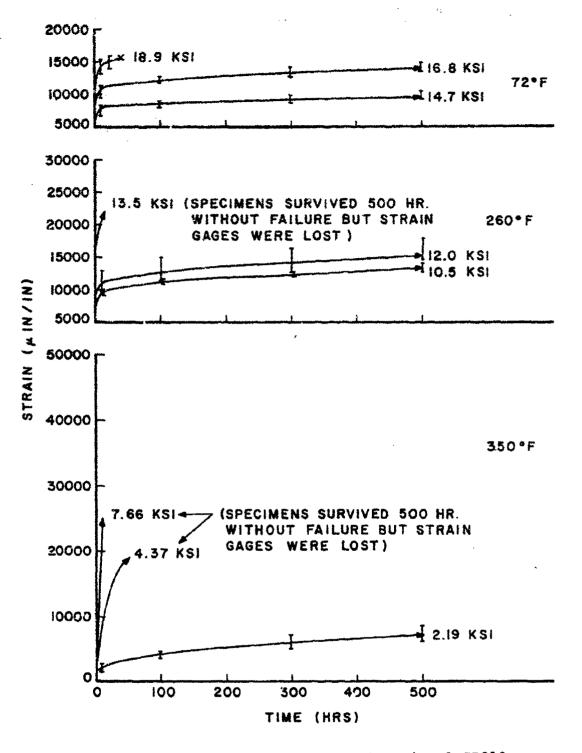


Figure 37. Tensile Creep Behavior of Bidirectional SP313 Composite Laminates: ±45° Fiber Orientation.

STRESS RUPTURE PROPERTIES OF SP313 COMPOSITE LAMINATES TABLE 19

	100		& ++ 1-20	13. 51 5001 3 21. 1 3 12. 01 5001 3 21. 2	7.66 5001 3 20.0 4.37 3302 3 115.5
	Graphite/Epoir		006	3,33 1693 1 4,12 1 1 1 2,86 3362 2,16 2,16	2.59 0.27* 0 2.22 70.1
			હ	157.] 1683 3 208.4 1 139.7 169.3 195.7	127.5 1683 3 159.0 113.4 5001 3 3
	Laminater Sp. Gr 1,55 Average Ply Thickness - 0,0054 inch No. of panels from which specimens were tested in this table - 20 Thickness of each type specimen - 00 6 piles sign Guide +450 8 piles		Fiber Orlenfations	Strees Level (kst) Time to Failure (hrs) No. of Specimens Residual Strength (kst) No. of Specimens Strees Level (kst) Time to Failure (hrs) No. of Specimens Residual Strength (kst) No. of Specimens	Stress Level (kst) Time to Failure (hrs) No. of Specimens No. of Specimens No. of Specimens Stress Level (kst) Time to Failure (hrs) No. of Specimens Residual Strength (kel) No. of Specimens
COMPOSITE MATERIAL PROPERTIES	Laminate Sp. Gr 1,55 Average Fly Thickness - 0,0054 inch No. of panels from which specimens v Thickness of each type specimen - 9 sign Guide	TURE	Temperature	260°F	350°F
E MATERU	Laminate Sp. Gr 1.55 Average Ply Thickness - (No. of panels from which shirtness of each type specific Guide STRESS RUPTURE	RESS RUI	+450		18.89 67.44 3 3 0 0 16.79 3362 3
MPOSITE	3M Laminato Average F No. of par Thickness Design Guide	ST	606ع		3.93 1683 3 5.41 1 3.44 500 ¹ 3 4.76
8	Prepreg by - 3M 13 50°F 1 Reference - Des		90		173.1 10.14 3 0 0 153.8 504 3 194.6
	m = SP313		Fiber Orlentation:	Stress Level (kst) Time to Failure (hrs) No. of Specimens Residual Strength (kst) No. of Specimens Stress Level (kst) Time to Failure (hrs) No. of Specimens Residual Strength (kst) No. of Specimens	Stress Level (kel) Time to Failure (hrs) No. of Specimens Residual Strength (kel) No. of Specimens Stress Level (kel) Time to Failure (hrs) No. of Specimens Residual Strength (kel) No. of Specimens
	Naterial System Fiber - T300 Maximum Tempe Resin Content - Fiber Content - Void Content - Test Method - T		Temperature	-61 ⁰ F	72022

Notes: All values represent arithmetic averages. All residual strengths determined by tensila test at 72°F. The funce to failure represent an average of some specimens which actually falled and some which did not fall within the 500-hour test period, as indicated below.

No failures within 500 hours.
 Average of one failure and two 500-hour survivals.
 Average of two failures and one 500-hour survival.
 Three failures.

Section of the sectio

TABLE 20

THERMOPHYSICAL PROPERTIES OF SP313 COMPOSITE LAMINATES

	COMPOSITE MAT	TERIAL PROPER	TIES				
Material System - SP313 Fiber - T300 Matr Maximum Temperature Rati Resin Content - 35.34% b Fiber Content - 57.00% b Void Content - ±2% by w Thickness of each type s	ix - PR313 ng - 350°F	No. of panels were tested Therm. Exp40		pecimens - 5 Ht20 ply			
T	HERMOPHYSICAL	PROPERTIES:	0*				
	-67°F	72°F	260°F	350°F			
Thermal Expansion $\alpha_{\mathbf{X}}(\min/\inf^{-c}\mathbf{F})$	0.16	∿ 0	0.13	0.13			
ay(uin/in-°F)	15.4	18.5	18.5	18.5			
No. of Specimens per direction	4	4	4	4			
Specific Heat Cp (btu/lb.~°F)	0.171	0.241	0.241	0.261			
No. of Specimens	3	3	3	3			
Thermal Conductivity kz (btu-ft/ft2-hr-°F)	0.23	0.29	0.37	0.41			
No. of Specimens	3	3	3	3			
Glass Transition Temp. Dry (°F) Wet (°F) None observed from -67°F to 450°F 250°F							
TH	ERMOPHYSICAL	PROPERTIES:	<u>+</u> 45°				
Thermal Expansion $a_{\rm X}({\rm pin/in^{\circ}F})$	1.81	1.94	1.94	1.94			
No. of Specimens per direction	3	3	3	3			
Thermal Conductivity kz (btu-ft/ft2-hr-°F)	0.23	0.27	0.33	0.37			
No. of Specimens	3	3	3	3			

Note: On unidirectionally reinforced specimens, the x-direction is along the fiber axis, the y-direction is across the fiber axis, and the z-direction is through the thickness (identical to y-direction). On ±45° bidirectionally reinforced specimens, the x and y directions are identical and oriented at 45° to either fiber direction, while the z-direction is through the thickness.

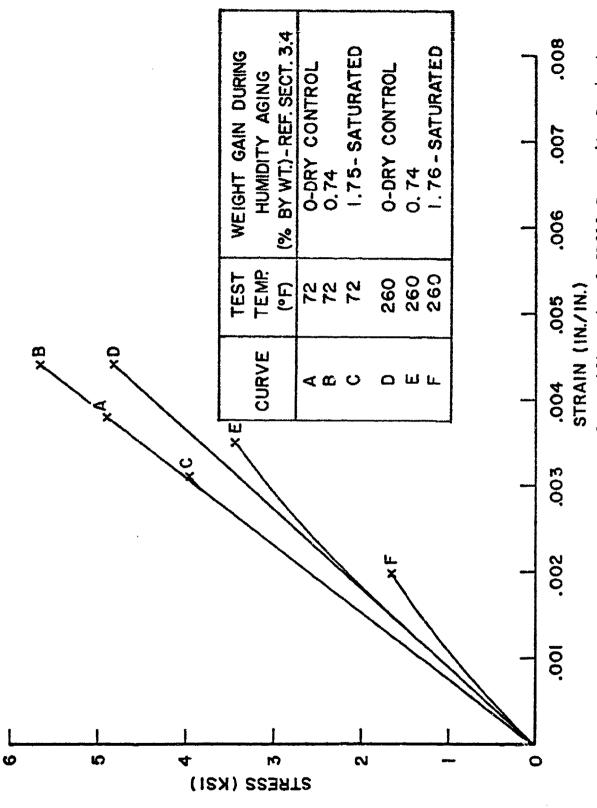
lvalues obtained by dropping sample from noted temperature to 72°F receiver.

TABLE 21 TENSILE PROPERTIES OF SP313 COMPOSITE LAMINATES AFTER HUMIDITY AGING

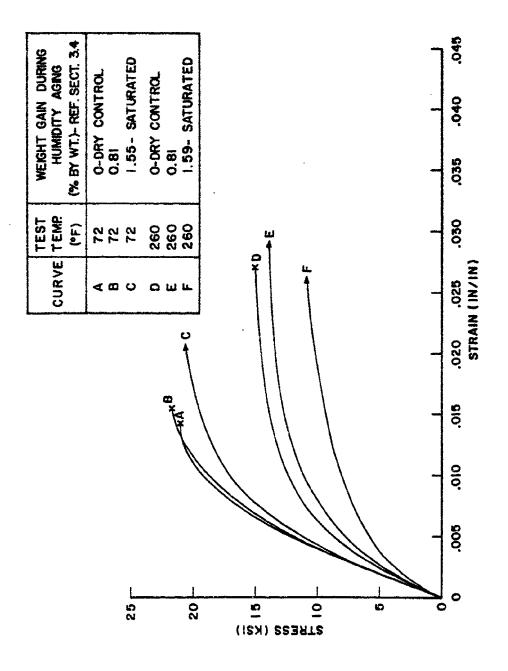
	Posite Material I	ROPER LIES		7.75			
Material System - SP313 Fiber - T300 Matrix - PR313 Maximum Rated Temperature - 350°F Resta Content - 32, 3% by wt. Fiber Content - 60, 3% by vol.	La: Av. No.	Prepreg by - 3M Graphite/Epoxy Laminate Sp. Gr 1.55 Average Ply Thickness - 0.0055 inch No. of panels from which specimens were tested in this table - 15					
Void Content - \$2% by vol.	Ag Th	ing Conditions - coliness of each : 00-15 plies; ±450	160°F. 100% R. ype specimen:	н.			
	TENSION: 90°						
	72°F	260°F	72 °F	260°F			
Exposure Time (hrs)	168	168	1990	1990			
Weight Gain (% of orig. dry wt.)	0.74	0.74	1.751	1.761			
Stnd. Dev. (%)	0.02 5	0.01 5	0, 04 5	0.07			
No. of Specimens	,	,	,				
Fy (kai)	5.65	3.44	3, 94	1.63			
Stnd. Dev. (ksi)	0.45	0.41	0.21	0.11			
Range (ksi)	5,10-6,34	2.86-3.87	3.75-4.29	1.56-1.79			
No. of Specimens	5	5	5	4			
Fy (kai)	5.65	3.44	3. 57	0.70			
Stnd. Dav.	0.45	0.41 5	0.23	0.13			
No. of Specimens	5	3	5	1			
E ^k y (Mai)	1. 32	1.10	1.28	0.93			
Stad. Dev.	0.02	0.07	0. 03	0.05			
No. of Specimens	5	5	5	4			
tu (μ in/in)	4,400	3,500	3,110	2,000			
Stnd. Dev.	400	400	138	189			
No. of Specimens	5	5	5	4			
Test Method Reference			sided tension 2 Guide	•			
	TENSION: ±45	0	<u> </u>				
Exposure Time (hrs)	48	48	1512	1536			
Weight Gain (% of orig. dry wt.)	0.81	0.81	1.55 ¹	1.591			
Stnd. Dev. (%) No. of Specimens	0.02 5	0.05 5	0,04 5	0,04			
or or opening		_	•				
F ^{tu} (ksi)	21.6	14.7	21.1	13.3			
Stnd. Dev. (ksi)	0,4	1.0	0.3	0.5			
Range (ksi)	21.3-22.1	13, 3-15, 9	20.9-21.8 5	12.7-14.1			
No. of Specimens	5	5	7	5			
F _x (ksi)	5. 3	3.9	5. 4	2. 53			
Stad. Dev.	0.7	0.2	1.2	0.32			
No. of Specimens	5	4	•	5			
Ex (Msi)	2.53	1.91	2.61	1.69			
Stnd. Dev.	0.28	0.13	0.15	0.29			
No. of Specimens	5	4	5	5			
e ^{tu} (μ in/in)	15,500	>20,000 ²	27.000	>25,0002			
Stnd. Dev. No. of Specimens	2	5 ²	12	52			
•	-	Straight-s	nded tension	Į			
Test Method Reference	į	Design					

Notes:

 ^{1. 100%} esturation level at aging conditions.
 2. Surface plies cracked at about 80% of ultimate load, breaking gages.



Tensile Stress-Strain Curves for Unidirectional SP313 Composite Laminates After Humidity Aging at 160°F and 100% R.H.: 90° Fiber Orientation. Figure 38.



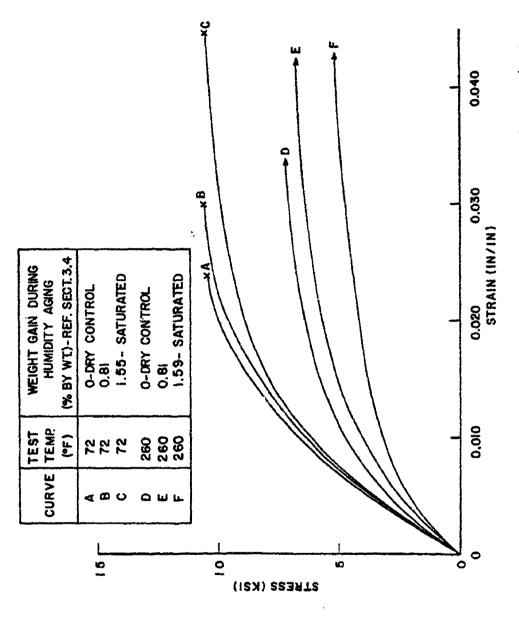
Tensile Stress-Strain Curves for Bidirectional SP313 Composite Laminates After Humidity Aging at 160°F and 1008 R.H.: +45° Fiber Orientation. Figure 39.

TABLE 22

SHEAR PROPERTIES OF SP313 COMPOSITE LAMINATES AFTER HUMIDITY AGING

COMP	osite material f	ROPERTIES				
Material System - SP313 Fiber - T300 Matrix - PR313 Maximum Rated Temperature - 350°F Resin Content - 32.1% by wt. Fiber Content - 59.9% by vol. Void Content - ±2% by vol.	Lamir Avera No. wer Aging Thick	panels from we e tested in this Conditions - 16 ness of each type	55 ss - 0.0052 inch hich specimens table - 6 cor, 100% R.H.	_		
	INPLANE SHEAR					
Test Temperature	72°F	260°F	72°F	260°F		
Exposure Time (hrs) Weight Gain (% of orig. dry wt.) Stnd. Dev. (%) No. of Specimens	48 0.81 0.02 5	48 0.81 0.05 5	1512 1.55 ¹ 0.04 5	1536 1.59 ¹ 0.04 5		
su F _{Xy} (ksi) Stnd. Dev. (ksi) Range (ksi) No. of Specimens	10,82 0.2 10.65-11.05	7.35 0.48 6.65-7.95 5	10.6 0.1 10.5-10.9 5	6.7 0.3 6.4-7.1 5		
G _{Xy} (Msi) Stnd. Dev. No. of Specimens	0.74 0.05 5	0, 55 0, 05 4	0.75 0.05 5	0.46 0.05 4		
Test Method Reference						
	INTERLAMINAR SH	EAR				
Test Temperature	72°F	260°F	72°F	260°F		
Exposure Time (hrs) Weight Gain (% of orig. dry wt.) Stnd. Dev. (%) No. of Specimens	504 0.74 0.08 5	504 0.77 0.05 5	1870 1.67 ¹ 0.12 5	1870 1.78 ¹ 0.14 5		
Fisu (ksi) Stnd. Dev. (ksi) Range (ksi) No. of Specimens	12.19 0.41 11.71-12.66 5	6,64 0,12 6,45-6,78 5	9.95 0.34 9.44-10.25 5	6, 02 0, 11 5, 83-6, 11 5		
Test Method Reference	·	Short Beam : Design Guide		•		

Note: 1. 100% saturation level at aging conditions.



Inplane Shear Stress-Strain Curves for SP313 Composite Laminates After Humidity Aging at 160°F and 100% R.H. Figure 40.

4.2 AS/3004

Tables 23-35 present the data generated for this graphite/polysulfone composite system. Figures 41-64 illustrate the stress-strain, fatigue, and creep behavior of the material, as well as the effect of humidity aging upon the composite material. There are two points of particular interest worthy of special mention in the discussion of this matrix system.

Firstly, the large deformations undergone by the +45° specimens resulted in so much energy dissipation through internal friction that the stress levels at which the cyclic fatigue loadings were conducted had to be significantly reduced. It was found that the maximum cyclic stress had to be kept at or below about 20% of the static ultimate in order to prevent the specimen from self-heating to a higher temperature than the test temperature. Specimen temperature was measured with a thermocouple taped to the side of the specimen and excursions of over 300°F above the test temperature were observed on a few specimens loaded to only 30% of static ultimate. It was found that a relatively narrow region of between 20% and 25% of static ultimate comprises the initial transition region, below which no self-heating occurs and fatigue life generally exceeds 107 cycles and above which, considerable self-heating occurs and fatigue life drops markedly. One specimen was tested at only 10 Hz rather than 30 Hz frequency to see if this had any effect upon the self-heating behavior of the material. This 10 Hz test was conducted with a maximum cyclic stress level of 30% of the static ultimate strength. In comparison with a 30 Hz test, also at 30% static ultimate, the 10 Hz test produced less self-heating and a longer fatique life. The reduction in self-heating was quite marked, with the temperature rise of the 10 Hz specimen being only one-third as great as that of the 30 Hz specimen (see data in Figure 56). In spite of this, the specimen temperature still rose 95°F above the test temperature and it seems that a considerably lower cyclic frequency than 10 Hz must be used in order to avert this phenomena at cyclic stresses above 20% of static ultimate on ±45° polysulfone matrix composites. All of the temperature measurements made during the fatigue tests on this material are summarized in Figure 56 and presented in detail in Appendix H.

Self-heating has been observed in fatigue tests on the ±45° orientations with the other composite materials characterized during this program but to a much lesser extent and only at considerably higher cyclic stress levels. This difference is no doubt due to the significantly smaller plastic deformations exhibited by the thermosetting matrices since the cyclic strain levels at which self-heating commences are comparable to the AS/3004 system.

The second point to be mentioned with regard to the AS/3004 composite system is the very low flow which occurs during the laminate consolidation or "cure" schedule. Since the matrix resin is an already fully polymerized thermoplastic material, the consolidation process merely serves to resoften the resin so the plies will become integrally bonded to each other. The resin does not liquify during this process and practically no flow occurs. This represents a distinct processing advantage.

TABLE 23 PROCESSING DATA FOR AS/3004 SYSTEM

Composite Processing Information

Material System - AS/3004
Fiber - AS Matrix - P1700

Graphité/ Polysulfone

Maximum Rated Temperature - 250°F

Prepreg by - Hercules

Laminate Processing Schedule

Prepreg Drying Procedure: Cut prepreg to desired size and quantity.

Remove release paper and place prepreg pieces in a 250-275°F circulating air oven and dry for a minimum of four hours. Extra drying time is not detrimental to the prepreg.

Layup Procedure: Use a three-sided steel mold of appropriate size. Clean mold and coat with release agent such as Frekote 33. Release agent must be capable of withstanding 675° f mold temperature. Bake release treated mold per manufacturer's instructions. Place dried prepreg in mold with a release ply on either side of the stack between the mold and the prepreg. Use either Teflon film or Teflon coated glass fabric, depending on whether a smooth-glossy or matte surface is desired.

Consolidation Procedure: Preheat the press to 675°F (a higher temperature may be necessary depending on mold size and mass). Place mold in the preheated press and apply contact pressure (about 15 psi). When the laminate reaches 650°F (as indicated by a thermocouple touching the edge of the prepreg stack), apply 250 psi and hold for 15 minutes. Cool the laminate slowly (about 5°F/minute) to below 150°F before releasing pressure and removing from press.

Postcure Schedule: None.

TABLE 24
PREPREG AND COMPOSITE PHYSICAL PROPERTIES: AS/3004

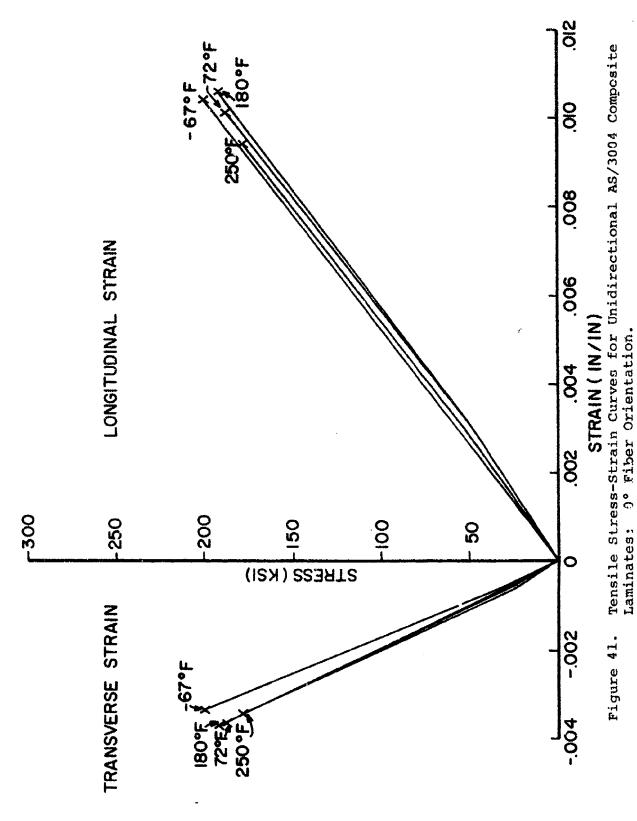
Composite P	hysical P	roperty Infor	mation	
Material System - AS/3004 Fiber - AS Matrix -	P1700		Graphite/Polysu	lfone
Maximum Rated Temperature	e - 250°F	Pre	preg by - Hercul	es
Prepre	g Physica	al Properties		
(Property) (St	nd. Dev.)	(Range)	(Test Method)	(Ref.)
Volatile Content-4.79%by wt. Resin Content-37.63%by wt. Resin Flow- Not Applicable No. of Rolls Involved-4 No. of Batches Involved - 1	2.34		HS-SG-500/232 HD-SG-2-6006C (5.2.6,P)	Hercules Hercules
Lamin	ate Physic	cal Properties	, l	
No. of Panels - 56	(Stnd. De	v.) (Range)	(Test Method)	(Ref.)
Fiber Content-57.17%by vol. Resin Content-33.64%by wt. Void Content-1.12% by vol. Laminate Sp. Gr 1.53 Fiber Sp. Gr 1.78 Matrix Sp. Gr 1.24 Thickness per ply-0.0055 in.	1.55 0.91 0.02 As repo As repo	30.80-38.13 0-3.51 1.50-1.56 orted by manuscreed by manuscreed	facturer. facturer.	Hercules

¹The properties reported here represent averages for all panels of this material used throughout the program.

TABLE 25
TENSILE PROPERTIES OF AS/3004 COMPOSITE LAMINATES

COMPOSITE MATERIAL PROPERTIES							
Material System - AS/3004 Prepreg by - Hercules Graphita/Polysulfone							
Fiber - AS		.C.,	ste Sp. G 😘 🔸				
Resin Content - 34.0%		21724	-	ws - 0,0053 lach			
Fiber Content - 57.2%	by vol.		panels from v a tested in thi	vhich specimens s table + Il			
Void Content - 0.5% b	y vota		es of each type ply: 90°-15 p				
	TENS	ON: 8ª					
	-67°F	72°F	18 0° y	350°F			
F _X (ksi)	200.5	187.9	191.5	179.1			
sind. dev. (ksi) Range (ksi) No. of Specimens	21.6 1624-214.9 5	22.4 160.0-222.8 5	47.9 124.6-258.3 5	18.7 149.7-197.7 5			
F ^{tpi} (ksi)	200.5	187.9	191.5	179.1			
sind. dev. No. of Specimens	21.6	22.4 5	47.9 5	18.7 5			
E. (Mai)	18.1	16.3	16.2	17.5			
stnd. dev. No. of Specimens	0.4 5	0.8 S	0.4 5	1.0 5			
*tu (pin/in)	10,400	10,100	10,600	9,400			
stad. dev. No. of Specimens	1,100	700 4	3,100 4	430 5			
t *xy	0.31	0.34 0.05	0, 32 0, 06	0, 34 0, 06			
stnd, dev. No. of Specimens	0.02	5	5	4			
Test Method Straight-sided Tension Reference Design Guide							
	TENS	ION: 90°	·				
P ^{tu} _y (kai)	6.82	5.02	4, 93	5. 39			
stnd. dev. (ksi) Range (ksi) No. of Specimens	I.45 4.58-8.26 5	0.98 3.41-6.02 5	1.31 3.17-6.76 5	0.94 4.19-6.56 5			
Fy (kei)	6.82	4.31	4. 55	4. 03			
stml. dev. No. of Specimens	1.45	1.32	1.41 5	0. 59 4			
Ey (Mai)	1.06	1.15	1.07	1.07			
stad. dev. No. of Specimens	0.10 S	0.14 5	0.04 5	0.03 5			
ata (atn/in)	6,200	4,690	4,600	4,900			
sind, dev. No. of Specimens	1,100 5	900	1,100	500 4			
*t yx	0.0201	0.0241	0.021	¹ 050,0			
Test Method Reference		Straight-sie Design G	ded Tennion nide				

Computed using elastic modulti and longitudinal Poisson's ratio.



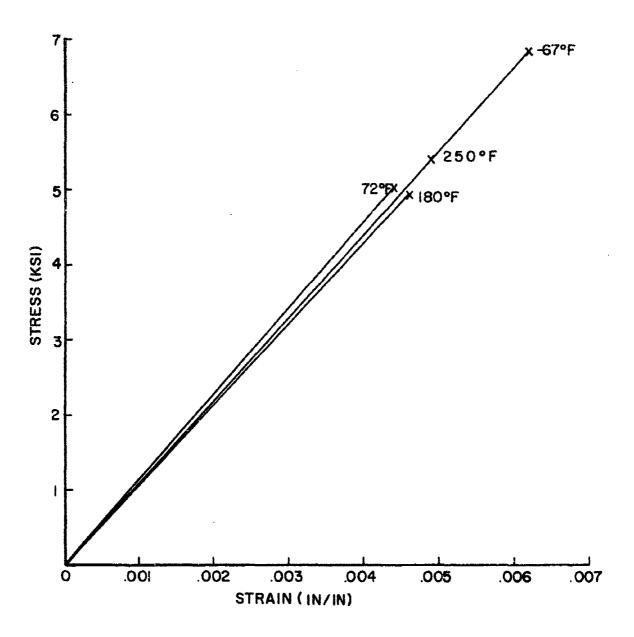
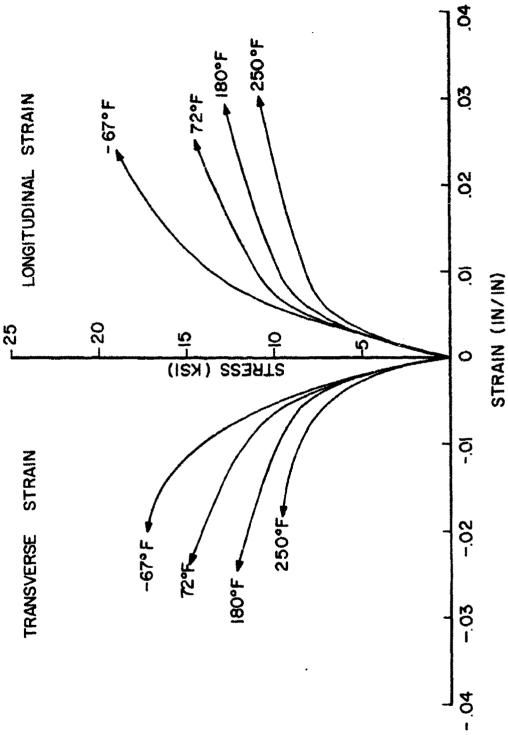


Figure 42. Tensile Stress-Strain Curves for Unidirectional AS/3004 Composite Laminates: 90° Fiber Orientation.

TABLE 26
TENSILE PROPERTIES OF AS/3004 COMPOSITE LAMINATES

	POSITE MATE						
Material System Fiber - AS	AS/3004 P: Matrix - Pl	repres by - H	•••	raphite/Polysulfone			
Maximum Rated Te		- 00-	nate Sp. Gr.				
	. 9% by wt.	ATC.		mess - 0.0054 inch			
Fiber Content - 57		No. o	f panels from	which specimens this table - 6			
Void Content - 0.	4% by vol.		mess of speci				
	TENSIC	N: ± 45°					
	67°F	72°F	180°F	250°F			
F _x (ksi)	41.62	31.93	27.76	24. 30			
stnd. dev. (ksi)	2.05	1.79	2. 09	0. 70			
Range (ksi)	38.05-43.12		25.09-30.04				
No. of Specimens	5	5	5	5			
Fxtpl (ksi)	4.97	3.94	3. 97	3.13			
stnd. dev. (ksi)	0.75	0, 38	0.23	0.46			
No. of Specimens	5 5 5 5						
E _x (Msi)	2.00	1.98	1. 93	1.84			
stnd. dev.	0.07	0.11	0.05	0.09			
No. of Specimens	5	5	5	5			
etu x" (#in/in)	>19,500 ¹	>40,000 ¹	>40,6001	>41,600 ¹			
stnd. dev.							
No. of Specimens	5	5	5	5			
"t "xy	0.81	0.75	0. 86	0.81			
stnd. dev.	0.06	0.13	0. 05	0.07			
No. of Specimens	4	5	5	5			
Test Method		 Straight-Side	i d Tension	ı			
Reference	1	Design Guide					

¹Visible neckdown occurred and surface plies cracked, creating electrical discontinuities in strain gages.



Tensile Stress-Strain Curves for Bidirectional AS/3004 Composite Laminates: +45° Fiber Orientation. Figure 43.

TABLE 27

COMPRESSIVE PROPERTIES OF AS/3004 COMPOSITE LAMINATES COMPOSITE MATERIAL PROPERTIES

Material	System - AS/	3004		G	raphite/Polysulfons	
Fiber -	AS M	atrix - P170	G P	repreg by - H	arcules	
	Rated Tempe	rature - 250		aminate Sp. G		
	stent - 33.1%				ickness -0.0052 in.	
	tent - 57.9%		N	o of panels fr	om which specimens	
Void Cont	ent - + 0		w	ero tested in t	his table - 2	
L			T	hickness of spe	ecimens - 20 ply	
		COM	IPRESSION :			
		-67°F	72°F	180°F	250°F	
F _X	(ksi)	147.9				
stnd. dev.	(kat)	2.6	102.1	102.6	90.2	
Range	(ksi)	1412-1498	10.8 838 - 1103	13.4	11.2	
No. of Specia		5	5	91.9-125.8	73.8-105.0	
		1	1 3	5	5	
cpl *	(ksi)	76.0	83.4	69.9	76.4	
stad. dev.		16.8	1	1	ł	
No. of Specia	mens	5	24.7	28.3	28.8	
		"	1	"	5	
c			l			
Ex	(Msi)	18.7	17.3	18.1	18.5	
stnd. dev.		3.0	0.5	0.9	1.4	
No. of Specia	mens	5	5	5	5	
			l		-	
CIL	(µ in/in)	8,500	(
ex	Or tuvers	0,500	6,300	6,000	5,000	
stnd. dev.		1,600	1,200	1,400	1,000	
No. of Specimens 5 5 5						
Test Method Gelanese coupon and test firture						
Administration of the control of the						
Reference AFML-TR-72-205, Pt. 1 COMPRESSION: 90°						
cu						
Fy	(ksi)	31.8	18.9	15.3	13.4	
stnd. dev.	(ksi)	2.0	1.5	0.7	1.3	
Range	(ksi)	29.9-34.0	16.8-20.7	14.8-16.5	11.3-14.8	
No. of Specim	nens	5	5	5	5	
cpl						
Fy	(ksi)	16.5	7.9	8.7	4.9	
stnd. dev.		7.8	2.8	2.8	0.9	
No. of Specin	nens	5	4	5	\$	
_		1 1				
e E	(ieM)	1.22	1,60	1.21	1.33	
Ey.	(2,22)					
stnd. dev.		0.07	0, 32	0.25	0.34	
No. of Specin	nens	5	5	5	5	
cu	(µ in/in)	47,000	11,9001	38,400	37, 000	
y	A. mimi		·		·	
stnd. dev.		18,000	5,000	32, 900	18,000	
No. of Specin	nens	5	4	.5	· 5	
Test Method		1	Calaman and a savera			
rest Method Reference		į		on and test fix	ture	
Veratesues.			AFML-IR-	.72-205, Pt. 1		

Ultimate strain values represent maximum observed strain rather than ultimate values. Buckling was observed in majority of tests.

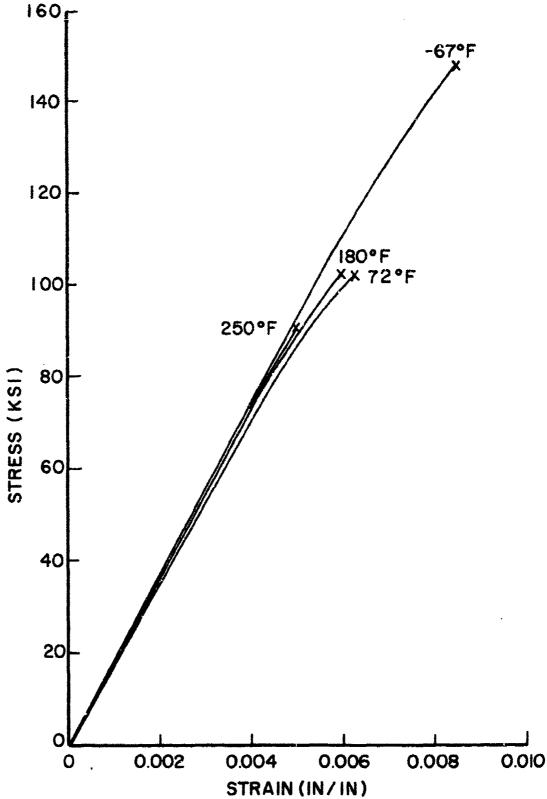


Figure 44. Compressive Stress-Strain Curves for Unidirectional AS/3004 Composite Laminates: 0° Fiber Orientation.

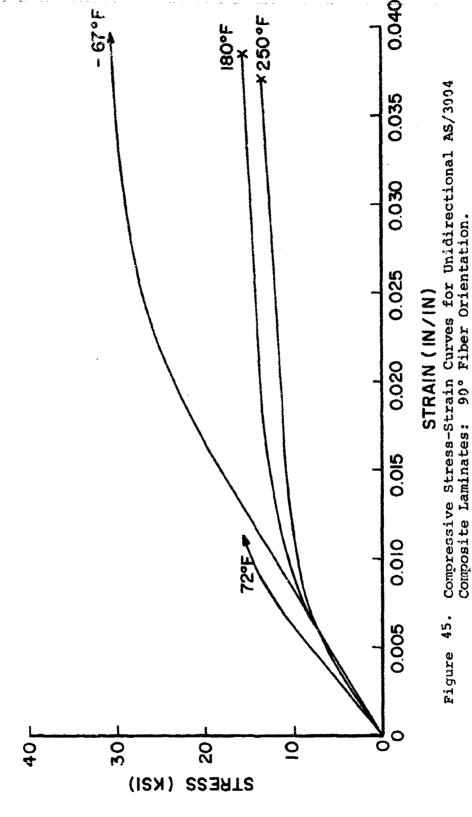
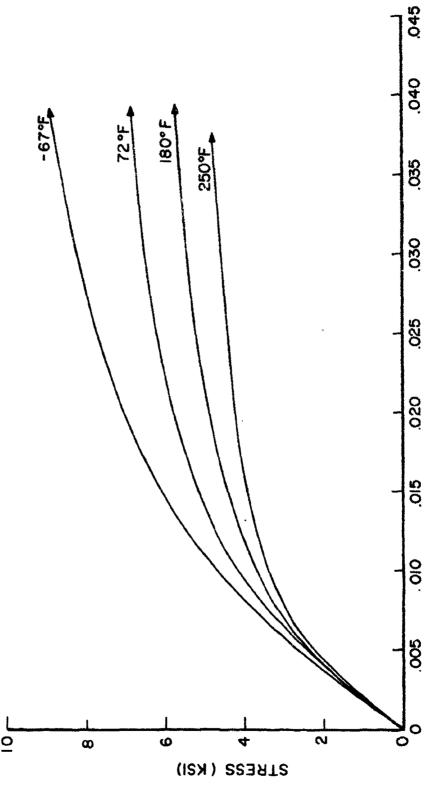


TABLE 28
FLEXURAL PROPERTIES OF AS/3004 COMPOSITE LAMINATES

COMPOSITE MATERIAL PROPERTIES								
Fiber - AS Maximum Rated Tempe Resin Content - 32,9% Fiber Content - 57,7%	Maximum Rated Temperature - 250°F Resin Content - 32, 9% by wt. Fiber Content - 57, 7% by vol. Void Content - 1, 5% by vol. Laminate Sp. Gr 1.52 Average Ply Thickness - 0.0056 in No. of panels from which specime were tested in this table - 4							
7014 0045645 - 1, 376		Thickne	as of specimen					
	FLEX	URE: 00						
	-67°F	72 ° F	180°F	250°F				
F _X (ksi)	227.9	191.5	156.3	135.2				
stnd. dev. (ksi)	4.3	10.1	2.3	3.2				
Range (ksi) No. of Specimens	222.9-232.0 5	176.2-201.5 5	153.6-159.0 5	129.9-138.2 5				
f E _x (Msi)	20.0	17.8	19.1	20.0				
stnd, dev.	0.7	1.4	1.7	0.5				
No. of Specimens	5 5 5							
Test Method Reference								
	FLEX	UR E: 900						
F ^{fu} y (ksi)	13.40	13.00	11.33	10.11				
stnd. dev. (ksi)	0.99	1.15	1.53	0.72				
Range (ksi) No. of Specimens	11.81-14.12 5	11.59-14.62 5	9.38-12.96 5	8.88-10.69 5				
E ^t (Msi)	1.31	1.28	1.17	1.08				
stnd. dev.	0.03	0.04	0.09	0.01				
No. of Specimens	5	5	5	5				
Test Method Reference	i E	4 pt. flex: 4 pt. flex: esign Guide;						

TABLE 29
SHEAR PROPERTIES OF AS/3004 COMPOSITE LAMINATES

co	mposite mat	ERIAL PROPI	ERTIES			
Material System - Ai Fiber - AS Maximum Rated Tem Resin Content - 33.6' Fiber Content - 57.4' Void Content - 1.0%	Matrix - P1 700 perature - 250° % by wt. % by vol.	E Laminat Average No. of powere to Thickness	by - Hercule: e Sp. Gr 1 Ply Thicknes anels from whisted in this to s of each type	.53 s - 0.0054 in, sich specimens able - 9		
	INPLAN	E SHEAR				
	-67°F	72°F	180°F	250°F		
F ^{SU} (ksi) stnd. dev. (ksi) Range No. of Specimens	20.81 0.99 19.03-21.56 5	5	13.88 1.04 12.55-15.02 5	12.15 0.35 11.77-12.57 5		
G ^S xy stnd, dev. (Msi) No. of Specimens	0.55 0.03 5	3,00				
Test Method Reference		45° Straight-e Comp. Mtls [Ve		Vol. 7,- p124)		
	INTERLA	MUNAR SHEAF	L			
F ^{isu} (ksi)	14.0	11.6	9.6	8. 4		
Stnd. Dev. (ksi) Range (ksi) No. of Specimens	1.0 11.9-15.3 9	1.0 10.2-13.3 9	0.5 8.4-10.0 10	0.5 7.9-9.6 7		
Test Method Reference		Short Beam S Design Guide	•			



Inplane Shear Stress-Strain Curves for AS/3004 Composite Laminates. STRAIN (IN/IN) Figure 46.

APOSITE LAMINATES ### Property of the control of t	reules Laminate Sp. Gr 1,53 Average Ply Thickness - 0,0055 inch No. of parale from which specimens were tested in this table - 38 Thickness of each type specimen - 00 - 6 pty esign Guide +450 15 ply		Fiber Orientations 0º 90º ±45º	183.2 3.94 6.94 2.14 6.94 2.14 6.94 2.14 6.94 2.14 6.94 2.14 6.94 2.14 6.94 2.14 6.94 2.14 6.94 2.14 6.94	Max. Stress (kel) 143.3 3.24 6.08 Lifetime (cycles) 2600 2740 1.21x106 No. of Spacimens 4 4 Residual Strength (kel) 0 0 0 Max. Stress (kel) 125.3 2.16 4.86 Max. Stress (kel) 92.430 8990 6.78x106 Lifetime (cycles) 5 4 5 5 Max. Stress (kel) 0 0 2 Max. Stress (kel) 107.5 1.88 3.64 Max. Stress (kel) 266.430 79.250 107+ No. of Specimens 5 4 4 Residual Strength (kel) 0 0 6 No. of Specimens 5 4 4 No. of Specimens 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6
FATIGUE PROPERTIES OF AS/3004 COMPOSITE COMPOSITE MATERIAL PROPERTIES	S/3004 Prepreg by - He Matrix - P1700 Fr by wt. Sy by vol. Wy yol. My yol. Helded Tension Reference - D	TENSILE FATIOUE,	Fiber Orientations 00 900 ±450	Max. Streas (kei) 180.4 4.09 10.406 Lifetime (cycles) 2820 14,410 622,7906 No. of Specimens Max. Streas (kei) 160.4 2.73 8.32 Lifetima (cycles) 257,400 163,640 5.77x106 No. of Specimens No. of Specimens Max. Streas (kei) 140.3 1.36 6.24 Max. Streas (kei) 140.3 1.36 6.24 Lifetime (cycles) 708,830 8.60x106 1074 Residual Strength (kei) 182.2 5.73 26.3 No. of Specimens	Max. Streas (kai) 150.3 4.02 8.01 Lifetime (cycles) 44 Residual Strength (kai) No. of Specimens Max. Stroas (kai) 131.5 3.52 Lifetime (cycles) 63.610 23.180 8.91x106 No. of Specimens No. of Specimens Max. Streas (kai) 112.7 3.01 3.20 Lifetime (cycles) 3.86xid 98.860 Max. Streas (kai) 12.7 3.01 3.20 Lifetime (cycles) 3.86xid 98.860 No. of Specimens No. of Specimens
	Aisterial System - A Fiber - AS Maximum Temperati Resin Content - 33.6 Fiber Content - 57.2 Void Content - 1.2 Test Method - Straig		Temperature	- 670 - 670	4 ₀ 21

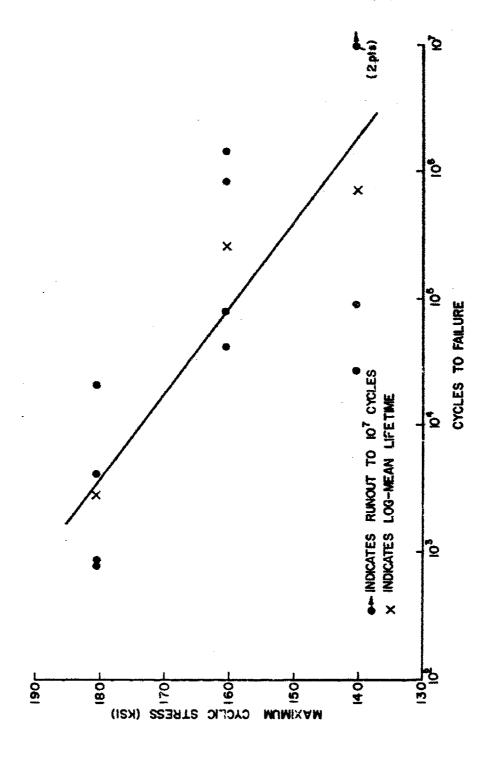
Notes: Fatigue lifetimes are log-mean galues. All residual strengths determined by tanelle test at 72°F.

1. Internal energy dissipation caused specimens to self-heat to between 160°F and 240°F at time of failures.

2. Internal energy dissipation caused specimens to self-heat to between 210°F and 240°F at time of failures.

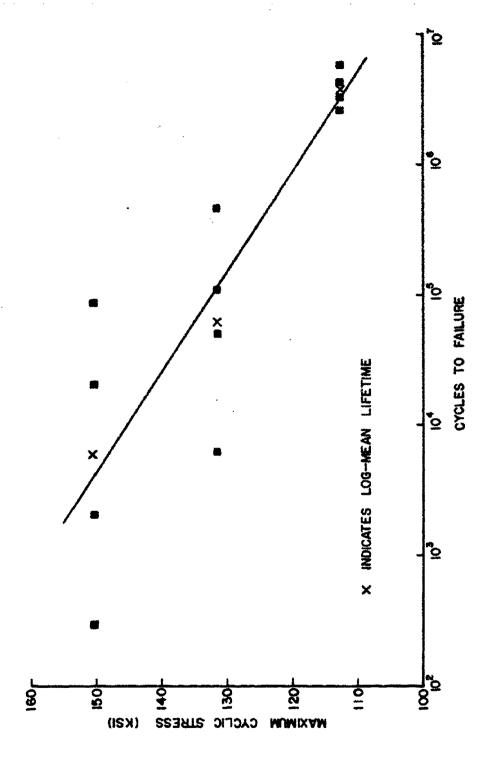
3. Internal energy dissipation caused specimens to self-heat to between 270°F and 340°F at time of failures.

4. Internal energy dissipation caused specimens to self-heat to between 57°F and 460°F at time of failures.

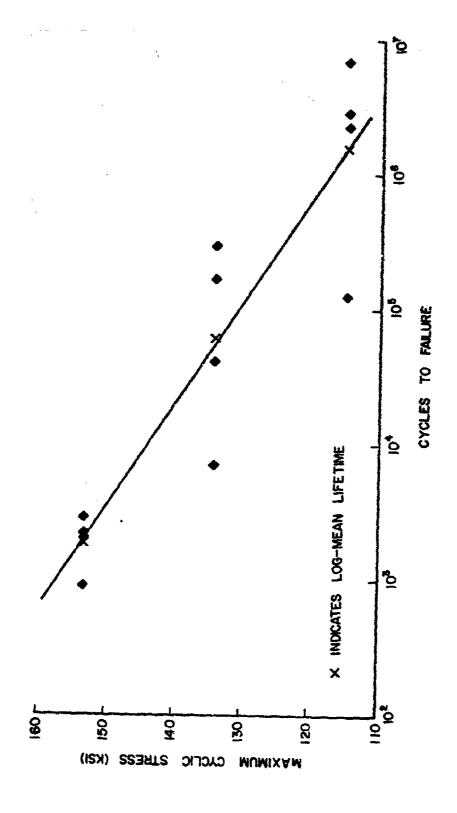


Tensile-Tensile Fatigue Behavior of Unidirectional AS/3004 Composite Laminates at -67°F: 0° Fiber Orientation, R=0.10, 30 Hz. Figure 47.

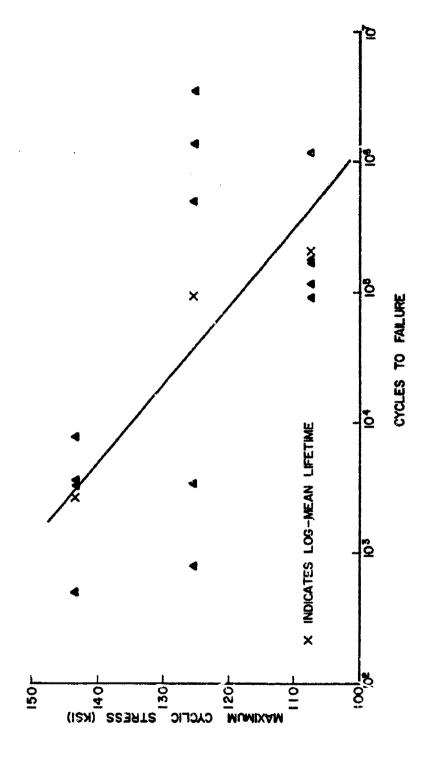
The state of the s



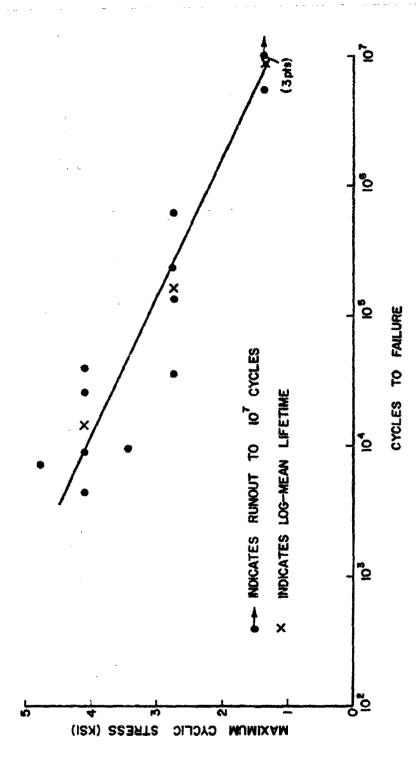
Tensile-Tensile Fatigue Behavior of Unidirectional AS/3004 Composite Laminates at 72°F: 0° Fiber Orientation, R=0.10, 30 Hz. Figure 48.



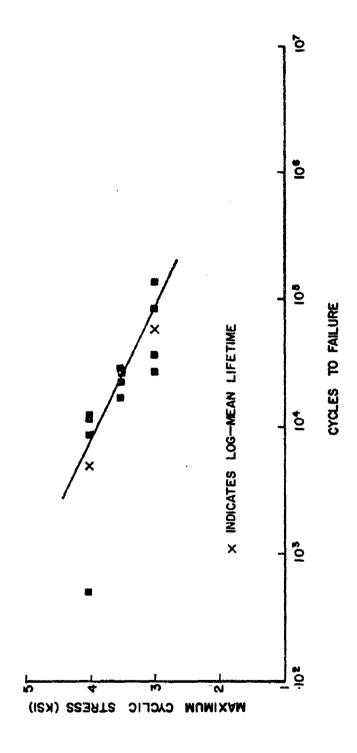
Tensile-Tensile Fatigue Behavior of Unidirectional AS/3004 Composite Laminates at $180^{\circ}F$: 0° Fiber Orientation, R=0.10, 30 Hz. Figure 49.



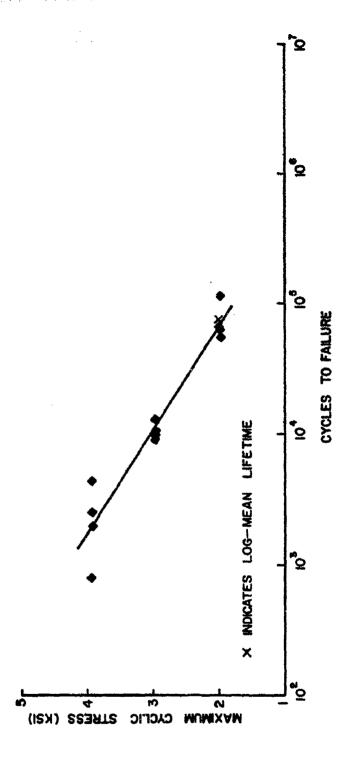
Tensile-Tensile Fatigue Behavior of Unidirectional AS/3004 Composite Laminates at 250°F: 0° Fiber Orientation, R=0.10, 30 Hz. Figure 50.



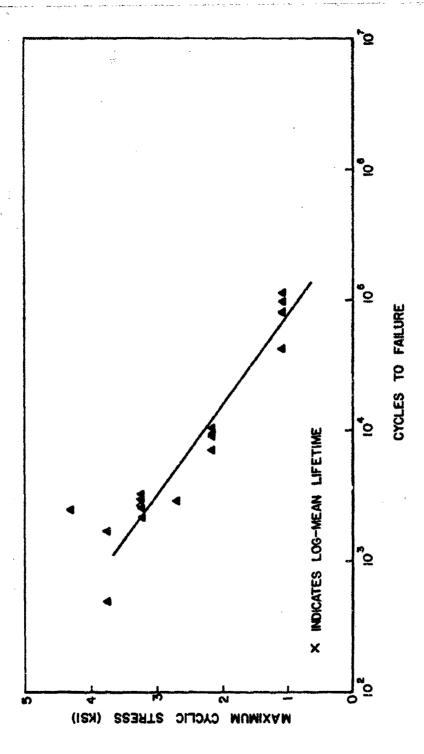
Tensile-Tensile Fatigue Behavior of Unidirectional AS/3004 Composite Laminates at -67°F: 90° Fiber Orientation, R=0.10, 30 Hz. Figure 51.



Tensile-Tensile Fatigue Behavior of Unidirectional AS/3004 Composite Laminates at 72°F: 90° Fiber Orientation, R=0.10, 30 Hz. 52. Figure

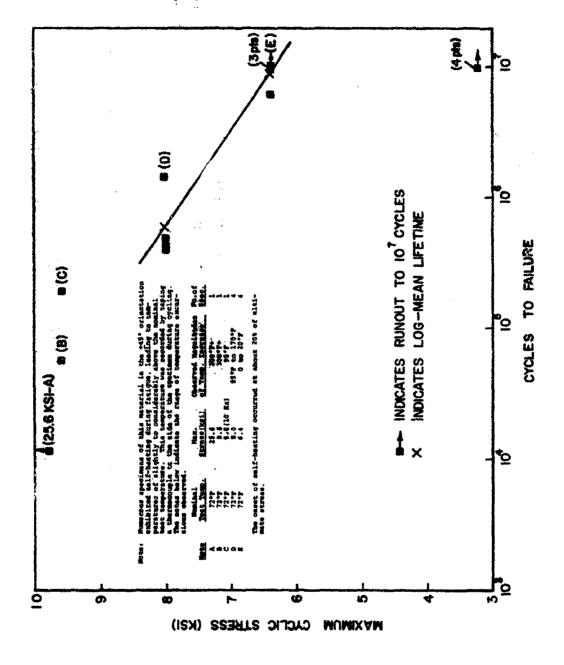


Tensile-Tensile Fatigue Behavior of Unidirectional AS/3004 Composite Laminates at 180°F: 90° Fiber Orientation, R=0.10, 30 Hz. Figure 53.



Tensile-Tensile Fatigue Behavior of Unidirectional AS/3004 Composite Laminates at 250°F: 90° Fiber Orientation, R=0.10, 30 Hz. Figure 54.

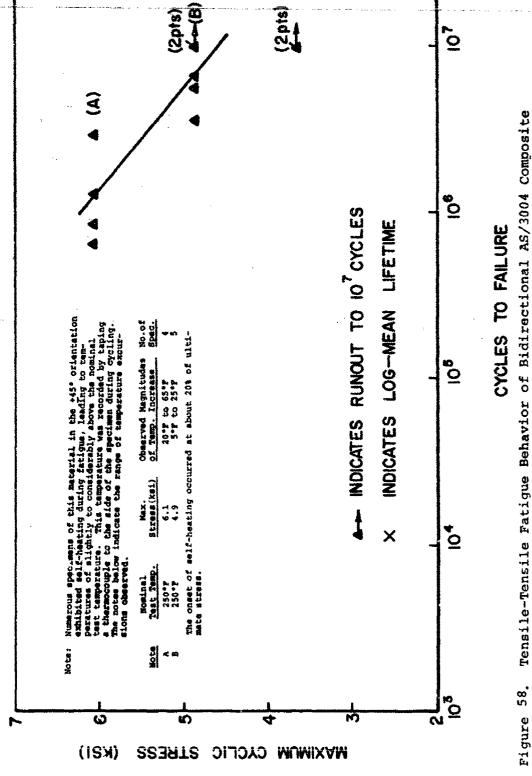
CYCLES TO FAILURE
Tensile-Tensile Fatigue Behavior of Bidirectional AS/3004 Composite
Laminates at -67°F: +45° Fiber Orientation, R=0.10, 30 Hz. Figure 55.



Tensile-Tensile Fatigue Behavior of Bidirectional AS/3004 Composite Laminates at 72°F: +45° Fiber Orientation, R=0.10, 30 Hz. Figure 56.

A STATE OF THE PROPERTY OF THE

Tensile-Tensile Fatigue Behavior of Bidirectional AS/3004 Composite Laminates at 180°F: +45° Fiber Orientation, R=0.10, 30 Hz. CYCLES TO FAILURE Figure 57.



Tensile-Tensile Fatigue Behavior of Bidirectional AS/3004 Composite Laminates at 250°F: +45° Fiber Orientation, R=0.10, 30 Hz.

TABLE 31

CREEP PROPERTIES OF AS/3004 COMPOSITE LAMINATES

Material Syste	yatem - AS/3004	Prepreg by . H	Hercules		Harcules		희	1/enida	Graphite/Polysulfone
Fiber - AS	Fiber - AS Matrix - P. 700		Laminate	Laminate Sp. Gr 1. 63	. 43				
Resin Content .	tent - 34.2% by wt.		Average 1	Ply Thicker	Average Ply Thickness - 0, 5055 inch	ich	;		
Fiber Content -	tent - 56,9% by vol.		No. of par Thickness	tels from	No, of parels from which specime. Thickness of each type specimen -	2	35		
Test Method	Straight-aided Tenelon	Reference .	- Design Guide	epin:		90° 15 ply <u>+</u> 45° 8 ply			
				CALEP	d				
Tamperature	Fiber Orionistions	00	900	oSPŦ	Temperature	Fiber Orlentations	90	006	, 1450
E 0-1-9-	Stress Level (kei) Creep Strain, 500 hr (p. in/in) No. of Specimens Residual Strength (kei) No. of Specimens Stress Level (kei) No. of Specimens Residual Strength (kei) No. of Specimens Stress Level (kei) Creep Strain, 500 hr (p. in/in) No. of Specimens Stress Level (kei) Creep Strain, 500 hr (p. in/in) No. of Specimens Residual Strength (kei)				F 0 0 9 1	Stress Level (ksi) Cresp Strain, 500 hr[h in/in) No. of Specimens Residual Strength (ksi) No. of Specimens Stress Level (ksi) Creep Strain, 500 hr[h in/in) No. of Specimens Residual Strength (ksi) No. of Specimens Stress Level (ksi) Creep Strain, 500 hr[h in/in) Creep Strain, 500 hr[h in/in) No. of Specimens Residual Strength (ksi) No. of Specimens	2.202.3 2.202.3 2.102.1 100.1 100.1 209.7 30.3 30.3 182.1	% 4 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5	6, 33 4003 3 3, 2, 92 5, 56 1103 3 30, 63 3 3, 9 3, 9 3, 9 3, 9
4 021	Stress Level (ksi) Creep Strain, 500 hr(s in/in) No. of Specimens Residual Strength (ksi) Stress Level (ksi) Creep Strain, 500 hr(s in/in) No. of Specimens Residual Strength (ksi) No. of Specimens Strain, 500 hr(s in/in) Creep Strain, 500 hr(s in/in) Creep Strain, 500 hr(s in/in) No. of Specimens Residual Strength (ksi) No. of Specimens	150.3 118 13.5 13.5 13.5 13.5 13.5 13.5 13.5 13.5	2.01 2.32 2.32 3.32 3.32 3.32 3.32 3.32 5.45 3.45	9.61 5.285 5.95 6.40 827 3.20 3.20 3.20 3.20	2 500 F	Strees Level (kel) Creep Strain, 500 hr [a lid] No. of Specimens Residual Strength (kel) No. of Specimens Strees Strain, 500 hr [a lid] No. of Specimens Residual Strength (kel) No. of Specimens Residual Strength (kel) No. of Specimens Strees 1:vvl (kel) No. of Specimens Residual Strain, 500 hr [a lid] No. of Specimens Residual Strength (kel) No. of Specimens	2 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4	5 1 1 0 1 7 1 1 1 0 0 0 0 0 0 0 0 0 0 0 0	7.29 11.570 2.9.95 4.865 5.855 2.43 2.43 2.43 2.43 2.43 2.43 3.69

All values represent arithmetic averages. All residual strength determined by tensile test at 72°F. Notes

All specimens failed during test.

One apocimen spilt along edge and axhibited considerably more strain than other two, but it still held load. Two specimens falled during test,

Three specimens failed on loading. Lost strain gage on one specimen early in test. One specimen failed on loading.

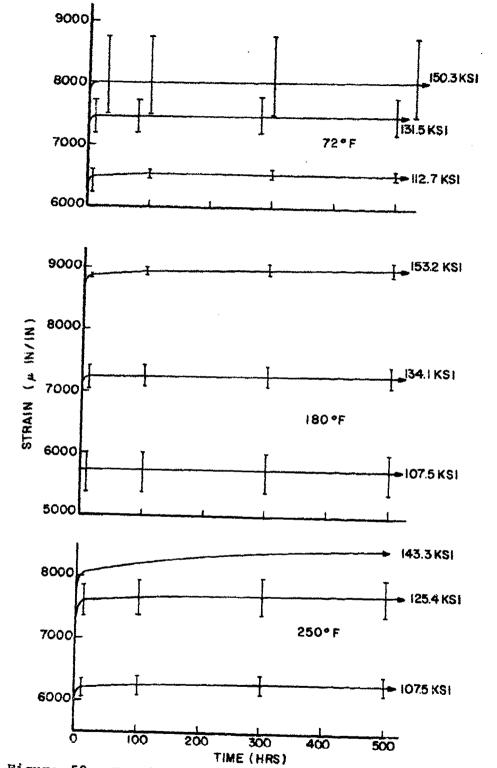


Figure 59. Tensile Creep Behavior of Unidirectional AS/3004 Composite Laminates: 0° Fiber Orientation.

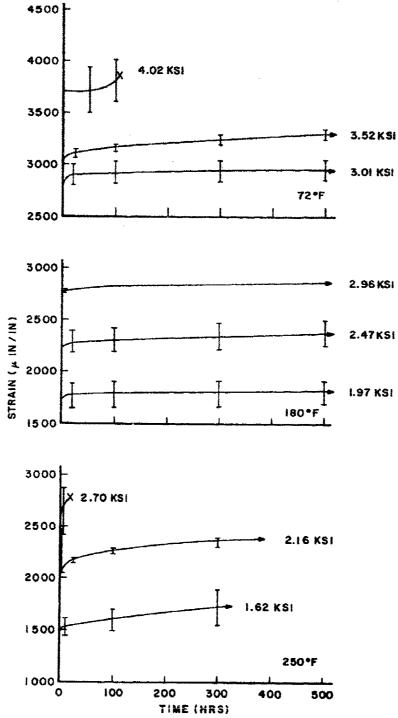


Figure 60. Tensile Creep Behavior of Unidirectional AS/3004 Composite Laminates: 90° Fiber Orientation.

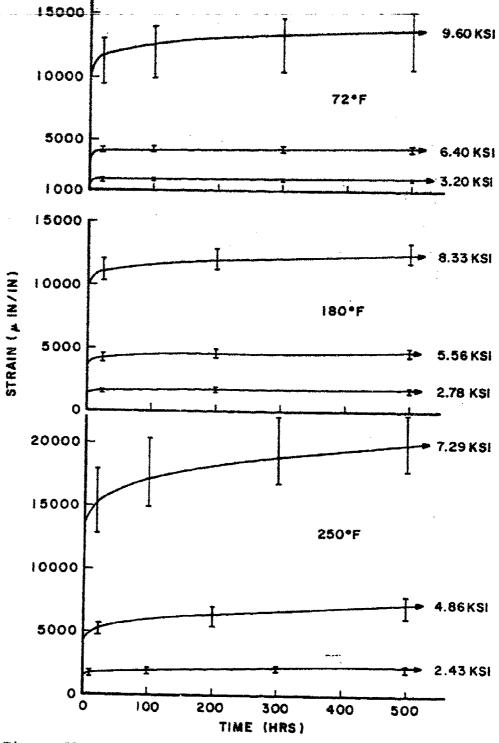


Figure 61. Tensile Creep Behavior of Bidirectional AS/3004 Composite Laminates: +45° Fiber Orientation.

TABLE 32

STRESS RUPTURE PROPERTIES OF AS/3004 COMPOSITE LAMINATES

_		ၓ	MPCSITE	MATERL	COMPOSITE MATERIAL PROPERTIES	93			
Material	tem - AS/3004	Prepreg by - H	Hercules				립	rephite/P	Jraphite/Polysulfons
Maximum Te			Laminate Average 1	Laminate Sp. Gr 1.53 Average Phy Thickness -	1.53 1.64 - 0.0056 inch	inch	:		
Fiber Con	Fiber Content = 57.0% by vol. Vold Content = 1.0% by vol.		No. of pt. Thickness	nele from	No, of panels from which specimes. Thickness of each type specimes -	No, of panels from which specimens were tested in this table - 40 Thickness of each type specimes - 0^{0} - 6 ply	3		
Test Meth	Test Method - Straight-sided Tension Re	Reference - Design Guide	Deelga Gu	i de		+450 8 ply			
			.9	STREES RUPTURE	PTURE				
Temperature	Fiber Orientations	90	006	-¥8 ₀	Temperature	Fiber Orlentations	90	906	e Zi
-670F	Stress Level (kel) Time to Emilure (hrs) No. of Specimens Residual Strength (kel) No. of Specimens Stress Level (kel) Time to Emilure (hrs) No. of Specimens Stross Level (kel) No. of Specimens Stress Level (kel) Time to Fallure (hrs) No. of Specimens Stress Level (kel) Time to Fallure (hrs) No. of Specimens Stress Level (kel) Time to Fallure (hrs)	150.3 500+ 3 172.0 3 131.5	~~ ~+	26.95 3 26.95 3 6.40	. 180°¥	Stress Level (ks) Time to Fallure (hre) No. of Specimens Residual Strength (ks) No. of Specimens Stress Level (ks) No. of Specimens Residual Strength (ks) No. of Specimens Residual Strength (ks) No. of Specimens Stress Level (ks) Time to Fallure (hrs) No. of Specimens Stress Level (ks) No. of Specimens Residual Strength (ks) No. of Specimens Residual Strength (ks) No. of Specimens Stress Level (ks) Time to Fallure (hrs)	193.2 2004 22.3 22.3 2004 3 209.7 3 143.3 143.3 181.2 181.2 181.2 181.2 181.2 181.2	2.96 9.00+ 3.65 1.500+ 3.47 9.55 3.77 17.4 17.4 17.4	2. 55 50 50 50 50 50 50 50 50 50 50 50 50
	No. of Specimens Residus Strength (kel) No. of Sjucimens	3 185.9 3	3 5,26 3	28.63 3		No. of Specimens Residual Strength (ket) No. of Specim ne	2.5		3.62

All values represent arithmetic averages. All residual strengths determined by tensile test at 720 ft.

1. Three epecimens falled on loading.

2. One specimen falled on loading. Nates

PARTE 33

THERMOPHYSICAL PROPERTIES OF AS/3004 COMPOSITE LAMINATES

	COMPOSITE MA	TERIAL PROPER	Ties	,		
Haterial System - AS/300 Fiber - AS Matr Maximum Temperature Rati Resin Content - 33.7% by Fiber Content - 57.4% by Void Content - 40 Thickness of each type s	ix - P1700 ng - 250°F wt. vol.	No. of panels were tested Therm. Exp 4	Gr 1.55 hickness -0.0 from which s in this table	pecimens -5		
Ţ	HERMOPHYSICA	L PROPERTIES:	0*			
	-67°F	72°F	180°F	250°F		
Thermal Expansion $\alpha_{\mathbf{X}}(\text{uin/in-}^{\bullet}\mathbf{F})$ $\alpha_{\mathbf{y}}(\text{uin/in-}^{\bullet}\mathbf{F})$	-0.007 17.00	-0.006 17.00	-0.006 17.00	-0.006 17.00		
No. of Specimens per direction	3	. 3	3	3		
Specific Heat Cp (btu/!b°F)	0.142	0.183	0.215	0.235		
No. of Specimens	4	4	4	4		
hermal Conductivity k _z (btu-ft/ft ² -hr-°f) 0.26 0.30 0.34 0.						
No. of Specimens	6	6	6 、	5		
Glass Transition Temp. Dry (°F) Wet (°F)			7°F 9°F			
TH	ERMOPHYSICAL	PROPERTIES:	±45°			
Thermal Expansion $\alpha_{X}(\mu in/in-^{\circ}F)$	±0	1.6	1.8	1.8		
No. of Specimens per direction	3	3	3	3		
Thermal Conductivity kz (btu-ft/ft2-hr-°F)	0.23	0.27	0.30	0.32		
No. of Specimens	3	3	4	4		

Note: On unidirectionally reinforced specimens, the x-direction is along the fiber axis, the y-direction is across the fiber axis, and the z-direction is through the thickness (identical to y-direction).

On +45° bidirectionally reinforced specimens, the x and y directions are identical and oriented at 45° to either fiber direction, while the z-direction is through the thickness.

TENSILE PROPERTIES OF AS/3004 COMPOSITE LAMINATES AFTER HUMIDITY AGING

COMPOSITE MATERIAL PROPERTIE	er ties	OPE	PR	L	TERL	MA	PΣ)MP0517	C
------------------------------	---------	-----	----	---	------	----	----	---------	---

Material System - AS/3004 Fiber - AS | Matrix - P1700

Maximum Rated Temperature - 250°F Resin Content - 33.9% by wt. Fiber Content - 56.1% by vol. Void Content - 12% by vol-

Graphite/Polyenifone

Prepreg by - Reccules Graphite/
Laminate Sp. Or. - 1.87.

Average Ply Thickness - 0.0054 inch
No. of panels from which specimens were tested in this table - 6

Aging Conditions - 1600y & 100% R. H.

	TENSION: 90	pa -		
	72°F	250°F	72°¥	250°T
Exposure Time (hrs)	9	•	744	746
Weight Gain (% of orig. dry wt.)	0.19	0,20	0.323	746 ₃
itnd. Dev. (%)	0.01	0.03	0.02	\$0.0
to, of Specimens	5	5	5	5
r ^{tu} (ksi)	5.72	4,13	3, 96	3. 03
Stad. Dev. (ksi)	0.77	0.13	0.45	0, 38
lange (ksi)	5.00-6.95	2. 90-4. 81	3.45-4.48	2.79-3.62
fo. of Specimens	5	5	5	5
.tpl (ksi)	٥٠,00	2.99	2.76	2.04
tnd. Dev.	0.52	0.57	0. 42	0. 52
lo. of Specimens	5	5	5	,
t T tnd. Dev.	1.20	1.09	1.11	1.08
	0.02	r.08	0.03	0. oz
io. of Specimens	5	5	5	5
tu (µ in/in)	4960	4000	3640	2960
ind, Dev.	710	840	450	420
le. of Specimens	5	5	5	5
Fest Method	l		-wided tension	•
Reference			n Guide	
	TENSION: ±	150	·	
Exposure Time (hrs)	3 0.25	3 0, 21	576 0.433	576 0. 43 3
Keight Gain (% of orig. dry wt.) itnd. Dev. (%)	0.2	0, 03	0.02	0.02
ine. of Specimens	5	5	5	5
4				
r ^{tu} (ksi)	37.48	20.46	32. 52	23.97
Stad. Dev. (ksi)	8.13	1.82	1.44	2.47
Range (kai)	27.08-45.23	17.99~22.02	31.22-34.45	20. 75-26. 5
No. of Specimens	1 *	•	, ,	4
tp) Fx (ksi)	3.46	2, 36	4. 40	2, 47
Stnd. Dev.	0.10	0.29	0. 30	0.31
No. of Specimens	5	4	5	+
E ^t (Msi)	1.94	1.84	2. 20	2.07
Stnd. Dav.	0.15	0.29	0.08	0.10
No. of Specimens	5	•	5	•
ε ^{tu} (μ in/in)	58,2001	38, 9001	50, 500 ¹	167,0002
Sind. Dev.	7,6001	11,0001	8100 ¹	
No. of Specimens	5	•	31	12
Test Method	1	i Straight-	sided tension	ı
Reference	}	Desig	n Guide	

Notes:

1. Surface plies cracked at about 60% of ultimate stress, breaking gages.

Surface piles on three specimens cracked at 60% of ultimate stress, breaking gages.
 100% saturation level at aging conditions.

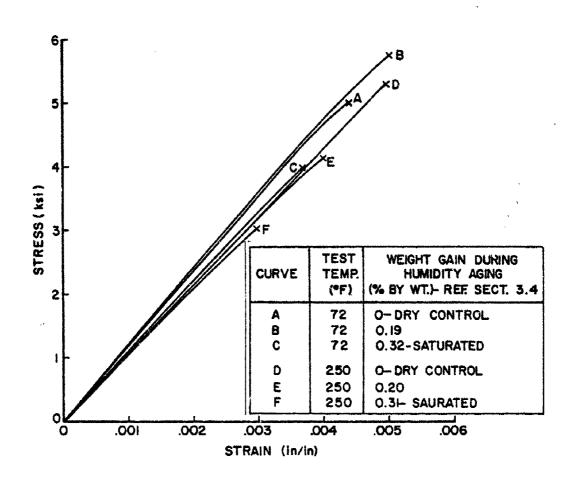
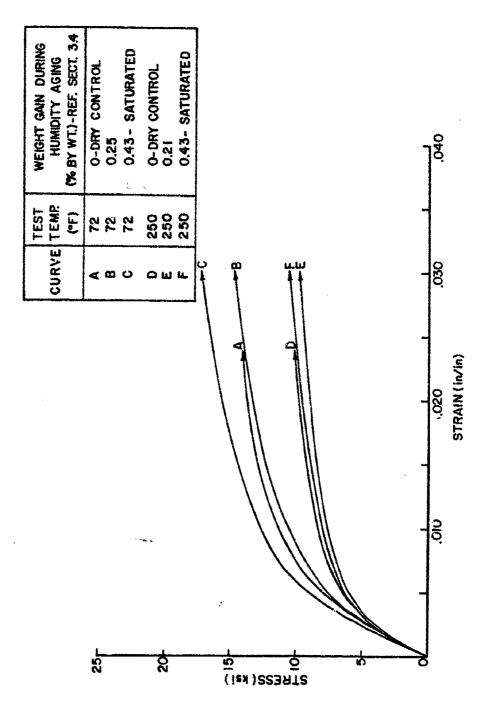


Figure 62. Tensile Stress-Strain Curves for Unidirectional AS/3004 Composite Laminates After Humidity Aging: 90° Fiber Orientation.



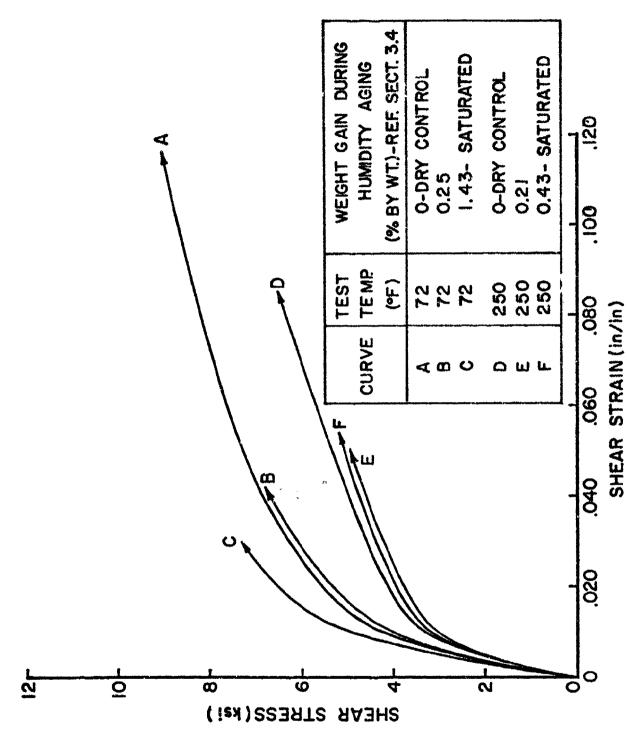
Tensile Stress-Strain Curves for Bidirectional AS/3004 Composite Laminates After Humidity Aging: +45° Fiber Orientation. Figure 63.

PABLE 35

SHEAR PROPERTIES OF AS/3004 COMPOSITE LAMINATES AFTER HUMIDITY AGING

COMP	OSITE MATERIAL	PROPERTIES	**************************************	
Material System - AS/3004	Prep	reg by - Hercu	Gra	phite/Polysuifon
Fiber - AS Matrix - P1700	_			
Maximum Rated Temperature - 250°F		inate Sp. Gr		L
Resin Content - 33.2% by wt.		age Ply Thickner of panels from v		
Fiber Content - 57.1% by vol. Void Content - 12% by vol.		or paners from v		
Void Content - 12% by vol.		g Conditions - 1		H
Thickness of each t	ype specimen: Inp	 lane shear-8 pli	es; Interlamina	r shear-14 plies
	INPLANE SHEAD	3		
Test Temperature	72°F	250°F	72°F	250°F
Exposure Time (hrs)	3	3	576	576
Weight Gain (% of orig. dry wt.)	0.25	0.21	0.431	0.431
Stad. Dev. (%)	0.02	0.03	0.02	0.02
No. of Specimens	5	5	5	5
att their	18. 74	10.77	16.26	11.00
Fay (icst)	4.07	10.23	1	11.98
Stnd. Dev. (ksi)	13.54-22.33	0.91 8.99-11.01	0.72	1.23
Range (ksi) No. of Specimens	5	4	5	10, 38-13, 28
		_	1	•
G _{XY} (Msi)	0, 54	0.48	0.60	0.48
Stad. Dev.	0,04	0.07	0.03	0.02
No. of Specimens	5		5	4
Test Method		1450 4440	 ght-sided tensio	_
Reference		J. Comp. Mals.		
II.	NTERLAMINAR SH			
Exposure Time (hrs)	552	552	625	625
Weight Gain (% of orig. dry wt.)	0.69	0.69	0.871	0.871
Stad. Dev. (%)	0.46	0,47	0.19	0.15
No. of Specimens	5	5	5	5
Fieu (ksi)	8.80	7.06	8.49	6, 53
Stnd. Dev. (ksi)	0.87	0.59	0.44	0.52
Range (ksi)	7. 35-9. 33	6.30-7.61	8.08-9.09	6.07-7.42
No. of Specimens	5	5	4	5
Test Method		Short Beam	(Shear, S/D×4	1
Reference		Design Guide		

 $^{^{1}}$ 100% saturation level at aging conditions.



Inplane Shear Stress-Strain Curves for AS/3004 Composite Laminates After Humidity Aging. Figure 64.

Tables 36-48 present the data generated for this graphite/polyimide composite system. Figures 65-87 illustrate the stress-strain, fatigue, and creep behavior of the material, as well as the effect of humidity aging upon the composite material. Two points of particular interest must be pointed out relative to this material system.

The first item concerns the fabrication of thick (15-20 plies and above) laminates with AS/4397. It has been found impossible to prevent delamination of panels over 20 plies thick from occurring during the postcure cycle. No delaminations are present at the conclusion of the cure schedule, prior to postcuring, but gross delaminations occur during the postcuring Sycle. Since the cure schedule takes the panel to 400°F while the postcuring schedule takes it to 450°F, the damage evidently occurs somewhere in this temperature range. A TGA was conducted on a sample of the cured but not postcured AS/4397 material which indicated that no volatiles were being released in the 400-450°F temperature region so this apparently does not account for the problem. A number of variations in the postcuring schedule were tried including very slow heat up rates, greatly extended hold times at intermediate temperatures, and the maintenance of pressure throughout the postcure, all without success. Perhaps the thermal stresses induced by raising a panel thicker than 20 plies to a temperature of 450°F are sufficient to cause the delamination.

The second point pertains to flexure testing for the AS/4397. As mentioned in Section 3.5.3, all flexure testing with the exception of the 0°, AS/4397 specimens was performed with a four-point loading technique. It was found necessary on the 0°/AS/4397 flexure specimens to use a three-point loading technique in order to insure consistent flexural failure modes rather than delamination failure modes. Fourteen room temperature four-point flexural tests were conducted on 0°, AS/4397 specimens with four good flexural failures, five mixed-mode failures, and

five outright shear failures resulting. The average flexural stress of each of these type failures was 224.4 ksi, 211.4 ksi, and 160.8 ksi, respectively. It is apparent that the flexural strength obtained from good failure modes in four-point loading is identical to the value reported in Table 41 for three-point loading. The flexural stress at failure understandably falls off as the failure mode changes to a combination of flexure and shear and ultimately, to pure shear. The shear stresses present in these fourteen specimens at failure ranged from 6700 to 7060 psi on the good flexural failures, between 6450 and 7430 psi on the mixed-mode failures, and between 4490 and 6111 psi on the shear failures.

TABLE 36 PROCESSING CONDITIONS FOR AS/4397 COMPOSITE LAMINATES

Composite Processing Information

Material System - AS/4397

Graphite/Polyimide

Fiber - AS Matrix - 4397

Maximum Rated Temperature - 450°F Pre

Prepreg by - Hercules

Laminate Processing Schedule

Layup Procedure: Prepreg warmed to R. T. in closed wrapper. Prepreg removed from package and plies cut to desired size using razor blade. Plies stacked in desired sequence (release paper removed from each ply). Stack placed in autoclave on sheet of nonporous Teflon and surrounded with cork dam to restrict fiber flow. Sheet of porous Teflon placed on top of stack and one ply of bleeder paper per four plies of prepreg placed on top of this. A sheet of nonporous Teflon is placed over the bleeder paper and covered by the silicone rubber bladder.

Gure Schedule: Under full vacuum, the temperature was increased to 275°F at a rate of 4 to 5°F per minute. When 275°F is reached, a pressure of 85 psi was applied above the bladder. At this pressure and still under full vacuum, the part is held at 275°F for 30 minutes. The temperature was then raised to 400°F at 5°F per minute and held at 400°F for 2 hours. The panel was cooled under pressure to below 150°F before removal.

Postcure Schedule: After trimming of flash, the panels were placed, unrestrained, in an oven and heated to 400°F at 5°F per minute. After 1 hour at this temperature, the temperature was raised to 450°F at 5°F per minute and then held for 48 hours before cooling to room temperature.

Note: It was found that when laminates thicker than about twenty plies were made, gross interply delamination occurred during postcure. Several modifications of the postcure schedule outlined in the table above were tried, including much slower heat-up rates, extended hold times at intermediate temperatures, and application of pressure, all without success.

TABLE 37
PREPREG AND COMPOSITE PHYSICAL PROPERTIES: AS/4397

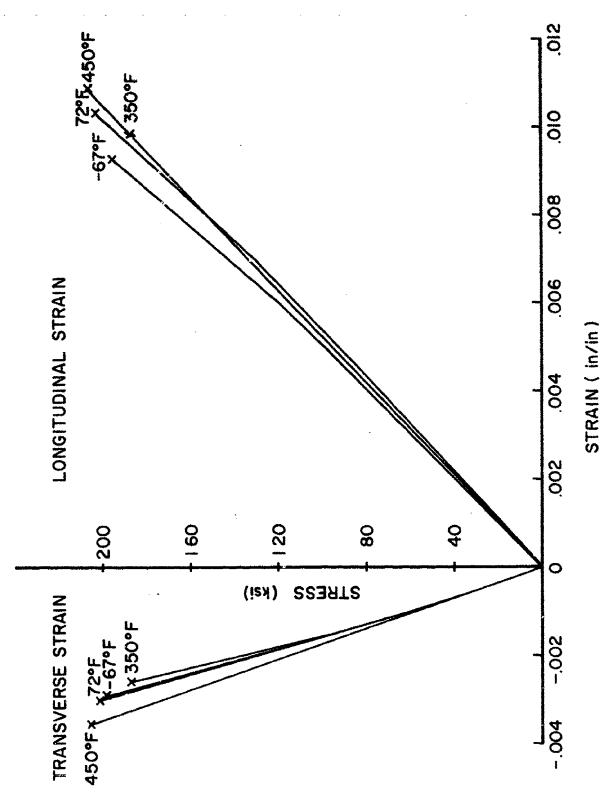
Composite P	hysical	Property Inf	ormation	
Material System - AS/4397 Fiber - AS Matrix -	4397		Graphite/Polyin	ide
Maximum Rated Temperature		e P	repreg by -Hercule	8
Prepre	g Physi	cal Properti	es	
·		.) (Range)		(Ref.)
Volatile Content-0.21% by wt. Resin Content-42.6% by wt. Resin Flow-25.9% by wt. No. of Rolls Involved-2 No. of Batches Involved - 1	1.3	40.4-43.8		
Lamin	ate Phys	sical Proper	ties ¹	
(St	nd. Dev	.) (Range)	(Test Method)	(Ref.)
No. of Panels - 46 Fiber Content-63.6% by vol. Resin Content-28.5% by wt. Void Content- = 0% by vol. Laminate Sp. Gr. = 1.57 Fiber Sp. Gr. = 1.78 Matrix Sp. Gr. = 1.26 Thickness per ply - 0.0056 in	1.8 0.02 As re As re	25.8-34.4 —— 1.53-1.60 ported by ma	HD-SG-2-6006C(5.2.1 HD-SG-2-6006C(5.2.1 Grid pt. count anufacturer. anufacturer.	}Hercules

¹The properties reported here represent averages for all panels of this material used throughout the program.

TENSILE PROPERTIES OF AS/4397 COMPOSITE LAMINATES

COMP	OSITE MATER	IAL PROPE	RTIES			
Material System - AS. Fiber - AS	Matrix - 4397		ules nate Sp. Gr	Graphite/Polyimide		
Maximum Rated Temp		F Avera	ge Ply Thicks	ness - 0.005? inch		
	2% by wt. 6% by vol.	No. o	f panels from	which specimens		
	% by vol:		re tosted in th			
	,, o,		6 piles, 900-1			
	•					
	Tensi	ON: 00				
	-67°F	72°F	350°F	450°F		
F _x (kai)	195.4	203.3	187.4	206.5		
stnd. dev. (ksi)	3.9	6.6	27.9	13.0		
Range (ksi)	189.5-200.0		149.7-222.7	185.4-217.6		
No. of Specimens	5	6	•	5		
r ^{tpl} (ksi)	195.4	203.3	179.1	206.5		
stnd. dev.	3, 9	6.6	30.8	13.0		
No. of Specimens	5	6	6	5		
Ex (Mai)	19.4	18.3	189	18.1		
stnd. dev.	0.5	0.6	1.2	0.6		
No. of Specimens	5	6	6	5		
stu (pin/in)	9300	10,300	9850	10,900		
stad. dev.	100		1240	200		
No. of Specimens	100	475 6	1240	4		
		_				
t *xy	0.31	0.30	0, 31	0.33		
stnd. dev.	0.02	0.02	0.03	0.03		
No. of Specimens 5 5 5						
Test Method Straight-wided tension Reference Design Cattle						
Reference Design Guide TENSION: 90°						
Fy (ksi)	5.29	5, 37	3,81	2.96		
stnd. dev. (ksi)	0.51 4.56-5.78	0.33	0,38	0,21		
Range (kei) No. of Specimens	7. 30-3. /8 5	4.94-5.85 5	3.22-4.40	2.75-3.28		
tol						
	5, 29	5, 37	2.76	2.14		
stnd. dev. No. of Specimens	0.51 5	0.33 \$	0.73 5	0.30		
-		•		1		
Ey (Mai)	1.47	1.39	1.09	0.76		
stad. dev.	0.02	0.01	0.13	0.05		
No. of Specimens	5	5	5	5		
etu (pin/in)	3600	3900	3400	4200		
y (Finite)	300	260	300	300		
No. of Specimens	5	5	5	5		
ŧ	0.0231	0.023 ¹	1	0.0141		
yx	0.023	0.023	0.0181	0.014-		
7.4						
Test Method		Straight-si	ded tension			

¹Computed using elastic modulii and longitudinal Poisson's ratio.



Tensile Stress-Strain Curves for Unidirectional AS/4397 Composite Laminates: 0° Fiber Orientation. 65. Figure

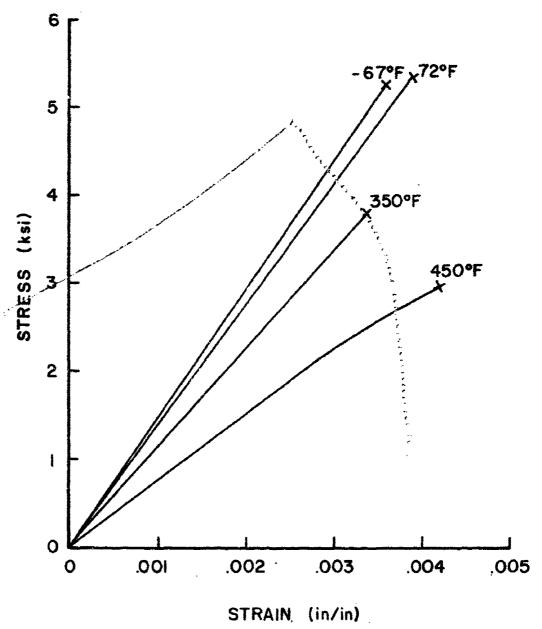


Figure 66. Tensile Stress-Strain Curves for Unidirectional AS/4397 Composite Laminates: 90° Fiber Orientation.

TABLE 39
TENSILE PROPERTIES OF AS/4397 COMPOSITE LAMINATES

	····	RIAL PROPE		1. 1. / / 1. 1. 1. 1. 1.
	Matrix -439 nperature - 49 .5% by wt. .1% by vol.	No. o	sate Sp. Gr	mess - 0.0057 inch which specimens his table - 4
	TENSIC	ON: ± 45°		
	-67°F	72°F	350°F	450°F
rtu (ksi) stnd. dev. (ksi) Range (ksi) No. of Specimens	19.26 0.37 18.78-19.81 5	18. 72 0. 37 18. 20-19. 20 5	16.61 0.76 15.26-16.93 5	16.70 0.41 16.34-17.40 5
Fx (ksi) stnd. dev. (ksi) No. of Specimens	8.69 1.45 5	7. 46 0. 73 5	3. 68 0. 96 5	2.78 0.67 5
Et (Msi) x stnd. dev.	2.81 0.14 5	2, 66 0, 09 5	2.05 0.17 5	1.79 0.19 5
etu (#in/in) x stnd. dev. No. of Specimens	10,700 800 5	11,800 1,700 5	>25,000 ¹ 5	>17,0001
xy stnd. dev. No. of Specimens	0.71 0.06	0. 72 0. 07 5	0. 71 0. 06 5	0.65 0.05 3
Test Method Reference		raight-sided te Design Guide	rasion	

Notes: 1. Surface plies cracked, creating electrical discontinuities in strain gages.

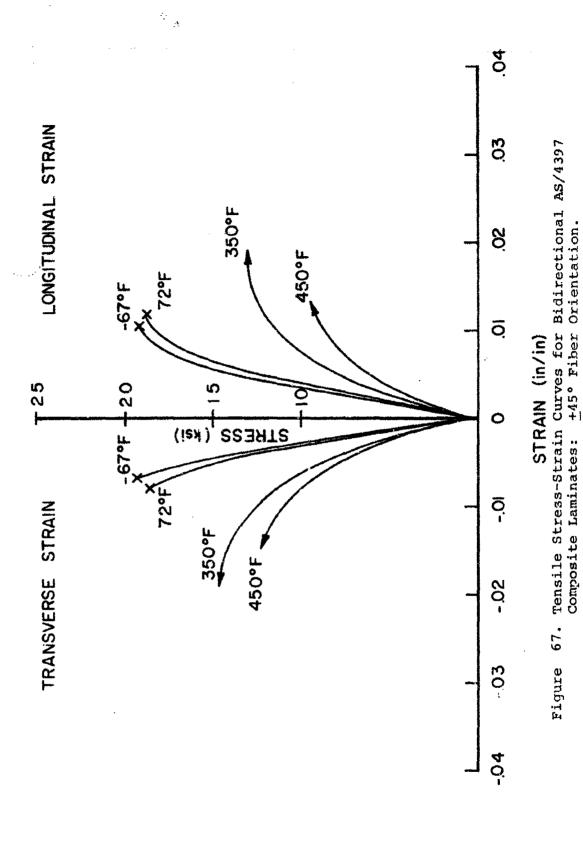


TABLE 40

COMPRESSIVE PROPERTIES OF AS/4397 COMPOSITE LAMINATES

COMPOSITE MATERIAL PROPERTIES

			ATERIAL PRO				
Material S Fiber - A	yetem - AS/4				aphite/Polyimide		
	S Mi Rated Temper	strix - 4397		opreg by - He			
	tent - 28.2% i			minate Sp. Gr	ickness -0.0054 in.		
	- 62.9%		No.	orego rty 1111	om which specimens		
	at - 40% by		We	re tested in th	his table - 1		
	of specimens						
<u> </u>			PRESSION : 0				
	***************************************	1					
		-67°F	72°F	350 ° F	450°F		
F.	(ksi)	235.8	206.1	164.6	152.8		
stnd. dev.	(ksi,	7.2	14.1 =	15.2	36.9		
Range	(kai)	232.1-243.7	189.7-221.9		110.7-179.8		
No. of Specin	nens	5	5	5	3		
cpl		1 1					
×	(kei)	105.9	172.2	121.7	70.5		
stnd. dev.		15.8	47.4	28.3	27.1		
No. of Specin	nens	5	3	5	3		
_		1 1					
E.Z	(Mai)	21.3	18.7	19.1	18.2		
stnd. dev.		1.0		i	3.1		
No. of Specin	Oens	5	0.81	2.2	4		
		"	;	5	_		
cu		1 . 1		1			
t x	(µ in/in)	13,2001	11,800 ²	8800	99003		
etnd. dev.	-	5900	3800	1700	5600		
No. of Specia	yeus .	5	5	5	3		
		1	,				
Test Method		Cal	lanese coupon	and test firtu	76		
Reference			Gelanese coupoa and test fixture AFML-TR-72-205, Pt. 1				
	~	COMI	COMPRESSION: 90°				
_ca	Charl's	36, 1					
Fy	(kai)	1	30.0	21.1	21.5		
stad. dev.	(ksi)	2.8	2.9	2.0	3.0		
Range	(ksi)	35.0-39.5		18.5-22.8	18.0-25.4		
No. of Specin	ne na	5	5	5	5		
mcb _l	(lent)	1	1	1			
Fy	(ksi)	10.7	14.5	7.6	7.91		
stad, dev.			7.8	1.4	2,78		
No. of Specia	nens	2	5	3	3		
c		1					
EÅ	(Msi)	1.97	1.45	1.16	1.694		
stnd, dev.		0.25	0.31	0.07	0,62		
No. of Specia	nens	5	5.51	5	5		
_ •		1	1	1	,		
_cu	(u in/in)				1 5		
*y	Or milnut	21,900	13000	24, 200	>9,4005		
stnd. dev.		4,700	7000	8400			
No. of Specim	tens	5	4	5	5		
]		1	1		
Test Method		1 '	i -	i .	1		
TACKING TACK		T (***)					
Reference			lagese coupon FML→TR-72-:		IF •		

- Notes: 1. Three of five specimens exhibited evidence of buckling.
 - 2. One of five specimens exhibited evidence of buckling.
 - One of three specimens exhibited evidence of buckling. The tabs
 - debonded on a fourth specimen prior to failure.

 4. This value appears high in comparison with the 72°F and 350°F. values but monetheless, is the measured average.
 - 5. Lost strain gage signal prior to failure on four of the five specimens.

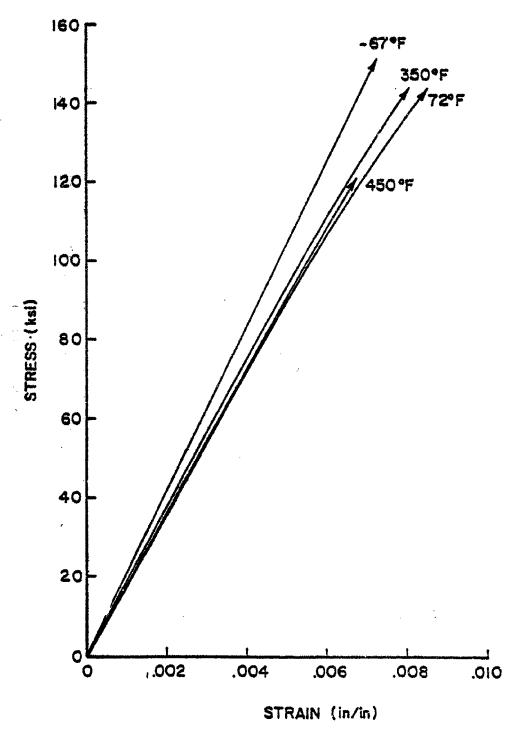
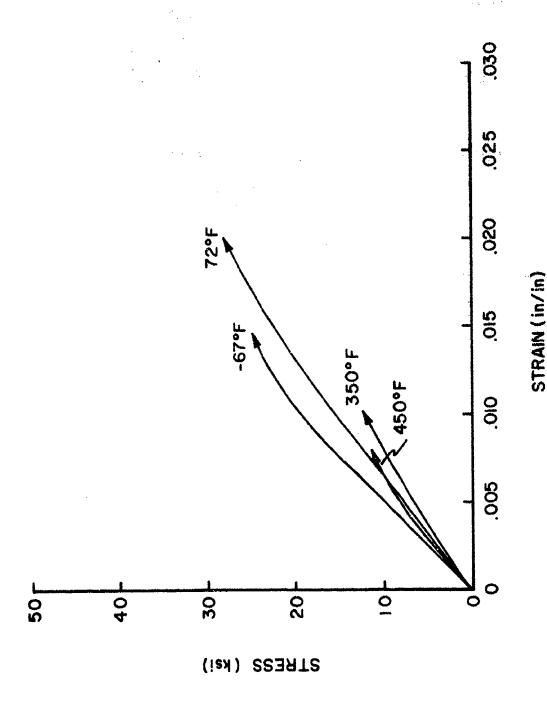


Figure 68. Compressive Stress-Strain Curves for Unidirectional AS/4397 Composite Laminates: 0° Fiber Orientation.



Compressive Stress-Strain Curves for Unidirectional AS/4397 Composite Laminates: 90° Fiber Orientation. Figure 69.

TABLE 41
FLEXURAL PROPERTIES OF AS/4397
COMPOSITE LAMINATES

	COY	POSITE MATE	RIAL PROPE	RTIES	
Materia Fiber -	il System - A	S/4397 Matrix - 439	Prepreg by -1	Hercules (Fraphite/Polyimide
		nperature - 450°	F Lamin	ate Sp. Gr.	. 1.57
	Content - 31.				ness -0.0058 inch
	iontent - 61.		No. of	panels from	which specimens
Void Co	ontent - 50	% by vol.		ested in this	
					pe specimen:
			09-14	plies: 90°-14	plies
		FLEX	URE: 00		
		-67°F	72°F	350°F	450°F
e,×	(ksi)	239.9	224.4	178.8	128.6
stnd. dev.	(ksi)	11.8	10,5	15.9	4.5
Range	(ksi)	228.5-257.5		165.8-204.6	123.9-133.7
No. of Speci	imens	5	5	5	5
f E _x	(Msi)	17.3	18.4	17.3	16.7
"x stnå. dev.	()	1.1	0.6	1.6	0.6
No. of Spec		5	5	5	5
No. or Spec	imens		•		1
Test Method	l			lexure	
Reference		1	-	Guide	
	الخفية المتالك المستركة المتالك المتعاددات		Jan.,	1971	
		FLEX	URE: 90°		1
fu Fy	(ksi)	9.28	8.88	5.34	4.32
stnd. dev.	(ksi)	1.03	0.51	0.77	0.80
Range	(ksi)	7.74-10.31	8.31-9.65	4.44-6.20	3.28-5.34
40. of Speci	inens	5	5	5	6
E Y	(Msi)	1.55	1.50	1.19	0.66
ind. dev.		0.12	0.21	0.04	0.09
No. of Speci	mens	5	5	5	6
-		1	1		l
Test Method	L	1	4 pt. fl	exure	
Reference		1	Design	Guide	
		<u> </u>	Jan.,	1971	

TABLE 42

SHEAR PROPERTIES OF AS/4397 COMPOSITE LAMINATES

COMPOSITE MATERIAL PROPERTIES

Material System - AS/4397

Graphite Polyimide

Fiber - AS

Matrix - 4397_

Maximum Rated Temperature -450°F

Prepreg by - Hercules

Resin Content - 27.8% by wt.

Laminate Sp. Gr. - 1.59

Fiber Content - 65.6% by vol.

Average Ply Thickness - 0.0057 in. No. of panels from which specimens

Yoid Content - =0 were tested in this table - 5 Thickness of specimens:inplane-8 ply; interlaminar-14 ply

	INPLAN	e shear		
	-67°F	72°F	350°F	450°F
F _{XY} (ksi	.) 9.63	9.36	8.31	8.35
stnd.dev. (ksi Range No. of Spaciment	9.39-9.90	0.19 9.10-9.60 5	0.38 7.63-8.49 5	0.21 8.17-8.70 5
G _{XY} (Msi stnd. dev. (Msi No. of Specimen	0.04	0.77 0.02 5	0.56 0.05 5	0.54 0.07 3
Test Method Reference	, —	5° Straight- . [Vol.6, p.		

INTERLAMINAR SHEAR

		-67°F	72°F	350°F	450°F
Fisu	(ksi)	14.73	13.62	9.79	6.21
Stnd. Dev. Range No. of Spe	(ksi) (ksi) cimens	3.41 10.77-18.96 5	1.73 10.96-15.14 5	1.18 8.71-11.47 5	0.89 5.13-7.24 5
Test Metho Reference	od	De	Short Bear esign Guide		L

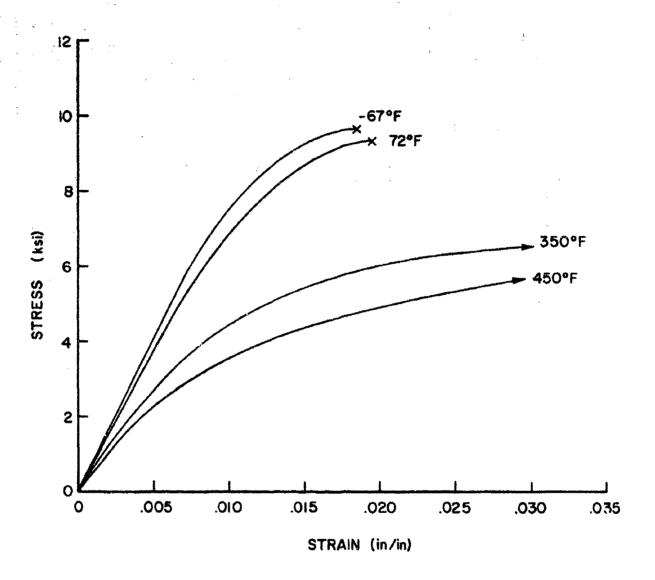


Figure 70. Inplane Shear Stress-Strain Curves for AS/4397 Composite Laminates.

TABLE 43

FATIGUE PROPERTIES OF AS/4397 COMPOSITE LAMINATES

			8	POSITE MA	COMPOSITE MATERIAL PROPERTIES	erties			
Material System	Material System - AS/4397	Prepreg	Prepreg by - Reroules	cules				Graph	Graphite/Pulyiside
Fiser - As Maximum Temp Resin Content - Fiber Content - Vold Content - Test Method - 6	matrix - rature Rating - 28.18 by wt. 64.08 by vol. å0	ion	Ference Park	Laminate Sp. Gr Average Ply Thickn No. of panels from v Thickness of each Thickness of each	Laminate Sp. Gr 1.57 Average Ply Thickness - 6.0057 inch No. of panels from which specimens wer Thickness of each type specimen; ce - Design Guide	th rare tested in (0° 6 90° 15 +45° 8	this table ? ply ply ply	v e	
		1		TENSILE	TENSILE FATIGUE, R=0.1	1.1			
Temperature	Fiber Orientation:	8	906	-450	Temperature	Fiber Orientation:	00	006	-45 ₀
-67 ⁰ F	Max. Strees (kel) 1.55. Lifetime (cycles) 1.58 No. of Specimens 4 No. of Specimens 0 No. of Specimens 0 Lifetime (cycles) 59, 156. Lifetime (cycles) 59, 156. No. of Specimens 0 No. of Specimens 0 Max. Strees (kel) 1.36.8 No. of Specimens 1.36.8 Residual Strength (kel) 200.7	175.6 1,586 4 4 4 156.3 156.3 156.8 136.8 136.8	175.8 3.70 1.386 10,130 0 0 0 0 1.150 35,020 1.150 35,020 0 1 5.09 47,030 1.930 472,030 1.930 472,030	13.48 4,5401 4,5401 11.56 95,860 0 10.592 5.6310 ⁶ 2 14.90	350 ⁰ FF	Max. Stress (kei) Lifetims (cycles) No. of Specimens Residual Strength (kei) Max. Stress (kei) Lifetims (cycles) No. of Specimens Residual Strength (kei) No. of Specimens Max. Stress (kei) Lifetime (cycles) No. of Specimens Kax. Stress (kei) Max. Stress (kei) No. of Specimens Residual Strength (kei) No. of Specimens Residual Strength (kei) No. of Specimens	166.7 5,370 4 149.9 11,990 6 131.2 527,460	3.05 9,610 4 4 10 10 10 10 10 10 10 10 10 10 10 10 10	11.63 21,5503 4 0 0 10.80 122,200 ¹ 4 0 9.97 641,000 ³
72°F	Max. Stress (fest) 192. Il Lifetime (cycles) 43,050 No. of Specimens 6 No. of Specimens 9 No. of Specimens 9 Lifetime (cycles) 28, 978 No. of Specimens 4 Residual Strength (lest) 28, 978 No. of Specimens 6 No. of Specimens 9 No. of Specimens 2	182.1 4.050 4.050 161.9 28,975 6.00 144.6 5.200 6.200 6.200 6.200 7.000 7.000	3.76 4 4 4 4 4 9.670 9.822 12,560 4 4 61,109	14:98 3,9903 4 4 0 13:10 15,8203 15,8203 11.23 0 11.23	4500%	Max. Stress (tat) Lifetime (cycles) No. of Specimens Residual Strength (ksi) Max. Stress (tat) Lifetime (cycles) No. of Specimens Residual Strength (ksi) No. of Specimens Max. Stress (tat) Litetime (cycles) No. of Specimens Max. Stress (tat) Litetime (cycles) No. of Specimens Residual Strength (ksi) No. of Specimens Residual Strength (ksi) No. of Specimens	165.2 2,410 0 154.9 612,60 4 2.1410 4	2.07 11,263 4 0 0 1.77 73,866 4 0 1.4806 1.4806	11.69 1,7003 4 6,7003 18,7804 18,7804 4 18,7804 18,7804 19,54 13,54

Note:

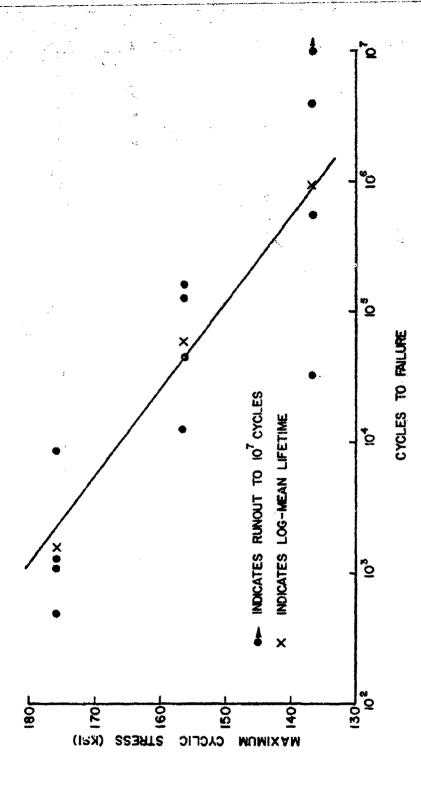
Patigue lifetimes are log-mean values. All residual strengths determined by tensile tast at 72°F.

1. Internal energy dissipation caused specimens to self heat between 9°F and 15°F above nominal test temperature at time of failure.

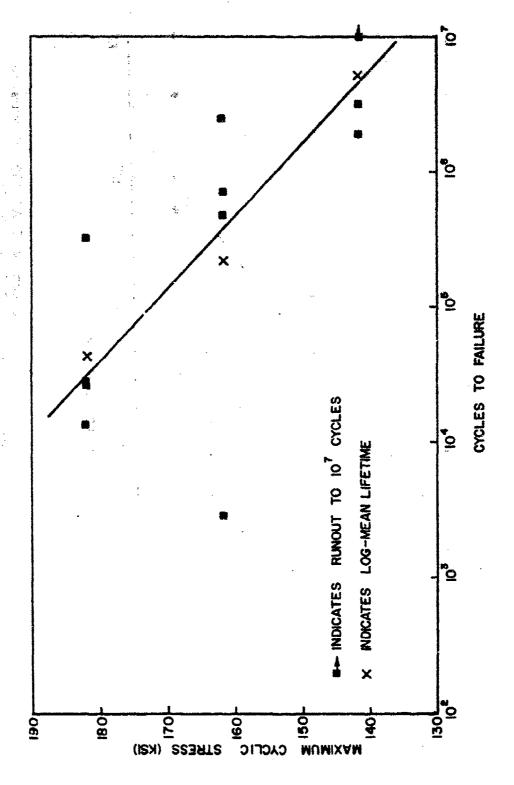
2. Internal energy dissipation caused specimens to self heat between 4°F and 6°F above nominal test temperature at time of failure.

3. Internal energy dissipation caused specimens to self heat between 29°F and 37°F above normal test temperature at time of failure.

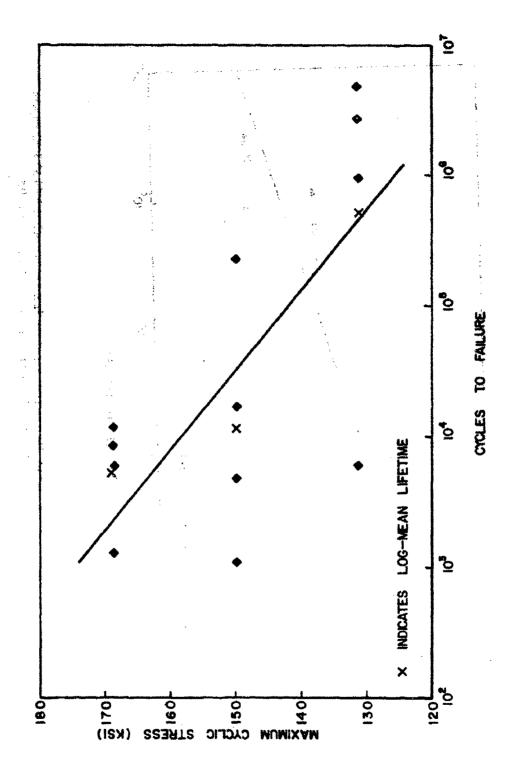
4. Internal energy dissipation caused specimens to self heat between 48°F and 52°F above normal test temperature at time of failure.



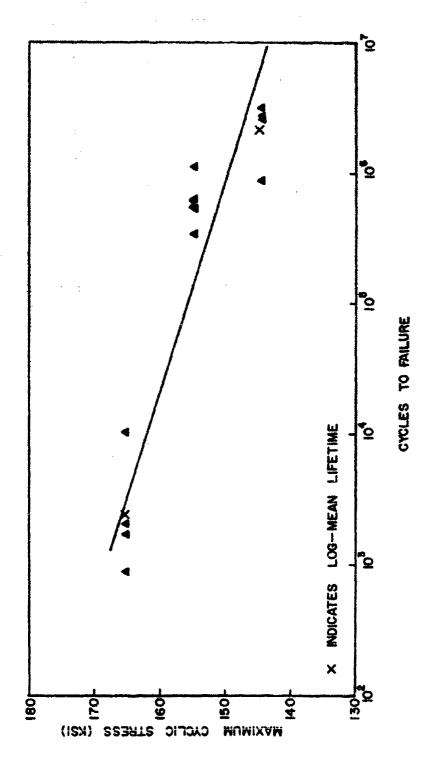
Tensile-Tensile Fatigue Behavior of Unidirectional AS/4397 Composite Laminates at -67°F: 0° Fiber Orientation, R=0.10, 30 Hz. Figure 71.



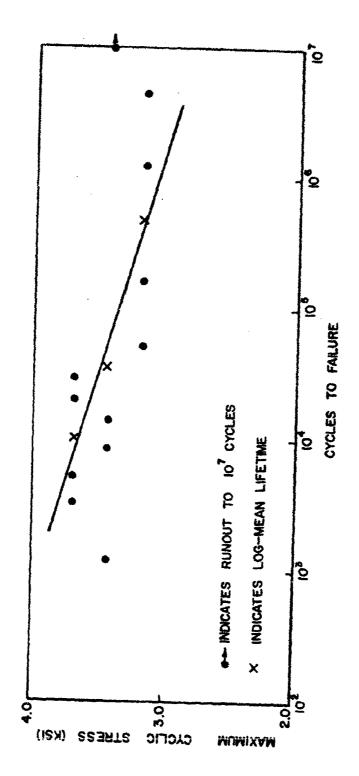
Tensile-Tensile Fatigue Behavior of Unidirectional AS/4397 Composite Laminates at 72°F: 0° Fiber Orientation, R=0.10, 30 Hz. Figure 72.



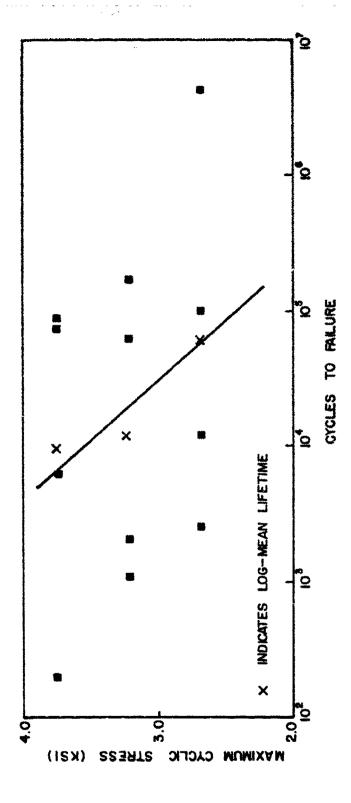
Tensile-Tensile Fatigue Behavior of Unidirectional AS/4397 Composite Laminates at 350°F: 0° Fiber Orientation, R=0.10, 30 Hz. Figure 73.



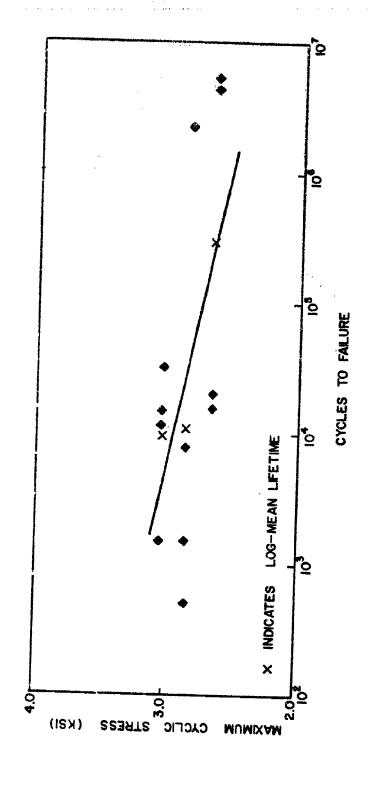
Tensile-Tensile Fatigue Behavior of Unidirectional AS/4397 Composite Laminates at 450°F: 0° Fiber Orientation, R=0.10, 30 Hz. Figure 74.



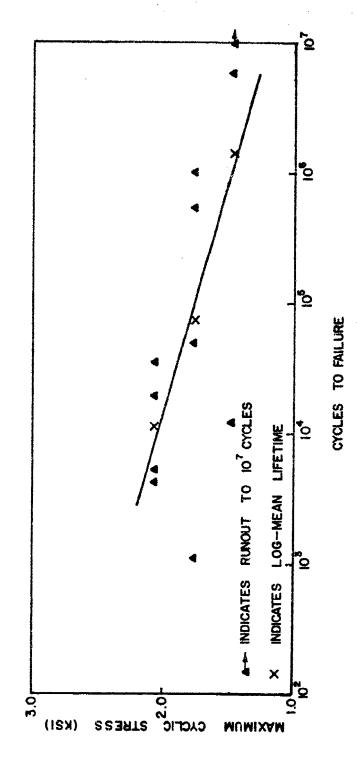
Tensile-Tensile Fatigue Behavior of Unidirectional AS/4397 Composite Laminates at -67°F: 90° Fiber Orientation, R=0.10, 30 Hz. Figure 75.



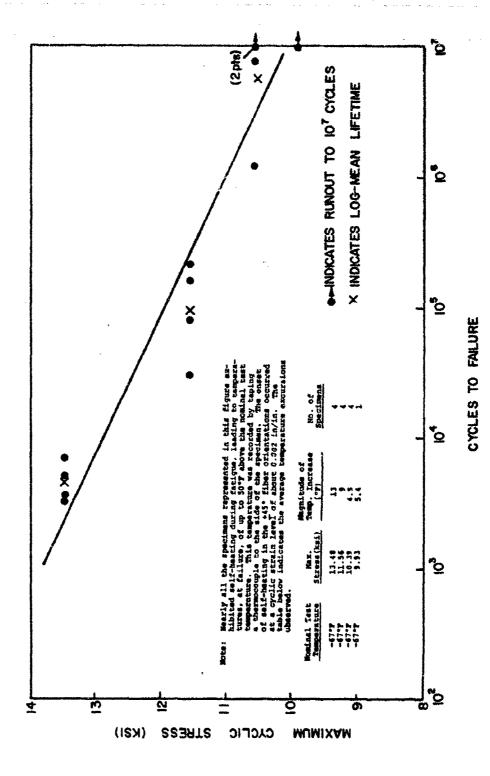
Tensile-Tensile Fatigue Behavior of Unidirectional AS/4397 Composite Laminates at 72°F: 90° Fiber Orientation, R=0.10, 30 Hz. Figure 76.



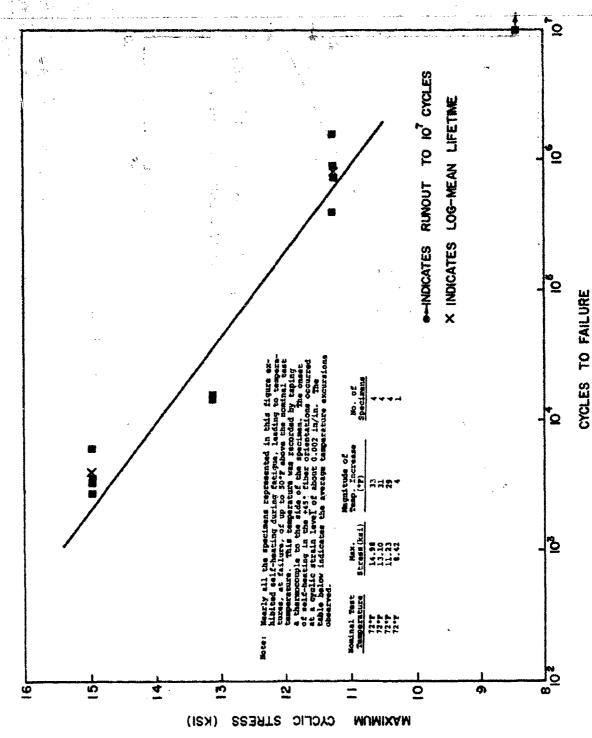
Tensile-Tensile Fatigue Behavior of Unidirectional AS/4397 Composite Leminates at 350°F: 90° Fiber Orientation, R=0.10, 30 Hz. Figure 77.



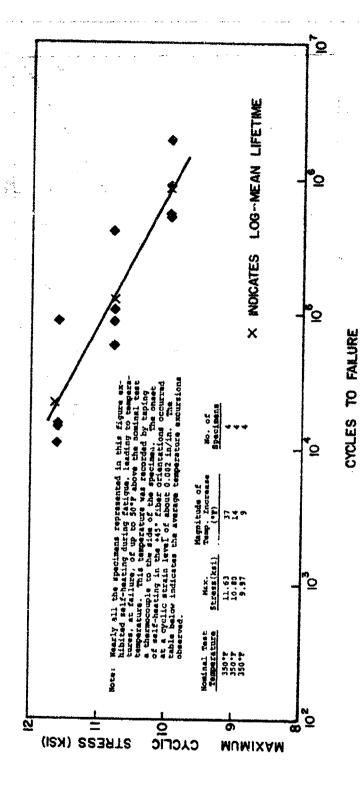
Tensile-Tensile Fatigue Behavior of Unidirectional AS/4397 Composite Laminates at 450°F: 90° Fiber Orientation, R=0.10, 30 Hz. Figure 78.



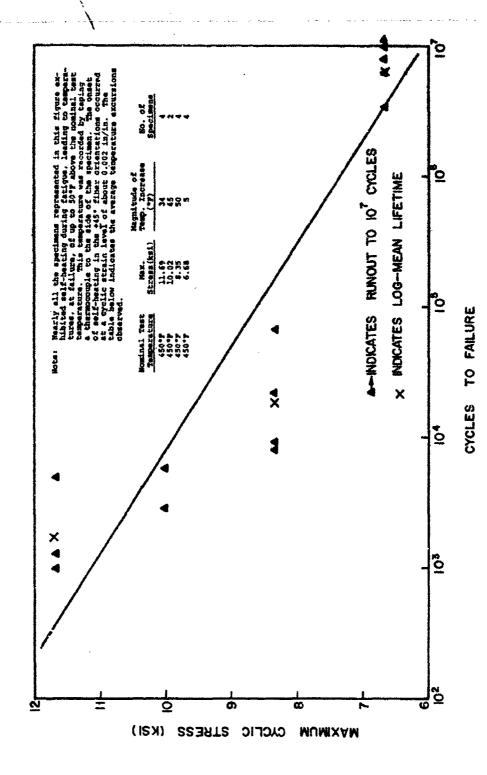
Tensile-Tensile Fatigue Behavior of Bidirectional AS/4397 Composite Laminates at -67°F: +45° Fiber Orientation, R=0.10, 30 Hz. Figure 79.



Tensile-Tensile Fatigue Behavior of Bidirectional AS/4397 Composite Laminates at 72°F: ±45° Fiber Orientation, R=0.10, 39 Hz. Figure 80.



Tensile-Tensile Fatigue Behavior of Bidirectional AS/4397 Composite Laminates at 350°F: +45° Fiber Orientation, R=0.10, 30 Hz. Figure 81.



Tensile-Tensile Fatigue Behavior of Bidirectional AS/4397 Composite Laminates at 450°F: +45° Fiber Orientation, R=0.10, 30 Hz. Figure 82.

TABLE 44

CREEP PROPERTIES OF AS/4397 COMPOSITE LAMINATES

		S	MPOSITE	MATERL	COMPOSITE MATERIAL PROPERTIES	52			
Material System Fiber - AS	yetem - AS/4397 	Prepreg by . Hercules	rcuies				0	aphite/P	Graphite/Polyimide
Maximum Tempe Resin Content -	Temperature Rating - 450°F tent - 28.18 by wt.		Laminate Average	Laminate Sp. Gr 1.57 Average Ply Thickness - No. of pensis from which	. 1.57	Laminate Sp. Gr 1.57 Average Ply Thickness - 0.0057 inch No of manie from which specimens were tasted in the section	;		
Void Content			Thicknes	s of each	Thickness of each type specimens	en: 0° 6 ply	n V		
Test Meth	Test Method - Straight-sided tension		ce - Des	Reference - Design Guide		+45° 8 ply			
				CREEP	Q.				
Temperature	Fiber Orlentation:	00	006	-45 ₀	Temperature	Fiber Orlentation:	90	906	+450
3029-	Stress Level (ksi) Creep Strain, 500 hr (µ in/in) No. of Specimens Residual Strength (ksi) No. of Specimens				350 ⁰ F	Stress Level (ket) Creep Strein, 500 hr(µ in/in) No. of Specimens Residual Strength (ket) No. of Specimens	131.2 240 21 189.9	2.67 1359 1.13	8.31.5 3.18.04
	Stress Level (ksi) Gresp Strain, 500 hr (µ in/in) No. of Specimens Residual Strength (ksi) No. of Specimens		-			Strees Level (kei) Creep Strain, 500 hr(µ in/in) No. of Specimens Residual Strength (kei) No. of Specimens	112.5 362 308.3	2,29 1235 23 3.54	4.98 5076 3 18.12
	Stress Level (ksi) Greep Strain, 500 hr(µ in/in) No. of Specimenc Residual Strongth (ksi) No. of Specimons					Stress Level (kai) Creep Strain, 500 hr(u in/in) No. of Specimens Residual Strength (kei) No. of Specimens	93.7 *0 3 209.7	1.90 662 23 3.85	3.32 2081 3
72 ⁰ F	Stress Level (ksi) Creep Strain, 500 hr(µ in/in) No. of Specimens Residual Strength (ksi) No. of Specimens	182.1 57 3 213.7	4.83 610 1 5.06	13.10 2020 3 18.58	₹500%	Stress Level (kai) Creep Strain, 509 hr (a in/in) No. of Specimens Residual Strength (kai) No. of Specimens	14425 1 0	1.48	8.35 5 3 17.97
	Stress Level (ksi) Creep Strain, 500 hr (µ in/in) No. of Specimens Residual Strength (ksi) No. of Specimens	161.9 12 3 203.0	4,29 633 3. 5,14	11.23 1380 3 18.74		Stress Level (kai) Creep Strain, 500 hr(µ in/in) No. of Specimens Residual Strength (kai) No. of Specimens	123.9 5371 23 193.1	# 1 + o	5.01 3 17.73
	Steeps Level (kal) Creep Strain, 500 he [u in/in) No. of Specimens Residual Strength (kai) No. of Specimens	14f. 6 9 3 218.4	3.76 469 3 4.85	9.36 765 3 38.10		Stress Level (kei) Greep Strain, 500 hr(µ in/in) No. of Specimens Residual Strength (kei) No. of Specimens	103.2 4299 2 218.0	0.39	1.63 2 2 16 ₁ 87
Matee: 111 .re	Rotes: 21 yelles represent existments				***************************************				,

values represent arithmetic averages. All residual attengths determined by tensile test at 72°F.

The specimens failed on loading or during test.

Three specimens failed on loading or during test.

One specimen failed on loading or during test.

Four specimen failed on loading or during test.

Specimens indeed on loading or during test.

Specimens underwent so may be train that surface plien aracked, oreating electrical discontinuities in strain gages serly in test.

Five specimens failed on loading. Motes: All

and the second s

Constitution of the second of

153

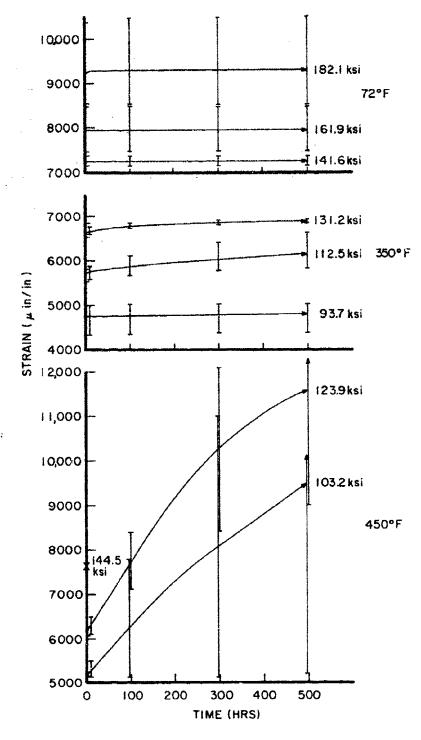


Figure 83. Tensile Creep Behavior of Unidirectional AS/4397 Composite Laminates: 0° Fiber Orientation.

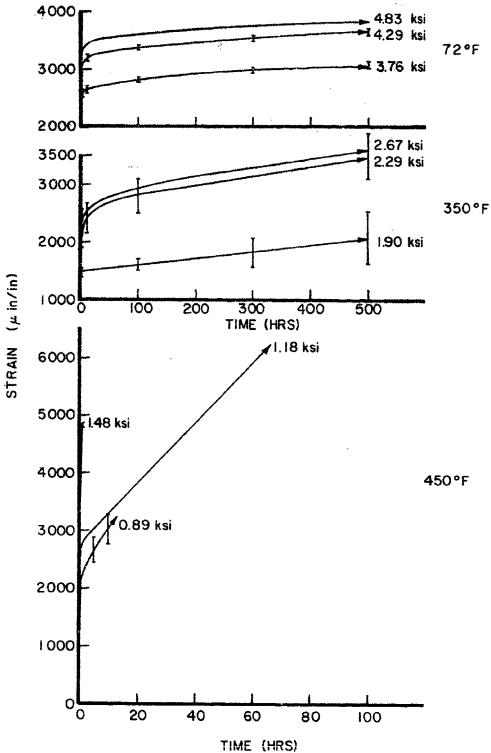
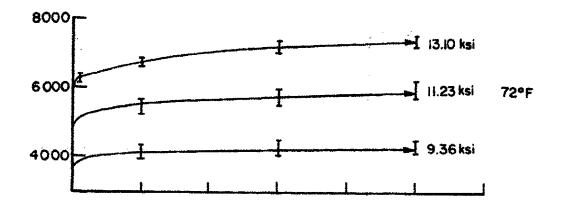


Figure 84. Tensile Creep Behavior of Unidirectional AS/4397 Composite Laminates: 90° Fiber Orientation.



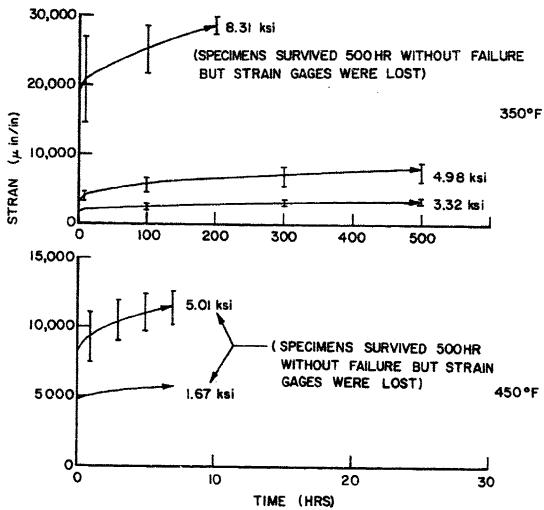


Figure 85. Tensile Creep Behavior of Bidirectional $\Delta S/4397$ Composite Laminates: $\pm 45^{\circ}$ Fiber Orientation.

STRESS RUPTURE PROPERTIES OF AS/4397 COMPOSITE LAMINATES

		8	MPOSITE	MATERL	COMPOSITE MATERIAL PROPERTIES	53			
Material S	yetem - A8/4397	Prepreg by - Heroules	roules				Grap	Graphite/Polyimide	failde
Maximum Teres and Resin Content Fiber Content Void Centent	merature Reling 1 - 28.01 by wt. 1 - 64.01 by vol.		Laminate Average I No. of par	Laminate Sp. Gr 1.57 Average Ply Thickness - No. of panels from which Thickness of each type	Laminate Sp. Gr 1.57 Average Ply Thickness - 0.0057 inch No. of panels from which specimens wo Thickness of each type specimens	₩ >	4		
Test Metho	Test Mathod - Straight-sided tension	Refer	ence - D	Reference - Design Guide	đe	465 6 ply			
			8.	STRESS RUPTURE	PTURE				
Temperature	Fiber Orientation:	00	006	<u>±</u> 450	Temperature	Fiber Orientations	8	906	+450
£,49-	Stress Level (kel) Time to Fallure (hrs) No. of Specimens Residual Strength (kel) No. of Specimens Stress Lavel (kel) Time to Fallure (hrs) No. of Specimens Residual Strength (kel) No. of Specimens				350 GE	Stress Level (kel) Time to Fallure (krs) No. of Specimens Residual Strength (kel) No. of Specimens Stress Level (kel) Time to Fallure (krs) No. of Specimens Residual Strength (kel) No. of Specimens	131.2 270-1 169-9 112.5 530- 208.3	2,678 4,13 1,13 1,13 2,13 2,13 3,15 4,13	24 8
72°F	Stress Level (ks!) Time to Failure (hrs) No. of Specimens Residual Strength (ks!) No. of Specimens Stress Level (ks!) Time to Failure (hrs) No. of Specimens Residual Strength (ks!) No. of Specimens	162.1 511+ 213.7 3 3 161.9 522+ 3 203.0	4.83 6.5 5.06 7.29 5.04 5.04 5.14	13, 10 5004 3 18.58 3 3 11,23 5004 3	480 OF	Stross Level (kel) Time to Fallure fire) No. of Specimens Residual Streagth (kel) No. of Specimens Stress Level (kel) Time to Fallure (hrs) No. of Specimies Residual Strength (kel)	20.00		

All values represent arithmetic averages. Residual strengths determined by tensile test at 72°7.

1. Two specimens failed on loading or during test.

2. Three specimens failed on loading or during test.

3. One specimen failed on loading or during test.

4. Five specimens failed on loading. Notes:

TABLE 46

THERMOPHYSICAL PROPERTIES OF AS/4397 COMPOSITE LAMINATES

	COMPOSITE MA	TERIAL PROPER	Ties			
Material System - AS/439* Fiber - AS Matri Maximum Temperature Ratir Resin Content - 30.3% by Fiber Content - 61.9% by Void Content - 40% Thickness of each type specific states of each	ix - 4397 ng - 450°F wt. vol.	Average Ply T No. of panels were tested	Gt1.55 hickness -0. from which in this tabl	specimens		
T		L PROPERTIES:		1		
	-67°F	12-8	350°P	450°F		
Thermal Expansion $a_{\mathbf{X}}(\mu \mathrm{in}/\mathrm{in}^{-2}\mathbf{P})$	± 0	÷o	∸ 0	40		
ay(pin/in-°F)	14.1	15.7	19.3	26.2		
No. of Specimens per direction	3	9	5	3		
Specific Heat Cp (btu/lb°F)	0.14	0.19	0.31	0.33		
No. of Specimens	1	1	. 1	1		
Thermal Conductivity k ₂ (btu-ft/ft ² -hr-°F)	0.33	0.38	0.47	0.51		
No. of Specimens	4 4 6 3					
Glass Transition Temp. Dry (*F) Wet (*F)	472°F 264°F					
THERMOPHYSICAL PROPERTIES: +45°						
Thermal Expansion $a_{\mathbf{X}}(\min/\inf^{-\mathbf{Y}})$	0.35	0.53	3.70	4.51		
No. of Specimens per direction	4	5	2	2		
Thermal Conductivity k ₂ (btu-ft/ft ² -hr-°F)		0.33	0.39	1		
No. of Specimens	~=	5	5			

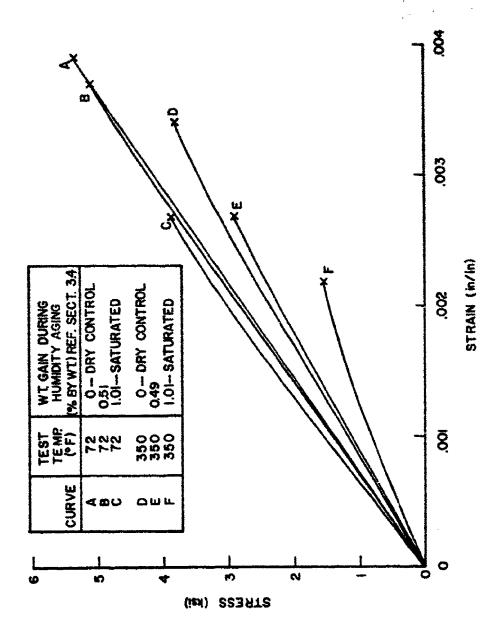
NOTE: On unidirectionally reinforced specimens, the x-direction is along the fiber axis, the y-direction is across the fiber axis, and the z-direction is through the thickness. On +45° bidirectionally reinforced specimens, the x and y directions are identical and oriented at 45° to either fiber direction, while the z-direction is through the thickness.

1. The 20-ply specimen being used for conductivity measurements delaminated when heated above 350°F so no accurate data were obtained at 450°F.

TABLE 47

TENSILE PROPERTIES OF AS/4397 COMPOSITE LAMINATES AFTER HUMIDITY AGING

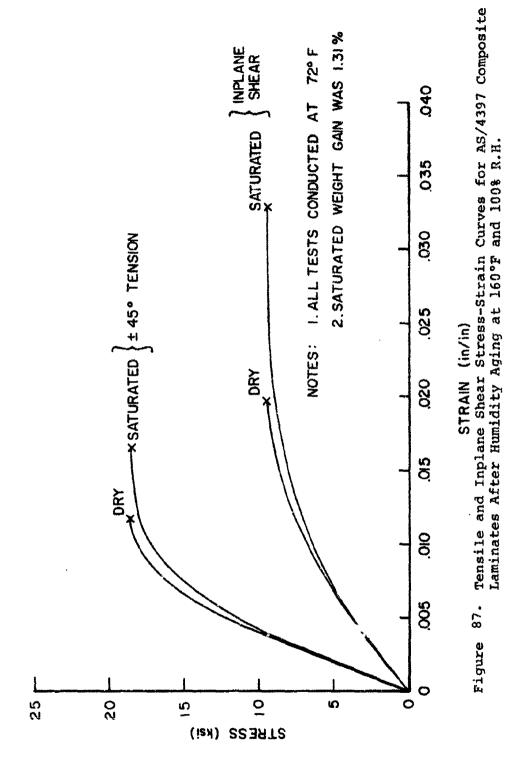
СОМ	Posite material	Proper ties				
Material System - AS/4397 Fiber - AS Matrix - 4397 Maximum Rated Temperature - 450°F Resin Content - 27.5°t by wt. Fiber Content - 64.7°t by vol. Void Content - 40°t	L. An N. A. Ti	o. of panels from wore tested in thi ging Conditions - sickness of each	- 1.58 mess - 0,00 5 6 i which specimen stable - 11 .160 °F, 100 t R. iype specimen:			
	· · · · · · · · · · · · · · · · · · ·	90 ⁰ -15 plies; <u>+</u> 45	o-8 plies			
	TENSION: 90	ō				
	72°F	350 °F	72°F	350°F		
Exposure Time (hrs) Weight Gain (% of orig. dry wt.) Sind. Dev. (%) No. of Specimens	21.5 0.51 0.03 5	21.5 0.49 0.03 5	1320 1.61 .04 5	1320 1.01 .03 5		
Fy (ksi) Sind. Dev. (ksi) Range (ksi) No. of Specimens	5.13 0.41 4.57-5.61 5	2.92 0.27 2.70-3.38	3.91 0.40 3.47-4.45 5	1.55 0.27 1.19-1.91 5		
Ftpl (ksi) Stnd, Dev. No. of Specimens	3.20 0.75 · 5	1.52 0.36 5	1.99 0.32 5	0.84 0.30 5		
Et (Msi) Sind. Dev. No. of Specimens tu	1.40 0.04 5	1.11 0.06 .5	1.54 0.09 5	0, 82 0, 06 5		
synd (µ in/in) Stnd. Dev. No. of Specimens Test Method	3700 300 5	2706 300 5 Straight	2700 300 5 -sided tension	2200 200 5		
Reference	Design Guide					
	TENSION: 1450					
Exposure Time (hrs) Weight Gain (% of orig. dry wt.) Stnd. Dev. (%) No. of Specimens			984 1.31 0.13 5			
rtu (ksi) Stnd. Dev. (ksi) Range (ksi) No. of Specimens			18.66 0.51 18.05-19.29-			
tpl F _X (ksi) Sind. Dev. No. of Specimens	ACTIVATION OF THE PROPERTY OF		6.83 1.48 5			
E _x (Msi) Stnd. Dev. No. of Specimens			2.61 0.08 5			
ε ^{tu} (μ in/in) Stad, Dev. No. of Specimens			16,600 2540 5			
Test Method Reference	1	Straight-s Design	sided tension Guide			



Tensile Stress-Strain for AS/4397 Composite Laminates After Humidity Aging at 160°F and 100% R.H.: 90° Fiber Orientation. Figure 86.

TABLE 48
SHEAR PROPERTIES OF AS/4397 COMPOSITE LAMINATES AFTER HUMIDITY AGING

сомро	SITE MATERIAL I	PROPERILES			
Material System - AS/4397 Fiber - AS Matrix - 4397		Prepreg by - Hercules Graphite/Polyimi Laminate Sp. Gr 1.58 Average Ply Thickness - 0.0058 inch No. of panels from which specimens were tested in this table - 5 Aging Conditions - 160°F, 100% R.H. Thickness of each type specimen: Inplane shear-8 plies; Interlaminat shear-14 pli			
Maximum Rated Temperature - 450°F Resin Content - 28.1% by wt. Fiber Content - 64.5% by vcl. Void Content - 40%	No. o wer Aging Thick				
	INPLANE SHEAR				
Test Temperature	72°F	35 8 F	72 ⁰ F	350°F	
Exposure Time (hrs)			984		
Weight Gain (% of orig. dry wt.)			1.31		
Sind. Dev. (%) No. of Specimens			0.13 5	-	
su For (ksi)			9.33	1	
F _{Ky} (ksi) Stnd. Dev. (ksi)			0.26		
Range (ksi)			9.03-9.64		
No. of Specimens			5		
G. (Msi)			0.75		
G _{Ky} (Msi) Stnd. Dev.			0.01	}	
No. of Specimens			5	1	
Yest Method		+450 straight-sided tension			
Reference		7. Comp. Mtls. [V6, p252 & V7, p124]			
I	NTERLAMINAR SH	EAR			
Expocure Time (hrs)	44	44	840	840	
Weight Gain (% of orig. dry wt.)	0.63	0.59	1.45	1.28	
Stnd. Dev. (%)	0.04	0,10	0.81	0.37	
No. of Specimens	,	,	5	,	
Fisu (ksi)	16.37	11.62	12.13	6, 49	
Stnd. Dev. (ksi)	1.94	8, 70	1.62	0.81	
Range (ksi) No. of Specimens	13.45-18.35	11.12-12.62	9, 35-13, 45 5	5.75-7.2	
Test Method		Short Beam Shear			
Reference	Design Guide - Jan., 1971				



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Figure 87.

4.4 T300/F178

Tables 49-60 present the data generated for this graphite/polyimide composite system. Figures 88-105 illustrate the stress-strain, fatigue, and creep behavior of the material, as well as the effect of humidity aging upon the composite material. One item which caused some concern during the characterization of this material relates to the tensile strengths.

The values reported in Table 51 appear low in comparison with those appearing in the Hexcel literature. After considerable review and rechecking of our results, however, including the specimen tabbing procedures (which are of increased importance with brittle materials), it has been concluded that the values in Table 51 for 0° tension are in fact realistic. Data corroborating this is reported by Jones[7] in a SAMPE paper (where the F178 was still designated HX580) and also by a private communication with Hexcel in which it was mentioned that the higher values, reported in their literature, may well have been obtained with lower temperature postcures (the use of higher temperature postcures to increase the high temperature capabilities of the resin result in a sacrifice of room temperature properties. The F178 resin seems to be a rather brittle matrix system, as attested to both by Jones [7] and by the observation during this program that audible cracking occurs much much earlier in a 0° tension test than for any of the other materials evaluated in this program. Because of this brittle nature, some investigators utilize a sandwich beam specimen rather than a coupon to generate tensile properties. The values so generated are generally higher than those obtained with coupons.

The strength and ultimate strain values for the 90° tension at 72°F also seem low in comparison with similar data from other sources [7,8]. No explanation of this discrepancy can be made. The elevated temperature results reported in Table 51 do not disagree with similar data from these same sources.

TABLE 49 PROCESSING CONDITIONS FOR T300/F178 COMPOSITE LAMINATES

Composite Processing Information

Material System - T300/F178

Graphite/Polyimide T300/F178

Fiber - T300 Matrix - F178 Maximum Rated Temperature - 450°F

Prepreg by - Hexcel

Laminate Processing Schedule

Layup Procedure: Prepreg warmed to R.T. in closed wrapper. Prepreg removed from package and plies cut to desired size using razor blade. Plies stacked in desired sequence (release paper removed from each ply). Stack placed in autoclave on sheet of nonporous teflon and surrounded by cork dam to restrict fiber flow. Sheet of porous teflon placed on top of stack and one ply of bleeder cloth (style 181 glass) per four plies of prepreg placed on top of this. A layer of porous teflon is placed atop the bleeder cloth and another layer of 181 glass over this to act as a vent. This entire stack is then covered by the silicone rubber bladder.

Cure Schedule: A low vacuum (2-3 psi) is applied and the temperature is then raised to 270°F at 3-4°F/min., where it is held for 30 minutes. At this time, a full vacuum is drawn and a pressure of 85 psi applied above the bladder. The temperature is then raised at 3-4°F/min. to 350°F, where it is held for 2 hours. The panel is cooled under pressure to below 200°F before removal.

Postcure Schedule: After trimming of flash, the panels were placed, unrestrained, in an oven and heated to 400°F at a rate of 3-4°F/min. After a 4-hour hold at 400°F, the temperature is again raised at 3-4°F/min. to 475°F, where it is held for 10 hours. The panel is cooled to R. T. at 3-4°F/min.

TABLE 50 PREPREG AND COMPOSITE PHYSICAL PROPERTIES: T300/F178

	Physical Pro	perty Inforn	nation	
Material System - T300/F: Fiber - T300 Matrix			Graphite/Polyin	nide
Maximum Rated Temperate	are - 450°F	Prep	oreg by - Hexcel	
Prep	reg Physical	Properties		
(Property)	(Stnd. Dev.)	(Range)	(Test Method)	(Ref.)
Volatile Content-N.A.1	distribus			
Resin Content- 41.7% Resin Flow- (Note 2 belo No. of Rolls Involved- 3		4T • T - 45 • 7 4	Hexcel, undesigna	.eea
	_			
No. of Batches Involved	<u> </u>			
	inate Physica	ıl Properties	3	
Lam	inate Physica	-	3 (Test Method)	(Ref.)
Lam	inate Physica	-		(Ref.)
Lam No. of Panels- 47	inate Physica	(Range)		(Ref.)
Lam	inate Physica (Stnd. Dev.)	(Range)	(Test Method) Grid	(Ref.)
Lam No. of Panels - 47 Fiber Content-59.5% by vol.	inate Physica (Stnd. Dev.)	(Range) 52-67 25.4-37.4	(Test Method) Grid	(Ref.)
No. of Panels - 47 Fiber Content-59.5% by vol. Resin Content-31.6% by wt.	inate Physica (Stnd. Dev.) 3.78 2.78	(Range) 52-67 25.4-37.4	(Test Method) Grid Point	(Ref.)
No. of Panels - 47 Fiber Content-59.5% by vol. Resin Content-31.6% by wt. Void Content- 0.2% Laminate Sp. Gr 1.58 Fiber Sp. Gr 1.70	inate Physica (Stnd. Dev.) 3.78 2.78 0.03 As report	(Range) 52-67 25.4-37.4 0-1.0 ted by manuf	(Test Method) Grid Point Count D792 facturer.	
No. of Panels - 47 Fiber Content-59.5% by vol. Resin Content-31.6% by wt. Void Content- 0.2% Laminate Sp. Gr 1.58	inate Physica (Stnd. Dev.) 3.78 2.78 0.03 As report	(Range) 52-67 25.4-37.4 0-1.0 ted by manuf	(Test Method) Grid Point Count D792 facturer.	

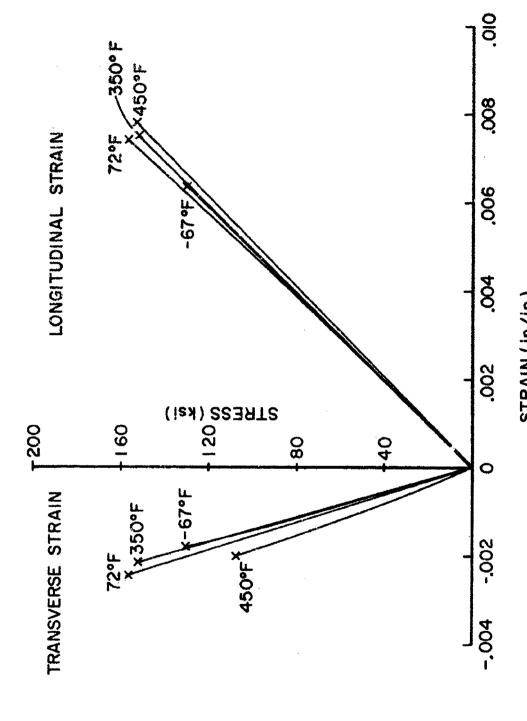
Notes:

- This prepreg contains no volatiles. Flow was not measured. 1.
- 2.
- The properties reported here represent averages for all panels of this material used throughout the program.

TABLE 51
TENSILE PROPERTIES OF T300/F178
COMPOSITE LAMINATES

COMPOSITE MATERIAL PROPERTIES Material System - T300/P178 Prepreg by - Hexcel Graphite/Polyimids Fiber - T300 Matrix - F178 Laminate Sp. Gr 1.57 Maximum Rated Temperature - 450°P Resin Content - Fiber Content - Void Content - Void Content - Thickness of each type spectmens 0°-6 ply; 30°-15 ply								
	TENS	ON: 90						
	67°F	72° F	350°y	450 0g				
F _x (ksi)	129.9	156.7	152.2	152, 9				
sind. dev. (ksi) Range (ksi) No. of Specimens	31.4	21, 0. 134, 2-194, 3 9	19.9 134.9-177.1 5	20, 4 132, 4-177, 8 5				
ptpl (kr')	129.9	156.7	152.2	152.9				
stad. dev. No. of Specimens	31.4 5	21. Q '9	19.9 S	20, 4 5				
Ek (Mei)	20.22	20.25	19.56	19.32				
stad. day. No. of Specimens	0.97 5	3, 82 9	0,61 5	1.16 5				
eina (sin/in)	6400	7500	7500	7800				
stad. dev. No. of Specimens	1500 5	1200 9	800 5	1000 4				
t "my stnd, dev. No. of Specimens	0.31 0.03 5	0.33 0.03 9	0, 28 0, 02 4	0.35 0.01 3				
Test Method Reference	Straight-mided tenmion Design Guide							
	TENS	ION: 90°						
r'y (kei)	3.28	3.82	2.97	2.14				
stnd. dev. (ksi) Range (ksi) No. of Specimens	0,83 2.03-4.13 5	0.83 0.40 0.83 0.64 2.03-4.13 3.22-4.35 2.03-4.16 1.10-2.70						
Fy (kei)	2.85	3, 33	2.95	1.35				
stnd. dev. No. of Specimens	0.47 5	0.71 7	0,53	0.50 5				
E's (Mai)	1.61	1,50	1.15	0.97				
stad. dev. No. of Specimens	0.10 5	0. 08 7	0.10 5	0.15 5				
atu (pin/in)	2100	2600	3000	2600				
stnd. dev. No. of Specimens	500 5	300 7	900	1000 5				
yx yx	0.0251	0.0241	0.016%	0-018 ¹				
Test Method Reference		Straight-si Design	ded tension Guide					

^{1.} Computed using elastic moduli and longitudinal Poisson's ratio.



STRAIN (in/in)
Tensile Stress-Strain Curves for Unidirectional T300/F178 Composite
Laminates: 0° Fiber Orientation. Figure 88.

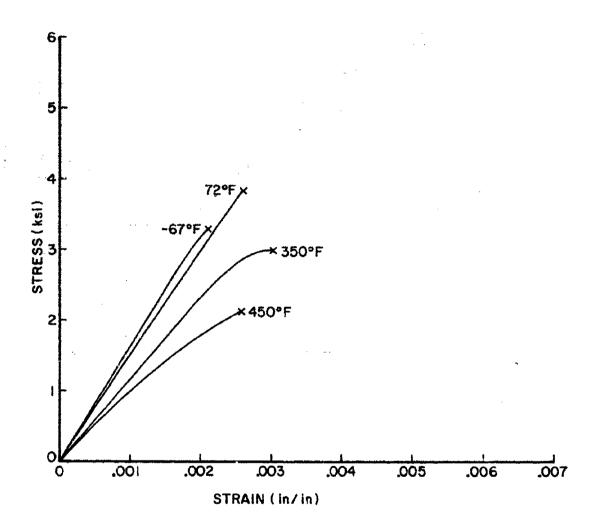
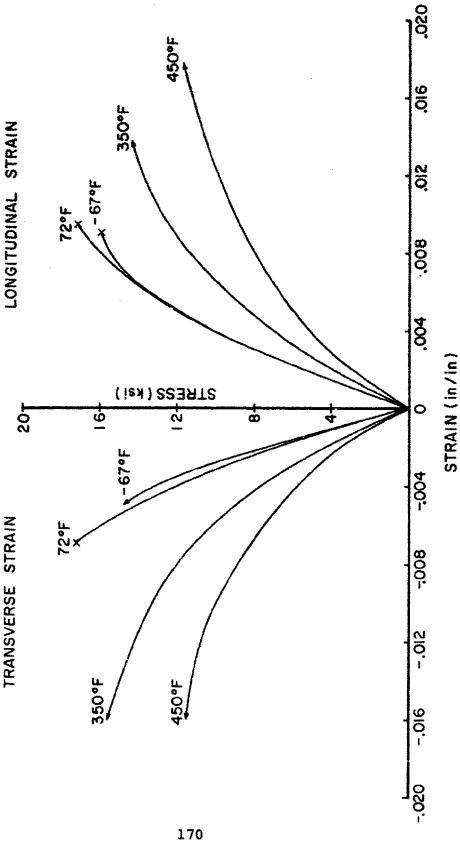


Figure 89. Tensile Stress-Strain Curves for Unidirectional T300/F178 Composite Laminates: 90° Fiber Orientation.

TABLE 52
TENSILE PROPERTIES OF T300/F178
COMPOSITE LAMINATES

COME	OSITE MATE	RIAL PROPE	RTIES	
Material System - T Fiber - T300 Maximum Rafed Ter Resin Content - Fiber Content - Vold Content -	Matrix - Fl nperature - 45	.78 Lamii iO°F Avera No. o mens	nate Sp. Gr ge Ply Thick E panels fro were tested	N.A. ness - 0.0058 inch m which speci- in this table-5 timens - 15 ply
	-67°F	72°F	350 °F	450 °F
tu Fx (ksi) stnd. dev. (ksi) Range (ksi) No. of Specimens Fx (ksi) stnd. dev. (ksi) No. of Specimens Et (Msi) x stnd. dev. Pio. of Specimens	15.82 1.02 14.30-17.14 5 9.02 2.31 5 2.59 0.20 5	17.17 1.19 15.44-18.24 5 7.28 0.76 5 2.66 0.13	14.61 0.55 14.21-15.52 5 4.71 0.23 5 1.94 0.06 5	12.18 0.36 11.81-12.73 5 3.03 0.36 5 1.49 0.07
tu (pin/in) stnd. dev. No. of Specimens t	9,000 1,100 5 0.66 0.07 5	9,400 1,500 5 0.76 0.03 5 Straight-sid		18,000+ ¹ 5 0.79 0.08 5

Specimens elongated so much that surface plies cracked, creating electrical discontinuities in strain gages.



Tensile Stress-Strain Curves for Bidirectional T300/F178 Composite Laminates: +45° Fiber Orientation. Figure 90.

TABLE 53

COMPRESSIVE PROPERTIES OF F178 COMPOSITE LAMINATES

	CO	MPOSITE M	ATERIAL PE	OPERTIES				
Material Sy	stem - P178	ئىقىد راكىتىن بىرى دىنىكى د		G	aphite/polyimide			
Fiber - #30	ii Mai	trix - F178		repreg by - He	xcel			
	sted Temper	ature - 450	or T	aminate Sp. C	r M.A.			
Resin Conte			A	verage Ply Th	ickness -0.0054 in.			
Fiber Conte			N	o. of panels in	om which specimens			
Aora Copter	x •		~	ere tested in t	his table - 1			
			3	hickness of 20 ply	specimens:			
 		COM	PRESSION :					
		-67°F	72 ⁰ F	350°F	450F			
-ca	*	 						
*	(ksi)	200.0	180.0	120.0	137.4			
atnd, dev. Range	(kei) (kei)	9.6	12.0 167.1-195.6	15.3	27.9			
No. of Specime		5	5	106.1-137.7	112.7-180.5 5			
_	· ······	1		1				
z z cby	(ksi)	94.91	69.5 ¹	54.7	105.1			
stnd. dev.		21.3	21.2	13.6	33.3			
No. of Specime	ens.	5	5	5	5			
s.	(Mai)	13.1	18.2	20.5	17.9			
stad. dev.		1.3	0.7	1.1	0.8			
No. of Specime	ens	5	5	5	5			
			_					
cu	(u in/in)	10,5002	10 4002					
r ₌	de mieni		10,400 ²	6,900	8,100			
stad. dev.		3,200	4,200	1,200	2,000			
No. of Specime	es.	5 1 5 1 5 1 5						
L		Celanese Compression Coumon & Past Pivbura						
Test Mothod Reference		Celanese Compression Coupon & Test Fixture						
Kerarence		APIL-T9-72-205, Pt. 1						
		COMPRESSION: 90°						
7,	(kai)	I						
etnd. dev.	(ksi)	1 _						
Range	(ksi)	Ho compression tests were conducted						
No. of Specime	2.0	on T300/F178 composite laminates with the 90° fiber orientation.						
_cpl	d 23	with the by liber orientation.						
F _y	(kai)	1						
stad. dev.		1						
No. of Specim	0 25	1						
ے		1						
Ey	(Mat)	1						
stnd. dev.		I						
No. of Specim	ens							
e co	(u in/in)	1						
stad, dev.		1						
No. of Specime	ens	I						
		1						
Test Method		I						
Reference		I						

- Hotes: 1. Proportional limits reported here represent first deviation from linearity. In majority of cases, this deviation was due, apparently, to buckling.
 - Ultimate strain values represent maximum observed strain rather than ultimate values. Buckling was observed in majority of tests.

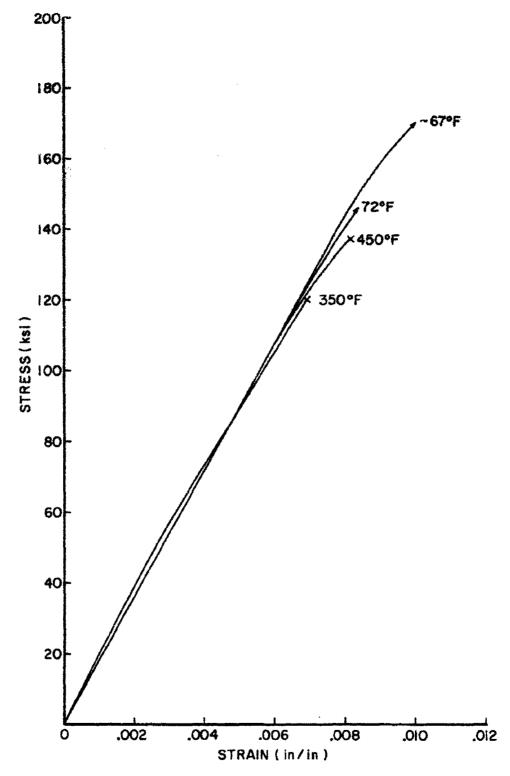


Figure 91. Compressive Stress-Strain Curves for Unidirectional T300/F178 Composite Laminates: 0° Fiber Orientation.

TABLE 54
FLEXURAL PROPERTIES OF F178 COMPOSITE LAMINATES

CON	POSITE MATE	RIAL PROP	FRTIE				
Material System - F		······································					
Fiber - T300	Matrix - F17	Prepreg by -	Hexcer [Graphite/Polyimide			
Maximum Rated Ten	•		nate Sp. Gr.	- 1 56			
Resin Content -	•			ness - 0.0052 in.			
Fiber Content -		No. o	f panels from	which specimens			
Void Content ~		were	tested in this	table - 2			
				ype specimen:			
		00-14	plics; 90°-14	plies			
	FLEX	URE: 00					
4	-67°F	72°F	350°F	450 °F			
fu F _x ; (ksi)	200.9	204.0	179.1	147. 4			
stnd. dev. (ksi)	9.9	9.5	11.8	7.9			
Range (ksi)	188.0-214.7	•	163.3-195.8				
No. of Specimens	5	5	5	5			
£							
E _x (Msi)	17.06	16.89	18.43	18.26			
sind, dev.	0.87	1.21	0.92	1.04			
No. of Specimens	5	5	5	5			
Test Method			lexure				
Reference		Jan.,	r Guide 1971				
	FLEX						
Fu (ksi)	9.36 8.12 4.91 4.14						
stud. dev. (ksi)	1.40	1.55					
Range (ksi)	7.91-11.42	6.55-10.35	0.87 3.77-5.87	0.33			
No. of Specimens	5	5	. <i>3.11-3.01</i> 5	3.86+4.70 5			
_ t			J				
Ey (Msi)	1.50						
stnd. dev.	0.08	0.10	0.09	0, 15			
No. of Specimens	5	5	5	5			
		•		•			
Test Method		4 - 0					
Reference		4 pt. fl. Design		I			
		Jan.,					

TABLE 55

SHEAR PROPERTIES OF T300/F178 COMPOSITE LAMINATES

COM	POSITE MATI	ERIAL PROPI	ERTIES			
Material System - T30	•		Annual Control of the	ite/polyimide		
	Matrix - F178		by - Hexcel	,		
Maximum Rated Temp	erature -450°		e Sp. GrN.			
Resin Content - Fiber Content -			•	s - 0.0057 in.		
Void Content -		•	sness from wheels to the state of the state	ich specimens		
Thickness of each t	voe specimen		hear - 15 p			
		Interlami	nar shear -			
	INPLA	VE SHEAR				
	-67°F	72°F	350°F	450°F		
T ^u _{ky} (ksi)	7.91	1.59	7.30	6.09		
stnd. dev. (ksi)	0.51	0.60	0.27	0.18		
No. of Specimens	5	5	5	5		
G _{xy} (Msi)	0.76	0.72	0.52	0.41		
stnd. dev. (Msi)	80.0	0.05	0.02	0.03		
No. of Specimens	5	t45° straight-sided tension				
Test Method	+45°	5° straight-sided tension				
Reference	J. Comp.	5° straight-sided tension p. Mtls. [V.6, p.252, and V.7, p.124]				
INTER LAMINAR SHEAR						
pisu (ksi)						
F ^{1Su} (ksi)	15.9	14.8	10.2	8.0		
Stnd. Dev. (ksi)	1.3	0.9	0.3	0.4		
Range (ksi)	14.8-17.7	14.1-16.1	9.9-10.6	7.4-8.3		
No. of Specimens	5	5	5	5		
Test Method		Short Beam	Shear, S/D=	4		
Reference			e - Jan., 1			

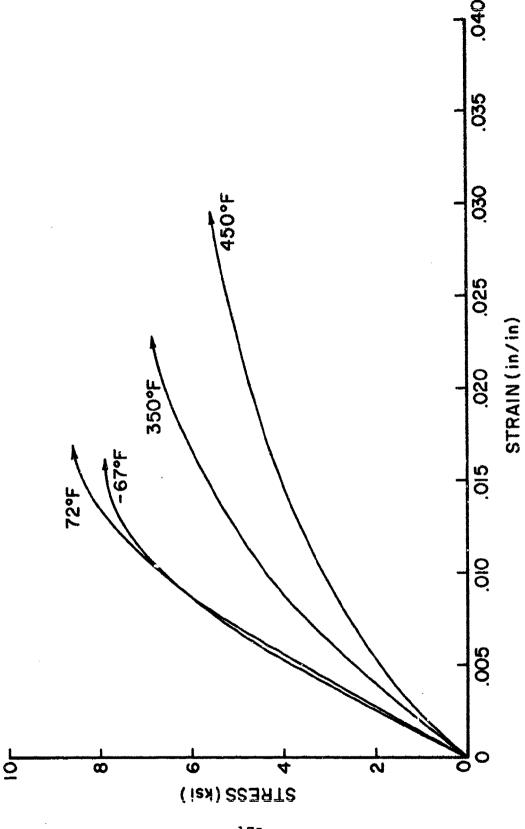


Figure 92. Inplane Shear Stress-Strain Curves for T300/F178 Composite Laminates.

FATIGUE PROPERTIES OF T300/F178 COMPOSITE LAMINATES

Material System	- T300/F178	epreg by	Prepreg by - Hexcel	e1	Nexce1			Graphit	Graphite/Polyimide
Fiber - T300 Maximum Temperi Resin Conton - 34 Fiber Content - 55 Void Content - 4	Matrix - iperature Rating 34.9% by wt 55.5% by vol 40%	8 1.	JŽŽĘ	aminate Sp. erage Ply: s. of panels	Laminate Sp. Gr 1.58 Average Ply Thickness - 0.0055 inch No. of panels from which specimens wer Thickness of each type of specimens	ere tested iv	tille table = 27 6 ply 15 ply		
Test Method -	. Straight-sided tension	lon	2	TENSILE	Reference - Design Guide TENSILE FATIGUE, R.O.	+45°	Ard		
Ternoarature	Fiber Orientation:	00	006	+450	Temperatura	Fiber Orientation:	00	006	+45°
- و نان ک					350 F	Max. Stress (ket) Lifetime (cycles) No. of Specimens Rasidual Strength (ket) Max. Stress (kst) Lifetime (cycles) No. of Specimens Residual Strength (ket) No. of Specimens Max. Stress (ket) Lifetime (cycles) No. of Specimens Residual Strength (ket) No. of Specimens Residual Strength (ket)	15,940 0 114.2 1.5x105 0 0 106.6 3.0x106 150.6	1,78 4 5.96 1 1.63 1040+2 5.46 1 1.49 177,640	10.95 7490 4 4 0 0 10.22 67,520 0 0 9,49
. 45° F	etima (cycles) of Specimens idual Strength (kst) of Specimens c. Streng (kst) etime (cycles) of Specimens of Specimens xx, Streng (kst) of Specimens xy, of Specimens xy, of Specimens etima (cycles) of Specimens xy, of Specimens of Specimens xy, of Specimens of Specimens	133.2 14,325 18,9 18,9 125.4 125.4 175.1 1 109.7 9.9x10 9.9x10	3.06 2910 4.64 13,730 13,730 1,31 740,123	12.02 36,170 4 4 11.16 10.30 10.30 2.58x106 16.53	450°F	Max. Stress (kei) Lifetime (cycles) No. of Specimens Residual Strength (kei) No. of Specimens Max. Stress (kai) Lifetime (cycles) No. of Specimens Rasidual Strength (kei) No. of Specimens Max. Stress (kai) Lifetime (cycles) No. of Specimens Residual Strength (kei) No. of Specimens Residual Strength (kei) No. of Specimens	114.7 134.500 4 107.0 944.470 9 44.470 0 5.4x106	1.50 75,4824 0 1.29 4363 5 5 0 0 0 1.07 89,500+ 4,500+ 1.504	9.75 4550 4 4 6 9.14 56,210 0 1.4×106

Patigue lifetimes are log-mean values. All residual strengths determined by tensils lest at 72°F.

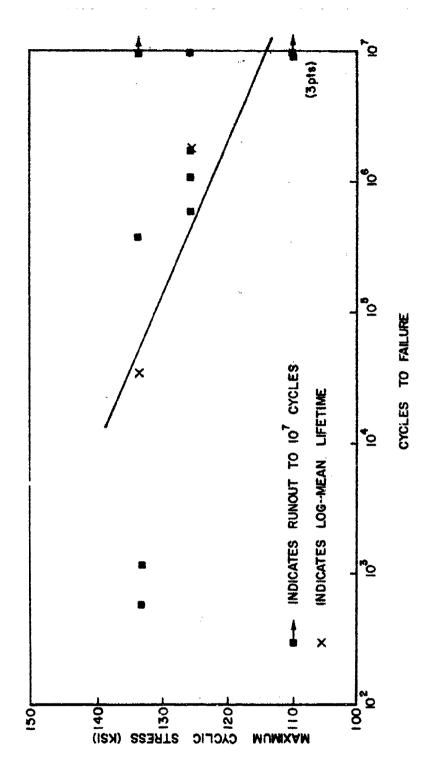
1. Two specimens falled during first cycls.

2. Two specimens falled during first cycls and one slipped in gripn after 602,000 cycles and was inadvertantly broken before cycling could resume.

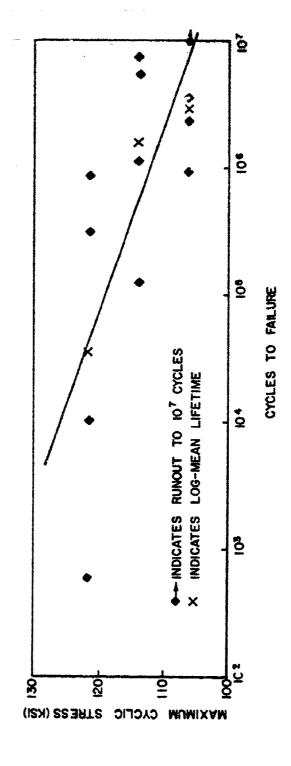
3. Three specimens falled during first cycle.

4. One specimen falled during first cycle.

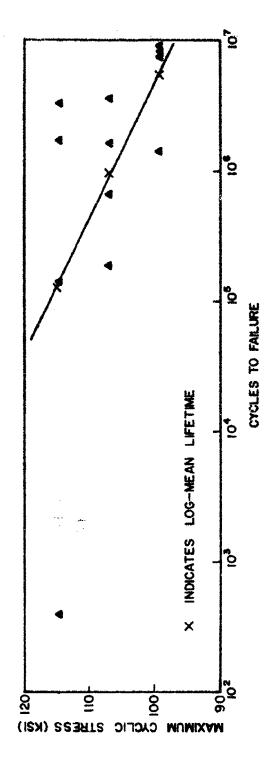
5. Specimen loaded too fast, no value obtained. Notes



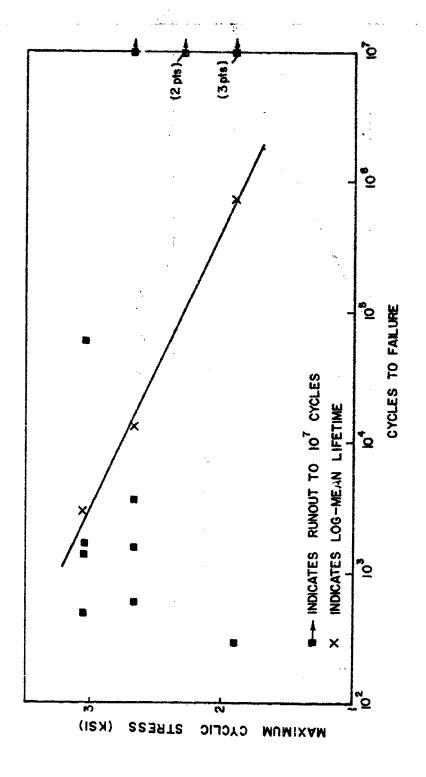
Tensile-Tensile Fatigue Behavior of Unidirectional #300/F178 Composite Laminates at 72°F: 0° Fiber Orientation, R=0.10, 30 Hz. Figure 93



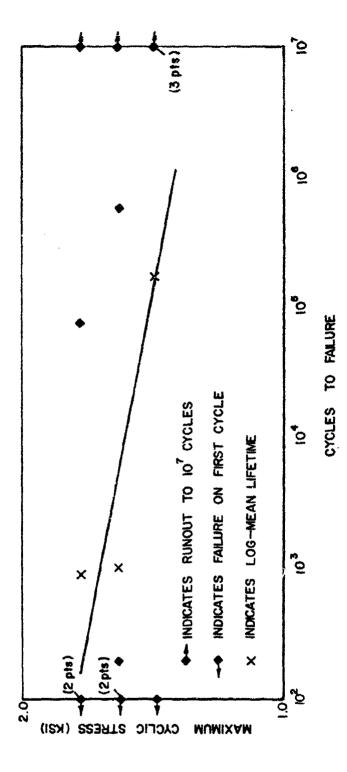
Tensile-Tensile Fatigue Behavior of Unidirectional T300/F178 Composite Laminates at 350°F: 0° Fiber Orientation, R=0.10, 30 Hz. Figure 94.



Tensile-Tensile Fatigue Behavior of Unidirectional T300/F178 Composite Laminates at 450°F: 0° Fiber Orientation, R=0.10, 30 Hz. 95g Figure



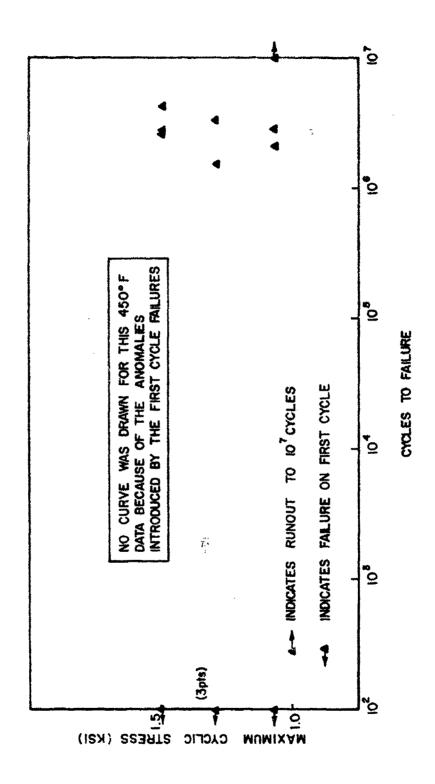
Tensile-Tensile Fatigue Behavior of Unidirectional T300/F178 Composite Laminates at 72°F: 90° Fiber Orientation, R=0.10, 30 Hz. Figure 96.



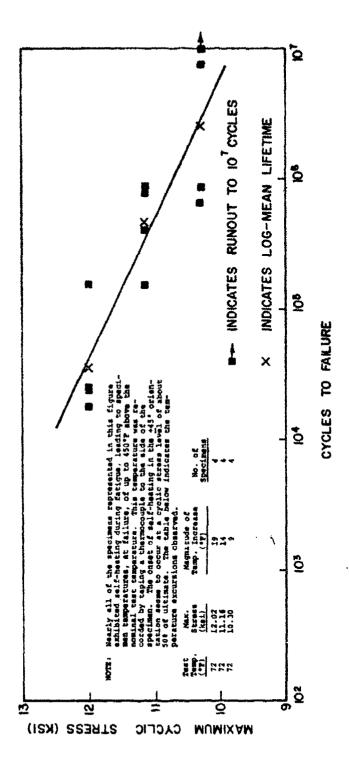
Tensile-Tensile Fatigue Behavior of Unidirectional T300/F178 Composite Laminates at 350°F: 90° Fiber Orientation, R=0.10, 30 Hz. Figure 97.

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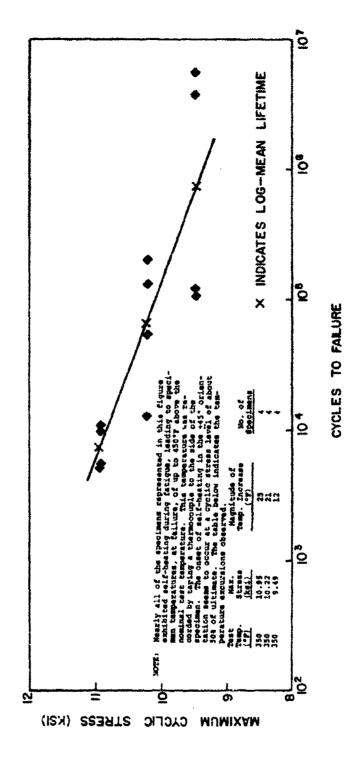
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Tensile-Tensile Fatigue Behavior of Unidirectional T300/F178 Composite Laminates at 450°F: 90° Fiber Orientation, R=0.10, 30 Hz. Figure 98.

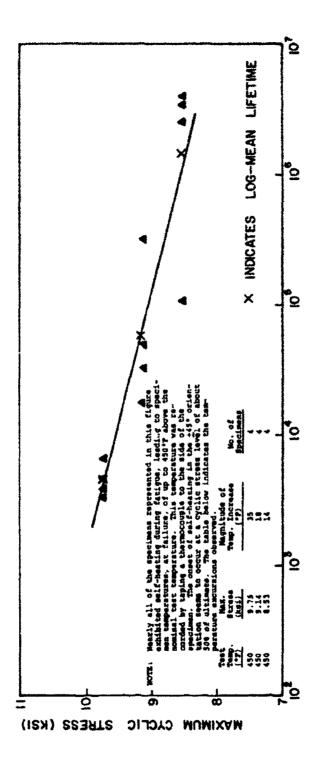


Tensile-Tensile Fatigue Behavior of Bidirectional T300/F178 Composite Laminates at 72°F: +45° Fiber Orientation, R=0.10, 30 Hz. Figure 99.



Tensile-Tensile Fatigue Behavior of Bidirectional T300/F178 Composite Laminates at 350°F: +45° Fiber Orientation, R=0.10, 30 Hz. Figure 100.

A CONTROL OF THE PROPERTY OF T



Tensile-Tensile Fatigue Behavior of Bidirectional T300/F178 Composite Laminates at 450°F: ±45° Fiber Orientation, R=0.10, 30 Hz. Figure 101.

CYCLES TO FAILURE

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merce of the second sec

CREEP PROPERTIES OF T300/F178 COMPOSITE LAMINATES TABLE 57

Material System	em - 7300/F178	Prepret by .	Hexcel			A PRINCIPAL OF THE PRIN	B	Constitute/Polyteids	Syledge
Aber - Tou Maximum Tempe Resin Content - Fibr Content - Void Content -	Albertourn Temperature Rating - 450°F Maximum Temperature Rating - 450°F Resin Content - 34.84 by wt. Fibrr Content - 55.68 by wol.		Laminate Average No. of pa	Laminate Sp. Cr Werage Ply Thicka No. of panels from Whickness of each	Laminate Sp. Gr 1,59 Average Ply Thickness - 0,0055 inch No. of panels from which specimens w Thickness of each type specimens	Landnate Sp. Gr 1.59 Average Ply Thickness - 0.0055 inch No. of panels from which specimens were tested in this table - 27 Thickness of each type specimen: 0 6 ply Thickness of each type specimen: 1 - 6 ply	5 ~		
Test Method	od - Straight-sided tension		ference -	Reference - Design Guide CREEP	uide	+450 8 ply			
Temperature	Fiber Orientations	90	200	+450	Temperature	Fiber Orientations	8	8	\$ 1.50 \$
J.049-	Stress Level (ke)) Creep Strain, 500 hr(µ in/in) No. of Specimens Residual Strength (kei) No. of Specimens				350 °F	Strass Level (kel) Creep Strain, 500 hr(u in/in) No. of Specimens Residual Strength (kel) No. of Specimens	121.8 101.8 174.7	7 0 0	20.27
	Stress Level (kei) Creep Strain, 500 hr (µ ln/ln) No. of Specimens Residual Strength (kei) No. of Specimens					Stress Level (kei) Creep Strain, 500 hr(µ in/in) No. of Specimens Residual Strength (kei) No. of Specimens	106. 24.3 24.3 24.3	1.87 1660 3.40 3.40	5.84 24.05 3.05 3.05
	Stress Level (ks)) Gresp Strain, 500 hr(µ ln/in) No. of Specimens Residusi Strength (ks!) No. of Specimens					Stress Level (kei) Creep Strain, 600 hr(µ in/in) No. of Specimens Residual Strength (kei) No. of Specimens			20°.54
1°21	Strass Level (kel) Creep Strain, 500 hr[u ln/ln) No. of Specimens Residual Strangth (kel) No. of Specimens	141.1	4.5 4.5 6.5 6.5 7.5 7.5 8.5 8.5 8.5 8.5 8.5 8.5 8.5 8.5 8.5 8	12.02 2607 2 19.33	450 of	Strees Level (kel) Crees Strain, 500 hr(u in/in) No. of Specimens Residual Strength (kel) No. of Specimens	107.0	3.02	4.87 5972 3 15.55
	Stress Level (kei) Creep Strain, 500 hr(µ in/in) No. of Specimens Residual Strengti (kei) No. of Specimens	125.4 43 3 166.6	2 8 8 6 4 6 4 6 4 6 4 6 4 6 4 6 4 6 4 6 4	10.30 2057 3 19.36		Strees Level (kel) Creep Strain, 500 hr(µ in/in) No. of Specimene Residual Strength (kel) No. of Specimess	# # # # # # # # # # # # # # # # # # #	3.74	35.53
	Stress I avai (kai) Creep Strain, 500 brib in/in) No. of Specimens Residual Strength (kei) No. of Specimens	11111		8.59 1740 3 19.65		Stress Lavel (kel) Cresp Strain, 500 hr(p la/ln) No. of Specimens Residual Strangth (kel) No. of Specimens			\$ 1 3 E E

Motes: All values represent arithmetic avarages. Residual strengths dotermined by tensile test at 72°F.

1. Three specimens failed on loading or during test.

2. One specimens failed on loading or during test.

3. Two specimens failed on loading or during test.

4. Two specimens failed on loading or during test.

failed on third specimen.

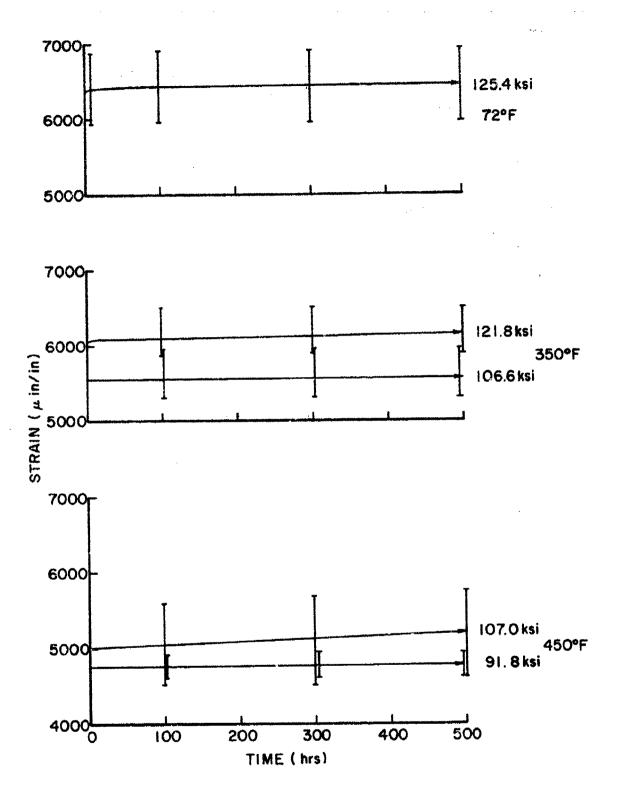


Figure 102. Tensile Creep Behavior of Unidirectional T300/F178
Composite Laminates: 0° Fiber Orientation.
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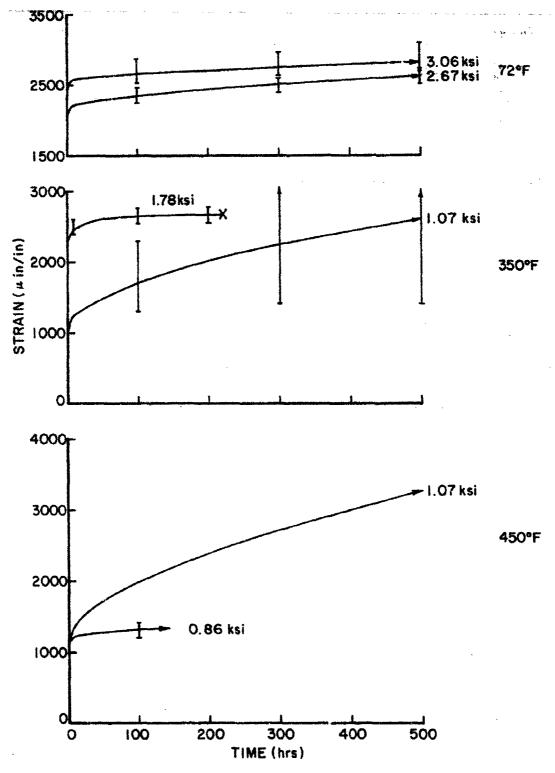
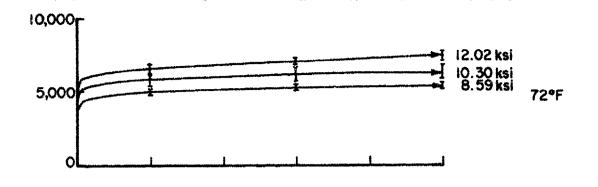
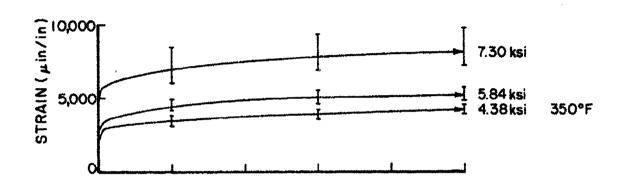
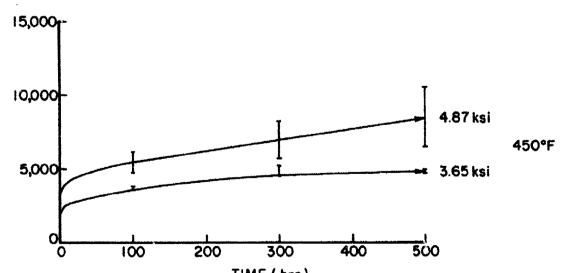


Figure 103. Tensile Creep Dehavior of Unidirectional T300/F178 Composite Laminates: 90° Fiber Orientation.







TIME (hrs)
Figure 104. Tensile Creep Behavior of Bidirectional T300/F178
Composite Laminates: +45° Fiber Orientation.

STRESS RUPTURE PROPERTIES OF T300/F178 COMPOSITE LAMINATES TABLE 58

		ŏ	OMPOSITI	E MATER L	COMPOSITE MATERIAL PROPERTIES	ES			
Material Syst	em - T300/F178 Matrix - F178	Prepreg by - Hexcel	excel				<u>-</u> ©l	caphite/	Graphite/Polyimide
Maximum Ter Resin Content Fiber Content Vold Centent	mperatu :- 34.8 :- 55.6		Laminate Average No. of pa	Laminate Sp. Gr 1.58 Average Ply Thickness - 6 No. of panels from which Ithickness of each type	Laminate Sp. Gr 1.58 Average Ply Thickness - 0.0055 inch No. of panels from which specimens w Thickness of each type specimen:	b wore tested 0*	.27		
Test Metho	Test Method - Straight-sided tension		Referenc	Reference - Design Guide	n Guide	90* 15 ply +45° *- 8 ply			
			is	STRESS RUPTURE	PTURE				
Temperature	Fiber Orientation:	o0	006	+450	Temperature	Fiber Orientations	00	906	÷450
-67°F	Stress Level (kel) Time to Fallure (hrs) No. of Specimens Residual Strength (kel) No. of Specimens	and the state of t			3500E	Stress Level [kel] Time to Fallure (hrs) No, of Specimens Residual Strength (kel) No, of Specimens	121.8 500+ 3 174.7	1.78	7.30 500+ 3 20.27 3
	Stress Lavel (kel) Time to Fallure (hrs) No. of Specimens Residual Strength (kel) No. of Specimens					Stress Level (ks!) Time to Fallure (hrs) No. of Specimens Residual Strength (ks!) No. of Specimens	10626 3492 3 141.1	3.40 3.40	5.84 3 18.06
72 ⁶ F	Strass Level (kel) Time to Falture (hrs) No. of Specimens Residual Strength (kel) No. of Specimens	1.41	3.06 505+ 3.40	12.02 597+ 2 19.33	350 ⁰ F	Stress Lovel [ks1] Time to Fallure firs) No. of Specimens Residual Strength (ks1) No. of Specimens	107.7 355+ 355+ 138.7	1.07 144 ³ 3.02	4.87 5004 3 15.55
	Strass Levol (ks!) Time to Failure (hrs) No. of Specimens Residual Strength (ke!) No. of Specimens	125.4 509+ 3 166.6	2.67 520+ 3.80	10.30 504+ 3 19.38		Stress Level (kal) Time to Fallure (hrs) No. of Specimens Residual Strength (kal) No. of Specim-no	5134 5334 164.0.	3,34	3.65 500+ 3 15.26

Residual strengths determined by tensile test 4. Three specimens failed on loading or during All values represent arithmetic averages. at 72°F.

1. Three specimens failed on loading. 4
2. One specimen failed during test.
3. Two specimens failed on loading. 5 Notes

test. 5. Two apecimens failed on loading or during test.

TABLE 59

THERMOPHYSICAL PROPERTIES OF F178 COMPOSITE LAMINATES

	COMPOSITE MAT	PRIAL PROPER	TIES				
Maximum Temperature Rati Resin Content - Fiber Content - Void Content - Thickness of each type s	ix - F178 .ng - 450°F I	io. of panels were tested Therm. Exp Therm. Cond	Gr1.57 hickness - 0. from which s in this table 20 ply Spec. 20 ply Glass	pecimens -4 Ht 14 ply			
	-67 ° F	72*£	350*F	450°F			
Thermal Expansion $\alpha_{\chi}(\mu in/in^{\circ}F)$	≟0 17.2	♣0 17-3	≟ 0 23.9	≛ 0 23.9			
α _Y (µin/in-°F) No. of Specimens per direction	3	4	7	23.9 3			
Specific Heat Cp (btu/lb*F) No. of Specimens	0.14 1	0.19	0.30 1	0.31 1			
Thermal Conductivity k ₃ (btu-ft/ft ² -hr-*F)							
No. of Specimens Glass Transition Temp. Dry ("F) Wet ("F)							
THERMOPHYSICAL PROPERTIES: ±45°							
Thermal Expansion . a _X (µin/in-*F)	2.1 1.8 1.8 1.6						
No. of Specimens per direction	4	5	6	. 3			
Thermal Conductivity k _z (btu-ft/ft ² -hr-*F		45 .00\$ 450		 -			
No. of Specimens							

On unidirectionally reinforced specimens, the x-direction is along the fiber axis, the y-direction is across the fiber axis, and the z-direction is through the thickness (identical to y-direction). On +45° bidirectionally reinforced specimens, the x and y directions are identical and oriented at 45° to either fiber direction, while the z-direction is through the thickness.

TABLE 60
TENSILE AND SHEAR PROPERTIES OF T300/F178 COMPOSITE LAMINATES AFTER HUMIDITY AGING

COMP	OSITE MATERIAL	PROPERTIES				
Material System - T300/F178 Fiber - T300 Matrix - F178 Maximum Rated Temperature - 450°F Resin Content - 34.5% by wt. Fiber Content - 56.3% by vol. Void Content - 20%	La Av No W Ag Th	. of panels from ere tested in this	- 1.57 noss - 0.0054 in which specimen table - 3 160°F and 1000 type specimen:	•		
	TENSION: 90°)				
	72°F	3 50 °F	72°¥	350°F		
Exposure Time (hrs) Weight Gain (% of orig. dry wt.) Stnd. Dev. (%) No. of Specimens fty (ksi) Stnd. Dev. (ksi) Range (ksi) No. of Specimens fty (ksi) Stnd. Dev. No. of Specimens £ty (Msi) Stnd. Dev. No. of Specimens £ty (Msi) Stnd. Dev. No. of Specimens	24.5 0.85 0.03 4 2.42 2.40 0.99-6.00 4 1.85 1.28 4	24.5 0.80 0.02 4 2.51 0.81 1.57-3.73 4 1.90 0.63 4	642 1.63 0.07 5 2.16 1.95 0.4-3.8 5 2.16 1.55 5	642 1.63 0.02 4 6.50 0.20 0.33-0.7 3 0.50 0.20 3		
ey (μ in/in) Sind. Dev.	1900 1800	2900 1000	1700 1200	770		
No. of Specimens	•	4	5	3		
Test Mothod Reference		Straight-aided tension Design Guide				
	INTERLAMINAR SE	(EAR				
Exposure Time (hrs) Weight Gsia (% of orig. dry wt.) Stad. Dev. (%) No. of Specimens	21.5 0.77 0.09 5	21.5 0.77 0.13 5	408 1.39 0.10 3	108 1.41 0.06 3		
Fish (ksi) Stnd. Dev. (ksi) Range (ksi) No. of Specimens	13.05 0.61 12.24-13.95 5	8.00 0.44 7,43-8.40 5	11.33 Q.29 11.10-11.66	7.38 0.41 6.94-7.76		
Test Method Reference		Short Beam Design Guide		3		

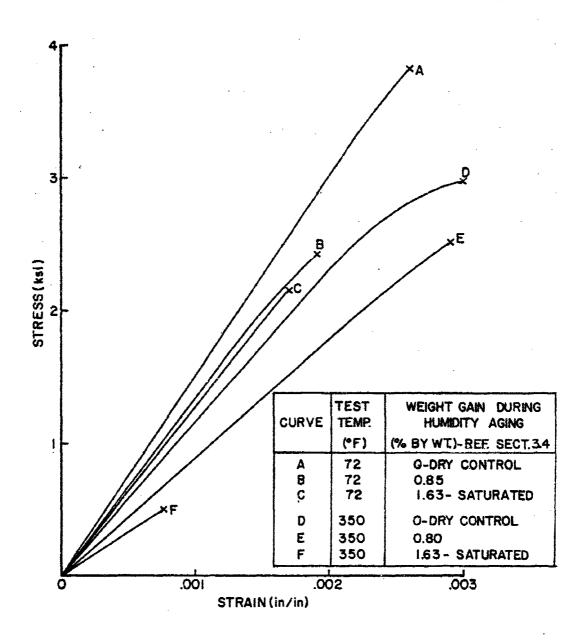


Figure 105. Tensile Stress-Strain Curves for Unidirectional T300/F178 Composite Laminates After Humidity Aging at 160°F and 100% R.H.: 90° Fiber Orientation.

4.5 COMPARATIVE ENVIRONMENTAL BEHAVIOR

One of the points of particular interest relative to the data generated in this program is the comparative susceptibility of the different composite materials to degradation during, or as the result of, elevated temperature, high humidity aging. 106 and 107 illustrate the effect of both test temperature and moisture absorption upon the strength retention of these composite materials. The notations "saturated" and "50% saturated", recall, refer to the specimen condition just prior to testing. As discussed in Section 3.4, the specimens tested at elevated temperature undoubtedly dry out to some extent during the testing process. A few seeming anomalies are apparent in these figures: (1) the 72°F values for partially saturated SP313 and AS/3004 90° tension specimens are higher than the values for dry specimens; (2) the 90° tension strengths of the partially saturated T300/F178 specimens seems uninfluenced by test temperature; and (3) the partially saturated interlaminar shear specimens of AS/4397 were stronger than the dry specimens. No definitive reason for these apparent anomalies can be stated.

Comparisons of the general trends indicated by the data indicate that (1) the polysulfone matrix is slightly less degraded than the epoxy matrix during humidity aging; (2) the two polyimide matrices resist degradation better than either the epoxy or polysulfone matrices do insofar as interlaminar shear strength retention is concerned; (3) up to 250°F, the polysulfone matrix seems to retain more 90° tensile strength than either of the two polyimide matrices although 250°F data for the two polyimides were not obtained.

Other investigators have obtained humidity aged data for the T300/F178 system which shows little, if any, strength loss in 90° tensile coupons as the result of humidity aging [8]. Since the data here indicate a marked (although not unusual) loss of strength with moisture absorption, this area no doubt deserves more thorough evaluation.

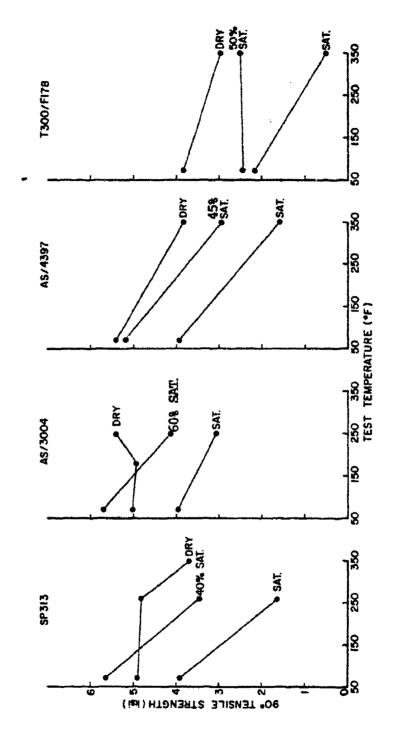


Figure 106. Comparative 90° Tensile Strength Retention of Composite Laminates After Aging at 160°F and 100% R.H.

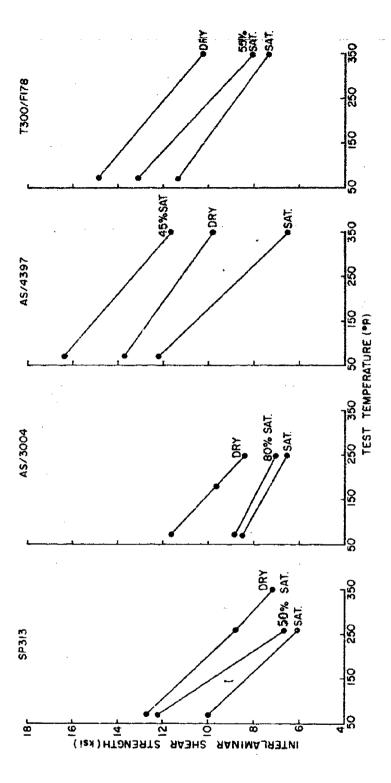


Figure 107. Comparative Interlaminar Shear Strength Retention After Humidity Aging.

SECTION 5

Each of the conclusions listed in this section was arrived at through inspection of the data in Section 4 and represent generalizations of overall composite behavior. Exceptions to each of these generalized conclusions can be found if the data are scrutinized in sufficient detail. In most cases, these exceptions are at least mentioned and discussed.

- 1. The static strengths (tensile, compressive, flexural, inplane, and interlaminar shear) of each material evaluated in this program decreased with increasing test temperature. In those cases where this was not true, the exception usually proved to be a lower strength at -67°F than at 72°F. This most probably is due to increased sensitivity to brittle failure at the lower temperature.
- 2. In those cases where the elastic modulus is primarily fiber dependent, the test temperature had relatively little effect on the modulus (0° tension, 0° compression, 0° flexure). In those cases where the composite modulus is primarily matrix dependent, however, the modulus for each material decreased with increasing temperature just as the strengths did.
- 3. The ultimate elongations of the fiber dependent specimens behaved in roughly the same fashion as the strength, decreasing with increasing temperature. The ultimate elongations of the matrix dependent specimens (90° and ±45° tension and 90° compression) increased with increasing temperature for any specific stress. Since the ultimate stress for these specimens, however, was simultaneously decreasing, the actual ultimate elongations for these type specimens exhibited some increases and some decreases with increasing test temperature.

- 4. The thermal conductivity and specific heat increased with increasing temperature for all four systems.
- 5. The coefficient of thermal expansion seemed relatively independent of temperature for the SP313 and AS/3004 material. With the AS/4397 and 90° orientation with T300/F178, the coefficient increased with increasing temperature while that for the ±45° orientation with T300/F178 decreased.
- 6. Fatigue life for each material decreased with increasing temperature at equivalent stress levels.
- 7. The relatively large plastic strains undergone by the AS/3004 ±45° orientation leads to substantial internal energy dissipation and self-heating in fatigue tests at 30 Hz. This phenomena also occurred for the other three materials but only at significantly higher stresses. The onset of this phenomena seems to occur at cyclic strain levels of above about 20% of the static ultimate strain.
- 8. Creep increased with increasing temperature for each material while the stress rupture lifetime decreased.
- 9. Humidity aging decreases the strength of each material evaluated. The polysulfone system seems less affected than the epoxy system by moisture absorbtion but the interlaminar shear data indicate that, on an absolute basis, the two polyimide systems withstand moisture degradation better than either the epoxy or polysulfone system. The 90° tensile data, however, are not as clear-cut; with the polysulfone system looking best up to 250°F but unusable at the 350°F temperature at which the two polyimides were tested.

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- Sims, D.F., "Inplane Shear Stress-Strain Response of Unidirectional Composite Materials," J. Comp. Mtls., V7, p.124, January 1973.
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APPENDIX A

PREPREG QUALITY CONTROL TEST SPECIFICATIONS AND TEST RESULTS

This appendix contains copies of the test specifications adhered to in determining prepreg properties. It also contains the test results obtained from running these various tests upon the prepreg materials. Summaries of these data are presented in Section 4.

3M TEST METHOD - SP313

PREPREG TEST METHOD VOLATILE CONTENT

- 1. Cut 3 specimens of 3" X 3" in size.
- 2. Weigh to the nearest 0.001 gram. Record the weight as W_1 .
- Preheat an air circulation oven to 250°F. and immediately after weighing suspend the specimens in the oven on a removable rack.
- 4. Expose the specimens to 250°F, for 15 minutes. Remove the rack.
- 5. Place the specimens in a desiccator.
- 6. When the specimens have cooled to room temperature, remove them from the desiccator and weigh to the nearest 0.001 gram. Record this weight as W_2 .
- 7. Calculation.

% Volatile Content =
$$\frac{W_1 - W_2}{W_1}$$
 x 100

8. Report % volatile content by weight as the average of three specimens.

PREPREC TEST METHOD UNCURED RESIN CONTENT

- 1. Cut 3 specimens 3" X 3".
- 2. Weigh the samples to the nearest .001 gram. Record this weight as
- 3. Wash each sample in a separate beaker of Dimethyl Formamide (DMF) at 180°F, under a hood for 5 minutes. Repeat for three complete washings. Rinse in MEK at 75°F. for one minute. Repeat for a total of 2 rinses. Separate fibers in solvent.
- Fold and place washed fibers in preweighed aluminum dish and dry in circulating oven for 15 minutes at 300°F.
 Cool in a desiccator at 75°F. for 15 minutes.
- Reweigh the sample to the nearest .001 gram. Record as W2.
- 7. Calculate.

Resin Content - Z Weight =
$$\frac{W_1 - W_2}{W_1}$$
 X 100

Report % resin content by weight as the average of 3 specimens.

PREPREG TEST

FLOW

The following flow test is designed to correlate with current autoclave and blanket press molding techniques for flowing resin over the surface area of a composite layup.

- 1. Prepare 3 flow specimens from the prepreg sample. Each specimen shall consist of 2 ply of prepreg oriented at 0° 90°. Specimen size is 3" X 3".
- 2. Weigh prepreg specimen and record as W_1 .
- 3. For each specimen cut (2) two 4" X 4" squares of TX-1040 porous bleeder release fabric. Also for each specimen cut four (4) 4" X 4" squares of style 191 bleeder fabric and two (2) 8" X 8" squares of 1 2 mil mylar.
- 4. Center the prepreg sample between the squares of TX-1040 fabric. Place 2 ply of Style 180 bleeder fabric on each side of the TX-1040 followed with the mylar film.
- Place the layup sandwich between two (2) caul plates.
- 6. Insert the total layup into a platen press preheated to 350°F. and apply 90 psi immediately. Cure for 15 minutes.
- 7. Remove the layup from the press. Remove any resin flash from the composite specimen and weigh. Record as W_2 .
- g. Calculate.

$$x \text{ Flow} = \frac{W_1 - W_2}{W_1} \times 100$$

Report average of 3 specimens.

NOTE:

- Three or more specimens can be cured in one cycle.
- Temperature and cure cycle can be varied to correlate with specific cure conditions.

TRW TEST METHOD AS/HME-Volatile Content

APPENDIX I

TEST PROCEDURES FOR CHARACTERIZATION OF GRAPHITE TAPE AND COMPOSITES

I.1 GRAPHITE TAPE CHARACTERIZATION

I.1.1 Volatile Matter

Volatile content of graphite prepreg was determined by thermally treating a tarred sample for 30 minutes at 350°F. After cooling to R.T., the specimen was reweighed and the volatile content was calculated by the following formula:

Volatile Content =
$$\frac{w_1 - w_2}{w_1} \times 100$$

Where:

W₁ = Weight Sample

W₂ = Weight Sample After Heat Aging

HERCULES SPECIFICATION-AS/3004-VOLATILE CONTENT

HS-SG-500/232 2-7-73 A STANDARD OF THE PROPERTY OF

Table II. Mechanical Properties (at 77° ± 5° F)

Property	Unit	Minimum averaja Value
Longitudinal, flexural strength	Psi	200,000
Longitudinal flexural modulus	Psi	15,000,000
Short beam shear	Psi	10,500

TEST METHODS:

Test specimens. Test specimens for mechanical and thickness tests shall be prepared in accordance with HD-SG-2-6007.

<u>Volatiles content test</u>. The volatiles content of the tape shall be determined as follows:

- a. Weigh a nominal 10 gram specimen of prepreg to the nearest milligram. No vessel required.
- b. Place weighed specimen on aluminum foil or other suitable base and bake 2 hours in a 300-320°F circulating air oven.
- c. Reweigh baked specimen after cooling to ambient temperature.
- d. Calculate volatiles content as follows:

Volatiles Content, weight percent =

Resin content test. Resin content shall be determined in accordance with procedure of HD-SG-2-6006.

HERCULES SPECIFICATION AS/3004 and AS/4397 PREPREG RESIN CONTENT

HD-SG-2-6006C

- 5.2.6 Procedure F (methylene chloride extraction method). Determine resin content of prepreg tape by methylene chloride extraction as follows:
 - a. Prepreg samples shall be as specified in table I. Take duplicate test specimens, one from each end of the sample.
 - b. Weigh the first specimen to the nearest 0.001 g.
 - c. Place specimen in a 250 ml Erlenmeyer flask and add 100 to 125 ml methylene chloride.
 - d. Place rubber stopper on flask and shake gently for about 1 minute.
 - e. Decant off methylene chloride, being careful not to lose any fiber.
 - f. Repeat steps c, d, and e two more times.
 - g. Remove specimen from flask and remove excess methylene chloride by patting with a clean towel.
 - h. Place specimen in an oven for a minimum of 5 minutes at $177 \pm 5^{\circ}$ C.
 - i. Remove specimen from oven, cool to room temperature, and weigh to the nearest 0.001 g.
 - j. Calculate resin content as follows:

Resin content, weight percent =
$$\frac{\tilde{W}_1 - W_2}{\tilde{W}_1}$$
 x 100

where: W₁ = original weight of sample, g

W₂ = final weight of sample, g

- k. Repeat steps b through j for the second specimen.
- 1. Report the resin content as the average of the two determinations to the nearest whole percent.
- 5.3 Resin flow. The resin flow properties of the prepreg shall be determined in accordance with procedure A or procedure B as specified in the applicable prepreg specification sheet.

HERCULES SPECIFICATION AS/4397 VOLATILE CONTENT

5. TEST PROCEDURES

- 5.1 Volatiles content. The volatiles content of the prepreg shall be deternined in accordance with the following:
 - 5.1.1 Test specimens. Test specimens shall be as follows:
 - a. Two 2-inch square specimens (1.0 \pm 0.2 grams) of prepreg are to be analyzed.
 - b. Release paper must be removed prior to analyzing. Any resin adhering to the release paper will be lost to the test.
 - 5.1.2 Test procedure. The test procedure shall be as follows:
 - a. Condition new Gooch filtering crucibles in beaker containing concentrated HNO3 for a minimum of 1 hour at $100\pm5^{\circ}$ C. Wash with water, dry in oven at $93\pm3^{\circ}$ C and desiccate.
 - b. Weigh conditioned filtering crucible to the nearest 0.1 milligram (mg).
 - c. Carefully remove release paper from prepreg specimen and place specimen in tared crucible.
 - d. Weigh crucible containing specimen to the nearest 0.1 mg.
 - e. Condition crudible and specimen in an oven maintained at 93.5° # 3°C for a minimum of 90 minutes and a maximum of 120 minutes, unless otherwise specified in the applicable prepres specification.



Prepregs with polyimide resin systems should be conditioned at $288 \pm 3^{\circ}$ C for 60 ± 1 minutes.

- f. Remove crucible from oven, cool to room temperature in a desiccator, and reweigh.
- g. Calculate volatiles content of prepreg as follows:

Weight % Volatiles =
$$\frac{W_2 - W_3}{W_2 - W_1} \times 100$$

where: W₁ = weight of empty conditioned filtering crucible, grams (g)

W₂ = original weight of crucible and specimen before heating, g

W3 = final weight of crucible and specimen after heating, &

HERCULES SPECIFICATION-AS/4397 FLOW

RD-SG-2-6006C

5.3 Resin flow. The resin flow properties of the prepreg shall be determined in accordance with procedure A or procedure B as specified in the applicable prepreg specification sheet.

5.3.1 Procedure A. Determine resin flow as follows:

- 4. The test specimen shall consist of two uniformly cut pieces of preg. Each piece shall be 2 inch by 2 inch.
- b. Cut four approximately 3-inch squares of glass bleeder cloth for each test.
- c. Cut two approximately 3-inch squares of porous tetrafluoreethylene (TFE) release cloth.
- d. Cut one approximately 6-inch by 12-inch piece of aluminum foil.
- e. If the prepreg has release paper on both sides, remove the release paper from one side of each of two 2 x 2 inch specimens.
- f. Sandwich the exposed sides of the graphite together so that the fibers are oriented 90 degrees to each other. Then remove the release paper from one side of the specimen sandwich.
- g. Weigh the sandwiched specimen to the nearest milligram on a precision balance. The side of the sandwiched specimen with the release paper attached is to be placed on the balance pan. Record the weight as W₁.
- h. Fold the 6×12 inch sheet of aluminum in half to form a 6×6 inch square. Then unfold and lay on a flat surface.
- Stack two pieces of the fiberglass bleeder cloth on one another and lay them on top of the äluminum foil aligning one edge with the center crease of the foil.
- j. Center one piece of release cloth on top of the bleeder cloths.
- k. Center the exposed side of the prepreg specimen on top of the release cloth.
- Remove the final piece of release paper from the specimen and weigh the release paper to the nearest milligram. Record the weight as W2.
- m. Center one piece of TFE release cloth on top of the freshly exposed graphite surface of the specimen; then place two pieces of bleeder cloth on top of the release cloth.
- n. Fold the aluminum foil over to form a 6 x 6 inch square completing the sandwich lay-up.

HERCULES SPECIFICATION AS/4397 FLOW (concluded)

HD-SG-2-6006C

- o. Pra-set the temperature of the platen press to the temperature specified in the applicable prepreg specification sheet and check.
- p. Place the sandwiched specimen on the top platen of the press and immediately (within 15 seconds) apply the pressure specified in the applicable prepreg specification sheet to the specimen. Start a timer when the required pressure is obtained.
- q. Remove the specimen from the press after the time specified in the applicable prepreg specification sheet has elapsed. Allow specimen to cool to room temperature.
- r. Remove the graphite specimen from the lay-up. Insure that no fibers are removed with the release cloth.
- s. Remove any resin which has extruded from the body of the graphite specimen and is clinging to the edges.
- t. Re-weigh the graphite specimen to the nearest milligram. Record weight as $W_{\mathbf{q}}$.
- u. Calculate the percent resin flow as follows:

Resin flow, percent =
$$\frac{(W_1 - W_2) - W_3}{W_1 - W_2} \times 100$$

where: W₁ = initial weight of specimen plus one piece of release paper, g.

 W_2 = weight of release paper from W_1 , g.

W, = final weight of specimen, g.

v. Report individual results of two determinations and also mean value.

Note: In step o, the temperature used for AS/4397 prepreg was 400°F.

HEXCEL TEST METHOD T300/F178 PREPREG RESIN CONTENT

Dissolve two specimens $4* \times 4*$ in NMP (n-methyl pyrrolidone). Heat up to 125°F for approximately 15 minutes. Filter off resin. Wash off with acetone.

Material:	SP313		Vendor: 3N	í
Lot/Batch Number	Spool/Roll Number	Volatile Content (% by wt)	Resin Content (% by wt)	Resin Flow (% by wt)
661	SLPS07606J#1&2	0.25	39.0	15.9
662	SLPS07606J-1-1	0.25	39.2	16.1
662	SLPS07606JB0-1-2	0.27	39.4	16.2
662	SLPS07606J-1-3	0.26	39,4	16.3
662	SLPS07606J-1-4	0.14	38.4	15.1

Graphite/epoxy prepreg

T300 fiber

PR313 epoxy resin
0.005 inch nominal thickness
3-inch wide tape

Test Procedures Followed

Property	Applicable Test Spec.	Source of Test Spec.
Volatile Content	No Numerical Designation	3M
Resin Content	No Numerical Designation	3M
Resin Flow	No Numerical Designation	3м

Prepreg test procedures supplied by 3M.

RP-1051

cc: with shipment

cc: G.A. Toren-230-1

cc: J.W. Davis-230-1 CC:

AFFIDAVIT

STATE OF MINNESOTA

COUNTY OF RAMSEY

The authorized representative of the Minnesota Mining and Manufacturing Company, St. Paul, Minnesota, whose signature is given below, being first duly sworn, does depose and say that the "SCOTCHPLY" Brand Reinforced Plastics Material described below, complies with mutually agreed Specifications and Purchase Order Requirements. The Quality Control System complies with all essential principles of Specifications MIL-I-45208A and MIL-Q-9858. Test reports and traceability records will be kept on file, available for review by the buyer. Copies of 3M Lot Acceptance Data Reports and the Shipment Check List, as may be required, are attached to this Affidavit.

Customer Name and Plant Location:

UNIVERSITY OF DAYTON

DAYTON, OHIO

Customer Purchase Order Number:

RI-72095

3M Company Shipment Invoice Number:

RP-31112

Applicable Customer Specification:

3M TEST METHODS

3M Company Product Identification:

SP-313 (5.0) T300, GRAPHITE-EPOXY PREPREG

3M Company Product Mfg. Code:

SLP S07606, LOT 661 J. # 1 -2 (119 net ft.)

Shipment Summary:

5.8 POUNDS OF 12" WIDTH

PHYSICAL PROPERTIES:

Volatile

Resin Content =

Fiber Content = 60.4 %

Flow

19.8 %

Further this Affiant sayeth not.

Title:

Inspector, Quality Control

Subscribed and sworn to before me this _

23

day of __

TINE 1975 A.D.

					
Material: AS/3004			Vendor: Hercules		
Lot/Batch Number	Spool/Roll Number	Volatile Content (% by wt)	Resin Content (% by wt)	Resin Flow (% by wt)	
376	10A	5.34	40.75	***	
376	9	4.75	38.01	**	
376	6	4.75	36.26	math, and, grav.	
376	3	4.31	35.48		
]	

Graphite/polysulfone

AS graphite fiber P1700 polysulfone thermoplastic 0.005 inch nominal tape thickness 12-inch wide tape

103C ITOCCULES IVIIOWED				
Property	Applicable Test Spec.	Source of Test Spec.		
Volatile Content	HD-SG-500/232	Hercules		
Resin Content	HD-SG-2-6006C(5.2.6F)	Hercules		
Resin Flow	Not Applicable			

PREPREG PHYSICAL PROPERTIES				
Material:	AS/4397		Vendor: He	rcules
Lot/Batch Number	Spool/Roll Number	Volatile Content (% by wt)	Resin Content (% by wt)	Resin Flow (% by wt)
362	2	0.23	42.5	25,2
382	3	0.19	42.6	26.5

Test Procedures Followed				
Property	Applicable Test Spec.	Source of Test Spec.		
Volatile Content	HD-SG-2-600C(5.1)	Hercules		
Resin Content	HD-SG-2-6006C(5.2.6F)	Hercules		
Resin Flow	HD-SG-2-6006C(5.3.1A)	Hercules		

HERCULES INCORPORATED QUALITY ASSURANCE LOT DATA REPORT

Customer: University of Dayton

Purchase Order No: R1-76095

Material: Graphite Fiber/Epoxy Material Type AS/4397

Quantity: 39# x 12" nominal

Lot No: 382

Spool No: 2,3

I. Fiber Properties 53-5

Tensile Strength	463 psi x 10 ³
Tensile Modulus	35.5 psi x 10^6
Wt./Unit Length	44.57 lb/in x 10 ⁻⁶
Density	0.0646 lb/in ³
	Test Value
 Laminate Mechanical Properties	Panel No. Average/Minim

II.

0° Tensile Strength, RT, ksi	3176	255/252
Oc Tensile Modulus, RT, msi	3176	22.1/21 9
0° Flex Strength, RT, ksi	31.75	252/246
0° Flex Strength 400°F., ksi	31.75	198/168
0° Flex Strength, 450°F, ksi	31.7 5	174/162
0 Flex Modulus, RT, msi	31.75	18.6/18.1
O Flex Modulus, 400 F. msi	31.75	17.8/16.5
0° Flex Modulus, 450°F, msi	3175	17.0/15.8
Short Beam Shear, RT, ksi	31.75	14.7/14.6
Short Beam Shear, 400°F, ksi	31.75	10.5/10.0
Short Beam Shear, 450°F., ksi	31.75	8.4/8.1
90° Tensile Strength, RT, psi	3175	7,240/7,100
90° Tensile Modulus, RT, msi	31.75	1.36/1.31
90° Tensile Elongation, %	3175	0.56/0.54

III. Panel Physical Properties

Panel No.	31.75	3176
Fiber Volume, %	53.1	65.0
Resin Content, %	28.75	27.29
Density (1b/in ³)	0.0572	0.0578
Void Content, %	0.99	0.56
Ply Thickness, Inches	0.0058	0.0057

IV. Individual Spool Physical Properties

Spoo1	No.		2	3
Resin	Content.	%	44	41

R. L. Frankenfield Representative QUALITY ASSURANCE DEPARTMENT

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RLF: 1do

						
Material:	T300/F	178	Vendor: Hexcel			
Lot/Batch Number	Spool Num	/Roll ber	Volatile Resin Content Content (% by wt) (% by wt)		ntent	Resin Flow (% by wt)
DP021	4				41.1	**
DP021	5	· · · · · · · · · · · · · · · · · · ·	W		42.2	** **
Graphite/po:	lyimide	F1	00 graphite 78 polyimide 005 inch nom -inch wide t	resin	n.	w, 309 finis
5		ſ <u></u>	Procedures F		· · · · · · · · · · · · · · · · · · ·	e C. Marcha Cara
Propert	Υ	App110	cable Test S	pec.	source	of Test Spec
Volatile Co	ntent	Not A	Applicable			
Resin Conte	nt	No Nume	erical Designation Hexcel		cel	
Resin Flow Not A		Not A	Applicable			
Flow tes 22	st not p	erform ccordin	ed. It is a g to Hexcel	high litera	flow sys	tem, however

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Dayton, Ohio

P.O. # RI 77135

B.O. # DP021

Flexural Strength

DRT (psi x 10³) 248 Mod (psi x 10⁶) 17.9 500°F 145

Mod

18.0

Short Beam Shear

14,800 DRT - psi

500°F - psi 7,500

	PREPREG	PHYSICAL PR	ROPERTIES	
Material:	AS/HME		Vendor: TRW	
Lot/Batch Number	Spool/Roll Number	Volatile Content (% by wt)	Resin Content (% by wt)	Resin Flow (% by wt)
10904	73-1	0.72	See special sheet	2.9
10904	73-2	1.20	See special sheet	2.8
10904	73-3	1.50	See special sheet	6.1
10904	73-4	1.40	See special sheet	8.0
10904	73-5	0.75	See special sheet	4.0
10904	73-6	0.62	See special sheet	3.2
10904	73-7	1.10	See special sheet	3.7
10904	73-8	0.67	See special sheet	3.4
10904	73-10	1.33	See special sheet	6.3

Property	Applicable Test Spec.	Source of Test Spec				
Volatile Content	1.1.1	TRW				
Resin Content	AFML-TR-67-243	AFML-TR-67-243				
Resin Flow	3M					

^{*}Same test as used for SP313. This method employs a 90 psi pressure while the actual cure schedule for the HME resin called for only 14 psi (vacuum bag). Hence, the actual flow during cure would be less than that measured here.

Material:	AS/HME		Vendor: TRW	
Lot/Batch Number	Spool/Roll Number	Volatile Content (% by wt)	Resin Content (% by wt)	Resin Flow (% by wt)
10904	73-11	1.43	See special sheet	6.2
10904	73-12	1.88	See special sheet	12.2
10904	73-13	0.83	See special sheet	9.7
10904	73-14	0.94	See special sheet	6.5
10904	73-15	1.16	See special sheet	10.9
10904	73-16	0.59	See special sheet	7.9
10904	73-17	1.28	See special sheet	8.8

Test Procedures	Followed
-----------------	----------

Property	Applicable Test Spec.	Source of Test Spec		
Volatile Content	1.1.1	TRW		
Resin Content	AFML-TR-67-243	AFML-TR-67-243		
Resin Flow	No Numerical Designation*	3M		

^{*}Same test as used for SP313. This method employs a 90 psi pressure while the actual cure schedule for the HME resin called for only 14 psi (vacuum bag). Hence, the actual flow during cure would be less than that measured here.

Material:	AS/HME		Vendor: TRW	
Lot/Batch Number	Spool/Roll Number	Volatile Content (% by wt)	Resin Content (% by wt)	Resin Flow (% by wt)
10904	75-1	1.88	See special sheet	7.0
10904	75-2	1.36	See special sheet	5.8
10904	75-3	1.54	See special sheet	6.4
10904	75-4	1.64	See special sheet	8.6
10904	75~5	1.43	See special sheet	7.5
10904	75-6	1.58	See special sheet	12.9
10904	75-7	2.08	See special sheet	9.5

Property	Applicable Test Spec.	Source of Test Spec.
Volatile Content	1.1.1	TRW
Resin Content	AFML-TR-67-243	AFML-TR-67-243
Resin Flow	No Numerical Designation*	3м

^{*}Same test as used for SP313. This method employs a 90 psi pressure while the actual cure schedule for the HME resin called for only 14 psi (vacuum bag). Hence, the actual flow during cure would be less than that measured here.

	_			
Material:	AS/HME		Vendor: TRW	
Lot/Batch Number	Spool/Roll Number	Volatile Content (% by wt)	Resin Content (% by wt)	Resin Flow (% by wt)
11939	27-1	0.80	See special sheet	5.2
11939	27-2	1.46	See special sheet	7.9
11939	27-3	1.14	See special sheet	5.2
11939	27-4	1.94	See special sheet	11.2
11939	27-5	1.01	See special sheet	4.4
11939	27-6	1.52	See special sheet	10.5
11939	27-7	3.45	See special sheet	12.8
11939	27-8	1.55	See special sheet	14.5

	TOUR CANDOCARE TOURS			
Property	Applicable Test Spec.	Source of Test Spec.		
Volatile Content	1.1.1	TRW		
Resin Content	AFML-TR-67-243	AFML-TR-67-243		
Resin Flow	No Numerical Designation*	3M		

^{*}Same test as used for SP313. This method employs a 90 psi pressure while the actual cure schedule for the HME resin called for only 14 psi (vacuum bag). Hence, the actual flow during cure would be less than that measured here.

As discussed in the introduction to Section 4, the high degree of scatter in the resin content of the HME low-flow system resulted in a comprehensive study of the resin content variability of this prepreg. The special supplementary table at the end of Appendix A presents the results of this study and vividly illustrates the magnitude of the problem. In short, although each batch of prepreg did indeed fall within the 35% ± 5% limit quoted by TRW, in-batch resin content variations were quite substantial, ranging from a low value of about 22% to a high value of over 46%. The problem was one of non-uniform resin distribution across the width of the prepreg tape.

AS/HME PREPREG RESIN CONTENT

		Resi	n Content	: (% by w	E.) ¹		Max.
Roll No.	Pos. 1	Pos. 2	Pos. 3	Pos. 4	Pos. 5	Avg.	Spread
10904-73-1	45.88	44.74	35.74	34.31	~ 29.39	~38.01	16.49
10904-73-2	37.77	34.99	35.24	33.05	38.18	35.85	5.13
10904-73-3	41.09	34.89	38.61	33.90	32.84	36,27	8.25
10904-73-4	30.03	36.92	36.04	42.01	41.46	37.29	11.98
10904-73-5	33.18	39.60	35.71	29.97	36.05	34.90	9.63
10904-73-6	30.09	33.66	42.39	28.30	31.70	33.23	14.09
10904-73-7	34.40	33.26	38.89	37.45	34.84	35,77	5,63
10904-73-8	29.57	33.83	36.69	30.92	35.46	33,29	7.12
10904-73-10	41.91	33.33	30.80	34.81	36.60	35.49	11.11
10904-73-11	46.14	36.21	39.00	40.14	28.97	38.09	17.17
10904-73-12	35.79	42.80	31.90	30.32	31.95	34.55	12.48
10904-73-13	40.69	39.13	34.61	34.68	29.94	35.81	10.75
10904-73-14	38.36	32.73	37.45	41.13	32.62	36.46	8.51
10904-73-15	36.77	35.65	34.35	40.34	32.79	35.98	7.55
10904-73-16	35.04	37.48	36.26	36.82	32.69	35.59	4.79
10904-73-17	37.14	32.02	31.20	34.18	21.76	31.26	15.38
10904-75-1	35.01	32.33	38.41	37.19	42.73	37.13	10.40
10904-75-2	30.54	37.80	39.44	37.10	40.74	37.12	10.20
10904-75-3	41.28	34.27	33.27	36.04	27.38	34.45	13.90
10904-75-4	29.76	34.41	37.71	36.48	39.32	35.57	9.56
10904-75-5	35.93	36.93	35.14	31.35	33.07	34.48	5.58
10904-75-6	40.24	30.43	34.18	37.53	35.17	35, 51	9.81
10904-75-7	38.22	43.05	33.37	36.61	27.79	35.81	15.26
11939-27-1	27.99	38.39	33,47	34.79	32.89	33.51	10.40
11939-27-2	23.93	39.50	32.89	35.03	30.63	32.40	15.57
11939-27-3	30.52	25.95	30.89	34.48	42.43	32.85	16.48
11939-27-4	38.83	34.52	35.73	32.77	28.09	33.99	10.72
11939-27-5	42.67	41.53	44.87	31.99	28.81	37.98	16.06
11939-27-6	32.25	41.27	36.46	37.66	43.59	38.25	11.34
11939-27-7	32.72	36.39	38.40	42.68	39.19	37.88	9.96
11939-27-8	39.29	43.10	40.10	38.17	34.34	39.00	8.76

Positions 1 through 5 represent locations distributed uniformly across the width of the prepreg tape from which samples were taken.

Intra-Roll			······································		<u>-</u>
Spread (%)	4-6	6-8	8-10	10-12	12+
Population	4	_ 2	7	8	10

APPENDIX B LAMINATE PHYSICAL PROPERTY DATA

All of the physical property measurements conducted upon the panels fabricated and used in this program are presented here. Summaries of these data appear in Section 4.

Material: SP313

			r	·			Thick-	Prepreg	
_			_	Resin	Fiber	Void	ness per	Lot/	Prepreg
Lam.	Fiber		Spec.	Content	Content	Content	ply	Batch	Spool/Roll
No.	Orien.		Grav.			(%by vol)	(mils)	No.	No.
Al	0°	6	1.48	30.3	57.9	5.7	5.2	661	J-1-2
A2	0°	6	1.47	29.9	61.2	3.9	5.2	661	J-1-2
A3	0°	6	1.47	27.2	65.9	5.6	5.3	661	J-1-2
A4	0.	6	1.46	28.4	61.7	5.7	5.1	661	J-1-2
A5	0°	6	1.57	29.0	64.6	÷ 0	5.1	661	J-1-2
A6	0°	6	1.56	29.8	63.9	≐ 0	5,2	661	J-1-2
A7	0.	6	1.56	29.3	64.3	≛ 0	5.2	661	J-1-2
A8	0°	6	1.56	29.1	64.5	÷ 0	5.2	661	J-1-2
A9	0°	6	1.55	28.0	63.7	3.2	5,2	661	J-1-2
A10	0°	10	1.58	26.0	68.0	≛ 0	5.2	661	J-1-2
A11	C°	10	1.57	26.8	67.1	≐0	5.4	661	J-1-2
A12	0°	10	1.57	27.1	66.8	≐ 0	5.9	661	J-1-2
A13	0°	10	1.57	26.2	66.2	≐ 0	5.3	661	J-1-2
A14	0°	10	1.59	24.9	69.3	≐ 0	5.4	661	J-1-2
A15	0°	10	1.58	27.1	66.7	≟0_	5.3	661	J-1-2
Al6	90°	15	1.56	29.9	63.7	≐ 0	5.3	662	J-1-3
A17	90°	15	1.56	31.4	62.0	≛ 0	5.4	662	J-1-3
A18	90°	15	1.55	32.9	60.4	≐ 0	5.3	662	J-1-3
A19	90°	15	1.57	30.3	63.2	≐ 0	5.3	662	J-1-3
A20	90°	15	1.56	30.2	63.4	≐ 0	5.3	662	J-1-3
A21	90°	15	1.57	30.0	63.5	≐ 0	5.4	662	J-1-3
A22	90°	15	1.56	33.0	60.3	≟ 0	5.3	662	J-1-3
A23	90°	15	1.56	32.3	61.0	≗0	5.5	662	J-1-3
A24	90°	15	1.55	33.9	59.2	≟ 0	5.3	662	J-1-3
A25	90°	15	1.55	32.7	60.6	≐ 0	5.4	662	J-1-3

^{*}Computed according to ASTM D2734-70(B). Values indicated as ±0 actually computed as negative values, but since negative void content is meaningless, they are reported as ±0 (approximately zero). Inspection of photomicrographs revealed an average void content of about 2% by volume and this is the value reported in Section 4.

Material: SP313

rici	CELLA.	* · · · ·							
Lam. No.	Fiber Orien	No. Plies	Spec. Grav.	Resin Content (%by wt)		Void Content* (%by vol)	Thick- nass per ply (mils)	Prepreg Lot/ Batch No.	Prepreg Spool/Roll No.
A26	90°	15	1.56	31.6	61.8		5.3	662	J-1-3
A27	90°.	15	1.55	33.8	59.4	≐o	5.3	662	J-1-3
A28	90°	15	1.53	33.0	60.2	0.2	5.7	662	J-1-3
A30	90°	15	1.56	33.9	57.4	= 0	5.8	662	3B0-1-2
A31	90°	15	1.56	32.5	59.5	≐ 0	5.3	662	JB0-1-2
A32	90°	15	1.53	32.5	59.5	≛ 0	5.3	662	JB0-1-2
A33	0°	14	1.62	31.7	50.3	≐ 0	5.4	662	JB0-1-2
A34	0°	14	1.61	32.0	60.0	≐0	5.4	662	JBO-1-2
A35	0°	16	1.56	34.3	57.6	≐ 0	5.3	662	JB0-1-2
A36	0°	20	1.56	35.5	56.2	≐ 0	5.3	662	JBO-1-2
A37	0.	40	1,56	35.4	66.3	≐ 0	5.1	662	JBO-1-2
A38	+45°	8	1.54	33.7	58.1	≐ 0	5.6	662	JBO-1-2
A39	+45°	8	1.57	31.0	61.2	÷ 0	5.6	662	JBO-1-2
A40	±45°	12	1.52	32.3	60.7	0.6	5.5	662	JBO-1-2
A43	±45°	12	1.52	32.4	58.8	0.9	5.5	662	JBO-1-2
A44	+45°	8	1.54	32.2	59.8	≗ 0	5.4	662	JBO-1-2
A46	0°	14	1.56	33.2	58.7	≛ 0	5.6	662	JB0-1-2
A47	+45°	8	1.55	31.9	60.1	≐ 0	5.5	662	J-1-1
A48	±45°	8	1.55	32.7	59.2	± 0	5.6	662	J-1-1
A50	+45°	8	1.56	31.9	60.1	≐ 0	5.5	662	J-1-1
A51	+45°	8	1.55	32.0	60.0	≐ 0	5.5	662	J-1-1
A52	45°	8	1.55	31.7	60.3	≐ 0	5.5	662	J-1-1
A53	+45°	8	1.54	30.7	60.5	≐ 0	5.5	662	J-1-1
A54	-45°	8	1.54	31.8	60.2	≛ 0	5.6	662	<i>z</i> −1−1
A55	45°	8	1.55	31.3	60.7	≐ 0	5.5	662	J-1-1

^{*}Computed according to ASTM D2734-70(B). Values indicated as ±0 actually computed as negative values, but since negative void content is meaningless, they are reported as ±0 (approximately zero). Inspection of photomicrographs revealed an average void content of about 2% by volume and this is the value reported in Section 4.

Material: SP313

PM	CELTA	1. SP.	373						
Lem. No.	Fiber Orien	No. Plies	Spec. Grav.	Resin Content (%by wt)		Void Content* (%by vol)	Thick- ness per ply (mils)	Prepreg Lot/ Batch No.	Prepreg Spool/Roll No.
A56	±45°	8	1.54	32.5	59.3	* 0	5.6	662	J-1-1
A57	±45°	8	1.55	31.4	62.0	# 0	5.5	662	J-1-1
A58	±45°	8	1.55	32.5	60.8	± 0	5.7	662	J-1-1
A59	0°	10	1.47	34.5	55.3	4.7	5.6	662	J-1-1
A60	0.0	20	1.47	41.1	50.9	1.6	5.9	662	J-1-1
A61	+45°	40	1.52	32.6	60.4	0.4	5.5	662	J-1-1
A62	+45°	8	1.54	30.7	62.7	0.2	5.5	662	J-1-4
A63	+45°	8	1.54	30.9	62.5	6.1	5.6	662	J-1-4
A64	0°	14	1.56	32.1	59.3	0.3	5.6	662	J-1-4
A65	<u>+45°</u>	20	1.54	33.4	59.6	≐ 0	5.5	662	J-1-4
A66	90°	14	1.54	31.3	62.1	≐ 0	5.4	662	J-1-4
A67	0°	14	1.54	30.5	60.1	2.00	5.7	662	J-1-4
Avg.			1.55	31.4	61.2	≑ 0*	5.4		
St Du			0.03	2.6	3.2		0.1		
		•							
				1					

^{*}Computed according to ASTM D2734-70(B). Values indicated as ±0 actually computed as negative values, but since negative void content is meaningless, they are reported as ±0 (approximately zero). Inspection of photomicrographs revealed an average void content of about 2% by volume and this is the value reported in Section 4.

Material: AS/3004

	*						Thick-	·	
Lam. No.	Fiber Orien,	No. Plies	Spec. Grav.	Resin Content (%by wt)		Void Content* (%by vol)	ness per ply (mils)	Prepreg Lot/ Batch No.	Prepreg Spool/Roll No.
Cl	0°	14	1.52	34.5	56.3	1.1	5.1	376	6
C2	0°	14	1.53	32.6	58.1	1.5	5.8	376	3
С3	0°	20	1.55	33.3	57.0	1.6	5.3	376	3
C4	0°	14	1.52	32.6	57.6	2.3	5.4	376	3
C5	0°	14	1.52	31.9	58.7	2.6	5.2	376	3
C6	0.	20	1.52	33.0	57.7	1.8	5.3	376	3
C7	0.0	6	1.55	32.8	58.6	0.3	5.7	376	6
C8	0.0	6	1.54	31.8	59.1	1.3	5.7	376	3
C9	0°	6	1.56	31.4	60.1	0.4	5.7	376	3
C10	0°	6	1.53	35.9	55.1	0.6	5.7	376	3
C1.1	0°	16	1.51	37.8	52.7	1.2	5.7	376	3
C12	0°	6	1.54	31.4	59.4	1.4	5.7	376	3
C13	0°	6	1.55	33.2	57.6	≟ 0	5.7	376	3
C14	0°	6	1.51	38.1	52.7	0.6	5.7	376	3
C15	90°	15	1.54	36.0	55.3	≐ 0	5.5	376	3
C16	90°	15	1.55	32.9	58.5	0.2	5.7	376	3
C17	90°	15	1.56	32.4	59.2	÷ 0	5.8	376	3
C18	90°	15	1.55	33.5	57.4	0.2	5.8	376	3
C19	+45°	8	1.54	34.8	55.7	≟ 0	5.5	376	6
C20	+45°	8	1.54	34.0	57.3	0.2	5.3	376	6
C21	<u>+</u> 45°	8	1.54	33.8	57.4	0.5	5.5	376	6
C22	+45°	8	1.55	33.5	57.8	0.2	5.4	376	6
C23	+45°	8	1.54	33.4	57.9	0.5	5.4	376	6
C24	<u>+45°</u>	8	1.53	33.6	57.2	1.3	5.4	376	6
C25	0°	6	1.51	38.0	52.7	0.9	5.7	376	3

^{*}ASTM D2734-70(B)

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Material: AS/3004

								-	
Lam. No.	Fiber Orien.	No. Plies	Spec. Grav.	Resin Content (%by wt)	Fiber Content (%by vol)	Void Content* (%by vol)	Thick- ness per ply (mils)	Prepreg Lot/ Batch No.	Prepreg Spool/Roll No.
C26	90°	15	1.54	30.8	59.9	1.7	5.5	376	3
C27	90°	15	1.56	31.2	60.4	0.2	5.4	376	3
C28	90°	15	1.54	33.4	57.7	0.7	5.5	376	3
C29	90°	15	1.54	34.8	56.4	0.2	5.4	376	3
C30	0°	40	1.56	31.6	60.1	0.1	5.4	376	3&9
C31	90°	15	1.53	33.5	57.2	1.3	5.5	376	3
C32	90°	15	1.52	34.5	56.1	1,3	5.4	376	3
C33	90°	30	1.54	34.4	57.0	0.1	5.1	376	3&9
C34	90°	15	1.53	34.4	56.6	0.7	5.3	376	3
C35	90°	15	1.54	32.0	59.0	1.2	5.5	376	9
C36	±45°	30	1.53	35.1	55.7	0.9	5.2	376	9
C37	90°	15	1.54	33.1	58.0	0.8	5.4	376	9
C38	90°	15	1.53	35.1	55.7	0.9	5.3	376	6
C39	90°	15	1.54	33.6	57.6	0.6	5.7	376	6
C40	<u>+</u> 45°	30	1.54	34.1	57.2	0.2	5.3	376	6
C41	+45°	8	1.51	32.8	57.3	2.6	5.4	376	6
C42	+45°	8	1.52	32.9	57.1	2.6	5.5	376	6
C43	+45°	8	1.50	33.9	55.9	2.9	5.5	376	6
C44	<u>+</u> 45°	8	1.50	32.7	56.8	3.5	5.6	376	6
C45	<u>+</u> 45°	8	1.52	32.7	57.4	2.4	5.4	376	6
C46	+45°	8	1.51	33.6	56.3	2.	5.4	376	6
C47	+45°	8	1.51	33.7	56.3	2 '	5.4	376	6
C48	+45°	8	1.53	33.6	57.3	1.	5.4	376	6
C49	+45°	8	1.54	33.7	57.3	0.8	5.4	376	6
C50	±45°	8	1.53	34.2	56.7	1.0	5.4	376	6

^{*}ASTM D2734-70(B)

Material: AS/3004

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Lam.	Fiber Orien.	No. Plies	Spec. Grav.	Resin Content (%by wt)		Void Content* (%by vol)	ness per ply	Prepreg Lot/ Batch No.	Prepreg Spool/Roll No.
C51	90°	15	1.51	35.3	53,7	1.7	5.4	376	10A
C52	90°	15	1.51	33.8	56.4	2.2	5.4	376	10A
C53	90°	15	1.53	33.6	57.3	1.1	5.3	376	10A
C54	+45°	8	1.53	33.0	57.6	1.7	5.3	376	10A
C55	+45°	8	1.52	32.1	58.2	2.2	5.3	376	10A
C56	±45°	8	1.52	34.0	56.6	1.5	5.4	376	10A
Avg.			1.53	33.6	57.2	1.1	5.5		
St.Dv.			0.02	1.6	1.7	0.9	0.2		
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^{*}ASTM D2734-70(B)

Material: AS/4397 Thick-Prepreg ness par Resin Fiber Void Lot/ Prepreg Spool/Roll Content Content Content' Batch Lam. Fiber No. Spec. ply (%by wt) (%by vol) (%by vol) Orien Plies Grav. (mils) No. No. No. D1 0 0 6 1.59 25.8 66.4 0.9 5.9 382 D3 00 6 1.56 29.6 62.4 1.2 5.9 382 2 **D4** 00 1.58 б 29.2 63.0 0.3 5.8 382 2 **D**5 00 1.53 6 34.1 56.5 2.2 382 5.8 2 **D6** 0 0 6 1.57 29.4 62.7 0.3 5.7 382 2 00 **D7** 6 1.56 28.5 62.7 2.0 5.7 382 2 D9 0 ° 1.60 14 28.0 66.0 ÷٥ 5.5 382 2 00 D10 20 1.56 28.2 62.9 2.2 5.3 382 2 D12 900 15 1.58 26.7 65.3 1.0 5.5 382 2

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LAMINATE PHYSICAL PROPERTIES

^{*}ASTM D2734-70(B). Photomicrographs showed all laminates to be practically void free.

Material: AS/4397

	rerra	· · AO	/437/						
Lam.	Fiber Orien	No. Plies	Spec. Grav.	Resin Content (%by wt)		Void Content* (%by vol)	Thick- ness per ply (mils)	Prepreg Lot/ Batch No.	Prepreg Spool/Roll No.
D29	+45°	8	1.58	28.0	64.6	≟ 0	5.6	382	2
D30	+45°	8	1.59	27.1	65.5	± 0	5.6	382	2
D31	+45°	8	1.58	28.5	63.9	* 0	5.6	382	2
D32	+45°	8	1.57	29.7	62.6		5.7	382	2
D33	+45°	8	1.56	28.1	64.1	≑ 0	5.8	382	2
D34	+45°	8	1.58	27.4	65.2	≟ 0	5.8	382	2
D35	+45°	8	1.59	28.6	63.7	0.3	5.7	382	2
D36	+45°	8	1.56	30.0	62.3	å 0	5.9	382	2
D37	±45°	8	1.56	29.1	63.2	≛ 0	5.7	382	2
D38	<u>+45°</u>	8	1.55	29.6	62.7	± 0	5.8	382	2
D39	±45°	8	1.59	28.3	64.1	å 0	5.9	382	2
D40	+45°	8	1.58	28.5	63.4	≐ 0	5.9	382	2
D41	±45°	8	1.56	28.6	63.9	≐ 0	5.8	382	2
D44	0°	20	1.54	31.0	61.2	≐ 0	5.5	382	2
D46	0°	6	1.58	28.0	64.0	≑ 0	5.8	382	3
D48	0°	14	1.55	30.9	61.3	≐ 0	5.7	382	3
D49	0°	20	1.55	30.1	62.1	÷ 0	5.5	382	3
D57	0°	6	1.54	30.5	61.8	∸ 0	5.4	382	3
D58	90°	15	1.55	29.2	63.2	÷ 0	5.7	382	3
D59	+45°	20	1.55	30.2	62.0	* 0	5.5	382	3
D60	+45°	20	1.55	29.9	62.4	≛ 0	5.5	382	3
Avg.			1.57	28.5	63.6	≐ 0	5.6		
St.Dv.		_	0.02	1.8	2.1		0.2		

^{*}ASTM D2734-70(B). Photomicrographs showed all laminates to be practically void free.

Material: T300/F178

							C 654		,
Lam. No.	Fiber Orien	No. Plies	Spec. Grav.	Resin Content (%by wt)	Fiber Content (%by vol)	Void Content (tby vol)	Thick- ness per ply (mils)	Prepreg Lot/ Batch No.	Prepreg Spool/Roll No.
E4	0°	6	1.57	33.3	56.6	0.2	6.0	DP021	5
E5	0°	6	1.57	27.1	65.3	≐ 0	5.2	DPO21	5
E6	0°	6	1.55	30.6	60.3	0.3	5.2	DP021	5
E7	0°	6	1.54	30.1	60.7	0.3	5.0	DPO21	5
E8	0°	6	1.55	29.7	60.4	1.0	5.0	DP021	5
E9	0°	14	1.55	28.9	61.4	1.0	5.4	DP021	5
E10	90°	15	1.58	32.1	57.3	0.7	5.0	DPO21	4
Ell	90°	15	1.58	30.3	60.5	0.2	5.1	DPO21	4
E12	90°	14	1.57	35.5	53.5	≐0	5.1	DP021	4
E13	90°	15	1.58	29.6	61.6	0.3	5.1	DP021	4
E14	90°	15	1.58	29.1	62.1	0.1	5.2	DP021	4
E15	90°	15	1.60	31.7	58.5	0.3	5.1	DPO21	4
E17	90°	15	1.59	32.5	57.5	0.2	5.2	DPO21	4
E18	90°	15	1.58	31.6	59.2	0.1	5.1	DPO21	4
E19	90°	15	1.59	28.8	62.3	0.3	5.1	DPO 21	4
E20	90°	15	1.58	31.8	58.6	0.1	5.1	DPO21	4
E21	0°	6	1.57	33.4	56.4	0.2	5.3	DPO 21	4
E22	0°	6	1.57	29.5	61.8	0.2	5,2	DPO 21	4
E23	90°	15	1.59	32.2	55.6	≐0	5.3	DEO 51	4
E24	0°	6	1.59	26.7	65.9	≐ 0	5.0	DPO 21	4
E25	0°	6	1.56	30.3	59.2	0.2	5.5	DPO 21	4
E26	90°	15	1.53	33.8	55.8	1.0	5.8	DEO 51	4
E27	90°	15	1.57	37.4	53.2	≐ 0	5.4	DPO 21	4
E28	90°	15	1.56	36.2	52.1	0.8	5.6	DPO 21	4
E29	90°	15	1.53	33.6	55.3	1.0	5.7	DPO 21	4

LAMINATE PHYSICAL PROPERTIES Material: T300/F178 Thick-Prepreg Resin Fiber Void ness per Lot/ Prepreg Spool/Roll Fiber No. Spec. Content Content Content ply Batch Lam. Plies (%by wt) (%by vol) (%by vol) (mils) No. No. No. Orien. Grav. E30 90° 15 1.58 33.3 56.4 0.3 5.4 DPO21 4 00 E31 20 1.57 35.5 53.8 0.1 5.4 **DP021** 4 E32 0 0 40 1.59 32.2 58.0 0.2 5.0 4 DPO21 E33 00 1.60 32.8 40 56.8 DPO21 5 0.6 5.2 E34 +45° 1.62 30.9 8 59.7 0.1 5.5 DPO21 5 E35 +45° 1.62 27.4 **≐**0 8 66.4 DPO21 5 6.0 +45° E36 8 1.64 30.4 5.4 5 60.5 **÷**0 DPO21 +45° E37 1.57 8 31.4 59.0 0.2 5.5 DPo21 5 E39 +45° 8 1.59 27.7 64.0 **40** 6.1 DPO21 5 E40 +450 8 1.57 28.4 63.1 **≟**0 6.0 DPO21 5 E41 +45° 8 1.58 28.3 63.2 **≟**0 5.1 DP021 5 E42 +45° 1.61 25.4 8 67.0 ٥÷ 5.5 DP021 5 E43 +45° 1.59 27.7 8 5.3 5 64.0 0.2 DPO21 E44 +45° 8 1.59 26.7 65.1 0.1 5.2 DPO 21 5 E46 +45° 40 1.58 32.6 57.5 0.2 5.1 DPO 21 5 E47 +45° 1.59 30.7 5.3 40 60.2 0.1 DPO 21 5 E48 +45° 1.58 28.3 8 63.4 0.1 5.4 DPO 21 5 5.7 E49 90° 15 1.58 32.9 56.1 **÷**0 DPO 21 5 E50 900 15 1.57 34.1 55.6 0.1 5.7 DPO 21 5 E51 90° 15 1.58 5 33.4 56.3 0.3 5.7 DPO 21 E52 90° 15 1.59 28.4 DPO 21 63.2 0.2 5.6 5 E53 90° 15 1.56 31.9 58.9 **÷**0 5.6 DP 021 Avg. 1.58 31.6 59.5 0.2 5.4

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TENSION DATA

All of the tension data generated during this program are listed in this section. These data are summarized and presented in both tabular and graphical form in Section 4.

Test:	Tension			Mate	Material: SP313	w.		
		Test	Ultimate		Stress at		Ultimate	
Spec.	Fiber	Temp.	Strength	Modulus	Prop. Lim.	Pois.	Strain	
SO.	orien.	('E')	(10~bsi)		(10~ps1)	Ratio	(11/11)	Remarks
A1-6	0.0	-67	147.7	21.5	147.7	0.40	0.0070	
A2-6	00	-67	145.5	20.0		0.29	* **	
A4-14	00	-67	153.6	1,9.9	1	1111	1 4 4	
A1-12	0.0	-67	133.2	19.4	1			
A6-15	0 و	-67	151.0	20.6	151.0	0.36	0.0071	
Avq.			146.2	20.7		0.36	0.00705	
Std. Dev			7.9	1.2		0.06	0.00007	
				,				
A1-10	00	72	183.9	19.3	183.9	0.31	0.0092	
A2-11	0 •	72	182.0	20.5	182.0	0.32	0.0084	
A4-5	0 0	72	218.2	19.5	218.2	0.27	1 1	
A5-16	<u>.</u> 60	72	200.8	20.1	200.8	0.33	0.0093	-
A6-2	0 0	72	213.1	21.1	213.1	0.34	C.0094	
A3-17	۰0	72	194.3	21.1	194.3	0.36	0.0086	
A3-2	0.0	72		19.9		0.32	1	
Avg.			198.7	20.3	198.7	0.32	0.0000	
Std.Dev			14.9	1.1	14.9	0.03	0.000449	
A4-15	0.0	260	162,3	19.4	162.3	0.33	0.0079	
A5-11	0.0	260	177.8	20.2	177.8	0.29	0.0080	
A6-6	00	260	182.0	19.0	182.0	0.34	0.0091	
A7-2	°	260	176.5	18.5	176.5	0,32	0.0091	
A3-7	° 0	260	184.5	19.6	184.5	0.30	0.0089	
Avg.			176.6	19.3	176.6	0.32	0.0086	
Std.Dev			8.6	9.0	8.6	0.02	9000.0	

Teat:	Tension			Mat∈	Material: SP313	13		
(Test	Ultimate		Stress at	•	Ultimate	
Spec. No.	Fiber Orien.	Temp. (°F)	Strength (10 ³ psi)	Modulus (10 ⁶ psi)	Prop.Lim. (10 ³ psi)	Pois. Ratio	Strain (in/in)	Remarks
A1-5	0 0	350	139.4		139.4	0.35	0.0069	
A4-6	00	350	117.2	19.6	85.8	0.31		
A6-11	00	350	149.3	20.0	134.7	0.35	0.0076	
-1		350	146.2	19.3			0.0073	
A7-17	0,0	350	156.3	19.2	1		0.0077	
Avg.			141.7	19.5	130.8	0.34	0.0074	
Std.Dev.			15.0	0.3		0.02	0.000316	
A16-8	06	-67	5.24	1.47	5.24		0.0037	
A17-3	•06	-67	5.83	1.19	5,83		0.0043	
	06	-67	5.60	1.44		1	0.0038	
A19-11	406	-67	5.26	1.40		***	0.0037	
A20-1	06	-67	4.08	1.46			0.0028	
Avg.			5.20	1.39	5.20		0.0037	
Std.Dev.			0.67				0.000540	
A16-3	06،	72	4.60	1.28	4.60		0.0035	
A17-9	06	72	4.82	1.30	4.82		0.0037	
A18-4	°06	72	4.88	1.28	4.88		0.0038	
A19-1	06	72	4.87	1.34	4.87		0.0037	
A20-10	06	72	5.36	1.28	5.36		0.0042	
A22-1	906	72	5.15	1.31	5,15		0.0040	
Avg.			4.94	1.30	4.94		0.0038	
Std.Dev.			0.27	0.03	0.27		0.0003	

Test:	Tension			Mate	Material: Sp	SP313		
		Test	Ultimate		Stress at		Ultimate	
Spec.	Fiber	Temp.	Strength	Modulus	Prop. Lim.	Pois.	Strain	•
S	Orien.	(*F)	(10°psi)	1	(10-ps1)	Ratio	(1n/1n)	Remarks
A16-9	06،	260	4.22	1.05	3.55	1 1	0.0040	
A17-7	•06	260	5.05	1.02	5.05		0.0049	
A18-7	606	260	4.01	•	3,37		0.0040	
A19-5	066	260	5.41	•	5.17	1	0.0049	
A20-7	606	260	5,11	1.09	3,45		0.0048	
AVG.			4.76	-	4.3.2	1	0.0045	
3td.Dev.			0.61	0.05	0.61	1	0,0005	
A16-4	06،	350	3.86	1.17	09.0		0.0041	
A17-1	06	350	4.21	1.03	1.95		0.0046	
A18-2	06،	350	3.31	0.99	1.93		0.0036	
A19-3	06 و	350	3.84	1.16	1,16		0.0044	
A20-11	06	350	3.25	06.0	2.29		0.0038	
Avg.			3,69	1.05	1,59		0.0041	
Std. Dev.			0.41	0.12	69.0		0.00041	
A38-8	±45°	-67	•	•	8.44	•	•	
A39-3	±45°	-67	•	•	9.56		•	
A44-10	±45°	-67	24.50		7.66		0.0115	
n47-1	±45°	-67	25.10		7.23	0.68	•	
A50-11	±45°	-67	•	2.87			0.0111	
Avg.			24.50	•	8.28	0.66	0.0112	
Std.Dev.			0.36	• • •		0.04	0.000894	
A38-7	±45°	72	20.67	2.61	8.00	0.74	0.0174	
A39-9	±45°	72	21.18	2.80	5.01	0.70	0.0150	
N44-4	±45°	72	20.85	2.76	6.33	0.80	0.0124	
A47-10	±45°	72	20.68	2.46	6.71	0.68	0.0143	
A50-1	1	72	21.58	2.87	5.23	0.74	0.0121	
Avg.			20.99	2.70	5.86	0.73	0.0142	
Std.Dev.			0.39	0.17	0.72	0.05	0.0022	

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		Remarks																							
	Ultimate	Strain (in/in)	0.0285		0.0275	0.0330	0.0199	0.0270	0.0054	0.025	0.031	0.029	0,033	0.022	0.028	0.005					-				
3	,	Pois.	0.75	0.72	08.0	0.71	0.72	0.74	0.04	0.82	0.80	0.85	0.83	0.85	0.83	0.02									
Material: SP313	Stress at	Prop. Lim. (10 3psi)	4.33	3.89	4.09	3.18	3.78	3.86	0.43	2,22	2.67	2.68	3.18	2.39	2.63	0.37									
Mate		Modulus (105psi)	1	2.04	2.24	2.00	2.13	2.12	0.10	•		٠,	٠.	1.89	} •	•									
	Ultimate	Strength	14.89	15.56	15.00	15.11	14.52	15.02	0.38	10.33	10.33	10.95	12.73	10.34	10.94	1.04									
	Test	Temp.	260	260	260	260	260			350	350	350	350	350											
Tension		Fiber	+450	+450	+45°	±45°	±45°			±45°	+450	±45°	±45°	±45°											
Test:		Spec.	A 38-9	A39-7	A44-7	A47-7	A50-5	AVG.	Std.Dev.	A.38-4	A39-1	A44-2	A47-11	A50-3	Avg.	Std. Dev.									

Spec. Fiber Temp. Strength No. Orien. (°F) (10 ³ psi) (10 ³ psi) (29-8 0° -67 206.3 C11-8 0° -67 206.1 C8-11 0° -67 212.8 C11-9 0° -67 214.9 Avg. C10-15 0° 72 180 187.1 C7-13 0° 180 180.6 C7-9 0° 180 180.6 C7-9 0° 180 180.6 C7-9 0° 180 180.6 C7-9 0° 180 191.5 Std.Dev. C9-9 0° 250 149.7 C7-6 0° 250 179.4 C10-15 0° 250 179.4 C10-15 0° 250 179.4 C7-6 0° 250 179.4	Ultimate						
lo. Fiber Temp. -8 0° -67 -18 0° -67 -8 0° -67 -9 0° -67 -9 0° -67 -19 0° 72 -14 0° 72 -15 0° 180 -19 0° 180 -19 0° 250 -10 0° 250	CATON CATO		Stress at		Ultimate		
-8 0° -67 -11 0° -67 -8 0° -67 -8 0° -67 -67 -1-9 0° -67 -1 0° 72 -1 0° 72 -1 0° 72 -1 0° 72 -1 0° 180 -1 0° 180 -1 0° 180 -1 0° 180 -1 0° 250 -1 0° 250	(10^{3}psi)	Modulus (10 ⁶ ps1)	Prop.Lim. (103psi)	Pois. Ratio	Strain (in/in)	Remarks	
1-8 0° -67 -11 0° -67 -8 0° -67 -9 0° -67 -67 0° -67 -1 0° 72 -1 0° 72 -1 0° 72 -1 0° 72 -1 0° 180 -1 0° 180 -1 0° 180 -1 0° 180 -1 0° 250 -1 0° 250	206.3		206.3	0.33		A CONTRACTOR OF THE PROPERTY O	
-11 0° -67 -8 0° -67 -9 0° -67 -9 0° -67 -1 0° 72 -1 0° 72 -1 0° 72 -1 0° 72 -1 0° 72 -1 0° 72 -1 0° 72 -1 0° 180 -1 0° 180 -1 0° 180 -1 0° 180 -1 0° 180 -1 0° 250 -1 0° 250 -1 0° 250 -1 0° 250 -1 0° 250 -1 0° 250 -1 0° 250 -1 0° 250 -1 0° 250 -1 0° 250 -1 0° 250 -1 0° 250	206.1	18.42	206.1	0.31	0.0107	Andrews with the state of the s	1
-8 0° -67 967 967 1-9 0° -67 -1 0° 72 1-1 0° 72 0-5 0° 72 9. 72 9. 180 180 180 190 190 9 0° 180 9 0° 180 9 0° 250 9 0° 250 1-1 0° 250 9 0° 250	162.4	17.66	162.4	0.32	0.0088		
1-9 0° -67 9. Dev. -7 0° 72 -1 0° 72 -1 0° 72 -14 0° 72 9. Dev. -15 0° 180 -14 0° 180 -14 0° 180 -14 0° 250 9. Dev. -1 0° 250 -1 0° 250 -1 0° 250 -1 0° 250 -1 0° 250 -1 0° 250 -1 0° 250 -1 0° 250 -1 0° 250 -1 0° 250 -1 0° 250 -1 0° 250 -1 0° 250 -1 0° 250 -1 0° 250 -1 0° 250 -1 0° 250	212.8	۲.	212.8	•	•		
9. Dev. -7 0° 72 -1 0° 72 -1 0° 72 -1 0° 72 -1 0° 72 -1 0° 72 -1 1 0° 72 -1 1 0° 72 -1 1 0° 72 -1 1 0° 180 -1 1 0° 180 -1 1 0° 180 -1 1 0° 250 -1 1 0° 250 -1 1 0° 250 -1 1 0° 250 -1 1 0° 250 -1 1 0° 250 -1 1 0° 250 -1 1 0° 250 -1 1 0° 250 -1 1 0° 250 -1 1 0° 250	214.9	18.53	214.9	0.32	0.0110		
-7 0° 72 -1 0° 72 -1 0° 72 -1 0° 72 0-5 0° 72 9 0° 72 9 0° 180 -14 0° 180 -14 0° 180 9 0° 180 9 0° 250 9 0° 250 -9 0° 250 -14 0° 250 -15 0° 250 -15 0° 250 -15 0° 250	200.5	φ.	200.5				-
-7 0° 72 -1 0° 72 0-5 0° 72 -14 0° 72 9 72 9 180 -15 0° 180 -180 -19 0° 180 9 0° 180 9 0° 250 9 0° 250 1-14 0° 250 9 0° 250 1-14 0° 250 1-14 0° 250 1-15 0° 250 1-16 0° 250 1-16 0° 250 1-17 0° 250	21.6	0.39	21.6	1 -1	임		-
1-1 0° 72 1-1 0° 72 0-5 0° 72 1-4 0° 72 9° 72 9° 72 180 180 180 190 1-14 0° 180 9° 180 9° 180 9° 250 1-14 0° 250		ı	- 1	- 1			
1-1 0° 72 0-5 0° 72 1-1 0° 72 1-1 0° 72 9. 72 9. 180 1-1 0° 180 9 0° 180 9 0° 180 9 0° 250 1-14 0° 250 9 0° 250 1-14 0° 250 1-14 0° 250 1-14 0° 250 1-14 0° 250 1-14 0° 250 1-15 0° 250	184.9	•	•	0.38	0.0100		
1-1 0° 72 0-5 0° 72 -14 0° 72 g. 72 9 0° 180 -15 0° 180 -13 0° 180 -9 0° 180 9 0° 250 1-14 0° 250 -9 0° 250 -9 0° 250 -9 0° 250 -15 0° 250 -15 0° 250	160.0	16.32	160.0	0.34	0.0091		_
0-5 6° 72 -14 0° 72 9	184.9	•					
9. Obev. -15 0° 180 -14 0° 180 -14 0° 180 -13 0° 180 -9 0° 180 9. O-1 0° 180 -9 0° 250 -9 0° 250 -14 0° 250 -15 0° 250	187.1	16.24	187.1	0.32	0.0105		-
9. Dev. -15 0° 180 -14 0° 180 -13 0° 180 9 0° 180 9 0° 250 -14 0° 250 -14 0° 250 -15 0° 250 -15 0° 250	222.6	17.46	222.6	0.40)		
0. Dev. -15 0° 180 -14 0° 180 -9 0° 180 9. 180 9. 250 1-14 0° 250 -9 0° 250 -9 0° 250 -9 0° 250 -1 0° 250 -1 0° 250	187.9		187.9		0.0101		
-15 0° 180 -14 0° 180 -13 0° 180 -9 0° 180 9. -9 0° 250 -9 0° 250 -14 0° 250 -6 0° 250 -6 0° 250 -7 0° 250	22.4	0.76	22.4	0.05	•		
-15 0° 180 -14 0° 180 -13 0° 180 -9 0° 180 9. -9 0° 250 -9 0° 250 -14 0° 250 -6 0° 250 -6 0° 250 -7 0° 250							
0° 180 0° 180 0° 180 0° 180 0° 250 0° 250 0° 250 0° 250	124.6		124.6		0.0000		
0° 180 0° 180 0° 180 0° 250 0° 250 0° 250 0° 250	191.4	16.30	191.4		0.0105		,
0° 180 0° 180 0° 250 0° 250 0° 250 0° 250	180.6	15.88	180.6	0.31	0.0105		
0° 180 0° 250 0° 250 0° 250 0° 250	202.6	15.79	202.6				
0° 250 0° 250 0° 250 0° 250 0° 250	258.3	16.73	258.3	0.33	0.0145		
0° 250 0° 250 0° 250 0° 250 0° 250	191.5	16.18	191.5	0.32	0.0106		
0° 250 0° 250 0° 250 0° 250 0° 250	47.9	0.37		0.06	0.0031		
0° 250 0° 250 0° 250 0° 250							
0° 250 0° 250 0° 250 0° 250	149.7	15.73	149.7	0.41	0600.0		
0° 250 0° 250 0° 250	197.7	18.00	197.7	0.34	0.0097		
0° 250	192.8	18.04	192.8	0.28	0.0100		
0° 250	176.1	17.66	176.1		0.0091		
	179.4	18.06		0.34	0.0092		
	179.1	17.50	179.1	0.34	0.0094		
Std.Dev. 18	18.7	1.00		* * 1	0.0004		

rest:	norsuer.			יז מנין	March Tar . Wo	12 3 4 T		
		Test	Ultimate		Stress at		Ultimate	
Spec.	Fiber Orien.	Temp.	Strength (10 ³ psi)	Modulus (106psi)	Prop.Lim. (103psi)	Pois. Ratio	Strain (in/in)	Remarks
8-5	06	-67	6.27	1.14	6.27	1	0.0055	
C26-3	06	-67	7.67	1.13	7.67		0.0067	
7-1	900	-67	4.58	6	4.58		7	
C26-6	60ء	-67	7.32	1,11	7,32		0,0063	
7-2	06	<i>L</i> 9-	8.26		8.26	***	0.0078	
9.			6.82		6.82		0,0062	
Std.Dev			1.45	0.10	1.45		0.0011	
212	000	7.7	.0	1 40	10 3		0 0035	
7-	000	7.2	5 54	4	5.54	91 40 94	9 1	
5-4	006	72	3.41	1.08	3.41			
0-910	006	72	5.14	•	5.14	****		
7-5	06	72	6.02	4 -	2.46		0,0054	
Avg.			5.02	1,15	4,31	144 449	0.0044	
Std.Dev.			0.98	• • •	1.32	100 to 100	0.0010	
				•				
5-5	90ء	180	3.17	1.06	3.17		0:0030	
C17-3	06	180	6.76	1.11	6.76		0.0063	
6-1	90ء	180	4.57	• •	4.57	1	0.0045	
C15-7	•06	180	5.40	•	3.49		0.0051	
8-8	90ء	180	4.75	1.10	4.75		0.0044	
Avg.			4.93	1.07	4.55	******	0.0046	
Std.Dev.			1:31	0.04	1.41		0.0011	
				- 1	- 1			
C27-8	。06	250	4.80	1.09	4.80		0.0044	
7-7	06	250	6.56	1.08	1 7 2			
7-6	06 ه	250	5.98	1,09	3.81	4 1 1	0.0057	
C26-1	06	250	4.19	1.01	3,39		0.0043	
C26-4	906	250	5.45	1.10	4.12		0.0051	
Avg.			5.39	1.07	4.03		0.0049	
04-2 Days			70.0	0.03	0.59	1	2,000,0	

Test:	Tension			Mat	Material: AS/	3/3004		
		Test	Ultimate	Initial	Stress at		Ultimate	
Spec.	Fiber	Temp.	Strength		Prop. Lim.	Pois.	Strain	į
ON	Orien.	(4F)	(10 psi)	(10°ps1)	(10-ps1)	Ratio	(in/in)	Remarks
C23-1		-67	41.96	2.00	4.37	0.83	0.0200+	Surface plies
C22-7		L9 -	43.12	2.09	6.26	٠ ١	0.0200+	1
C21-6		-67	2	2.04	4.93	0.89	0.0200+	discontinuities
C23-6	±45°	19 -	42.84		•	1	0.0340+	in dages
C24-4		<i>L</i> 9-	38.05	1.88	4.65	٠	0.0035+	
Avg.			41.62			0.81	0.0195+	Andreas de la companya del la companya de la compan
Std. Dev.			2.05	• •	•	•		
C21-1	±45°	72	33.06	1.91	3.63	0.53	0.0280+	
C20-3	±45°	72	29.96	1.99		0.78	0.0790+	
C20-5	±45°	72	31.09	2.14	1 +		0.0230+	
C19-4	± 4 5°	72	30.67	1.98	4.54	0.87	0.0160+	
C21-3	±45°	72	34.87	١.	: .	i •	0.0520+	THE THE PROPERTY OF THE PROPER
Avg.			31.93	٠.			0.0400+	
Std.Dev.			1.79	0.11		0.13	***	
								-
C20-8	±45°	180	25.09	1,88	3.80	0.89	0.0390+	
C19-6	±45°	180	29,30	2.00	4,28			
C19-8	+450	180	28.23	1.90		. 4	0.0540+	
C21-7	±45°	180	30.04	1.92	3.80	0.83	0.0290+	
C20-4	±45°	180	26.16	•			0.0270+	4
Avg.			27.76	•			0.0406+	
Std.Dev.			2.09	0.05	0.23	0.05	********	
C24-6	±45°	250	23.53	1.72		0.77	0.0315+	
C19-1	±45°	250	24.14	1.77		0,76	0	
C19-7	±45°	250	23.77	1.89		0.89	•	
C23-3	±45°	250	25.14	1.84			0	
C21-2	±45°	250	24.90	1.96		-	0.0580+	
Avg.			24.30	٠	3.13	0.81	0.0416+	
Std. Dev.			0.70	60.0			****	

Initial	Stress at	Doia	Ultimate Strain	
(106psi)	(103psi)	Ratio	(in/in)	Remarks
		0.31	-	
	197.7	0.32	0.0093	
	200.0	30.53	0.0093	
-	189.6	0.31	0.004	
-	195.0	0.31	0.0093	
0.	4	0.02	0.003	
18			0.0107	
1.7			0.0108	
1.			0.010.0	Complete to the second control of the second
	194.4	0.31	0.0099	
	195.8	0.31	0.0097	
	208.4		0.0101	
	203.3	0.30	0.0103	
		0.02	0.000	
10 60	7 666	0.29	0.0115	
1	1.40.7	0 28	0.0086	
+	1.47.	300	2222	
1	103 7	0.37	0.0093	
+	138.9	0.31		
_	191.6		0.0100	
	179.1	•	0.0099	
7.	30.8	•	0.0012	A STATE OF THE PROPERTY OF THE
	_	-		
				1
	Initial Modulus (106psi) 19.85 19.88 19.38 19.38 19.74 17.49 18.47 17.49 18.25 19.24 19.37 18.88 19.37 18.88	Initial Stress Modulus Prop.L (106psi) (103ps 19.88 197. 19.88 197. 19.38 195. 19.46 4. 17.64 208. 17.64 208. 17.64 208. 18.71 194. 18.71 194. 18.71 195. 19.06 208. 18.25 203. 19.26 149. 19.37 193. 19.37 193. 19.30 191.88 179.	Initial Stress at Modulus Prop.Lim. Po. (106psi) (103psi) Ra 19.88	Initial Stress at Modulus Prop.Lim. Pois. Strain (106psi) (103psi) Ratio (in/in) (106psi) (103psi) Ratio (in/in) 19.88

Spec. Fiber Test Test Ultimate Initial Stress at Strain Nodius. Strength Modulus Prop. Lin. Strength Modulus Prop. Lin. Olithmate Strength Modulus Prop. Lin. Pois. Strain Strain Strength Modulus Prop. Lin. Pois. Strain Strain Strength Modulus Prop. Lin. Pois. Strain Strength Modulus Prop. Lin. Pois. Strain Strength Modulus Prop. Lin.	Test:	Tension			Mate	Material: AS/	AS/4397		
Fiber Temp. Strength Modulus Prop.Lim. Pois. Strain Orien. (°F) (10 ³ psj) (10 ⁶ psj) (10 ⁵ psj) Ratio (in/in) 0.0 450 217.1 17.81 217.1 0.29 0.0111 0.0 450 217.6 18.55 217.6 0.36 0.0110 0.0 450 206.3 18.97 206.3 0.0106 0.0 450 206.1 17.80 206.1 0.32 0.0106 0.0 450 206.5 18.14 206.5 0.33 0.0109 13.0 0.59 13.0 0.002 0.05 13.0 0.05 0.003 0.			Test	Ultimate	Initial			Ultimate	
0° 450 217.1 17.81 217.1 0.29 0.0111 0° 450 217.6 18.55 217.6 0.36 0.0110 0° 450 217.6 18.55 217.6 0.36 0.0110 0° 450 206.3 18.97 206.3 0.0109 0° 450 18.14 206.5 0.33 0.0109 0° 450 18.14 206.5 0.33 0.0109 90° -67 5.00 1.49 4.56 0.0034 90° -67 5.45 1.49 5.26 0.0034 90° -67 5.66 1.45 5.29 0.0034 90° -67 5.66 1.45 5.29 0.0036 90° -67 5.25 1.39 5.25 0.0039 90° 72 5.25 1.39 5.34 0.0039 90° 72 5.85 1.39 5.85 0.0039 90° <td>Spec.</td> <td>Fiber</td> <td>Temp.</td> <td>Strength</td> <td>Modulus (106mei)</td> <td>Prop. Lim.</td> <td>Pois.</td> <td>Strain (in/in)</td> <td>Remarks</td>	Spec.	Fiber	Temp.	Strength	Modulus (106mei)	Prop. Lim.	Pois.	Strain (in/in)	Remarks
0° 450 217.6 18.55 217.6 0.36 0° 450 206.3 18.97 206.3	7-4-7	00	450	217 1	17 81	217 1	0, 0	11100	
0° 450 206.3 18.97 206.1 0.32 0° 450 206.1 17.80 206.1 0.33 0° 450 185.4 17.57 185.4 0.33 0° 450 185.4 17.57 185.4 0.33 13.0 206.5 18.14 206.5 0.33 90° -67 5.00 1.46 5.00 90° -67 5.45 1.49 5.45 90° -67 5.45 1.49 5.26 90° -67 5.26 1.45 5.29 90° -72 5.25 1.39 5.25 90° 72 4.94 1.39 5.34 90° 72 5.46 1.39 5.34 90° 72 5.85 1.39 5.34 90° 72 5.85 1.39 5.37 <td< td=""><td>D5-18</td><td></td><td>450</td><td>217.6</td><td>18.55</td><td></td><td>0.36</td><td>0.0110</td><td></td></td<>	D5-18		450	217.6	18.55		0.36	0.0110	
0° 450 206.1 17.80 206.1 0.33 0° 450 185.4 17.57 185.4 0.33 0° 450 185.4 17.57 185.4 0.33 13.0 206.5 181.4 206.5 0.33 90° -67 5.00 1.46 5.00 90° -67 5.45 1.49 4.56 90° -67 5.45 1.49 4.56 90° -67 5.29 1.47 5.29 90° -67 5.29 1.47 5.29 90° 72 5.29 1.39 5.25 90° 72 5.25 1.39 5.25 90° 72 5.85 1.39 5.34 90° 72 5.85 1.39 5.34 90° 72 5.37 1.39 5.37 90° 72 5.37 1.39 5.37 <	D3-10		450	206.3	18.97		******	0.0106	
0° 450 185.4 17.57 185.4 0.33 13.0 206.5 18.14 206.5 0.33 13.0 0.59 13.0 0.03 90° -67 4.56 1.49 4.56 90° -67 5.45 1.49 4.56 90° -67 5.45 1.47 5.45 90° -67 5.66 1.45 5.29 90° -67 5.29 1.47 5.29 90° 72 5.29 1.47 5.29 90° 72 5.25 1.39 5.25 90° 72 5.46 1.40 5.46 90° 72 5.34 1.39 5.34 90° 72 5.85 1.39 5.36 90° 72 5.37 1.39 5.37 90° 72 5.37 1.39 5.37 90° 72 5.37 1.39 5.37 90° 90° 90° 90° 90° 90° 90°	D3-19	0 ه	450	206.1	17.80		0.32	***	
90° -67 5.00 1.46 5.00 90° -67 4°56 1.49 4.56 90° -67 4°56 1.49 4.56 90° -67 5.45 1.49 5.78 90° -67 5.29 1.45 5.26 90° 72 5.29 1.45 5.26 90° 72 5.26 1.39 5.25 90° 72 5.46 1.39 5.25 90° 72 5.46 1.39 5.34 90° 72 5.34 1.39 5.35 90° 72 5.34 1.39 5.35 90° 72 5.34 1.39 5.35 90° 72 5.34 1.39 5.35 90° 72 5.35 1.39 5.35 90° 72 5.85 1.39 5.35 90° 72 5.35 1.39 5.37 90° 72 5.35 1.39 5.35	D5-1.3	0 ه	450	185.4	17.57		0.33	0.0109	
90° -67 5.00 1.46 5.00 90° -67 4.56 1.49 4.56 90° -67 5.45 1.49 4.56 90° -67 5.26 1.47 5.28 90° -67 5.26 1.47 5.29 90° 72 5.25 1.39 4.94 90° 72 4.94 1.39 5.25 90° 72 5.46 1.40 5.46 90° 72 5.34 1.39 5.34 90° 72 5.85 1.39 5.34 90° 72 5.85 1.39 5.35 90° 72 5.85 1.39 5.37 90° 72 5.85 1.39 5.37 90° 72 5.35 1.39 5.37 90° 72 5.35 0.01 0.33 0.01 0.	Avg.			206.5	18.14			0.0109	
90° -67 5.00 1.46 5.00 90° -67 4.56 1.49 4.56 90° -67 5.45 1.47 5.45 90° -67 5.78 1.49 5.78 90° -67 5.29 1.47 5.29 90° 72 5.29 1.39 5.29 90° 72 5.46 1.39 5.25 90° 72 5.46 1.39 5.36 90° 72 5.85 1.39 5.36 90° 72 5.85 1.39 5.36 90° 72 5.37 1.39 5.37 90° 72 5.37 1.39 5.37 90° 72 5.37 1.39 5.37 5.37 1.39 5.37 6.33 0.01 0.33 0.01 0.33	Std.Dev.			13.0	0.59		0.03	0.0002	
90° -67 5.00 1.46 5.00 90° -67 4.56 1.49 4.56 90° -67 5.78 1.49 5.45 90° -67 5.29 1.45 5.78 90° -67 5.26 1.45 5.66 90° 72 5.29 1.47 5.29 90° 72 5.25 1.39 5.25 90° 72 5.46 1.40 5.46 90° 72 5.34 1.39 5.34 90° 72 5.34 1.39 5.34 90° 72 5.37 1.39 5.35 90° 72 5.37 1.39 5.37 90° 72 5.37 1.39 5.37 90° 72 5.37 1.39 5.37 90° 72 5.37 0.01 0.33 <									
90° -67 4.56 1.49 4.56 90° -67 5.45 1.49 5.45 90° -67 5.29 1.47 5.29 90° -67 5.29 1.47 5.29 90° 72 5.25 1.39 5.25 90° 72 4.94 1.39 4.94 90° 72 5.46 1.40 5.46 90° 72 5.34 1.39 5.34 90° 72 5.36 1.39 5.36 90° 72 5.37 1.39 5.35 90° 72 5.37 1.39 5.37 90° 72 5.37 1.39 5.37 90° 72 5.37 1.39 5.37 90° 72 5.37 0.01 0.33	D15-6	۰06	<i>L</i> 9-	5.00	1.46	5.00	•	0.0034	
90° -67 5.45 1.47 5.45 90° -67 5.28 1.49 5.78 90° -67 5.29 1.47 5.29 90° 72 5.25 1.39 5.25 90° 72 5.46 1.40 5.46 90° 72 5.34 1.39 5.34 90° 72 5.34 1.39 5.35 90° 72 5.34 1.39 5.35 90° 72 5.34 1.39 5.35 90° 72 5.34 1.39 5.35 90° 72 5.35 1.39 5.35	D19-2	06 ه	-67	,	•	4.56		0.0031	
90° -67 5.78 1.49 5.78 90° -67 5.66 1.45 5.66 90° -67 5.29 1.47 5.29 90° 72 5.25 1.39 5.25 90° 72 5.46 1.40 5.46 90° 72 5.34 1.39 5.34 90° 72 5.36 1.39 5.34 90° 72 5.36 1.39 5.35 90° 72 5.36 1.39 5.37 90° 72 5.37 1.39 5.37 90° 72 5.37 1.39 5.37 90° 72 5.37 1.39 5.37 90° 72 5.37 0.01 0.33	D17-8	06ء	-67		1.47	5.45		0.0037	
90° -67 5.26 1.45 5.66 90° 72 5.29 1.47 5.29 90° 72 5.25 1.39 5.25 90° 72 4.94 1.39 5.46 90° 72 5.46 1.40 5.46 90° 72 5.34 1.39 5.34 90° 72 5.85 1.39 5.34 90° 72 5.85 1.39 5.34 90° 72 5.35 1.39 5.34 90° 72 5.35 1.39 5.35 90° 72 5.35 1.39 5.35 90° 72 5.35 1.39 5.37 90° 72 5.37 90° 72 5.37 90° 72 5.37 90° 9 9 <td< td=""><td>D20-5</td><td>90,0</td><td>-67</td><td>٠ ١</td><td>1.49</td><td>5,78</td><td>1</td><td>6500.0</td><td></td></td<>	D20-5	90,0	-67	٠ ١	1.49	5,78	1	6500.0	
90° 72 5.29 1.47 5.29 90° 72 5.25 1.39 5.25 90° 72 4.94 1.39 5.25 90° 72 5.34 1.39 5.34 90° 72 5.34 1.39 5.34 90° 72 5.37 1.39 5.35 90° 72 5.37 1.39 5.37 90° 72 5.37 1.39 5.37 90° 72 5.37 1.39 5.37 90° 72 5.37 1.39 5.37 90° 9.33 0.01 0.33	D20-2	06،	-67		1.45	2.66	1 1	0.0039	
90° 72 5.25 1.39 5.25 90° 72 4.94 1.39 5.25 90° 72 5.46 1.39 5.34 90° 72 5.34 1.39 5.34 90° 72 5.85 1.39 5.37 90° 72 5.37 1.39 5.37 90° 72 5.37 1.39 5.37 90° 72 5.37 1.39 5.37 90° 72 5.37 1.39 5.37 90° 72 5.37 1.39 5.37 90° 9.33 0.01 0.33	Avg.			5.29	1.47	5.29	***	0.0036	
90° 72 5.25 1.39 5.25 90° 72 4.94 1.39 4.94 90° 72 5.46 1.40 5.46 90° 72 5.34 1.39 5.34 90° 72 5.85 1.39 5.85 90° 72 5.37 1.39 5.37 90° 72 5.37 1.39 5.37 90° 72 5.37 1.39 5.37 90° 9.33 0.01 0.33	Std.Dev.				•	0.51	-	0.0003	
90° 72 5.25 1.39 5.25 90° 72 4.94 1.39 4.94 90° 72 5.34 1.38 5.34 90° 72 5.85 1.39 5.85 90° 0.33 0.01 0.33									
90° 72 4.94 1.39 4.94 90° 72 5.46 1.40 5.46 90° 72 5.34 1.39 5.34 90° 72 5.37 1.39 5.85 0.33 0.01 0.33	D15-1	06 ء	72	5.25	•	57.5		0.0038	
90° 72 5.46 1.40 5.46 90° 72 5.34 1.39 5.34 90° 72 5.37 1.39 5.85 0.33 0.01 0.33	8-910	06	72	4.94	٠.	4.94		0.0036	
90° 72 5.34 1.38 5.34 90° 72 5.85 1.39 5.85 5.37 1.39 5.37 0.33 0.01 0.33 1 0.33 1 0.33 1 0.33 1 0.33 1 0.33 1 0.33 1 0.33 1 0.33 1 0.33 1 0.33 1 0.33 1 0.33 1 0.33 1 0.34 1 0.34 1 0.34	D18-6	06 و	72	5.46		5.46	name casa hann	0.0039	
90° 72 5.85 1.39 5.85 5.37 1.39 5.37 0.33 0.01 0.33 0.4	D17-6	06 ه	72	5.34		5.34	1	0.0039	
5.37 1.39 5.37 0.33 0.01 0.33	1-610	0	72	5.85		58.85		0.0043	
0.33	Avg.			5.37		5.37	*** ***	6800.0	
	Std.Dev.			0.33	•	0.33	Park Span Span	0.0003	

Fiber Test Ultimate Initial Stress Orien. (°F) (10 ³ psi) (10 ⁶ psi) (10 ³ ps	١	200			Mate	Material: AS/	/4397		
Fiber Test Ultimate Intliary Orien. (°F) (10 ³ psi) (10 ⁶ psi) 90° 350 4.40 1.21 90° 350 3.88 1.09 90° 350 3.91 1.27 90° 450 3.22 1.13 90° 450 2.93 0.81 90° 450 2.93 0.076 90° 450 2.93 0.076 90° 450 2.75 0.69 450 2.75 0.69 450 450 2.96 0.76 90° 450 2.96 0.76 90° 450 2.98 0.76 90° 450 2.98 0.76 90° 450 2.98 0.76 90° 450 2.98 0.76 90° 450 2.99 0.76 90° 450 2.99 0.76 90° 450 2.99 0.76 90° 450 2.99 0.76 90° 450 2.99 0.76 90° 450 2.99 0.76 90° 450 2.99 0.76 90° 450 2.99 0.76 90° 450 2.99 0.76 90° 450 2.99 0.76 145° -67 19.29 2.81 145° -67 19.26 145° 72 18.91 2.75 145° 72 18.65 2.75 145° 72 18.65 145° 72 18.65 145° 72 18.65 145° 72 18.65 145° 72 18.65 145° 72 18.65 145° 72 18.65 145° 72 18.65 145° 72 18.65 145° 72 18.65		USTOIL			1	U		Ultimate	
Orien. (°F) (103psi) (106psi) 90° 350 3.88 1.09 90° 350 3.91 1.27 90° 350 3.91 1.27 90° 350 3.64 1.17 90° 350 3.22 1.13 90° 450 2.93 0.07 90° 450 2.75 0.69 90° 450 2.75 0.76 90° 450 2.75 0.76 90° 450 2.75 0.05 450 2.75 0.05 450 -67 19.29 2.84 445° -67 19.81 2.95 445° -67 19.81 2.58 445° -67 19.29 2.58 445° -67 19.20 2.58 445° -67 19.20 2.58 445° -67 19.20 2.72 445° 72 18.63 2.72 445° 72 18.65 2.72 445° 72 18.65 2.72 445° 72 18.65 2.70 445° 72 18.65 2.70			Test	Strength		Prop. Lim.	Pois.	Strain	O cmod
90° 350 4.40 1.21 2.4 90° 350 3.88 1.09 3.8 90° 350 3.64 1.17 2.5 90° 350 3.64 1.17 2.5 90° 450 3.04 0.07 0.7 90° 450 2.93 0.69 1.8 90° 450 2.75 0.69 1.8 90° 450 2.75 0.69 1.8 90° 450 2.75 0.69 1.8 450 2.75 0.76 2.5 90° 450 2.75 0.76 2.5 45° -67 19.29 2.84 8. 445° -67 19.81 2.84 8. 445° -67 19.81 2.58 8. 445° -67 19.81 2.58 8. 445° -67 19.81 2.75 7. 445° -72 18.91 2.75 7. 445° 72 18.65 2.75 7. 445° 72 18.65 2.75 7. 445° 72 18.65 2.75 7. 4		-	((E)	(10 ³ psi)	_1	(10 psi)	Ratio	(in/in)	NGWALLO
90° 3.88 1.09 3.8 90° 350 3.91 1.27 1.7 90° 350 3.64 1.17 2.5 90° 350 3.64 1.17 2.5 90° 450 3.22 1.13 3.2 90° 450 2.93 0.07 0.7 90° 450 2.75 0.69 1.8 90° 450 2.75 0.69 1.8 90° 450 2.75 0.76 2.5 90° 450 2.75 0.76 2.5 90° 450 2.75 0.69 0.7 450 2.75 0.76 2.5 90° 450 2.75 0.69 0.7 445° -67 19.29 2.84 8. 445° -67 19.81 2.75 8. 445° -67 19.89 2.75 8. 445° 72 18.65 2.75 7. 445° 72 18.65 2.75 7. 445° 72 18.65 2.70 7. 445° 72 18.65 2.66 7. 445° 72	+	1	350	4.40		2.41		0.0039	
90° 350 3.91 1.27 1.7 90° 350 3.64 1.17 2.5 90° 350 3.64 1.17 2.5 90° 350 3.22 1.13 3.2 90° 450 2.93 0.81 1.8 90° 450 2.93 0.81 1.8 90° 450 2.75 0.69 1.8 $90°$ 450 2.75 0.76 2.5 $90°$ 450 2.79 0.76 2.5 450 2.79 0.76 2.2 450 2.96 0.76 2.2 450 2.96 0.76 2.2 450 -67 19.29 2.86 10.6 450 -67 19.29 2.86 10.6 445 -67 19.29 2.84 8.6 445 -67 19.29 2.81 8.6 445 72 18.91 2.72 8.6 445 72 18.65 2.75 7.6 445 72 18.65 2.66 7.6 445 72 18.65 2.66 7.6 445 72 18.65 2.66 7.6 445 72 18.65 2.66 7.6 445 72 18.20 2.66 7.6 445 72 18.20 2.66 7.6	12-3	000	350	3.88		3.88	-	0.0036	
90°3503.641.172.590°3503.221.133.290°3503.811.172.790°4502.930.811.890°4502.930.811.890°4502.750.691.890°4502.750.691.890°4502.750.762.3 $90°$ 4502.790.762.3 $45°$ -6719.292.838. $\frac{45}{45}°$ -6719.292.838. $\frac{45}{45}°$ -6719.292.848. $\frac{45}{45}°$ -6719.292.818. $\frac{45}{45}°$ -6719.292.818. $\frac{45}{45}°$ 7218.912.757. $\frac{45}{45}°$ 7218.652.757. $\frac{45}{45}°$ 7218.652.616. $\frac{45}{45}°$ 7218.652.667. $\frac{45}{45}°$ 7218.652.667. $\frac{45}{45}°$ 7218.652.667.	1-0-1	000	350		•	1.75		0.0033	
90° 350 3.22 1.13 3.2 90° 3.81 1.17 2.7 90° 450 3.04 0.79 2.5 90° 450 2.93 0.81 1.8 90° 450 2.75 0.69 1.8 90° 450 2.75 0.69 1.8 90° 450 2.75 0.76 2.5 90° 450 2.79 0.76 2. 90° 450 2.79 0.76 2. 45° -67 19.13 2.86 10.6 445° -67 19.29 2.84 8. 445° -67 19.29 2.84 8. 445° -67 19.29 2.84 8. 445° 72 18.63 2.75 7. 445° 72 18.63 2.75 7. 445° 72 18.65 2.75 7. 445° 72 18.65 2.75 7. 445° 72 18.65 2.66 7. 445° 72 18.65 2.66 7. 445° 72 18.65 2.66 7. 445	116-4	000	350		۱ ۰	2.56		0.0032	
90° 450 3.04 0.79 2.5 90° 450 2.93 0.81 1.8 90° 450 2.93 0.81 1.8 90° 450 2.75 0.69 1.8 90° 450 2.75 0.69 1.8 90° 450 2.79 0.76 2. 90° 450 2.79 0.76 2. 450 2.79 0.76 2. 20° 450 2.79 0.76 2. 45° -67 19.13 2.86 10.05 445° -67 19.29 2.84 8. 445° -67 19.29 2.84 8. 445° -67 19.26 2.84 8. 445° 72 18.63 2.75 7. 445° 72 18.63 2.75 7. 445° 72 18.65 2.75 7. 445° 72 18.65 2.75 7. 445° 72 18.65 2.75 7. 445° 72 18.65 2.66 7. 445° 72 18.72 2.66 7. 445°	1 5 - 1	000	350		•	3.22		0.0029	
90° 450 3.04 0.79 2.5 90° 450 2.93 0.81 1.8 90° 450 2.75 0.69 1.8 90° 450 2.75 0.69 1.8 90° 450 2.75 0.69 1.8 90° 450 2.75 0.76 2.3 2.96 0.76 2.3 2.96 0.76 2.3 4.45° -67 19.29 2.83 8. 445° -67 19.29 2.84 8. 445° -67 19.81 2.84 8. 445° -67 19.29 2.58 6. 445° -67 19.20 2.75 7. 445° 72 18.63 2.75 7. 445° 72 18.65 2.75 7. 445° 72 18.65 2.70 7. 445° 72 18.65 2.70 7. 445° 72 18.65 2.70 7. 445° 72 18.72 2.66 7. 445° 72 18.72 2.66 7. 445° 72 19.20 <t< td=""><td>*-CT/</td><td>2</td><td>222</td><td></td><td>٥</td><td>2.76</td><td>-</td><td>0.0034</td><td></td></t<>	*-CT/	2	222		٥	2.76	-	0.0034	
90° 450 3.04 0.79 2.5 90° 450 2.93 0.81 1.8 90° 450 2.75 0.69 1.8 90° 450 2.75 0.76 2.7 90° 450 2.79 0.76 2.7 450 2.96 0.76 2.7 450 -67 19.13 2.86 10.6 445 ° -67 19.29 2.83 8.6 445 ° -67 19.81 2.95 9.6 445 ° -67 19.29 2.84 8.6 445 ° -67 19.29 2.84 8.6 445 ° -67 19.29 2.84 8.6 445 ° -72 18.91 2.72 8.6 445 ° 72 18.91 2.72 2.49 7.6 445 ° 72 18.65 2.70 7.7 445 ° 72 18.65 2.70 7.7 445 ° 72 18.65 2.70 7.7 445 ° 72 18.72 2.66 7.7 445 ° 72 18.72 2.66 7.7	d.Dev			, ,,	l ef	0.73		0.0003	
90° 450 3.04 0.79 4.50 90° 450 2.75 0.69 1.8 90° 450 2.75 0.76 2.3 90° 450 2.79 0.76 2.3 90° 450 2.96 0.76 2.3 90° 450 2.96 0.76 2.3 445° -67 19.13 2.86 10.6 445° -67 19.29 2.83 8.6 445° -67 19.29 2.95 9.6 445° -67 19.29 2.95 9.6 445° -67 19.29 2.58 8.6 445° -72 18.91 2.72 8.6 445° 72 18.63 2.49 7.6 445° 72 18.65 2.49 7.6 445° 72 18.65 2.49 7.6 445° 72 18.65 2.66 7.2 445° 72 18.65 2.66 7.2 445° 72 18.65 2.66 7.2 445° 72 19.20 2.66 7.2				- 1		1		0.0043	
90° 450 2.93 0.69 1.8 90° 450 2.75 0.69 1.8 90° 450 2.79 0.76 2.2 90° 450 2.79 0.76 2.2 90° 450 2.96 0.76 2.2 2.96 0.76 2.2 0.76 0.76 0.76 2.96 0.76 0.76 0.76 0.76 0.76 0.76 0.76 2.96 0.76 0.76 0.76 0.76 0.76 0.76 2.45° -67 19.29 2.84 0.76 0.14 0.76 2.45° -67 19.29 2.58 0.14 0.14 0.14 0.14 0.14 0.14 0.37 0.14 <td>01-610</td> <td>06</td> <td>450</td> <td>3.04</td> <td></td> <td>•</td> <td>1</td> <td>0.0040</td> <td></td>	01-610	06	450	3.04		•	1	0.0040	
90° 450 2.75 0.69 1.5 90° 450 3.28 0.76 2.5 90° 450 2.79 0.76 2.5 90° 450 2.96 0.76 2.5 2.96 0.76 2.5 2.5 2.45° -67 19.13 2.86 10.6 2.45° -67 19.29 2.84 8.5 2.45° -67 19.29 2.95 9.5 2.45° -67 19.20 2.95 9.5 2.45° 72 18.91 2.75 7.5 2.45° 72 18.65 2.49 7.5 2.45° 72 18.65 2.49 7.5 2.45° 72 18.65 2.75 7.5 2.45° 72 18.65 2.75 7.5 2.45° 72 18.65 2.75 7.5 2.45° 72 18.65 2.66 7.5 2.45° 72 18.72 2.66 7.5 2.45° 72 19.20 2.66 7.5 2.45° 72 19.20 2.66 7.5 2.75° 2.66 7.5	516-10	06	450	2.93		•		0 00 0	
90° 450 3.28 0.76 2.96 90° 450 2.96 0.76 2.96 2.96 0.76 2.96 2.96 0.76 2.96 2.96 0.05 0.06 2.96 2.86 0.06 2.45° -67 19.29 2.86 2.45° -67 19.29 2.95 2.95 2.95 0.14 0.14 2.45° -67 19.26 2.86 2.45° -67 19.26 2.81 2.75 2.75 0.14 1.16 2.45° 7.2 18.63 2.72 2.49 2.45° 7.2 18.65 2.49 7.2 2.45° 7.2 18.65 2.76 7.2 2.45° 7.2 18.65 2.66 7.2 2.45° 7.2 18.72 2.66 7.2 2.45° 7.2 19.20 2.66 7.2 2.45° 7.2 19.20 2.66 7.2 2.45° 7.2 19.20 2.66 7.2	217-9	06	450	2.75	- 5	•		0 00 0	
90° 450 2.79 0.76 2.96 2.96 0.76 2.96 0.21 0.05 0.05 $\frac{445^{\circ}}{145^{\circ}}$ -67 19.13 2.86 10.6 $\frac{445^{\circ}}{145^{\circ}}$ -67 19.29 2.86 10.6 $\frac{445^{\circ}}{145^{\circ}}$ -67 19.29 2.95 9.6 $\frac{445^{\circ}}{145^{\circ}}$ -67 19.26 2.84 8.6 $\frac{445^{\circ}}{145^{\circ}}$ 72 18.91 2.72 8.6 $\frac{445^{\circ}}{145^{\circ}}$ 72 18.65 2.49 7.6 $\frac{445^{\circ}}{145^{\circ}}$ 72 18.65 2.49 7.6 $\frac{445^{\circ}}{145^{\circ}}$ 72 18.65 2.70 7.6 $\frac{445^{\circ}}{145^{\circ}}$ 72 18.65 2.70 7.6 $\frac{445^{\circ}}{145^{\circ}}$ 72 18.65 2.66 7.6 $\frac{445^{\circ}}{145^{\circ}}$ 72 18.65 2.66 7.6	518-10	°06	450	3.28	. (•1		86000	
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	515-2	06	450	2.79	- 1	•		0 0042	
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	AVG.			2.96	- 1	•		0000	
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	td. Dev			0.21	* (•		222	
445° -67 19.13 2.86 10. 445° -67 19.29 2.83 8. 445° -67 19.81 2.84 8. 445° -67 19.29 2.84 8. 445° -67 19.29 2.84 8. 45° -67 19.26 2.81 8. 45° 72 18.91 2.72 8. 45° 72 18.63 2.75 7. 45° 72 18.65 2.49 7. 45° 72 18.65 2.70 7. 45° 72 18.65 2.70 7. 45° 72 18.72 2.66 7. 45° 72 18.72 2.66 7.	_				· Ł	- 1	15,5	3010 0	
±45° -67 19.29 2.83 8. ±45° -67 18.78 2.95 9. ±45° -67 19.29 2.84 8. ±45° -67 19.29 2.58 6. ±45° -67 19.26 2.81 8. ±45° 72 18.91 2.72 8. ±45° 72 18.63 2.75 7. ±45° 72 18.65 2.49 7. ±45° 72 18.65 2.70 7. ±45° 72 18.65 2.70 7. ±45° 72 18.65 2.66 7. ±45° 72 18.72 2.66 7.	027-10	+450	-67	19.13	- 41	•	0.0	00000	
±45° -67 18.78 2.95 9.81 ±45° -67 19.81 2.84 8. ±45° -67 19.29 2.58 6. ±45° -67 19.26 2.81 8. ±45° 72 18.91 2.72 8. ±45° 72 18.63 2.75 7. ±45° 72 18.65 2.49 7. ±45° 72 18.65 2.70 7. ±45° 72 19.20 2.66 7. ±45° 72 18.72 2.66 7. 50 0.09 0.09 0.09	029-1	±45°	-67	19.29	- 4 1	•}	08 0	0.030	
±45° -67 19.81 2.84 B. ±45° -67 19.29 2.58 6. 19.26 2.81 8. 0.37 0.14 1. 45° 72 18.91 2.72 8. ±45° 72 18.63 2.75 7. ±45° 72 18.65 2.49 7. ±45° 72 18.65 2.70 7. ±45° 72 19.20 2.61 6. ±45° 72 19.20 2.61 6. 509 0.09 0.09 0.	028-7	±45°	-67		e i	٠.	20.0	2010	
±45° -67 19.29 2.58 9.5 19.26 2.81 8. 0.37 0.14 1. ±45° 72 18.91 2.72 8. ±45° 72 18.63 2.75 7. ±45° 72 18.65 2.49 7. ±45° 72 18.65 2.70 7. ±45° 72 19.20 2.61 6. ±45° 72 19.20 2.61 6. 5 73 18.72 2.66 7. 6 73 0.09 0.	D29-9	±45°	-67	5	*1	•	0000	0.0121	_
19.26 2.81 0.37 0.14 1. 18.91 2.72 8. 18.63 2.75 7. 18.20 2.49 7. 18.5° 72 18.65 2.49 7. 18.5° 72 18.65 2.70 7. 18.72 2.66 7. 18.72 2.66 7. 18.72 2.66 7.	D30-3	±45°	-67	oj.	* 1	•ŧ	12.0	0.0107	
±45° 72 18.91 2.72 8. ±45° 72 18.63 2.75 7. ±45° 72 18.65 2.49 7. ±45° 72 18.65 2.70 7. ±45° 72 19.20 2.61 6. ±45° 72 19.20 2.66 7. 50 37 0.09 0.	Avg.			6	* (• •	0.06	0.0008	
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	td.Dev.			• 1	•1	*1			
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$					1	1	0.75	0.0112	
±45° 72 18.50 2.49 7. ±45° 72 18.65 2.70 7. ±45° 72 18.65 2.70 7. ±45° 72 19.20 2.61 6. ±45° 72 18.72 2.66 7. 6.37 0.09 0.	D27-9	±45°	72	18.91	7/:7	•1	0,82	0.0110	
±45° 72 18.20 2.49 1. ±45° 72 18.65 2.70 7. ±45° 72 19.20 2.61 6. ±45° 72 18.72 2.66 7. n 37 0.09 0.	D27-1	±45°	72	18.63	6.13	٠Į	63 0	0 0142	
±45° 72 18.65 2.00 /** ±45° 72 19.20 2.61 6. 18.72 2.66 7.	D30-5	±45°	72	18.20	-	4	4	•	
±45° 72 19.20 2.61 8. 18.72 2.66 7.	D29-4	±45°	72	• 1	7.70	•	20,00	,	
18.72 2.00 7:	D28-3	±45°	72	*1	2.6T	•	4	٠,	
	Avg.		-	• 5	2.00	•	0.07	0.0017	
	Std.Dev.		_	*1	0.03	•[•}	1	

П		-	Ţ	.]		-				-												-			-	7	\neg
		•	Kemarks	Surface plies	Pracked , creating	electrical breaks	in strain gages								*												
	Ultimate	Strain	(1n/1n)	0.0200+	0.0200+	0,0200+	0.0373+	0.0274+	0.0250+		0.0180+		0.0112+	0.0114+	0.0262+	0.0167+						-					
AS/4397		Pois.	Ratio	0.62	0.72	0.71	0.75	0.76	0.71	0.06	0.70		0.64	1	0.62	0.65	*** *** ***										
Material: AS	Stress at	Prop. Lim.	(TSd_OT)	4.44	2.02	3.89	4.18	3.88	3.68	96.0	3.62	3,04	2.77	1.78	2.73	2.78	0.67		-								
Mate		Modulus		1.81	2.10	1,99	2.07	2.28	2.05	0.17	1.97	1.84	1.87		٠ ا		0.19										
	Ultimate	Strength	(10°psi)	16.98	16.94	16.94	16.93	15.26	16.61	0.76	17.40	16.67	16.50	16.34	16.57	16.70	0.41										
	Test	Temp.	(YF)	350	350	350	350	350			450	450	450	450	450												
Tension			Orien.	+45°	±45°	±45°	±45°	±45°			±45°	±45°	±45°	±45°	±45°												
Test:		Spec.	NO.	D29-3	D28-10	D28-5	D27-5	D30-1	Avg.	Std.Dev.	D30-4	D29-8	D29-2	D27-3	D28-8	Avg.	Std.Dev.										

		Remarks																															
	Ultimate	Strain (in/in)	0.0051	0 0072	0 0064	20000	0.00		2.000.0	-,	6200 0	0.00.0		0.0092	*	0.00.2	0.0067	0.0067	0.0077	0.0074	0.0075	0.0012		0.0080	0.0067	0.0085	0.0075	0.0068	0.0075	0.0008			
T300/F178		Pois. Ratio	0 23	200	0.23	4	0.31	0.26	0.31	0.03	400	0.34			0.30	_ł	-4	0.29	- 4	- 1		0.03			•	0.28		0.25	0.28	• 2	ui .		
Material: T3	Stress at	Prop.Lim.	2001	2007	19791	13/00	93.6	156.3	129.9	31.4	- 1			194.3	134.2	152.7	137.8	135.9	174.3	158.4	156.7	21.0		177.1	134.	170.4	140.	138.	152.2	0 00	-1		
Mate		Modulus (106psi)	.) .	16.91	21.49	20.65	20.36	19.63	20.22	0.97		19.56	20.31	19,83	20.41	19.35	19.89	19.92	22.05	20.96	20.25	0.82	·i	20.41	19.68	19.29	18.74	10 68	2000	١	70.0		
	Ultimate	Strength	7767 011	100.7	162.1	137.0	93.6	156.3	129.9	31.4	1	146.4	176.6	194.3	134.2	١.	١.	135.9	174 3	158.4	156.7		• }	1 27 1	13/10	170.4	140.7	1 200	al .	n)	19.9		
	Test	Temp.		-67	-67	-67	-67	-67				72	72	72	72	7.2	7.5	7.5	2.5	75	7,			036	330	350	020	250	350				
Tension		Fiber	Orien.	0 0	0.0	0	°	°O				00	00	°C	ိုင်	°	°	000	000	000					20				٥				
Test:		Spec.	ġ.	E22-4	E6-8	R7-5	E8-4	E5-11	Arra	Std. Dev.		E6-16	E5-10	50-1	E 2 2 - 1 1	27 10	E7-13	1-47C	1 773	20-13	E5-8	AV9.	Std. Dev.	- 6	E22-12	E8-1/	E2-2	E7-4	E6-3	Avq.	Std. Dev.		

Test:	Tension			Mate	Material: man	T300/E178		
		Test	Tiltimate		1 8	7	77 1 2 2 2 2 2	
Spec.		Temp.	Strength	Modulus	Prop. Lim.	Pois.	Strain	
Q	Orien.	(°F)	(10 ³ psi)		(10 ³ psi)	Ratio	(in/in)	Remarks
E22-6	0	450	141.8	20.58	141.8	0.33	0.0067	
E6-14	00	450	140.8	18.31	140.8	0.35	# **	ade formane de la companya de la co
E8-12	00	450	177.8	20,33	177.8		0.0085	
E5-18	00	450	171.9	19.38	171.9	1	0.0088	
E7-6	0.0	450		17.99	132.4	0.35	0.0073	
Avg.			152.9	19.32	152.9	0.35	0.0078	
Std.Dev				1.16	20.4	0.01	0.0010	
E14-4	°06	-67	2.03	1.70	2.03		0.0012	
9-013	06	-67	3.17	1.47	3.17	**	0.0021	AND THE RESIDENCE OF THE PERSON OF THE PERSO
E23-5	90°	-67	4.13		2.94	1	0.0026	
E13-10	900	-67	3.95	1.70	2.98		0.0024	
E11-5	06	-67	3.13	•	3.13		0.0020	
Avg.			3.28	•	2.85		0.0021	
Std. Dev.			0.83	0.10	0.47		0.0005	
E10-3	°06	72	3.94	1.55	3.68		0.0026	
E10-5	900	72	4,35	1,52	3.49	1 1	0.0030	
E10-4	°06	72	3,22	1,62	2.17	1	0.0021	
E13-6	90°	72	3,37	1.49	3.37		0.0023	
E11-7	006	72	4.07	1.40	•		0.0029	
E14-2	906	72	3.82	1.54			0.0026	
E23-3	06	72	3.97	1.39	3.97		0.0028	er franches de la company
Avg.			3.82	1.50	•	1	0.0026	
Std.Dev.			0.40	0.08	0.71	1	0.0003	
								And the second s
								and the analysis are assumed to the state of
		-						
								,

Test:	Tension			Mate	Material: T3(T300/F178		
		Test	Ultimate	;	Stress at		Ultimate	
Spec. No.	Fiber Orien.	Temp.	Strength (10 ³ psi)	Modulus (106psi)	Prop.Lim. (103psi)	Pois. Ratio	Strain (in/in)	Remarks
E10-2	900	350	2.03			1		
E23-6	906	350	4.16	1.02	3.45	****	0.0042	
E14-7	06	350	2,38	1.12			0.0020	
E11-2	06،	350	3,28	1.17	2.40		0.0029	
E13-2	90ء	350		1,14	2.99		0.0027	
Avg.			2.97	1,15	2.95	:	0.0030	
Std.Dev.			· •!	0.10	0.53		0,000	
			- 1	. 1				
E14-8	。 06	450	2.01	1.05	1.10		0.0024	
E11-3	06،	450	2,37	0.93	0.92		0.0030	
E13-7	•06	450	2.70	. 7	16.1		0.0030	-
E23-7	06 06	450	2.54	0.74	1.88	***	0.0036	
Avq.			2,40		1.45		0.0030	
Std. Dev.			0.30	0.14	0.51		0,0005	
E42-5	+45°	-67	14.30	2.37	5.11	0.55	0.0097	
E39-1	+45°	-67	15.88	2.74	10.66	0.69	0.0074	
E40-3	±45°	-67	17.14	2.77	10.71	0.72	0.0086	
E36-2	±45°	-67	15.71	2.38	8.92	0.69	0.0104	
E35-4	±45°	-67	16.06	2.67	69.6	0.67	0.0000	
Avg.			15.82	2.59	9.02	0.66	0.0000	
Std. Dev.			1.02	0.20	2.31	0.07	0.0011	
			ł	t				
E35-3	±45°	72	17.61	2.70	7.65	0.76	0.000.0	
E39-7	+45°	72	18.24	2.69		0.73	0.0114	
E40-2	±45°	72	18.10	2.73		0.79	0.0086	
E36-1	±45°	72	16.48	2.75		0.77	0.0077	
E42-6	±45°	72	15.44	2.44	7.38	0.73	0.0104	-
Avg.			17.17	2.66	7.28	0,76	0.0094	
Std.Dev.			1.19	0.13	0.76	0.03	0.0015	

Spec. Fiber No. Orien. E39-8 ±45° E35-2 ±45° E42-7 ±45° E36-9 ±45°	Test		•	Stress at		Ultimate		
	_	_					****	
 		Strength (10 3psi)	Modulus (106psi)	Prop.Lim. (103psi)	Pois. Ratio	Strain (in/in)	Remarks	, , , , , , , , , , , , , , , , , , ,
	5° 350	14.71	4	4.60	0.88	0.0174+	Surface plies	
	_	14.27	1.89	4.59	0.91	0.0171+	cracked, destroving	ving
		14.21	2.01	4.55	0.89	0.0139	gages	
	Н	14.32	1.95	5.11	0.86	0.0132		
	_	15.52	1.98	4.69	0.80	0.0167+	-	
	Ļ	14.61	1.94	4.71	0.87	0.0157+		
Std.Dev.		0.55	0.06	0.23	0.04	agy see no		
E39-9 ±45°	Н	12.05	1.48	2.76	0.75	+6810.0		
	5° 450	12.35	1.54	3.04	0.88	0.0188+		
		11.81	1.49	2.95	0.72	0.0164+		
		12.73	1.56	3.64	0.74	0.0186+		
E40-10 ±45°	5° 450	11.98	1.37	2.77	0.86	0.0178+	→	
Avg.		12,18	1.49	3.03	0.79	0.0180+		
Std. Dev.		0.36	0.07	0.36	80.0			
	-							
	-							
						_		
	-							

APPENDIX D COMPRESSION DATA

All of the compression data generated during this program are presented in this section. They are summarized in tabular and graphical form in Section 4.

Spec. Fiber Test Ultimate Initial Stress at Ultimate No. Orien. (Fem.) Strength Modylus Prop.Lim. Strangh A64-13 0° -67 124.1 18.36 0.0246 A64-18 0° -67 124.1 18.36 0.0246 A64-18 0° -67 124.1 18.36 0.0246 A64-15 0° -67 173.2 21.46 59.3 0.0246 Buckling A64-15 0° -67 173.2 21.6 43.6 0.0246 Buckling A64-1 0° -67 173.2 21.6 43.6 0.0320 Buckling A64-2 0° -67 170.2 20.0 23.0 0.0320 Buckling A64-1 0° -67 172 143.6 20.9 31.3 0.0320 Buckling A64-1 0° 72 143.6 20.9 3	Test:	Compression	sion			Material:	SP313	
Fiber Temp. Strength Modulus Prop.Lim. Strain (infin) Orien. (°F) (103psi) (106psi) (103psi) (infin) Remarks (infin) 0° -67 124.1 18.36 0.0246 0° -67 173.2 25.10 35.6 0.0320 0.0246 0° -67 173.2 25.10 35.6 0.0246 Buckling 0° -67 173.2 20.07 35.6 0.0358 Buckling 0° -67 172 143.6 20.9 31.3 0.0056 Buckling 0° 72 152.6 19.4 47.1 0.0099 Buckling 0° 72 152.6 19.4 47.1 0.0099 Buckling 0° 72 157.4 19.8 35.8 0.0187 Buckling 0° 260 135.5 18.74 42.5 0.0187 Buckling 0° 260 135.5 18.74 42.5 0.0077 Buckling 0° 260 135.5 18.74 42.5 0.0077 Buckling 0° 260 135.5 18.74 42.5 0.0077 Buckling 0° 260 135.5 18.74 62.5 0.0077 Buckling 0° 260 135.5 18.74 62.5 0.0067 Buckling 0° 260 141.5 17.01 91.1 0.0067 Buckling 0° 260 141.5 17.01 0.0060 Buckling 0° 260 141.5 17.01 0			Test	Ultimate	Initial	Stress at		
0° -67 124.1 18.36 0.0246 0° -67 225.4 21.46 59.3 0.0320 0° -67 173.2 27.76 45.3 0.0320 0° -67 173.2 27.76 43.6 0.0240 0° -67 123.1 14.41 0.0112 Buckling 0° -67 123.1 20.07 35.6 0.0058 Buckling 0° -67 166.3 21.15 53.0 0.0320 Buckling 0° -67 143.6 20.9 31.3 0.0056 Buckling 0° 72 143.6 20.9 31.3 0.0059 Buckling 0° 72 18.4 47.1 0.0099 Buckling 0° 72 18.4 47.1 0.0099 Buckling 0° 72 18.4 42.5 0.0126 Buckling 0° 260 135.5 21.59 </td <td>Spec. No.</td> <td>Fiber Orien.</td> <td>Temp. (°F)</td> <td>Strength (103psi)</td> <td>Modulus (10⁶psi)</td> <td>Prop.Lim. (103psi)</td> <td>Strain (in/in)</td> <td>Remarks</td>	Spec. No.	Fiber Orien.	Temp. (°F)	Strength (103psi)	Modulus (10 ⁶ psi)	Prop.Lim. (103psi)	Strain (in/in)	Remarks
0° -67 225.4 21.46 59.3 0.0320 0° -67 173.8 27.76 43.9 0.0240 Buckling 0° -67 173.2 25.10 35.6 0.0240 Buckling 0° -67 170.2 20.07 35.6 0.0390 Buckling 0° -67 170.2 20.92 35.0 0.0202 Buckling 0° -67 170.2 20.92 35.0 0.0309 Buckling 0° 72 143.6 20.9 31.3 0.0056 Buckling 0° 72 150.7 19.4 47.1 0.0099 Buckling 0° 72 152.6 18.4 40.6 0.0197 Buckling 0° 72 152.6 18.4 42.5 0.0058 Buckling 0° 260 139.5 19.74 42.5 0.0077 Buckling 0° 260 136.6 18.46 42.4	A64-3	۰0	<i>L</i> 9-	124.1	18.36		0.0246	
0° -67 178.8 27.76 43.9 0.0048 Buckling 0° -67 123.1 25.10 35.6 0.00240 Buckling 0° -67 170.2 20.07 35.6 0.0058 Buckling 0° -67 170.2 20.07 35.6 0.0050 Buckling 0° -67 169.4 20.9 31.3 0.0056 Buckling 0° 72 143.6 20.9 31.3 0.0056 Buckling 0° 72 150.7 19.4 47.1 0.0099 Buckling 0° 72 152.6 18.4 40.6 0.0197 Buckling 0° 72 152.6 18.4 40.6 0.0099 Buckling 0° 72 167.1 19.8 32.6 0.0197 Buckling 0° 260 139.5 18.4 42.4 0.0058 Buckling 0° 260 136.6 18.4	A64-18	0.0	-67	225.4	21.46	59.3	0.0320	A COMMAND OF THE PARTY OF THE P
0° -67 173.2 25.10 35.6 0.0240 0° -67 123.1 14.41 0.0112 Buckling 0° -67 170.4 20.92 90.4 0.058 Buckling 0° -67 166.3 21.15 53.0 0.0202 Buckling 0° 72 166.3 21.15 53.0 0.0056 Buckling 0° 72 150.7 19.4 47.1 0.0099 Buckling 0° 72 167.1 20.0 27.5 0.0099 Buckling 0° 72 167.1 20.1 32.6 0.0190 Buckling 0° 72 167.1 20.1 32.6 0.0190 Buckling 0° 260 136.6 19.74 42.5 0.0177 Buckling 0° 260 136.6 18.46 42.4 0.0077 Buckling 0° 260 195.6 21.44 59.9	A64-15	0.0	-67	178.8	27.76	43.9	0.0048	
0° -67 123.1 14.41 0.0112 0° -67 170.2 20.07 35.6 0.0390 0° -67 166.3 20.09 90.4 0.0320 0° -67 166.3 21.15 53.0 0.0132 0° 72 143.6 20.9 31.3 0.0056 0° 72 152.6 18.4 40.6 0.0190 0° 72 152.6 18.4 40.6 0.0190 0° 72 157.4 19.8 35.8 0.0197 0° 72 157.4 19.8 35.8 0.0197 0° 72 157.4 19.8 35.8 0.0126 0° 260 139.5 19.7 42.5 0.0177 0° 260 134.6 21.5 0.0073 0° 260 141.5 17.01 91.1 0.0077 0° 260 147.9 67.0 <t< td=""><td>A64-12</td><td>0 0</td><td>67</td><td>173.2</td><td>25.10</td><td>35.6</td><td>0.0240</td><td>en de la companya de</td></t<>	A64-12	0 0	67	173.2	25.10	35.6	0.0240	en de la companya de
0° -67 170.2 20.07 35.6 0.0058 0° -67 166.3 21.15 53.0 0.0202 166.3 21.15 53.0 0.0202 0° 72 143.6 20.9 31.3 0.0056 0° 72 152.6 18.4 47.1 0.0099 0° 72 152.6 18.4 40.6 0.0190 0° 72 167.1 20.0 27.5 0.0089 0° 72 167.1 20.1 32.6 0.0197 0° 72 167.1 20.1 32.6 0.0197 0° 260 139.8 35.8 0.0177 0° 260 136.6 18.46 42.5 0.0177 0° 260 136.6 21.59 78.4 0.0077 0° 260 194.6 21.44 59.9 0.0087 0° 260 147.9 17.01 91.1 0.0104 0° 260 147.9 17.79 67.0 0.0104	A64-51	0 و	-67	123.1	14.41		0.0112	Buckling
0° -67 169.4 20.92 90.4 0.0390 0° 72 166.3 21.15 53.0 0.0202 0° 72 143.6 20.9 31.3 0.0056 0° 72 150.7 19.4 47.1 0.0099 0° 72 152.6 18.4 40.6 0.0190 0° 72 167.1 20.0 27.5 0.0197 0° 72 167.1 20.1 32.6 0.0197 0° 72 167.4 19.8 35.8 0.0126 0° 72 167.4 19.8 35.8 0.0156 0° 260 136.6 18.46 42.4 0.0058 0° 260 136.6 18.46 42.4 0.0077 0° 260 136.6 21.44 59.9 0.0077 0° 260 194.6 21.44 59.9 0.0067 0° 260 141.5 17.01 91.1 0.0077 0° 260 141.5 17.01	A67-20	0 و	-67	170.2	20.02	35.6	0.0058	Buckling
0° 72 143.6 20.9 31.3 0.0132 0° 72 143.6 20.9 31.3 0.0056 0° 72 150.7 19.4 47.1 0.0056 0° 72 152.6 18.4 40.6 0.0099 0° 72 172.8 20.0 27.5 0.0089 0° 72 167.4 19.8 35.8 0.0126 1 12.1 0.9 7.9 0.0126 0° 260 139.5 19.74 42.5 0.0177 0° 260 136.6 18.46 42.4 0.0077 0° 260 136.6 18.46 42.4 0.0077 0° 260 136.6 18.46 42.4 0.0077 0° 260 119.8 17.79 67.0 0.0067 0° 260 141.5 17.79 67.0 0.0104 0° 260 147.5 0.0067 0° 260 147.5 0.0067 0° 260 147.5 0.007 0° 260 147.5 0.007 10° 260 147.5 0.007 10° 2	A67-22		-67	169.4	20.92	\$0.4	0.0390	Buckling
0° 72 143.6 20.9 31.3 0.0056 0° 72 150.7 19.4 47.1 0.0099 0° 72 152.6 18.4 40.6 0.0190 0° 72 172.8 20.0 27.5 0.0089 0° 72 167.1 20.0 27.5 0.0197 1 157.1 20.1 32.6 0.0197 0° 260 139.5 19.8 35.8 0.0186 0° 260 139.5 19.74 42.5 0.0177 0° 260 136.6 18.46 42.4 0.0073 0° 260 136.6 18.46 42.4 0.0077 0° 260 136.6 21.59 78.4 0.0077 0° 260 141.5 17.79 67.0 0.0067 0° 260 141.5 17.79 67.0 0.0104 0° 260 147.9 19.3 0.0060 260 147.5 0.0067 0.0104 14.5<	Avg.			166.3	21.15	53.0	0.0202	
0° 72 143.6 20.9 31.3 0.0056 0° 72 150.7 19.4 47.1 0.0099 0° 72 152.6 18.4 40.6 0.0190 0° 72 167.1 20.0 27.5 0.0089 0° 72 167.4 19.8 32.6 0.0197 0° 260 139.5 19.74 42.5 0.0177 0° 260 136.6 18.46 42.5 0.0073 0° 260 155.5 21.59 78.4 0.0077 0° 260 155.5 21.59 78.4 0.0077 0° 260 141.5 17.01 91.1 0.0077 0° 260 141.5 17.01 91.1 0.0067 0° 260 141.5 17.79 67.0 0.0104 0° 260 147.9 19.34 63.5 0.0060 260 19.5 19.34 63.5 0.0060 260 19.5 19.34 63.5 0.00	Std.Dev			35.0	4.36	23.0	0.0132	
0° 72 143.6 20.9 31.3 0.0056 0° 72 150.7 19.4 47.1 0.0099 0° 72 152.6 18.4 40.6 0.0190 0° 72 172.8 20.0 27.5 0.0089 0° 72 167.1 20.1 32.6 0.0197 0° 260 139.5 19.74 42.5 0.0177 0° 260 136.6 18.46 42.4 0.0077 0° 260 136.6 18.46 42.4 0.0077 0° 260 136.6 21.59 78.4 0.0077 0° 260 136.6 21.44 59.9 0.0077 0° 260 141.5 17.79 67.0 0.0067 0° 260 141.5 17.79 67.0 0.0104 0° 260 147.9 19.3 67.0 0.0060 0° 260 147.9 19.5 0.0060 0° 260 147.9 0.0060 <tr< td=""><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr<>								
0° 72 150.7 19.4 47.1 0.0099 0° 72 152.6 18.4 40.6 0.0190 0° 72 172.8 20.0 27.5 0.089 0° 72 167.1 20.1 32.6 0.0197 0° 260 139.5 19.74 42.5 0.0177 0° 260 135.5 21.59 78.4 0.0077 0° 260 136.6 18.46 42.4 0.0077 0° 260 155.5 21.44 59.9 0.0220 0° 260 194.6 21.44 59.9 0.0067 0° 260 141.5 17.79 67.0 0.0067 0° 260 141.5 17.79 67.0 0.0104 0° 260 147.9 19.34 63.5 0.0104 0° 260 147.9 19.34 63.5 0.0104 0° 260 147.9 19.5 0.0060 0° 260 147.9 0.0060 <	A64-1	0	72	143.6	20.9	31.3	0.0056	Buckling
0° 72 152.6 18.4 40.6 0.0190 0° 72 172.8 20.0 27.5 0.0089 0° 72 167.4 19.8 35.8 0.0126 15.1 0.9 7.9 0.0126 0° 260 139.5 19.74 42.5 0.0177 0° 260 136.6 18.46 42.4 0.0077 0° 260 155.5 21.59 78.4 0.0077 0° 260 194.6 21.44 59.9 0.0067 0° 260 141.5 17.01 91.1 0.0067 0° 260 141.5 17.01 91.1 0.0067 0° 260 141.5 17.79 67.0 0.0067 0° 260 147.9 19.34 63.5 0.0104 0° 260 147.9 19.34 63.5 0.0104 0° 260 147.9 19.34 67.0 0.0104	A64-2		72	150.7	19.4	47.1	0.0099	Buckling
0° 72 172.8 20.0 27.5 0.0089 0° 72 167.1 20.1 32.6 0.0197 157.4 19.8 35.8 0.0126 12.1 0.9 7.9 0.0126 0° 260 135.6 18.46 42.5 0.0177 0° 260 136.6 18.46 42.4 0.0077 0° 260 194.6 21.59 78.4 0.0077 0° 260 119.8 17.04 59.9 0.00220 0° 260 141.5 17.04 59.9 0.0067 0° 260 141.5 17.04 59.9 0.0067 0° 260 141.5 17.04 59.9 0.0067 0° 260 141.5 17.04 59.9 0.0067 0° 260 141.5 19.34 63.5 0.0104 1 25.6 1.91 19.5 0.0060	A64-6		7.2	152.6	18.4	40.6	0.0190	
0° 72 167.1 20.1 32.6 0.0197 157.4 19.8 35.8 0.0126 12.1 0.9 7.9 0.0126 0° 260 139.5 19.74 42.5 0.0177 0° 260 136.6 18.46 42.4 0.0077 0° 260 194.6 21.59 78.4 0.0077 0° 260 119.8 17.01 91.1 0.00220 0° 260 141.5 17.79 67.0 0.0082 0° 260 141.5 17.79 67.0 0.0104 0° 260 147.9 19.34 63.5 0.0067 10° 25.6 1.91 19.5 0.0060	A64-10		72	172.8	20.0	27.5	0.0089	Buckling
0° 260 139.5 19.8 35.8 0.0126 0° 260 139.5 19.74 42.5 0.0177 0° 260 136.6 18.46 42.4 0.0077 0° 260 194.6 21.59 78.4 0.0077 0° 260 119.8 17.01 91.1 0.0067 0° 260 141.5 17.01 91.1 0.0067 0° 260 141.5 17.79 67.0 0.0082 0° 260 147.9 19.34 63.5 0.0104 1 25.6 1.91 19.5 0.0060	A64-19		72	167.1	20.1	32.6	0.0197	
0° 260 139.5 19.74 42.5 0.0177 0° 260 136.6 18.46 42.4 0.0077 0° 260 155.5 21.59 78.4 0.0077 0° 260 194.6 21.44 59.9 0.0220 0° 260 141.5 17.01 91.1 0.0067 0° 260 141.5 17.79 67.0 0.0082 0° 260 0.0104 147.9 19.34 63.5 0.0060 25.6 1.91 19.5 0.0060	Avg.			157.4	19.8	35.8	0.0126	
-8	Std.Dev.			12.1	6.0	7.9	0.0058	
-8								
-11 0° 260 136.6 18.46 42.4 0.0073 -16 0° 260 155.5 21.59 78.4 0.0077 -17 0° 260 194.6 21.44 59.9 0.0220 -18 0° 260 141.5 17.01 91.1 0.0067 -18 0° 260 141.5 17.79 67.0 0.0082 -16 0° 260 0.0104 -26 147.9 19.34 63.5 0.0060 -27 147.9 1.91 19.5 0.0060 -28 1.91 19.5 0.0060 -29 1.91 19.5 0.0060 -20 1.91 19.5 0.0060	A64-8	0	260	139.5	19.74	42.5	0.0177	
-16 0° 260 155.5 21.59 78.4 0.0077	A64-11	00	260	136.6	18.46	42.4	0.0073	Buckling
-17	A64-16	°	260	155.5	21.59	78.4	0.0077	Buckling
7-17 0° 260 119.8 17.01 91.1 0.0067 7-18 0° 260 141.5 17.79 67.0 0.0082 7-16 0° 260 0.0104 7-16 0° 250 19.34 63.5 0.0114 7-17.9 19.34 63.5 0.0114 7-18 0.0060	A64-17	°0	260	194.6	21.44	59.9	0.0220	
-18 0° 260 141.5 17.79 67.0 0.0082 -16 0° 260 0.0104 9. 147.9 19.34 63.5 0.0114 Dev. 25.6 1.91 19.5 0.0060	A67-17	00	260	119.8	17.01	91.1	0.0067	Buckling
-16 0° 260 0.0104 9. 147.9 19.34 63.5 0.0114 .Dev. 25.6 1.91 19.5 0.0060	A67-18	0.0	260	141.5	17.79	67.0	0.0082	Buckling
.Dev. 25.6 1.91 19.5	A67-16	0 0	260	1	770 444 440	* * 1	0.0104	
.Dev. 25.6 1.91 19.5 0	Avg.			147.9	19.34	63.5	0.0114	
	Std.Dev.			25.6	1.91		0.000.0	

1		21.00		The second secon	Material:	SP313	A STATE OF THE PROPERTY OF THE
Test:	Compression	11076					
,		Test	Ultimate	Initial	Stress at	Ultimate	
Spec.	Fiber	Temp.	Strength	Modulus	Prop. Lim.	Strain (in/in)	Remarks
Ņ.	Orien.	(°F)	(10 ⁵ psi)	(10°ps1)		+ /117 /117)	
	0	35.0	145.7	22.62	28.8	0.0146	
A64/	000	250	7.071	25.44		0.0055	Buckling
.A64-20	, 0	220	2.5.2.	33 88	T	0.0057	Buckling
A64-13	0 0	350		27.64	T	0.0048	Buckling
A64-4	00	350		24.12	†	0.0057	Buckling
A6414	0	350	145.2	25.70	1 200	2600.0	
AVG.			148.1	24.96	23.0	0.0073	
Std. Dev.			6.8	1.91	73.8	7*00.0	
				ı		6060 6	Rickling
A66-9	06	-67	41.01	2.12	77.0	0.0297	
A67-2	06	-67	51.52	1.80	74.07	0.0430	Direction
F 1-734	006	-67	37.15	1.55	8.10	0.0208	Duch Ling
ıl m	006	-67	34.67	1.55		0.0419	Buckling
466-6	°06	-67	•	2.23	31.33	0.0191	
Ava.			42.38	1.85	17.99	0.0333	
Std. Dev.			7.05	0.32	C/ .7T	0.0163	
						1	Buckling
A67-9	°06	72	24.05	•	2.74	0.0130	
A67-3	06	72	32.29	1.53	0.40	0.00.0	Buckling
A67-5	06	72	25.22	1.80		0.050	Buckling
A67-8	06	72	26.28	1.39	000	0.0154	Buckling
A67-11	06	72	27.55	1./8	3.00	2010.0	
A67-21	°06	72	22.86	1.43	3.02	0.0172	
Avg.			26.38	• [200	0100	
Std. Det	7		3.33	0.40	•	20.0	
<u></u>							

and the second s		Dogue Programme	475 245 4 4 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5	buckting	Buckling	Buckling		Buckling					nest-Legenfulden, genörfolgen spieleinstrogen und seine Millen gelenstricht er Westerspränden der seine Legenfunden der	ereniserstendende Proces de Administration in Administration de Administration des Processes de Administration	Buckling		oracine quality angenei aleganism demandrate y director and the second and the se	jelinistaus ist statut kalantaanjalis viisterajaisilijas ja	or or other comments are not the comments of t	also designed in especial designed in the second						
SP313	Ultimate	Strain	(111/411)	0.011/	0.0106	0.0269	0.0395	0.0137	0.0205	0.0125	0.0500	0.0388	0.0508	0.0275	0.0065	0.0347	0.0184									•
Material: S	Stress at	Prop. Lim.	7787 071	4.04	1	1		2.55			2.83	39	21	4.98	-	4.35	H									
		Modulus (105ps 1)	+-	7007	1.51	1.54	1.32	1.46	1.49	0.11	1.37	1.91	1.18	1.57	1.78	1.56	0.30									
	Ultimate	Strength	10 37	76.07	19.09	22.75	18.42	20.78	19.88	1.88	15,32	19.71	17.32	17.04	13.78	16.63	2.23									
lon	Test	Temp.	760	200	760	260	260	260			350	350	350	350	350											
Test: Compression		Fiber	000	26	206	°06	906	06			606	06	。06	06	06											
Test:		Spec.	266-4	F-000	A.66-13	A66-3	A66-11	A.66-7	Avg.	Std Dev.	A66-17	A66-15	A66-8	A66-12	A66-10	Avg.	Std Dev.									

st Ultimate Ini mp. Strength Mod (10 ³ ps1) (10 ⁶ 7 149.0 18. 7 149.0 18. 7 149.2 23. 7 147.6 17. 147.9 18. 2 109.3 17. 8 3.8 17. 100.9 16. 100.9 17. 9 7.1 17. 0 97.1 17. 0 97.3 19. 0 125.8 17. 0 97.1 17. 0 97.1 17. 0 97.1 17. 0 97.1 17. 0 97.1 17. 0 97.1 18. 0 102.6 18. 0 103.6 18.	Test:	Compression	sion		AND 10 10 10 10 10 10 10 10 10 10 10 10 10	Material:	AS/3004	and the constitution of the state of the sta
Orien. (°F) (10 ³ psi) 0° -67 149.0 0° -67 149.8 0° -67 147.6 0° -67 147.6 0° 72 105.9 0° 72 105.9 0° 72 100.3 0° 72 105.9 0° 180 97.3 0° 180 97.3 0° 180 97.3 0° 250 91.9 0° 250 73.8 0° 250 73.8	2000	, , ,	Test	Ultimate	Initial	Stress at	Ultimate	
0° -67 149.0 0° -67 149.8 0° -67 143.2 0° -67 147.6 0° 72 101.4 0° 72 105.9 0° 72 105.9 0° 72 105.9 0° 72 105.9 0° 180 97.1 0° 180 97.3 0° 180 97.3 0° 180 91.9 0° 180 91.9 0° 250 91.9 0° 250 91.9 0° 250 91.9 0° 250 91.9 0° 250 91.9 0° 250 91.9 0° 250 92.4 0° 250 92.4 0° 250 92.4 0° 250 92.4 0° 250 92.4 0° 250 92.4 0° 250 <t< td=""><td>No.</td><td>orien.</td><td>(oE)</td><td>(10³psi)</td><td>(10⁶psi)</td><td>(103psi)</td><td>- 1</td><td>Remarks</td></t<>	No.	orien.	(oE)	(10 ³ psi)	(10 ⁶ psi)	(103psi)	- 1	Remarks
0° -67 149.8 0° -67 149.8 0° -67 143.2 0° 72 147.6 147.9 0° 72 101.4 0° 72 100.3 0° 72 100.3 0° 72 100.9 0° 180 97.1 0° 180 97.1 0° 180 97.1 0° 180 97.1 0° 250 91.9 0° 250 91.9 0° 250 91.9	C3-7	۰0	-67	149.0	18.5	65.1	0.0104	
0° -67 149.4 0° -67 143.2 0° -67 147.6 0° 72 147.9 0° 72 101.4 0° 72 100.3 0° 72 100.3 0° 72 100.3 0° 180 97.1 0° 180 97.3 0° 180 97.3 0° 180 97.3 0° 180 97.3 0° 250 97.9 0° 250 91.9 0° 250 105.0 0° 250 105.0	(C3-3	00	-67	149.8	16.2	72.8	0.0082	
0° -67 143.2 0° -67 147.6 147.9 147.9 0° 72 101.4 0° 72 105.9 0° 72 109.3 0° 72 109.3 0° 180 97.1 0° 180 97.3 0° 180 97.3 0° 180 97.3 0° 180 97.3 0° 250 91.9 0° 250 105.0 0° 250 105.0	C39	0 0	-67	149.4	17.1	105.4	0.0093	
0° -67 147.6 147.9 2.6 0° 72 101.4 0° 72 105.9 0° 72 100.3 0° 72 100.3 0° 180 97.1 0° 180 97.3 0° 180 97.3 0° 180 97.3 0° 180 97.3 0° 250 91.9 0° 250 105.0 0° 250 105.0	c3-16	00	19-	143.2	23.8	64.7	0.0061	
0° 72 101.4 0° 72 105.9 0° 72 105.9 0° 72 109.3 0° 72 109.3 0° 180 97.1 0° 180 97.1 0° 180 97.1 0° 180 97.1 0° 250 91.9 0° 250 105.0 0° 250 105.0	C6-21	00	67	147.6	17.8	72.1	0.0084	
0° 72 101.4 0° 72 105.9 0° 72 105.9 0° 72 109.3 0° 72 109.3 0° 180 97.1 0° 180 97.3 0° 180 97.3 0° 180 97.3 0° 250 91.9 0° 250 105.0 0° 250 105.0	Avg.			147.9	18.7	76.0	0.0085	
0° 72 101.4 0° 72 105.9 0° 72 110.3 0° 72 110.3 0° 72 109.3 0° 72 109.3 0° 180 97.1 0° 180 97.1 0° 180 97.3 0° 180 97.3 0° 180 91.9 0° 250 91.9 0° 250 105.0 0° 250 105.0 0° 250 105.0 0° 250 92.4 0° 250 92.4 11.7 10.5 10.5	Std Dev.			2.6	3.0	16.8	0.0016	
0° 72 101.4 0° 72 105.9 0° 72 110.3 0° 72 110.3 0° 72 109.3 0° 180 97.1 0° 180 97.1 0° 180 97.1 0° 180 91.9 0° 250 87.6 0° 250 105.0 0° 250 105.0								
0° 72 105.9 0° 72 110.3 0° 72 110.3 0° 72 109.3 0° 180 100.9 0° 180 97.1 0° 180 97.1 0° 180 97.1 0° 250 91.9 0° 250 13.4 13.4 13.4 13.4 10.5.0	C3-1	0 0	72	101.4	18.2	52.9	0.0061	
0° 72 110.3 0° 72 83.8 0° 72 83.8 102.1 102.1 10.9 10.9 180 97.3 0° 180 97.3 0° 180 97.3 0° 180 91.9 0° 250 87.6 0° 250 105.0 0° 250 105.0	c3-15	0.0	72	105.9	16.9	105.9	0.0064	
0° 72 83.8 0° 72 109.3 102.1 10.8 10.9	C3-16	00	72	110.3	17.1	65.3	0.0068	
0° 72 109.3 102.1 10.8 0° 180 100.9 0° 180 97.1 0° 180 97.3 0° 180 97.3 0° 180 97.3 0° 250 91.9 0° 250 91.9 0° 250 91.9 0° 250 91.9	C3-8	00	72	83.8	17.6	83.8	0.0045	oristingsveridelikaristaristaristingsveridelikaristingskaristingskaristingsveridelikaristingsveridelikaristing
102.1 10.8 10.8 0° 180 97.1 0° 180 97.3 0° 180 97.3 0° 180 97.3 0° 180 91.9 0° 250 91.9 0° 250 91.9 0° 250 91.9 0° 250 91.9 0° 250 91.9	C3-2	0 0	72	109.3	16.7	109.3	0.0078	
0° 180 100.9 0° 180 97.1 0° 180 97.3 0° 180 97.3 0° 180 97.3 0° 250 91.9 0° 250 91.9 0° 250 105.0 0° 250 105.0	Avg.			102.1	17.3	83.4	0.0063	
0° 180 100.9 0° 180 97.1 0° 180 97.3 0° 180 91.9 0° 250 87.6 0° 250 87.6 0° 250 105.0 0° 250 105.0	Std Dev.			10.8		24.7	0.0012	
0° 180 100.9 0° 180 97.1 0° 180 97.3 0° 180 91.9 0° 250 87.6 0° 250 91.9 0° 250 105.0 0° 250 105.0								
0° 180 97.1 0° 180 97.3 0° 180 97.3 0° 180 91.9 0° 250 87.6 0° 250 91.9 0° 250 105.0 0° 250 105.0	C3-5	۰0	180	100.9	17.7	100.9	0.0053	
0° 180 97.3 0° 180 125.8 0° 180 91.9 10.250 87.6 0° 250 87.6 0° 250 91.9 0° 250 105.0 0° 250 92.4	C3-10	°O	180	97.1	17.8	39.8	0.0063	
0° 180 125.8 0° 180 91.9 102.6 13.4 13.4 0° 250 87.6 0° 250 91.9 0° 250 73.8 0° 250 91.9 0° 250 91.9	C3-19	00	180	97.3	19.7	97.3	0.0048	
0° 180 91.9 102.6 13.4 0° 250 87.6 0° 250 91.9 0° 250 73.8 0° 250 105.0 0° 250 92.4	C6-22	0 0	180	125.8	17.7	65.1	0.0083	
102.6 18. 0 250 87.6 20. 0 250 91.9 17. 0 250 105.0 18. 0 250 92.4 17.	C3-18	°0	180	91.9	17.9	46.2	0.0057	
0° 250 87.6 20. 0° 250 91.9 17. 0° 250 73.8 18. 0° 250 105.0 18. 0° 250 92.4 17.	Avg.			102.6	18.1	69.9		
0° 250 87.6 20. 0° 250 91.9 17. 0° 250 73.8 18. 0° 250 105.0 18. 0° 250 92.4 17. 90.2 18.	Std.Dev.			13.4		28.3	0.0014	
0° 250 87.6 20. 0° 250 91.9 17. 0° 250 73.8 18. 0° 250 105.0 18. 0° 250 92.4 17. 17. 90.2 18.								
0° 250 91.9 17. 0° 250 73.8 18. 0° 250 105.0 18. 0° 250 92.4 17.	C3-22	00	250	87.6	•	87.6	0.0040	
0° 250 73.8 18. 0° 250 105.0 18. 0° 250 92.4 17.	C3-4	0 0	250	91.9		28.7	0.0060	
0° 250 105.0 18. 0° 250 92.4 17. 90.2 18.	C3-21	0.0	250	73.8		73.8	0.0037	
0° 250 92.4 17. 90.2 18.	c3-11	0 و	250	105.0		105.0	0.0058	
90.2 18.	C3-23	0 و	250	92.4		86.7	0.0054	
	Avg.			2.06			0.000.0	
.7 7.7.7	Btd.Dev.			11.2	1.4	28.8	0.0010	Septimber per per per per per per per per per p

90° 180 90° 180 90° 180 90° 180 90° 250 90° 250 90° 250 90° 250

		Test	Ultimate	Initial	Stress at	Ultimate	
Spec.	Fiber	Temp.	Strength	Modulus	Prop.Lim.		•
No.	Orien.	(%E)	(10 ³ psi)	(10°psi)	(10 ⁵ psi)	(in/in)	Remarks
D10-37	°	-67	237.3	21.17	104.9	0.0095	Buckling
DI0-41	0.0	-67	243.7	21.37	129.6	0.0198	
-26	0.0	-67	240.4	22.78	86.5	0.0084	Buckling
D10-47	0 0	-67	225.5	20.19	1,66	0.0195	
D10-27	0.0	-67	232.1	20.83	109.7	0.0086	Buckling
Avg.			235.8	21.27	105.9	0.0132	
Std.Dev.			7.2	0.95	15.8	0.0059	
							ер де об да буде е ещерналирие инделастовара до се объедо да реше едерейне у се поделение постава на подава на пода
D10-28	00	72	220.0	19.22		0.0185	
D10-29	0 0	7.2	200.6	18.06	200.6	0.0110	
D10-34	00	72	221.9	19.75	1	0.0103	
D10-33	0 0	72	189.7	17.82	117.4	0.0105 (
D10-40	0.0	72	198.4	18.42	198.4	0.0089	Buckling
Avg.			206.1	18.65	172.2	0.0118	
Std.Dev			14.1	0.81	47.4	0.0038	
D10-30	0،	356	151.8	20.72	151.8	0.0073	
D10-35	° 0	350	153.6	18.08	153.6	0.0083	
D10-39	0°	350	179.3	21.84	100.3	0.0085	
210-38	°0	350	182.9	16.44	101.4	0.0117	
D10-36	0	350	155.5	18.41	101.3	0.0083	
Avg.			164.6	19.0	•	0.0088	
Std.Dev.			15.2	2.16	28.3	0.0017	
21-010	00	Q 24	170.0	16 00	O VS	0 0163	A CAMPANIAN TO A
D10-32	00	450		17.19	55.6	2010	ann der eine eine der der der der der der der der der de
D10-44	00	450	110.7	15.93	101.8	0.0071	
D10-45	0	450	168.0	22.69	1 1 1	0.0062	Buckling
Avg.			152.8	18.18		0.0099	
Std.Dev			36.9	3.06	70.5	0.0056	ARREST AR
					27.1	-	

Test:	Compression	ion			Material:	AS/4397	
		Test	Ultimate	Initial	Stress at	Ultimate	
Spec.	Fiber Orien.	Temp.	Strength	Modulus (10°psi)	Prop.Lim.	Strain (in/in)	Remarks
D1.0-3	90ء	-67	32.17	1.64		0.0227	
6-01a)	06	-67	35.00	1.96	15.36	0.0262	
D10-8	06	-67	37.83	1.83	6.10	0.0209	
D10-13	06	-67	36.22	2.25		0.0143	
DI0-19	906	-67	39.47	2.18		0.0252	
Avg.			36.14	1.97	10.73	0.0219	
5td.Dev.			2.79	0.25		0.0047	
DT0-1	06	72	30.78	1.14	8.76	-	
D10-7	066	72	29.36	2.02	8.44	0.0106	
D10-10	06	72	33.95	1.30	27.39	0.0277	
D10-14	06	72	29.65	1.54	12.48	0.0180	
D10-21	90e	72	26.00	1.25	15.21	0.0195	
Avg.			29.95	1.45	14.46	0.0190	
Std. Dev.			2.86	0.31	7.75	0.007	
D10-2	•06	350	18.52	1.07	1	0.012	
D10-12	。06	350	22.77	1.15		0.028	
D10-20	906	350	22.68	1.19	7.34	0.034	
D10-25	906	350	22.15	1.25	60.6	0.020	
D10-24	°06	350	19.34	1.13	6.31	0.027	
Avg.			21.09	1.16	7.58	0.024	
5td.Dev.			2.01	0.07	1,41	900.0	
D10-11	• 06	450	25.41	2.00	11.11	0.0098+	lost strain gage before failure
D10-23	906	450	22.32	1.73	6.27	0.0045+	lost strain gage before failure
DI0-I2	06	450	19.02	1.36		0.0155	•
D10-18	90°	450	18.00	0.87		0.0128+	lost strain gage before failure
D10-5	• 06	450	22.49	2.49	6.34	0.0045+	lost strain gage before failume
Avg.			21.45	I.69	16.7	0.0094	
Std.Dev.			2.97	0.62	2.78	1 -	

Test:	Compression	gion			Material:	T300/F178	
		Test	Ultimate	Initial	Stress at	Ultimate	
Spec.	Fiber Orien.	Temp.	Strength (10 ³ psi)	Modulus (10 ⁶ psi)	Prop.Lim. (103ps1)	Strain (in/in)	Remarks
E31-39	00	-67	203.5	18.50	127.4	0.0154	
E31-45	0.0	-67	192.6	19.77	78.0	0.0088+	Both Prop. Limit & Ult. Strain
E31-33	0.0	-67	196.2	16.54	76.9	0.0102+	of buck
E31-36	0 0	-67	215.2	18.55	87.6	0.0111+	
E31-43	0	-67	192.4	17.14	104.8	0.068+	
Avg.			200.0	18.10		0.0105	
Std.Dev.			9.6	1.28	21.3	0.0032	
E31-41	0 ه	72	167.1	18.21	9.69	+9800.0	Puckling
E31-35	0 0	72	186.7	17.60	36.2	0.0175	
E31-48	90	72	181.5	17.47	8.98	0.0078+	Buckling
E31-37	0 و	72	195.7	18.53	88.9	0.0109	
E31-44	0 ه	7.2	169.0	19.07	65.8	0.0073+	Buckling
Avg.			180.0	18.18	69.5	0.0104	
Std.Dev.			12.0	99.0	21.2	0.0042	
E31-38	۰,0	320	110.3	19.49	49.8	0.0063	
E31-34	٠0	350	110.3	21.11	73.9	0.0059	
E31-42	0 ه	350	135.4	19.15	62.7	0.0082	
E31-47	0 ه	350	137.7	20.79	47.2	0.0081	
E31-46		350	106.1	21.79	39.8	0.0000	
Avg.			120.0	20.42	54.7	0.0069	
Std.Dev.			15.3	1.11	13.6	0.0012	
E31-40	0 ه	450	119.5	17.88	119.5	0.0067	
E31-30	0 ه	450	124.0	19.32	124.0	0.0064	
E31-31	0 ه	450	150.0	17.46	68.8	0.0097	
E31-28	့0	450	180.5	17.68	142.4	0.0107	
E31-29	0	450	112.7	17.27	70.9	0.0068	
Avg.			137.4	17.92	105.2	0.0081	
Std. Dev.			28.0	0.81	33.3	0.0020	

APPENDIX E

FLEXURE DATA

All of the flexure data generated during this program are listed in this appendix. Summarles of these data are tabulated in Section 4.

	exure			L/D Ratio:	32:1
Materials					
Specimen Number	Fiber Orien- tation	Test Temp. (°F)	Ultimate Strength (10 ³ psi)	Modulus of Elasticity (10 ⁶ psi)	Remarks
A46-1	0°	-67	197.0	17.34	
A46-5	0°	-67	177.1	17.10	
A46-12	0°	-67	156.4	17.56	
A46-14	0°	-67	209.8	18.45	
A46-21	0°	-67	209.5	17.69	
Avg.			190.0	17.63	
Std.Dev.			23.0	0.52	
A46-4	0°	72	176.8	17.47	
A46-7	0°	72	176.7	16.88	
A46-17	0°	72	192.4	17.60	
A46-18	٥°	72	233.3	18.94	
A46-30	0°	72	224.3	17.95	
Avg.			200.7	17.77	
Std.Dev.			26.6	0.76	
A46-6	0°	260	136.9	17.85	
A46-13	0°	260	113.8	17.51	
A46-15	0°	260	147.9	17.40	
A46-19	0°	260	159.6	17.70	
A46-26	0°	260	120.1	16.18	
Avg.			135.7	17.33	
Std.Dev,			19.0	0.65	
A46-10	0°	350	96.2	15.78	
A46-16	0.	350	117.9	17.24	
A46-20	70	350	87.0	15.64	
A46-24	o •	350	89.7	16.33	
A46-25	0°	350	91.3	16.44	
Avg.			96.4	16.29	
Std.Dev.			12.5	0.63	

	exure		L/D Ratio: 32:1		
Materials	: SP313				
Specimen Number	Fiber Orien- tation	Test Temp. (°F)	Ultimate Strength (10 ³ psi)	Modulus of Elasticity (106psi)	Remarks
A34-1	90°	-67	11.71	1.54	
A34-5	90°	-67	10.46	1.47	
A34-12	90°	-67	11.89	1.43	
A34-14	90°	-67	11.31	1.41	
A34-21	90°	-67	10.84	1.43	
Avg.			11.24	1.46	
Std.Dev.			0 60	0.05	
A34-4	90°	72	11.34	1.30	
A34-7	90°	72	11.34	1.39	
A34-17	90°	72	9.47	1.37	
A34-18	90°	72	10.65	1.32	
A34-30	90°	72	10.51	1.44	
Avg.			10.66	1.36	
Std.Dev.			0.77	0.06	
A34-6	90°	260	6.55	1.13	
A34-13	90°	260	6.40	1.13	
A34-15	90°	260	6.69	1.06	
A34-19	90°	260	7.47	1.24	
A34-26	90°	260	5.37	1.06	
Avg.			6.50	1.12	
Std.Dev.			0.75	0.07	
A34-10	90°	350_	5.06	1.01	
A34-16	90°	350	4.46	0.97	
A34-20	90°	350	4.67	0.89	
A34-24	90°	350	5.02	0.93	
A34-25	90°	350	4.92	0.97	
Avg.			4.82	0.95	
Std.Dev.			0.26	0.05	

Test: Fl	exure		L/D Ratio:	32:1	
Materials	: AS/30	04			
Specimen Number	Fiber Orien- tation	Test Temp. (°F)	Ultimate Strength (10 ³ psi)	Modulus of Elasticity (10 ⁶ psi)	Remarks
C2-9	0°	~67	231.4	20.3	:
C2-11	0.0	-67	232,0	19.2	·
C2-18	0°	-67	229.6	20.7	
C2-15	0.0	-67	223.6	20.3	
C2-6	0°	-67	222.9	19.3	
Avg.			227.9	20.0	
Std.Dev.			4.3	0.7	
C1-3	0°	72	189.3	18.3	
C1-4	0.0	72	201.5	19.0	
C1-1	0°	72	190.5	15.5	
C1-2	0°	72	199.9	17.9	
C1-5	0°	72	176.2	18.5	İ
Avg.			191.5	17.8	\
Std.Dev.			10.1	1.4	
C2-8	0°	180	157.5	19.6	
C2-16	0°	180	157.2	19.4	
C2-12	0°	180	154.2	19.0	
C2-13	0°	180	153.6	19.8	
C2-7	0°	130	159.0	20.8	
Avg.			156.3	19.7	
Std.Dev.			2.3	0.7	
C2-20	0 °	250	138.2	20.8	
C2-17	0°	250	136.1	19.6	
C2-10	0°	250	129.9	19.9	
C2-19	0°	250	136.7	19.7	
C2-14	0 °	250	135.3	19.9	
Avg.			135.2	20.0	
Std.Dev.			3.2	0.5	

Test: Flexure				L/D Ratio:	32:1
Materials	: AS/30	04			
Specimen Number	Fiber Orien- tation	Test Temp. (°F)	Ultimate Strength (10 ³ psi)	Modulus of Elasticity (10 ⁶ psi)	Remarks
C2-31	90°	-67	11.81	1.30	
C2-30	90°	-67	13.05	1.28	
C2-26	90°	-67	14.06	1.29	
C2-27	90°	-67	13.94	1.34	
C2-28	90°	-67	14.12	1.36	
Avg.			13.40	1.31	
Std.Dev.			0.99	0.03	
C2-23	90°	72	13.49	1.22	
C2-22	90°	72	12.96	1.26	
C2-21	90°	72	12.36	1.31	
C2-29	90°	72	11.59	1.32	
C2-24	90°	72	14.62	1.30	
Avg.			13.00	1.28	
Std.Dev.			1.15	0.04	_
C2-32	90°	180	11.86	1.26	
C2-25	90°	180	12.96	1.28	
C5-1	90°	180	9.38	1.06	
C5-2	90°	180	10.07	1.13	
C4-6	90°	180	12.36	1.13	
Avg.			11.33	1.17	
Std.Dev.			1.53	0.09	
C4-4	90°	250	10.51	1.08	
C4-2	90°	250	10.34	1.09	
C4-1	90°	250	8.88	1.07	
C4-3	90°	250	10.13	1.07	1
C4-5	90°	250	10.69	1.08	
Avg.			10.11	1.08	
Std.Dev.			0.72	0.01	

Test: Flexure				L/D Ratio:	32:1
Materials	: AS/43	97			
Specimen Number	Fiber Orien- tation	Test Temp. (°F)	Ultimate Strength (10 ³ psi)	Mcdulus of Elasticity (106psi)	Remarks
D9-20	0°	-67	228.5	17.05	
D9-12	0°	-67	257.5	19.06	
D48-11	0°	-67	244.0	17.25	
D48-5	0°	-67	238.8	16.80	
D48-20	0°	-67	230.8	16.17	
Avg.			239.9	17.27	
Std.Dev.			11.8	1.08	
D48-12	0°	72	229.1	17.59	
D48-22	0°	72	222.9	18.76	
D48-22	0°	72	212.3	18.20	
D9-3	00	72	239.5	18.96	
D9-3	0°	72	239.3	18.71	
		12	224.4	18.44	
Avg. Std.Dev.			10.5	0.55	
Sca. Dev.			10.5	0.33	
D48-15	0°	350	182.9	18.13	
D48-19	0°	350	172.3	14.62	
D9-15	0°	350	204.6	17.46	
D9-14	0°	350	168.2	18.84	
D9-13	0°	350	165.8	17.25	
Avg.			178.8	17.26	
Std.Dev.		•	15.9	1.60	
D9-4	0°	450	133.7	17.25	
D48-14	0.	450	129.3	16.13	
D48-7	0°	450	123.9	16.17	
D48-17	0.	450	124.0	16.56	
D48-10	0.0	450	132.0	17.51	
	0-	430	128.6	16.72	
Avg. Std.Dev.		 	4.5	0.63	
Ju. Dev.		<u> </u>	1 7.5	0.03	

	exure			L/D Ratio:	32:1
Materials	: AS/43	97			
Specimen Number	Fiber Orien- tation	Test Temp. (°F)	Ultimate Strength (10 ³ psi)	Modulus of Elasticity (106psi)	Remarks
D9-44	90°	-67	10.31	1.54	
D9-36	90°	-67	9.51	1.60	
D48-25	90°	-67	10.02	1.55	
D48-35	90°	-67	8.83	1.37	
D9-25	90°	-67	7.74	1.70	
Avg.			9.28	1.55	
Std.Dev.			1.03	0.12	
D9-41	90°	72	8.31	1.44	
D48-30	90°	72	9.65	1.45	
D9-40	90°	72	8.97	1.43	
D9-45	90°	72	8.92	1.87	
D48-36	90°	72	8.56	1.33	
Avg.			8.88	1.50	
Std.Dev.			0.51	0.21	
D9-35	90°	350	4.87	1.24	
D48-31	90°	350	6.08	1.18	
D9-28	90°	350	4.44	1.15	
D48-23	90°	350	6.20	1.16	
D48-42	90°	350	5.15	1.20	
Avg.			5.34	1.19	
Std.Dev.			0.77	0.04	*
					
		-			

Test: Flexure				L/D Ratio: 32:1		
Materials	: AS/43	97				
Specimen Number	Fiber Orien- tation	Test Temp. (°F)	Ultimate Strength (10 ³ psi)	Modulus of Elasticity (10 ⁶ psi)	Remarks	
D9-46	90°	450	3.80	0.59		
D48-27	90°	450	5.34	0.72		
D9-42	90°	450	3.28	0.53		
D48-39	90°	450	4.84	0.75		
D48-45	90°	450	4.87	0.72		
D9-30	90°	450	3.80	0.68		
Avg.			4.32	0.66		
Std.Dev.			0.80	0.09		
	1					
	 					
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	Nest: Flexure L/D Ratio: 32:1							
Materials	Materials: T300/F178							
Specimen Number	Fiber Orien- tation	Test Temp. (°F)	Ultimate Strength (10 ³ psi)	Modulus of Elasticity (10 ⁶ psi)	Remarks			
E9-10	0°	-67	188.0	15.85				
E9-12	0,0	67	205.3	17.28				
E9-7	0°	-67	196.7	16.60				
E12-8	0°	-67	199.6	18.13				
E12-10	0°	-67	214.7	17.43				
Avg.			200.9	17.06				
Std.Dev.			9.9	0.87				
E9-1	0°	72	189.3	14.97				
E9-17	0°	72	204.6	16.89				
E9-20	0°	72	202.7	16.79				
E12-12	0°	72	215.1	17.76	•			
E12-5	0°	72	208.1	18.06				
Avg.			204.0	16.89				
Std.Dev.			9.5	1.21				
E9-13	0°	350	163.3	17.29				
E12-11	0°	350	178.7	18.65				
E12-6	0°	350	195.8	19.13				
E12-13	0°	350	182.3	17.66				
E9-11	0°	350	175.2	19.41				
Avg.			179.1	18.43				
Std.Dev.			11.8	0.92				
E9-4	0°	450	145.2	16.96				
E9-14	0°	450	137.4	17.31				
E9-5	0°	450	146.6	18.76				
E12-4	0°	450	148.4	19.16				
E12-7	0°	450	159.4	19.10				
Avg.	·		147.4	18.26				
Std.Dev.			7.9	1.04				

Test: Fl	exure			L/D Ratio:	32:1
Materials	: T300/	F178			
Specimen Number	Fiber Orien- tation	Test Temp. (°F)	Ultimate Strength (10 ³ psi)	Modulus of Elasticity (10 ⁶ psi)	Remarks
E9-24	90°	-67	7.91	1.37	
E9-34	90°	-67	8.49	1.51	
E9-33	90°	-67	8.87	1.58	
E9-26	90°	-67	10.08	1.51	
E12-1	90°	-67	11.42	1.55	
Avg.			9.36	1.50	
Std.Dev.			1.40	0.08	
E9-39	90°	72	9.04	1.34	
E9-36	90°	72	7.98	1.23	
E9-41	90°	72	6.78	1.31	
E9-32	90°	72	6.55	1.10	
E12-4	90°	72	10.25	1.34	
Avg.			8.12	1.26	
Std.Dev.			1.55	0.10	
E9-35	90°	350	4.65	1.03	
E9-25	90°	350	3.77	1.13	
E9-43	90°	350	4.57	0.96	
E12-3	90°	350	5.87	0.98	
E9-30	90°	350	5.68	1.15	
Avg.			4.91	1.05	
Std.Dev.			0.87	0.09	
E9-44	90°	450	4.02	0.85	
E9-37	90°	450	4.18	0.82	
E12-2	90°	450	3,95	0.86	
E9-28	90°	450	3.86	1.18	
E9-27	90°	450	4.70	0.93	
Avg.			4.14	0.93	
Std.Dev.			0.33	0.15	

APPENDIX F INPLANE SHEAR DATA

All of the inplane shear data generated during this program are presented in this section. These data are both tabularly and graphically summarized in Section 4.

	olane She	ear				
Materials	SP313					
Specimen Number	Fiber Orien- tation	Test Temp. (°F)	Ultimate Strength (psi)	Inplane Shear Modulus (10 ⁶ psi)	Ultimate Strain (in/in)	Remarks
A38-8	±45°	-67	12,110	0.82		Tensile Coupon
A39-3	±45°	-67	12,170	0.91		Tensile Coupon
A44-10	±45°	-67	12,290	0.88		Tensile Coupon
A47-1	±45°	-67	12,560	0.98		Tensile Coupon
A50-11	±45°	-67	12,220	0.90		Tensile Coupon
Avg.			12,270	0.92		
Std. Dev.			190	0.06		
A38-7	±45°	72	10,330	0.75		Tensile Coupon
A39-9	±45°	72	10,590	0.81		Tensile Coupon
A44-4	±45°	72	10,430	0.76		Tensile Coupon
A47-10	±45°	72	10,340	0.74		Tensile Coupon
A50-1	±45°	72	10,790	0.86	<u> </u>	Tensile Coupon
Avg.			10,500	0.78		
Std. Dev.			190	0.05		
A38-9	±45°	260	7440	0.63		Tensile Coupon
A39-7	±45°	260	7780	0.59		Tensile Coupon
A44-7	±45°	260	7500	0.62		Tensile Coupon
A47-7	±45°	260	7560	0.58		Tensile Coupon
A50-5	±45°	260	7510	0.62		Tensile Coupon
Avg.			7560	0.61		
Std. Dev.			130	0.02		
A38-4	±45°	350	5170	0.53		Tensile Coupon
A39-1	±45°	350	5170	0.53		Tensile Coupon
A44-2	±45°	350	5480	0.55		Tensile Coupon
A47-11	±45°	350	6360	0.54		Tensile Coupon
A50-3	±45°	350	5170	0.51		Tensile Coupon
Avg.			5470	0.53		
Std. Dev.			520	0.01		

	olane She	ear				
Materials:	SP313					
Specimen Number	Fiber Orien- tation	Test Temp. (°F)	Ultimate Strength (psi)	Inplane Shear Modulus (10 ⁶ psi)	Ultimate Strain (in/in)	Remarks
A40-1A	±45°	72	15,110	4.76		Dbl. Rail Shear
A40-1B	±45°	72	15,400	6.06		Dbl. Rail Shear
Avg.			15,260	5.41		
A10-1A	0°	72	3220	0.75		Dbl. Rail Shear
A10-1B	0°	72	3130	1.33		Dbl. Rail Shear
A11-1A	0°	72	2910	0.98		Dbl. Rail Shear
All-lB	0°	72	2980	0.85		Dbl. Rail Shear
Al4-lA	0°	72	2490	1.18		Dbl. Rail Shear
A14-1B	0°	72	2390	0.74		Dbl. Rail Shear
Avg.			2850	0.97		
Std. Dev.			340	0.24		
A10-3A	90°	72	8360	0.82		Dbl. Rail Shear
A10-3B	90°	72	8410	1.04		Dbl. Rail Shear
A14-3B	90°	72	8580	0.78		Dbl. Rail Shear
A14-3A	90°	72	8670	0.89		Dbl. Rail Shear
A13-2A	90°	72	9230	0.94		Dbl. Rail Shear
A13-2B	90°	72	9140	0.76		Dbl. Rail Shear
Avg.			8730	0.87		
Std. Dev.			370	0.11		
A11-2A	90°	260	6700	0.85		Dbl. Rail Shear
A11-2B	90°	260	6800	0.65		Dbl. Rail Shear
A11-3A	90°	260	6850	0.78		Dbl. Rail Shear
A11-3B	90°	260	6610	0.70		Dbl. Rail Shear
A15-2A	90°	260	6480	0.63		Dbl. Rail Shear
A15-2B	90°	260	6440	0.73		Dbl. Rail Shear
Avg.			6650	0.72		
Std. Dev.			170	0.08		

Specimen Number Fiber Orientation Test Temp. (°F) Ultimate Strength (psi) Inplane Shear Modulus (106psi) Ultimate Strain (in/in) Remarks A12-2A 90° 350 Dbl. Rail Shear A12-2B 90° 350 5160 0.56 Dbl. Rail Shear A13-3A 90° 350 5040 0.61 Dbl. Rail Shear A13-3B 90° 350 5150 0.54 Dbl. Rail Shear A14-2A 90° 350 5610 0.62 Dbl. Rail Shear Avg. 5240 0.58 Dbl. Rail Shear Avg. 250 0.04 Dbl. Rail Shear A43-1A 0°/90° 72 11,860 0.75 Dbl. Rail Shear A43-2B 0°/90° 72 11,750 0.74 Dbl. Rail Shear A43-2B 0°/90° 72 12,090 0.83 Dbl. Rail Shear A43-3B 0°/90° 72 11,520 0.77 Dbl. Rail Shear A43-4A 0°/90°		olane She	ear				
Specimen Number Fiber Orientation Test Temp. (°F) Ultimate Strength (notal us (106 psi)) Ultimate Strain (in/in) Remarks A12-2A 90° 350 Dbl. Rail Shear A12-2B 90° 350 5160 0.56 Dbl. Rail Shear A13-3A 90° 350 5040 0.61 Dbl. Rail Shear A13-3B 90° 350 5150 0.54 Dbl. Rail Shear A14-2A 90° 350 Dbl. Rail Shear A14-2B 90° 350 5610 0.62 Dbl. Rail Shear Avg. 5240 0.58 Dbl. Rail Shear A43-1A 0°/90° 72 11,860 0.75 Dbl. Rail Shear A43-2B 0°/90° 72 11,750 0.74 Dbl. Rail Shear A43-2B 0°/90° 72 12,090 0.83 Dbl. Rail Shear A43-3B 0°/90° 72 11,520 0.77 Dbl. Rail Shear A43-4B 0°/90°<	Materials	SP313					
A12-2B 90° 350 5160 0.56 Dbl. Rail Shear A13-3A 90° 350 5040 0.61 Dbl. Rail Shear A13-3B 90° 350 5150 0.54 Dbl. Rail Shear A14-2A 90° 350 Dbl. Rail Shear A14-2B 90° 350 5610 0.62 Dbl. Rail Shear Avg. 5240 0.58 Std. Dev. 250 0.04 A43-1A 0°/90° 72 11,860 0.75 Dbl. Rail Shear A43-1B 0°/90° 72 11,640 0.89 Dbl. Rail Shear A43-2A 0°/90° 72 11,750 0.74 Dbl. Rail Shear A43-2B 0°/90° 72 12,090 0.83 Dbl. Rail Shear A43-3B 0°/90° 72 11,520 0.77 Dbl. Rail Shear A43-3B 0°/90° 72 11,950 0.68 Dbl. Rail Shear A43-4A 0°/90° 72 11,570 0.65 Dbl. Rail Shear A43-4B 0°/90° 72 11,570 0.65 Dbl. Rail Shear A43-4B 0°/90° 72 12,030 0.89 Dbl. Rail Shear A43-4B 0°/90° 72 12,030 0.89 Dbl. Rail Shear		Orien-	Temp.	Strength	Shear Modulus	Strain	
A13-3A 90° 350 5040 0.61 Dbl. Rail Shear A13-3B 90° 350 5150 0.54 Dbl. Rail Shear A14-2A 90° 350 Dbl. Rail Shear A14-2B 90° 350 5610 0.62 Dbl. Rail Shear Avg. 5240 0.58 Std. Dev. 250 0.04 Dbl. Rail Shear A43-1A 0°/90° 72 11,640 0.89 Dbl. Rail Shear A43-2A 0°/90° 72 11,750 0.74 Dbl. Rail Shear A43-2B 0°/90° 72 11,520 0.83 Dbl. Rail Shear A43-3B 0°/90° 72 11,520 0.77 Dbl. Rail Shear A43-3B 0°/90° 72 11,520 0.77 Dbl. Rail Shear A43-3B 0°/90° 72 11,520 0.77 Dbl. Rail Shear A43-3B 0°/90° 72 11,520 0.68 Dbl. Rail Shear A43-4A 0°/90° 72 11,570 0.65 Dbl. Rail Shear A43-4B 0°/90° 72 12,030 0.89 Dbl. Rail Shear A43-4B 0°/90° 72 12,030 0.89 Dbl. Rail Shear Avg. 11,800 0.78	A12-2A	90°	350				Dol. Rail Shear
A13-3B 90° 350 5150 0.54 Dbl. Rail Shear A14-2A 90° 350 Dbl. Rail Shear A14-2B 90° 350 5610 0.62 Dbl. Rail Shear Avg. 5240 0.58 Std. Dev. 250 0.04 Dbl. Rail Shear A43-1A 0°/90° 72 11,860 0.75 Dbl. Rail Shear A43-2A 0°/90° 72 11,640 0.89 Dbl. Rail Shear A43-2B 0°/90° 72 11,750 0.74 Dbl. Rail Shear A43-3A 0°/90° 72 11,520 0.77 Dbl. Rail Shear A43-3B 0°/90° 72 11,520 0.77 Dbl. Rail Shear A43-3B 0°/90° 72 11,520 0.68 Dbl. Rail Shear A43-4A 0°/90° 72 11,570 0.65 Dbl. Rail Shear A43-4B 0°/90° 72 12,030 0.89 Dbl. Rail Shear A43-4B 0°/90° 72 12,030 0.89 Dbl. Rail Shear A43-4B 0°/90° 72 12,030 0.89 Dbl. Rail Shear Avg. 11,800 0.78	A12-2B	90°	350	5160	0.56		Dbl. Rail Shear
A14-2A 90° 350 Dbl. Rail Shear A14-2B 90° 350 5610 0.62 Dbl. Rail Shear Avg. 5240 0.58 Std. Dev. 250 0.04 Dbl. Rail Shear A43-1A 0°/90° 72 11,860 0.75 Dbl. Rail Shear A43-2A 0°/90° 72 11,750 0.74 Dbl. Rail Shear A43-2B 0°/90° 72 12,090 0.83 Dbl. Rail Shear A43-3A 0°/90° 72 11,520 0.77 Dbl. Rail Shear A43-3B 0°/90° 72 11,950 0.68 Dbl. Rail Shear A43-4A 0°/90° 72 11,570 0.65 Dbl. Rail Shear A43-4B 0°/90° 72 12,030 0.89 Dbl. Rail Shear A43-4B 0°/90° 72 12,030 0.89 Dbl. Rail Shear A43-4B 0°/90° 72 12,030 0.89 Dbl. Rail Shear Avg. 11,800 0.78	A13-3A	90°	350	5040	0.61		Dol. Rail Shear
A14-2B 90° 350 5610 0.62 Dbl. Rail Shear Avg. 5240 0.58 Std. Dev. 250 0.04 Dbl. Rail Shear A43-1A 0°/90° 72 11,860 0.75 Dbl. Rail Shear A43-2A 0°/90° 72 11,750 0.74 Dbl. Rail Shear A43-2B 0°/90° 72 12,090 0.83 Dbl. Rail Shear A43-3A 0°/90° 72 11,520 0.77 Dbl. Rail Shear A43-3B 0°/90° 72 11,950 0.68 Dbl. Rail Shear A43-4A 0°/90° 72 11,570 0.65 Dbl. Rail Shear A43-4B 0°/90° 72 12,030 0.89 Dbl. Rail Shear Avg. 11,800 0.78	A13-3B	90°	350	5150	0.54		Dbl. Rail Shear
Avg. 5240 0.58 Std. Dev. 250 0.04 A43-1A 0°/90° 72 11,860 0.75 Dbl. Rail Shear A43-1B 0°/90° 72 11,640 0.89 Dbl. Rail Shear A43-2A 0°/90° 72 11,750 0.74 Dbl. Rail Shear A43-2B 0°/90° 72 12,090 0.83 Dbl. Rail Shear A43-3A 0°/90° 72 11,520 0.77 Dbl. Rail Shear A43-3B 0°/90° 72 11,950 0.68 Dbl. Rail Shear A43-4A 0°/90° 72 11,570 0.65 Dbl. Rail Shear A43-4B 0°/90° 72 12,030 0.89 Dbl. Rail Shear Avg. 11,800 0.78 Dbl. Rail Shear	A14-2A	90°	350				Dbl. Rail Shear
Std. Dev. 250 0.04 A43-1A 0°/90° 72 11,860 0.75 Dbl. Rail Shear A43-1B 0°/90° 72 11,640 0.89 Dbl. Rail Shear A43-2A 0°/90° 72 11,750 0.74 Dbl. Rail Shear A43-2B 0°/90° 72 12,090 0.83 Dbl. Rail Shear A43-3A 0°/90° 72 11,520 0.77 Dbl. Rail Shear A43-3B 0°/90° 72 11,950 0.68 Dbl. Rail Shear A43-4A 0°/90° 72 11,570 0.65 Dbl. Rail Shear A43-4B 0°/90° 72 12,030 0.89 Dbl. Rail Shear Avg. 11,800 0.78 Dbl. Rail Shear	A14-2B	90°	350	5610	0.62		Dol. Rail Shear
A43-1A 0°/90° 72 11,860 0.75 Dbl. Rail Shear A43-1B 0°/90° 72 11,640 0.89 Dbl. Rail Shear A43-2A 0°/90° 72 11,750 0.74 Dbl. Rail Shear A43-2B 0°/90° 72 12,090 0.83 Dbl. Rail Shear A43-3A 0°/90° 72 11,520 0.77 Dbl. Rail Shear A43-3B 0°/90° 72 11,950 0.68 Dbl. Rail Shear A43-4A 0°/90° 72 11,570 0.65 Dbl. Rail Shear A43-4B 0°/90° 72 12,030 0.89 Dbl. Rail Shear Avq. 11,800 0.78	Avg.			5240	0.58		
A43-1B 0°/90° 72 11,640 0.89 Dbl. Rail Shear A43-2A 0°/90° 72 11,750 0.74 Dbl. Rail Shear A43-2B 0°/90° 72 12,090 0.83 Dbl. Rail Shear A43-3A 0°/90° 72 11,520 0.77 Dbl. Rail Shear A43-3B 0°/90° 72 11,520 0.68 Dbl. Rail Shear A43-4A 0°/90° 72 11,570 0.65 Dbl. Rail Shear A43-4B 0°/90° 72 12,030 0.89 Dbl. Rail Shear Avg. 11,800 0.78	Std. Dev.			250	0.04		
A43-1B 0°/90° 72 11,640 0.89 Dbl. Rail Shear A43-2A 0°/90° 72 11,750 0.74 Dbl. Rail Shear A43-2B 0°/90° 72 12,090 0.83 Dbl. Rail Shear A43-3A 0°/90° 72 11,520 0.77 Dbl. Rail Shear A43-3B 0°/90° 72 11,520 0.68 Dbl. Rail Shear A43-4A 0°/90° 72 11,570 0.65 Dbl. Rail Shear A43-4B 0°/90° 72 12,030 0.89 Dbl. Rail Shear Avg. 11,800 0.78							
A43-2A 0°/90° 72 11,750 0.74 Dbl. Rail Shear A43-2B 0°/90° 72 12,090 0.83 Dbl. Rail Shear A43-3A 0°/90° 72 11,520 0.77 Dbl. Rail Shear A43-3B 0°/90° 72 11,950 0.68 Dbl. Rail Shear A43-4A 0°/90° 72 11,570 0.65 Dbl. Rail Shear A43-4B 0°/90° 72 12,030 0.89 Dbl. Rail Shear Avg. 11,800 0.78	A43-1A	0°/90°	72	11,860	0.75		Dbl. Rail Shear
A43-2B 0°/90° 72 12,090 0.83 Dbl. Rail Shear A43-3A 0°/90° 72 11,520 0.77 Dbl. Rail Shear A43-3B 0°/90° 72 11,950 0.68 Dbl. Rail Shear A43-4A 0°/90° 72 11,570 0.65 Dbl. Rail Shear A43-4B 0°/90° 72 12,030 0.89 Dbl. Rail Shear Avg. 11,800 0.78	A43-1B	0°/90°	72	11,640	0.89		Dbl. Rail Shear
A43-3A 0°/90° 72 11,520 0.77 Dbl. Rail Shear A43-3B 0°/90° 72 11,950 0.68 Dbl. Rail Shear A43-4A 0°/90° 72 11,570 0.65 Dbl. Rail Shear A43-4B 0°/90° 72 12,030 0.89 Dbl. Rail Shear Avg. 11,800 0.78	A43-2A	0°/90°	72	11,750	0.74		Dbl. Rail Shear
A43-3B 0°/90° 72 11,950 0.68 Dbl. Rail Shear A43-4A 0°/90° 72 11,570 0.65 Dbl. Rail Shear A43-4B 0°/90° 72 12,030 0.89 Dbl. Rail Shear Avg. 11,800 0.78	A43-2B	0°/90°	72	12,090	0.83		Dbl. Rail Shear
A43-4A 0°/90° 72 11,570 0.65 Dbl. Rail Shear A43-4B 0°/90° 72 12,030 0.89 Dbl. Rail Shear Avg. 11,800 0.78	A43-3A	0°/90°	72	11,520	0.77		Dbl. Rail Shear
A43-4B 0°/90° 72 12,030 0.89 Dbl. Rail Shear Avg. 11,800 0.78	A43-3B	0°/90°	72	11,950	0.68		Dbl. Rail Shear
Avg. 11,800 0.78	A43-4A	0°/90°	72	11,570	0.65		Dbl. Rail Shear
	A43-4B	0°/90°	72	12,030	0.89		Dbl. Rail Shear
Std. Dev. 330 0.09	Avg.			11,800	0.78		
	Std. Dev.			330	0.09		

Test: In	olane She	ear		·		
Materials	AS/300	4				
Specimen Number	Fiber Orien- tation	Test Temp. (°F)	Ultimate Strength (psi)		Ultimate Strain (in/in)	Remarks
C23-1	±45°	-67	20,980	0.55		Tensile Coupon
C22-7	±45°	-67	21,560	0.59		Tensile Coupon
C21-6	±45°	-67	21,060	0.54		Tensile Coupon
C23-6	±45°	-67	21,420			Tensile Coupon
C24-4	±45°	-67	19,030	0.53		Tensile Coupon
Avg.			20,810	0.55		
Std. Dev.			990	0.03		
C21-1	±45°	72	16,530	0.63		Tensile Coupon
C20-3	±45°	72	14,980	0.54		Tensile Coupon
C20-5	±45°	72	15,550	0.56		Tensile Coupon
C19-4	±45°	72	15,330	0.53		Tensile Coupon
C21-3	±45°	72	17,440	0.52		Tensile Coupon
Avg.			15,970	0.56		
Std. Dev.			1,000	0.04		
C20-8	±45°	180	12,550	0.50		Tensile Coupon
C19-6	±45°	180	14,650	0.55		Tensile Coupon
C19-8	±45°	180	14,110	0.50		Tensile Coupon
C21-7	±45°	180	15,020	0.53		Tensile Coupon
C20-4	±45°	180	13,080	0.54		Tensile Coupon
Avg.			13,880	0.52		
Std. Dev.			1,040	0.02		
C24-6	±45°	250	11,770	0.49		Tensile Coupon
C19+1	±45°	250	12,070	0.50		Tensile Coupon
C19-7	±45°	250	11,890	0.53		Tensile Coupon
C23-3	±45°	250	12,570	0.57		Tensile Coupon
C21-2	±45°	250	12,450	0.69		Tensile Coupon
Avg.			12,150	0.56		
Std. Dev.			350	0.08		

	lane Sh					
Materials	: AS/4397	<u> </u>				
Specimen Number	Fiber Orien- tation	Test Temp. (°F)	Ultimate Strength (psi)	Inplane Shear Modulus (10 ⁶ psi)	Ultimate Strain (in/in)	Remarks
D27-10	±45°	-67	9570	0.85		
D29-1	±45°	-67	9640			
D28-7	±45°	-67	9390	0.82		
D29-9	±45°	-67	9900	0.86		
D30-3	±45°	-67	9642	0.77		
Avg.			9630	0.83		
Std. Dev.			190	0.04		
D27-9	±45°	72	9460	0.77		
D27-1	±45°	72	9320	0.76		
D30-5	±45°	72	9100	0.77		
D29-4	±45°	72	9320	0.81		
D28-3	±45°	72	9600	0.77		
Avg.			9360	0.77		
Std. Dev.			190	0.02		
D29-3	±45°	350	8490	0.56		
D28-10	±45°	350	8470	0.61		
D28-5	±45°	350	8480	0.51		
D27-5	±45°	350	8470	0.51		
D30-1	±45°	350	7630	0.61		
Avg.			8310	0.56		
Std. Dev.			380	0.05		*
D30-4	±45°	450	8700	0.58		
D29-8	±45°	450	8330			
D29-2	±45°	450	8250	0.57		
D27-3	±4,5°	450	8170			
D28-8	±45°	450	8290	0.45		
Avg.			8350	0.54		
Std. Dev.			210	0.07		

Test: In	olane Sho	ear				
Materials	T300/1	7178				
Specimen Number	Fiber Orien- tation	Test Temp. (°F)	Ultimate Strength (psi)	Inplane Shear Modulus (10 ⁶ psi)	Ultimate Strain (in/in)	Remarks
E42-5	±45°	-67	7150	0.65		
A39-1	±45°	-67	7940	0.80		
E40-3	±45°	-67	8570	0.80		
E36-2	±45°	-67	7860	0.70		
E35-4	±45°	-67	8030	0.83		
Avg.			7910	0.76		
Std. Dev.			510	0.08		
E35-3	±45°	72	8810	0.67		
E29-7	±45°	72	9120	0.69		
E40-2	±45°	72	9050	0.77		
E36-1	±45°	72	8240	0.77		
E42-6	±45°	72	7720	0.71		
Avg.			8590	0.72		
Std. Dev.			600	0.05		
E39-8	±45°	350	7350	0.50		
E35-2	±45°	350	7140	0.49		
E42-7	±45°	350	7100	0.53		
E36-9	±45°	350	7160	0.53		
E40-1	±45°	350	7760	0.55		
Avg.			7300	0.52		
Std. Dev.			270	0.02		
E39-9	±45°	450	6030	0.42		
E35-1	±45°	450	6170	0.41		
E42-2	±45°	450	5900	0.44		
E36-6	±45°	450	6360	0.44		
E40-10	±45°	450	5990	0.37	1	
Avg.	1		6090	0.41		
Std. Dev.			180	0.03		

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APPENDIX G INTERLAMINAR SHEAR DATA

All of the interlaminar shear data generated during this program are tabulated in this appendix. Tabular summaries of these data appear in Section 4.

		Short-Beam)	Shear
Materials:	SP313		L/D Ratio: 4/1
Specimen Number	Test Temp. (°F)	Ultimate Strength (10 ³ psi)	Remarks
A35-5	-67	15.00	
A35-9	-67	14.89	
A35-12	-67	14.57	
A35-37	-67	14.21	
A35-47	-67	13.76	
Avg.		14.49	
Std.Dev.		0.51	
A35-3	72	12.65	
A35-4	72	12.88	
A35-22	72	13.02	
A35-31	72	11.88	
A35-40	72	13.04	
Avg.		12.69	
Std.Dev.		0.48	
A35-15	260	8.39	
A35-18	260	8.86	
A35-20	260	8.53	
A35-28	260	8.93	
A35-41	260	9.11	
Avg.		8.76	
Std.Dev.		0.30	
A35-1	350	7.29	
A35-6	350	6.98	
A35-35	350	7.44	
A3539	350	7.21	
A35-46	350	6.99	
Avg.		7.18	
Std.Dev.		0.19	_

	laminar (Short-Beam)	Shear
Materials: /	AS/3004		L/D Ratio: 4/1
Specimen Number	Test Temp. (°F)	Ultimate Strength (10 ³ psi)	Remarks
C5-29	-67	13.93	
C5-8	-67	11.91	
C5-9	-67	13.36	
C5-11	-67	14.54	
C5-35	-67	14.09	
C38-5	-67	15.23	
C38-14	-67	15.30	
C38-15	-67	13.94	
C38-16	-67	14.13	
Avg.		14.05	
Std.Dev.		1.02	
C1-6	72	10.97	
C1-11	72	12.47	
C1-8	72	12.74	
C1-10	72	11.31	
C1-12	72	13.26	
C5-4	72	10.15	
C5-14	72	10.69	
C38-5-3	72	11.08	
C38-5-12	72	11.54	
Avg.		11.58	
Std.Dev.		1.03	
	 		
		<u></u>	<u> </u>

		Short-Beam)	Shear
Materials: A	5/3004		L/D Ratio: 4/1
Specimen Number	Test Temp. (°F)	Ultimate Strength (10 ³ psi)	Remarks
C5-26	180	9.41	
C5-12	180	9.62	
C5-24	180	9.05	
C5-19	180	9.12	
C5-17	180	8.41	
C38-5-9	180	9.92	
C38-5-4	180	10.02	
C38-5-6	180	9.19	
C38-5-8	180	9.35	
C38-5-13	180	9.69	
Avg.		9.38	
Std.Dev.		0.47	
C1-7	250	8.72	
C1-9	250	9.55	
C5-5	250	8.15	
C5-27	250	7.92	
C5-7	250	8.35	
C38-5-7	250	8.35	
C38-5-10	250	8.09	
Avg.		8.45	
Std.Dev.		0.55	
		1	
	<u> </u>	<u> </u>	
	 		
<u> </u>			<u> </u>

		Short-Beam)	Shear
Materials: 1	AS/4397		L/D Ratio: 4/1
Specimen Number	Test Temp. (°F)	Ultimate Strength (10 ³ psi)	Remarks
D9-20	-67	10.77	
D9~35	-67	15.91	
D9-39	-67	18.96	
D9-1	-67	16.32	
D9-12	-67	11.71	
Avg.		14.73	
Std.Dev.		3.41	
D9-38	72	14.87	
D9-30	72	12.86	
D9-41	72	15.14	
D9-13	72	10.96	
D9-2	72	14.27	
Avg.		13.62	
Std.Dev.		1.73	
D9-40	350	11.47	
D9-21	350	8.71	
D9-27	350	9.48	
D9-7	350	10.59	
D9-11	350	8.71	
Avg.		9.79	
Std.Dev.		1.18	
D9-6	450	7.24	
D9-45	450	6.56	
D9-23	450	5.44	
D9-17	450	5.13	
D9-26	450	6.67	
Avg.		6.21	
Std.Dev.		0.89	

		Short-Beam)	
Materials:	T300/F178		L/D Ratio: 4/1
Specimen Number	Test Temp. (°F)	Ultimate Strength (10 ³ psi)	Remarks
E9-5	-67	15.12	
E9-12	-67	15.12	
E9-17	-67	17.69	
B9-14	-67	16.86	
E9-21	-67	14.82	
Avg.		15.92	
Std.Dev.		1.28	·
E9-3	72	14.10	
E9-13	72	14.06	
E9-16	72	15.42	
E9-4	72	16.08	
E9-15	72	14.44	
Avg.		14.82	
Std.Dev.		0.89	
E9-19	350	10.58	
E9-6	350	10.35	
E9-7	350	10.13	
E9-18	350	9.96	
E9-9	350	9.86	
Avg.		10.17	
Std.Dev.		0.29	
E9-1	450	8.10	
E9-10	450	7.38	
E9-11	450	8.19	
E9-2	450	8.07	
E9-20	450	8.26	
Avg.		8.00	
Std.Dev.		0.36	

FATIGUE DATA

All of the tensile fatigue data generated during the program, along with residual strengths of specimens which "ran out" to 10⁷ cycles are presented here. The residual strengths were all determined with a tensile test at 72°F, regardless of what temperature the specimen saw during the fatigue test. Summaries of these data are presented in Section 4 where the fatigue lifetimes are reported as log-mean values.

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R = +0.1	Frequency = 30 Hz	Function: Sine		Remarks											The second s										A STATE OF THE PARTY OF THE PAR	A THE PROPERTY OF THE PROPERTY
		_	Residual	Strength (10 ³ ps1)	190.6	-	***	-			***************************************		***************************************			1	-				685-440 MB)					
		٠	Temp.	Rise (°F)			******	-	-				-	-			1	1								
			Cycles	to Failure	10,280,300+	8,400	1,872,200	54,900	1,200	009	006	900	1,100	1,500	3,800	364,600	24,400	1,324,200	9,270,700	399,700	2,600	245,300	7,800	2,800		
			Max.	Stress (& ult.)	22	5	70	70	8	90	96	90	80	80	80	80	70	20	70	70	98	8	90	90		
			MIn.	Stress (103psi)	13.5	13.5	13.5	13.5	15.7	15.7	15.7	15.2	14.0	14.0	14.0	14.0	12.2	12.2	12.2	12.2	12.8	12.8	12.8	12.8		
atigue			Max.	Stress	134.6	134.6	134.6	134.6	157.2	157.2	157.2	157.2	139.8	139.8	139.8	139.8	122.3	122.3	122.3	122.3	127.5	127.5	127.5	127.5		
Tensile-Tensile Fatigue			Test	Temp.	72	72	72	72	260	260	260	260	260	260	260	260	260	260	260	260	 350	320	350	350		
Tensile-	al: SP313	1	Fiber	Orienta-	00	00	00	00	00	00	00	00	00	00	00	0.	00	0	°	0°	00	°O	00	0.		
Test:	Material:			Specimen	A6-4	A416	A2-13	A1-8	A1-3	A28	A4-12	A6-12	A1-17	A2-1	A4-2	A6-1	A2-16	A4-18	A68	A7-18	A1-13	A2-10	A4-1	A6-18		

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Tensile-Tensile Fatigue	rensile r	atigne				***************************************		1
SP313	~							Frequency = 10 Hz
Γ	1008	200	Min	Max	Cycles	Temo.	Residual	1
orienta-	Temp.	Stress	Stress	Stress (* ult.)	to Failure	Rise (°F)	Strength (103 pst)	Remarks
	350	113.4	11.3	8	11,100		1	
	320	113.4	11.3	80	91,400	-	-	
	350	113.4	11.3	80	4,520,600	1	-	
	350	113.4	11.3	8	49,700	Carrier de la ca		
				C	007			e for administrative de distribute de la compressión de la compres
00	350	99.2	0.99	70	2,400		-	
0°	320	99.2	0.99	70	640,800		1	
00	350	99.2	66.0	70	11,406,700+	***	176.7	
00	350	99.2	0.99	70	7,409,400	1		
96	19-	4.68	0.47	96	700		-	
06ء	-67	4.68	0.47	90	200			
°06	-67	4.68	0.47	96	2,300			
0 6ء	-67	4.68	0.47	96	1,200			
06ء	<u> </u>	4.16	0.42	80	45,000	-		
06ء	<i>L</i> 9–	4.16	0.42	80	1,300			
06	<i>L</i> 9-	4.16	0.42	80	17,800			
.06	<u>-67</u>	4.16	0.42	8	006			
.06	-67	3.64	0.36	5	11,400	1		
90°	- 67	3.64	0.36	02	3,295,300			
°06	-67	3.64	0.36	20	1,900			
90°	-67	3.64	0.36	70	43,900	-		

Material: SP313	400	Tensile-Tensile Fatique SP313	K.	X	Se OVO	Temo.	Residual	Frequency = 30 Hz
	Test Temp. (°F)	Max. Stress (10 ³ nai)	Stress (10 psi)	Stress (1 ult.)	Cycles to Failure	Rise (°F)	Strength (103 pst)	Remarks
		4.42	0.44	8	3,500	į	-	
	72	4.42	0.44	90	4,100	-	1	
. 1	72	4.42	0.44	90	1,800	1	1	er film en
1	72	4.42	0.44	96	006	-	-	
- 1		,						
i	72	3.93	0.39	င္ထ	T,900		l	
	72	3.93	0.39	80	200			
	72	3.93	0.39	80	1,700			
-	72	3.93	0.39	8	82,200			
\vdash	72	3.44	0.34	70	65,300	-	1	
-	72	3.44	0.34	70	2,800			
-	72	3.44	0.34	70	2,500	*	-	
 	72	3.44	0.34	20	10,000,100+	-	6.32	
H	72	3.44	0.34	70	10,000,100+	***************************************	3.70	
H								ge flavorig game of the second particular and provide the second
	260	4.29	0.43	06	2,100			
-	260	4.29	0.43	90	006			
	260	4.29	0.43	06	008		and constraints	
-	260	4.29	0.43	06	200		-	
	260	3.81	0.38	08	1,200		-	
	260	3.81	0.38	08	11,200	1	********	
	260	3.81	0.38	08	400	********		
 	260	3.81	0.38	80	100		-	
~		_	_				_	

R = +0.1	Frequency = .30 Hz	Function: Sine		Renarks								-									-					
			Residual	(10 ³ ps1)	-	1		1	-	-	-		1	********	*****	-	***************************************	***************************************	1		-		1000 1000			
			Temp.	(4.)	1	1		1	ŀ	1		-		-	1		ļ	-		4	1		-			
			Cycles	Failure	14,000	25,000	30,600	12,400	2,000	9,200	300	800	100	3,000	11, 300	17,800	40,900	2,851,600	3,700	25,200	10,100	6,100	9,500	9,400	_	- Company of the Comp
			Max.	(% ult.)	2	70	70	70	90	06	06	90	80	88	88	80	0,0	22	70	70	75	73	75	75		
			Min.	(10 psi)	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.30	00.30	0.30	0.30	0.26	0.26	0.26	0.26	1.84	1.84	1.84	1.84		
atigue			Max.	Stress (10 ³ pet)	3.33	3.33	3.33	3.33	3,32	3.32	3.32	3.32	2.95	2.95	2.95	2.95	2.59	2.59	2.59	2.59	13.38	18.38	18.38	18.38		
Tensile F	~		Test	Temp.	260	260	260	260	350	350	350	350	350	350	320	350	320	320	350	350	-67	-67	-67	-67		
Tensile-Tensile Patigue	al: SP313	l	Fiber	Orienta-	°8	°06	°06	°06	06	06ء	°06	90°	90°	°06	°06	06	°06	06،	°06	06،	+45°	+45°	+45°	±45°		
Test:	Material:			Specimen	A17-2	A18-4	A20-9	R22-4	A19-10	A20-2	A21-7	A22-7	A16-10	A17-5	A19-2	A19-7	A17-8	A20-4	A21-3	A23-2	A38-3	A39-11	A47-8	A50-8		

R = +0.1	Frequency # 30 Hz	Function: Sine		(10° pst) remarks	THE PARTY OF THE P													depotential									The state of the s
				+	1			1						1		_											
			Temp.			-	-										į				I		İ			 	
			Cycles to	Failure	61,200	71,400	33,900	36,100		1,487,300	753,200	205,000	1,173,400	9,300	14,000	7,200	9,700	166,200	153,500	224,200	120,500	1,641,700	3,533,400	4,359,500	2,670,100		
			Max. Stress	(* ult.)	70	70	2	70		09	99	09	09	08	88	80	8	20	92	92	20	9	09	09	09		
			Min. Stress	(10-psi)	1.72	1.72	1.72	1.72		1.47	1.47	1.47	1.47	1.68	1.68	1.68	1.68	1.47	1.47	1.47	1.47	1.26	1.26	1.26	1.26		
Fatigue			Max. Stress	(10 ³ psi)	17.15	17.15	17.15	17.15		14.70	14.70	14.70	14.70	16.79	16.79	16.79	16.79	14.69	14.69	14.69	14.69	12.59	12.59	12.59	12.59		•
ı	1		Test Temp.	(°F)	-67	-67	19-	-67	***************************************	-67	-67	-67	-67	72	72	72	72	72	72	72	72	72	72	72	72		
Tensile-Tensile	al: SP313	1	Fiber Orienta-	tion	±45°	±45°	±45°	±45°		+450	±45°	+45°	+45°	±45°	±45°	±45°	+45°	±45°	±45°	±45°	±45°	+45°	±45°	±45°	±45°		
Test:	Material:		Specimen	Number	A38-11	A44-1	P488-7	A51-2		A44-9	A48-3	A48-10	A51-10	A.39-8	A47-4	A48-5	A50-4	A38-10	A39-5	A50-9	A51-4	A39-10	A44-5	A47-5	A58-10		

Test:	Tensile-Tensile Fatigue	ensile F	atigue						R = +0.1
Material:	al: SP313								Frequency = 30 Hz
	1								Punction: Sine
	Fiber	Test	Max.	Hin.	Max.	Cycles	Temp.	Residual	
Specimen	Oriental	Temp.	Stress	Stress (103psi)	Stress (* ult.)	ro Failure	KISG (°F)	(10 ³ ps1)	Remarks
A39-2	+45°	260	12.01	1.20	80	5,400	-	1	
A47-2	+45°	260	12.01	1.20	88	000′9	ł	l	
A50-10	±45°	260	12.01	1.20	8	8,000	-	-	
A53-8	±45°	260	12.01	1.20	80	4,000	-	-	
A38-5	±45°	260	10.51	1.05	70	193,400	-		
A44-2	<u>+45°</u>	260	10.51	1.05	20	227,300	*******		
A484	±45°	260	10.51	1.05	20	137,900		*****	
A515	∓42。	260	10.51	1.05	70	251,200	***************************************		
A44-8	±45°	260	9.01	0.90	09	10,000,000+		20.84	
A48-11	+ 4 5°	260	9.01	06.0	09	10,000,100+	-	19.80	
A502	+45°	260	9.01	0.00	09	10,000,100+		20.87	
A513	+45°	260	9.01	06.0	09	10,000,100+	1	20.03	
A38-1	±45°	350	8.75	0.88	80	49,500	*****		
A394	+45°	350	8.75	0.88	08	7,500			
A441	+45°	320	8.75	0.88	80	14,400			
A473	+45°	320	8.75	88*0	Ú8	8, 600	, mar (m)		
A53-9	±45°	350	8.20	0.82	75	492,500	-	-	
A551	+45°	350	8.20	0.82	75	3,750,600		-	
A57-2	+45°	350	8.20	0.82	75	10,000,100+	******	18.32	
F62-2	+45°	350	8.20	0.82	75	5,555,200			
					-				
									g finage agency and the state of program of the state of

Test:	: Tensile-Tensile Fatique	Tensile F	atique					- Third	D or AD 1
Material:	tal: SP313						-	A STATE OF THE PARTY OF THE PAR	7:01
	1		;						Frequency # 50 R2
Specimen		Test Temp.	Max. Stress	Min. Stress	Max. Stress	Cycles to	Temp. Rise	Residual Strength	
A50-7	+450	1	7.66	0.77	70 70	5,119,900	(A)	(103 pst)	Remarks
A51-8		ŧ	7.66	0.77	20	10,000,100	-	16.43	e e tipe de la companya de la companya de la companya de la companya de la companya de la companya de la compa
A53-11	÷45°	350	7.66	0.77	70	6,974,800		-	oraniente bezonte de comence de la companya de companya de companya de companya de companya de companya de com
A63-7	+45°	350	7.66	0.77	70	10,000,100	-	16.50	Andres
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	Test:	Tensile-Tensile Fatique	Pensile F	atique						R = +0.1
Fiber Test Hex. Min. Hext. Cycles Residual Frienction. Cycles Strength Criental Tesp. Strength Strength Cycles	Materi	al: AS/30	04							= .30
Operator Togst Nast. Stress Cycles (Pring) Tripe Resempth (Pring) Orienta - Togst Stress Stress Stress Stress Stress Orienta - Togst (103 psi) (100 psi) (
Upon (***) (10.3 ps.) (10.3 ps.) (10.3 ps.) (10.3 ps.) (10.3 ps.) 0° -67 180.4 18.0 90 4,200 0° -67 180.4 18.0 90 4,200 0° -67 180.4 18.0 90 4,200 0° -67 180.4 18.0 90 4,200 0° -67 160.4 16.0 80 1,463,600 0° -67 160.4 16.0 80 857,800 0° -67 160.4 16.0 80 81,500 0° -67 160.4 16.0 80 81,500 0° -67 140.3 14.0 70 10,000,100+ 0° -67 140.3 14.0 70 10,000,000+ 158.6 0° -67 140.3 14.0	1	Fiber	Test	Max.	Min.	Max.	Cycles	Temp. Rise	Residual	
0° -67 180.4 18.0 90 21,000 0° -67 180.4 18.0 90 90 90 0° -67 180.4 18.0 90 4,200 0° -67 180.4 18.0 90 4,200 0° -67 160.4 16.0 80 1,463,600 0° -67 160.4 16.0 80 857,800 0° -67 160.4 16.0 80 81,500 0° -67 140.3 14.0 70 12,900 0° -67 140.3 14.0 70 15,000 0° -67 140.3 14.0 70 15,500 0° -67 140.3 14.0 70 15,500 0° -67 140.3 14.0 70 15,500 </td <td>Number</td> <td>tion</td> <td>(GE)</td> <td>(10³ psi)</td> <td>(10³0si)</td> <td>(& ult.)</td> <td>Failure</td> <td>(°F)</td> <td>(10³ ps1)</td> <td>Remarks</td>	Number	tion	(GE)	(10 ³ psi)	(10 ³ 0si)	(& ult.)	Failure	(°F)	(10 ³ ps1)	Remarks
0° -67 180.4 18.0 90 90 0° -67 180.4 18.0 90 4,200 0° -67 180.4 18.0 90 4,200 0° -67 160.4 16.0 80 1,463,600 0° -67 160.4 16.0 80 857,800 0° -67 160.4 16.0 80 81,500 0° -67 140.3 14.0 70 91,800 0° -67 140.3 14.0 70 10,000,100+ 0° -67 140.3 14.0 70 15,500 0° -67 140.3 14.0 70 15,500 0° -67 140.3 14.0 70 15,500 0° -67 140.3 14.0 70 15,000	C13-3	0,0	<i>-</i> 9 <i>-</i>	180.4	18.0	98	21,000	{	-	
0° -67 180.4 18.0 90 4,200 0° -67 180.4 18.0 90 800 0° -67 160.4 16.0 80 1,463,600 0° -67 160.4 16.0 80 857,800 0° -67 160.4 16.0 80 81,500 0° -67 160.4 16.0 80 81,500 0° -67 140.3 14.0 70 10,000,100+ 0° -67 140.3 14.0 70 15,500 0° -67 140.3 14.0 70 15,500 0° -67 140.3 14.0 70 15,500 0° -67 140.3 14.0 70 15,500 0° -67 140.3 14.0 70 15,500	C13-10	0.0	-67	180.4	18.0	90	006	1	-	
0° -67 180.4 18.0 90 800 0° -67 160.4 16.0 80 1,463,600 0° -67 160.4 16.0 80 42,900 0° -67 160.4 16.0 80 42,900 0° -67 160.4 16.0 80 81,500 0° -67 140.3 14.0 70 10,000,100+ 0° -67 140.3 14.0 70 10,000,000+ 0° -67 140.3 14.0 70 15,500 0° -67 140.3 14.0 70 10,000,000+ 0° -67 140.3 14.0 70 10,000,000+ 0° -67 169.1 16.9 90 1,700 0° 72 150.3 15.0 80 2,100 -	C12-2	00	-67	180.4	18.0	90	4,200	1		
0° -67 160.4 16.0 80 1,463,600 0° -67 160.4 16.0 80 857,800 0° -67 160.4 16.0 80 42,900 0° -67 160.4 16.0 80 81,500 0° -67 140.3 14.0 70 91,800 0° -67 140.3 14.0 70 10,000,100+ 0° -67 140.3 14.0 70 15,500 0° -67 140.3 14.0 70 15,500 0° -67 140.3 14.0 70 15,000 0° -67 140.3 14.0 70 15,000 0° -72 169.1 16.9 90 1,700 0° 72 150.3 15.0 80 2,100 <td>C12-4</td> <td>0.0</td> <td>-67</td> <td>180.4</td> <td>18.0</td> <td>90</td> <td>008</td> <td></td> <td></td> <td></td>	C12-4	0.0	-67	180.4	18.0	90	008			
0° -67 160.4 16.0 80 1,463,600 0° -67 160.4 16.0 80 857,800 0° -67 160.4 16.0 80 42,900 0° -67 160.4 16.0 80 81,500 0° -67 140.3 14.0 70 91,800 0° -67 140.3 14.0 70 10,000,100+ 0° -67 140.3 14.0 70 15,500 0° -67 140.3 14.0 70 15,500 0° -67 140.3 14.0 70 15,500 0° -67 140.3 14.0 70 15,500 0° -67 169.1 16.9 90 1,700 0° 72 169.1 16.9 90 1,000 <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td>										
0° -67 160.4 16.0 80 857,800 0° -67 160.4 16.0 80 42,900 0° -67 160.4 16.0 80 81,500 0° -67 140.3 14.0 70 91,800 0° -67 140.3 14.0 70 27,500 0° -67 140.3 14.0 70 15,500 0° -67 140.3 14.0 70 15,500 0° -67 140.3 14.0 70 15,500 0° -67 140.3 14.0 70 15,000,000 0° -67 169.1 16.9 90 1,700 0° 72 169.1 16.9 90 1,000 0° 72 150.3 15.0 80 2,100	C12-10	00	-67	160.4	16.0	80	1,463,600			
0° -67 160.4 16.0 80 42,900 0° -67 160.4 16.0 80 81,500 0° -67 140.3 14.0 70 91,800 0° -67 140.3 14.0 70 27,500 0° -67 140.3 14.0 70 15,500 0° -67 140.3 14.0 70 15,500 0° -67 140.3 14.0 70 15,500 0° -67 140.3 14.0 70 15,000 0° -67 140.3 16.9 90 1,700 0° 72 169.1 16.9 90 1,000 0° 72 150.3 15.0 80 2,100 0° 72 150.3 15.0 80 20,700	C12-11	0،	<u>-</u> 9	160.4	16.0	8	008'128	1	********	
0° -67 160.4 16.0 80 81,500 0° -67 140.3 14.0 70 91,800 0° -67 140.3 14.0 70 10,000,100+ 0° -67 140.3 14.0 70 15,500 0° -67 140.3 14.0 70 15,500 0° -67 140.3 14.0 70 15,500 0° -67 140.3 14.0 70 15,500 0° 72 169.1 16.9 90 1,700 0° 72 169.1 16.9 90 1,000 0° 72 150.3 15.0 80 2,100 0° 72 150.3 15.0 80 2,100 0° 72 150.3 15.0 80 20,700 0° 72 150.3 15.0 80 2,100	C12-12	00	- 67	160.4	16.0	80	42,900			
0° -67 140.3 14.0 70 91,800 0° -67 140.3 14.0 70 10,000,100+ 0° -67 140.3 14.0 70 27,500 0° -67 140.3 14.0 70 15,500 0° -67 140.3 14.0 70 15,500 0° 72 169.1 16.9 90 1,700 0° 72 169.1 16.9 90 1,000 0° 72 150.3 15.0 80 2,100 0° 72 150.3 15.0 80 2,100 0° 72 150.3 15.0 80 20,700 0° 72 150.3 15.0 80 20,700 0° 72 150.3 15.0 80 20,700 0° 72 150.3 15.0 80 80 20,700 <	C25-4	0.	-67	160.4	16.0	80	81,500		1000	
0° -67 140.3 14.0 70 91,800 0° -67 140.3 14.0 70 10,000,100+ 0° -67 140.3 14.0 70 27,500 0° -67 140.3 14.0 70 15,500 0° -67 140.3 14.0 70 15,500 0° -67 140.3 14.0 70 10,000,000+ 0° 72 169.1 16.9 90 1,700 0° 72 169.1 16.9 90 1,000 0° 72 150.3 15.0 80 2,100 0° 72 150.3 15.0 80 20,700 0° 72 150.3 15.0 80 80,790 0° 72 150.3 15.0 80 80,790 0° 72 150.3 15.0					•					
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0° -67 140.3 14.0 70 27,500 0° -67 140.3 14.0 70 15,500 0° -67 140.3 14.0 70 15,500 0° 72 169.1 16.9 90 1,700 0° 72 169.1 16.9 90 1,000 0° 72 150.3 15.0 80 2,130 0° 72 150.3 15.0 80 2,130 0° 72 150.3 15.0 80 20,700 0° 72 150.3 15.0 80 80,790 0° 72 150.3 15.0 80 87,900	C11-12	00	-67	140.3	14.0	70	10,000,100+	-	9.851	
0° -67 140.3 14.0 70 15,500 0° -67 140.3 14.0 70 10,000,000+ 0° 72 169.1 16.9 90 1,700 0° 72 150.3 15.0 80 300 0° 72 150.3 15.0 80 2,100 0° 72 150.3 15.0 80 2,100 0° 72 150.3 15.0 80 2,100 0° 72 150.3 15.0 80 87,900	C12-3	0	-67	140.3	14.0	22	27,500	1	**********	
0° -67 140.3 14.0 70 10,000,000+ 0° 72 169.1 16.9 90 1,700 0° 72 169.1 16.9 90 1,700 0° 72 150.3 15.0 80 300 0° 72 150.3 15.0 80 2,130 0° 72 150.3 15.0 80 20,700 0° 72 150.3 15.0 80 87,900	C10-14	00	-67	140.3	14.0	20	15,500	1		
0° 72 169.1 16.9 90 1,700 0° 72 169.1 16.9 90 1,700 0° 72 150.3 15.0 80 2,100 0° 72 150.3 15.0 80 2,100 0° 72 150.3 15.0 80 20,700 0° 72 150.3 15.0 80 80,790	C12-13	0.0	-67	140.3	14.0	70	10,000,000+		205.71	
0° 72 169.1 16.9 90 1,700 0° 72 169.1 16.9 90 1,000 0° 72 150.3 15.0 80 2,100 0° 72 150.3 15.0 80 2,100 0° 72 150.3 15.0 80 80,700 0° 72 150.3 15.0 80 87,900										
0° 72 169.1 16.9 90 1,000 0° 72 150.3 15.0 80 300 0° 72 150.3 15.0 80 2,100 0° 72 150.3 15.0 80 20,700 0° 72 150.3 15.0 80 87,900	C13-6	0،	7.2	169.1	16.9	90	1,700			
0° 72 150.3 15.0 80 300 0° 72 150.3 15.0 80 2,100 0° 72 150.3 15.0 80 20,700 0° 72 150.3 15.0 80 87,900	C8-15	0،	7.2	1.691	16.9	ጽ	1,000	***************************************		
0° 72 150.3 15.0 80 300 0° 72 150.3 15.0 80 2,100 0° 72 150.3 15.0 80 20,700 0° 72 150.3 15.0 80 87,900										
0° 72 150.3 15.0 80 2,100 0° 72 150.3 15.0 80 20,700 0° 72 150.3 15.0 80 87,900	C13-9	0،	72	150.3	15.0	80	300	******		
0° 72 150.3 15.0 80 20,700 0° 72 150.3 15.0 80 87,900	C13-11	တိ	7.5	150.3	15.0	8	2,100			
0° 72 150.3 15.0 80 87,900	C7-4	00	72	150.3	15.0	80	20,700			
	છ− 3	0.	72	150.3	15.0	80	87,900			
										тайдын тоор дойны дамбарындага барынаштайдар решиний күргөн жаны тайыр тоор байсын тайыр жана байсындага байсы
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Prince P	Test:	. Tensile-Tensile Fati	Tensile !	Fatigue						R = +0.1
Piber Test Hax. Hin. Hax. Cycles Rise Stress Stress	Mater	Į	304							Frequency = 30 Hz
Piber Test Hax. Max. Gycles Stress Stress Stress Stress Stress Stress Stress Stress Stress Stress Stress Stress Stress Stress Gycles Cyp Gycles Cyp Gycles Gy										Function: Sine
n Orienta- Temp. Stress Stress	_	Piber	Test	Max.	Min.	Max.	Cycles	Temp.	Residual	
0° 72 131.5 13.2 70 6,200 0° 72 131.5 13.2 70 462,300 0° 72 131.5 13.2 70 110,900 0° 72 113.5 13.2 70 110,900 0° 72 112.7 11.3 60 2,632,500 0° 72 112.7 11.3 60 3,315,300 0° 72 112.7 11.3 60 4,335,000 0° 180 172.4 17.2 90 1,800 0° 180 153.2 15.3 80 2,000 0° 180 153.2 15.3 80 2,000 0° 180 153.2 15.3 80 2,000 0° 180 134.1 13.4 70 169,20	Specimen	Orienta	Temp.	Stress	Stress (103ost)	Stress (* ult.)	to Failure	Rise (°F)	Strength (103 ps1)	Remarks
0° 72 131.5 13.2 70 462,300 0° 72 131.5 13.2 70 51,500 0° 72 131.5 13.2 70 110,900 0° 72 112.7 11.3 60 2,632,500 0° 72 112.7 11.3 60 4,335,000 0° 72 112.7 11.3 60 4,335,000 0° 180 172.4 17.2 90 1,800 0° 180 172.4 17.2 90 1,800 0° 180 153.2 15.3 80 2,900 0° 180 153.2 15.3 80 2,900 0° 180 153.2 15.3 80 2,900 0° 180 153.2 15.3 80 2,900 <	C13-14	°	72	131.5	13.2	2	6,200	1		
0° 72 131.5 13.2 70 51,500 0° 72 131.5 13.2 70 110,900 0° 72 112.7 11.3 60 2,632,500 0° 72 112.7 11.3 60 5,868,700 0° 72 112.7 11.3 60 4,335,000 0° 72 112.7 11.3 60 4,335,000 0° 180 172.4 17.2 90 3,500 0° 180 172.4 17.2 90 3,500 0° 180 172.4 17.2 90 3,500 0° 180 153.2 15.3 80 2,900 0° 180 153.2 15.3 80 2,000 0° 180 134.1 13.4 70 7,100	C14-4	တိ	72	131.5	13.2	70	462,300		***************************************	· · · · · · · · · · · · · · · · · · ·
0° 72 131.5 13.2 70 110,900 0° 72 112.7 11.3 60 2,632,500 0° 72 112.7 11.3 60 5,868,700 0° 72 112.7 11.3 60 4,335,000 0° 180 172.4 17.2 90 3,500 0° 180 172.4 17.2 90 1,800 0° 180 153.2 15.3 80 900 0° 180 153.2 15.3 80 2,900 0° 180 153.2 15.3 80 2,200 0° 180 153.2 15.3 80 2,200 0° 180 153.2 15.3 80 2,200 0° 180 134.1 13.4 70 7,100	C14-10	00	72	131.5	13.2	70	51,500			servärdir vänd öthunnsmetrum och råst alkestraleten se detkrimmetralet krämteridet krämteridet gege
0° 72 112.7 11.3 60 2,632,500 — 0° 72 112.7 11.3 60 5,868,700 — 0° 72 112.7 11.3 60 4,335,300 — 0° 72 112.7 11.3 60 4,335,000 — 0° 180 172.4 17.2 90 3,500 — 0° 180 172.4 17.2 90 1,800 — 0° 180 153.2 15.3 80 2,900 — 0° 180 153.2 15.3 80 2,000 — 0° 180 153.2 15.3 80 2,200 — 0° 180 134.1 13.4 70 7,100 — 0° 180 134.1 13.4 70 41,500 — 0° 180 134.1 13.4 70 41,500 —	210-2	°0	72	131.5	13.2	70	110,900			· · · · · · · · · · · · · · · · · · ·
0° 72 112.7 11.3 60 2,632,500 — 0° 72 112.7 11.3 60 5,868,700 — 0° 72 112.7 11.3 60 4,335,300 — 0° 72 112.7 11.3 60 4,335,000 — 0° 180 172.4 17.2 90 3,500 — 0° 180 172.4 17.2 90 1,800 — 0° 180 153.2 15.3 80 2,900 — 0° 180 153.2 15.3 80 2,000 — 0° 180 153.2 15.3 80 2,200 — 0° 180 134.1 13.4 70 7,100 — 0° 180 134.1 13.4 70 41,500 — 0° 180 134.1 13.4 70 41,500 —					- 1					
0° 72 112.7 11.3 60 5,868,700 — 0° 72 112.7 11.3 60 4,335,300 — 0° 72 112.7 11.3 60 4,335,000 — 0° 180 172.4 17.2 90 3,500 — 0° 180 172.4 17.2 90 1,800 — 0° 180 153.2 15.3 80 2,900 — 0° 180 153.2 15.3 80 2,000 — 0° 180 153.2 15.3 80 2,000 — 0° 180 153.2 15.3 80 2,000 — 0° 180 134.1 13.4 70 290,800 — 0° 180 134.1 13.4 70 41,500 — 0° 180 134.1 13.4 70 41,500 —	11-5	°o	72	112.7		99	2,632,500	***************************************	494-540 000	
0° 72 112.7 11.3 60 3,315,300 0° 72 112.7 11.3 60 4,335,000 0° 180 172.4 17.2 90 3,500 0° 180 172.4 17.2 90 1,800 0° 180 153.2 15.3 80 2,900 0° 180 153.2 15.3 80 2,900 0° 180 153.2 15.3 80 2,900 0° 180 153.2 15.3 80 2,000 0° 180 134.1 13.4 70 290,800 0° 180 134.1 13.4 70 41,500 0° 180 134.1 13.4 70 41,500	38-1	00	72	112.7	11.3	9	5,868,700	1	1	
0° 72 112.7 11.3 60 4,335,000 0° 180 172.4 17.2 90 3,500 0° 180 172.4 17.2 90 3,500 0° 180 153.2 15.3 80 2,900 0° 180 153.2 15.3 80 2,000 0° 180 153.2 15.3 80 2,000 0° 180 134.1 13.4 70 290,800 0° 180 134.1 13.4 70 7,100 0° 180 134.1 13.4 70 41,500 0° 180 134.1 13.4 70 41,500	3-14	00	72	112.7	11.3	09	3,315,300	-		
0° 180 172.4 17.2 90 3,500 — 0° 180 172.4 17.2 90 1,800 — 0° 180 153.2 15.3 80 900 — 0° 180 153.2 15.3 80 2,900 — 0° 180 153.2 15.3 80 2,000 — 0° 180 153.2 15.3 80 2,000 — 0° 180 134.1 13.4 70 290,800 — 0° 180 134.1 13.4 70 7,100 — 0° 180 134.1 13.4 70 41,500 — 0° 180 134.1 13.4 70 41,500 —	10-11	00	72	112.7		09	4,335,000	-	***************************************	
0° 180 172.4 17.2 90 3,500 — 0° 180 172.4 17.2 90 1,800 — 0° 180 153.2 15.3 80 2,900 — 0° 180 153.2 15.3 80 2,900 — 0° 180 153.2 15.3 80 2,200 — 0° 180 153.2 15.3 80 2,200 — 0° 180 134.1 13.4 70 290,800 — 0° 180 134.1 13.4 70 169,200 — 0° 180 134.1 13.4 70 41,500 — 0° 180 134.1 13.4 70 41,500 —										
0° 180 172.4 17.2 90 1,800 0° 180 153.2 15.3 80 900 0° 180 153.2 15.3 80 2,900 0° 180 153.2 15.3 80 2,000 0° 180 134.1 13.4 70 290,800 0° 180 134.1 13.4 70 7,100 0° 180 134.1 13.4 70 41,500 0° 180 134.1 13.4 70 41,500	:11-2	00	180	172.4	17.2	90	3,500	-	******	
0° 180 153.2 15.3 80 900 0° 180 153.2 15.3 80 2,900 0° 180 153.2 15.3 80 2,000 0° 180 153.2 15.3 80 2,000 0° 180 134.1 13.4 70 290,800 0° 180 134.1 13.4 70 7,100 0° 180 134.1 13.4 70 41,500 0° 180 134.1 13.4 70 41,500	9-13	0.	180	172.4	17.2	96	1,800	-	edd gallynga	· · · · · · · · · · · · · · · · · · ·
0° 180 153.2 15.3 80 900 0° 180 153.2 15.3 80 2,900 0° 180 153.2 15.3 80 2,900 0° 180 153.2 15.3 80 2,000 0° 180 134.1 13.4 70 7,100 0° 180 134.1 13.4 70 41,500 0° 180 134.1 13.4 70 41,500			•							
0° 180 153.2 15.3 80 2,900 0° 180 153.2 15.3 80 2,000 0° 180 153.2 15.3 80 2,000 0° 180 134.1 13.4 70 7,100 0° 180 134.1 13.4 70 169,200 0° 180 134.1 13.4 70 41,500	6-8	0°	180	153.2	15.3	8	006	1		
0° 180 153.2 15.3 80 2,000 0° 180 153.2 15.3 80 2,200 0° 180 134.1 13.4 70 290,800 0° 180 134.1 13.4 70 7,100 0° 180 134.1 13.4 70 169,200 0° 180 134.1 13.4 70 41,500	14-14	00	180	153.2	15.3	80	2,900	1	tani asperano	
0° 180 153.2 15.3 80 2,200 0° 180 134.1 13.4 70 290,800 0° 180 134.1 13.4 70 7,100 0° 180 134.1 13.4 70 41,500 0° 180 134.1 13.4 70 41,500	11-10	00	180	153.2	15.3	80	2,000	-		
0° 180 134.1 13.4 70 290,800 0° 180 134.1 13.4 70 7,100 0° 180 134.1 13.4 70 169,200 0° 180 134.1 13.4 70 41,500	88	00	180	153.2	15.3	8	2,200	*****	-91-91-10	en en de de la company de la c
0° 180 134.1 13.4 70 290,800 0° 180 134.1 13.4 70 7,100 0° 180 134.1 13.4 70 169,200 0° 180 134.1 13.4 70 41,500										
0° 180 134.1 13.4 70 7,100 0° 180 134.1 13.4 70 169,200 0° 180 134.1 13.4 70 41,500	12-15	00	180	134.1	-	70	290,800	1		
0° 180 134.1 13.4 70 169,200 0° 180 134.1 13.4 70 41,500	14-11	00	180	134.1	13.4	70	7,100	1		
0° 180 134.1 13.4 70 41,500	14-1	.0	180	134.1	13.4	70	169,200		***************************************	
	11-11	0،	180	4	13.4	70	41,500			
										n dil ununi di pung king mang di saggi mang giput saggi saggi saggi saggi na king di kanang dili saggi ng magsang sag
								-		

Test:	Tensile-Tensile Fatigue	Pensile F	atigue						R = +0.1
Material:	al: AS/3004	204							Frequency = 30 Hz
1					;				Function: Sine
Specimen	Fiber Orienta-	Test Temp.	Max. Stream	Min. Stress	Max. Stress	Cycles to	Tamp. Rise	Residual Strength	
Number	tion	- 1	(10 ³ psi)	(10 ³ pst)	(* ult.)	Failure	(eF)	(10 ³ psi)	Remarks
C8-14	00	180	114.9	11.5	09	2,269,500		!	
C25-14	00	180	114.9	11.5	09	6,849,600	1		, 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1
c9- 10	00	180	114.9	11.5	09	127,500	1		e De service de la companya de la companya de la companya de la companya de la companya de la companya de la c
ფ-11	0.	180	114.9	11.5	60	2,892,200		***************************************	d de la company de la company de la company de la company de la company de la company de la company de la comp
C25-1	00	250	161.2	16.1	96	600		- Marie andre state	
C25-3	0°	250	143.3	14.3	80	3,300		******	
C25-6	00	250	143.3	14.3	80	500			
225-7	00	250	143.3	14.3	80	7,700		I	
25-8	00	250	143.3	14.3	80	3,600			
C25-11	00	250	125.3	12.5	20	3,400			
c25-15	00	250	125.3	12.5	70	3,552,500	-	***************************************	
C14-3	ი	250	125.3	12.5	70	501,400	-		
C14-5	00	250	125.3	12.5	70	1,392,500	****	1	
CL3-5	00	250	125.3	12.5	7.0	800		-	
C14-7	00	250	107.5	10.8	9	116,100			
C14-8	00	250	107.5	10.8	09	92,200	1		
C14-12	00	250	107.5	10.8	09	171,700	-	1	
C13-2	00	250	107.5	10.8	09	171,800	elle ggs-dige		
C25-10	00	250	107.5	10.8	9	1,187,200			
C39-8	°06	-67	4.77	0.48	70	7,400	**********	***************************************	
									A description to the property of the state o

Tasti	Tensile-Tensile		Fatigue						R = +0.1
Material:	al: As								Frequency = 30 Hz
									Function: Sine
	Fiber	Test	Kax.	Min.	Max.	Cycles	Temp.	Residual Strenoth	
Specimen	Urienta		(10 7 081)	(10 pst)	(ult.)	Failure	(d.)	(10 ³ ps1)	Remarks
C38-8	06	1	4.09	0.41	9	4,500	and reduces		
7-920	°06	-67	4.09	0.41	99	40,300	and coldinar		
C37-7	.06	<u>-</u> 9-		0.41	8	601'6		****	A PARTICULAR PROPERTY OF THE CONTRACT OF THE C
C35-2	°06	- 67	4.09	0.41	99	26,100	-	***************************************	
C35-8	06ء	-67	3.41	0.34	20	9,700	-		
C39-2	06،	<u>-67</u>	2.73	0.27	\$ 0	134,200			
C37-7	06،	-67	2.73	0.27	40	900'029	-		
C32- 5	°06	-67	2.73	0.27	\$	239,400	-	1	
C37-8	90ء	19-	2.73	0.27	40	36,000		•	
C32-6	06،	-67	1.36	0.14	2	+000'000'01	distribution of the contract o	4.93	
C35-3	06	-67	1.36	0.14	82	+000,000,01		6.24	
C37-5	°06	-67		0.14	20	10,000,000+	-	6.02	
C38-3	°06	-67	1.36	0.14	20	5,461,300		-	
29-88	°06	72	4.02	0.40	8	8,700	1		
3 2 2	°06	72	4.02	0.40	08	12,400		-	
C29-5	°06	72	4.02	0.40	08	11,700			
C29-1	°06	72	4.02	0.40	08	200			engije na nakemen na pozini de estirir Astani na kompte d'Alban postejen i Astani e esti kastini e et i stana na
									Deservation of the state of the
C28-8	°06	72	3.52	0.35	02	22,600			
C28-7	06	72	3.52	0.35	0/	28,200			,在这个时间,我们的时候就是一个时间的时候,我们就是一个时间,我们就会看到一个时间,我们就是一个时间的,我们也会看到一个时间,我们也会会会会会会会会会会会会会会
C28-4	°06	72		0.35	70	17,100	**********	-	والمواقعة والمواقعة والمواقعة والمواقعة والمواقعة والمواقعة والمواقعة والمواقعة والمواقعة والمواقعة والمواقعة
27-5	.06	72	3.52	0.35	20	26,500		-	aaninger-statelekolonische Vorgenteit vir bildelening der gebriegering de diebegeweite der mittele gesche Vorgenteit der mittelenische Vorgenteit der der der der der der der der der der
									A ANALISA MANAGAMBAN MANAGAMBAN MANAGAMBAN MANAGAMBAN MANAGAMBAN MANAGAMBAN MANAGAMBAN MANAGAMBAN MANAGAMBAN M

R = +0.1	Frequency # 30 Hz		Strengtn [10] psj) Remarks	***************************************		*** ED	e Produce and the second secon								g, ha sirit: selleti ya da a a a a a a a a a a a a a a a a a				A CAMBAN AND AND AND AND AND AND AND AND AND A	e ∰e versit statutet van een maast det statut te en een een een te jaar de een de een de een een de een een de een een		Failed on installation		AND WEST AND THE THE PROPERTY OF THE PROPERTY	namen eine der der der der der der der der der de	
		<u> </u>		-		-																-				
		Temp	(°F)			-		-	-	-	1		*******	-					-	-				i		
		Cycles	to Failure	140,000	84,800	36,900	27,400	4,500	800	2,000	2,600	13,200	10,800	10,000	9,400	000'99	118,900	26,900	64,700		2,500			500	1,700	
		Max.	Stress (* ult.)	9	09	09	60	80	80	80	80	69	09	69	69	40	40	40	40		80	80		70	70	
pulled and problem of the state		Min.	Stress (10 ost)	0.30	o.33	0.30	0.30	0.39	0.39	0.39	0.39	0.30	0.30	0.30	0.30	0.20	0.20	0.20	0.20		0.43	0.43		0.38	0.38	
atique		Max.	Stress	3.03	3.01	3.01	3.01	3.94	3.94	3.94	3.94	2.96	2.96	2.96	2.96	1.97	1.97	1.97	1.97		4.31	4.31		3.76	3.76	
Pensile F	04	Test	Temp.	72	72	7.5	72	185	180	180	180	180	180	180	180	180	180	180	180		250	250		250	250	
Tenalle-Tenaile Fatique	al: AS/3004	Fiber	Orienta-	900	06	°06	°06	°06	°06	°06	°06	 °06	06	066	•06	06	06	.06	906		06،	06،		°06	60ء	
Tear	Material:		Specimen	C274	27-3	C34-8	C34-6	C343	C34-1	C328	C32-7	C32-2	C32-1	C31-8	C31-4	C312	C396	C16-5	C18-4		C28-2	C26-2	Annahum Annahu	29-2	C354	

Piper Resident Piper Resident Piper Resident Piper Cycles Stress Stress Piper Cycles Stress Stress Piper Cycles Piper Cy	Test:	Tensile-Tensile Fatigue	Fensile F	atigue						R = +0.1
Orienta Test Max. Hin Orienta Test Test Cycles Stress S	Mater	al: AS/3(004							Prequency = 30 Hz
Piber Fist Wax. Hin. Hax. Cyoles Strength Strength Lo. Cyoles Strength Cyoles Strength Cyoles Strength Cyoles Cyol				المؤدران وسنوب وسيوس من وسندس والمراور						Function: Sine
1.1. Linual (ref) (10.3 mid.) (10.4 mid.) (10.3 mid.) (10.3 mid.) (10.4 mid.) (10.3 mid.) <th< td=""><td></td><td>Fiber</td><td>Test</td><td>Max.</td><td>Min.</td><td>Max.</td><td>Cycles</td><td>Temp. Rise</td><td>Residual Strength</td><td></td></th<>		Fiber	Test	Max.	Min.	Max.	Cycles	Temp. Rise	Residual Strength	
90° 250 3.24 0.32 60 2,200 90° 250 3.24 0.32 60 3,300 90° 250 3.24 0.32 60 3,000 90° 250 3.24 0.32 60 2,600 90° 250 2.70 0.27 50 2,900 90° 250 2.16 0.22 40 9,400 90° 250 2.16 0.22 40 7,100 90° 250 2.16 0.22 40 7,100 90° 250 1.08 0.11 20 81,400 90° 250 1.08 0.11 20 81,400 445° -67 10.4 1.04 25 83,600	Number	tion	(°F)	(10 ³ pet)	(10 ³ psi)	(8 ult.)	Failure	(aE)	(10 ³ ps1)	Remarks
90° 250 3.24 0.32 60 3,300 90° 250 3.24 0.32 60 3,000 90° 250 3.24 0.22 60 2,600 90° 250 2.16 0.22 40 9,400 90° 250 2.16 0.22 40 9,400 90° 250 2.16 0.22 40 9,400 90° 250 2.16 0.22 40 9,300 90° 250 2.16 0.22 40 9,300 90° 250 1.08 0.11 20 81,400 90° 250 1.08 0.11 20 81,400 445°	C37-1	°06	250	3.24	0.32	09	2,200		***************************************	
90° 250 3.24 0.32 60 3,000 90° 250 3.24 0.32 60 2,600 90° 250 2.16 0.27 80 9,400 90° 250 2.16 0.22 40 9,400 90° 250 2.16 0.22 40 9,400 90° 250 2.16 0.22 40 9,400 90° 250 2.16 0.22 40 9,400 90° 250 2.16 0.22 40 9,300 90° 250 1.08 0.11 20 42,600 90° 250 1.08 0.11 20 81,400 445° -67 10.4 1.04 25 83,900	C38-2	°06	250	3.24	0.32	9	3,300		-	
90° 250 3.24 0.32 60 2,600 90° 250 2.70 0.27 50 2,900 90° 250 2.16 0.22 40 10,500 90° 250 2.16 0.22 40 10,500 90° 250 2.16 0.22 40 7,100 90° 250 1.08 0.11 20 42,600 90° 250 1.08 0.11 20 42,600 90° 250 1.08 0.11 20 81,400 45° 250 1.08 0.11 20 81,400 45° 250 1.08 0.11 20 81,400 45° 250 1.08 0.11 20 81,400 <td>C39-1</td> <td>°06</td> <td>250</td> <td>3.24</td> <td>0.32</td> <td>09</td> <td>3,000</td> <td>-</td> <td>-</td> <td></td>	C39-1	°06	250	3.24	0.32	09	3,000	-	-	
90° 250 2.70 0.27 50 2,900 90° 250 2.16 0.22 40 9,400 90° 250 2.16 0.22 40 10,500 90° 250 2.16 0.22 40 7,100 90° 250 2.16 0.22 40 9,300 90° 250 1.08 0.11 20 42,600 90° 250 1.08 0.11 20 81,400 90° 250 1.08 0.11 20 81,400 45° -67 10.4 1.04 25 830,900 117 45° -67 10.4 1.04 25 804,400 18 45° -67 10.4 2.5 80,40	C35-5	°06	250	3.24	0.32	60	2,600			
90° 250 2.70 0.27 50 2,900 90° 250 2.16 0.22 40 9,400 90° 250 2.16 0.22 40 10,500 90° 250 2.16 0.22 40 7,100 90° 250 2.16 0.22 40 7,100 90° 250 1.08 0.11 20 42,600 90° 250 1.08 0.11 20 81,400 445° -67 1.08 0.11 20 81,400 445° -67 1.04 25 845,700 9 445° -67 10.4 1.04 25 830,900 110 445° -67 10.4 1.04 25 348,600<	`						-			
90° 250 2.16 0.22 40 9,400 90° 250 2.16 0.22 40 10,500 90° 250 2.16 0.22 40 7,100 90° 250 2.16 0.22 40 7,100 90° 250 1.08 0.11 20 42,600 90° 250 1.08 0.11 20 99,000 90° 250 1.08 0.11 20 81,400 445° -67 10.4 1.04 25 830,900 11 445° -67 10.4 1.04 25 804,400 18 445° -67 10.4 1.04 25 348,600 110 </td <td>C37-3</td> <td>06،</td> <td>250</td> <td>2.70</td> <td>0.27</td> <td>50</td> <td>2,900</td> <td>-</td> <td>Age-vape-spin</td> <td></td>	C37-3	06،	250	2.70	0.27	50	2,900	-	Age-vape-spin	
90° 250 2.16 0.22 40 9,400 90° 250 2.16 0.22 40 10,500 90° 250 2.16 0.22 40 7,100 90° 250 2.16 0.22 40 9,300 90° 250 1.08 0.11 20 114,900 90° 250 1.08 0.11 20 99,000 445° -67 1.08 0.11 20 81,400 445° -67 10.4 1.04 25 830,900 117 445° -67 10.4 1.04 25 804,400 18 445° -67 10.4 1.04 25 804,400 18 445° -67 8.32 0.83 20 4,5										
90° 250 2.16 0.22 40 10,500 90° 250 2.16 0.22 40 7,100 90° 250 2.16 0.22 40 9,300 90° 250 1.08 0.11 20 114,900 90° 250 1.08 0.11 20 99,000 90° 250 1.08 0.11 20 81,400 445° -67 1.04 1.04 25 645,700 9 445° -67 10.4 1.04 25 804,400 18 445° -67 10.4 1.04 25 804,400 18 445° -67 8.32 0.83 20 4,519,300 9 <	C33-3	°06	250	2,16	0.22	40	007'6	ŀ	İ	данда надада бен давал надада надада нада на надалента предестава на бала ката предестава надада надада надада
90° 250 2.16 0.22 40 7,100 90° 250 2.16 0.22 40 9,300 90° 250 1.08 0.11 20 42,600 90° 250 1.08 0.11 20 114,900 90° 250 1.08 0.11 20 81,400 90° 250 1.08 0.11 20 81,400 445° -67 1.04 1.04 25 645,700 9 445° -67 10.4 1.04 25 830,900 110 445° -67 10.4 1.04 25 834,400 18 <td>C26-5</td> <td>°06</td> <td>250</td> <td>2.16</td> <td>0.22</td> <td>40</td> <td>10,500</td> <td></td> <td></td> <td></td>	C26-5	°06	250	2.16	0.22	40	10,500			
90° 250 2.16 0.22 40 9,300 90° 250 1.08 0.11 20 114,900 90° 250 1.08 0.11 20 114,900 90° 250 1.08 0.11 20 99,000 90° 250 1.08 0.11 20 81,400 445° -67 10.4 1.04 25 845,700 9 445° -67 10.4 1.04 25 804,400 18 445° -67 10.4 1.04 25 804,400 18 445° -67 8.32 0.83 20 4,519,300 9 445° -67 8.32 0.83 20 6,490,600 445° <t< td=""><td>C35-6</td><td>°06</td><td>250</td><td>2.16</td><td>0.22</td><td>40</td><td>7,100</td><td>-</td><td>-</td><td></td></t<>	C35-6	°06	250	2.16	0.22	40	7,100	-	-	
90° 250 1.08 0.11 20 42,600 90° 250 1.08 0.11 20 114,900 90° 250 1.08 0.11 20 99,000 90° 250 1.08 0.11 20 81,400 445° -67 10.4 1.04 25 645,700 9 10 445° -67 10.4 1.04 25 830,900 117 11 445° -67 10.4 1.04 25 804,400 18 18 445° -67 10.4 1.04 25 348,600 110 11 445° -67 8.32 0.83 20 4,519,300 9 11 445° -67 8.32 0.83 20 6,490,600	C37-4	°06	250	2.16	0.22	40	9,300			
90° 250 1.08 0.11 20 42,600 90° 250 1.08 0.11 20 114,900 90° 250 1.08 0.11 20 99,000 40° 250 1.08 0.11 20 81,400 445° -67 10.4 1.04 25 830,900 117 445° -67 10.4 1.04 25 804,400 18 445° -67 10.4 1.04 25 804,400 18 445° -67 10.4 1.04 25 804,400 110 445° -67 8.32 0.83 20 4,519,300 9 445° -67 8.32 0.83 20 6,490,600 445° -67 8.32 0.83 20										
90° 250 1.08 0.11 20 114,900 90° 250 1.08 0.11 20 99,000 445° 250 1.08 0.11 20 81,400 445° -67 10.4 1.04 25 830,900 117 445° -67 10.4 1.04 25 804,400 18	C28-3	06،	250	1.08	0.11	20	42,600		000-00	
90° 250 1.08 0.11 20 81,400 445° -67 10.4 1.04 25 645,700 9 no 445° -67 10.4 1.04 25 830,900 117 no 445° -67 10.4 1.04 25 804,400 18 no 445° -67 10.4 1.04 25 348,600 110 no 445° -67 8.32 0.83 20 4,519,300 9 no 445° -67 8.32 0.83 20 4,519,600 no 445° -67 8.32 0.83 20 6,490,600 445° -67 8.32 0.83 20 6,490,600 445° -67 8.32 0.83 20 10,000,000+	c35-7	06	250	1.08	0.11	20	114,900	-		да — Вундан ал во манятирния на при применения применения применения применения применения применения применен
90° 250 1.08 0.11 20 81,400	C37-6	06،	250	1.08	0.11	20	000'66			рай желден — Адарай калада күчүндө каладанан караштан арай жанада арай жанада жанада жанада жанада жанада жана
+45° -67 10.4 1.04 25 645,700 9 no +45° -67 10.4 1.04 25 830,900 117 no +45° -67 10.4 1.04 25 804,400 18 no +45° -67 10.4 1.04 25 348,600 110 no +45° -67 8.32 0.83 20 4,519,300 9 +45° -67 8.32 0.83 20 6,490,600 +45° -67 8.32 0.83 20 6,490,600 +45° -67 8.32 0.83 20 10,000,000+	C38-4	06،	250	1.08	0.11	20	81,400			
+45° -67 10.4 1.04 25 645,700 9 po +45° -67 10.4 1.04 25 830,900 117 +45° -67 10.4 1.04 25 348,600 110 +45° -67 8.32 0.83 20 4,519,300 9 +45° -67 8.32 0.83 20 3,769,600 +45° -67 8.32 0.83 20 6,490,600 +45° -67 8.32 0.83 20 10,000,000+ +45° -67 8.32 0.83 20 10,000,000+						one, age of me to the second the second contract				
+45° -67 10.4 1.04 25 830,900 117 ±45° -67 10.4 1.04 25 804,400 18 ±45° -67 10.4 1.04 25 348,600 110 ±45° -67 8.32 0.83 20 4,519,300 9 ±45° -67 8.32 0.83 20 3,769,600 ±45° -67 8.32 0.83 20 6,490,600 ±45° -67 8.32 0.83 20 10,000,000+	C43-3	+45°	-67	10.4	1.04	22	645, 700	6		題
±45° -67 10.4 1.04 25 804,400 18 ±45° -67 10.4 1.04 25 348,600 110 ±45° -67 8.32 0.83 20 4,519,300 9 ±45° -67 8.32 0.83 20 3,769,600 ±45° -67 8.32 0.83 20 6,490,600 ±45° -67 8.32 0.83 20 10,000,000+	C43-6	+45°	-67	10.4	1.04	25	830,900	117		300,000 cycles
±45° -67 10.4 1.04 25 348,600 110 ±45° -67 8.32 0.83 20 4,519,300 9 ±45° -67 8.32 0.83 20 3,769,600 ±45° -67 8.32 0.83 20 6,490,600 ±45° -67 8.32 0.83 20 10,000,000+	C43-1	±45°	-67	10.4	1.04	25	804,400	18		
±45° -67 8.32 0.83 20 4,519,300 9 ±45° -67 8.32 0.83 20 3,769,600 +45° -67 8.32 0.83 20 6,490,600 +45° -67 8.32 0.83 20 10,000,000+	C42-4	±45°	-67	10.4	1.04	25	348,600	110	ann ann aite	
±45° -67 8.32 0.83 20 4,519,300 9 +45° -67 8.32 0.83 20 3,769,600 +45° -67 8.32 0.83 20 6,490,600 +45° -67 8.32 0.83 20 10,000,000+										
+45° -67 8.32 0.83 20 3,769,600 +45° -67 8.32 0.83 20 6,490,600 +45° -67 8.32 0.83 20 10,000,000+	C42-3	±45°	-67	8.32	0.83	20	4,519,300	6	-	
+45° -67 8.32 0.83 20 6,490,600 +45° -67 8.32 0.83 20 10,000,000+	C42-2	+45°	-67	8.32	0.83	20	3,769,600			
+45° -67 8.32 0.83 20 10,000,000+	C42-1	+450	-6 7	8.32	0.83	20	6,490,600	1		
	C41-8	+45°	-67	8.32	0.83	20	10,000,000+		22.43	
The state of the s					:	~~				

Test:	: Tensile-Tensile Fatigue	ensile F	atigue						R = +0.1
Material:	ial: AS/3004	204							ě
									1
Specimen	Fiber Orienta-	Test Temp.	Max. Stress	Min. Stress	Max. Stress	Cycles to	Temp.	Residual Strength	
Number	tion	(°F)	(10 ³ psi)	(10 ³ psi)	(4 ult.)	Failure	(*F)	(103 pst)	Remarks
C44-6	±45°	-67	6.24	0.62	15	9,085,500	-	-	
C44-2	+45°	-67	6.24	0.62	15	10,000,000+		26.28	THE THE PARTY OF T
C22-3	±45°	72	25.6	2.56	80	11,500			specimen heated up and
									couldn't ever reach load
C22-8	±45°	72	9.61	96.0	æ	57,600	275+		and the second s
C24-2	±45°	72	9.61	96.0	30	196,200	+ 06		10 Hz. frequency
									n da da da da da da da da da da da da da
C24-3	±45°	72	8.01	0.80	25	1,448,800	۲.		Temp. not measured
C24-8	+45°	72	8.01	0.80	25	434,600	158		The statement of the st
C46-1	±45°	72	8.01	08.0	25	409,100	228		
G9-1	±45°	72	8.01	0.80	25	506,000	240	***************************************	ger meletakan dan persempan persempan persempan pendapan pendapan pendapan pendapan pendapan pendapan pendapan
									Alle Marie d
C23-5	±45°	72	6.40	0.64	20	10,000,000+	******	29.36	
C23-7	+45°	72	6.40	0.64	20	10,000,000+		28.87	
C49-8	+45°	72	6.40	0.64	20	10,004,400+	15	25.55	er de de la company de la comp
C47-8	+45°	72	6.40	0.64	20	6,301,200	20	404+40	
C22-5	±45°	72	3.20	0.32	10	10,000,000+	ż.	32.10	
C23-2	+45°	72	3.20	0.32	유	10,000,000+		34.23	
C46-4	+45°	72	3.20	0.32	10	10,259,508+	-	27.09	And the state of t
C46-3	+45°	72	3.20	0.32	10	10,033,700+	-	26.60	
				, , , , , , , , , , , , , , , , , , ,		A STATE OF THE PERSON AND PROPERTY OF THE PERSON AND PROPERTY AND PROPERTY OF THE PERSON AND PROPERTY			

R = +0.1	Frequency = .30 Hz	Function: Sine		Remarks																							N
		•	Residual	(10 ³ ps1)	1	****	-		 20.87	27.79	17.20	9.53	28.78	31.29	33.25	33.53	***************************************	1		-		-	-	29.70	29.73	•	
			Temp.	(°F)	41	28	32	56	10	Ť	5	77		1			63	59	09	20		22	œ	9	_	4	
			Cycles	Failure	1,021,600	1,055,400	1,289,800	1,363,700	10,000,000+	10,009,500+	10,006,800+	10,009,700+	10,000,000+	10,000,100+	10,000,000+	10,013,800+	1,300,000	646,000	859,900	2,982,900		5,666,200	3,654,400	10,454,500+	10,054,600+	6,596,200	
			Max.	(ult.)	25	25	25	25	R	70	70	70	2	22	97	10	25	25	25	25		20	22	20	20	20	
			<u> </u>	(10 psi)	69.0	69.0	69.0	0.69	0.56	0.56	0.56	0.56	 0.28	0.28	0.28	0.28	0.61	0.61	0.61	0.61		0.49	0.49	0.49	0.49	0.49	
atigue			⊢	(10 ³ pet)	6.94	6.94	6.94	6.94	5.55	5.55	5.55	5.55	2.78	2.78	2.78	2.78	80.9	80.9	90.9	80.9		4.86	4.86	4.86	4.86	4.86	
ensile F	94			(•F)	Γ	180	180	180	180	180	180	180	180	180	180	180	250	250	250	250	•	250	250	250	250	250	
Tensile-Tensile Fatigue	11: AS/3004		Fiber	Orienta-	+45°	±45°	+45°	+45°	+45°	+45°	+45°	+45°	+45°	+45°	+45°	+45°	±45°	+45°	+45°	+45°		±45°	+45°	+45°	±45°	±45°	
Test:	Material:			Specimen	C46-8	C49-5	C49-1	C49-6	C49-7	C48-8	C46-7	C49-4	C46-5	C48-1	C26-7	C54-7	C26-5	C49-3	C26-2	9-550		C55-4	C54-5	C54-3	C45-6	C45-5	

		-1				 	 1		1		 	 _	7	 ~~~	 ~~	 ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	 _	7	-	
R = +0.1	Frequency = 30 Hz	Function: Sine	Remarks																	
			Residual Strength (10 ³ psi)	26.89	33.17															
			Temp. Rise (°F)	1	********															
			Cycles to Failure	10,000,000+	10,000,000+															And the state of t
			Max. Stress	Т	15															
			Min. Stress	0.37	0.37														-	
atigue			Max. Stress	3.65	3.65															
ensile F	04		Test Temp.		250															-
Tensile-Tensile Fatigue	al: AS/3004	1	Fiber Orienta-	+45°	+45°										_					
Test:	Material:		Specimen	C44-8	C48-6															

R * +0.1	Frequency = .30 Hz	Function: Sine		Remarks																						
			Residual	(10^{3} pg1)	-	-		***	-		1	**********	200.7	***************************************		-	1	I	1	Manager (Aller	-		1	-		
			Temp.	Kise (°%)		I	1		-	1	1				1		l	1					-			
			Cycles	to Failure	8,700	200	1,100	1,300	129,600	45,900	162,000	12,700	10,000,100+	562,800	4,024,700	33,300	324,700	13,600	27,100	28,100	2,900	721,300	481,400	2,527,206		
			Max.	Stress (* ult.)	06	8	96	06	80	88	80	80	70	70	20	70	20	8	જ	8	80	80	8	80		•
			Min.	Stress (103psi)	17.6	17.6	17.6	9.7.	15.6	15.6	15.6	15.6	13.7	13.7	13.7	13.7	18.2	18.2	18.2	18.2	16.2	16.2	16.2	16.2		
Fatigue			Max.	Stress (103 psi)	175.8	175.8	175.8	175.8	156.3	156.3	156.3	156.3	136.8	136.8	136.8	136.8	182.1	182.1	182.1	182.1	161.9	161.9	161.9	161.9	,	
rengile F	397		Test	Temp.	-67	-67	<u>-67</u>	-67	-6 7	-67	<u>-67</u>	-67	-67	-67	-67	-67	72	72	72	72	72	72	72	72		
Tensile-Tensile	al: AS/439		Fiber	Orienta- tion	0,0	00	0.	00	0.	0.0	00	0°	0.	00	00	0ه	0،	00	0	0°	00	00	00	00		
Test:	Material:			Specimen	D7-9	D3-9	12-7	D6-12	D5-2	D7-17	D6-5	D1-18	6 90	D3-2	05-8	D46-17	D4-5	D4-6	D3-11	D3-18	D5-1	03-15	D5-6	D4-16		

R = +0.1	Frequency = .30 Hz	Function: Sine		Remarks																						
			Residual	(10 ³ ps1)	-	208.1		181.1					 		-		1		***************************************	-		-	•	1		
			Temp.	(e.F.)	1					1	l			-	-	-	1		-	-		-	-	l		
			Cycles	Failure	1,919,000	10,000,000+	3,160,500	11,681,400+	12,000	6,200	3,600	1,300	1,100	17,100	228,900	4,800	2,739,300	968,000	4,865,800	000'9	2,100	006	1,700	10,500		
			Max.	(% ult.)	70	20	20	70	90	8	ક	8	80	08	80	08	70	70	70	70	80	80	8	80		
			Min.	(10 pst)	14.2	14.2	14.2	14.2	16.9	16.9	16.9	16.9	15.0	15.0	15.0	15.0	13.1	13.1	13.1	13.1	16.5	16.5	16.5	16.5		
Fatigue			Max.	(10 ³ psi)	141.6	141.6	141.6	141.6	168.7	168.7	168.7	168.7	149.9	149.9	149.9	149.9	131.2	131.2	131.2	131.2	165.2	165.2	165.2	165.2		
ensile F	AS/4397		•	remp.		72	72	72	350	350	350	350	350	320	350	320	350	350	350	350	450	450	450	450		
Tensile-Tensile	11: AS,		Piber	orienta- tion	°°	°O	00	00	00	°O	00	00	0°	0ء	°O	00	00	0,0	0°	0.	00	° 0	00	0,0		
Test:	Material:			Specimen	D7-14	05-12	D7-2	D4-10	D6-15	D1-9	D46-4	D46-14	D3-7	11-70	D5-14	D46-15	06-13	D4-3	9/a	D46-16	D6-3	D7-12	D1-15	D7-13		

2 1 1 1 2 1 1 1 2 1 1 1 2 1 1 1 2 1 1 1 2 1 1 1 2 1	Tensile-Tensile Fatigue : AS/4397	ile	Fatique						4
## Street Cycles Temp. Residual Remarks (**) (**) (**) (**) (**) (**) (**) (**			, ,						
(* ult.) Pailure (**) (10 ³ Psi) 75	a- Temp.			Min. Stress	Max. Stress	Cycles to	Temp.	Residual	1
75 649,000 75 1,132,200 75 348,600 70 2,740,600 70 3,207,200 70 3,207,200 70 2,694,600 70 2,694,600 70 3,300 65 10,000,100+ 65 14,400 65 14,400 60 53,200 60 165,400 60 1,260,400	n (°F) (10 ³ pst)	(10 3 281)		10-pst)	(* ult.)	Pailure	(*F)	(10 ³ ps1)	Remarks
75 1,132,200 75 348,600 70 2,740,600 70 3,207,200 70 3,207,200 70 2,694,600 70 2,694,600 70 3,300 70 5,300 65 10,000,100+ 65 14,400 65 14,400 60 53,200 60 1,260,400	+	+	1	7,5	75	649,000	1		
75 1,132,200 — 75 348,600 — 70 2,740,600 — 70 3,207,200 — 70 3,207,200 — 70 5,300 — 70 5,300 — 65 10,000,100+ — 4 65 14,400 — 4 65 14,400 — 4 60 53,200 — 6 60 1,260,400 — 6 60 1,260,400 — 6	450 154.9	+	_	15.5	75	549,300			Appuide to the specification of the second s
75 348,600 70 2,740,600 70 3,207,200 70 2,694,600 70 20,200 70 5,300 65 10,000,100+ 4 65 14,400 4 65 1,200 4 60 53,200 6 60 1,260,400 60 1,260,400	450 154.9	-	_	15.5	75				And strangenistics are the backer discuss
70 2,740,600 70 3,207,200 70 2,694,600 70 20,200 70 5,300 70 3,300 65 10,000,100+ 4 65 14,400 4 65 14,400 4 60 53,200 60 165,400 60 1,260,400 60 1,260,400	154.9	-	\Box	5.5	75	348,600		dies yes also	
70 887,500 70 2,694,600 70 20,200 70 5,300 70 29,800 65 10,000,100+ 4 65 14,400 4 65 1,200 4 60 53,200 60 4,476,300 60 1,260,400	0° 450 144.6	9		4.5	70	2,740,600			
70 3,207,200 70 2,694,600 70 20,200 70 5,300 70 29,800 65 10,000,100+ 65 8,700 65 14,400 60 53,200 60 1,200 60 1,260,400 60 1,260,400	450 144.6	-		4.5	70	887,500	****		
70 2,694,600 70 5,300 70 3,300 70 29,800 65 10,000,100+ 65 8,700 65 14,400 60 53,200 60 1,260,400 60 1,260,400	450 144.6	-		4.5	70	3,207,200		-	A THE RESERVE THE PROPERTY OF
70 20,200 70 5,300 70 3,300 65 10,000,100+ 4 65 14,400 4 65 14,400 6 60 53,200 60 60 4,476,300 6 60 1,260,400	0° 450 144.6 1	-	ri	4.5	70	2,694,600		day. Ch. vale	And the second s
70 5,300 70 3,300 70 29,800 65 10,000,100+ 65 8,700 65 14,400 60 53,200 60 1,260,400 60 1,260,400	000 75 270	+	Je	21	C.				and the control of th
65 10,000,100+ 65 10,000,100+ 65 8,700 65 14,400 65 13,200 60 53,200 60 4,476,300 60 1,260,400	07.5 79-	\dagger	ء اد	12	5 5	20,200	-	-	
65 10,000,100+ 65 10,000,100+ 65 8,700 65 14,400 65 1,200 60 53,200 60 4,476,300 60 1,260,400	07:5	十	2 6		5 5	00,300			
65 10,000,100+ 65 8,700 65 14,400 65 1,200 60 53,200 60 4,476,300 60 4,476,300	5.70	+		7	2	3, 300	***************************************		
65 10,000,100+ 65 8,700 65 14,400 65 1,200 60 53,200 60 165,400 60 4,476,300 60 1,260,400	-0/ 3.70	+	2	丁	9	29,800			
65 8,700 65 14,400 65 1,200 60 53,200 60 4,476,300 60 1,260,400	77 2 79-	+	~	_	65	יטטר טטט טר			
65 14,400 65 1,200 60 53,200 60 165,400 60 4,476,300 60 1,260,400	+-	+-	0	. Z	55	8.700		4.3/	er i den er er en en en en en en en en en en en en en
65 1,200 60 53,200 60 165,400 60 4,476,300 60 1,260,400	†-	†-	0	×	65	14.400	•		
60 53,200 60 165,400 60 4,476,300 60 1,260,400	-67 3.44		0	4	65	1,200			
60 165,400 60 4,476,300 60 1,260,400	9.5	+	c	1					The state of the s
60 165,400 60 4,476,300 60 1,260,400	-01 3.18	+	9	77	90	53,200	-		
60 4,476,300 60 1,260,400	-6/ 3.18	1	5	22	9	165,400	-	***************************************	AND THE PROPERTY OF THE PROPER
60 1,260,400	-67 3.18		ö	32	09	4,476,300	-		Anderson and the second of the second of the second of the second of the second of the second of the second of
	90° -67 3.18 0.		ဝ	32	99	1,260,400			A CONTRACTOR OF THE PROPERTY O
									oranty per entre de la constitue de la constit
		-		1					And we will have a supplicated to the supplication of the supplica
									Andrew Communication and the second control of the second control

Test:	Tensile-Tensile Fatique	Pensile i	Patique		The state of the s				R = +0.1
Material:	lal: AS/4397	39.7							Frequency = .30 Hz
									Function: Sine
	Fiber	Test	Max.	Min.	Max.	Cycles	Temp.	Residual	į .
Specimen	Orienta-	Temp (*F)	(103 psi)	(10 ps.)	(% ult.)	Failure	(*F)	(10 ³ psi)	Remarks
D22-1	8	-67	2.65	0.27	50	10,000,100+		4.09	
D12-8	°06	72	3.76	0.38	20	000'06	-		
D13-4	06	72	3.76	0.38	20	75,800	1	-	
520-7	.06	72	3.76	0.38	20	6,400			
D15-9	°06	72	3.76	0.38	20	200	-		
D12-5	°06	72	3.22	0.32	99	171,000	-	-	
D23-1	06	7.2	3.22	0.32	09	2,100	1		
D23-5	06	72	3.22	0.32	09	1,100			
D17-5	06،	72	3.22	0.32	09	63,000	ł	-	
D18-3	900	72	2.68	0.27	50	12,200	-		
023-9	06	72	2.68	0.27	50	4,357,100	1	********	
D26-8	°06	72	2.68	0.27	50	2,600		-	
D22-7	906	72	2.68	0.27	20	100,900	-	-	
						and the state of t			
D14-2	066	350	3.05	0.31	80	11,700			
D25-2	°06	350	3.05	0.31	80	1,500			
D13-10	°06	350	3.05	0.31	80	32,600			
D12-2	°06	350	3.05	0.31	80	14,900	l		
D58-6	06	350	2.86	0.29	7.5	7,800			
D22-5	06	350	2.86	0.29	75	500	-		
D13-8	90°	350	2.86	0.29	2/2	2,276,000	1		да жандары на варабитуулуна түүнө түүлүү түүлүү түүлүү айтай жандарын айтай түүлүү түүлүү түүлүү түүлүү түүлүү
D22-9	°06	350	2.86	0.29	75	1,500	-		
								_	

Test:	Tensile-Tensile Fatique	Censile F	atique						
Maturial	A1. AC/A307	10.7						-	
		77				-			Frequency = 30 Hz
						-			Function: Sine
Specimen	Piber Orienta-	Test Temp.	Stress	Min. Stress	Max. Stress	Cycles	Temp.	Residual	
Number	tion	(*F)	(10 ³ psi)	(10 ³ psi)	(% ult.)	Failure	(A)	(10 ³ ps1)	Remarks
D19-8	。 06	350	2.67	0.27	0/_	20,300	1		
D20-1	°06	350	2.67	0.27	70	15,900			
D13-1	စိ	320	2.67	0.27	70	4,348,600	-		APPROMITERATURE CONTRACTOR CONTRA
D21-9	06،	350	2.67	0.27	70	5,392,000	*****	Mile disappears	editionade des representation de la descripción
									editidy anagum dan daga da inga na panganangan naganangan kananangan pangangan san inga dipangangan pangangan
D12-6	06°	450	2.07	0.21	29	4,300			
D20-8	90°	450	2.07	0.21	22	19,900			
D14-5	06ء	450	2.07	0.21	20	5,300			
D15-5	0 66	450	2.07	0.21	70	.10.000			Grips slipped
028-10	°06	450	2.07	0.21	70	35,400			
									den elektriken in den en
D13-7	05ء	450	1.77	0.18	99	543,700	***		
D17-10	°86	450	1.77	0.18	09	1,100			enter de la company de la comp
D16-3	°06	450	1.77	0.18	9	49,500	11	100 000.000	
D20-3	066	450	1.77	0.18	9	A	GR-300-020		Grips slipped
019-7	066	450	1.77	0.18	09	***************************************			1
D58-9	°06	450	1.77	0.18	9	1,005,600		tengan syp	
D20-9	°06	450	1.48	0.15	50	5,788,000			
D18-4	90°	450	1.48	0.15	50	12,300	******		
D20-10	90°	450	1.48	0.15	50	5,933,400		******	
D58-8	₀06	450	1.48	0.15	50	10,001,000+	1	3.74	
									ARTER AND THE STREET OF THE STREET, WHICH AND THE STREET, WHICH AN
D37-9	±45°	-67	13.48	1.35	70	3,600	16		
D33-3	±45°	-67	13.48	1.35	73	7,000	00		and the second s
271-6	±45°	-67	13.48	1.35	2	5,100	18		
D40-4	+45°		13.48	1.35	70	3, 300	11	***************************************	AND THE PROPERTY OF THE PROPER
				***************************************			***************************************	Transferential Property Company of the Propert	no destablicación de contrata de contrata de contrata de contrata de contrata de contrata de contrata de contra

Fiber Fast Hax. Hax. Hax. Cycles Line Test:	Tensile-Tensile	Cenaile F	Fatigue						R = +0.1	
Piper Culture Culture Line Factor Culture Line Max. Lines Stress	Materi	1a1: AS/	4397							· (
Printer Vast Win. Win. Cycles Temp. Residual Streams Streams Stream Streams Streams Stream Streams Streams Stream Streams Streamgth Streams Content of (**) Research Content of (**) Research Streamsth Research #45° -67 11.56 1.16 60 215,000 5 #45° -67 11.56 1.16 60 215,000 5 #45° -67 11.56 1.16 60 215,000 5 #45° -67 11.56 1.16 60 215,000 5 #45° -67 10.59 1.06 55 10,001,500 5 14.23 #45° -67 10.59 1.06 55 10,011,500 9 15.57 #45° -67 10.59 1.06 55 10,010,900+ 5 16.21 #45° -67 10.59 1.06 55 10,010,900+ 5										
Oxfenter - Temp. (TP) Oxfenter or James (TP) Carter		Piber	Test	Max.	Min.	MAX.	Cycles	Temp.	Residual	
±45° -67 11.56 1.16 60 160,200 11 ±45° -67 11.56 1.16 60 30,400 9 ±45° -67 11.56 1.16 60 215,000 5 ±45° -67 11.56 1.16 60 215,000 5 ±45° -67 10.59 1.06 55 1,241,500 3 ±45° -67 10.59 1.06 55 10,011,500 5 ±45° -67 10.59 1.06 55 10,011,500 3 ±45° -67 10.59 1.06 55 10,011,500 3 ±45° -67 9.93 0.99 50 10,011,500 3 ±45° -67 10.59 1.06 55 10,011,500 3 ±45° -72 14.98 1.50 80 3,800 29 ±45° 72 14.98 1.50 80 2,900 <	Specimen	Orienta- tion	Temp.	(103 pg)	(10 pst)	(* ult.)	Failure	(* F)	(10 ³ pst)	Remarks
+45° -67 11.56 1.16 60 30,400 9 +45° -67 11.56 1.16 60 215,000 5 +45° -67 11.56 1.16 60 215,000 5 +45° -67 10.59 1.06 55 1,241,500 3 +45° -67 10.59 1.06 55 17,781,800 5 +45° -67 10.59 1.06 55 10,001,500 5 +45° -67 10.59 1.06 55 10,010,900+ 5 +45° -67 10.59 1.06 55 10,010,900+ 5 +45° -67 10.59 1.06 55 10,010,900+ 5 +45° -67 10.59 1.06 55 10,011,500 36 +45° -72 14.98 1.50 80 5,400 29 +45° 72 14.98 1.50 80 2,900	D39-9	+45°	-67	11.56	1.16	60	160,300	11		
+45° -67 11.56 1.16 60 215,000 5 +45° -67 11.56 1.16 60 80,300 11 +45° -67 10.59 1.06 55 1,241,500 3 +45° -67 10.59 1.06 55 1,241,500 3 +45° -67 10.59 1.06 55 10,001,500 2 +45° -67 10.59 1.06 55 10,011,500 9 +45° -67 10.59 1.06 55 10,011,500 9 +45° -67 10.59 1.06 55 10,011,500 9 +45° -72 14.98 1.50 80 3,600 41 +45° 72 14.98 1.50 80 2,900 25 +45° 72 13.10 1.31 70 15,900 23 +45° 72 13.10 1.31 70 15,900 <td< td=""><td>D37-10</td><td>+45°</td><td>67</td><td>11.56</td><td>1.16</td><td>9</td><td>30,400</td><td>6</td><td>-</td><td></td></td<>	D37-10	+45°	67	11.56	1.16	9	30,400	6	-	
+45° -67 11.56 1.16 60 80,300 11 +45° -67 10.59 1.06 55 1,241,500 3 +45° -67 10.59 1.06 55 10,001,500 5 +45° -67 10.59 1.06 55 10,001,500 5 +45° -67 10.59 1.06 55 10,011,500 9 +45° -67 10.59 1.06 55 10,011,500 9 +45° -67 10.59 1.06 55 10,010,900+ 5 +45° -67 9.93 0.99 50 10,010,900+ 5 +45° 72 14.98 1.50 80 3,600 41 +45° 72 14.98 1.50 80 2,900 25 +45° 72 13.10 1.31 70 15,900 23 +45° 72 13.10 1.31 70 15,900	D35-1	+45°	-67	11.56	1.16	09	215,000	ഹ	1	
+45° -67 10.59 1.06 55 1,241,500 3 +45° -67 10.59 1.06 55 7,781,800 5 +45° -67 10.59 1.06 55 10,001,500 2 +45° -67 10.59 1.06 55 10,011,500 9 +45° -67 10.59 1.06 55 10,011,500 9 +45° -67 10.59 1.06 50 9 +45° -67 10.99 50 10,010,900+ 5 +45° -72 14.98 1.50 80 5,400 36 +45° 72 14.98 1.50 80 5,900 29 +45° 72 13.10 1.31 70 15,900 32 +45° 72 13.10 1.31 70 15,900 23 +45° 72 13.10 1.31 70 15,100 32 +45° 72 11.23 1.12 60 913,900 23 +45° </td <td>D41-7</td> <td>+45°</td> <td>-67</td> <td>11.56</td> <td>1.16</td> <td>60</td> <td>80,300</td> <td>11</td> <td>-</td> <td></td>	D41-7	+45°	-67	11.56	1.16	60	80,300	11	-	
+45° -67 10.59 1.06 55 1,241,500 3 +45° -67 10.59 1.06 55 7,781,800 5 +45° -67 10.59 1.06 55 10,001,500 2 +45° -67 10.59 1.06 55 10,011,500 9 +45° -67 10.59 1.06 50 10,010,900+ 5 +45° -67 9.93 0.99 50 10,010,900+ 5 +45° -67 14.98 1.50 80 3,600 41 +45° 72 14.98 1.50 80 3,800 29 +45° 72 14.98 1.50 80 3,800 29 +45° 72 14.98 1.50 80 2,900 25 +45° 72 13.10 1.31 70 15,900 23 +45° 72 13.10 1.31 70 15,100 32 +45° 72 11.23 1.12 60 913,900 23<										
+45° -67 10.59 1.06 55 7,781,800 5 +45° -67 10.59 1.06 55 10,001,500 2 +45° -67 10.59 1.06 55 10,011,500 9 +45° -67 10.59 1.06 55 10,011,500 9 +45° -67 9.93 0.99 50 10,010,900+ 5 +45° -67 9.93 0.99 50 10,010,900+ 5 +45° 72 14.98 1.50 80 3,600 41 +45° 72 14.98 1.50 80 3,800 29 +45° 72 14.98 1.50 80 2,900 25 +45° 72 13.10 1.31 70 15,900 23 +45° 72 13.10 1.31 70 15,100 32 +45° 72 13.10 1.31 70 15,100 23	D41-5	+45°	-67	10.59	1.06	22	1,241,500	e,	***********	
445° -67 10.59 1.06 55 10,001,500 2 445° -67 10.59 1.06 55 10,011,500 9 ±45° -67 9.93 0.99 50 10,010,900+ 5 ±45° 72 14.98 1.50 80 3,600 41 ±45° 72 14.98 1.50 80 3,600 41 ±45° 72 14.98 1.50 80 3,800 29 ±45° 72 14.98 1.50 80 3,800 29 ±45° 72 14.98 1.50 80 3,800 29 ±45° 72 13.10 1.31 70 15,900 25 ±45° 72 13.10 1.31 70 15,900 23 ±45° 72 13.10 1.31 70 15,900 23 ±45° 72 11.23 1.12 60 913,900 23 </td <td>D34-4</td> <td>+45°</td> <td>-67</td> <td>10.59</td> <td>1.06</td> <td>55</td> <td>7,781,800</td> <td>ហ</td> <td></td> <td></td>	D34-4	+45°	-67	10.59	1.06	55	7,781,800	ហ		
+45° -67 10.59 1.06 55 10,011,500 9 +45° -67 9.93 0.99 50 10,010,900+ 5 +45° -67 9.93 0.99 50 10,010,900+ 5 +45° 72 14.98 1.50 80 3,600 41 +45° 72 14.98 1.50 80 3,800 29 +45° 72 14.98 1.50 80 3,800 29 +45° 72 14.98 1.50 80 2,900 25 +45° 72 13.10 1.31 70 15,900 23 +45° 72 13.10 1.31 70 15,100 32 +45° 72 13.10 1.31 70 15,100 32 +45° 72 13.10 1.31 70 15,100 25 +45° 72 11.23 1.12 60 913,900 23 +45° 72 11.23 1.12 60 1,628,100 25	D41-8	+45°	- 92	10.59	1.06	22	10,001,500	7	14.23	
±45° -67 9.93 0.99 50 10,010,900+ 5 ±45° 72 14.98 1.50 80 5,400 36 ±45° 72 14.98 1.50 80 3,600 41 ±45° 72 14.98 1.50 80 3,800 29 ±45° 72 14.98 1.50 80 2,900 25 ±45° 72 13.10 1.31 70 15,900 25 ±45° 72 13.10 1.31 70 15,100 32 ±45° 72 13.10 1.31 70 15,100 32 ±45° 72 13.10 1.31 70 15,100 32 ±45° 72 11.23 1.12 60 913,900 23 ±45° 72 11.23 1.12 60 1,628,100 23 ±45° 72 11.23 1.12 60 408,300 31	D33-1	+45°	-67	10.59	1.06	52	10,011,500	6	15.57	
±45° -67 9.93 0.99 50 10,010,900+ 5 ±45° 72 14.98 1.50 80 5,400 36 ±45° 72 14.98 1.50 80 3,800 29 ±45° 72 14.98 1.50 80 2,900 29 ±45° 72 14.98 1.50 80 2,900 29 ±45° 72 13.10 1.31 70 15,900 36 ±45° 72 13.10 1.31 70 16,400 32 ±45° 72 13.10 1.31 70 15,100 32 ±45° 72 11.23 1.12 60 913,900 23 ±45° 72 11.23 1.12 60 913,900 25 ±45° 72 11.23 1.12 60 913,900 25 ±45° 72 11.23 1.12 60 408,300 31										
445° 72 14.98 1.50 80 6,400 36 445° 72 14.98 1.50 80 3,600 41 445° 72 14.98 1.50 80 2,900 29 445° 72 13.10 1.31 70 15,900 35 445° 72 13.10 1.31 70 15,900 32 445° 72 13.10 1.31 70 16,400 32 445° 72 13.10 1.31 70 16,400 32 445° 72 13.10 1.31 70 15,100 32 445° 72 11.23 1.12 60 913,900 25 445° 72 11.23 1.12 60 2408,300 37 445° 72 11.23 1.12 60 408,300 37 445° 72 11.23 1.12 60 408,30 37	D38-3	+45°	-67	9.93	0.99	50	10,010,900+	5	16.21	
±45° 72 14.98 1.50 80 6,400 36 ±45° 72 14.98 1.50 80 3,600 41 ±45° 72 14.98 1.50 80 3,800 29 ±45° 72 13.10 1.31 70 15,900 25 ±45° 72 13.10 1.31 70 15,900 23 ±45° 72 13.10 1.31 70 15,900 23 ±45° 72 13.10 1.31 70 15,100 32 ±45° 72 13.10 1.31 70 15,100 32 ±45° 72 11.23 1.12 60 913,900 25 ±45° 72 11.23 1.12 60 1,628,100 32 ±45° 72 11.23 1.12 60 408,300 37 ±45° 72 11.23 1.12 60 408,300 37 ±45° 72 11.23 1.12 60 408,300 37										
+45° 72 14.98 1.50 80 3,600 41 ±45° 72 14.98 1.50 80 3,800 29 ±45° 72 13.10 1.31 70 15,900 36 ±45° 72 13.10 1.31 70 15,900 23 ±45° 72 13.10 1.31 70 16,400 32 ±45° 72 13.10 1.31 70 15,100 32 ±45° 72 13.10 1.31 70 15,100 32 ±45° 72 11.23 1.12 60 913,900 23 ±45° 72 11.23 1.12 60 1,628,100 32 ±45° 72 11.23 1.12 60 408,300 37 ±45° 72 11.23 1.12 60 408,300 37 ±45° 72 11.23 1.12 60 408,300 37	D31-3	±45"	72	14.98	1.50	8	6,400	8		
±45° 72 14.98 1.50 80 3,800 29 ±45° 72 14.98 1.50 80 2,900 25 ±45° 72 13.10 1.31 70 15,900 36 ±45° 72 13.10 1.31 70 15,900 23 ±45° 72 13.10 1.31 70 15,400 32 ±45° 72 13.10 1.31 70 15,100 32 ±45° 72 11.23 1.12 60 913,900 23 ±45° 72 11.23 1.12 60 1,628,100 25 ±45° 72 11.23 1.12 60 408,300 37 ±45° 72 11.23 1.12 60 408,300 37 ±45° 72 11.23 1.12 60 408,300 37 ±45° 72 11.23 1.12 60 408,300 31 <td>D29-6</td> <td>+45°</td> <td>7.7</td> <td>14.98</td> <td>1.50</td> <td>80</td> <td>3,600</td> <td>41</td> <td></td> <td></td>	D29-6	+45°	7.7	14.98	1.50	80	3,600	41		
±45° 72 14.98 1.50 80 2,900 25 ±45° 72 13.10 1.31 70 15,900 36 ±45° 72 13.10 1.31 70 15,900 23 ±45° 72 13.10 1.31 70 16,400 32 ±45° 72 13.10 1.31 70 15,100 32 ±45° 72 11.23 1.12 60 913,900 23 ±45° 72 11.23 1.12 60 1,628,100 25 ±45° 72 11.23 1.12 60 408,300 37 ±45° 72 11.23 1.12 60 743,300 31	D28-4	±45°	7.7	14.98	1.50	80	3,800	53		
±45° 72 13.10 1.31 70 15,900 36 ±45° 72 13.10 1.31 70 15,900 23 ±45° 72 13.10 1.31 70 16,400 32 ±45° 72 13.10 1.31 70 15,100 32 ±45° 72 11.23 1.12 60 913,900 23 ±45° 72 11.23 1.12 60 1,628,100 25 ±45° 72 11.23 1.12 60 408,300 37 ±45° 72 11.23 1.12 60 743,300 31	D27-4	±45°	72	14.98	1.50	80	2,900	25		
±45° 72 13.10 1.31 70 15,900 36 +45° 72 13.10 1.31 70 15,900 23 +45° 72 13.10 1.31 70 16,400 32 +45° 72 13.10 1.31 70 15,100 32 +45° 72 11.23 1.12 60 913,900 23 +45° 72 11.23 1.12 60 408,300 37 +45° 72 11.23 1.12 60 408,300 37 +45° 72 11.23 1.12 60 37 37 +45° 72 11.23 1.12 60 37 37										
+45° 72 13.10 1.31 70 15,900 23 +45° 72 13.10 1.31 70 16,400 32 +45° 72 13.10 1.31 70 15,100 32 +45° 72 11.23 1.12 60 913,900 23 +45° 72 11.23 1.12 60 408,300 37 +45° 72 11.23 1.12 60 408,300 37 +45° 72 11.23 1.12 60 408,300 37	D31-9	+45°	72	13.10	1.31	20	15,900	38	400-0-1-10	
+45° 72 13.10 1.31 70 16,400 32 +45° 72 13.10 1.31 70 15,100 32 +45° 72 11.23 1.12 60 913,900 23 +45° 72 11.23 1.12 60 408,300 37 +45° 72 11.23 1.12 60 408,300 37 +45° 72 11.23 1.12 60 743,300 31	D28-1	+45°	72	13.10	1.31	0/	15,900	23	-	
±45° 72 13.10 1.31 70 15,100 32 ±45° 72 11.23 1.12 60 913,900 23 ±45° 72 11.23 1.12 60 408,100 25 ±45° 72 11.23 1.12 60 408,300 37 ±45° 72 11.23 1.12 60 743,300 31	D32-9	+45°	72	13.10	1.31	02	16,400	32		!!
±45° 72 11.23 1.12 60 913,900 23 +45° 72 11.23 1.12 60 1,628,100 25 ±45° 72 11.23 1.12 60 408,300 37 ±45° 72 11.23 1.12 60 743,300 31	D31-6	<u>+</u> 45°	72	13.10	1.31	70	15,100	32		
±45° 72 11.23 1.12 60 913,900 23 ±45° 72 11.23 1.12 60 1,628,100 25 ±45° 72 11.23 1.12 60 408,300 37 ±45° 72 11.23 1.12 60 743,300 31										
+45° 72 11.23 1.12 60 1,628,100 25 +45° 72 11.23 1.12 60 408,300 37 +45° 72 11.23 1.12 60 743,300 31	D32-3	+45°	72	11.23	1.12	09	913,900	23		
+45° 72 11.23 1.12 60 408,300 37 +45° 72 11.23 1.12 60 743,300 31	D29-10	+450	72	11.23	1.12	09	1,628,100	25		
+45° 72 11.23 1.12 60 743,300 31	D27-7	+45°	7.2	11.23	1.12	09	408,300	37	***************************************	
	D28-9	<u>+</u> 45°	72	11.23	1.12	09	743,300	31	400	

Test:	Tensile-Tensile Fatigue	ensile F	atigue						R = +0.1
Material:	al: AS/4397	397							Frequency = .30 Hz
									Function: Sine
	Fiber	Test	Max.	Min.	Max.	Cycles	Temp.	Residual	
Specimen	orienta- tion	· cub.	(10 ³ psi)	(10 pst)	(* ult.)	Failure	(0E)	(10 ³ ps1)	Remarks
D32-6	±45°	72	8.42	0.84	45	10,000,000+	4	18.72	ender der Aufreche Anders der Aufreche Anders der Aufrech der Aufrech der Bereitster der Bereitster der Bereits
									т өзейн табанда дең алам төрүге кендерен арамдарын арамдарында такарында такарын арамдарын аламдарын аламдары
D40-9	±45°	320	11.63	1.16	02	15,000	6	-	
D38-4	+45°	320	11.63	1.16	70	14,900	59		
D35-4	+45°	350	11.63	1.16	70	87,700	14		
D40-2	+45°	350	11.63	1.16	70	11,000	35		
D40-1	±45°	350	10.80	1.08	65	107,900	14		
D35-5	+45°	350	10.80	1.08	65	405,600	13	400.000.000	
D36-9	±45°	350	10.80	1.08	65	87,700	51	****	
D38-7	+45°	350	10.80	1.08	65	58,100	7		
D41-3	±45°	350	9.97	1.00	60	542,800	1	-	
D38-2	+45°	350	9.97	1.00	9	1,945,100	6		
D33-7	+45°	320	9.97	1.00	99	000′968	8	· ·	
D37-5	+45°	350	9.97	1.00	09	528,800	, ,		
									Alle de la constante de la con
D39-6	±45°	450	11.69	1.17	70	4,900	47	-	
D37-6	+45°	450	11.69	1.17	70	1,300	32	-	
D36-8	±45°	450	11.69	1.17	70	1,000	22	1	
D38-5	±45°	450	11.69	1.17	70	1,300	34	1	
D37-4	±45°	450	10.02	1.00	09	2,800	42	1	
D41-4	+45°	450	10.02	11.00	09	2,900	48		gget et en generale et et deur et et en en en en en en en en en en en en en
									Манадартирован повер выполняем программенто постар фало Адентуй программенторы поверх постарующего программент
									AL CARVELAND PARTIES AND REPORTED FOR A VIOLENCE AND REAL PROPERTY AND A PROPERTY OF A PROPERTY OF A PARTIES AND A PROPERTY OF A PARTIES AND A

Test:	Tensile-Tensile Fatigue	ensile F	atigue						ж = +0.1
Materi	1 6	7.							Frequency = .30 Hz
									Punction: Sine
Specimen	Fiber Orienta-	Test Temp.	Max. Stress	Min. Stress	Max. Stress	Cycles to	Temp. Rise	Residual	4 7 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2
Number	tion	(eF)	(10 tosi)	(10-psi)	(* ult.)	Fallure	(4.1)	(10° pst)	Remarks
D34-2	1450	450	25.00	70.0	202	67,600	2,5		AND THE COLUMN CONTRACTOR OF THE COLUMN COLU
041-10	+45°	450	8.35	0.84	20	21,900	49	***************************************	· · · · · · · · · · · · · · · · · · ·
D36-4	±45°	450	8,35	0.84	50	8,200	63		· · · · · · · · · · · · · · · · · · ·
				,					terrenta de la composição de la composição de la composição de la composição de la composição de la composição
D36-7	±45°	450	6.68	0.67	40	6,227,000			
D41-1	+45°	450	6.68	0.67	40	3,449,800	7	-	***
D33-10	±45°	450	89.9	0.67	40	10,001,000+	7	13.54	
D34-7	+45°	450	89.9	0.67	40	8,124,700	4		•
									**
Marketin divine divine divine divine									
									e dan yapat, Adallah yapat da Chimada da masayan yapat da ayaba yalka yalka da da da da da da da da da da da d
									A STATE OF THE STA
									e der mid er der statte state midde bestelle i state met er förstate för mid kalle state state mid bydde bestelle state
									terre de de la companya de la companya de la companya de la companya de la companya de la companya de la compa

	× ×	đ																								
R = +0.1	Frequency = 30	Punction: Sine		Remarks								*************************************			erstrukkirkerikkirkeri enterikation enterikation enterikation enterikation enterikation enterikation enterikat											
			Residual	(103 pst)	******	***************************************	189.9	AMPLICATION COMM	****			*******	175.1	-	Andreas - Andrea	181.7	*****	140.6	187.0	***************************************	-	-				
			Temp.	(.F)	-	-		approximate of the second	****			A STATE OF THE PARTY OF THE PAR	***************************************			-		-		***		-	OH 1987 240			
			Cycles	Fallure	2,400	300	10,000,100	385,600	1,200	300		608,000	10,000,100+	1,775,300	1,106,700	10,000,100+	9,519,600	10,000,100+	10,000,100+	312,300	873,000	909	10,200			
	9		Max.	(% ult.)	8	96	85	82	జ	82		8	80	8	980	70	20	20	70	80	8	90	80		-	
	hite/Polyimide		Min.	(10 pet)	14.1	14.1	13.3	13.3	13.3	13.3		12.5	12.5	12.5	12.5	11.0	11.0	11.0	11.0	12.2	12.2	12.2	12.2			
atigue	Graphite/		Max.	(10 ³ ps1)	141.1	141.1	133.2	133.2	133.2	133.2		125.4	125.4	125.4	125.4	109.5	109.5	109.5	109.5	121.8	121.8	121.8	121.8			
Tensile F	T300/F178 G		Test			72	72	72	72	72		72	72	72	72	72	72	72	72	350	350	320	350			
Tensile-Tensile Fatigue			Fiber	tion	00	00	00	00	°O	0,0	_	00	00	00	00	00	00	0	00	00	00	°O	00			
Tast:	Material:			Number	E5-1	E7-12	E4-5	E8-16	E7-11	E22-2		E4-13	E21-5	E8-6	6-93	E4-17	E6-11.	E8-13	E21-4	E4-2	E21-3	E6-5	E8-5			

		ı			The second name of the last of	The fall heart has an a second district to the second district to th	and the Real Property lies and the last of	the state of the latest and the state of the		-
Material:		T300/F178	Graphite	ite/Polyimide	ide				Frequency = ,30 Hz	_
									Function: Sine	
	Piber		Max.	Min.	Max.	Cycles	Temp.	Residual		-
Spectmen	Orienta-	Temp.	Stress (10 ³ ps1)	(10 pat)	(* ult.)	Failure	(4E)	(10 pst)	Remarks	
11	00	1	114.2	11.4	75	5,584,300	***************************************			es esta y
ES-4	0		114.2	11.4	75	1,146,300	200000		beliebelve ut eleveten Ablest abbelserne Aralle ser, teratekt. "des e datskestere ikrekerses	
E6-13	00	350	114.2	11.4	75	127,100	45.45.4		Gran and an analysis of the state of the sta	
E21-9	٥٥	350	114.2	11.4	75	7,426,900	***************************************			
မှ	00	350	106.6	11.0	70	2,346,900	-	*******		
F6-17	0،	350	106.6	11.0	70	3,592,300		****		
E7-9	00	350	106.6	11.0	10	10,002,000+	-	150.6	istoron dillistik dakala karandiya sarandiya sarandiya da internation da karandi sarandi karandi karandi karandi	
E21-16	00	350	106.6	11.0	70	934,000	440 MV 504	(III)		
E21-7	00	450	114.7	11.5	75	1,730,500	-			
E22-7	0.0	450	114.7	11.5	75	400	Bringlises	-		
-2	0.	450	114.7	11.5	75	3,338,500		***************************************		
E7-17	00	450	114.7	11.5	75	141,600	***************************************			
E21-14	00	450	107.0	10.7	70	1,679,500		***************************************		
æ-7	0 و	450	107.0	10.7	70	3,671,200				
-18	00	450	107.0	10.7	70	190,400	-			
E6-7	00	450	107.0	10.7	70	677,800	***			
E4-16	0.	450	99.4	9.6	65	7,670,900				
E21-1	00	450	99.4	6.6	65	8,238,800	****	********		
E5-16	00	450	99.4	9.6	65	9,416,700	***********			
7	00	450	99,4	9.6	65	1,434,200				٦
									. A STATE OF THE S	٦
									kalin ne ngga gapaga nentungga hararan allang saga nega nagagaga nggagan nggasapanga allan nenganingga ngga n	

Paterial: T300/F1/8 Graphite/Polyninde Specimen oriental contents Fiher tion oriental Nax. Tents Hax. Stress Cycles contents Tent tion oriental	Test: '	Tensile-Tensile Fatigue	ensile P	atigue						R = +0.1
Piber Test Max. Min. Max. Cycles	Material		F178 G	aphite/	Polyimid	a				Frequency #.30 Hz
Piber Test Max. Min. Fiber Cycles Stress									Function: Sine	
1. John (**) (**)	<u> </u>	Fiber	1	Max.	Min.	Max.	Cycles	Temp.	Residual	
90° 72 3.06 0.31 80 1,400 90° 72 3.06 0.31 80 1,700 90° 72 3.06 0.31 80 1,700 90° 72 3.06 0.31 80 60,200 90° 72 2.67 0.27 70 10,001,000+ 90° 72 2.67 0.27 70 1,600 90° 72 2.67 0.27 70 1,600 90° 72 2.67 0.27 70 1,600 90° 72 2.67 0.27 70 600 90° 72 2.29 0.23 60 10,001,000+ 90° 72 1.91 0.19 50 10,001,000+ 90° 72 1.91 0.19 50 10,001,000+ 90° 72 1.91 0.19 50 10,001,000+ 90° 72 1.91 0.19 <t< td=""><td></td><td>tion</td><td></td><td>(10³ ps1)</td><td>(10³pst)</td><td>(* ult.)</td><td>Failure</td><td>(*F)</td><td>(10³ ps1)</td><td>Remarks</td></t<>		tion		(10 ³ ps1)	(10 ³ pst)	(* ult.)	Failure	(*F)	(10 ³ ps1)	Remarks
90° 72 3.06 0.31 80 1,700 90° 72 3.06 0.31 80 60,200 90° 72 3.06 0.31 80 60,200 90° 72 2.67 0.27 70 10,001,000+ 90° 72 2.67 0.27 70 1,600 90° 72 2.67 0.27 70 1,600 90° 72 2.29 0.27 70 1,600 90° 72 2.29 0.23 60 10,001,000 90° 72 1.91 0.19 50 10,001,000+ 90° 72 1.91 0.19 50 10,001,000+ 90° 72 1.91 0.19 50 10,001,000+ 90° 72 1.91 0.19 50 10,001,000+ 90° 350 2.08 0.21 70 90° 350 1.78 60	-	900	1	3.06	0.31	8	1,400	1	1	
90° 72 3.06 0.31 80 60,200 90° 72 3.06 0.31 80 60,200 90° 72 2.67 0.27 70 10,001,000+ 90° 72 2.67 0.27 70 1,600 90° 72 2.67 0.27 70 1,600 90° 72 2.29 0.27 70 1,600 90° 72 2.29 0.23 60 10,001,000 90° 72 1.91 0.19 50 10,001,000+ 90° 72 1.91 0.19 50 10,001,000+ 90° 72 1.91 0.19 50 10,001,000+ 90° 72 1.91 0.19 50 10,001,000+ 90° 350 2.08 0.21 70 90° 350 1.78 0.18 60 10,001,000+ 90° 350 1.78 0.18<	18-7	90°	72	3.06	0.31	80	1,700			
90° 72 3.06 0.31 80 500 90° 72 2.67 0.27 70 10,001,000+ 90° 72 2.67 0.27 70 1,600 90° 72 2.67 0.27 70 1,600 90° 72 2.67 0.27 70 1,600 90° 72 2.29 0.23 60 10,001,000 90° 72 2.29 0.23 60 10,001,000 90° 72 1.91 0.19 50 10,001,000+ 90° 72 1.91 0.19 50 10,001,000+ 90° 72 1.91 0.19 50 10,001,000+ 90° 72 1.91 0.19 50 10,001,000+ 90° 350 2.08 0.21 70 90° 350 1.78 0.18 60 10,001,000+ 90° 350 1.78 0.18	327-10	°06	72	3.06	0.31	08	60,200			
90° 72 2.67 0.27 70 10,001,000+ 90° 72 2.67 0.27 70 1,600 90° 72 2.67 0.27 70 1,600 90° 72 2.67 0.27 70 1,600 90° 72 2.29 0.23 60 10,001,000 90° 72 1.91 0.19 50 10,001,000+ 90° 72 1.91 0.19 50 10,001,000+ 90° 72 1.91 0.19 50 10,001,000+ 90° 72 1.91 0.19 50 10,001,000+ 90° 350 1.78 0.18 60 90° 350 1.78 0.18 60 90° 350 1.78 0.18 60 10,000,600+ 90° 350 1.78 0.18 60 10,000,600+	329-6	.06	72	3.06	0.31	80	200		-	
90° 72 2.67 0.27 70 10,001,000+ 90° 72 2.67 0.27 70 1,600 90° 72 2.67 0.27 70 1,600 90° 72 2.29 0.23 60 10,001,000 90° 72 2.29 0.23 60 10,001,000 90° 72 1.91 0.19 50 10,001,000+ 90° 72 1.91 0.19 50 10,001,000+ 90° 72 1.91 0.19 50 10,001,000+ 90° 72 1.91 0.19 50 10,001,000+ 90° 72 1.91 0.19 50 10,001,000+ 90° 72 1.91 0.19 50 10,001,000+ 90° 350 2.08 0.21 70 90° 350 1.78 60 10,000,000+ 90° 350 1.78 60										
90° 72 2.67 0.27 70 3,700 90° 72 2.67 0.27 70 1,600 90° 72 2.67 0.27 70 1,600 90° 72 2.29 0.23 60 10,001,000 90° 72 2.29 0.23 60 10,001,000 90° 72 1.91 0.19 50 10,001,000 90° 72 1.91 0.19 50 10,001,000 90° 72 1.91 0.19 50 10,001,000 90° 72 1.91 0.19 50 10,001,000 90° 72 1.91 0.19 50 10,001,000 90° 350 2.08 0.21 70 90° 350 1.78 0.18 60 90° 350 1.78 0.18 60 10,000,600 90° 350 1.78 0.18 60 10,000,600	318-2	06ء	72	2.67	0.27	22	10,001,000+			No residual-loaded too fast
90° 72 2.67 0.27 70 1,600 90° 72 2.29 0.23 60 10,001,000 90° 72 2.29 0.23 60 10,001,000 90° 72 1.91 0.19 50 10,000,100+ 90° 72 1.91 0.19 50 10,000,100+ 90° 72 1.91 0.19 50 10,001,000+ 90° 72 1.91 0.19 50 10,001,000+ 90° 350 2.08 0.21 70 90° 350 1.78 0.18 60 90° 350 1.78 0.18 60 72,300 90° 350 1.78 0.18 60 10,000,600+ 90° 350 1.78 0.18 60 10,000,600+	327-4	°06	72	2.67	0.27	70	3,700		******	
90° 72 2.67 0.27 70 600 90° 72 2.29 0.23 60 10,001,000 90° 72 2.29 0.23 60 10,001,000 90° 72 1.91 0.19 50 10,000,100+ 90° 72 1.91 0.19 50 10,001,000+ 90° 72 1.91 0.19 50 10,001,000+ 90° 72 1.91 0.19 50 10,001,000+ 90° 350 2.08 0.21 70 90° 350 1.78 0.18 60 90° 350 1.78 0.18 60 10,000,600+ 90° 350 1.78 0.18 60 10,000,600+	229-1	°06	72	2.67	0.27	70	1,600			akot nedijus-vijus-vijus gransakotijus praksaksis praksaksis programja programja programja programja programja
90° 72 2.29 0.23 60 10,001,000 90° 72 2.29 0.23 60 10,001,000 90° 72 1.91 0.19 50 300 90° 72 1.91 0.19 50 10,001,000+ 90° 72 1.91 0.19 50 10,001,000+ 90° 72 1.91 0.19 50 10,001,000+ 90° 350 2.08 0.21 70 90° 350 1.78 0.18 60 90° 350 1.78 0.18 60 90° 350 1.78 0.18 60 72,300 90° 350 1.78 0.18 60 10,000,600+	330-4	90°	72	2.67	0.27	70	009		***************************************	Martin de la companya de alemante al martin de la companya del la companya del la companya de la companya de la companya del la companya de la companya de la companya del la companya d
90° 72 2.29 0.23 60 10,001,000 90° 72 2.29 0.23 60 10,009,600+ 90° 72 1.91 0.19 50 10,000,100+ 90° 72 1.91 0.19 50 10,001,000+ 90° 72 1.91 0.19 50 10,001,000+ 90° 350 2.08 0.21 70 90° 350 1.78 0.18 60 90° 350 1.78 0.18 60 90° 350 1.78 0.18 60 90° 350 1.78 0.18 60 10,000,600+ 90° 350 1.78 0.18 60 10,000,600+										
90° 72 2.29 0.23 60 10,009,600+ 90° 72 1.91 0.19 50 300 90° 72 1.91 0.19 50 10,000,100+ 90° 72 1.91 0.19 50 10,001,000+ 90° 72 1.91 0.19 50 10,001,000+ 90° 350 2.08 0.21 70 90° 350 1.78 0.18 60 90° 350 1.78 0.18 60 90° 350 1.78 0.18 60 90° 350 1.78 0.18 60 10,000,600+ 90° 350 1.78 0.18 60 10,000,600+	317-3	•06	72	2.29	0.23	99	10,001,000	1	****	Broke after 107 cycles
90° 72 1.91 0.19 50 300 90° 72 1.91 0.19 50 10,000,100+ 90° 72 1.91 0.19 50 10,001,000+ 90° 72 1.91 0.19 50 10,001,000+ 90° 350 2.08 0.21 70 90° 350 1.78 0.18 60 90° 350 1.78 0.18 60 90° 350 1.78 0.18 60 72,300 90° 350 1.78 0.18 60 10,000,600+	318-3	°06	72	2.29	0.23	09	10,309,600+		3.95	
90° 72 1.91 0.19 50 300 90° 72 1.91 0.19 50 10,000,100+ 90° 72 1.91 0.19 50 10,001,000+ 90° 350 2.08 0.21 70 90° 350 1.78 0.18 60 90° 350 1.78 0.18 60 90° 350 1.78 0.18 60 90° 350 1.78 0.18 60 10,000,600+ 90° 350 1.78 0.18 60 10,000,600+										
90° 72 1.91 0.19 50 10,000,100+ 90° 72 1.91 0.19 50 10,001,000+ 90° 350 2.08 0.21 70 90° 350 1.78 0.18 60 90° 350 1.78 0.18 60 90° 350 1.78 0.18 60 90° 350 1.78 0.18 60 10,000,600+ 90° 35C 1.78 0.18 60 10,000,600+	328-3	°06	72	1.91	0.19	20	300	1	1	
90° 72 1.91 0.19 50 10,001,000+ 90° 72 1.91 0.19 50 10,001,000+ 90° 350 2.08 0.21 70 90° 350 1.78 0.18 60 90° 350 1.78 0.18 60 90° 350 1.78 0.18 60 72,300 90° 350 1.78 0.18 60 10,000,600+	330-5	°06	72	1.91	6T.0	20	10,000,100+	1	4,70	
90° 72 1.91 0.19 50 10,001,000+ 90° 350 2.08 0.21 70 —— 90° 350 1.78 0.18 60 —— 90° 350 1.78 0.18 60 —— 90° 350 1.78 0.18 60 72,300 90° 350 1.78 0.18 60 10,000,600+	228-4	°06	72	1.91	0.19	50	10,001,000+		4.55	
90° 350 2.08 0.21 70 —— 90° 350 1.78 0.18 60 —— 90° 350 1.78 0.18 60 —— 90° 350 1.78 0.18 60 72,300 90° 350 1.78 0.18 60 10,000,600+	111-9	90°	72	1.91	0.19	50	10,001,000+	1	4.65	
90° 350 2.08 0.21 70 —— 90° 350 1.78 0.18 60 —— 90° 350 1.78 0.18 60 —— 90° 350 1.78 0.18 60 72,300 90° 35C 1.78 0.18 60 10,000,600+										
90° 350 1.78 0.18 60 90° 350 1.78 0.18 60 90° 350 1.78 0.18 60 72,300 90° 350 1.78 0.18 60 10,000,600+	328-6	°06	350	2.08	0.21	70	***************************************	-	Ages (Ages)	Failed on loading
90° 350 1.78 0.18 60 —— 90° 350 1.78 0.18 60 78,300 90° 35C 1.78 0.18 60 10,000,600+	7-823	°06	350	1.78	0.18	09	*********		***************************************	Failed on loading
90° 350 1.78 0.18 60 78,300 90° 35C 1.78 0.18 60 10,000,600+	350-6	06	350	1.78	0.18	09	-			Failed on loading
90° 35C 1.78 0.18 60	330-9	8	350	1.78	0.18	8	78,300			Failed inside tabs
	353-8	06ء	350	1.78	0.18	99	10,000,600+		5.96	

		Γ			Ī	B	T	T	1	T	T	Τ	T	1	T	T	T	T-	T-	T-	<u> </u>	-	1	T	T	1	T-	Τ-	1	
R = +0.1	Frequency = .30 Hz	Function: Sine		Remarks	Failed on loading	SIL	outside machine.	Failed on loading					Failed on loading		Failed on loading					Failed on loading	Failed on installation	THE RESIDENCE OF THE PROPERTY		Failed on loading		Failed on loading	en en de la companya de la companya de la companya de la companya de la companya de la companya de la companya			
			Residual	(10 ³ ps1)			5.46		00 TAT 140		6.37	6.13		6.20			***************************************	***************************************					**************************************					5.28		
			Temp.	(eF)		****		***************************************	11011		*******						1			1	-	ł							-	
			Cycles	Failure	-	601,900	10,001,100+		200		10,000,400	10,001,300		10,000,800	1	2,838,700	4,234,200	2,700,800		Male anno states	-	1,580,900	3,358,400				2,121,800	10,000,100+	2,891,200	
	ge Ge		Max.	(* ult.)	55	55	55	55	55		20	50	20	50	70	2	70	70		60	60	09	09	9		50	20	S	50	
	te/20lyimide		Min.	(10 ³ pai)	0.16	0.16	0.16	0.16	0.16		0.15	0.15	0.15	0.15	0.15	9.15	0.15	0.15		0.13	0.13	0.13	0.13	0.13		0.11	0.11	0.11	0.11	
Patigue	Graphite		Max.	(10 ³ pst)	1.63	1.63	1.63	1.63	1.63		1.49	1.49	1.49	1.49	1.50	1.50	1.50	1.50		1.29	1.29	1.29	1.29	1.29		1.07	1.07	1.07	1.07	
Tensile-Tensile Fatigue	T300/F178 Graph		Test	(°F)	350	320	350	320	320		320	350	350	320	450	450	450	450		450	450	450	450	450		450	450	450	450	
1			Fiber	tion	°06	°06	°06	°06	ક્ષ		န	。 06	°06	Sc.	°06	°06	°06	•06		°06	ŝ	90°	°06	°06		ઢ	5.0°	°06	900	
Test:	Material		Coori	Number	E50-5	E53-9	E52-8	E52-1	E53-2		E30-6	E28-5	E53-1 0	E52-9	E28-8	5-53	E-0-8	E52-3		E50-4	E30-7	E53-6	E52-5	E53-1		E50-8	E30-10	B53-7	E52-6	

lin	: T300/F178 Gr	Graphi te/Polyimide	1+0 (Do.)	vimide				Frequency = 30 Hz
Piber Orient 145° 145° 145° 145° 145° 145° 145° 145°								
┠╼┸╃╃┸╃╃╃								Function: Sina
╸ ┞ ┩┩┩┩┩	Test	Max.	Min.	Max.	Cycles	Temp.	Residual	
<u> </u>	Temp.	Stress (103 psi)	(10 3psi)	(* ult.)	Failure	(*F)	(10 ³ ps1)	Remarks
	T —	12.02	1.20	70	24,400	29		
	72	12.02	1.20	70	18,200	16		
	72	12.02	1.20	70	24,700	13		
	72	12.02	1.20	70	156,100	18		
	72	11.16	1.12	65	411,400	22		
	72	11.16	1.12	65	903,800	18		
	72	11.16	1.12	65	008'86L	7	1	
	72	11.16	1.12	65	155,600	ជ	1	
	72	10.3	1.03	09	7,614,500	ហ		
	72	10.3	1.03	09	660,300	13	1	
	72	10.3	1.03	09	10,014,400+	7	16.53	
E36-7 +45°	72	10.3	1.03	9	878,200	14		
	350	10.95	1.10	75	10,900	23		
_	350	10.95	1.10	75	2,200	53	-	
-	350	10.95	1.10	75	006'6	8	1	
E42-8 ±45°	320	10.95	1.10	75	5,600	П	•	
	320	10.22	1.02	70	55,700	14		
E36-4 +45°	350	10.22	1.02	70	13,200	13		
E37-7 +45°	350	10.22	1.02	70	136,200	25	********	
E39-6 +45°	350	10.22	1.02	70	207,500	67	-	

-	ncy = 30 Hz	on: Sine		rks																					
R = +0.1	Frequency	Function:		Remarks																					
			Residual	(10 ³ ps1)	•			-			1				-	-									
			Temp.	(*F)	ជ	11	6	18	43	1.7	38	31	11	27	14	23	23	13	6	#					
			Cycles	Failure	2,660,100	3,810,400	110,300	124,000	4,000	6,700	3,400	4,700	322,000	33,500	51,400	18,000	111,000	3,573,900	2,599,300	4,108,400				and a second second second second second second second second second second second second second second second	
	nide		Max.	(* ult.)	65	65	65	65	80	8	8	80	75	75	75	75	70	2	20	20			-		
	nte/Polyimide		Min.	(10 ³ psi)	0.95	0.95	0.95	0.95	96.0	0.98	0.98	0.98	0.91	0.91	16.0	0.91	0.85	0.85	0.85	0.85					
Fatigue	Graphi		Max.	(103 psi)	9.49	9.49	9.49	9.49	9.75	9.75	9.75	9.75	9.14	9.14	9.14	9.14	 8.53	8.53	8.53	8.53					
Pensile F	T300/F178		Test	remp.	350	350	320	350	450	450	450	450	450	450	450	450	450	450	450	450					
Tensile-Tensile	al: T30		Fiber	Orienta-	±45°	+45°	+45°	+45°	+45°	+45°	+45°	+45°	±45°	+45°	+45°	+45°	±45°	±45°	+45°	+45°					
Test:	Material:			Specimen	E40-4	E42-1	E34-3	E36-8	E48-1.	E34-1	E43-6	E37-3	E48-3	E43-2	E44-4	E35-6	E43-1	E48-7	E44-9	E35-8					

APPENDIX I CREEP AND STRESS RUPTURE DATA

All of the tensile creep data generated during this program, along with residual strengths of specimens which "ran out" to 500 hours are presented in this section. The residual strengths were all determined with a 72°F tensile test regardless of what temperature the specimen saw during the creep test.

The stress rupture data were also obtained from these same specimens with the characteristic of interest being time to fracture rather than elongation.

Summaries of these data are presented in Section 4 in both tabular and graphical form.

In the succeeding tables the specimen numbering system can be used to identify the material being tested. The letter, appearing first, in the specimen numbering code indicates the material, as follows:

A - SP313

C - AS/3004

D - AS/4397

E - T300/F178.

SP313 Test: Creep Test: Creep Orient: 0° 0. Orient: 0° Orient:___ Spec. No: <u>A3-14</u> Spec. No: A7-4 Spec. No: A5-5 Temp: R.T. Temp: R.T. Temp: R.T. Stress: 173.1 ksi 90% ult. Stress: 173.1 ksi 90 % ult. Stress 173.1 ksi 90 * ult. Accum. Elap. Accum. Elap. Elap. Accum. Time Remarks Time Strain Time Strain Remarks Strain Remarks (# in/in) (Pin/in) (hrs.) (hrs.) (hrs.) (µin/in) failed on loading 7560 8/6/75 Failed or loading 0 1 7560 7580 3 7570 7570 7590 8 7510 12 7720 18.8 24 7730 slipped 31.3 7670 33.8 failure Recovery Recovery Recovery

(T) 6.	Creep		Tart	Creep		Tast.	Creer	
			3			1)
,	. 0°		1	: <u>0*</u>		Orient		
Spec. N	lo: <u>A3-</u>		1	No: A5-		1	No: <u>A7-14</u>	
Temp:	R.T.		Temp:	R.T.		Temp:	R.T.	
Stress	: 153.8 ks	i 801 ult.	Stress	153.8 kai	80 % ult.	Stress	153.8 ks	80 % ult.
	Accum.		, -	Accum.			Accum.	
Time	Strain	Remarks	Time		Remarks	Time		Remarks
	(U in/in)		-	(#in/in)			(µin/in)	
0	6990		0	7574		0	7721	
1/2	7000		0.1	7582			7723	
1	7000		0.5	7594		0.1	7727	
2	7000		_1	7587		0.5	7730	
3	7000		2	7595		1	7730	
4	7000		3	7604		2	7737	
8	6990		72	7595_		3	7738	
12	6990		120	7604		4	7736	
24	6990		168	7610		5	7741	
36	6990		264	7618		6	7746	
48	6990		288	7620		7	7750	
72	6990		337	7616		8	7752	
168	7140		408	7612		.24	7750	
216	7140		456	7609		48	7767	
240	7130		504	7610		120	7760	
248	7120		7.7.	19.5		168	7770	
336	7120	 				216	7779	
384	7100					288	7778	
432	7100		-			336	7772	
504	7090					384	7782	
694.5	7100					456	7772	
934.3	7100					500	7782	
·						300		
Resid	Str.	207.7 ksi	Resid.	Str.	187.7 ksi	Resid	Str.	188.4 ksi
	Recover	y	-	Recovery			Recovery	
0	300		0	16		0	50	
3	290		1	0		1	34	
			2	-7		2	26	
			3	-8		3	22	

Test: Creep 0° Orient: Spec. No: A5-17 Temp: R.T. Stress: 134.6 ksi 70* ult. Accum. Elap. Time Strain Remarks (hrs.) (µ in/in) 0.016 0.5 Resid Str. 210.9 ksi Recovery

Test:	SP313 Creex)
Orien	:: 0°	· · · · · · · · · · · · · · · · · · ·
į	No: A7	2-7
l	R.T.	
	134.6 ksi	
Elap.	Accum.	
Time	Strain	Remarks
(hrs.)	(#in/in)	
0	5860	
0.5	5860	
1	5860	
2	5870	
3	5870	
4	5840	
8	5840	
12	5820	
24	5790	
36	5780	
48	5790	
72	5750	
168	5790	
216	5790	
264	5780	
336	5770	
384	5780	
432	5800	
527	5820	
530	5840	
Resid	Str.	201.0 ksi
]	Recovery	
0	71	
3	72	
	1	

7	Creep	
i .	t:0°	
Spec.	No: <u>A8-</u>	5
Temp	R.T.	
Stres	s <u>134.6</u>)cs:	<u>70</u> 4 ult.
Elap.	Accum.	
Time	Strain	Remar'-
(hrs.)	(µin/in)	
0	6804	
0.016	6807	
0.5	6813	
1	6816	
2	6813	
3	6813	
4	6814	
5	6822	
6	6824	
7	6826	
8	6827	
72	6834	
120	6842	
168	6834	
240	6836	
289	6830	
336	6828	
408	6831	
456	6829	
500	6819	
Resid	. Str.	158.4 ksi
	Recovery	
С	26	
1	6	
2	8	
3	3	

Test: Creep			Test: Creep			Test: Creep				
ľ			Į.							
	: 0°		Orient					·· <u>·</u>		
Spec. N	io: <u>A3-4</u>		Spec. No: A5-18				Spec. No: A7-3			
Temp:	260°	<u> </u>	Temp:	260°F	<u> </u>		Temp:	260°F		
Stress	: 157.2 ka	90 % ult.		157.2 km	90 t ult.		Strees	157.2 ksi	90 4 ulc.	
	Accum.			Accum.			Clap.	Accum.	į	
	Strain	Remarks		Strain	Remarks		Cime	Strain	Remarks	
,	(µin/in)			(µin/in)		μ		(µin/in)		
0	7605		0	8360		 	0	7948		
1	7634		0.016	8720		<u> </u>	.016	8418		
_2	7634		0.1	Failure			.06	8443		
3	7634					Þ	-1	Failure		
4	7634					-				
5	7643					1				
6	7652					۱L				
7	7660									
8	7658									
24	7668									
48	7689		 			IL				
72 7694										
144	7750			<u> </u>		l L				
192	7759	L				Į L				
240	7741									
312	7750					1				
360	7770					1 1				
408	7779	L			ļ	1 1				
480	7803			<u> </u>	L	1				
504	7800					1 1				
						1				
		L		<u></u>		1 }				
				<u> </u>						
						4 L		ļ		
						4				
Resid.	Str.	208.9 ksi				1				
		 				1				
<u></u> _				<u> </u>	<u> </u>	┨┞		<u> </u>	L	
	Recovery			Recovery		11		Recovery		
0	151		·			1				
1	133					1		<u> </u>	<u> </u>	
2	128	 _		ļ		┨┞	 		<u> </u>	
1_3	125		l	<u> </u>		JL		<u>L</u>	<u> </u>	

Test: Creap Orient: 0° Spec. No: A3-1 Temp: 260°F Stress: 139.8 kai 80° ult. Elap. Accum. Time Strain (hin/in) O 1948 O.016 8418 O.06 3443 O.1 7060 O.1 7060 O.1 Failure O.1 Failure O.2 7056 O.3 Frilure O.3 Frilure O.4 7056 O.7 7010 O.7					59313	· ·····			
Spec. No: A3-1	Test:	Creep		Test:_	Cree	2	Zest:	Creen	
Temp: 260°F Temp: 260°F Stress: 139.8 ksi 30 t ult.	Orient	:0*		Orient	: 0°		Orient: 0°		
Stress: 139.8 ksi 30 to ult. Stress: 139.8 ksi 30 to ult. Elap. Accum. Elap. Accum. Time Strain (\(\mu\infty\frac{1}{1}\) (\(\mu\i	1			7 1			Spec. No: <u>A7-5</u>		
Elap. Accum. Time Strain (hrs.) (µin/in) 0 7948 0 0.1 7060 0 .5 7044 0 .0 1 7060 0 .5 7044 0 .0 1 7056 0 .	Temp:	2604	<u> </u>	Temp:	260°F		Temp:	260°F	
Time (Nrs.) (µ in/in) Remarks (µrs.) (µin/in) Remarks (µrs.) (µ	Stress	: 139.8 ks	i <u>80</u> t ult.	Stress: 139.8 ksi 80 % ult.			Stress	139.8 ksi	80 t ult.
(hrs.) (µin/in) (hrs.) (µin/in) 0 7032 0 0 7032 0 0 0 0 0 0 0 0 0	3 " " 1				1				
0 7948 0 7621 0 7032 0 .016 8418 0 .1 7060 0 .5 7044 1 .5 7049 0 .1 Failure 0 .1 Failure 0 .1 7056 5 7050 0 .4 7056 5 7015 7 7010 0 .24 7028 96 7054 0 .267 7085 315 7098 435 7120 483 7134 507 7732						Remarks		_	Remarks
0.016 8418 0.1 7060 0.5 7044 0.06 8443 0.33 Feilure 2 7049 2 7049 2 7050 4 7056 5 7015 7 7010 24 7028 96 7054 0.26 7 7085 315 7098 435 7120 443 7134 507 7132 7 7132							3		
0.06 8443									
Pailure 2 7049 3 7050 4 7056 5 7015 7 7010 24 7028 96 7054 120 7060 267 7085 315 7098 435 7120 483 7134 507 7132				0.1	7060				
	0.06			0.33	Fzilure		1.5	7049	
	0.1	Failure					2	7049	
S 7015 7 7010 24 7028 96 7054 120 7085 315 7098 435 7120 483 7134 507 7132							3	7050	
7 7010 24 7028 96 7054 120 7060 267 7085 315 7098 435 7120 483 7134 507 7132							4	7056	
							5	7015	
96 7054 120 7060 267 7085 315 7098 435 7120 483 7134 507 7132							7	7010	
Recovery Recovery							4		
Recovery Recovery									
Recovery Recovery Recovery 0 134 1 134 2 134									
Recovery Recovery Recovery 0 134 1 134 2 134							267	7085	
Recovery Recovery Recovery 0 134 1 134 2 134							315	7098	
So7 7132 So7 7132							435	7120	
So7 7132 So7 7132							483	7134	
Recovery Recovery 0 134 1 134 2 134							I I	7132	
Recovery Recovery 0 134 1 134 2 134									
Recovery Recovery Recovery									
Recovery Recovery Recovery									
Recovery Recovery 0 134 1 134 2 134									
Recovery Recovery 0 134 1 134 2 134									
Recovery Recovery 0 134 1 134 2 134									
Recovery Recovery Recovery									
Recovery Recovery Recovery									
Recovery Recovery 0 134 1 134 2 134							Resid	. Str.	195.7 ksi
0 134 1 134 2 134									
0 134 1 134 2 134									
0 134 1 134 2 134									
1 134 2 134	Recovery				Recovery			Recovery	,
2 134				1			0	134	
				1			1	134	
3 130							2	134	
		L					3	130	

				SP313					
Test:_	Creep		Test:	Creep		Test: Creep			
	<u>. 0°</u>		Orient	: 0*		Orient: 0°			
Spec. 1	Vo: A3-3		Spec. 1	No: A5-1	.5	Spec. 1	No: A7-	3	
Temp:	260°F		Temp:	260°F		Temp:	Temp: 260°F		
Stress	<u>: 122.3 ks</u>	i 70 % ult.	Stress:	122.3 ks	i_708 ult.	Stress	Stress122.3 ksi 70% ul		
Elap.	Accum.		1	Accum.		Elap. Accum.			
Time	Strain	Remarks	Time	Strain	Remarks	Time	Strain	Remarks	
	(µin/in)			(#in/in)			(µin/in)		
0	6236		0	6240		0	6392		
0.5	5232		0.5	6252		0.5	6400		
1	6233		1	6254		1	6400		
2	6236		2.5	6257		2	6404		
3	6240		3	6260		3	6404		
4	6240		4	6262		4	6404		
5	6240		5	6264		5	6404		
6	6240		6	6267		6	6404		
7	6240		7	6267		7	6404		
8_	6236		8	6267		24	6418		
120	6256		72	6322		48	6428		
168	6274		120	6348		96	6442		
216	6276		240	6403		168	6500		
288	6293		288	6418		336	6586		
336	6300		336	6437		384	6600		
384	6302		408	6470		50A	6678		
456	6316		456	6485					
504	6298		504	6504					
						-			
						-			
Resid	. Str.	150.1 ksi	Resid.	Str.	161.5 ksi	Resid	. Str.	192.6 ksi	
	Recover	7		Recovery			Recovery		
0	92		0	275	TI	0	346		
1	66		1	263		1	341		
2	63		2	263		2	330		
3	62		3	263		3	326		

		Test: Creen						
Test: Creep		1			Test: Creep			
Orient: 0°		1			Orient: 0°			
Spec. No: A7-10		Spec. No: A5-13			Spec. 1	No: A7-1	2	
Temp: 350°F		Temp:	350°F		Temp: 350°F			
Stress: 127.5 ksi	90 t ult.	Stress	<u>127.5</u> ks	<u>1 90</u> 0 ult.	Stress	127.5 ksi	90% ult.	
Elap. Accum.		Elap.			Elap.			
1	Remarks	Time		Remarks	Time		Remarks	
(hrs.) (µin/in)			(Pin/in)			(µin/in)		
0 6783		0	6604		0	6695		
0.1 Failure		1	6728		0.1	6880		
		2	6738		0.5	7000		
		3	6740		0.6	7019		
		4	6747		0.6	Pailure		
		5	6752					
		_6						
		7	6775					
		8	6779					
		75.3 7288						
		120	7528					
		168	7537					
		240	7718					
		288	7791					
		336	7908					
		411	7900					
		457	7921					
		480	7928					
		504	7935					
		Resid.	Str.	159.0 ksi				
Recovery		Recovery				Recovery		
		0	970					
		1	1000					
		2	1020					
		3	1020					

				SP313					
Test:	Creep		Test:_	Cresp	1	Test:	Test: Creep		
Orient	0•		Orient	: 0°		Orient: 0°			
Spec. N	lo: <u>A3-6</u>		Spec. 1	Vo: <u>A5-1</u>		Spec. No: <u>A3-11</u>			
Temp:	350°F		Temp:	350°F		Temp: 350*F			
Stress	: 113.4 ks	i_80* ult.	Stress:	113.4 ksi	30 t ult.	Stress	111.4 ksi	80 t ult.	
Elap.	Accum.		Elap.	Accum.		Elap.	Accum,		
Time	Strain	Remarks	Time	Strain	Remarks	Time	Strain	Remarks	
(brs.)			(hrs.)			(hxs.)	(µin/in)		
0	5900		-	6463		0	5875		
0.1	5923		0.2	6470		0.5	5935		
0.5	5937		0.7	6485		1	5958		
1	5949		1.2	6492		1	5979		
2	5952		2.2	6496		1.3	5993		
3	5954		4.2	6501		4	6014		
5	5963		8.2	6496		5	6022		
6	5967		23.2	6491		6	6041		
7	5976		48.2	6524		7 6051			
8	5978		20.2	6710		8 6065			
24	6018		168.2	6829		24 6266			
48	6094		220.2	6940		48 6486			
72	6176		291.2	7057		96	5773		
144	6479		336.2	7113		168	7025		
192	6567		384.2	7164		216	7159		
240	6667		156.2	7238		264	7284		
312	6758		505.2	7284		336	7473		
360	6837					384	7588		
408	6885					432	7685		
480	6894		<u> </u>			504	7802		
504	6911								
Resid	. Str.	219.0 ksi	Resid.	Str.	156.4 ksi	Resid.	Str.	178.3 ksi	
Recovery			Recovery				Recovery		
0	1130		0	866		0	2038		
1	1042			794		1	1933		
. 2	1036		_2_	781		2	1912		
3	1020		3	776	1	3	1903		

				SP313				
Test:_	Creep		Test: Creep			Test: Creen		
	: <u>0•</u>		•	: <u>0°</u>		Orient:0*		
Spec. 1	Yo: <u>A7-</u>	73 .	Spec. 1	No: A5-5		Spec. No: A3-16		
Temp:	350°P		Temp	350°F		Temp	350°F	· .
Stress	: <u>99.2</u> ks	i_70	Stress	99.2 ks	1708 ult.	Stress	99.2 ksi	70 t ult.
Elap.	Accum.		Elap.	Accum.		Elap.		
Time	Strain	Remarks	Time	Strain	Remarks	Time		Remarks
(hrs.)	(µin/in)		(hrs.)	(Fin/in)		(hrs.)	(µin/in)	
0	6170		0	5196		0	5084	
0.5	6169		0.5	5250		24	5200	
1	6172		1	5260		72	5545	
2	6172		2	5284		146	5962	
3	6172		3	5300		194	6135	
4	6172		4	5307		266	6366	
5	6170		5	5321		314	6473	
. 6	6170		6	5328				
7	6168		7	5331				
24	6170		24	5450				
48	6200		48	5546				
72	6240		96	5641				
96	6264		168	5687				
144	6287		216	5688				
192	6295		264	5696				
240	6270		336	5673				
312	6272		384	5672				
360	6268		432	5638				
408	6278		504	5600				
504	6304							
528	6312							
								<u> </u>
ļ			<u> </u>		L			
ļ								
Resid	Str.	123.0 ksi	Resid	Str.	164.6 ksi	Resid	. Str.	199.4 ksi
}	Recovery			Recovery			Recovery	
0	0 1144			373		0	1372	
1	1100	 	0	277		1	1318	
2	1090		2	265		2	1318	
3	1090	 	3	263		3	1319	
	T # X Y Y		1	<u> </u>	<u></u>	<u> </u>	4717	

SP313 Creev Test: Test: Test: Creep 90° 90° 90° Orient: Orient: Orient:_ Spec. No: A27-3 Spec. No: A30-7 A25-2 Spec. No:___ R.T. Temp: R.T. R.T. Temp:_ Temp:____ Stress: 3.93 kmi 80% ult. Stress: 3.93 ksi 80 % ult. Stress 3.93 ksi 80 ult. Elap. Accum. Accum. Elap. Accura. Strain Remarks Time Strain Time Remarks Time Strain Remarks (µ in/in) (Pin/in) (hr s.) (hrs.) (hrs.) (µin/in) 3068 Failed on loading Failed on loading 0.1 3114 0.2 3130 0.5 3158 3172 2 3182 3197 3201 72 3250 168 3309 240 3403 288 3375 336 3403 408 3406 456 3417 504 3434 Resid Str. 5.41 ksi Recovery Recovery Recovery 0 433 311 302 295

				SP313					
Test:_	Creep		Test:	Creep		Test: Creep			
Orient	: 90°	· · · · · · · · · · · · · · · · · · ·	Orient	: 90°		Orient: 90°			
Spec. 1	No: <u>A25</u> -	9	Spec. 1	No: A30-1	.1	Spec. No: A32-7 Temp: R.T.			
Temp:	R.T.		Temp:	R.T.					
Stress	. 3.44 ksi	700 ult.	Stress	3,44 ksi	70 % ult.	Stress	3.44 ksi	708 ult.	
Elap.	Accum.		Elap. Accum.			Elap.	Accum.		
Time	Strain	Remarks	Time	Strain	Remarks	Time	Strain	Remarks	
(hrs.)	(µ in/in)	· .	(hrs.)	(Win/in)		(hrs.)	(µin/in)		
0	2506	· ·	0	2636		0	2683		
1	2610		1	2719		1	2767		
2	2624		2	2735		2	2783		
3	2635		3	2748		3	2795		
20	2674		20	2793		20	2837		
24	2692		24	2812		24	2859		
72	2701	1	72	2820		72	2865		
144	2758		144	2880		144	2926		
192	2794		192	2920		192	2964		
236	2818		236	2945		236	2988		
308	2795		308	2920		308	2968		
356	2826		356	2956		356	3000	_	
404.	2841		404	2975		404	3018		
476	2898		476	3042		476	3079		
501	2890		501	3029		501	3074		
Resid	Str.	5.41 ksi	Resid	Str.	3.97 ksi	Resid.	Str.	4.91 ksi	
Recovery			Recovery				Recovery	·	
0	267		0	347		0	370		
_1	198		1	262		1_1	275		
2	186		2	247	<u> </u>	2	263		
15.5	121	1	15.5	174	ļ	15.5	191	1	

	Creep			Cree	10	Test: Creep				
Orient	900		•	: <u>90°</u>		Orient	Orient: 90°			
Spec. N	ro: A31	-4	Spec. N	Vo: A23	-11	4	Spec. No: A27~9			
Temp:	R.T.		Temp:	R.T.	····	Temp:	Temp: R.T.			
Stress	: 2.94 ks	i_60* wt.	Stress:	2.94 ksi	60 % Wit.	Stress 2,94 kmi 60 % ul				
Elap.	Accum.			Accum.		Elap. Accum.				
Time	Strain	Remarks	Time	Strain	Remarks	Time		Remarks		
	(# in/in)			(#in/in)			(µin/in)			
0	2275		0	2300		0	2355			
0.2	2322		0.2	2366		0.2	2405			
0.5	2348		0.5	2387		0.5	2430			
1	2360		1	2407		1	2456			
2	2378	<u> </u>	2	2419		2	2461			
4	2394	L	4	2440		4	2485			
5	2404		5	2448		5	2488			
6	2410	*	6	2454		6	2493			
7	2415		7	2457		7	2496			
8	2416		-8	2467		8	2501			
24	2444		24	2489		24 2527				
96	2451		96	2514		96				
144	2493		144	2548		144	2591			
192	2505		192	2562		192	2610			
264	2515		264	2573		264	2622			
312	2564		312	2629		312	2683			
360	2600		360	2664		360	2721			
456	2668		456	2739		456	2810			
480	2706		480	2782		480	2864			
504	2679		504	2752		504	2826			
		 								
7	C	4 52 2-4	7-12	04	C 04 1-4	2-42	24.11	2.04.1		
kesia.	Str.	4.52 ksi	Resid	Str.	5.04 ksi	esia.	Str.	3.84 ksi		
Recovery		Recovery				Recovery	<u> </u>			
0	460		0	522		0	573			
1	389		1	425		1	485			
2	379		2	407	<u> </u>	2	471			
3	369	1	. 3	397	L	3	462			

SP313 -

Orient: 90° Orient: 90° Orient: 90° Spec. No: A24-11 Acs. No: A25-10 Temp: 260°F Spec. No: A25-10 Temp: 260°F Spec. No: A30-9 Temp: 260°F Stress: 3.33 ksi 70° ult. Stress: 3.31 ksi 70° ult. Stress: 3.32° ult. 3.02° ult. Stress: 3.33 ksi 70° ult. 3.02° ult. 3.02° ult. 3.02° ult. 3.02° ult. 3.02° ult. 3.02	Test: Creep		Test: Creen			Test: Creep		
Spec. No: A24-11	I							
Temp:			i i					
Stress: 3.33 ksi 70% ult. Elap. Accum. Time (hrs.) (\(\mu\)in/in) 0 3211 0 0 3015 0 0 2995 0 0.016 3147 0 0.016 3118 0 0.016 3102 0 0.	1					3		
Elap. Accum. Time Strain (hrs.) (µin/in) Control (hrs.) (µin/in) C	Temp: 200-1		Temp: 250-F			r emil.	20U-F	
Time (hrs.) (µ in/in) (hrs.) (µ in/in) (hrs.) (µ in/in)		70 ult.			70 ult.			70 * ult.
(hrs.) (µin/in)	1 1	~						
0 3211 0 0 3015 0 0 2995 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0		Kemarks			Kemarks	1 7		Kemarks
0.016 3447 0.016 3118 0.016 3102 0.1 3639 0.1 3209 0.33 3270 0.2 3286 0.5 3228 0.5								
0.1 3639	The second secon			**********				
0.2 Failure 0.33 3270 0.5 3285 1 3311 1.33 Failure 2 3352 3 3400 4 3420 5 3430 6 3436 7 3438 8 3442 2 2 3466 49 3503 73 3570 144 3698 193 4820 240 4834 312 4870 312 4870 360 4890 408 4895 480 4921 504 4922 Recovery Recovery Recovery Recovery Recovery Recovery Recovery Recovery Recovery Recovery Recovery Recovery Recovery 0 2121 1 1875 2 1865						—		
0.5 3285 0.5 3278 1 3317 1 3317 2 3352 3 3400 4 3420 5 3430 6 3436 7 3438 8 3442 2 3466 4 3598 1 3570 1 368 3 3570 1 368 3 3 3 3 3 3 3 3 3								
1 3311 1 3317 2 3352 3 3400 4 3420 5 3430 6 3436 7 3438 8 3442 2 3466 49 3503 73 3570 144 3698 193 4820 240 4834 312 4870 360 4890 408 4895 480 4921 504 4922 1 504 4922 1 504 4922 1 1 1875 2 1865 186	U.Z FALLUFE							
1.33 Failure								
3 3400 4 3420 5 3430 6 3436 7 3438 8 3442 2 4 3446 4 9 3503 73 3570 144 3698 193 4820 240 4834 312 4870 360 4890 408 4895 480 4921 504 4922 504 4922 504 4922 504 4922	 					-		
			11.33	rallule				
5 3430 6 3436 7 3438 8 3442 2/ 3446 49 3503 73 3570 144 3698 193 4820 240 4834 312 4870 360 4890 408 4895 480 4921 504 4922 Recovery						-		
6 3436 7 3438 8 3442 2/ 3446 49 3503 73 3570 144 3698 193 4820 240 4834 312 4870 360 4890 408 4895 480 4921 504 4922 Recovery								
7 3438 8 3442 2/ 3446 49 3503 73 3570 144 3698 193 4820 240 4834 312 4870 360 4890 408 4895 480 4921 504 4922								
8 3442 2/ 3446 49 3503 73 3570 144 3698 193 4820 240 4834 312 4870 360 4890 408 4895 480 4921 504 4922 504 4922					-			
2					***********			
49 3503 73 3570 144 3698 193 4820 240 4834 312 4870 360 4890 408 4895 480 4921 504 4922 4922								
73 3570 144 3698 193 4820 240 4834 312 4870 360 4890 408 4895 480 4921 504 4922 Recovery Recovery Recovery Recovery Recovery Recovery 0 2121 1 1876 2 1865								
144 3698 193 4820 240 4834 312 4870 360 4890 408 4895 480 4921 504 4922								
193 4820 240 4834 312 4870 360 4890 408 4895 480 4921 504 4922				 				
240				 		[]	}	
312 4870 360 4890 408 4895 480 4921 504 4922								
360 4890 408 4895 480 4921 504 4922								
						·		
						408	4895	
						480		
Recovery Recovery Recovery 0 2121 1 1876 2 1865						504		
Recovery Recovery Recovery 0 2121 1 1875 2 1865								
Recovery Recovery Recovery 0 2121 1 1875 2 1865								
Recovery Recovery Recovery 0 2121 1 1875 2 1865						Resid.	Str.	4.12 ksi
0 2121 1 1875 2 1865								
1 1875 2 1865	Recovery	7	Recovery				Recovery	
2 1865						0		
<u> </u>				<u> </u>	<u> </u>	1	1875	
						{ 		
3 1839]	<u></u>	<u> </u>] [_3	1839	

				SP313		-		
•	Creep		Test: Creep			Test: Creep		
Orient	90.		Orient: 90°			Orient: 90°		
Spec. 1	Vo: A25-2		Spec. No: A26-11			Spec. No: A28-1		
Temp:	260°F		Temp:	260°F		Temp	260°F	
Strees	: 3.10 ks	i 65% ult.	Stress	3.10 ks	65 % wit.	Stress	3.10 kmi	65 % ult.
	Accum.			Accum.] [Elap.		_
	Strain	Remarks			Remarks	Time		Remarks
	(µin/in)		£	(Pin/in)			(µin/in)	
0	Failed c	n loading	0	Failed (n loading		2550	
<u></u>			ļ			0.016	2603	
	·			<u> </u>	<u> </u>	0.1	2654	
						0.5	2720	
<u></u>				<u> </u>	 	1	2740	
						2	2772	
						3	2790	
L						4	2815	
				<u> </u>		5	2828	
						6	2839	
L			L			7	2852	
						-8	2860	
						24.	2971	
						108.8	Failure	
				L				
	Recovery			Recovery			Recovery	
				ļ				
	<u></u>			<u> </u>			ļ	
	<u> </u>							
	<u></u>	<u> </u>		<u>L</u>	<u> </u>	l L	<u> </u>	L

Temp: 260°F Temp: 260°F Temp: 260°F Stress: 2.86 ksi 60° ult. Stress: 2.86 ksi 60° ult. Stress: 2.86 ksi 60° ult. Elap. Accum. Elap. Accum. Elap. Accum.	Test: Creen			SP313						
Spec. No: A26-4	Test:	Creep		11						
Temp: 260°F Temp: 260°F Temp: 260°F Stress: 2.86 ksi 60°8 ult. Stress: 2.86 ksi 60°8 ult. Stress: 2.86 ksi 60°8 ult. Elap. Accum. Time Strain Remarks (hrs.) (μ in/in) Strain (hrs.) (μ in/in) Co Failed on loading O 2535 O 2566 O 25	Orient	: 90°		Orient	90*		Orient: 90°			
Stress: 2.86 ksi 60 t ult. Stress: 2.86 ksi 60 t ult. Stress: 2.86 ksi 60 t ult. Stress: 2.86 ksi 60 t ult. Elap. Accum. Time Strain (μ in/in) (μ	Spec. I	No: A26	-4	Spec. No: <u>A27-5</u>			Spec. No: <u>A31-2</u>			
Elap. Accum. Time (μ in/in)	Temp:	260°F		Temp:	Temp: 260°F			Temp: 260°F		
Time (hrs.) Strain (μ in/in) Remarks (hrs.) Time (hrs.) Strain (μ in/in) Remarks (μ in/in) Time (hrs.) Remarks (μ in/in) Time (μ in/in) Time (hrs.) Remarks (μ in/in) Time (μ in/in)	Street	: 2.86 ks	i_60% wlt.	Stress		i 608 ult.	Stress	2,86 ksi	<u>60</u> € ult.	
(hrs.) (µin/in) (hrs.) (µin/in) (hrs.) (µin/in) 0 Failed on loading 0 2535 0 2566 0 0.016 2707 0 0.1 2644 0.1 2767 0 0.4 2645 0.4 2790 0 0.5 2796 0 0.5 27	Elap.	Accum.		Elap.	Accum.		Elap.	Accum,		
0 Failed on loading 0 2535 0 2566 0.016 2605 0.016 2707 0 0.1 2644 0.1 2767 0 0.5 2645 0.4 2790 0 0.5 2646 0.5 2796 0 1 2662 1 2810 0 2 2673 2 2823 0 3 2676 3 2836 0 4 2677 4 2848 0 5 2681 5 2856 0 6 2680 6 2860 0 0 7 2679 7 2864 0 <t< td=""><td></td><td>1</td><td>4</td><td>3</td><td></td><td>Remarks</td><td>1</td><td></td><td>Remarks</td></t<>		1	4	3		Remarks	1		Remarks	
0.016 2605 0.016 2707 0.1 2644 0.1 2767 0.4 2645 0.4 2790 0.5 2646 0.5 2796 1 2662 1 2610 2 2673 2 2823 3 2676 3 2836 4 2677 4 2848 5 2681 5 2856 6 2680 6 2860 7 2679 7 2864 8 2679 8 2871 24 2664 24 2941 48 2673 48 3000 120 2742 120 3107 169 2782 169 3145 217 2821 217 3181 288 2875 288 3248 336 2907 336 3290 384 2936 364 3332 456 2977 456 3380				-			ļ			
0.1 2644 0.1 2767 0.4 2645 0.4 2790 0.5 2646 0.5 2796 1 2662 1 2810 2 2673 2 2823 3 2676 3 2836 4 2677 4 2848 5 2681 5 2856 6 2680 6 2860 7 2679 7 2864 8 2679 8 2871 24 2664 24 2941 48 2673 48 3000 120 2742 120 3107 169 2782 169 3145 217 2821 217 3181 288 2875 288 3248 336 2907 336 3290 384 2936 384 3332 456 2977 456 3380	0	Failed o	n loading	0	2535		<u> </u>			
0.4 2645 0.4 2790 0.5 2646 0.5 2796 1 2662 1 2810 2 2673 2 2823 3 2676 3 2836 4 2677 4 2848 5 2681 5 2856 6 2680 6 2860 7 2679 7 2864 8 2679 8 2871 24 2664 24 2941 48 2673 48 3000 120 2742 120 3107 169 2782 169 3145 217 2821 217 3181 288 2875 288 3248 336 2907 336 3290 384 2936 384 3332 456 2977 456 3380				 	2605		1			
0.5 2646 0.5 2796 1 2662 1 2610 2 2673 2 2823 3 2676 3 2836 4 2677 4 2848 5 2681 5 2856 6 2680 6 2860 7 2679 7 2864 8 2679 8 2871 24 2664 24 2941 48 2673 48 3000 120 2742 120 3107 169 2782 169 3145 217 2821 217 3181 288 2875 288 3248 336 2907 336 3290 384 2936 384 3332 456 2977 456 3380				0.1	2644		0.1	2767		
1 2662 1 2810 2 2673 2 2823 3 2676 3 2836 4 2677 4 2848 5 2681 5 2856 6 2680 6 2860 7 2679 7 2864 8 2679 8 2871 24 2664 24 2941 48 2673 48 3000 120 2742 120 3107 169 2782 169 3145 217 2821 217 3181 288 2875 288 3248 336 2907 336 3290 384 2936 384 3332 456 2977 456 3380				0.4	,		9.4			
2 2673 2 2823 3 2676 3 2836 4 2677 4 2848 5 2681 5 2856 6 2680 6 2860 7 2679 7 2864 8 2679 8 2871 24 2664 24 2941 48 2673 48 3000 120 2742 120 3107 169 2782 169 3145 217 2821 217 3181 288 2875 288 3248 336 2907 336 3290 384 2936 384 3332 456 2977 456 3380	<u></u>			0.5	2646		0.5	2796		
3 2676 3 2836 4 2677 4 2848 5 2681 5 2856 6 2580 6 2860 7 2679 7 2864 8 2679 8 2871 24 2664 24 2941 48 2673 48 3000 120 2742 120 3107 169 2782 169 3145 217 2821 217 3181 288 2875 288 3248 336 2907 336 3290 384 2936 384 3332 456 2977 456 3380				1	2662		1	2810		
4 2677 4 2848 5 2681 5 2856 6 2680 6 2860 7 2679 7 2864 8 2679 8 2871 24 2664 24 2941 48 2673 48 3000 120 2742 120 3107 169 2792 169 3145 217 2821 217 3181 288 2875 288 3248 336 2907 336 3290 384 2936 384 3332 456 2977 456 3380				2	2673		2	2823		
5 2681 5 2856 6 2680 6 2860 7 2679 7 2864 8 2679 8 2871 24 2664 24 2941 48 2673 48 3000 120 2742 120 3107 169 2782 169 3145 217 2821 217 3181 288 2875 288 3248 336 2907 336 3290 384 2936 384 3332 456 2977 456 3380				3	2676		3	2836		
6 2680 6 2860 7 2679 7 2864 8 2679 8 2871 24 2664 24 2941 48 2673 48 3000 120 2742 120 3107 169 2782 169 3145 217 2821 217 3181 288 2875 288 3248 336 2907 336 3290 384 2936 384 3332 456 2977 456 3380				4	2677		4	2848	<u> </u>	
7 2679 7 2864 8 2679 8 2871 24 2664 24 2941 48 2673 48 3000 120 2742 120 3107 169 2782 169 3145 217 2821 217 3181 288 2875 288 3248 336 2907 336 3290 384 2936 384 3332 456 2977 456 3380			·	5	2681		5	2856		
8 2679 8 2871 24 2664 24 2941 48 2673 48 3000 120 2742 120 3107 169 2782 169 3145 217 2821 217 3181 288 2875 288 3248 336 2907 336 3290 384 2936 384 3332 456 2977 456 3380				: 6	2680		б	2860		
24 2664 24 2941 48 2673 48 3000 120 2742 120 3107 169 2782 169 3145 217 2821 217 3181 288 2875 288 3248 336 2907 336 3290 384 2936 384 3332 456 2977 456 3380				7	2679		7	2864		
48 2673 48 3000 120 2742 120 3107 169 2782 169 3145 217 2821 217 3181 288 2875 288 3248 336 2907 336 3290 384 2936 384 3332 456 2977 456 3380				8	2679		8	2871		
120 2742 120 3107 169 2782 169 3145 217 2821 217 3181 288 2875 288 3248 336 2907 336 3290 384 2936 384 3332 456 2977 456 3380				24	2664		24	2941		
169 2782 169 3145 217 2821 217 3181 288 2875 288 3248 336 2907 336 3290 384 2936 384 3332 456 2977 456 3380		·		48	2673		48	3000		
217 2821 217 3181 288 2875 288 3248 336 2907 384 2936 384 3332 456 2977 456 3380				120	2742		120	3107		
288 2875 288 3248 336 2907 336 3290 384 2936 384 3332 456 2977 456 3380				169	2782		169	3145		
336 2907 336 3290 384 2936 384 3332 456 2977 456 3380				217	2821		217	3181		
384 2936 384 3332 456 2977 456 3380		1		288	2875		288	3248		
456 2977 456 3380				336	2907		336	3290		
				384	2936		384	3332		
504 3000 504 3406				456	2977		456	3380		
				504	3000		504	3406		
Resid Str. 4.96 ksi Resid Str. 5.37 k				Resid	Str.	4.96 ksi	Resid.	Str.	5.37 ksi	
Recovery Recovery Recovery		Recovery			Recovery			Recovery	r	
0 570 0 928				0	570		0	928		
1 510 1 828				1	510		1	828		
2 492 2 805			<u> </u>	2	492		2	805		
3 477 3 792			<u> </u>	3	477	L	1 3_	792	<u> </u>	

SP313 Test: Creep Test: Creep Test: Creeo Orient: 900 Orient: 90. Orient: 90° Spec. No: A30-10 Spec. No: A32-5 Spec. No: A28-3 Temp: 350** Temp: 350*P Temp: 350°F Stress_2.59 ksi_700 uit. Streem: 2.59 ksi 70 % wit. Stress: 2.59 ksi 70 % uit. Accum. Elap. Accum. Elap. Accum. Elap. Strain Time Strain Time Remarks Remarks Time Strain Remarks (µin/in) (hrs.) (#in/in) (µin/in) (hrs.) (hrs.) 0 Failed on loading 2928 2620 0 0 0.016 3230 0.016 2742 0.03 3311 2916 0.1 3765 0.2 3034 0.13 3834 0.5 3360 Failure Failure Recovery Recovery Recovery

				SP313					
Test:	Creep		Test:	Creep		Test: Creep			
Orient	: 90°		Orient: 90°			Orient: 90°			
Spec. 1	Vo: <u>A31-8</u>		Spec. 1	No: A24-	9	Spec.	No: A28	-11	
Temp:	350°	F	Temp:	350°	<u> </u>	Temp	350	£	
Stress	: 2.22 ks	i_60 * ult.	Storess	2.22_ks	_60 ut.	Stress	2,22 ks	60 ult.	
	Accum.		Elap.		_	Elap,	Accum.		
Time			Time		Remarks	Time	Strain	Remarks	
(hrs.)	(µin/in)		(hrs.)			(hrs.)			
0	2182		0	2166		0	2245		
0.016	2305		0.3	2691		0.25	2654		
0.1	2517	<u> </u>	0.5	2815		0.5	2802		
0.2	2667		1.2	3070		1	2946		
0.5	2837		_2_	3291		2	3151		
1	2990		3	3438		3	3343		
2	3233		4	3557		71	Failure		
3	3384		5	3639					
4	3497		6	3712					
5	3616		7	3788					
6	3767.		8	3843					
12.4	Failure		24	5006					
***			48	6006					
			72	6597					
			127	Pailure					
			***	1 444			<u> </u>		
									
 				 			 		
<u> </u>							 		
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-							 		
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 				 				<u> </u>	
									
				 	 		 	 	
	 			 	 		 	 	
-	 	 			 			 	
	Recovery			Recovery			Recovery	<u>L</u>	
					<u> </u>		<u> </u>		
—		-			 		 	 	
-	}			 	 			 	
—	 	 		 	<u> </u>		 	 	
L	1	1	1 1	1	1	1 1	1	1	

			-	SPJLJ					
_	Creep		Test:	Creer		Test:	Test: Creep		
1	Orient: 90°			Orient: 90*			Orient: 90°		
Spec. 1	Spec. No: A28-4			Spec. No: <u>A32-2</u>			No:A32-	10	
Temp:	350°F		Temp	350°F		Temp	350°F	·	
·	Stress: 1.65 ksi 50 % ult.			1.85 ksi	50 tult.	Stress	1.85 kmi	50 t ult.	
	Accum.	1	Elap.	Accum.		Elap.	Accum.		
1	Strain	Remarks	Time		Remarks	Time	Strain	Remarks	
(hrs.)	(µin/in)		(hrs.)	(µin/in)		(hrs.)	(µin/in)		
0	Failed o	n loading	0	2213		0	1786		
				2655		0.016	1316		
			0.033	Pailure		0.1	1991		
						0.25	2025		
						0.75	2085		
L						1	2101		
						2	2150		
						3	2195		
						4	2236		
						5	2280		
						6	2303		
						7	2338		
						8	2378		
						9	2398		
						24	2792		
						48	3204		
						96	3719		
						168	4210		
						216	4465		
						264	4685		
						336	4966		
						384	5101		
						432	5241		
						500	5433	·	
				1					
						Resid	. Str.		
Recovery		Recovery			Recovery				
 						0	3762		
\vdash	-					1	3346		
						2	3182		
<u></u>						3	2995		

				SP313				
	Creep		Test: Cresp		Test: Creep			
Orient	: <u>±45°</u>		Orient: +45°		Orient: +45°			
Spec. N	No: <u>A51-</u>	7	Spec. I	No: A56	-5	Spec. No: A62-10		
Temp:	R.T.		Temp:	R.T.		Temp	R.T.	
Stress	: 18.89 ks	i 901 ult.	<u> </u>	18.89 ksi	90 % ult.		<u> 18,89</u> ksi	90% ult.
Elap.	Accum.			Accum.		Elap.		
Time	Strain	Remarks	Time	Strain	Remarks	Time	f " '. '	Remarks
*	(µ in/in)		-	(Pin/in)			(µin/in)	
0	8720			10,000		0	9030	
	Failure	i		11,213		,	9910	
		ļ	0.033	11.583		0.1	10.570	
ļ			0.1	12,145		0.5	11,361	
			0.25	12,694		1_1_	11,643	
			0.5	13,064		3	12,308	
			1	13,474		5	12,638	
			2	13.920		-6	12,774	
			3	14,181		7	12,880	
			4	14,405		8	12,986	
			5	14,600		24	14,113	
			6	14,785		80.8	Failure	
			7	149,325				
			8	15,045				
			24	15,997				
			48	16,888				
			53.9	Failure				
	<u> </u>							
Recovery			Recovery			Recovery		
		لـــــــــــــــــــــــــــــــــــــ	·	*		,	<u> </u>	

Test: Creep Test: Creep	8-3 ksi 80% ult.		
Orient:	8-3 ksi 80% ult.		
Spec. No: A48-1 Spec. No: A54-11 Spec. No: A5 Temp: R.T. Temp: R.T. Temp: R.T. Stress: 16.79 ksi 80 % ult. Stress: 16.79 ksi 80 % ult. Stress 16.79 ksi 80 % ult. Elap. Accum. Time Strain (hrs.) (μ in/in) Time Strain (hrs.) (μ in/in) Time Strain (hrs.) (μ in/in)	ksi <u>801</u> ult.		
Stress: 16.79 ksi 80 t ult. Stress: 16.79 ksi 80 t ult. Stress 16.79 ksi 80 t ult.	csi_80% ult.		
Stress: 16.79 ksi 80 tult. Stress: 16.79 ksi 80 tult. Stress 16.79 ksi 80 tult. <th< td=""><td>csi_80% ult.</td></th<>	csi_80% ult.		
Elap. Accum. Time Strain Remarks Time Strain Remarks (hrs.) (\(\mu\)in/in) Elap. Accum. Time (hrs.) (\(\mu\)in/in) Elap. Accum. Time Strain (hrs.) (\(\mu\)in/in (hrs.) (\(\mu\)in/in/in			
Time Strain Remarks Time Strain Remarks Time Strain (hrs.) (μ in/in) (hrs.) (μin/in) (hrs.) (μin/in)	. 1		
(hrs.) (μ in/in) (hrs.) (μin/in) (hrs.) (μin/in			
0 7904 0 Failed on loading 0 8525			
0.016 8565 0.016 9200			
0.1 9034 0.1 9685			
0.2 9242 0.2 9898			
0.57 9560 0.5 10,173			
0.97 9717	1		
2 9964 2 10.671			
3 10,116 3 10,826			
4 10,230 4 10,940			
5 10,308 5 11,050			
6 10,383 6 11,111			
7 10,450 7 11,185			
8 10,514 8 11,255			
24 11,002 24 11,736			
48 11,390 48 12,101			
72 11,657 72 12,369			
144 12.143			
192 12,598 192 13,283			
240 13,156 240 13,790			
312 13,437 312 14,033			
360 13,584 360 14,165			
408 13,330 408 14,303			
480 13.491 480 14.436			
504 13,542 504 14,478			
Resid. Str. 20.66 ksi Resid. Str.	20 551 1		
Resid. Str. 20.66 ksi Resid. Str.	20.55 ksi		
Recovery Recover Recove	Recovery		
0 5725 0 6152	<u> </u>		
1 3658 1 3750			
2 3583 2 3486			
3 3549 3 3358	1		

	- A	
	Creep	
Orient		
Spec. N	io: <u>A62-</u>	4
Temp:	R.T.	
Stress	: <u>14.69</u> ks	i_70* ult.
	Accum.	
Time	Strain	Remarks
(hrs.)		
0	6396	
0.016	6779	
0.1	6997	
0.5	7245	
1	7340	
2	7413	L
3	7536	
4	7573	
5	7617	
21	7892	
48	8078	
72	8179	
144	8330	
192	8503	
240	8620	
336	8899	
360	8985	
408	9070	
480	9175	
504	9210	
Resid	Str.	22.2 ksi
	Recover	y
0	2760	
1	1606	
2	1508	<u> </u>
3	1439	
		

SP313							
	Test: Creen						
Orient	<u>+45*</u>						
3	Spec. No: <u>A54-2</u>						
Temp: R.T.							
Stress: 14.69 ksi 70% wlt.							
Elap.	Accum.						
Time	Strain	Remarks					
	(#in/in)						
0	6506						
0.016	6820						
0.1	7254						
0.25	7442						
0.5	7590						
1	7741						
2	7893						
3	8000						
4	8062						
5	8115						
6	8162						
7	8203						
8	8242						
24	8505						
96	8888						
144	9018						
168	9129						
288	9634						
312	9702						
360	9862						
432	10,021						
480	10,034	<u> </u>					
504	10,042						
Resid	Str.	20.79 ksi					
	Bassassi	<u> </u>					
	Recovery	т					
<u> </u>	2868	 					
1	2610						
2	2443	 					
]3	2320	<u> </u>					

Test:	Creep						
Orient: +45*							
Spec. No: A55-9*							
Temp: R.T.							
Stress 14.69 ksi 70 t ult.							
Elap.	Accum.						
Time	Strain	Remarks					
(hrs.)	(µin/in)						
0	6470						
0.016	6939						
0.1	7184						
0.3	7442						
0.5	7558						
1	7670						
2	7928						
3	7913						
4	7955						
5	8025						
6	8060						
7	8090						
-8	8114						
24	8350						
48	8506						
84.25	Pailure						
Speci	men had	0.020"					
notel	in side	near edge					
of ta	b before	testing					
	Recovery						
	<u> </u>						
	 						
	 						
	 						
1	I	1					

SP313 Test: Creep Test: Test: Creep Creep +45° +45° +45* Orient: Orient: Orient: Spec. No: A57-8 Spec. No: A62-11 Spec. No: A52-3 Temp: 260°F Temp: 260°F Temp: 260*P Stress13.51 ksi 90 t ult. Stress: 13.51 ksi 90% ult. Stress: 13.51 ksi 90* ult. Elap. Accum. Elap. Accura. Elap. Accum. Strain Remarks Time Strain Remarks Time Time Strain Remarks (# in/in) (hrs.) (µin/in) (Pin/in) (hrs.) (hrs.) 8500 0 9830 8940 0.016 1000 0.016 11,615 0.016 10,627 12.260 13.465 14.083 0.25 14,827 0.25 13,465 14,919 0.25 16,034 14,518 0.5 15,784 15,806 17,667 16,620 1.25 23,200 17,065 18,065 17,735 1.33 50,000 18,437 No data 18,394 No Data - Gage 19,650 Strain greater than limits of indicator Pailed 5 No data, gage failed 500 Run-Out 360 Load taken off Load taken off 21.07 ksi Resid Str. 20.61 ksi Resid. Str. Resid. Str. 21.52 ksi Recovery Recovery Recovery

			72.25	Creep		7		
	Creep		,		{		Creeo	
1	+45°		•	+45		•	: <u>+45*</u>	
Spec. 1	io: <u>A53</u> -	2	1 -	Vo: A57-		1	No: <u>A62-</u>	
Temp:	260°F		Temp:	260	°F	Temp	260°F	
Storess	: <u>12.01</u> ks	1 808 ult.	Stress	12.01 ksi	ant ult.	Stress	12.01 kmi	80 % wit.
Elap.	Accum.		Elap.	Accum.		Elap.	Accum.	
Time	Strain	Remarks	1 1		Remarks	Time		Remarks
	(μ in/in)			(µin/in)			(µin/in)	···
0	6484		C	7496		0	5785	
	7259		0.016	7996		0.016	6564	
0.1	7952		0.1	9136		0.1	7488	
0.25	8422		0.25	9850		0.25	8000	
0.5	8786		0.5	10.340		0.5	8393	
1	9218	 	1	10,830		1	8595	
2	9639		2	11,400		2	8894	
3	9850		3	11.809		1_3_	9054	
4	10,040		4	12,070		4	9180	
_5	10,206		5	12,338		5	9287	
6	10,334	L	6	12,507		6	9379	
7_	10,444		7	12,652			9455	
8	10.543	 	8	12.777		8	9533	
24	11,206	L	24	13.648		24	10.100	
48	11,735		48	14,297		48	10,532	<u> </u>
120	12.781		120	15,054		120	11.267	
168	13,129		168	15,202		168	11,608	
240	13,457		240	15,360	 	216	11,877	
312	13,947		312	16,010		288	12,236	
360	14,221	<u></u>	360	16,670		336	12,496	
408	14,430		408	17.065		384	12,964	
480	14,715		480	17.649		456	14,000	ļ
500	14,786		500	17.794		501	14.460	ļ
				ļ	 		 	
					 		 	
-			<u></u>				-	t
Resid	Str.	19.65 ksi	Resid.	Str.	21.79 ksi	Resid	Str.	22.02 ksi
Recovery		Recovery		Recovery				
10	9167	T	0	11,521		0	9318	T
1	8166		1	10,063		1	7474	
2	7918		2	9800		2	7176	
3	7791		3	9570		3	6963	
			·					· · · · · · · · · · · · · · · · · · ·

Creep Test: Orient: +45° Spec. No: A53-6 260°F Temp:___ Stress: 10.51 ksi 70% ult. Elap. Accum. Strain (µ in/in) Remarks Time (hrs.) 6185 0.1 8770 No data gage failed load taken off 500 Run-out Resid. Str. 21.43 ks Recovery

·	SP313							
Test:								
1	Orient: +45°							
Spec. 1	Spec. No: <u>A56-10</u>							
Temp:	Temp: 250°F							
Stress	Stress: 10.51 ksi 700 ult.							
Elap.	Accum.							
Time	Strain	Remarks						
(hrs.)								
0	5854							
0.016	6724							
0.1	7402							
0.25	7806							
0.5	8074							
11_	8391							
2	8690							
3	8870							
4	9048							
5	9138							
_ 6	9308							
7	9500							
8	10,108							
48	10.585							
120	11,295							
168	11.656							
216	11,991							
288	12.444							
336	12,691							
384	12,943							
456	13,490							
500	13,779	ļ						
								
<u></u>	<u> </u>							
Resid.	Str.	21.04 ksi						
<u></u>	Recovery	<u> </u>						
0	·····							
1	8696 7523							
2	7330							
3	7225							
·	,	 						

Orient: +45° Spec. No: A57-11 Temp: 260°F Stress 10.51 ksi 70 % ult. Elap. Accum. Time Strain (hrs.) (µin/in) 0 5855 0.016 6479 0.1 7203 0.25 7666 0.5 7954 1 8297 2 8647 3 8864 4 9003 5 9089 6 9204 7 9268 8 9340 24 9955 48 10,400 120 11.094 168 11,422 216 11.687 288 12,041 336 12,251 384 12,453 456 12,598 500 12,683 Resid. Str. 20.23 ksi Recovery 0 7676 1 6640 2 6445	Test:	Cree	2						
Temp: 260°F Stress 10.51 ksi 70 * ult. Elap. Accum. Strain (μin/in) 0 5855 0.016 6479 0.1 72C3 0.25 7666 0.5 7954 1 8297 2 8647 3 8864 4 9003 5 9089 6 9204 7 9268 8 9340 24 9955 48 10,400 120 11.094 168 11,422 216 11.687 288 12,041 336 12,251 384 12,453 456 12,598 500 12,683 Resid. Str. 20.23 ksi Recovery 0 7676 1 6640 2 6445	Orient	Orient: +45°							
Stress 10.51 ksi 70 % ult. Elap. Accum. Strain (μ in/in) 0 5855 0.016 6479 0.1 7203 0.25 7666 0.5 7954 1 8297 2 8647 3 8864 4 9003 5 9089 6 9204 7 9268 8 9340 24 9955 48 10,400 120 11.094 168 11,422 216 11.687 288 12,041 336 12,251 384 12,453 456 12,598 500 12,683 Resid. Str. 20.23 ksi Recovery 0 7676 1 6640 2 6445	Spec.	No: <u>157-</u>	<u> </u>						
Elap. Accum. Strain (hrs.) (μin/in) 0 5855 0.016 6479 0.1 72C3 0.25 7666 0.5 7954 1 8297 2 8647 3 8864 4 9003 5 9089 6 9204 7 9268 8 9340 24 9955 48 10,400 120 11.094 168 11,422 216 11.687 288 12,041 336 12,251 384 12,453 456 12,598 500 12,683 Resid. Str. 20.23 ksi Recovery 0 7676 1 6640 2 6445	Temp	260°							
Time (hrs.) (μin/in) 0 5855 0.016 6479 0.1 72C3 0.25 7666 0.5 7954 1 8297 2 8647 3 8864 4 9003 5 9089 6 9204 7 9268 8 9340 24 9955 48 10,400 120 11,094 168 11,422 216 11,687 288 12,041 336 12,251 384 12,453 456 12,598 500 12,683 Resid. Str. 20.23 ksi Recovery 0 7676 1 6640 2 6445	Stress	Stress 10.51 ksi 70 % ult.							
(hrs.) (µin/in) 0 5855 0.016 6479 0.1 7203 0.25 7666 0.5 7954 1 8297 2 8647 3 8864 4 9003 5 9089 6 9204 7 9268 8 9340 24 9955 48 10,400 120 11.094 168 11,422 216 11.687 288 12,041 336 12,251 384 12,453 456 12,598 500 12,683 Resid. Str. 20.23 ksi Recovery 0 7676 1 6640 2 6445									
0 5855 0.016 6479 0.1 7203 0.25 7666 0.5 7954 1 8297 2 8647 3 8864 4 9003 5 9089 6 9204 7 9268 8 9340 24 9955 48 10,400 120 11.094 168 11,422 216 11.687 288 12,041 336 12,251 384 12,453 456 12,598 500 12,683 Resid. Str. 20.23 ksi Recovery 0 7676 1 6640 2 6445	Time		Remarks						
0.016 6479 0.1 72C3 0.25 7666 0.5 7954 1 8297 2 8647 3 8864 4 9003 5 9089 6 9204 7 9268 8 9340 24 9955 48 10,400 120 11.094 168 11,422 216 11.687 288 12,041 336 12,251 384 12,453 456 12,598 500 12,683 Resid. Str. 20.23 ksi Recovery 0 7676 1 6640 2 6445	(hrs.)								
0.1 72C9 0.25 7666 0.5 7954 1 8297 2 8647 3 8864 4 9003 5 9089 6 9204 7 9268 8 9340 24 9955 48 10,400 120 11.094 168 11,422 216 11.687 288 12,041 336 12,251 384 12,453 456 12,598 500 12,683 Resid. Str. 20.23 ksi Recovery 0 7676 1 6640 2 6445		5855	<u> </u>						
0.25 7666 0.5 7954 1 8297 2 8647 3 8864 4 9003 5 9089 6 9204 7 9268 8 9340 24 9955 48 10,400 120 11.094 168 11,422 216 11.687 288 12,041 336 12,251 384 12,453 456 12,598 500 12,683 Resid. Str. 20.23 ksi Recovery 0 7676 1 6640 2 6445	0.016	6479	, , ,						
0.25 7666 0.5 7954 1 8297 2 8647 3 8864 4 9003 5 9089 6 9204 7 9268 8 9340 24 9955 48 10,400 120 11.094 168 11,422 216 11.687 288 12,041 336 12,251 384 12,453 456 12,598 500 12,683 Resid. Str. 20.23 ksi Recovery 0 7676 1 6640 2 6445	0.1	7200							
1 8297 2 8647 3 8864 4 9003 5 9089 6 9204 7 9268 8 9340 24 9955 48 10,400 120 11.094 168 11,422 216 11.687 288 12,041 336 12,251 384 12,453 456 12,598 500 12,683 Resid. Str. 20.23 ksi Recovery 0 7676 1 6640 2 6445		7666							
2 8647 3 8864 4 9003 5 9089 6 9204 7 9268 8 9340 24 9955 48 10,400 120 11.094 168 11,422 216 11.687 288 12,041 336 12,251 384 12,453 456 12,598 500 12,683 Resid. Str. 20.23 ksi Recovery 0 7676 1 6640 2 6445	0.5	7954							
3 8864 4 9003 5 9089 6 9204 7 9268 8 9340 24 9955 48 10,400 120 11.094 168 11,422 216 11.687 288 12,041 336 12,251 384 12,453 456 12,598 500 12,683 Resid. Str. 20.23 ksi Recovery 0 7676 1 6640 2 6445	1	8297							
3 8864 4 9003 5 9089 6 9204 7 9268 8 9340 24 9955 48 10,400 120 11.094 168 11,422 216 11.687 288 12,041 336 12,251 384 12,453 456 12,598 500 12,683 Resid. Str. 20.23 ksi Recovery 0 7676 1 6640 2 6445	2	8647							
.4 9003 5 9089 6 9204 7 9268 8 9340 24 9955 48 10,400 120 11.094 168 11,422 216 11.687 288 12,041 336 12,251 384 12,453 456 12,598 500 12,683 Resid. Str. 20.23 ksi Recovery 0 7676 1 6640 2 6445									
5 9089 6 9204 7 9268 8 9340 24 9955 48 10,400 120 11.094 168 11,422 216 11.687 288 12,041 336 12,251 384 12,453 456 12,598 500 12,683 Resid. Str. 20.23 ksi Recovery 0 7676 1 6640 2 6445									
7 9268 8 9340 24 9955 48 10,400 120 11.094 168 11,422 216 11.687 288 12,041 336 12,251 384 12,453 456 12,598 500 12,683 Resid. Str. 20.23 ksi Recovery 0 7676 1 6640 2 6445									
7 9268 8 9340 24 9955 48 10,400 120 11.094 168 11,422 216 11.687 288 12,041 336 12,251 384 12,453 456 12,598 500 12,683 Resid. Str. 20.23 ksi Recovery 0 7676 1 6640 2 6445		9204							
24 9955 48 10,400 120 11.094 168 11,422 216 11.687 288 12,041 336 12,251 384 12,453 456 12,598 500 12,683 Resid. Str. 20.23 ksi Recovery 0 7676 1 6640 2 6445	7								
24 9955 48 10,400 120 11.094 168 11,422 216 11.687 288 12,041 336 12,251 384 12,453 456 12,598 500 12,683 Resid. Str. 20.23 ksi Recovery 0 7676 1 6640 2 6445	8								
48 10,400 120 11.094 168 11,422 216 11.687 288 12,041 336 12,251 384 12,453 456 12,598 500 12,683 Resid. Str. 20.23 ksi Recovery 0 7676 1 6640 2 6445									
120 11.094 168 11,422 216 11.687 288 12,041 336 12,251 384 12,453 456 12,598 500 12,683 Resid. Str. 20.23 ksi Recovery 0 7676 1 6640 2 6445									
168	120								
216 11.687 288 12,041 336 12,251 384 12,453 456 12,598 500 12,683 Resid. Str. 20.23 ksi Recovery 0 7676 1 6640 2 6445									
288 12,041 336 12,251 384 12,453 456 12,598 500 12,683 Resid. Str. 20.23 ksi Recovery 0 7676 1 6640 2 6445									
336 12,251 384 12,453 456 12,598 500 12,683 Resid. Str. 20.23 ksi Recovery 0 7676 1 6640 2 6445	1								
Resid. Str. 20.23 ksi Recovery 0 7676 1 6640 2 6445	336								
Resid. Str. 20.23 ksi Recovery 0 7676 1 6640 2 6445	384								
Resid. Str. 20.23 ksi Recovery 0 7676 1 6640 2 6445	456								
Resid. Str. 20.23 ksi Recovery 0 7676 1 6640 2 6445	500								
Recovery 0 7676 1 6640 2 6445									
Recovery 0 7676 1 6640 2 6445									
Recovery 0 7676 1 6640 2 6445	Resid	. Str.	20.23 ksi						
0 7676 1 6640 2 6445									
0 7676 1 6640 2 6445									
1 6640 2 6445		Recovery							
1 6640 2 6445	0	7676							
	1								
	2	6445							
3 6341	3	6341							

The second secon	±45° 257-5
Spec. No: A56-2 Spec. No: A51-1 Spec. No: Temp: 350°F Temp: Temp: Temp: Stress: 7.66 ksi 70 % ult. Stress 7.66 ksi 70 % ult. Stress 7.66 ksi 70 % ult.	A57-5
Temp: 350°F Temp: 350°F Temp: Stress: 7.66 ksi 70 % ult. Stress: 7.66 ksi 70 % ult. Stress 7.6	
Stress: 7.66 ksi 70 t ult. Stress: 7.66 ksi 70 t ult. Stress 7.6	350°F
Trian Anguer Trian Anguer Trian Anguer	6 ksi 70% ult.
	cum.
Time Strain Remarks Time Strain Remarks Time Str	1 1
(hrs.) $(\mu in/n)$ (hrs.) $(\mu in/in)$ (hrs.) $(\mu in/in)$ 0 542	the same of the same of the same of
the state of the s	
0.033 9467 0.033 0.1 806	
0.066 13.640 0.05 0.25 928	
0.1 14,917 0.066 0.5 10.3	
0.166 15.890 0:1 111.	
0.25 18,227 0.166 2 13,3	
0.3 27,350 0.5 3 14,6	
No data	
qaqe falled 2 5 16.6	
500 Load taken off 3 6 17,1	
No failure 4 7 17,6	
5 7.5 18,0	
	data
	a failed
Gage failed	
	taken off
504 Load taken off No No failure	failtre
NO TAILUTE	
Dramatic neckdown	
width reduced 8%	
thickness unchanged	
Resid. Str. 19.68 ksi Resid. Str. 19.6 ksi Resid. S	tr. 20.7 ksi
Recovery Recovery Rec	covery

				26313	······································	-		
Test:_	Creep		Test: Creep			Test: Creep		
	±45°			+45		Orient: +45°		
Spec. 1	to: A54-3	<u> </u>	ı	No: A56		Spec. No: A58-7		
Temp:	350°	F	Temp:	350°	F	Temp: 350°P		
	: 4.37 ksi	40% ult.			40 % ult.		4.37 ksi	40 ult.
	Accum.			Accum.			Accum.	
	Strain	Remarks		Strain	Remarks		Strain	Remarks
	(µin/in)			(Pin/in)			(µin/in)	
	2382		0	2532		U	Failed o	n loading
0.016	2660			2674				
0.05	2954		0.05	2875				
0.21	3882		0.16	3175				
0.3	4062		0.21	3976				
0.4	4492		0.3	4181				
0.5	4681		0.4	4445				
1	5486		0.5	4700				
2	6444		1	4916				
3	7121		2	5961				
4	7750		3	7226				
5	8541		4	8121				
6			5	8930				
7	9000		6	9947				
8	9267		7	10,540				
15	11,152		8	10,880				
24	13,650		15	13,222				
48	17,141		24	15,835				
57	22,105		No	ata				
58	31,982		Gaq	failed				
No	data		330	test ter	minated			
Gad	e failed	i		No fail				
330	test ter	minated			L			
	No fail							
	<u> </u>			<u> </u>	<u> </u>		<u> </u>	<u></u>
	Recovery			Recovery	Y		Recovery	
	ļ				ļ	l	 	
<u></u>	ļ		<u> </u>	<u> </u>			<u> </u>	
							ļ	
L	<u> </u>	<u> </u>		<u> </u>	1	l L		<u> </u>

				SP313				
Test:	Creep		Test: Creep			Test: Creep		
Orient	Orient: ±45°		Orient: +45°		Orient: +45°			
	io: <u>A51-</u>		Spec. I	No: A57-	.7	Spec. 1	No: A62-	7
Temp:	350°	<u> </u>	Temp:	350°1		Temp:	350°	E
Stress	: <u>2.19</u> ks	i 20% wit.	Stress:	2.19 ksi	20 t ult.	Stress	2.19 ks	20 % ult.
Elap.	Accum.		:	Accum.	·	Elap.		
Time	Strain	Remarks	Time	Strain	Remarks	Time	Strain	Remarks
	(µ in/in)		(hrs.)	······································		(hrs.)		
0	1210		0	5715		0	1270	
0.016	1483		0.016	7207		0.016	1294	
0.1	1524		0.1	8400		0.1	1384	
0.25	1559		0.25	9715		0.25	1476	
0.5	1595		0.5	No data	 	0.5	1542	
1	1652			Gage fai	led	1	1627	
2	1747					2	1749	
3	1816					3	1827	
4	1886					4	1896	
5	1941					5	1949	
6	1998					6	1999	
7	2047			-		7	2042	
8	2090					8	2088	
72.5	3842					72.5	3400	
120.5	4598					120.5	3990	
168	5088					168	4528	
240	5674					240	8827	
288	60 45					288	9203	
333.5	6352					333.5		
432	6853					432	9531	
456	6971					456	9577 ·	
500	7212		500	test te	minated	500	9625	
Resid	. Str.	20.48 ksi	Resid	Str.	15,24 ksi	Resid.	Str.	18.94 ksi
	L	<u> </u>		<u> </u>	1		Ļ	<u> </u>
	Recover	у		Recovery			Recovery	
0	6247			 		0	8662	
1	6045	 		 	 	- <u>1</u>	8429	
-2-	5989					3	8368	
3	5939		l	1	L	3	8309	L

				AS/3004	l ————————————————————————————————————				
Test:	Creep			Creep		Test:	Creep		
Orient	Orient: 0°			Orient: 0°			Orient: 0*		
Spec. N	io: <u>C9-2</u>		Spec. 1	Vo: <u>C11</u> -	·3	Spec. I	No: C12	-7	
Temp:	R.T.		Temp:	R.T.		Temp	R.T.		
Stress	: 150.3 ks	i_80% ult.	Stress:	150.3 ksi	80 % ult.	Stress	150.3 ksi	80 % ult.	
Elap.	Accum.		Elap.	Accum.		Elap.	Accum.		
		Remarks		Strain	Remarks		Strain	Remarks	
	(µ in/in)	ļ		(Pin/in)		-	(µin/in)		
0	7465		0	7622		0	8684		
0.016	7471			7633		0.016	8692		
0.1	7476		0.1	7636		0.1	8719		
0.25	7482		0.25	7636		0.5	8729		
0.5	7482		0.5	7636		1	8733		
1.3	7488		1	7640		2	8734		
2	7484		2	7640		72	8745		
3	7484		3	7654		96	8741		
25	7486		4	7657		120	8742		
48	7491		5	7660		168	8732		
120	7468		6	7667		240	8803		
168	7501		7	7668		288	8787		
216	7505		8	7672		336	8799		
288	7496		24	7672		408	8810		
336	7505		48	7653		456	8793		
384	7495		72	7657		594	8782		
456	7540		144	7758					
504	7468		192	7737					
			240	7756					
			312	7768					
			360	7750					
			406.3	7743					
			500	7803				1	
Resid.	Str.	186.4 ksi	Resid	Str.	140.6 ksi	Resid.	Str.	189.0 ksi	
 									
	Recover	'y		Recovery	<u> </u>		Recovery	,	
0	38	 	0	218	T	0	370	T	
1	38	 	1	210		1	361	 	
2	39		2	203	<u> </u>	2	359	1	
3	20		3	210	1	3	360		
		·	1						

				AS/3004		-		
	Test: Creep Test: Creep			1	Creep			
Orient	0•			: <u>0</u> •		Orient: 0°		
Spec. N	lo: <u>C12</u>	=5	Spec. 1	Vo: <u>C3-13</u>		Spec.	No: <u>Cll</u>	-6
Temp:	R.T.		Temp:	R.T.		Temp	R.T.	
Stress	: <u>131.5</u> ks	i_70% ult.	Stress	<u>131.5 k</u> si	70 % ult.	Stres	131.5 ksi	70 tult.
Elap.		_	Elap.	Accum.		Elap.		
Time	Strain	Remarks	Time	Strain	Remarks	Time	Strain	Remarks
(hrs.)			(hrs.)			(hrs.)	(µin/in)	
0.016	7130		0 036	7365		0	7665	
	7140		0.016			0.016	7670	
0.1	7140		0.1	7367		0.1	7676	
0.25	7147		0.25	7371		0.25	7678	
0.5	7149		0.5	7377		0.5	7692	
1.25	7158		1.25	7381		1.25	7698	
2	7159		2	7388		2	7709	
18	7196		18	7416		18	7757	
24	7183		24	7404		24	7752	
96	7170		96	7388		96	7739	
144	7199		144	7417		144	7772	
192	7204		192	7423		192	7777	
264	7203		264	7414		264	7778	
312	7216		312	7419		312	7801	
360	7215		360	7416		360	7802	
432	7258		432	7454		432	7852	
480	7210	82°F	480	7404	82°F	480	7804	82°F
500	7208	82°F	500	7401	82°F	500	7801	82°F
Note:	Lab temp	erature ro	se 10°F	above no	rmal duri	g <u>last</u>	40 hours	
Resid.	Str.	202.4 ksi	Resid	Str.	179.4 ksi	Resid	. Str.	175.8 ksi
	Recover			Recovery			Recovery	
	,		 			{ ├	· · · · · · · · · ·	
0	124	 	 •	91	 	-0-	167	
	116	}	1	89	 		166	
3	127	 	3	97 102	 	2 3	166 178	
<u></u>	1 136	ـــــا	1	1 102		1 <u>-</u> -	1 1/6	<u> </u>

Test: Creep ٥° Orient:___ Spec. No: C8-5 Temp: R.T. Stress: 112.7 kai 60 * ult. Elap. Accum. Strain Time Remarks (# in/in) (hrs.) 6508 0.016 6510 0.1 6509 0.25 6508 0.5 6511 6511 1.16 2 6512 6513 5 6513 6 6509 6514 96 120 6511 168 6512 240 653.4 288 6512 336 6512 408 6512 431 6511 Resid. Str. 198.5 ksi Recovery 0 0 -10 -10 3 -14

Test: Creep Orient: 0.0 Temp: R.T. Stress: 112.7 ksi 60 % ult. Accum. Elap. Time Strain Remarks (hrs.) (#in/in) 6174 0.016 6175 0.1 6184 0.25 6188 0.5 6189 1.16 6194 6198 2 6200 6202 6 6204 96 6452 120 6452 168 6458 240 6460 288 6461 336 6468 408 6465 431 6466 206.5 ksi Resid Str. Recovery 0 289 274 273 269 3

AS/3004

0. Orient: Spec. No: <u>C7-2</u> Temp: R.T. Stress Il2.7 ksi 60% ult. Elap. Accum. Time Strain Remarks (hrs.) (#in/in) 0 6596 0.016 6596 b.1 6596 6598 0.25 6594 0.5 .16 6596 6598 6598 6599 5 6 6600 6605 96 .20 6604 68 6605 240 6606 288 6607 336 6610 408 6607 431 6601 Resid. 187.1 ksi Str. Recovery 0 0 -5 2 -5 3 -8

Test: Creep

AS/3004 Test: Test: Creep Test: Creep Orient: Orient:__ Orient: 00 0.0 C9-12 C18-8 Spec. No: C8-13 Spec. No: Spec. No: 180°F 180°F Temp: 180°F Temp: Temp:_ Stress: 153.2 ksi 80 0 ult. Stress: 153.2 ksi 801 ult. Stress 153.2 kgi 80% ult. Elap. Accum. Accum. Elap. Elap. Accum. Time Strain Remarks Time Strain Remarks Time Strain Remarks (# in/in) (hrs.) (hrs.) (hrs.) (Fin/in) (µin/in) 0 8291 Failed on loading 0 8851 0.016 8424 0.016 8860 0.1 8544 0.1 8866 0.25 8605 8869 0.5 8652 0.5 8871 1 8695 1 8874 2 8732 2 8866 3 8755 3 8864 8785 8856 6.5 8800 5 8866 8808 8868 8819 8868 13 8845 8 8862 15 8865 24 8870 24 8904 48 8875 96 9018 120 8895 144 9050 168 8898 192 9064 8900 264 9077 9080 293 Resid. Str. 218.6 ksi Resid Str. 191.9 ksi Recovery Recovery Recovery 0 692 168 536 144 532 148 528 142

AS/3004 Creep Test: Orient: 0.

Test:

Time

0

0.016 0.1

0.25

0.5

3

4

6

7

8

24

48

120 168.6

216

Orient:

Creep

Spec. No: C7-1

Temp: 180°P

(hrs.) (# in/in)

7158 7172

7182

7183 7186

7188 7193 7194

7195

7196

7196

7198

7198

7206

7219 7231

7246 7261

Resid Str.

0

3

Recovery

90 76

74

73

0.

Stress: 134.1 ksi 70 t ult. Accum. Strain

Remarks

189.0 ksi

Spec. No: C8-4							
Temp: 180°F							
Stress: 134.1 ksi 70% ult.							
-	Accum.						
Time	Strain	Remarks					
(hrs.)	(µin/in)						
0	7408						
0.016	7408						
0.1	7414						
0.25	7414						
0.5	7414						
1	7415						
2	7415						
3	7419						
4	7418						
5	7420						
6	7419						
7	7419						
8	7420						
72	7435						
121	7439						
168	7436						
216	7440						
Resid	Str.	210.9 ksi					
	Recovery						
0	28						

Test: Creep Orient: 0.0 Spec. No: Cll-13

Spec. No: Cll-13							
Temp: 180°F							
Stress 134.1 ksi 70% ult.							
Elap.	Accum.						
THIRD	DELAID	Remarks					
	(µin/in)						
0	7005						
0.016	7003						
).1	7005						
0.25	7015						
).5	7016						
1	7016						
2	7017						
3	7027						
4	7028						
5	7028						
6	7029						
7	7035						
8	7040						
10	7058						
24	7060						
49	7063						
96	7060						
192	7089						
216.2	7079						
Resid.	Str.	229.1 ksi					
	Recovery						
0	92						
1	79						
2	80						
3	130						

15

15

				NS/ 3004				
	st: Creep Test: Creep						Cree	Р
Orient	Orient: 0° Orient: 0°				Orient: 0°			
Spec. N	lo: <u>C8</u> -	-2	Spec. 1	lo: <u>C25</u>	5-13	Spec. No: <u>C10-12</u>		
Temp:	18	10.k	Temp:	180°F		Temp:	180*	<u> </u>
Stress	: <u>107.5</u> kari	_609 ult.	Stress:	107.5 ksi	60 8 ult.	Stress	107.5 ksi	60 t ult.
	Accum.	1	1	Accum.		Elap.		
Time	Strain	Remarks	Time		Remarks	Time		Remarks
	(µ in/in)		1	(Hin/in)		(hrs.)		
0	5346		0	5991		0	5803	
0.1	5360		0.1	5998		0.1	5805	
0.25	5361	 	0.25	5995	 	0.25	5804	
0.5	5361		0.5	6001		0.5	5811	
	5363	 	1	6001	 	1	5812	
2	5367		2	6003		2	5811	
3	5366		3	6005		3	5815	<u> </u>
4	5365		4	6006		4	5813	<u> </u>
5	5364		5	6006		5	5814	
6	5365		6	6008		6	5814	
7	5367		7	6008		7	5815	
8	5369		8	6008		8	5815	
48	5368		48	6008		48	5827	
144	5380		144	6009		144	5838	
168.5	5377		168.5	6012		168.5	5836	
216	5379		216	6006		216	5837	
288	5378		288	6008		288	5834	
336	5377		336	6005		336	5843	
384	5382		384	6007		384	5843	
432	5376		432	6013		432	5835	
476	5379		476	6016		476	5832	
			<u> </u>			<u> </u>		
		 				·		
Resid.	Str.	192.7 ksi	Resid	Str.	150.0 ksi	Resid.	Str.	203.8 ksi
		1						
	Recover	У	L	Recovery			Recovery	r
0	49	<u> </u>	0	20	 		75	
1.25	33	 	1.25	- 8		1.25	57	
2	32	 	2	4	ļ	2	57	<u> </u>
3	32		3	4	<u></u>	3	53	L

AS/3004 Test: Test: Test: Creep Creep Creen 0. 0. Orient: Orient: 0. Orient:_ Spec. No: <u>Cl3-4</u> Spec. No: C14-6 Spec. No:__ C9-4 250°F Temp: 250°F Temp: 250°F Temp:_ Stress: 143.3 kmi 80 % wlt. Stress: 143.3 ksi 80% ult. Stress 143,3 kgi 80 % ult. Elap. Accum. Elap. Accum. Elap. Accum. Time Strain Remarks Time Strain Remarks Time Strain Remarks (# in/in) (#in/in) (hr ..) (hrs.) (µin/in) (hrs.) Failed on loading 7850 Failed on loading 0 0.016 7897 0.1 7849 0.25 7852 0.65 7862 1.6 7973 7980 3 7983 4 8000 5 8005 6 8029 8035 8 8042 8049 10 12 8056 8066 8123 48.4 8155 168 8263 216 288 8390 312 8404 Resid Str. 181.2 ksi Recovery Recovery Recovery 0 512 386 372 368

		-		AS/3004	: 			
Test: Creep Test: Creep				Test: Creep				
Orient:0°		•	Orient: 0°		Orient: 0°			
Spec. N	lo: <u>C1</u>	4-9	Spec. 1	No: <u>C7-</u> 1	0	Spec. No: <u>C12-6</u>		
Temp:	250°F		Temp:	2501	F	Temp:	250	• F
Stress	:125.4 ks	i 70% ult.	Stress	125.4 ksi	70 % ult.	Stress	125.4 ks	70% ult.
Elap.	Accum.		1	Accum.		:	Accum.	
1 1	Strain	Remarks	Time	Strain	Remarks	Time		Remarks
-	(µ in/in)		1	(#in/in)		· · · · · · · · · · · · · · · · · · ·	(µin/in)	
0	9448		0	7699		0	7240	
0.016				7758		0.016	7258	
0.1	9668		0.1	7787		0.1	7294	
0.25	9822		0.25	7799		0.25	7301	
0.5	9870		0.5	7806	ļ	0.5	7309	
1	9906		11	7820		1	7316	
2	9968		2	7825		2	7326	
3	9975		3	7834		3	7333	
4	9990		4	7838		4	7338	
5	10,018		5	7848		_5	7327	
6	10.020		6	7848		6	7332	
7	10,040		7	7853		7	7332	
8	10,065		8	7853		8	7333	
24	10,392		24	7884		24	7351	
·	10,611		72	7920		72	7374	
120	10,675		120	7937		120	7379	
168	10,688		168	7952		168	7388	
240	11,037		240	7970		240	7387	
		 						
								
		 						
					†			1
Resid.	Str.	169.4 ksi	Resid	Str.	201.9 ksi	Resid.	Str.	173.3 ksi
	Recovery Recovery				Recovery			
1-		· 	1	1136			416	
0	2368	 	. 1	1135 1103	 	1	410	
2	1949 1912	 	2	1098	 	2	410	
3.25	1885	 	3.25	1086		3.25	410	
	7007		1 4.27	1 2000	<u> </u>	(2.23	127	<u></u>

	*			AS/3004					
Test:	Creen		Test:	Creep		Test:	Creep	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	
Orient	Orient: 0°			Orient: 0°			Orient: 0°		
Spec.	o: <u>C13</u> -	1	Spec. I	io: C25	-9	Spec. No: C13-8			
Temp	250°F		Temp:	250°1			250°		
States	: 107.5 ks	i 60 ult.	Stress:	107.5 ksi	60 t ult.	Stress	107.5 ks	60° ult.	
Eisp.	Accum.		Elap.	Accum.		Elap.	Accum		
		Remarks	Time	Strain	Remarks			Remarks	
(hrs.)	(# in/in)		(hrs.)	(Min/in)		(hrs.)	(µin/in)		
0	6319		0	5940		0	No data		
0.016	6313		0.016	5970			gage fai	led	
0.1	6319		0.1	6003					
0.25	6324		0.25	6006					
0.5	6326		0.5	6010					
1	6326		1	6012					
2	6327		2	6026					
3	6336		3	6029					
4	6338		4	6032					
5	6342		5	6034					
6	6338		6	6038					
7	6337		7	6041					
8	6342		8	6042					
24	6354		24	6059					
96	6379		96	6087					
144	6405		144	6094					
192	6419		192	6102					
264	6404		264	6058					
308	6430		308	6050		308	test ter	minated	
						}	ļ	 	
		 							
Resid.	Str.	135.5 ksi	Resid	Str.	185.3 ksi	Resid	Str.	134.3 ksi	
		 							
	Recover			Recovery			Recovery		
		7				 		·	
0	223	 	0	337	 		 -		
	199	 	1	307	 		 	 	
	194	 	2	306	 		 	 	
3.5	188		3.5	298		l ——	1		

AS/3004 Test: Creep Test: Test: Creep Creeo Orient: 90* Orient: 900 Orient: 90° Spec. No: C15-8 Spec. No: C17-6 Spec. No: C16-8 Temp: R.T. R.T. Temp: R.T. Temp: Strees: 4.02 ksi 80% ult. Stress: 4.02 kgi 80 % ult. Stress 4.02 ksi 80% ult. Elap. Accum. Elap. Accum, Elap. Accum; Time Strain Remarks Time Strain Remarks Time Strain Remarks (brs.) (# in/in) (hrs.) (#in/in) (hrs.) (µin/in) 0 4020 0 3865 0 3428 3874 0.016 4044 0.016 0.016 3438 0.05 Failure 0.1 3884 0.1 3440 0.25 3992 0.25 3455 0.55 3907 0.55 3460 3911 3470 1 3920 3481 3926 3484 3923 3480 5 6 3924 3486 6 7 393Q 3467 3929 3494 3959 24 24 3528 72 4001 72 3591 105.3 Pailure 105.4 4100 Failed After Restart Recovery Recovery Recovery

Test: Creep Orient: 90° Spec. No:___ C18-5 R.T. Temp: Stress: 3.52 ksi 70 * ult. Elap. Accum. Strain (µin/in) Remarks Time (hrs.) 0.016 0.1 0.3 3.3 4.16 5.25 3.71 ksi Resid. Str. Recovery

AS/3004 Test: Creen					
-	Creep				
	90°				
Spec. 1	No: Cl8-	7			
Temp:	R.T.				
Stress	3.52 ksi	70% ult.			
Elap.	Accum.				
Time	Strain	Remarks			
(hrs.)					
0	3065				
0.016	3077				
0.1	3085				
0.3	3092				
0.5	3095				
1	3105				
2	3115				
3.3	3120				
4.16	3117				
5.25	3117				
6	3117				
7	3131				
8	3137				
24	3149				
48	3189				
120	3202				
168	31.75				
216	3178				
288	3293				
336	3200				
384	3326				
457	3244				
504	3329				
]	<u> </u>				
	 	<u> </u>			
		<u> </u>			
Resid	Str.	6.56 ksi			
	Recovery	!			
0	286				
1	251				
2	245				
3	244				

Test:	Creep					
	: 90°					
Spec. No: C18-3						
	R.T.					
	3.52 ksi	}				
	Accum.					
Time	Accum. Strain	Remarks				
(hrs.)	(µin/in)					
0	2986					
.016	2996					
.1	3005					
. 3	3015					
) . 5	3015					
1	3025					
2	3038					
3.3	3040					
.16	3040					
.25	3040					
6	3040					
_ 7	3054					
3	3064					
24	30.72					
48	3116					
30	3130					
168	3107	ues e				
216	3111					
288_	3239					
336	3155					
384	3280					
157	3208					
504	3294					
Resid	. Str.	5.49 ksi				
	Recovery	,				
_ 0	321					
1	291					
2	283					
3	284	<u> </u>				

	/3004
Test: Cr	eep
Orient:	90°
Spec. No:	C15=2

Test: Creep

Spec. No: Cl8-1 Temp: R.T.

Orient:__

Time

(hrs.)

0.016

0.1

0.25

0.5

522.1

Resid.

90°

Stress: 3.01 ksi 60 % ult. Accum. Strain

(# in/in)

Str.

Recovery

5.22 ksi

Remarks

Stress:	3.01	_ksi_	60%	ult.

Spec. No: C15-2								
Temp	Temp: R.T.							
Stress: 3.01 ksi 60% ult.								
Elap.	Accum.							
Time	Strain	Remarks						
(hrs.)	(#in/in)							
. 0	2671							
0.016	2820							
0.1	2830							
0.25	2835							
0.5	2843							
1	2869							
2	2864							
19	2831.							
24	2873							
48	2920							
96	2943							
168	2888							
216	2954							
264	2942							
336	2961							
384	2974							
432	2920							
522.1	2901							
Resid.	Str.	6.20 ksi						
	Recovery							
0	114							
1	75							
_								

Test:	Creep					
Orient: 90°						
Spec. No: C16-2						
	R.T.					
	3.01 ksi	60 tult.				
	Accum.					
Time	Strair.	Remarks				
(hrs.)	(µin/in)					
0	2774					
0.016	2932					
0.1	2944					
0.25	2952					
0.5	2961					
1.	2976					
2	2979					
18	2966					
24	2990					
48	3038					
96	3061					
168	3009					
216	3073					
264	3062					
336	3082					
384	3095					
432	3052					
522.1	3033					
Resid	Str.	5.60 ksi				
	Recovery					
0						
1	132					
	101					
-2-	94					

2	_	4

Test:	Creep		Test:	Creep		Test:	Creep		
_			Orient: 90°		Test: Creen Orient: 90*				
	70: <u>C17-8</u>		i .	Spec. No: C16-7		1 5	Spec. No: C15-1		
1		3	3		-				
Temp:	180°1		Temp:	180*1		1 1	180°F		
Stress	: 2.96 ks	60 % ult.	Stress:		60 t ult.	Stress	2.96 ksi	60 t ult.	
Elap.	Accum.	_	Elap.				Accum.		
Time	Strain (# in/in)	Remarks	Time	Strain (#in/in)	Remarks	Time	Strain (µin/in)	Remarks	
0	2666		0	2710		0	2926		
0.016			0.016	2727					
			ļ			0.016			
0.1	2691		6	2734		0-1	Failure		
0.25	2699		1-1-	2745					
0.5	2696		3	2756					
1.1	2715		4	2764					
2	2727		5	2766					
3	2733		47	2808		 			
4	2737		77	2823					
5	2746		168	2833					
6	2754		215	2841					
7	2761	 	264	2840		│ ├ ───			
7.75	2765		360	2852	 	 			
53.1	Failure		385	2851	 	┨┠───			
		 	505	2860 2859		∮ ├ ──	 		
	·		303	2039		 			
					 	 			
		 			 				
			-						
		 				 			
		 			 	1		 	
			-						
			Resid.	Str.	5.65 ksi	1		<u> </u>	
						1			
						1			
					1	1			
						1			
	Recover	У		Recovery			Recovery		
			0	-27					
		 	1	-47		↓	<u> </u>	<u> </u>	
		ļ	2	-55	ļ	 	ļ	 	
	<u> </u>	<u>i</u>	1_3	-60	<u></u>	J [<u> </u>	L	

	_			AS/3004		-				
	Creap		Test: Creep			•	Test: Creep			
•	90°		Orient: 90°			Orient: 90°				
1	o: <u>C18-</u>		Spec. 1	No: <u>C17-</u>	1	Spec. No: C18-6				
Temp:_	180°)	<u> </u>	Temp: 180*F			Temp	180°F			
Stress:	2.47 ks	i <u>50 % ul</u> t.	Stress	2.47 ks	50% ult.	Stress	2.47 ks:	. 50% ult.		
,	Accum.	_	Elap.			Elap.				
Time	Strain	Remarks	Time		Remarks	Time		Remarks		
0	(μ in/in) 2196		(hrs.)			(hrs.)				
			0	2356		0	2172			
0.016	2222		0.016	2368		0.016	2176			
0.1	2234		0.1	2375		0.1	2188			
0.4	2242		0.4	2382		0.4	2187			
0.5	2245		0.5	2381		0.5	2188			
1.16	2246		1.16	2387		1.16	2188			
2	2246		3	2387		2	2188			
3	2242		3	2387		3	2186			
1.9	2237		19	2390		19	2170			
24	2237		24	2389		24	2167			
48	2246		48	2406		48	2176			
96	2270		96	2423		96	2189			
168	2291		168	2442		168	2203			
216	2295		216	2453		216	2207			
264	2307		264	2459		264	2212			
336	2311		336	2473		336	2220	_		
384	2321		384	2491		384	2230			
432	2330		432	2486		432	2238			
504	2332		504	2498		504	2241			
 										
 										
 			i							
Resid	Str.	4.55 ksi	Resid	Str.	3.53 ksi	Resid	Str.	5.58 ksi		
										
	Recovery	7	1	Recovery			Recovery			
-	98		0	186		0	49			
1-1-	87		1	160		1	48			
2	83		3	151		2	45			
131	81		3	145		3	42			

Test:	Creep		Test:	Creep		Test: Creep		
Orient	900		Orient: 90°			Orient: 90°		
	o: C38-1	3	1	Spec. No: C29-7 Spec. No: C31-3				
Temp: 180°F			Temp:	180°F			180°F	
, -		i 40 % ult.	1		40 % ult.	1	i.97 ksi	40 % ult.
Elap. Time (hrs.)	Accum. Strain (μ in/in)	Remarks	Elap. Time (hrs.)		Remarks	Elap. Time (hrs.)	Accum. Strain (µin/in)	Remarks
0	1827		0	1612		0	1763	
0.016	1836		0.016	1614		0.016	1764	
0.25	1846		0.1	1608		0.1	1770	
0.6	1850		0.25	1608		0.25	1774	
1.16	1854		0.6	1610		0.6	1775	
2.25	1857		1.16	1613		1.16	1783	
3	1860		2.25	1616		2.25	1784	
5	1865		3	1615		3	1784	
6	1867		. 5	1618		5	1793	
8	1873		6	1623		6	1793	
72	1894		8	1624		8	1798	_
120	1905		72	1644		72	1822	
170	1901		120	1653		120	1834	
266	1905		170	1650		170	1834	
288	1904		266	1668		266	1845	
336	1908		288	1664		288	1843	
408	1910		336	1670		336	1854	
456	1908		408	1670		408	1859	
504	1906		456	1680		456	1859	
			504	1668		504	1856	
Resid	. Str.	3.79 ksi	Resid.	Str.	5.51 ksi	Resid	. Str.	6.74 ksi
	Recover	y y	Recovery Recovery					
0	58		0	84		0	116	
1	45		1	76		1	101	
2	44		2	74		2	100	
3	44		3	72		3	97	

AS/3004 Test: Creep Test: Creep Test: Creep Orient: 90° Orient: 90° Orient: 90° Spec. No: C29-4 Spec. No: C15-3 Spec. No: C29-3 Temp: 250°F Temp: 250°F Temp: 250°F Stress: 2.70 ksi 50% ult. Stress 2.70 ksi 50 tolt. Stress: 2.70 ksi 50 % ult. Accum. Elap. Accum. Elap. Accum. Elap. Time Strain Time Strain Remarks Remarks Time Strain Remarks $(\mu in/in)$ (Pin/in) (µin/in) (hrs.) (hrs.) (hrs.) 2383 0 2775 2324 0 restart 0 0.016 2428 0.016 2778 0.016 2320 0.1 2478 0.1 2781 0.1 2335 0.25 2568 0.25 2793 0.25 2363 2375 0.5 2658 0.5 2807 0.6 2762 Failure 2387 1.6 **Failure** 2401 2415 2420 4 2427 5 6 2438 7 2441 24 2511 43.3 Failure Recovery Racovery Recovery

				AS/3004				
Test:_	Creep		Test: Creep			Test: Creep		
Orient	90*		Orient: 90*			Orient	: <u>90°</u>	
Spec. 1	io:C34-	7	Spec.	No: C31	-6	Spec. No: <u>C34-2</u>		
Temp:	250°1		Temp	250°F		Temp: 250°F		
Stress	: 2.12 ks:	40 % wit.	Stress	2.12 ks	40% ult.	Stress	2.12 ksi	40 % ult.
Elap.	Accum.		Elap.	Accum.		Elap.	Accum.	
Time		Remarks	Time	1	Remarks	Time	Strain	Remarks
(brs.)	(µin/in)		(hrs.)	(Pin/in)		(hrs.)	(µin/in)	
0	2006		0	2028		0	2031	
8.016	2023		0.016	2070		0.016	2049	
0.1	2036		0.1	2180		0.1	2068	
0.25	2042		0.25	2224		0.25	2075	
0.5	2058		0.5	2316		0.5	2090	
1	2066		1	2476		1	2100	
2.25	2080		2	2742		2.25	2110	
3	2085		2.8	Failure		3	2117	
4	2093					4	2125	
5	2099					5	2129	
6	2103					6	2135	
7	2106					7	2137	
8	2110					8	2142	
24	2155				·	24	2192	
48	2200					48	2243	
120	2262					120	2316	
168	2282					168	2342	
216	2298					216	2360	
288	2326					288	2392	
336	2343					336	2408	
357.8	Failure					338	Test te	minated
				<u> </u>				
						Resid	. Str.	2.86 ksi
			 					
		<u> </u>		<u> </u>	<u> </u>		<u> </u>	L,
	Recover	У	ļ	Recovery	<u></u>		Recovery	
-				 				
				<u> </u>				
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AS/3004 Test: Creep Test: Creen Test: Creep Orient: 90° 90° Orient:___ Orient: 90° Spec. No: C31-5 Spec. No: C34-5 Spec. No: C34-4 Temp: 250°F Temp: 250°F Temp:____ 250°F Stress: 1.62 ksi 30 % ult. Stress: 1.62 ksi 30% ult. Stress 1.62 kgi 30 % ult. Accum. Elap. Accum. Elap. Accum. Elap. Time Time Strain Remarks Time Strain Remarks Strain Remarks (hrs.) (# in/in) (hrs.) (#in/in) (µin/in) (hrs.) 1397 1460 1570 0.016 1425 1465 0.016 0.016 1583 0.1 1433 1469 1588 0.25 1437 0.25 1476 0.25 1589 0.5 1438 0.5 1484 1592 1 1438 1488 1595 2 1441 1500 1598 1443 1517 1596 4 1444 1514 20.3 Failure 1444 1518 1447 6 1520 1449 7 1526 8 8 1449 1528 1460 1570 24 24 48 1470 96 1670 96 1490 144 1723 168 1508 1778 192 216.5 1525 245.8 Failure 264 1535 346 1587 349.3 Failure Recovery Recovery Recovery

			C 250	AS/3004		(28		~
Test:	Creen		Test: Creep			Test: Creen		
Orient:	<u>+45°</u>		Orient: <u>+45*</u>			Orient: ±45°		
Spec. N	o: <u>C41</u> -	1	Spec. No: C41-5			Spec. No: C24-1		
Temp:_	R.T.		Temp:	R.T.		Temp:	R.T.	
Stress:	9.61 ksi	30 t ult.	Stress:	9.61 ksi	30% ult.	Stress	9.61 ksi	m ult.
Elap.	Accum.		Elap.	Accum.	l l	Elap.		
Time	Strain	Remarks	1 - 1		Remarks	Time		Remarks
(hrs.)	(µ in/in)		(hrs.)	(#in/in)		(hrs.)	(µin/in)	
0	8920		0	6950		0	9248	
0.016	9363		0.016	7381		0.016	9806	
0.1	10,107		0.1	7746		0.1	10,310	
0.25	10,483		0.25	7992		0.25	10,739	
0.5	10.808		0.5	8175		0.5	11,016	
1	11,183		1	8397		1	11,372	
1.5	11,413		1.5	8534		1.5	11,578	
2	11,584		2	8633		2	11,743	
3	11.853		3	8793		3	11.988	
4	12,034		4	8894		-4	12,153	
5	12,157		5	8964		5	12,263	
6	12,274		6	9030		6	12,369	
7	12,363		7	9082		7	12,451	
24	13.085		24	9499		24	13.107	
48	13.493		48	9730		48	13.476	
72	13,756	·	72	9884		72	13,717	
96	13,984		96	10,015		96	13,923	
168	14,344		168	1228		168	14.236	
216	14,500		216	10,288		216	14,374	<u> </u>
264	14,641		264	10,376		264	14,508	
336	14,784		336	10,429		336	14,618	1
384	14,972		384	10,575		384	14,799	
432	15,109		432	10.662		432	14,930	1
504	15,222		504	10,724		504	15.028	·
743			24.1	137.123			13,141	
Resid	Str.	29.24 ksi	Resid.	Str.	23.35 ksi	Resid	Str.	28.25 ksi
 	Recover	<u>,</u>	Recovery			Recovery		
101	8764		0	5118		0	7923	
1	8090	 	1	4692		1	7369	1
2	7997	1	2	4619		2	7275	
3.25	7936	 	3,25	4574		3.25	7215	
			مستلة خت	•		·		

				AS/3004					
Test:	Test: Creep			Test: Creep			Test: Creep		
	<u>±45</u>		Orient	±45°		Orient: ±45°			
	10: C4		Spec. 1	No: C41-	4		No: C41-	-7	
Temp:	Temp: R.T.			R.T.		Temp	R.T.	·	
Stress	: 6.41 ks:	20 1 ult.	Stress	6.41 ksi	20 t ult.	Storess	6.41 ksi	20 * ult.	
Elap.	Accum.		Elap.	Accum.		Elap.	Accum.		
Time		Remarks	Time		Remarks	Time	Strain	Remarks	
(hrs.)	(µ ir./in)		(hrs.)	(Pin/in)		(hrs.)	(µin/in)		
0	3638		0	3400		0	3468		
0.016	3804		0.016	3504		0.016	3543		
0.1	3897		0.1	3579		0.1	3609		
0.25	3938		0.25	3613		0.25	3643		
0.75	4005		0.75	3664		0.75	3691		
l	4027		1	3681		1	3707		
2	4082		2	3724		2	3752		
3	4114		3	3748		3	3774		
4	4138		4	3766		4_	3792		
5	4159		5	3783		5	3819		
6	4178		. 6	3798		6_	3824		
7	4193		7	3812		7_	3838		
8	4211		8	3824		8	3850		
24	4308		24	3900		24	3929		
96	4429		95	4005		96	4050		
144	4482		144	4054		144	4101		
192	4517		192	4075		192	4132		
264	4521		264	4089		264	4148		
312	4532		312	4097		312	4157		
360	4548		360	4109		360	4171		
432	4540		432	4101		432	4167		
480	4591		480	4144		480	4237		
502	4594		502	4146		502	4248		
<u></u>								<u></u>	
						<u> </u>			
Resid	. Str.	31.00 ksi	Resid.	Str.	25.42 ksi	Resid	Str.	29.46 ksi	
	<u> </u>			<u> </u>		 		L	
_	Recover	У		Recovery			Recovery	·	
0	1257		0	1015		0	988		
1	1063		_1	877		1	865	ļ	
2	1040		2	853		2	838		
	1022		3	841	i	3	831	L	

				AS/3004			
Cest:	Creep		Test:	Cree	>		
Orient	+45°		Orient: +45°				
Spec. N	io: <u>C21-</u> 6		Spec. No: <u>C22-2</u>				
Temp:	R.T.		Temp:	R.T.			
Stress	Stress: 3.20 ksi 10 t ult.			3.20)csi	10 ult.		
Elap. Time	Accum. Strain	Remarks	Elap. Time	Accum. Strain	Remark		
	(µ in/in)		(hrs.)	(#in/in)			
0	1595		0	1616			
0.016	1648		0.016	1645			
0.1	1660		0.1	1669			
0.25	1670		0.25	1679			
0.5	1674		0.5	1687	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,		
1	1682		1	1701			
2	1691		2	1712			
3	1696		3	1720			
4	1702		4	1729			
5	1700		5	1737			
6	1711		6	1744			
7	1718		7	1752			
8	1722		8	1755			
25.5	1745		25.5	1785			
48.5	1752		48.5	1793			
72	1800		72	1844			
144	1885		144	1951			
192	1857		192	1922			
240	1878		240	1944			
312	1853		312	1962			
361	1891	<u> </u>	361	1958			
409	1893		409	1960			
504	1926		504	2005			
Resid	Str.	30.36 ksi	Resid	. Str.	32.15 k		
	Recover	7		Recovery			
0	342		0	451			
1	305		1	407			
2	297		2	401			
		T		33.4			

Test:	Creap					
	: +45°	·				
Spec. No: C21-4						
Temp	R.T.					
Stress	3.20 kai	10\$ uit.				
Elap.	Accum.					
Time	Strain (µin/in)	Remarks				
0	1490					
0.016	1510					
0.1	150 <i>1</i>					
0.25	1570					
0.5	1580					
1	1588					
2	1597					
3	1602					
4	1610					
5	1616					
6	1621					
7	1628					
8	1631					
25.5	1655					
48.5	1659	,				
72	1707					
144	1819					
192	1792					
240	1812					
312	1828					
361	1823					
409	1824					
504	1872					
Resid	Str.	25.58 ksi				
 -	Recovery					
0	422	T				
1	380					
2	371					
3	369					

AS/3004 Test: Creep Creep Creep Test: Test: +45* +45* +45* Orient: Orient: Orient: Spec. No: C48-5 Spec. No: C42-7 C48-3 Spec. No: Temp: 180°F Temp: 180°F Temp: 180°F Stress: 8.33 ksi 30 1 ult. Stress: 8.33 ksi 30 % ult. Stress 8.33 ksi 30% ult. Elap. Accum. Elap. Accum. Elap. Accum. Remarks Strain Time Strain Remarks Time Time Strain Remarks (# in/in) (#in/in) (hr =.) (hrs.) (µin/in) (hrs.) 9999 O 7038 0 8090 0 0.016 11,039 0.016 8177 0.016 9068 11,361 0.1 8745 9286 9413 0.25 11,410 0.25 8947 0.25 0.5 0.5 9120 0.5 9498 11,452 9366 9612 11,519 2 11,598 2 9587 9740 2 3 9718 3 9832 3 11,660 4 11,713 9900 9810 10.092 8 11,862 8 10.038 8 11,890 9 10,080 10,128 10,163 10 11,922 10 10,119 10 24 10,416 10,447 24 12,158 24 12,651 96 10,982 96 11,018 144 11,160 144 11,229 144 12,822 192 12,957 192 11,299 192 11,371 11,465 13,123 266 266 11,557 266 312 312 13,203 312 11,532 11,631 360 13,294 360 11,603 360 11,723 442 11,800 442 13,361 442 11,681 11,870 480 13,427 480 11.758 480 11,903 500.3 13,454 500.1 11,780 500.1 32.97 ksi Resid. Str. 34.38 ksi Resid Str. 31.40 ksi Resid Str. Recovery Recovery Recovery

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7132

6763

6675

6647

7090

6657

6561

6534

0

2

8520

7832

7728

7694

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Test:	Creep		Test:_	Creep			Creep	
Orient	<u>+</u> 45°		Orient: ±45°			Orient	±45°	
Spec. N	io: C47-	<u> </u>	Spec. No: C47-1			Spec. No: C47-6		
Temp:	180	'F	Temp:	180°F		Temp:	780 °1	·
Stress	: <u>5.55</u> ks:	20 t ult.	Stress:	<u>5.55 ksi</u>	26 t ult.	Stress	5.55 josi	200 ult.
Elap.	Accum.		Elap.	Accum.		Elap.	Accum.	
Time		Remarks	Time		Remarks	Time		Remarks
(hrs.)	(µ in/in)		1	(Pin/in)		(hrs.)	(µin/in)	
0	3400		0	3862		0	3477	
0.016	3517		0.016	3973		0.016	3656	
0.1	3594		0.1	4082		0.1	3724	
0.25	3626		0.25	4163		0.25	3752	
0.5	3654		0.5	4222		0.5	3778	
1	3699		1	4281		1	3812	
2	3731		2	4348		2	3852	
3	3757		3	4388		3	3878	
4	3787		4	4418		4	3894	
5	3804		5	4440		5	3910	
6	3813		6	4456		6	3921	
7	3821		7	4474		7	3936	
24_	3953		24	4626		24	4049	
48	4050		48	4720		48	4130	
96	4202		96	4837		96	4224	
168	4283		168	4936		168	4302	
216	4312		216	4972		216	4330	
264	4349		264	5018		264	4361	
336	4377		336	5061		336	4394	
384	4406		384	5086		384	4418	
432	4426		432	5110		432	4440	
504	4459		504	5132		504	4458	
Resid	. Str.	31.47 ksi	Regid	Str.	28.33 ks:	Resid	. Str.	32.68 ksi
Vesto	JCF.	72.77 731	weard.	301.	20.33 AS			52.00 AS
	Recover	y		Recovery	<u> </u>		Recovery	<u> </u>
0	1408	T	_0_	1742		C	1322	
1	1240		3.	1550		1	1184	
2	1220		2	1516		2	1159	
3	1197		3	1493		3	1137	

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	Creep		Test:_	Creeo		Test: Creep			
Orient:	<u>+</u> 45°			Orient: +45°			Orient: +45°		
	o: C22-1		Spec. No: <u>C23-8</u>			Spec. No: C24-7			
Temp:_	180	<u> </u>	Temp:	180°F		Temp: 180*F			
Stress:	2.78 ks	10 % alt.	Stress:	2.79 ks	100 Wt.	Stress	2.78 ksi	<u>10</u> % ult.	
Elap.	Accum.			Accum.			Accum.		
		Remarks			Remarks	Time		Remarks	
	(p in/in)		1	(#in/in)		1	(µin/in)		
0	1522		0	1419		0	1367		
0.016	1553		0.016	1436		0.016	1375		
0.1	1590		0.1	1452		0.1	1397		
0.25	1607		0.25	1473		0.25	1406		
0.5	1618		0.5	1482		0.5	1413		
1	1630		1	1493		1	1420		
						2			
3	1664		3	1521		3	1445		
4	1680		4	1534		4	1456		
24	1757		24	1588		24	1508		
48	1791		48	1621		48	1534		
144	1856		144	1673		144	1585		
168	1869		168	1680		168	1599		
216	1891		216	1696		216	1611		
288	1910		288	1713		288	1623		
336	1910		336	1710		·	1620		
384	1922		384	1717		336 384	1629		
456	1930		456	1723		456	1631		
504	1967		504	1741		504	1648		
├									
									
Resid.	Str.	30.99 ksi	Resid	. Str.	33.79 ksi	Resid	. Str.	31.04 ksi	
	Recover	r		Recovery			Recovery		
0	525		0	397		0	360		
	490		1	354		1	331		
2	485		2	349		2	322		
3	481		3	345		3	316		

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Test:	Test: Creep		Test: Creep			Test: Cresp			
			Orient: +45°			Orient: +45°			
Orient: <u>±45°</u> Spec. No: <u>C45-2</u>			Spec. No: C43-3			Spec. No: C42-6			
						1			
Temp:	250	F	Temp:	250°F		Temp:	250°F		
Stress	: <u>7.29 k</u> si	30 % ult.	Stress	7.29 ks	308 ult.	Stress	7,29 ksi	30 % ult.	
	Accum.			Accum.		Elap.		_	
	Strain	Remarks	Time		Remarks	Time	Strain	Remarks	
	(μ in/in)		1	(#in/in)			(µin/in)		
0	9280		0	7716		0	7902		
0.008			0.008	8042		0.008			
	12,090		0.025	8160		0.025	12,661		
0.05	12,856		0.05	8332		0.05	13,180		
0.1	14,942		0.1	9330		0.1	13,239		
0.15	15,268		0.15	9524		0.15	13,258		
0.2	15,330		0.2	9633		0.2	13,260		
0.25	15,381		0.25	9692		0.25	13,273		
0.5	15,558		0.5	10.043		0.5	13,346		
1	15,774		1	10.377		1	13.441		
2	16,111		2	10,830		2	13,578		
3	16,321		3	11,076		3	13,674		
4	16,506		4	11,281		4	13,762		
5	16,677		5	11,475		5	13,848		
6	16,802		6	11,614		6	13,907		
7	16,928		7	11,749		7	13,967		
8	17,020		8	11,902		8	14,031		
10	17,280		10	12,103		10	14,123		
12	17,442		12	12,251		12	14,209		
14	17.610		14	12,422		14	14.315		
16	17,762		16	12,558		16	14,393		
18	17,905		18	12,695		18	14,471		
20	18,019		20	12,807		20	14,535		
23	18,708		23	12,970		23	14,636		
72	19,863		72	14,444		72	15,557		
120	20,737		120	15,244		120	16,124		
168	21,359		168	15,794		168	16,598		
216	22,009	, , , , , , , , , , , , , , , , , , , ,	216	16,378		216	17,124		
	Recovery			Recovery			Recovery		
Conti	nued on r	next page	Conti	nued on	next page	Conti	nued on n	ext page	
					- -			- •	

AS/3004 C45-2 continued C43-3 continued C42-6 continued Test: Creep Test: Creep Test: Creep ±45° Orient:__ ±45° Orient: ±45° Orient: Spec. No: C45-2 Spec. No: C43-3 Spec. No: C42-6 Temp: 250°F Temp: 250°F Temp: 250°F Stress: 7.29 ksi 30 * ult. Stress: 7.29 ksi 30% ult. Stress 7.29 ksi 30% ult. Elap. Accum. Elap. Accum. Elap. Accum. Strain Strain Remarks Time Remarks Time Strain Time Remarks (# in/in) (#in/in) (hrs.) (hrs.) (hrs.) (µin/in) 288.8 288.8 22,378 16,695 288.8 17,432 336 336 22,668 16,970 336 17,677 408 17,305 408 23,054 408 18,022 456 23,286 456 17,522 456 18,219 506.5 23,487 506.5 17,704 506.5 18,406 25.29 ksi Resid 31.21 ksi Resid. Str. 33.36 ksi Resid Str. Str. Recovery Recovery Recovery 13,162 14,520 19,264 0 11,939 1 14,292 18,629 11.798 18,521 14,259 18,493 11,780 14,247

AS/3004 Creep Test: Creep Test: Creep Test: Orient: ±45° +45* ±45° Orient: Orient: Spec. No: C48-7 C48-4 Spec. No: C47-7 Spec. No: 250°F Temp: 250°F Temp: 250°F Temp: Stress: 4.86 ksi 20 % ult. Stress: 4.86 ksi 20% ult. Stress 4.86 ksi 20 ult. Elap. Elap. Elap. Accum. Accum. Accum. Strain Remarks Time Strain Time Time Remarks Strain Remarks (µ in/in) (hrs.) (#in/in) (hrs.) (µin/in) (hrs.) 3093 0 3814 0 3185 0.016 3357 0.016 4344 0.016 3253 4162 0.1 0.1 4908 0.1 3428 0.3 4346 0.3 5144 0.3 4063 0.5 4422 5254 0.5 0.5 4100 4608 5608 4180 2.2 4882 2.2 2.2 Gage failed 4288 4937 391.8 Failure 3 3 4339 4 4998 4 4386 5 5049 5 4427 6 5098 6 4459 5153 7 4482 8 5252 4540 24 5712 24 4782 48 6127 48 4992 120 6722 20 5336 168 6993 168 5467 216 7212 216 5566 288 7452 288 5681 336 7589 336 5757 384 7708 384 5821 Test terminated Test terminated 27.41 ksi Resid Str. Resid Str. 32.28 ksi Recovery Recovery Recovery

				AS/3004				
	Creep		Test:	Creep			Çreer	
Orient	<u>+45</u>	•	Orient: +45°			Orient: +45°		
Spec. N	To: C50-	-3	Spec. No: C50-8			Spec. No: C48-2		
Temp:	250	•P	Temp: 250°F			Temp	250	E
Stress	: <u>2.43</u> Ks	1 <u>10</u> ut.	Stress	_2,43ks	108 Wt.	Stress	2.43 ksi	10% ult.
Elap.	Accum.		Elap.	Accurs.		Elap.	Accum,	
Time	Strain	Remarks	Time	Strain	Remarks		Strain	Remarks
(hrs.)	(# in/in)	 	(hrs.)	(Pin/in)		(hrs.)	(µin/in)	
0	1220		0	1442		0	1631	
0.016	1388		0.016	1642			No data	
0.1	1444		0.1	1638			gage fai	led
0.25	1415		0.25	1684		528	no fail	
0.5	1423		0.5	1705				
1	1432		1	1742				
2	1437		2	1769				
3.5	1449		3.5	1800				
. 5	1457		5	1824				
6	1464		. 6	1837				
7	1471		7	1847				_
8	1475		8	1858				
24	1538		24	1950				
72	1632		72	2109				
144	1710		144	2218				
192	1750		192	2270				
240.4	1786		240.4	2315				
312	1819		312	2352				
360.2	1838		360.2	2387				
408	1865		408	2420				
480	1922		480	2462				
528	1960		528	2492				
Resid	Str.	34.85 ksi	Resid.	Str.	33.27 ksi	Resid	Str.	32.94 ksi
	Recover	y		Recovery	<u> </u>	Recovery		
0	785		0	1340		-		Γ
1	740	 	1	1310				
2	725		2	1237				
3	721	 	3	1223		{		

				AS/4397	· · · · · · · · · · · · · · · · · · ·				
Test:_	Creep		Test:	Creep		Test:	Creep		
Orient	0 *		Orient	Orient: 0°			Orient: 0°		
Spec. N	lo: <u>D46-1</u>		Spec. 1	Spec. No: <u>D46-13</u>			Spec. No: <u>D46-7</u>		
Temp:	R.T.		Temp:	R.T.		Temp:	k.T.		
Strass	182.1 ks	90 * ult.	Stress:	182.1 ks:	901 ult.	Stress	<u>182.1</u> ksi	90% ult.	
Elap.	Accum.		Elap.	Accum.		Elap.	Accum.		
Time		Remarks	Time	Strain	Remarks	Time	Strain	Remarks	
(hrs.)	(µ in/in)		(hrs.)	(#in/in)		(hrs.)	(µin/in)		
0	8912		0	8455		0	10,382		
0.016	8911		0.016	8459		0.016	10,395		
0.1	8913	ii	0.1	8460		0.1	10,403		
0.25	8914		0.25	8461		0.25	10,401		
0.5	8914		0.5	8462		0.5	10.403		
1	8922		1	8466		1	10,406		
2.25	8924		2	8463		2	10,407		
4	8922		3	8462		3	10,408		
5.15	8924		4	8463		4	10,408		
6	8925		5	8464		5	10,408		
7	8926		6	8465		6	10,412		
24	8926		7	8465		7	10,408		
120	8931		8	8463		8	10,408		
218	8933		96	8462		96	10,441		
290	8937		120	8465		120	10,447		
336.5	8935		144	8464		144	10,439		
385	8933		168	8466		168	10.445		
505.7	8935		264	8459		264.2	10,444		
	7.3.5		313.5	8459		312	10,443		
			362	8458		362	10,444		
			434	8459		434	10,445		
			482.5	8465		482	10,450		
			531	8461		531	10,525		
Resid	. Str.	201.0 ksi	Resid.	Str.	206.5 ksi	Resid	. Str.	233.4 ksi	
		 				<u> </u>			
	Recover	<u>'</u>		Recovery	<u> </u>		Recovery		
0	46		0	38		 	no data		
1	35	1	1	22					
2	22	 	2	22	<u> </u>				
3	23	 	3	22				<u> </u>	
	L 23					ا	<u> </u>	<u></u>	

AS/4397 Test: Creep Test: Creep Test: Creep Orient: 0 0 Orient: 0° Orient: 0. Spec. No: D5-7 Spec. No: D6-17 Spec. No: 07-19 Temp: R.T. Temp: R.T. Temp: R.T. Stress: 161.9 ksi 80 % ult. Stress 161.9 ksi 80% ult. Stress: 161.9 ksi gu * ult. Elap. Accum. Elap. Elap. Accum. Accum. Strain Remarks Time Strain Remarks Time Strain Remarks Time (# in/in) (#in/in) (µin/in) (hrs.) (hrs.) (hrs.) Resid. Str. 234.4 ksi Resid. Str. 188.7 ksi Resid. Str. 185.8 ksi Recovery Recovery Recovery

			AS/4397				
Creep					Test:	Creep	
: 0°		Orient: 0°			Orient: 0°		
		Spec. No: D3-13			Spec. No: D4-13		
R.T.		Temp:	R,T.		Temp:	R.T.	
: 141.6 ks	i 70% w.t.	Stress:	141.6 ksi	70% ult.	Stress	141.6 ksi	701 ult.
Accum.		Elap.	Accum.		Elap.	Accum.	
	Kemarks			Remarks			Remarks
					1		
	———						
							
				 			
				 	J		
							<u> </u>
					-		
							
		·					
							
		-	1.2.2		201		

Str.	204.0 ksi	Resid.	Str.	218.6ksi	Resid.	Str.	232, 4 ksi
Recover	y		Recovery	<u> </u>		Recovery	
19		0	-6	T	0	3.8	T
2		1.25	-22		1.25	11	
-4		2	-23		2	4	
-4		3	-24		3	1	T
	: 0° :: 0° Ro: D1-14 R. T. : 141.6 ks Accum. Strain (\(\mu\) in/in) 7360 7369 7375 7371 7381 7382 7388 7408 7415 7398 7388 7388 7383 7404 7375 7384 7379 Str. Recover	: 0° Io: D1-14 R. T. : 141.6 ksi 70% ult. Accum. Strain (μ in/in) 7360 7369 7375 7375 7371 7381 7382 7388 7408 7415 7398 7388 7388 7388 7388 7388 7388 7388	10° Orient Spec.1	10° Orient: 0° Spec. No: D3-1	O	Crient: 0° Crient: 0° Crient Spec. No: D3-13 Temp: R. T.	Corient: 0° Spec. No: D3-13 Spec. No: D4-13 Spec. D4-13 Spec. D4-13 Spec. D4-13 Spec. D4-13 Spec. D4-13 Spec. D4-13 Spec. D4-13 Spec. D4-13 Spec. D4-13 Spec. D4-13 Spec. D4-13 Spec. D4-13 Spec. D4-13 Spec. D4-13 Spec. D4-13 Spec. D4-13 Spec. D4-13 Spec. D4-

سمسميير			·	AS/4397	·				
	t: Creep Test: Creep			[Creep			
	Orient: 0°			Orient: 00			Orient: 0°		
	Io: D5-4		Spec.	No: D46-6	·	Spac. No: D1-1			
Temp:			Temp:	350°					
Stress	: 131.2 ks	170 % ult.	Stress	131.2 ksi	70 tut.	Stress 131.2 ksi 70% ult.			
Elap.	Accum.		Elap.	Accum.		Elap.	Accum.		
Time	Strain	Remarks	Time	Strain	Remarks	Time	Strain	Remarks	
(hrs.)	(µin/in)		(hrs.)	(Min/in)		(hrs.)	(µin/in)		
0	6746			6539		0	Failed on	Loading	
0.016	6746		0.016	6542					
0.1	6753		0.1	6538					
0,25	6753		0.25	6545					
0,5	6755		0.5	6546					
1	6760		1.1	6552					
2	6766		3,5	6564					
3	6769		4	6569					
4	6774		5	6571					
5	6773		6	6575					
6	6775		7	6579					
72	6837		24	6646					
120	6854		49	6695					
168	6870		72	6717					
240	6884		96	6743					
264	6894		168	6770					
288	6901		192	6786					
312	6909		240	6806					
336	6923		264	6821					
408	6953		385	6833					
456	6965		432.5	6823					
504	69-16		504.5	6828					
576	6961								
Resid.	Str.	217, 1 ksi	Resid.	Str.	162.7 ksi				
	Recover	<u> </u>		Recovery	i	 	Recovery		
0	284		0	344			T	Γ	
4	187	 	1	332					
			2	328					
			3	324					
4	187		2	328					

				AS/43
,	Creep		Test:	Creep
Orient	: 00	[Orient	: 0°
2	lo: D46-1	11	Spec. I	No: D4-
	350°F		Temp:	350°F
Stress	: <u>112.5</u> ks	i 600 ult.	Stress	112.5 k
Elap.	Accum.		Elap.	Accum
Time	Strain	Remarks	Time	Strain
(hrs.)	(# in/in)		(hrs.)	(#in/ir
0	5548		0	5757
0.016	5558		0.016	5744
0,134	5562		0.1	5768
0.25	5564		0.3	5772
0.5	5577		0.5	5772
1.5	5578		1	5776
2	5576		2.16	5776
3	5585		3.25	5776
	,			

24, 5

170.

Resid Str.

Recovery

229. 7 ksi

Orient	Orient: 0°					
Spec. No: D4-2						
Temp:	350°F					
Stress:	112,5 ksi	604 ult.				
Élap,	Accum.					
Time	Strain	Remarks				
(hrs.)	(#in/in)					
0	5757					
0.016	5744					
0.1	5768					
0.3	5772					
0.5	5772					
_1	5776					
2.16	5776					
3.25	5776					
4.5	5780					
6	5787					
24	5776					
49	5785					
63	5800					
87	5814					
159	5809					
184	5802					
208.1	5800					
256	5802					
328	5793					
376	5303					
424.1	5822					
496	5831					
544	5840					
Resid.	Str.	211.1 ksi				
	Recovery					
0	112					
1	96					
2	105					
3	98	L				

Test:	Creep	
Orient	:_ 0°	
1	No: D3-6	
	350°F	
}	112.5 ks:	60% ult.
Elap.	Accum.	
Time	Strain	Remarks
(hrs.)	(µin/in)	
0	5816	
0.016	5826	
0.1	5850	
0.3	5853	
0.5	5853	
1	5854	
2.16	7873	
3.25	5873	
4.5	5881	
6	5893	
24	5928	
49	5996	
63	6052	
87	6106	
159	6224	
184	6268	
208.1	6298	
256	6374	
328	6451	
376	6497	
424.1	6573	
496	6646	
544	6686	ļJ
	 	ļ
		
 	<u> </u>	
<u> </u>		
Resid	Recovery	184. 2 ks
0	868	
1	862	
2	852	
3	836	
I		<u> </u>

AS/4397												
Test: Creep			Test: Creep			Test: Creep						
Orient: 0°			Orient: 0°			Orient: 0°						
ξ -	lo: D7-5		Spec. 1	Spec. No: D6-4			Spec. No: D5-15					
Temp:	350°F		Temp: 350°F			Temp: 350°F						
Stress: 93.7 ksi 50% ult.			Stress: 93.7 ksi 501 ult.			Stress 93.7 kmi 50% ult.						
Elap.	Accum.		Elap.	Accum.		Elap.	Accum.					
Time	Strain	Remarks	Time	Strain	Remarks	Time	Strain	Remarks				
	(µ in/in)		(hrs.)			(hrs.)						
0	4948		0	5005		0	4326					
0.066	5023		0.066	5008		0.066	4328					
0.1	4946		0.1	5010		0.1	4327					
0.25	4945		0.25	5007		0.25	4331					
0.5	4953		0.5	5010		0.5	4331					
1	4953		1	5011		1	4332					
2	4958		2	5013		2	4333					
3	4965		3	5015		3	4333					
4.6	4969		4.6	5020		4.6	4334					
5	4971		5	5023		5	5335					
6.5	4978		6.5	5024		6.5	4333					
7	4978		7	5022		7	4335					
8	4981		8	5024		8	4337					
24. 25	4983		24. 25	5021		24.25						
72	4927		72	5024		72	4375					
144	4867		144	5054		144	4358					
192	4828		192	5061		192	4329					
240	4756		240	5107		240	4299					
312.8	4754		312.8	5086		312.8	4253					
336	4742		336	5086		336	4242					
360	4728		360	5090		360	4234					
48C	4721		480	5115		480	4210					
552	4699		552	5104		552	4184					
576	4690		576	5106		576	4189					
							1407					
Resid	Str.	203, 0 ksi	Resid.	Str.	212.6 ksi	Resid	Str.	213.5				
	Recover	y		Recovery			Recovery					
0	-193		0	89	 	0	170					
1	-187		1	108		1	184	<u> </u>				
2	-213		- 3	89		2	173					
3	-217			79		3	177					

Test: Greep	Test: Creep			Test: Creep		
Orient: 0°	Orient: 0°			Orient: 0°		
Spec. No. 25-11	Spec - No: <u>D6-1</u>			Spec. No: D7-11		
Te:np: 450°F	Temp: 450°F			Temp: 450°F		
Streets: 144.5 ksi 70* ult.	Stress: 144.5 ksi 704 ult.			Stress144.5 ksi 70% ult.		
Elap. Accum.	Elap.	Accum.		Elap.	Accum.	
Time Strain Remarks	Time	Strain	Remarks	Time		Remarks
(hrs.) (# in/in)	(hrs.)		1	(hrs.)		
0 Gage failed on loading	0	7859		0	7419	
	0, 016	7864		0.016		
	0.1	7877		0.1	7425	
	0, 25	7886		0.25	7448	
	0, 5	7896		0.5	7453	
	1	Failure		1	Failure	
Recovery	Recovery			Recovery		
					[

AS/4397 Test: Creep Test: Creep Test: Creep Orient: 00 Orient: 00 Orient: 00 Spec. No: D4-18 Spec. No: D5-19 Spec. No: D7-8 Temp: 450°F Temp: 450°F Temp: 450°F Stress: 123.9 ksi 60% ult. Stress 123.9 ksi 60 % wlt. Stress: 123 9 kmi 60% ult. Accum. Elap. Accum. Accum. Elap. Elap. Time Strain Remarks Time Strain Remarks Time Strain Remarks (Hin/in) (hrs.) (µin/in) (hrs.) (µin/in) (hrs.) 6341 6066 6965 0.016 6365 0.016 6076 0.016 6998 6076 0.1 7067 0, 1 6438 0. 1 0.25 6076 0, 25 7165 6463 0, 25 0.5 6360 0.5 6071 0. 5 7307 7428 6345 6064 2 6371 2 6055 7468 z 6049 6407 3 7496 4 3 6454 6044 7502 72 7872 6029 7557 7573 144 9487 24 6055 6.8 168 9731 96 7048 12,6 Failure 7255 240 11,290 120 11,817 264 8278 288 312 12,637 312 8467 362 337 12, 898 8650 409 13, 652 432 8839 14,070 479 8951 457 481 14, 222 522 9004 577 14,650 177.9 ksi 208.3 ksi Resid. Str. Resid. Str. Recovery Recovery Recovery 3540 8592 0 0 8574 1.3 3665 3695 8565 3686 8563

THE REPORT OF THE PROPERTY OF

				AS/4397	·				
	Creep			Creep		,	Creep		
Orient	: 0°		Orient	: <u>0°</u>		Orient: 0°			
Spec. N	lo: <u>D6-8</u>		Spec. No: <u>D46-8</u>			Spec. No: <u>D46-10</u>			
Temp:	450°F		Temp: 450°F			Temp: 450°F			
Stress	: 103.2 ks	i ⁵⁾ 8 ult.	Stress:	103.2 ksi	50% ult.	Stress	<u>103.2 k</u> si	50% ult.	
Elap.	Accum.		Elap.	Accum.		Elap.		_	
		Remarks	Time	Strain	Remarks	Time	Strain	Remarks	
(hrs.)	(µin/in)		(nrs.)	(#in/in)		-	(µin/in)		
- 0	Failed on	Loading		5293		0	5157		
			0.016	5306		0.016			
			0.1	5312		0.1	5180		
			0.25	5321		0.25	5198		
			0,5	5329		0,5	5203		
			1	5352		1	5174		
			2	5378		2	5180		
			3	5415		3	5212		
			4	5432		4	5182		
			5	5458		5	5182		
			6	5485		6	5180		
			7	5513		7	5205		
			8	5583		8	5190		
			24	5944		24	5192		
		_	50	6617		50	5183		
			120	8292		120	5183		
			168.5	9249		168.5	5192		
			216	10, 192		216	5190		
			289	11, 484		289	5143		
			385	12,612		385	5133		
				13, 423		481	5164		
			505	13, 594		505	5174		
			Pesid.	Str.	212.0 ksi	Resid	Str.	224. 0 ksi	
	D	1		Banarra	<u> </u>		P. a a a se	<u> </u>	
	Recover	у	<u> </u>	Recovery	,	-	Recovery	·	
		 	0	8515	 	0	96		
		 	1_1	8564	 	1	68	 	
	 	 	2	8570	 	2	56	 	
<u> </u>	<u> </u>		3	8570		3	9	L	

				AS/4397						
Test:_	Creep		Test:			Test:				
Orient	; 90°		Orien	t: 90°		Ories	st: 90°			
	To: D20-	4	Spec.	No: D23-	4	Spec.	Spec. No: D23-10			
Temp:	R.T.		Temp	Temp: R.T.			Temp: R.T.			
Stress	: <u>4.83 k</u> si	90% ult.	Stress	Stress: 4.83 ksi 90 % ult.			9 <u>4.83 k</u> si	90% ult.		
Elap.	Accum.		Elap.	1		Elap.				
Time	Strain	Remarks	Time	1 .	Remarks	Time		Remarks		
(hrs.)	(µ in/in)		(hrs.)	(Pin/in)		(hrs.	_			
0	3237		0	Failed or	Loading	0	Failed on	Loading		
0.016	3257									
0.15	3370									
0.25	3382									
0.5	3399									
1.3	3420									
2, 3	3418									
3,3	3427									
4	3432									
5	3442									
6	3444									
24	3498			T						
48	3548									
120.1	3651									
168	. 3655									
216.2	3646									
288	3808									
336	3758									
388	3810									
456	3822									
508	3842									
L										
Resid.	Str.	5.06 ksi					1			
	L			Passes	1		D. con-			
	Recover	У		Recovery			Recovery			
0	530		 	 	 	┨		 		
1	432			 	 	┨	+	 		
2	422	 			 	┥	 	 		
. 3	412	1	1 1	l	1	1 1	1	1		

				AS/4397	<i>!</i>			
Test:_	Creep		Test:			,	Greep	
Orient	: 90°		Orient	: 90°		Orient	:: 90°	
Spec. 1	Vo: D14-	4	Spec. I	No: D21-	4	Spec. I	No: D12-	<u> </u>
Temp:	R.T.		Temp:	R.T.		Temp	R.T.	
Stress	: 4.29 ksi	80 % uit.	Stress	4.29 ksi	80% ult.	Stress	4.29 ksi	80% ult
Elap.	Accum.		Elap.	Accum.		Elap.	Accum.	
Time	Strain	Remarks	Time	Strain	Remarks	Time	Strain	Remar
	(# in/in)		(hrs.)			(hrs.)		
0	3028		0	3007		0	3030	
0.016	3050		0.016	3036		0.016	3068	
0.05	3062		0.05	3050		0.05	3080	
0.1	3092		0.1	3063		0.1	3090	ļ
0.25	3087		0.25	3078		0.25	3105	
0.5	3099		0.5	3094		0.5	3115	<u> </u>
1	3115		1	3112		1	3131	
2	3122		2	3130		2	3146	
3	3146		3	3146		3	3162	
4	3153		4	3165		4	3178	
5	3162		55	3173		5	3185	
6	3169		6	3180		6	3191	
7	3178		7	3187		7	3196	
8	3182		8	3193		8	3203	
25	3241		25	3261		25	3263	
48	3298		48	3323		48	3321	<u> </u>
121	3350		121	3380		121	3376	
168	3417		168	3448		168	3440	ļ
216	3464		216	3495		216	3487	
312	3511		312	3541		312	3535	
384	3601		384	3576	<u> </u>	384	3597	
456	3605		456	3636		456	3627	<u></u>
504	3636		504	3668		504	3660	1
								<u> </u>
					<u> </u>			
						 		
Resid.	Str.	4.82 ksi	Resid.	Str.	6.23 ksi	Resid.	Str.	4.37 k
	Recover	y		Recovery	<u> </u>		Recovery	r
0	620	<u></u>	0	635		0	615	T
1	562	1	1	653		1	564	
2	539		2	629		2	539	1
	T			l	1		1	1
			· · · · · · · · · · · · · · · · · · ·			<u> - استوستون</u>	, , , , , , , , , , , , , , , , , , , 	

Test: Creep Orient: 90° Spec. No: D21-10 Temp: R.T. Stress: 3.76 ksi Accum. Elap. Time Strain Remarks (# in/in) (hrs.) 0.1 0.25 0.5 144.5 Resid. Str. 4. 99 kai Recovery

	AS/4397	
Test:_	Creep	
Orient	: 90	
Spec. 1	No: D25-1	
Temp:	R.T.	
Stress:	3.76 ksi	70 % ult.
Elap.	Accum.	
Time	Strain	Remarks
(hrs.)	(Pin/in)	
0	2628	
0.05	2644	
0.1	2646	
0.25	2646	
0.5	2648	
1	2650	
2	2654	
3	2655	
4	2659	
5	2664	
. 6	2680	
7	2682	
- 8	2688	
24	2746	
72	2839	
144.5	2882	
192	2938	
240	2976	
336	3021	
408	3087	
480	3109	
502	3138	
Resid.	CA-	4 22 1
Vesig.	OFF.	4. 23 ksi
	Recovery	1
0	490	
- -	433	<u> </u>
2	422	
3	413	<u> </u>
' <u>-</u> -	<u> </u>	<u> </u>

Test:	Creep	
Orient	:: <u>90</u> °	
Spec. 1	No: D18-5	
}	R.T.	
	3,76 ksi	70% uit.
Elap.	Accum.	
Time	Strain	Remarks
(hrs.)	(µin/in)	
0	2569	
0.05	2584	
0.1	2584	
0.25	2585	
0,5	2586	
1	2589	
2	2592	
3	2592	
4	2597	
5	2602	
6	2622	
7	2623	
8	2629	
24	2684	
72	2777	
144.5	2810	
192	2872	
240	2908	
336	2943	
408	3000	
580	3022	
502	3050	
		11
Resid.	Str.	5.32 ksi
	Bassess	<u> </u>
-	Recovery	
	510	 -
1-1-	444	
2	434	 -
3	424	<u> </u>

				AS/4397					
	Creep		1 -	Creep			Creep		
Orient	: <u>90°</u>		£ .	: <u>90</u> °		Orient: 90°			
Spec. 1	Vo: D15-	0	Spec. 1	No: D22-	10	Spec.	. No: D23-8		
Temp:	350°F		Temp:	350°F			350°F		
Stress	2.67 ks	<u>i_70</u> % ult.	Stress	2.67 ksi	70 % ult.	Stress 2.67 ksi 70% ult.			
Elap.	Accum.		Elap.	Accum.		Elap.	Accum.		
Time	St. ain	Remarks	Time	Strain	Remarks	Time	Strain	Remarks	
(hrs.)	(µin/in)		(hrs.)	(#in/in)		(hrs.)	(µin/in)		
0	2058		0	2046		0	2476		
0.016	2119		0.016	2109		0.016	2616		
0.05	2161		0.1	2209					
0, 1	2206		0.2	Failure					
0.25	2258								
0.5	2308								
1, 25	2396								
2	2438								
3.5	2472								
4	2488			_					
5	2513								
6	2527						****		
7	2541								
24	2688								
48	2776								
120	2932								
144	2980								
168	3019								
172	3060								
196	3085								
268	3165								
316.7	3168								
364	3192								
436	3282								
460	3310								
484	3323								
509	3358								
Resid.	Str.	4.13 ksi							
	Recover	у		Recovery			Recovery		
0	1601								
3	1400								
4	1411								
L	<u> </u>	L		L					

				AS/439/			-			
Test:_	Cree	p	Test: Creep			, –	Cree	<u> </u>		
Orient	90°		Orient	90°			: 90°			
Spec. N	o: D15-7	·	Spec. N	io: D13	-2	Spec.	No: D21-6	·		
Temp:	_			350°F			350°			
Stress	. 2.29 ksi	60% ult.	Stress:	Stress: 2.29 ksi 60% ult.			Stress 2.29 ksi 60% ult.			
Elap.	Accum.		Elap.	Accum.		Elap.	Accum.			
Time	Strain	Remarks	Time	Strain	Remarks	Time		Remarks		
(hrs.)	(µ in/in)		(hrs.)	(Pin/in)		·	(µin/in)			
0	1817		0	1952		0	Failed on	Loading		
0.016	1841		0.016	2050						
0.1	1879		0.1	2174						
0.25	1912		0.25	2241						
0.5	1934		0.5	2264						
	1968		1	2364						
2	2010		2	2417						
3	2046		3	2459				<u> </u>		
4	2073		4	2530						
5	2093		5	2554						
6	2095		6	2579						
7	2107		7	2607			<u></u>			
8	2121		8	2632						
31	2277		31	2814						
96	2502		96	3079		<u> </u>	ļ			
112.4	2555		112.4	3175						
168	2622		168	3269						
240	2737		240	3413				<u> </u>		
288	278 9		288	3480			ļ			
336	2858		336	3582			<u> </u>	ļ		
408	2937		408	3146						
460.5	2987		460.5	3169		l	<u> </u>	<u> </u>		
508	3066		508	3148			ļ	ļ. <u></u>		
		 			ļ		ļ	ļ		
<u> </u>		 			 		 	 		
		2 22 1			2 071	ļ 	 			
Resid	Str.	3, 22 ksi	Resid.	Str.	3.87 ksi		 	 		
Recovery			Recovery			Recovery				
0	1154		0	1496						
1	1043		1	1454						
2	1016		2	1448				1		
3	984		3	1441	1]		<u> </u>		

				AS/439	7					
Test:_	Creep		Test:	Creep		Test:	Creep			
Orient	: 90°		Orien	:: <u>90</u> °	····	Orien	t: 90°			
	No: D25-	5	Spec. 1	No: D25-	10	Spec.	Spec. No: D21-2			
Temp:	350°F		Temp:	350°F	······································	Temp: 350°F				
Stress	: <u>1.90 k</u> si	50% ult.	Stress	1.90 ksi	50% ult.	Stres	Stress 1.90 ksi 50% ult.			
Elap.	Accum.		Elap.	1		Elap.	Accum.			
Time	Strain	Remarks	Time	Strain	Remarks	Time		Remarks		
(hrs.)	(µin/in)		(hrs.)	(#in/in)		(hrs.)	(µin/in)			
0	1372		0	1513		0_	Failed on	Loading		
0.016	1397		0,016	1513						
0.1	1404		0.1	1506						
0.25	1406		0,25	1513						
0, 5	1409		0.5	1513						
1	1413		1	1518						
3	1419		3	1532						
4	1423		4	1538						
5	1425		5	1537						
24	1447		24	1578						
48	1453		48	1639			1			
72	1458		72	1666						
145.4	1498		145.4	1781	<u> </u>					
169	1517		169	1813						
194	1555		194	1876						
218	1562		218	1951						
245	1585		245	2004						
316	1602		316	2094						
341	1552		341	2130						
367	1555		367	2172						
486	1638		486	2553						
501	No Failus	e	501	Failure						
Resid	Str.	3.85 ksi								
	Recovery	·		Recovery	L,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	 	Recovery	<u> </u>		
·	2.000761	,		*******			Recovery			
							 			
										
						 		 		
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Test:	Creep		Test:	Creep		Test:				
	: 90°		, ,	: 90°			:			
	lo: <u>D25</u> -	9	Spec. No: <u>D58-1</u>			Spec. No:				
	450°F			Temp: 450°F			Temp:			
Stress	Stress: 1.48 kmi 50 % ult.			1.48 ksi	50% ult.	Stressksi_% ult.				
Elap.	Accum.		Elap.	Accum.		Elap.	Accum.			
Time	Strain	Remarks		Strain	Remarks		Strain	Remarks		
	(µin/in)			(Pin/in)		(hrs.)	(µin/in)			
0	2931		0	2147						
	2970		0.016			 				
0. 15	4665		0.25	4027			···			
0.28	Failure		0.5	4569						
			 	5116						
			2	5813						
-			-	Failure						
-						 				
-										
-			<u></u>							
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	·							 		
								<u></u>		
		<u> </u>		<u> </u>	<u> </u>			<u>L</u>		
	Recover	у		Recovery			Recovery	·		
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				AS/4397					
Test:	Creep		Test:_	Creep		Test:	Creep		
Orient	900		Orient	: 90°		Orien	t: 90°		
Spec. N	lo: D25-7	<u> </u>	Spec. 1	No: D26-4		Spec. No: D25-3			
	450°F		Temp:	450°F		Temp: 450°F			
1		i_40 t ult.	Stress: 1.18 ksi 40% ult.			Stress 1.18 ksi 40% ult.			
Elap.	Accum.		Elap.	Accum.		Elap.			
Time	Strain	Remarks	Time	Strain	Remarks	Time	Strain	Remarks	
 	(µ in/in)			(µin/in)		(hrs.)	(µin/in)		
0	1480		0	2055		0	Failed on	Loading	
0.016	1591		0,016	2140			<u> </u>		
0.1	2863		0.13	2255					
0.25	2849	<u> </u>	0, 25	2302					
0,5	2949		0.5	2383					
1	5023		1	2462		L	L		
2	3031		2	2578					
3	3059		3	2675					
9	3026		4	2723					
24	3027		5_	2770					
96	3338		6	2820					
264	5772		7	2847					
312	6649		24	3341					
361	7521		72						
402.3	Failure		144	21,392					
			216	13,604					
			228	Failure					
	-								
	Recover	У		Recovery	. —		Recovery	,	
								<u></u>	
					<u> </u>		<u> </u>		
								1	
				1	<u> </u>		1	<u> </u>	

	AS/	4397						
Test: Creep	Test: Cree			Creep				
Orient: 90°	Orient: 90°		Orien	t: 90°				
Spec. No: D58-2		Spec. No: D58-5			Spec. No: D58-3			
Temp: 450° F	Temp: 450°	<u>'F</u>	Temp	450°F				
Stress: 0.89 ksi 30% ult	Stress: 0.39	ksi 30% ult.	Stress	Stress 0.39 ksi 30% ult.				
Elap. Accum.	Elap. Acci	- 1	Elap.	Accum.				
Time Strain Remarks			Time	Strain	Remarks			
(hrs.) (# in/in)	(hrs.) (#in.			(µin/in)				
0 1654	0 1336		0	963				
0.016 2018	0.016 1505		0.016					
0.1 2321	0.1 1634		0.1	2246				
0. 25 2533	0.25 1702		0.25	2262				
0.5 Failure	0.5 1793		0.5	2348	<u> </u>			
	1 1882		1	2420				
	2 2074		2	2563				
	3 2188		3	2677				
	4 2364		4					
	5 2494		4	2823				
	6 2582		6	2927	}			
	7 2641		7	3061	ļ			
 -	8 2735		32.2	Failure	 			
	15 Failu	re			 			
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Recovery	Reco	very		Recovery	,			
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Test:	Creen		Test:	Creep		Test:	Creet
Orient	: + 45°		Orient	: <u>+ 45°</u>		Orient	: ± 45°
Spec. I	ic: D32-	2	Spec.	No: D28-	6	Spec. 1	No: D27
Temp:	R.T.		Temp	R.T.	Temp: R.T.		
Stress	: <u>13.10</u> ks	70% ult.	Stress	13,10 ksi	Stress	13.10 k	
Elap.	Accum.		Elap.	Accum.		Elap.	Accum
Time	Strain	Remarks	Time	Strain	Remarks	Time	Strain
(hrs.)	(µin/in)		(hrs.)	(#in/in)		(hrs.)	/µin/in
0	5422		0	5333		0	5306
0.016	5518		0.016	5475		0.016	5549
0.13	5711		0.13	5648		0.13	5755
0.25	5780	Ī	0,25	5716		0.25	5824
0,5	5834		0.5	5796		1	5981
1	5912		1	5871		2.3	6104
2.3	6019		2.3	5969		4	6197
4	6094		4	6047		5	6219
5	6115		5	6068		6	6248
6	6145		6	6094		7	6273
7	6168		7	6118		24.4	6521
24.4	6417		24.4	6330		96	6836
96	6611		96	6576		144	6944
144	6621		144	6677		192	7113
192	6928		192	6873		264.25	7346
264.25	7203		264.25	7014		288	7382
288	7200		288	7050		312	7409
312	7277		312	7077		360	7448
360	7272		360	7118		432	7533
432	7277		432	7197		504	7567
504	7315		504	7233		528	7582
528	7439		528	7248		600	7670
600	7537		600	7339			
						l I	
			l L			<u> </u>	
Resid.	Str.	18.98 ksi	Resid	Str.	18,30 ksi	Resid	Str.
				<u> </u>		l L	
	Recover	У		Recovery			Recove
0	1820		0	1733		0	1834
	1503			1448	ļ	 	1520
2	1385	<u> </u>	2	1274	 	2	1336
3	1254	1] 3	1190	<u> </u>]3	1250

Orient: ± 45°								
Spec. No: D27-2								
Temp: R.T.								
Stress_13.10 ksi 70% ult.								
								
Elap.	Accum.							
Time (hrs.)	Strain (µin/in)	Remarks						
0	5306							
0.016	5549							
0,13	5755							
0.25								
1	5981							
2.3	6104							
4	6197	ļ						
5	6219							
6	6248							
7	6273							
24. 4								
96	6836							
144	6944							
192	7113							
264.25	7346							
288	7382							
312	7409							
360	7448							
432	7533							
504	7567							
528	7582							
600	7670							
Resid.	Str.	18,48 ksi						
	Recovery	·						
0	1834							
1	1520							
2	1336							
3	1250							

AS/	4	3	9	7	

Recovery Recovery Recovery Recovery 0 1187 0 1247 0 1176 1 836 1 887 1 859				(T) = -A	AS/439		- The same		
Spec. No: D28-2 Spec. No: D32-4 Temp: R.T. Stress: 11.23 ksi 60 t ult. Stress: 12.23 ksi 60 t ult. Stress: 12.23 ksi 60 t ult. Stress: 12.23 k	Test:	Creep							
Temp: R.T. Stress: 11.23 ksi 60 t ult. Elap. Accum. Time Strain (μ in/in) 0 4363 0.016 4528 0.1 4611 0.25 4672 0.5 4702 0.5 4702 0.5 4702 0.5 4806 2 5238 2 4806 5 4878 6 4986 6 4986 6 5316 6 4996 6 4996 6 4996 6 5316 7 4909 7 5326 7 4909 7 5326 7 4909 24.1 5034 24.1 5034 24.1 5034 24.1 5444 2525 2144 5780 244 5525 216 5418 226 240 5825 312 5551 312 6039 360 593 360 593 360 6082 384 5516 384 6105 384 5706 528 5722 Recovery O 1187 1 887 1 887 1 887	Orien	t: <u> </u>	Orient: ± 45				Orient: +45		
Stress: 11.23 ksi 60 % ult. Elap. Accum. Time Strain (hrs.) (µin/in)	Spec.	No:DZ	5-2	Spec. 1	No: D32-	4	Spec. 1	No: D27-	8
Elap. Strain (hrs.) (µin/in) Elap. Accum. Time (hrs.) (µin/in) O 4363 O 4811 O 4363 O 4811 O 0 4468 O 0.016 4528 O 0.016 4934 O 0.11 4611 O 0.25 4672 O 0.5 5121 O 0.5 4702 O 0.5 5121 O 0.5 4780 O 0.5 5121 O 0.5 4780 O 0.5 4888 O 0.016 4886 O 0.016 4886 O 0.016 4886 O 0.016 4886 O 0.016 48934 O 0.016 4599 Temp	R.T.		Temp	R.T.		Temp:	R.T.		
Time Strain Remarks (hrs.) (h	Stres	s: <u>11.23 k</u> s	160 t ult.	Stress	<u>11.23 ksi</u>	60% wit.	Stress	11.23 kmi	60 t ult.
(hrs.) (μ in/in) (hrs.) (μ in/in) (hrs.) (μ in/in) 0 4363 0 4811 0 4486 0.016 4528 0.016 4934 0.016 4599 0.1 4611 0.25 5093 0.1 4688 0.25 4672 0.25 5093 0.25 4750 0.5 4702 0.5 5121 0.5 4780 1 4748 1 5174 1 4835 2 4806 2 5238 2 4900 4 4866 4 5298 4 4960 5 4878 5 5316 6 4992 7 4909 7 5326 7 5004 24.1 5034 24.1 5464 24.3 5131 72 5178 72 5622 72 5282 144 5325 144 5780 144	Elap.	Accum.		Elap.	Accum.		Elap.	Accum.	
0 4363 0 4811 0 4486 0.016 4528 0.016 4934 0.016 4599 0.1 4611 0.1 5021 0.1 4688 0.25 4672 0.25 5093 0.25 4750 0.5 4702 0.5 5121 0.5 4780 1 4748 1 5174 1 4835 2 4806 2 5238 2 4900 4 4866 4 5298 4 4960 5 4878 5 5310 3 4976 6 4896 6 5316 6 4992 7 4909 7 5326 7 5004 24.1 5034 24.1 5464 24.3 5131 72 5178 72 5622 72 5282 144 5325 144 5780 144 5433 <	1		1 1	1		1 1			Remarks
0.016 4528	-						(hrs.)		
0.1 4611 0,1 5021 0,1 4688 0.25 4672 0,25 5093 0,25 4750 0.5 4702 0,5 5121 0.5 4780 1 4748 1 5174 1 4835 2 4806 2 5238 2 4900 4 4866 4 5298 4 4960 5 4878 5 5310 3 4976 6 4896 6 5316 6 4992 7 4909 7 5326 7 5004 24.1 5034 24.1 5464 24.3 5131 72 5178 72 5622 72 5282 144 5325 144 5780 144 5433 216 5418 216 5884 216 5526 240 5422 240 5895 240 5538 312 5551 312 6035 312 5664 360	0	4363		0	4811		0	4486	
0.25 4672 0.25 5093 0.25 4750 0.5 4702 0.5 5121 0.5 4780 1 4748 1 5174 1 4835 2 4806 2 5238 2 4900 4 4866 4 5298 4 4900 5 4878 5 5310 3 4976 6 4896 6 5316 6 4992 7 4909 7 5326 7 5004 24.1 5034 24.1 5464 24. 5131 72 5178 72 5622 72 5282 144 5325 144 5780 14433 216 5433 216 5418 216 5884 216 5526 240 5538 312 5551 312 6035 312 5664 360 5712 384 5616 384 6105 384 5731 409 5742 480 <td>0.01</td> <td>4528</td> <td></td> <td>0.016</td> <td>4934</td> <td></td> <td>0, 016</td> <td>4599</td> <td></td>	0.01	4528		0.016	4934		0, 016	4599	
0.5 4702 0.5 5121 0.5 4780 1 4748 1 5174 1 4835 2 4806 2 5238 2 4900 4 4866 4 5298 4 4960 5 4878 5 5310 5 4976 6 4896 6 5316 6 4992 7 4909 7 5326 7 5004 24.1 5034 24.1 5464 24. 5131 72 5178 72 5622 72 5282 144 5325 144 5780 144 5433 216 5418 216 5884 216 5526 240 5422 240 5895 240 5538 312 5551 312 6035 312 5664 384 5616 384 6105 384 5731 409 5522 409 6117 409 5742 480 5706 480 6209 480 5824 528 5722 528 5225 528 5845 Recovery Reco	0.1			0, 1	5021		0, 1	4688	
1 4748 1 5174 1 4835 2 4806 2 5238 2 4900 4 4866 4 5298 4 4960 5 4878 5 5310 3 4976 6 4896 6 5316 6 4992 7 4909 7 5326 7 5004 24.1 5034 24.1 5464 24.3 5131 72 5178 72 5622 72 5282 144 5325 144 5780 144 5433 216 5418 216 5884 216 5526 240 5422 240 5895 240 5538 312 5551 312 6635 312 5664 384 5616 384 6105 384 5731 409 5622 409 6117 409 5742 480 5706 480 6209 480 5845 528	-			0.25	***************************************		0, 25	4750	
2 4806 2 5238 2 4900 4 4866 4 5298 4 4960 5 4878 5 5310 3 4976 6 4896 6 5316 6 4992 7 4909 7 5326 7 5004 24.1 5034 24.1 5464 24.3 5131 72 5178 72 5622 72 5282 144 5325 144 5780 144 5433 216 5418 216 5884 216 5526 240 5422 240 5895 240 5538 312 5551 312 6035 312 5664 360 5593 360 6082 360 5712 384 5616 384 6105 384 5731 409 5706 480 6209 480 5824 528 5722 528 6225 528 5845 Recov	0.5	4702		0.5	5121	L	0.5	4780	
4 4866 4 5298 4 4960 5 4878 5 5310 3 4976 6 4896 6 5316 6 4992 7 4909 7 5326 7 5004 24.1 5034 24.1 5464 24.3 5131 72 5178 72 5622 72 5282 144 5325 144 5780 144 5433 216 5418 216 5884 216 5526 240 5895 240 5538 312 5664 360 5593 360 6082 360 5712 384 5616 384 6105 384 5731 409 5622 409 6117 409 5742 480 5706 480 6209 480 5824 528 5722 528 6225 528 5845 Recovery Recovery Recovery Recovery 0 117	1	4748		1	5174	<u> </u>	1	4835	
5 4878 5 5310 3 4976 6 4896 6 5316 6 4992 7 4909 7 5326 7 5004 24.1 5034 24.1 5464 24.3 5131 72 5178 72 5622 72 5282 144 5325 144 5780 144 5433 216 5418 216 5884 216 5526 240 5422 240 5895 240 5538 312 5551 312 6035 312 5664 360 5593 360 6082 360 5712 384 5616 384 6105 384 5731 409 5622 409 6117 409 5742 480 5706 480 6209 480 5824 528 5722 528 6225 528 5845 Recovery 0 1187 0 1247	2	4806		2	5238		2	4900	
6 4896 6 5316 6 4992 7 5004 24.1 5034 24.1 5464 24.3 5131 72 5178 72 5622 72 5282 144 5325 144 5780 144 5433 216 5526 240 5895 240 5538 312 5551 312 6035 312 5664 384 5616 384 6105 384 5731 409 5622 409 6117 409 5742 480 5706 480 6209 480 5702 528 5722 528 6225 72 528 5845 722 72 5282	4	4866		4	5298		4	4960	
7 4909 7 5326 7 5004 24.1 5034 24.1 5464 24.3 5131 72 5178 72 5622 72 5282 144 5325 144 5780 144 5433 216 5418 216 5884 215 5526 240 5422 240 5895 240 5538 312 5551 312 6035 312 5664 360 5593 360 6082 360 5712 384 5616 384 6105 384 5731 409 5622 409 6117 409 5742 480 5706 480 6209 480 5824 528 5722 528 6225 528 5845 Resid Str. 18.96 ksi Resid Str. 18.70 ksi Resid Str. 18.55 ksi Recovery Recovery Recovery 0 1187 0 1247 0 1176 1 836 1 887 1 8859	5	4878		5	5310		5	4976	
24.1 5034 24.1 5464 24.3 5131 72 5178 72 5622 72 5282 144 5325 144 5780 144 5433 216 5418 216 5884 216 5526 240 5422 240 5895 249 5538 312 5551 312 6035 312 5664 360 5593 360 6082 360 5712 384 5616 384 6105 384 5731 409 5622 409 6117 409 5742 480 5706 480 6209 480 5824 528 5722 528 6225 528 5845 Recovery 0 1187 0 1247 0 1176 1 836 1 887 1 859	6	4896		6	5316		6	4992	
72 5178 72 5622 72 5282 144 5325 144 5780 144 5433 216 5418 216 5884 216 5526 240 5422 240 5895 240 5538 312 5551 312 6035 312 5664 360 5593 360 6082 360 5712 384 5616 384 6105 384 5731 409 5522 409 6117 409 5742 480 5706 480 6209 480 5824 528 5722 528 6225 528 5845 Resid. Str. 18.70 ksi Resid. Str. 18.55 ksi Recovery Recovery Recovery 0 1247 0 1176 1 836 1 887 1 859	7	4909		7	5326		7	5004	
144 5325 144 5780 144 5433 216 5418 216 5884 215 5526 240 5422 240 5895 240 5538 312 5551 312 6035 312 5664 360 5593 360 6082 360 5712 384 5616 384 6105 384 5731 409 5622 409 6117 409 5742 480 5706 480 6209 480 5824 528 5722 528 6225 528 5845 Resid Str. 18.70 ksi Resid Str. 18.55 ksi Recovery Recovery Recovery 0 1176 0 1176 1 836 1 887 1 859	24.	5034		24.1	5464		24.	5131	
216 5418 216 5884 215 5526 240 5422 312 5895 312 5538 312 5551 312 6035 312 5664 360 5593 360 6082 360 5712 384 5616 384 6105 384 5731 409 5622 409 6117 409 5742 480 5706 480 6209 480 5824 528 5722 528 5225 528 5845 Resid Str. 18.96 ksi Recovery Recovery 0 1187 0 1247 0 1176 1 836 1 887 1 859	72	5178		72	5622		72	5282	
240 5422 240 5895 240 5538 312 5551 312 6035 312 5664 360 5593 360 6082 360 5712 384 5616 384 6105 384 5731 409 5622 409 6117 409 5742 480 5706 480 6209 480 5824 528 5722 528 6225 528 5845 Resid. Str. 18.70 ksi Resid. Str. 18.55 ksi Recovery 0 1187 0 1247 0 1176 1 836 1 887 1 859	144	5325		144	5780		144	5433	
312 5551 312 6035 312 5664 360 5593 360 6082 360 5712 384 5616 384 6105 384 5731 409 5622 409 6117 409 5742 480 5209 480 5824 528 5722 528 5225 528 5845 Resid. Str. 18.70 ksi Resid. Str. 18.55 ksi Recovery 0 1187 0 1247 0 1176 1 836 1 887 1 859	216	5418		216	5884		216	5526	
360 5593 360 6082 360 5712 384 5616 384 6105 384 5731 409 5622 409 6117 409 5742 480 5706 480 6209 480 5824 528 5722 528 6225 528 5845 Resid. Str. 18.70 ksi Resid. Str. 18.55 ksi Recovery Recovery 0 1187 0 1247 0 1176 1 836 1 887 1 859	240	5422		240	5895		240	5538	
384 5616 384 6105 384 5731 409 5622 409 6117 409 5742 480 5706 480 6209 480 5824 528 5722 528 6225 528 5845 Resid Str. 18.96 ksi Resid Str. 18.70 ksi Resid Str. 18.55 ksi Recovery Recovery Recovery 0 1176 1 3859	312	5551		312	6035		312	5664	
409 5622 409 6117 409 5742 480 5706 480 6209 528 5824 528 5722 528 6225 528 5845 Resid Str. 18.96 ksi Resid. Str. 18.70 ksi Resid. Str. 18.55 ksi Recovery Recovery Recovery 0 1247 0 1176 1 859	360	5593		360	6082		360	5712	
480 5706 480 6209 480 5824 528 5722 528 6225 528 5845 Resid Str. 18.96 ksi Resid Str. 18.70 ksi Resid Str. 18.55 ksi Recovery Recovery Recovery 0 1247 0 1176 1 859	384	5616		384	6105		384	5731	<u> </u>
528 5722 528 6225 528 5845 Resid Str. 18.96 ksi Resid. Str. 18.70 ksi Resid. Str. 18.55 ksi Recovery Recovery Recovery Recovery 0 1187 0 1247 0 1176 1 836 1 887 1 859	409	5622		409	6117		409	5742	<u> </u>
Resid Str. 18.96 ksi Recovery Recovery 0 1187 1 836 1 887 1 859 Resid Str. 18.55 ksi Resid Str. 18.55 ksi 0 1247 0 1176 1 859	480	5706		480	6209	<u> </u>	480	5824	
Recovery Recovery Recovery Recovery 0 1187 0 1247 0 1176 1 836 1 887 1 859	528	5722		528	6225		528	5845	
Recovery Recovery Recovery Recovery 0 1187 0 1247 0 1176 1 836 1 887 1 859						L			
Recovery Recovery Recovery Recovery 0 1187 0 1247 0 1176 1 836 1 887 1 859					<u> </u>				<u> </u>
Recovery Recovery Recovery Recovery 0 1187 0 1247 0 1176 1 836 1 887 1 859		 	 						 -
0 1187 0 1247 0 1176 1 836 1 887 1 859	Resid	Str.	18.96 ksi	Resid.	Str.	18.70 ksi	Resid.	Str.	18.55 ksi
0 1187 0 1247 0 1176 1 836 1 887 1 859		Recovery		Recovery			 	Recovery	<u> </u>
1 836 1 887 1 859	10			1	·		0		
						 	1		
2 788 2 830 2 808 2	2		 		830	 	-		1
3 752 3 795 3 776			 	1		1			
				·			'		

			Trans	A3/439/		C 48 21 22 2			
	Creep	1		Creep		Test: Creen			
•	±45°		Orient: + 45°			Orient: +45°			
T .	io: <u>D38-8</u>		1 '	No: D31-	1		No: D39-		
Temp:	R.T.		Temp:	R.T.		Temp:	R.T.		
Stress	: <u>9.36</u> kg	i 50% ult.		9.36 ksi	50 % ult.	Stress	9,36 ksi	50% ult.	
Elap.	Accum.	_	Elap.	Accum.		Elap.		_	
Time	Strain	Remarks	Time	Strain	Remarks	Time	Strain	Remarks	
(hrs.)	(μ in/in)		(hrs.)			(hrs.)			
0	3406		0	3725		0	3418		
0.016	3447		0.016			0.016	3478		
0.1	3494		0.1	3816		0.1	3522		
0.25	3502		0.25	3861		0.25	3532		
0.5	3518		0.5	3880		0.5	3554		
1	3570		1	3935		1	3588		
2	3630		2	3990		2	3647		
4	3676	 	4	4034		4	3678		
5	3681		5	4044		5	3684		
6	3707		6	4072		6	3708		
7	3719			4085		7	3716		
72	3949		72	4310		72	3923		
125	3994		125	4359		125	3971		
168	4016		168	4383		168	3994		
240	4085		240	4454		240	4074		
288.2	4086		288. 2	4473		288.2	4122		
312	4108		312	4497		312	4124		
408	4122		408	4512		408	4150		
432	4143		432	4527		432	4167		
456	4144		456	4532		456	4169		
480	4145		480	4530		480	4169		
484	4145		484	4526		484	4167		
Resid.	Str.	18.05 ksi	Resid.	Str.	18.57 ksi	Resid.	Str.	17,67 ksi	
	Recover	у		Recovery			Recovery		
0	692		0	919		0	786		
1	502		1	703			594		
2	464		2	663		_2	556		
2.6	456		2,6	650		2.5	549		

				AS/4397	7				
Test:	Cruep		Test: Creep			Test:	Creep		
Orient	: ± 45°		Orient	Orient: ± 45°		Orient: + 45°			
Spec. I	No: D38-1	0	Spec. I	Spec. No: D40-10			Spec. No: D36-10		
Tamp:	350°F		Temp:	350°F		Temp:	350°F		
Stress	:_8 <u>.31</u> ks	i_50% ult.	Stress	8.31 ksi	50 t ult.	Stress	8.31 ksi	50t ult.	
1	Accum.			Accum.		Elap.	Accum,		
Time	i :	Remarks	1	Strain	Remarks	Time	Strain	Remarks	
	(µin/in)			(Pin/in)		(hrs.)			
0.1	5248		0	15,624		0	14, 399		
0.016	,			22,417		0.016			
0.1	7240		0.1	23, 672		0.1	20,093		
0.28	8888		0, 28	25, 268		0.25	Gage Fai	led	
0.5	9589		0.5	25,824		500	No Failu	e	
1	10,770		1	26,029		<u> </u>			
2	11.902		2	26, 213					
3	12, 730		3	26,313					
4.5	13, 359		4.5	26, 389					
5	13,571		5_	26, 397					
6	13, 897		6	26, 462					
7	14, 180		7	24,533					
24	16, 546		24	27, 137					
48	19, 157		48	27,616					
72	20, 766		72	28,008					
168	24, 982		168	29, 177					
192	26, 463		192	29, 414					
216	32, 160		216	29,636					
	Gage Fail	ed	240	29, 926					
505	No Failur	• 1	336	30, 867					
			384	31, 499					
			433	33, 324					
				Gage Fail	ed				
			505	No Failur	ę				
Resid.	Str.	18.07 ksi	Resid.	Str.	18.07 ksi	Resid.	Str.	17.98 ksi	
	Recover	<u>'</u> y		Recovery			Recovery		
<u></u>	<u> </u>		! I	<u> </u>	<u> </u>	<u> </u>	<u> </u>	<u> </u>	

				AS/4397					
Test:				Creep		Test:			
Orient	Orient: ± 45° Orient: ± 45°			: + 45°		Orient: + 45°			
Spec. I	Spec. No: D35-10 Spec. No: D37-7				7	Spec.	No: D39-4		
Temp:	350°F		Temp:	350°F			350°F		
l .		30e ult.	Stress:	4.98 ksi	30% ult.	Stress	1.98 ksi	30% ult.	
Elap.	Accum.		Elap.	Accum.		Elap.	Accum.		
Time	Strain	Remarks	Time	Strain	Remarks	Time	Strain	Remarks	
(hrs.)	(Pin/in)		(hrs.)	(Pin/in)		(hrs.)	(µin/in)		
0	2055		. 0	2451		0	2130		
0.016	2115		0,016	2634		0.016	2319		
0.1	2253		0.1	2758		0.1	2579		
0.25	2380		0, 25	2946		0.25	2795		
C. 5	2506		0,5	3129		0.5	2937		
1	2647		1	3337		1	3226		
2	2811		2	3575		2	3421		
4	3049		4	3931		4	3817		
5	3143		5	4076		5	4023		
6	3168		6	4139		6	4045		
7	3234		7	4231		7	4153		
24	3813		24	5031		24	4971		
48	4228		48	5713		48	5650		
72	4498		72	6137		72	6097		
96	4706		96	6437		96	6439		
169.5	5169	,	169.5	7135		169.5	7432		
217.5	5397		217.5	7487		217.5	7778		
241.5	5491		241.5	7633		241.5	7830		
265.5	5588		265.5	7799		265.5	7953		
337.5	5833		337.5	8219		337.5	8330		
384	5986		384	8488		384	8524		
408	6057		408	8625		408	8643		
432	6133		432	8760		432	8785		
504	6330		504	9158		504	9118		
Resid.	Str.	18.36 ksi	Resid.	Str.	19,00 ksi	Resid.	Str.	17.00 ksi	
	Recover	'у	<u> </u>	Recovery			Recovery	<u> </u>	
0	4315		0	6812		0	6898		
1	4940		1	6305		1	6568		
2	3985			6279		2_	6530		
3,5	3926		2.5	6059	<u> </u>	3,5	6452		
3,5	3926	L	2,5	6059	لــــا	3.5	6452	<u> </u>	

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	Стеер		Test:	Cresp		Test:	Creer	
	: + 45°		Orient: ± 45°			Orient: ± 45°		
Spec. 1	No: D36-2	2		No: D39-	2		No: D38-	
Temp:	350°F		Temp	350°F		Temp	350°F	
Stress	: 3.32 ks	i 20% ult.	Stress	3.32 ksi	20% ult.	Stress	3.32 ksi	20% ult.
Elap.	Accum.		Elap.	Accum.		Elap.	Accum.	
Time	Strain	Remarks	Time	Strain	Remarks	Time		Remarks
(hrs.)			(hrs.)				(µin/in)	
0	1423		0	1646		0	1498	
0,016			0.016	1688		0.016	1565	
0.1	1548		0.1	1810		0.1	1635	
0.25	1577		0.25	1898		0.25	1652	
0.5	1628		0.5	1948		0.5	1682	
1	1688		1	2025		1	1714	
2	1775		2	2074		2	1748	
3.25	1813		3.25	2130		3, 25	1784	
4	1863		4	2147		4	1813	
5	1889		5	2164		5	1828	
6	1910		6	2200		6	1855	
7	1942		7	2223		7	1870	
24	2229		24	2411		24	2111	
144	2816		144	2833		144	2670	
192	2962		192	2943		192	2807	
264	3135	!	264	3060		264	2915	
312	3212		312	3161		312	3023	
360	3334		360	3259		360	3140	
432.5	3464		432, 5			432.5	3265	
528	3619		528	3638		528	3554	
Resid.	Str.	18.07 ksi	Resid.	Str.	18.13 kai	Resid.	Str.	18.00 ksi
		ļ						
Recovery			Recovery			Recovery		
0	4114		0	4567		0	4133	
2	3135		2	3100		2	3598	
3	3519		3	3137		3	3206	
L		L	1	L	L	L		

				AS/439/				
Test:	Creep		Test:	Creep		Test: Creep		
Orient	: ± 45°		Orient: ± 45°			Orient: ± 45°		
Spec. No: D38-9				No: 140-7		Spec.]	No: D39	
Temp:	450°F		Yemp:	450°F		Temp	450° F	•
		i 30 ult.			30% ult.		5.01 ksi	30% ult.
Elap.	Accum.		Elap.	Accum.		Elap.		
	Strain	Remarks	Time		Remarks	Time		Remarks
	(µin/in)		(hrs.)			(hrs.)		
0	Gage Fail			4630	L	0	7435	
529	No Failur	e	0,016			0.016		
			0.1	5465		0.1	10, 234	
			0.25	6197		0.25		
			0.5	6839		0.5	10, 761	
			1	7546		1	11,056	
			2	8435		2	11,548	
			3, 25	8992		3.25	11,908	
			4	9395		4	12, 150	
			5	9720		5	12, 344	
			6	9996		6	12,584	
			7	10, 255		7	12, 783	
			24	Gage Fai	ed	24	Gage Fail	ed
			529	No Failu		529	No Failur	
		1						
								
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	<u> </u>	 					 	
	ļ	1.2.25				-	-	1.2 62
Resid.	Str.	17,75 ksi	Resid.	Str.	17.54 kai	Resid.	Str.	17.91 kai
	Recover	y	Recovery			Recovery		
		 			T		<u> </u>	T
					<u> </u>			
	 	 	-	 			 	
	 	i		 				
<u> </u>	L	L	l	<u> </u>	L		L	L

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Test:_	Creep			Creep		,		······································
Orient	<u>+ 45°</u>		Orient: +45°			Orient	:	
Spec. 1	io: D40-8		Spec. 1	No: D38-	1	Spec. 1	Yo:	
Temp:	450°F		Temp:	450°F			 	
Stress	: <u>1.67 k</u> si	10% ult.	Stress	1.67 ksi	10% ult.		ks:	
Time	Accum. Strain (μ in/in)	Remarks	Time	Accum. Strain (#in/in)	Remarks	Time	Accum. Strain (tin/in)	Remarki
0	3510		0	1667			_) *****	
0.016	4115		0.016					
	Gage Fail	ed	0.1	3979				
5	Failure		0.25	4431				
			0,5	4837				
			1	5044				
			2	5086				
			3	5292				
			4	5413				
			5	5547				<u></u>
	<u> </u>		6	5650				
	ļ	 	7.2	5741				
	<u> </u>	[71	9312				ļ
	ļ	 	(00	Gage Fai				ļ
			683	No Failur	e	<u> </u>		ļ
	 	 		ļ		 		
								
			 	<u> </u>				-
		 	-			 		
		 						
	 	1						
	 							
			Resid.	Str.	16,89 ksi			
	Recover	y		Recovery			Recovery	<u> </u>
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 	 	 		 			<u> </u>	
	 	 			 		 	

AS/4397 Test: Creep Rupture Test: Creep Rupture Test: Creep Rupture Orient: + 45° Orient: + 45° Orient: + 45° Spec. No: D41-2 Spec. No: D37-1 Spec. No: D40-3 Temp: 450°F 450°F 450°F Temp:___ Temp: Stress: 8,35 ksi 50% ult. Streis: 8.35 km 50 t ult. Stress 8.35 ksi 50 * ult. Elap. Accum. Elap. Accum. Elap. Accum. Strain Remarks Time Strain Remarks Time Strain Time Remarks (µin/in) (hrs.) (Pin/in) (µin/in) (p42-) (hrs.) O Gages No Gages No Gages 0 Failed on Loading 482 No Failure 326 Failure Recovery Recovery Recovery

T300/F178 Test: Creep Creep Test: Test: Creep Orient: 00 00 Orient: Orient: Spec. No: E6-4 Spec. No: E4-9 Spec. No: E8-8 Temp: R.T. Temp: R.T. Temp: R.T. Stress 141.1 kai 90 t ult. Stress: 141.1 ksi 90% ult. Stress: 141.1 ksi 90% ult. Elap. Accum. Elap. Elap. Accum. Accum, Remarks Strain Time Strain Remarks Time Strain Time Remarks (# in/in) (hrs.) (Pin/in) (hrs.) (µin/in) (brs.) 0 6882 Failed on Loading Failed on Loading 0.016 6891 0.1 6893 0.25 6892 0.5 6893 6893 2 6895 Tabs failed repeatedly Recovery Recovery Recovery

Test: Creep								
Orient: 0°								
Spec. No: <u>E21-12</u>								
	R,T,							
Stress	: 125, 4 ks	i <u>80</u> % ult.						
Elap.	Accum.							
Time		Remarks						
(hrs.)	(µ in/in)							
0	6366							
0.016	6374							
0.1	6372							
0,25	6375							
0,5	6381							
1	6380							
2	6376							
3	6373							
4	6380							
6	6373							
7.5	6384							
8	6382							
24	6383							
48	6385							
72	6393							
144	6401							
168	6409							
192	6398							
240	6392							
312	6402							
337	6396							
363	6406							
389	6401							
413	6402							
509	6412							
Resid.	Str.	171.5 ksi						
	Recovery	<u> </u>						
0	85							
1	75							
2	73							

Test:	Test: Creep								
Orient	Orient: 0°								
Spec. I	Spec. No: E5-15								
Temp:	R.T.								
Stress	125.4 ksi	80 tult.							
Elap.	Accum.								
Time	Strain	Remarks							
(hrs.)	(#in/in)								
0	6869								
0.016	6874								
0.1	6872								
0.25	6869								
0.5	6875								
1	6876								
2	6872								
3	6871								
4	6877								
6	6868								
7.5									
8	6880								
24	6884								
48	6885								
72	6896								
144	6911								
168	6916								
192	6907								
240	6901								
312	6911								
337	6905								
363	6915								
389	6912								
413	6912								
509	6920								
Resid.	Str.	170.0 ksi							
	Recovery								
0									
	72								
2	70								
	······································								
·									

Test: Creep											
Orient: 0°											
Spec. No: <u>E4-15</u>											
Temp: R.T.											
Stress 125.4 ksi 80% ult.											
Elap.	lap. Accum.										
Time	Strain	Remarks									
	(µin/in)										
0	5924										
0.016	5925										
0.1	5916										
0.25	5919										
0.5	5922										
ì	5920										
Z	5915										
3	5918										
4	5922										
6	5918										
7.5	5927										
8	5926										
24	5929										
48	5927										
72	5939										
1,44	5946										
168	5953										
192	5945										
240	5939										
312	5948										
337	5942										
363	5948										
389	5943										
413	5944										
509	5956										
Resid.	Str.	158. Z ksi									
	Recovery										
0	61										
1	52										
2	45										
		I									

				T300/F1:	18				
Test: Creep			Test: Creep			Test: <u>Creep</u>			
Orient: 0°			Orient: 0°			Orient: 0°			
Spec. N	(o: E6-18		Spec.	No: E22-	10		No: E8-1	1	
Temp:	350°F		Temp:	350°F		Temp:	350°F		
Stress	: 121.8 ks	i <u>80</u> % ult.	Stress:	121.8 kai	80% ult.	Stress	121.8 ksi	80 ult.	
Elap.	Accum.		Elap.	Accum.		Elap.	Accum.		
Time	Strain	Remarks	Time	Strain	Remarks	Time	Strain	Remarks	
(hrs.)	(µin/in)		(hrs.)	(µin/in)		(hrs.)	(µin/in)		
0	6445		0	5843	ļ	0	5845		
0.016	6417		0.016	5849		0,01	5863		
0.1	6455		0.1	5857		0.1	5873		
0.25	6457		0, 25	5875		0.25	5900		
0.5	6472		0.5	5887		0.5	5897		
1	6492		1	5928		1	5922		
2	6487		2	5941		2	5915		
3	6464		3	5936		3	5915		
4	6468		4	5865		4	5859		
5	6479		5	5888		5	5882		
6.2	6476		6.2	5879		6.3	5878		
7	6478		7	5942		7	5928		
8	6466		8	5942		8	5932		
24	6468		24	5945		24	5900		
48	6485		48	5959		48	5907		
96	6487		96	5937		96	5865		
216	6553		216	5988		216	5772		
263	6547	ļl	263	6025		263	5771		
336	6540	 	336	5992		336	5655		
432	6505		432	6082		432	5601		
500	No Failur	e	500	No Failur	<u> - </u>	500	No Failu	<u>e</u>	
			·	ļ		 		L	
 									
<u></u>	 			 	<u> </u>	 		 	
	ļ	 		 					
Resid.	Str.	176.5 ksi	Resid.	Str.	155. l ksi	Resid.	Str.	192.4 ksi	
								2,7-1,7-1,7	
	Recovery			Recovery			Recovery		
0	126		0	182		0	-316		
1	107		1	136		1_	-370		
3	97		3	200		3	-332	<u> </u>	
L							<u> </u>		

				T300/F17	8					
	Creep		Test: Creep			Test: Creep				
Orient	:0°		Orient: 0°			Orient: 0°				
	Spec. No: E22-9			Spec. No: E6-1			Spec. No: E7-16			
Temp:	350°F		Temp:	350° F		Temp	350°F			
Stress	Stress: 106.6 ksi 70% ult.			106.6 ksi	70% ult.	Stress 106.6 ksi 70 ult				
Elap.	Accum.		Elap.	Accum.		Elap.	Accum.			
Time	Strain	Remarks	Time	Strain	Remarks	Time	Strain	Remarks		
(hrs.)	(µ in/in)		(hrs.)			(hrs.)				
0	5380		0	5339		0	5959			
0.016	5393		0.016	5357		0.016	5968			
0.15	5402		0.15	5357		0.1	5966			
0, 25	5400		0.25	5357		0.25	5975			
0.5	5402		0.5	5354		0.5	5965			
1	5400		ı	5364		1	5952			
2	5405		2	5361		2	6620			
3	5407		3	5362		3	6609			
4.2			4.2	5364		4	6613			
5	5407		5	5349		5	6611			
6	5404		6	5369		6	6605			
7	5405		7	5374		7	6589			
24	5402	 	24	5377		8	6573			
96	5386	 	96	5385		24	6521			
120	5378	 	120	5377		- 57	Failure			
145	5359		145	5358		 	FAILUIFE			
169,5							 			
184	5361	 	169.5	5369 5355						
280	5335	} <u>-</u>	280	5359						
304	5340	 	304	5352		 	 			
352	5327	 	352	5337			 			
434	5300	 	434	5337				 		
		 		 	 	-	 			
456	5306	 	456	5340			 	 		
504	5303		504	5346	 					
				 			 			
Resid	Str.	136.2 ksi	Resid.	Str.	146.0 ksi		 			
1			1.00.00	1	1					
	Recover	y		Recovery	·		Recovery			
0	- 1		0	22						
1	-17		1	9						
2	-20		2	3						
3	~26		3	0						

				T300/F17	8					
Test: Creep			Test:	1			Test: Cresp			
Orient	rient: 0°			:: 0°		Orient: 0°				
	Vo: E21-1	7	1	Spec. No: E4-10			Spec. No: E7-15			
Tamb	450°F			450°F			450°F			
		1	i			1 I				
Stress: 107.0 ksi 70% ult.			Stress:	107.0 ks	70° ult.	Stress	107.0 ksi	70 t ult.		
Elap.	Accum.		Elap.	Accum.		Elap.				
Time	Strain	Remarks	Time	Strain	Remarks	Time	Strain	Remarks		
	(µ in/in)		(hrs.)			(hre.)	(µin/in)			
0	5518		0	4476		0	Failed o	n Loading		
0.016	5539		0.016	4495						
0.1	5540		0.1	4507		 				
0.25	5543		0.25	4508		-				
0.6	5550		0.6	4508						
1	5559		1	4515						
2	5559		2	4516				<u> </u>		
3	5565		3	4519						
4	5568		4	4510				L		
5	5563		5	4514				<u> </u>		
6	5572		6	4508						
7	5572		7	4508						
8	5577		8	4513						
26	5584		26	4505						
126	5608		179	4506						
164	5627		251.4	4494						
179	5622		314	4519			,			
251.4	5645		362	4520						
314	5661		432	4525						
362	5686		480	4562						
432	5712		528	4609						
480	5747									
528	5768									
								L		
Resid.	Str.	140.6 ksi	Resid.	Str.	136.8 ksi					
						L	·	L		
	Recover	y .		Recovery			Recovery			
0	234		0	71						
1	181		1	12						
2	168		2	1						
3	160		3	-10						

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T	C-005											
Test: Creep												
Orient: 90°												
Spec. No: E14-1												
Temp: R.T.												
Storess	Stress: 3.06 ksi 80 % ult.											
	Elap. Accum.											
Time !	Strain	Remarks										
	(# in/in)											
0	2269											
0.016	2296											
0.1	2318											
0.25	2336											
0.5	2346											
11	2365											
2	2381											
3	2397											
4	2406											
5	2410											
6	2414											
7	2417											
8	2424											
24	2487											
48	2488											
72	2500											
144	2515											
168	2528											
192	2550											
240	2637											
314	2705											
408	2655											
505	2716											
	-											
Resid	Str.	3,35 ksi										
	Recover	y										
0	566											
1	501	1										
2	490	1										
		<u> </u>										

T300/F178											
Test: Creep											
Orient: 90°											
Spec. No: E18-5											
Temp: R.T.											
Stress: 3.06 ksi 80 % wit.											
Elap. Accum.											
Time	Strain	Remarks									
	(#in/in)										
0	2597										
0.016	2620										
0,1	2649										
0, 25	2661										
0.5	2678										
1	2696										
<u> </u>	2718										
3	2733										
4	2745										
5	2751										
6	2751										
	2756										
8	2762										
24	2832	 									
48	2832	<u> </u>									
72	2845										
144	2860										
168	2875										
192	2900	ļ									
240	2995	 									
314	3064	 -									
408	3011										
505	3069	 									
ļ		 									
		 									
Regid.	Str.	3.61 ksi									
	Recovery										
0	615										
1	542	<u></u>									
2	530										
1	1	1									

Test:	Creep								
Orient: 90°									
Spec. No: Ell-8									
Temp: R.T.									
Stress3.06 ksi 80% ult.									
Elar.	Accum.								
Time	Strain	Remarks							
(brs.)	(Min/in)								
0	2288								
0.016	2307								
0.1	2335								
0.25	2353								
0.5	2367								
1	2382								
2	2405								
3	2417								
4	2429								
5	2435								
6	2437								
7	2440								
8	2449								
24	2523								
48	2524								
72	2538								
144	2553								
168	2567								
192	2591								
240	2683								
314	2751								
408	2657								
505	2709								
Resid.	Str.	3. 24 ksi							
	Recovery	!							
0	508								
1	447								
2	438								

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				T300/F17	8				
Test: Creep			Test: Creep			Test: Creep			
Orient	: 90°		Orient: 90°			Orient: 90°			
Spec. 1	Vo: E11-	6	Spec.	No: E14-	6	Spec.	No: <u>E13-8</u>		
Temp:	R.T.		Temp	R.T.		Temp	R.T.		
Stress	: 2.65 ks	<u>i 700 uit.</u>	Stress	2.65 kmi	781 ult.	Stress	2.65 ksi	70 t ult.	
Elap.			Elap.	Accum,	,	Elap.	Accum.		
Time	Strain	Remarks	Time	Strain	Remarks	Time	Strain	Remarks	
(brs.)			ļ	(Pin/in)		(hrs.)	(µin/in)		
0	1952		0	2110		0	2181		
0.016	1980		0.016	2124		0.016	2194		
0.1	2003		0.1	2147		0.1	2220		
0.3	2010		0.3	2157		0.3	2229		
0.5	2019		0.5	2160		0.5	2234		
1	2030		1	2175		1	2246		
2	2051		2	2192		2	2266		
4	8902		4	2212		4	2281		
5	2076		5	2214		5	2287		
6	2080		6	2220		6	2290		
7	2086		7	2221		7	2293		
24	2122		24	2264		24	2236		
48	2193		48	2332		48	2401		
72	2250		72	2387		72	2453		
144	2328		144	2468		144	2534		
168	2346		168	2483		168	2551		
194	2317	,	194	2450		194	2498		
218	2320		218	2455		218	2497		
232	:320		232	2452		232	2493		
328	1.3 ,3		328	2491		328	2529		
352	2439		352	2579		352	2598		
400	2500		400	2660		400	2679		
472	2515		472	2670		472	2692		
496	2517		96	2675		496	2693		
520	2500		520	2665		520	2684		
Resid.	Str.	3.69 ksi	Resid.	Str.	3.51 ksi	Resid.	Str.	4.19 ksi	
	Recovery			Recovery			Recovery		
0	531		0	627		0	554		
i	480		1	566		1	492		
2	468		2	556		2	479		
3	451		3	548		3	476		
<u> </u>				·	<u></u>	·			

			77.53	Creep		(A 5	7 5 6 6 7		
Test: Creep						Test: Creep			
Orient: 90°			Orient: 90°			Orient: 90°			
1 -	io:_E26-4			No: E27-8		Spec. No: E50-7			
Temp:	350°F		Temp:	350°F		Temp	350°F	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	
Stress	Streis: 1.78 ksi 60 % ult.			1.78 ksi	60% ult.	5tress_1.78 ksi 60% ult.			
Elap.	Accum.		, - :	Accum.		Elap. Accure.			
Time	Strain	Remarks	Time		Remarks	Time		Remarks	
(hrs.)	(# in/in)			(#in/in)		-	(µin/in)		
0	1788		0	1826		0	Failed on	Loading	
0,016	1811		0.016	1971					
0.1	1827		0.1	2005			~~~~		
0.25	1854		0.25	2036					
0.5	1898		0.5	2076	ļl				
	1990	<u> </u>	1_1_	2153	<u> </u>			ورود دورود د	
2	2095		2	2248					
3	2163		3	2301	L				
4.5	2243		4.5	2377					
5	2269		5	2387	ļ J				
6	2300		6	2411					
7	2334		7	2450	<u> </u>				
8	2376		8	2450					
24	2497		7.4	2603					
96,5	2527		96.5	2699					
144	2524		144	2740					
192.1	2534		192.1	2769					
219.9	Failure		219.9	Testinte	rupted				
			0	Failed or	Restart				
				ļ <u> </u>					
				<u> </u>					
									
				<u> </u>					
				<u> </u>					
				<u> </u>	ļ				
				ļ					
		<u> </u>		<u></u>			<u> </u>		
<u> </u>	Recover	У		Recovery			Recovery	, ·	
					[······································	
		}		ļ					
				 	 		<u> </u>		
	L	L		L	L		<u> </u>		

				T300/F17	78			
Test:	Creep		Test:	Creep		Test:	Creep	
Orient	Orient: 90° Orient: 90°				Orient: 90°			
Spec. N	lo: <u>E52</u> .	7	Spec. I	Vo: E52.	· Z	Spec. 1	No: <u>E52-</u> _I	0
Temp:	350°F		Temp:	350°F		Temp:	350°F	
Stress	: <u>1.07</u> ks	50 a ult.	Stress	1.07 ksi	50 e ult.	Stress 1.07 ksi 50% ul-		
Elap.	Accum.		Elap.	Accum.		Elap.	Accum.	
Time	Strain	Remarks	Time	Strain	Remarks	Time	Strain	Remarks
	(µ in/in)		(hrs.)			(hrs.)		
0	1025		0	903		0	1021	
0.016	1013		0.016	950		0.016	1044	
0,1	997		0.1	1096		0.1	1098	
0.25	1020		0.25	1105		0,25	1120	
0,6	1041		0.6	1112		0.6	1130	
1	1081		1	1140		•	1141	
2	1168		2	1164		2	1174	
3	1173		3	1125		3	1192	1000
4.1	1216		4.1	1170		4.1	1210	
5	1215		5	1176		5	1216	
6	1253		6	1200		6	1229	
7.1	1264		7, 1	1193		7.1	1240	
8	1293		8	1235		8	1252	
24	1496		24	1297		24	1337	
48	1774		48	1325		48	1415	
144	2606		144	1351		144	1556	
288.5	3618		288.5	1407		288.9	1632	
336,75	3906		336.79			336, 75		
384	4171		384	1408		384	1661	
456.5	4565		456.5	1429		456.5	1679	i
504.5	4829		504.5			504.5		
-			7.5.5					
1	**************************************				1	1	······	
					<u> </u>		·	
		 			 			†
Resid.	Str.	5.32 ksi	Resid.	Str.	5.54 ksi	Resid	Str.	5, 34 kai
	Recover	y		Recovery	<u> </u>	Recovery		<u>. </u>
0	3813		0	493	T	0	710	
1	3806		1	414		,	672	
2	3806		2	414		2	666	
3	3796		3	426		3	661	F

		3	Creep			Creep			
		1 Orient			· 1				
o: E14-	Orient: 90°			Orient: 90°			Orient: 90°		
Spec. No: El4-5		Spec. No: E27-1			Spec. No: E26-9				
Temp: 450°F		Temp:	450°F			: 450°1			
		1		1	ł				
					· }				
	Remarks			Remarks			Remarks		
	1	3	1	1	. 1		2102222		
		0			- Internation		loading		
	Loose Wire								
	change in								
						 			
بسيده كالنفسة فسيبدعه			<u> </u>						
						<u> </u>			
2907									
3053									
3261									
l. Str.	3.02 ksi								
				ļ					
			<u> </u>		<u> </u>				
Recover	y		Recovery			Recovery			
2220									
2118									
2082									
2061									
	Accum. Strain (#in/in) 1159 1195 1099 1115 1117 1140 1220 1243 1266 1287 1315 1328 1552 2254 2412 2556 2749 2907 3053 3261 . Str. Recover 2220 2118 2082	Strain (#in/in) 1159 1195	Accum. Strain Remarks (μ in/in) 1159 1195	Accum. Strain (#in/in) 1159 1195 caused caus	Accum. Strain (# in/in) Remarks (# in/in) 0 Failed on loading 1195 Change in 1115 1117 1140 1220 1243 1266 1287 1315 1328 1552 2254 2412 2556 2749 2907 3053 3261	Accum. Strain Remarks (#in/in) 1159 1195 O Failed on loading (hrs.) 1115 O Failed on loading (hrs.) 1115 O Failed on loading (hrs.) 1115 O Failed on loading (hrs.) 1116 O Failed on loading (hrs.) 1117 O Failed on loading (hrs.) 1118 O Failed on loading (hrs.) 1119 O Failed on loading (hrs.) 1111 O	Accum. Strain (μ in/in) Remarks (μ in/in) 1159 1195 1195 1195 11115 1117 1118 1120 1220 1243 1266 1287 1315 1328 1441 22556 2749 2907 3053 3261 Recovery		

				T300/F17					
Test: Creep			Test: Creep			Test: Creep			
Orient	: 90°		Orient: 90°			Orient: 90*			
Spec. 1	No: E27-6	<u></u>	Spec. No: E26-8			Spec. No: E29-8			
Temp:	Temp: 450°F			450°F		Temp	450°F		
Stress	: 0.86 ksi	40% w.t.	1		40 % ult.	Stress 0.86 ksi 40 % ult.			
Elap.	Accum.		Elap.	Accum.		Elap.	Accum.		
Time		Remarks	Time	Strain	Remarks	Time		Remarks	
(hrs.)	(µin/in)		(hrs.)	(#in/in)		(hrs.)	(µin/in)		
0	949		0	1059		0	Failed o	n loading	
0.016	1021		0.016	1053					
0.25	1056		0.1	1252	temp over				
0.5	1067		0.25	1188					
1	1073		0.5	1192					
2	1079		1	1193					
3	1093		2	1220			T		
4	1126		3	1241				`	
5.1	1121		4	1249					
6	1115		5	1263					
7	1147		. 6	1269					
24	1166		9	1274					
48	1.171		24	1297			·		
96	1171		48	1275					
	Gage fa:	led -	169	1435					
		ccurate	193.3	1476					
			240,3	1581					
				Failure					
L									
					<u> </u>		1		
	Recovery		Recovery				Recovery		

				T300/F17	8				
Test: Creap			Test: Creep			Test: Creep			
	: <u>±45°</u>		Orient: ±45*			Orient: ±45°			
Spec. No: E39-4			Spec. No: E36-10			Spec. 1	No: E37-4		
Temp: RT			Temp:	RT		Temp	RT		
Stress	.12.02ksi	70% ult.	Stress:	12.02ksi	70 t ult.	Stress 12.02ksi 70 % ult.			
Elap.			Elap.	Accum.		Elap.			
Time	Strain	Remarks	Time	Strain	Remarks	Time	Strain	Remarks	
-	(µin/in)		(hrs.)			(hrs.)			
0	4833	 	0	4513		0	4627		
0.016	5017	·	0.016	4759 4987		0.016	5896 6108		
	5269					0.1	.,		
0.25	5381 5491		0.25	5085 5175		0.25	6336 6485		
1	5626		1	5282		2.5	6707		
2	5771		2	5400			6903		
3.3	5882		3.3	5480	ļ <u> </u>	3	6912		
4	5932		4	5521		4	6993		
5	5982		5	5560		5	7068		
6	6023		6	5589		6.1	7126		
7.5	6071		7.5	5629		8	7211		
24	6327		24	5840	ļ	23.3	Failure		
96.7	7010		96.7	6433					
120	7093		120	6508					
169.3	7147		169.3						
293	7254		293	6659		ļ			
312	7289		312	6696]			
360	7350		360	6755					
432	7435		432	6841					
457.5			457.5						
480	7515		480	6913					
530 597	7647 7775		530 597	7044 7170					
27/	1113		39/	11.10	 	 			
									
	- CA	10 04 5-2	Bon & a	. Str.	19.71 ksi				
Kesi	l. Str.	18.94 ksi	Kesia	. SEF.	13./1 KS1	 			
-	Recovery			Recovery			Recovery		
0	3140	<u></u>	0	2790					
1.7	2412		1.7	2035	-	ļ			
2.7	2371		2.7	1984					
3	2359		3	1982					
1	<u> </u>	L	I		L	<u> </u>		L	

				T300/F17		سببسيوس			
Test:_	Creep		Test: Creep			Test: Creep			
ŧ	±45°		1	: <u> </u>		Orient: ±45°			
Spec. N	To: E40-9		Spec. No: <u>E37-1</u>			Spec. No: E35-9			
Temp:	RT		Temp:	RT		Temp:	RT		
Stress	Stress: 10.30ksi 60% ult.		Stress:	10.30ksi	60 % ult.	Stress	10.30 ksi	60 % Wit.	
Elap.	Accum.			Accum.		1 - 1	Accum.		
Time	Strain	Remarks	Time		Remarks	Time	Strain	Remarks	
	(µ in/in)			(Min/in)		-	$(\mu in/in)$		
0	3870		0	4464		0	4126		
0.016			0.016	4642		0.016	4247		
0.1	4265		0.1	4860		0.1	4407		
0.25	4348		0.25	4960		0.25	4488		
0.5	4454		0.5	5090		0.5	4593		
1	4577		1	5246		1	4720		
2.5	4693		2.5	5384		2.5	4836		
3	4700		3	5389		3	4841		
4	4743		4	5440		4	4888		
5.1	4795		5.1	5499		5.1	4937		
6.1	4827		6.1	5539		6.1	4972		
8	4877		8	5598		8	5019		
24	5085		24	5844		24	5233		
50	5283		50	6090		50	5439		
96	5408		96	6246		96	5566		
168	5646		168	6524		168	5820		
216	5684		216	6574		216	5867		
241.5	5681		241.5	6574		241.5	5868		
357	5737		357	6640		357	5926		
384	5744		384	6652		384	5936		
432	5776		432	6693		432	5969		
504	5821		504	6750		504	6019		
Resi	l. Str.	19.60 ks	Resid	Str.	19.53 ksi	Resid	Str.	18.92 ksi	
	Recover	y		Recovery			Recovery		
0	1854		0	2300		0	2033		
1	1320		1	1601		1	1425		
2	1291		2	1560		2	1390		
3.5	1200		3.5	1451		3.5	1294		

77A-	Creep			Test: Creep					
_		· · · · · · · · · · · · · · · · · · ·	-	1			•		
Orient			-	Orient					
Spec. 1	lo: E37-9		-	Spec. No: E36-3					
Temp:	RT		-	Temp: RT					
Stress	: <u>8.59 k</u> si	_50 € v	lt.	Stress: 8.59 ksi 50% ult.					
Elap.	Accum.	m. Elap.			Accum.	_			
Time	Strain	Remai	rks	Time	Strain	Rema	rks		
(hrs.)	(µin/in)			(hrs.)	(#in/in)				
0	3778			0	3446				
0.016	3901			0.016	3525				
0.1	4014			0.1	3616				
0.25	4097			0.25	3696				
0.5	4178			0.5	3768				
1	4267			1	3850				
2	4352			2	3949				
3	4417			3	4035				
4	4463			4	4082				
5	4501			5	4121				
6	4534			6	4155				
7	4563			7	4178				
24	4829			24	4425				
48	5007			48	4598				
96	5207			96	4786				
168	5372			168	4928				
216	5373			216	4917				
264	5392			264	4935				
336	5408			336	4947				
384	5503			384	5044				
432.5	5563			432.5	5110				
503	5622			503	5165				
			\dashv						
Resid	l. Str.	19.54	ksi	Resid	. Str.	19.98	ksi		
	Recover	<u>!</u> Y	\dashv		Recovery	!			
0	2167	<u> </u>		0	1720				
ì	1706			1	1366				
2	1595			2	1290				

Test: Creep										
Orien	Orient: ±45°									
Spec.	No: E37-2									
Temp										
Stress 8.59 ksi 50% ult.										
Elap.	Accum.									
Time	Strain	Remarks								
(hrs.)	(µin/in)									
0	3620									
0.016	3697									
0.1	3777									
0.25	3855									
0.5	3921									
1	4005									
2	4082									
3	4137									
4	4180									
5	4218									
6	4245									
7	4267									
24	4508									
48	4677									
96	4872									
168	5035									
216	5030									
264	5048									
336	5062									
384	5154									
432.5	5219									
503	5276									
										
		 								
Resid	. Str.	20.05 ksi								
										
	Recovery	<u> </u>								
0	1858									
ī	1474	 								
2	1390	 								
-	1224									
	5	L 1								

				T300/F17	<u> </u>			
*****	Creep		. –	Creep			Creep	······································
	±45°		Orient: ±45°			Orient: ±45°		
Spec. N	lo: E44-2		Spec. No: E34-7 Temp: 350°F			Spec.	10:E48-8	
	350°F					Temp	350°F	
Stress	tress: 7.30 ksi 50% ult. St		Stress:	7.30 ksi	50 t ult.	Stress	7.30 ksi	50 tilt.
	lap. Accum.		Elap. Accum.		11 - 1			
Time	Strain	Remarks	Time	Strain	Remarks	Time	Strain	Remarks
	(µ in/in)		(hrs.)			(hrs.)		
<u> </u>	3903		0	3759		0	4490	
0.016	4195		0.016			0.016	4902	
0.1	4404		0.1	4271		0.1	5829	
0.25	4543		0.25	4339		0.25	5904	
0.5	4712		0.5	4408		0.5	6003	
1	4819		1	4498		1	6141	
2	5016		2	4630		2	6330	
3.6	5177		3.6	4756		3	6507	
4	5224		4	4778		4	6583	
5	5274		5	4831		5	6663	
6	5342		6	4885		6	6738	
7	5408		7	4929		7	6807	
8	5455		8	4965		8	6873	
72	6404		72	5810		24	7454	
120	6725		120	6088		96	8443	
168	6978		168	6298		144	8737	
240	7195	<u> </u>	240	6543		192	8961	
289	7358		289	6688		264	9212	<u></u>
336	7459	<u> </u>	336	6799		312	9346	
432.6	7672		432.6	7022		360	9457	<u> </u>
503.2	7810	<u> </u>	503.2	7179		432	9593	
	. پيد بي د					481	9679	<u> </u>
		ļ	ļ			506.6	9718	ļ
Resid	l. Str.	20.78 ksi	Resid.	Str.	19.22 ksi	Resid	. Str.	20.81 ks
	Recovery		Recovery			Recovery		
0	4480		0	3896		O	6170	1
1.5	3997		1.5	3478		1	5626	
2.5	3921		2.5	3418		2	5513	
						3	5445	

T300/F178

Test:	Creep			Creep		Test:	CT. SD	
-	: ±45°		1 -	: ±45°		1 -		
l l			į.	io: <u>£39-</u> 1		Orient: ±45° Spec. No: E36-5		
1 "	To: <u>E37-6</u>							
Temp:	350°F		Temp:	350°1		Temp:	350*1	
Stress	: 5.84 ksi	400 ult.			40 % ult.	Stress	5.84 ksi	40 t ult.
	Accum.		, -	Accum.		:	Accum.	
Time	Strain	Remarks	Time	Strain	Remarks		Strain	Remarks
(grs.)	(µ in/in)			(Pin/in)			(µin/in)	
0	2997		0	2546	 	0	2938	
0.016	3182		0.016	2654		0.016	2982	
0.1	3278		0.1	2782		0.1	3071	
0.25	3377		0,25	2849		0.25	3140	
0.7	3479		0.7	2921	 	0.7	3231	
1.3	3581		1.3	2994		1.3	3292	
2	3665		2	3052		2	3348	
3	3740		3	3106		3	3404	
4	3791		4	3146		4	3447	
5	3830		5	3180		5	3489	
6.5	3881		6.5	3223		6.5	3528	
7	3902		7	3239	<u> </u>	7	3545	
8	3923		8	3259		8	3568	<u> </u>
24	4199		24	3527		24	3830	
72	4687		72	4008		72	4187	
144.5	5045		144.5	4308		144.5	4484	
192	5235		192	4419		192	4624	
240.1	5322		240.1	4521		240.1	4742	
312	5395		312	4623		312	4886	
336	5431		336	4644		336	4943	
360	5469		360	4669		360	4988	
408	5541		408	4728		408	5067	
480	5645		480	4776		480	5182	
500	5669		500	4795	 	500	5217	
Resid	Str.	17.34 ksi	Resid	. Str.	15.72 ksi	Resid	Str.	20.62 ksi
	Recover	!		Recovery		Recovery		
 						-		,
<u>n</u>	2888	 	0	2433	 	1.5	2450 2193	
1.5	2619	 	1.5	2172	 		2170	
12	2582	 	2	2147	 	2		
<u>L3</u>	2537		3	2118	L	3	2139	

				T300/F17	8	
Test: Creep			Test: Creep			
Orient: <u>±45°</u>			Orient	Orient: ±45°		
Spec. N	io: <u>E43-5</u>		t -	lo: <u>E48-</u> 2		
Temp:	350°F		Temp:	350°F		
Stress	: 4.38 ksi	30 % ult.	Stress:	4.38 lisi	30 % ult.	
Elap.	Accum.		Elap.	Accum.		
Time	Strain	Remarks	Time	Strain	Remarks	
(br=.)	(# im/in)		(hrs.)	(Pin/in)		
0	2226		0	2087		
0.03	2337		0.03	2160		
0.13	2413		0.13	2242		
0.25	2472		0.25	2291		
0.5	2541		0,5	2341		
1	2618		1	2397		
2	2719		2	2467		
3	2772		3	2510		
4	2827		4	2548		
5	2873		5	2583		
6	2910		6	2603		
7	2940		7	2627		
24	3217		24	2839		
48	3406		48	2981		
120	4629		120	3722		
168.4	3850		163.4	3290		
216	3979		216	3371		
288.5	4162		288.5	3517		
336	4274		336	3594		
384	4381		384	3685		
456	4517		456	3802		
504	4601		504	3866		
	1	,				
Resid.	Str.	20.49 ksi	Resid.	Str.	20.53 ksi	
Recovery				Recovery		
		<u>'</u>				
٥	2704	 	0	2003		
1	2555	 -	1-1-	1857	 	
2	2536		2	1837		

Test:	Creep)					
Orient	±45°						
Spec.	No: E44-						
Temp	350°1						
Stress	4.38 ksi	30 % ult.					
Elap.	Accum.						
Time	Strain	Remarks					
(hrs.)	(µin/in)						
0	2288						
0.03	2321						
0.13	2354						
0.25	2385						
0.5	2420						
1	2470						
2	2529						
3	2571						
4	2602						
5	2631						
6	2652						
7	2671						
24	2893						
48	3054						
120	4282						
168.4	3458						
216	3561						
288.5	3696						
336	3770						
384	3842						
456	3920						
504	3969						
Resid	. Str.	20.61 ksi					
	Recovery						
0	2050	· · · · · · · · · · · · · · · · · · ·					
ī	1879						
2	1867						
3	1851						
-		<u> </u>					

T300/F178 Test: Creep Test: Creen Crient: ±450 Orient: ±45° Sper. No: E48-6 Spec. No: E43-10 450°F 450°P Temp: Temp:_ Stress: 4.87 ksi 40 % ult. Stress: 4.87 ksi 40 t ult. Elap. Elap. Accum Accum. Time Time Strain Remarks Strain Remarks (# in/in) (hrs.) (hrs.) (Fin/in) 0.016 0.016 0.1 0.1 0.25 0.25 0.5 0.5 1.1 1,1 16.37 ksi 13.72 ksi Resid Str. Resid Str. Recovery Recovery

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77.0.00	Test: Creep						
_							
Orient	±45°						
Spec. I	Vo: E34-6	-					
	450°F						
	4.87 ksi						
Elap.	Accura						
Time		Remarks					
(brs.)	(µin/in)						
0	2427						
0.016	2495						
0.1	2778						
0.25	2873						
0.5	2965						
1.1	3124						
2	3292						
3	3411						
4	3524	····					
5	3615						
6	3687						
7	3772						
8	3798						
24	4093						
48	4382						
120	4898						
158	5124						
216	5342						
288	5600						
337	5783						
384	5945						
480	6314						
503	6417						
							
Resid	Str.	16.56 ksi					
	Recovery						
0	4079						
1	1932						
2	3888	·					
3	3853						
	3033	L					

T300/F178

				T300/F17					
	Creer		1	Creep		Test: Creep			
	±45°		1	: ±45°		Orient: ±45*			
Spec. N	io: E44-6		Spec. N	to: <u>E34-8</u>		Spec. N	to: E43-3) 	
Temp:			Temp:	450°F		Temp: 450°F			
Stream	:3.65 ksi	30% ult.	Stress:	3.65 ksi	30 tult.	Stress	3.65 ksi	30 t ult	<u>-</u>
Elap. Time	Accum. Strain	Remarks	Elap. Time	Accum. Strain	Remarks	Elap. Time	Accum. Strain	Remar	ks.
(hrs.)	(# in/in)		(hrz.)	(#in/in)		(hrs.)	(µin/in)		
0	1677		0	1593		0	1918		
0.016	1733		0.016	1665		0.016	2011		
0.1	1831		0.1	1828		0.1	2139		
0.25	1912		0.25	1888		0.25	2200		
0.5	1977		0.5	1934		0.5	2264		
1.1	2067		1.1	2034		1.1	2381		
2	2175		2	2131		2	2491		
3	2279		3	2223		3	2587		
4	2359		4	2292		4	2667		
5.1	2434		5.1	2360		5.1	2742		
6	2475		6	2411		6	2793		
7	2525		7	2461		7	2847		
8	2576		8	2501		8	2900		
24	3028		24	2939		24	3310		
72	3390		72	3264		72	3825		
144	3935		144	3788		144	4365		
192	4146		192	4021		192	4523		
240	4319		240	4222		240	4657		
312	4596		312	4437		312	4800	<u></u>	
360	4758		360	4705		360	4875		
408	4931		408	4929		408	4967	<u> </u>	
480	5208		480	5301		460	5089		
504	5283		504	5464		504	5126		
Dogi d	C4	15 25 kg	Ponid	***	10.39 ksi	Pagió	. Str.	20.05	be:
Resid.	SEF.	15.35 ks:	Resid.	Str.	20.37 KS1	WESTO	. 361.	20.03	~3.
	Recover	y		Recovery		Recovery			
0	3753		0	3826		0	3607		
1	3574		1	3741		1	3424		
2	3538		2	3715		2	3397		
3	3519		3	3690		3	3353	1	

APPENDIX J THERMAL EXPANSION DATA

All of the thermal expansion data generated during this program are presented in this appendix. In addition, a typical thermal expansion curve is included at the end of the section. These data are summarized in Section 4.

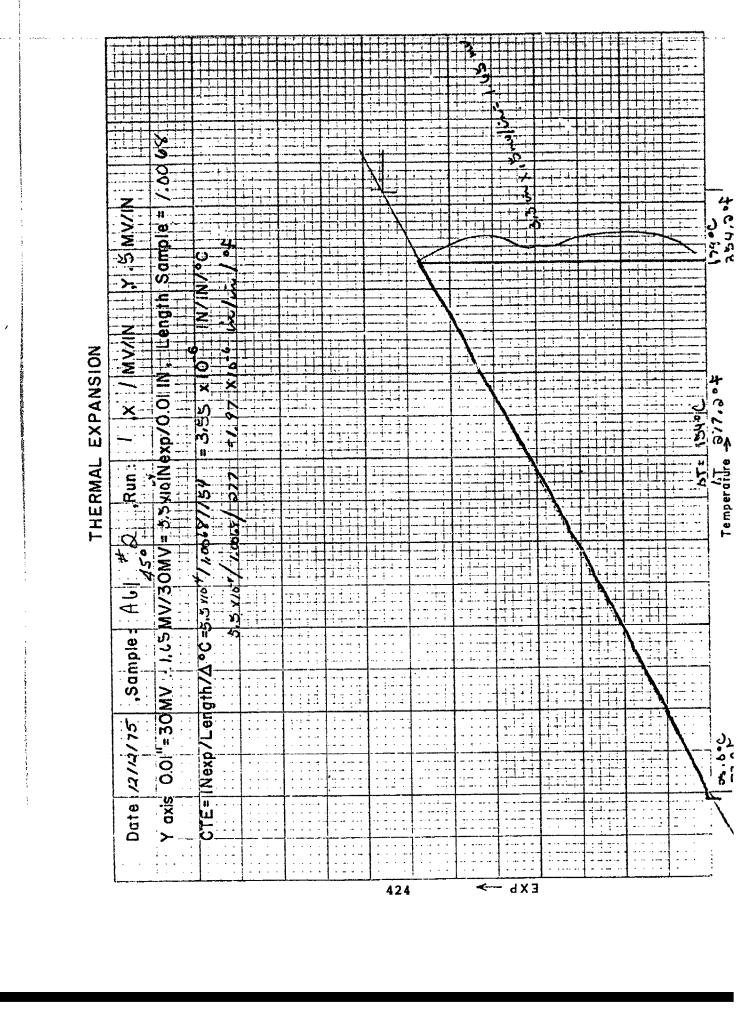
			ermal Expansion	A STATE OF THE PARTY OF THE PAR
Material				Graphite/Epoxy
Specimen Number	Fiber Orien- tation	Temp. Range (°F)	Coeff. Therm. Expansion (10 ⁻⁶ in/in-°F)	Remarks
A37-4	0°	-67+72	0.14	Difficult to measure
A37-4	0°	72+170	0.01	these very low values
A37-4	0°	175→350	0.47	with a dilatometer
A37-5	Go.	72 →200	-0.04	
A37-5	0°	200+380	0	
A37-6	0°	-70+72	17	
A37-6	0°	72+260	-0.02	
A37-6	0°	260+375	0.06	
A37-7	0.0	72+165	<u> </u>	Double the normal length
A37-7	00	72+175	≛0	
A37-7	0.0	72+165	≟ 0	
A37-7	0°	72+165	<u> </u>	
A37-7	0°	72+215	≛0	
A37-7	0°	165+350	0.16	
A37-7	0°	175+350	0.11	
A37-7	0°	165+350	0.12	
A37-7	0°	165+350	0.08	
A37-7	0°	215+350	0.19	
A37-1	90°	-71 →75	15.3	
A37-1	90°	77+350	17.1	
	000	60 =		
A37-2	90°	-69 +70	15.3	
A37-2	90°	73+350	19.1	
A37-3	90°	-69 → 73	15.7	
A37-3	90°	98+350	19.7	
	T			

Test: Coefficient of Thermal Expansion Materials: SP313 Graphite/Epoxy					
Specimen Number	Fiber	Temp. _Range (°F)	Coeff. Therm. Expansion (10-6in/in-°F)	Remarks	
A61-1	±45°	-67+72	1.60		
A61-1	±45°	<i>77</i> +385	1.93		
A61-2	±45°	-67→72	1.92	_	
A61-2	±45°	77→354	1.97		
A61-3	±45°	-67→72	1.93		
A61-3	±45°	98→360	1.92		
			<u>-</u>		
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	<u> </u>	<u> </u>			

			ermal Expansion	
Material	1			
Specimen Number	Fiber Orien- tation	Temp. ∴ange (°F)	Coeff. Therm. Expansion (10 ⁻⁶ in/in-°F)	Remarks
C30-4	0 •	-70 +50	-0.003	Very difficult to
C30-4	٥°	80→275	-0.01	obtain accurate values
C30-5	0°	-70→65	-0.007	when the expansions are
C30-5	0 °	75→275	-0.008	this low
C30-6	0°	-70→65	-0.007	
C30-6	0 °	90→275	-0.004	
C30-1	90°	-70→60	16.4	
C30-1	90°	-65→70	15.9	
C30-1	90 °	80→275	16.2	
C30-2	90°	-70+50	17.7	
C30-2	90°	75→275	16.7	
C30-3	90°	-70→70	18.1	
C30-3	90°	75+275	18.0	
C36-1	±45°	- 75→10	≟ 0	
C36-1	±45°	10→53	1.26	
C36-1	±45°	119+300	1.89	
C36-1	±45°	145+300	1.78	
C36-2	±45°	- 75→57	≜ 0	
C36-2	±45°	57÷95	2.15	
C36-2	±45°	130+300	2.07	
C36-3	±45°	-70→-15	≟ 0	
C36-3	+45°	-15+71	1.36	
C36-3	±45°	165+305	1.44	
	1 143	<u>11.65≯305.</u>		
	 			
	 			
	 			
	 	 		<u> </u>
	<u> </u>	 		
	 			
L	1	<u> </u>	i	<u> </u>

	Test: Coefficient of Thermal Expansion					
Material	s: AS/43	397	Graphit	e/Polvimide		
Specimen Number	Fiber Orien- tation	Temp. Range (°F)	Coeff. Therm. Expansion (10 ⁻⁶ in/in-°F)	Remarks		
D44-1	90°	-86+81	14,2			
D44-1	90°	72 →360	17.5			
D44-1	90°	81+150	16.7	. :		
D44-1	90°	300+400	22.8			
D44-1	90°	400→500	26.4			
D44-2	90°	69 → 60	14.1			
D44-2	90°	85 → 321	17.2			
D44-2	90°	72 → 14 5	15.5			
D44-2	90°	310+400	19.5			
D44-2	90°	400+460	26.9			
D44-3	90°	-78+64	13.9			
D44-3	90°	80+285	16.5			
D44-3	90°	71→170	15.3			
D44-3	90°	290+375	19.5			
D44-3	90°	375+470	25.3			
D60-1	±45°	<u>-90+-8</u>				
D60-1	±45 °	<u>-8 →74</u>	1.26			
D60-2	±45°	-40 ⁺ 70	≐ 0			
D60-2	±45°	71+150	≈ 0			
D60-2	±45°	300+390	3.35			
D60-2	±45 °	395,475	3.85			
D60-3	±45°-	100→-30	± 0			
D60-3	±45°	-30+43	1.40			
D60-3	±45°	72+120	≐ 0			
D60-3	±45°	285→400	4,04			
D60-3	±45°	400+485	5,16			
D44-4	e°	74+270	± ()			

Test: Coefficient of Thermal Expansion						
Materials: T300/F178 Graphite/Polyimide						
Specimen Number	Fiber Orien- tation	Temp. Range (°F)	Coeff. Therm. Expansion (10 ⁻⁶ in/in-°F)	Remarks		
E33-1	90°	-54 +72	17.7	·		
E33-1	900	79+143	16.8			
E33-1	90°	252→345	24.0			
E33-1	90°	318-475	22.2			
				7		
E33-2	90°	-44 →77	16.9			
E33-2	90°	77+143	16.9			
E33-2	90°	296+345	24.4			
E33-2	90°	318+475	24.1			
E33-3	90°	-63+81	16.9			
E33-3	90°	78+143	17.5			
E33-3	90°	85+147	17.9			
E33-3	90°	296+350	24.5			
E33-3	90°	301+363	22.7			
E33-3	90°	341+475	25.5			
E47-1	±45°	-100→81	2.25			
E47-1	±45°	81→475	1.47			
E47-1	± 45 °	77+298	1.80			
E47-1	±45°	210+387	2.10			
E47-2	+45°	-64∻81	2_09			
E47-2	±45°	-69→108	2.18			
E47-2	<u>+45°</u>	81 →47 5	1,90			
E47-2	±45°	86→209	1.70			
E47-2	± 45°	209→386	1.93			
E47-3	±45°	-95→68	2.02			
E47-3	±45°	77+372	1.86			
E47-3	±45°	296→475	1.55			



APPENDIX K SPECIFIC HEAT DATA

All of the specific heat data generated during this program are presented in this section. A typical set of differential scanning calorimeter (DSC) traces, from which specific heat is determined, is included at the end of this section.

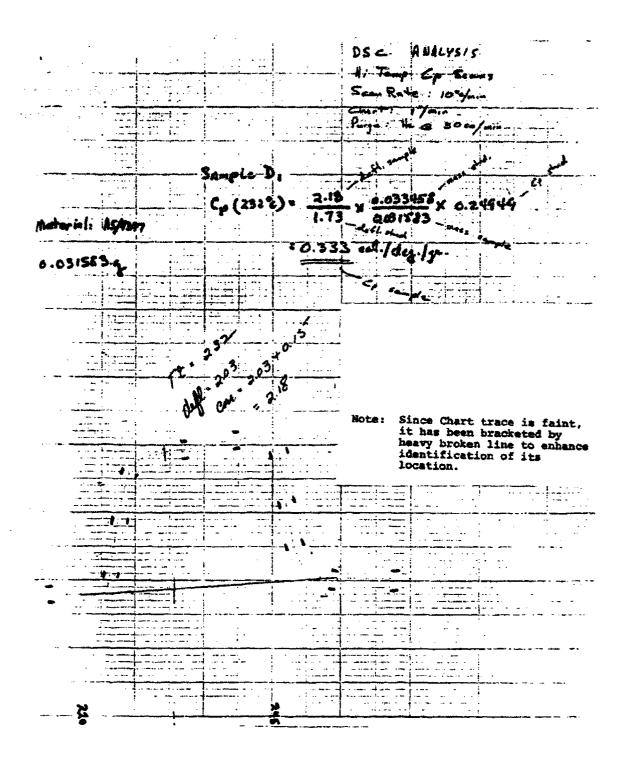
Test: Spe Materials	ecific Hea	Married Color Colo	phite/Epoxy
Specimen Number	Avg. Temp. (°F)	Specific Heat (Btu/lb-°F)	Remarks
A35-1	215	0.25	all tests on SP313 used a
A35-1	142	0.24	drop calorimeter
A35-1	110	0.24	
A35-1	83	0.23	
A35-1	66	0.17	
A35-1	-66	0.16	
A35-2	214	0,28	
A35-2	142	0.26	
A35-2	109	0.22	
A35-2	83	0.26	
A35-2	-33	0.21	
A35-2	-66	0.17	
A35-3	213	0.24	
A35-3	142	0.23	
A35-3	109	0.26	
A35-3	83	0_27	
A35-3	-66	0.13	
	<u> </u>		

		ecific Hea	t .	
Specimen Number Temp. (PF) Retu/1b-°F) Remarks	Materials	: AS/3004		
C3A 68 0.18 determined using a Differenti C3A 86 0.19 Scanning Calorimeter technique C3A 104 0.19 with sapphire (Al ₂ O ₃) as a C3A 122 0.20 reference. C3A 140 0.21 0.21 C3A 158 0.21 0.22 C3A 176 0.22 0.23 C3A 212 0.23 0.23 C3A 230 0.23 0.24 C3A 248 0.24 0.24 C3A 68 0.18 0.24 C3A 104 0.19 0.20 C3A 122 0.19 0.20 C3A 140 0.20 0.20 C3A 176 0.20 0.20 C3A 194 0.21 0.21 C3A 212 0.21 0.21 C3A 230 0.21 0.21		Temp.	Heat	Remarks
C3A 86 0.19 Scanning Calorimeter technique C3A 104 0.19 with sapphire (Al ₂ O ₃) as a C3A 122 0.20 reference. C3A 140 0.21 0.21 C3A 158 0.21 0.22 C3A 176 0.22 0.23 C3A 212 0.23 0.23 C3A 230 0.23 0.24 C3A 248 0.24 0.24 C3A 68 0.18 0.24 C3A 104 0.19 0.20 C3A 122 0.19 0.20 C3A 140 0.20 0.20 C3A 158 0.20 0.20 C3A 176 0.20 0.20 C3A 194 0.21 0.21 C3A 212 0.21 0.21 C3A 230 0.21 0.21	C3A	50	0.18	All values on this page
C3A 104 0.19 with sapphire (Al ₂ O ₃) as a C3A 122 0.20 reference. C3A 140 0.21 C3A 158 0.21 C3A 176 0.22 C3A 194 0.22 C3A 212 0.23 C3A 230 0.23 C3A 248 0.24 C3A 50 0.17 C3A 68 0.18 C3A 86 0.18 C3A 104 0.19 C3A 122 0.19 C3A 122 0.19 C3A 158 0.20 C3A 158 0.20 C3A 176 0.20 C3A 194 0.21 C3A 212 0.21 C3A 212 0.21 C3A 212 0.21 C3A 230 0.21	C3A	68 .	0.18	determined using a Differential
C3A 122 0.20 reference. C3A 140 0.21 0.21 C3A 158 0.21 0.22 C3A 176 0.22 0.23 C3A 212 0.23 0.23 C3A 230 0.24 0.24 C3A 248 0.24 0.24 C3A 68 0.18 0.18 C3A 86 0.18 0.20 C3A 104 0.19 0.20 C3A 140 0.20 0.20 C3A 158 0.20 0.20 C3A 194 0.21 0.21 C3A 212 0.21 0.21	C3A	- 86	0.19	Scanning Calorimeter technique
C3A 140 0.21 C3A 158 0.21 C3A 176 0.22 C3A 194 0.22 C3A 212 0.23 C3A 230 0.23 C3A 248 0.24 C3A 50 0.17 C3A 68 0.18 C3A 86 0.18 C3A 104 0.19 C3A 122 0.19 C3A 140 0.20 C3A 158 0.20 C3A 176 0.20 C3A 194 0.21 C3A 212 0.21 C3A 230 0.21	C3A	104	0.19	with sapphire (Al ₂ O ₃) as a
C3A 158 0.21 C3A 176 0.22 C3A 194 0.22 C3A 212 0.23 C3A 230 0.23 C3A 248 0.24 C3A 50 0.17 C3A 68 0.18 C3A 86 0.18 C3A 104 0.19 C3A 122 0.19 C3A 140 0.20 C3A 158 0.20 C3A 176 0.20 C3A 194 0.21 C3A 212 0.21 C3A 230 0.21	C3A	122	0.20	reference.
C3A 176 0.22 C3A 194 0.22 C3A 212 0.23 C3A 230 0.23 C3A 248 0.24 C3A 50 0.17 C3A 68 0.18 C3A 86 0.18 C3A 104 0.19 C3A 122 0.19 C3A 140 0.20 C3A 158 0.20 C3A 176 0.20 C3A 194 0.21 C3A 212 0.21 C3A 230 0.21	C3A	140	0.21	
C3A 194 0.22 C3A 212 0.23 C3A 230 0.23 C3A 248 0.24 C3A 50 0.17 C3A 68 0.18 C3A 86 0.18 C3A 104 0.19 C3A 122 0.19 C3A 140 0.20 C3A 158 0.20 C3A 176 0.20 C3A 194 0.21 C3A 212 0.21 C3A 230 0.21	C3A	158	0.21	
C3A 212 0.23 C3A 230 0.23 C3A 248 0.24 C3A 50 0.17 C3A 68 0.18 C3A 86 0.18 C3A 104 0.19 C3A 122 0.19 C3A 140 0.20 C3A 158 0.20 C3A 176 0.20 C3A 194 0.21 C3A 212 0.21 C3A 230 0.21	C3A	176	0.22	
C3A 230 0.23 C3A 248 0.24 C3A 50 0.17 C3A 68 0.18 C3A 86 0.18 C3A 104 0.19 C3A 122 0.19 C3A 140 0.20 C3A 158 0.20 C3A 176 0.20 C3A 194 0.21 C3A 212 0.21 C3A 230 0.21	C3A	194	0.22	
C3A 248 0.24 C3A 50 0.17 C3A 68 0.18 C3A 86 0.18 C3A 104 0.19 C3A 122 0.19 C3A 140 0.20 C3A 158 0.20 C3A 176 0.20 C3A 194 0.21 C3A 212 0.21 C3A 230 0.21	C3A	212	0.23	
C3A 50 0.17 C3A 68 0.18 C3A 86 0.18 C3A 104 0.19 C3A 122 0.19 C3A 140 0.20 C3A 158 0.20 C3A 176 0.20 C3A 194 0.21 C3A 212 0.21 C3A 230 0.21	C3A	230	0.23	
C3A 68 0.18 C3A 86 0.18 C3A 104 0.19 C3A 122 0.19 C3A 140 0.20 C3A 158 0.20 C3A 176 0.20 C3A 194 0.21 C3A 212 0.21 C3A 230 0.21	C3A	248	0.24	
C3A 68 0.18 C3A 86 0.18 C3A 104 0.19 C3A 122 0.19 C3A 140 0.20 C3A 158 0.20 C3A 176 0.20 C3A 194 0.21 C3A 212 0.21 C3A 230 0.21				
C3A 86 0.18 C3A 104 0.19 C3A 122 0.19 C3A 140 0.20 C3A 158 0.20 C3A 176 0.20 C3A 194 0.21 C3A 212 0.21 C3A 230 0.21	C3A	50	0.17	
C3A 104 0.19 C3A 122 0.19 C3A 140 0.20 C3A 158 0.20 C3A 176 0.20 C3A 194 0.21 C3A 212 0.21 C3A 230 0.21	C3A	68	0.18	
C3A 122 0.19 C3A 140 0.20 C3A 158 0.20 C3A 176 0.20 C3A 194 0.21 C3A 212 0.21 C3A 230 0.21	C3A	86	0.18	
C3A 140 0.20 C3A 158 0.20 C3A 176 0.20 C3A 194 0.21 C3A 212 0.21 C3A 230 0.21	C3A	104	0.19	
C3A 158 0.20 C3A 176 0.20 C3A 194 0.21 C3A 212 0.21 C3A 230 0.21	C3A	122	0.19	
C3A 176 0.20 C3A 194 0.21 C3A 212 0.21 C3A 230 0.21	C3A	140	0.20	
C3A 194 0.21 C3A 212 0.21 C3A 230 0.21	C3A	158	0.20	
C3A 212 0.21 C3A 230 0.21	C3A	176	0.20	
C3A 230 0.21	C3A	194	0.21	
	C3A	212	0.21	
C3A 248 0.22	C3A	230	0.21	
	C3A	248	0.22	
i i		<u> </u>		

Test: Sp	ecific Kea	t	
Materials	: AS/3004		
Specimen Number	Avg. Temp. (°F)	Specific Heat (Btu/lb-°F)	Remarks
C3B	50	0.18	All values on this page
СЗВ	68	0.18	determined using a Differential
СЗВ	86	19 م	Scanning Calorimeter technique
С3В	104	0.19	with sapphire (Al_2O_3) as a
C3B	122	0.20	reference.
СЗВ	140	0.21	
C3B	158	0.21	
C3B	176	0.22	
C3B	194	0.22	
C3B	212	0.22	
C3B	230	0.23	
C3B	248	0.23	
СЗВ	50	0.18	
C3B	68	0.19	
C3B	86	0.19	
СЗВ	104	0.20	
C3B	122	0.20	
СЗВ	140	0.21	
C3B	158	0.22	
СЗВ	176	0.22	
СЗВ	194	0.22	
СЗВ	212	0.23	
СЗВ	230	0.23	
СЗВ	248	0.24	

Test: Sp	ecific Hea	L	
Materials	: AS/4397	& T300/F178	
Specimen Number	Avg. Temp. (°F)	Specific Heat (Btu/lb-°F)	Remarks
AS/4397	Graphite/P	olyimide	All values on this page
			determined using a
Dl	-67	0.142	Differential Scanning
Dl	72	0.192	Calorimeter technique with
D1.	350	0.309	sapphire (Al ₂ O ₃) as a refer-
Dl	450	0.333	ence.
T300/F178	Graphite/P	olyimide	
El	-67	0.136	
El	72	0.190	
E1	350	0.298	
E1	450	0.313	
	<u> </u>		
		 	<u> </u>

Scen Rate: 10°c/mi Chart: 1"/ami Purge: He at 30 cc/mi Standard ref. mtl.		, , , , , , , , , , , , , , , , , , ,		DSC And	ALYSIS_		
Scen Rate: 10°c/min Chart: 1°/min Purse: He al 30 cc/min All Ostandard rat. wtl. STo 485, Aug T: 150 Light: (3id): 0.0331589 Co (232°c) At,6; 0.24449 = 1/209777 Note: Since Chart trace is fait has been bracketed beauty broken line to an heavy broken line to an	in the second se			Hi Temp	Co Scan	6 • .	
Purge: Ne ed 30 eclusion Al. O. standard ref. mtl. BT. 485, Aug T. 430 Cp (231c) At.6. 0-24f49 = 4/20y Note: Since Chart trace is fa it has been bracketed beauty broken line to an	series de la companya			Scan Rate	: 10°c/mi		
Co (232c) At 6 0 24649 cat/day Note: Since Chart trace is fa it has been bracketed beavy broken line to an				Purge: 1	le at 30 cc		
Co (232c) At 6; 0 2444 9 zat/229 77	News Sand	143 ₄	W.T.	- ST- 485,	Aug Texs	0	
Co (231c) At 6; 0 24646 Entrangement trace is fa it has been bracketed heavy broken line to en	A complete and a comp		100 m g g 2 m			1	. <u>.</u>
Co (232c) At,6, 0 24449 Entagement trace is fa it has been bracketed heavy broken line to en	The second secon			221660			
Note: Since Chart trace is fa it has been bracketed heavy broken line to en	e ne seperati ng sakernas A s <u>a papanganistan</u> e, ma ndalisti intel 100 .		10-0				
Note: Since Chart trace is fa it has been bracketed be heavy broken line to en	i i i i i i i i i i i i i i i i i i i		(2) At 6	7444	9-1/	<u> </u>	
Note: Since Chart trace is fait has been bracketed it heavy broken line to en identification of its location.	:	. 4			//	7	
it has been bracketed the beavy broken line to enidentification of its location.	<u> </u>		A NA I ()	- N-4-			
heavy broken line to en identification of its location.			31	ે,∉	: Since Cr it has h	een braci	e is fair cetad by
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APPENDIX L THERMAL CONDUCTIVITY DATA

All of the thermal conductivity measurements made during this program are tabulated in this section. Summaries of these data are presented in Section 4.

Test: I		onductivit		
Specimen Number	Fiber Orien- tation	Temp.	Thermal Conductivity (Btu-ft/ft ² -hr-°F)	Remarks
A60-1	0 °	-132	0.195	
A60-1	0°	-132	0.199	
A60-1	0°	-119	0.214	
A60-1	0°	-102	0.196	
A60-1	0 °	-1	0.241	
A60-1	0 °	36	0.321	
A60-1	0°	68	0.272	
A60-1	0.0	89	0.281	
A60-1	0.	115	0.316	
A60-1	0°	186	0.288	
A60-1	0°	210	0.360	
A60-1	0°	224	0.308	
A60-1	0°	235	0.309	
A60-1	0°	269	0.323	
A60-1	0.	302	0.323	
A60-1	00	362	0.369	
A60-2	0.0	-97	0.184	
A60-2	0.0	-94	0.264	
A60-2	0°	131	0.375	
A60-2	0°	205	0.354	
A60-2	0°	217	0.377	
A60-2	0 °	230	0.354	
A60-2	0.	243	0.365	
A60-2	0°	295	0.363	
A60-2	0°	351	0.425	
A60-2	0°	381	0.426	

Test: T Material	hermal Co s: SP313	onductivity		
Specimen Number	Fiber Orien- tation	Temp.	Thermal Conductivity (Btu-ft/ft ² -hr-°F)	Remarks
A65-1	±45°	-48	0.235	
A65-1	±45°	59	0.275	
A65-1	±45°	227	0.317	
A65-1	±45°	358	0.349	
	<u> </u>			
		,		

	بعدر محمد بموالا مراسم بمساعد ماشار بالانتخاب	nductivit		
Materia:		004	Graphite/Po	olysulfone
Specimen Number	Fiber Orien- tation	Temp.	Thermal Conductivity (Btu-ft/ft ² -hr-°F)	Remarks
C33-1	0°	-162	0.186	
C39-1	0.0	56	0.277	
C33-1	0°	80	0.259	
C33-1	Co	91	0.330	
C33-1	0°	177	0.123	
C33-1	0°	228	0.344	
C33-1	0°	237	0.349	
C33-1	0°	289	0.336	
C33-1	0°	311	0.225	
C33-1	0°	364	0.343	
C33-1	0°	378	0.331	
C33-2	0°	-111	0.298	
C33-2	0 °	-36	0.301	
C33-2	0°	-36	0.291	
C33-2	0 °	12	0.313	
C33-2	0 °	68	0.336	
C33-2	0°	113	0.363	
C33-2	0 °	257	0.412	
C33-2	0°	324	0.339	
1				
C40-1	±45°	-40	0.231	
C40-1	±45°	111	0.255	
C40-1	±45°	1.89	0.305	<u></u>
C40-1	±45°	255	0.280	
C40-1	±45°	325	0.286	
C40-2	±45°	151	0.328	
C40-2	±45°	177	0.338	
C40-2	±45°	257	0.342	
**************************************			<u> </u>	

Test: ' Materia	Ls: AS/4	onductivit 397	Graphite/Poly	imide
Specimen Number	Fiber Orien- tation	Temp.	Thermal Conductivity (Btu-ft/ft ² -hr-°F)	Remarks
D49-1	0°	-6 9	0.281	
D49-1	0°	-29	0.367	
D49-1	0°	32	0.328	
D49-1	0.0	61	0.404	
D49-1	0°	90	0.347	
D49-1	0°	109	0.424	
D49-1	0°	137	0.418	
D49-1	0°	161	0.441	
D49-1	0°	174	0.418	
D49-1	0°	189	0.418	
D49-1	0°	205	0.421	
D49-1	0°	225	0.406	
D49-1	0°	246	0.429	
D49-1	0°	271	0.394	
D49-1	0°	318	0.475	
D49-1	0°	322	0.449	
D49-1	0°	342	0.491	
D49-1	00	342	0.532	
D49-1	0°	367	0.460	.
D49-1	0°	388	0.469	
D49-1	0°	408	0.471	
D49-1	0 °	433	0.490	
D59-1	±45°	158	0.357	
D59-1	±45°	160	0.357	
D59-1	±45°	180	0.324	
D59-1	±45°	203	0.383	
D59-1	±45°	234	0.361	
D59-1	±45°	255	0.342	
D59-1	±45°	279	0.387	

Test: 1	hermal Co	nductivit	7	
Materia]	3: T300	/F178	Graphite/	Polyimide
Specimen Number	Fiber Orien- tation	Temp.	Thermal Conductivity (Btu-ft/ft ² -hr-°F)	Remarks
E32-1	0°	151	0.263	
E32-1	0°	174	0.255	
E32-1	0°	243	0.332	
E32-1	0 °	266	0.327	
E32-1	0°	288	0.286	
E32-1	0°	338	0.398	
E32-1	0°	358	0.370	
E32-1	0.0	367	0.369	
E32-1	0°	379	0.396	
E32-1	0°	399	0.391	
E32-1	0°	424	0.375	
E32-1	0°	446	0.360	
E32-1	0°	468	0.440	
				
				
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APPENDIX M GLASS-TRANSITION TEMPERATURE DATA

The glass-transition temperatures determined for the materials characterized during this program are presented here along with a typical thermo-mechanical analyzer (TMA) trace, from which Tg's are determined.

Composite	Tg(°)	?)
Material	Dry	Wet
SP313	None observed from -67°F to 450°F	250
AS/3004	417	379
AS/4397	472	264
T300/F178	None observed up to 450°F	246

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APPENDIX N HUMIDITY AGED TENSION DATA

All of the tensile data generated during this program on specimens which had been humidity aged at 160°F and 100% R.H. are presented in this section. Summaries of these data are tabulated and plotted in the form of stress-strain curves in Section 4. No +45° tensile tests after humidity aging were conducted on the T300/F178 material. Only room temperature tests were run on saturated AS/4397 material in the +45° configuration.

Test:	Tension	n After	Envi	ronmental	Aging @ 16	160°F &	100% R.H		Material: SP	SP313
Sport	3,004	Test	Γ.	Init.	Stress at	200	Ult.	Exposure	Weight	
NO O	Orien.	(9F)	•	(10 ⁶ psi)	(ksi)	Ratio	(in/in)	(hrs)	(8)	Remarks
A32-8	°06	72	5.10	1.32	5,10	i	0.00390	168	0.75	50% Saturated
A22-3	06	72	5.64	1.34	5.64		0.00430	168	0.76	
A30-1	90ء	72	5.54	1.29	5.54	1	0.00440	168	0.70	50% Saturated
A28-8	06	7.2	5.64	1.32	5.64	1	0.00450	168	0.74	
A27-4	•06	72	6.34	1.31	6.34	-	0.000.0	168	0.76	50% Saturated
Avg			5.65	1.32	5.65	ı	D.00440			
Std Dev	4		0.45	0.02	0.45		0.000400		0.02	
A24-4	906	260	3.87	1.09	3.87	i	0.00390	168	0.75	50% Saturated
A22-8	∘06	260	3.71	1.21	3.71	ì	0.00340	168	0.74	50% Saturated
A22-2	900	260	3.20	1.03	3.20	ı	0.00380	168		
A27-2	1 0 0 6	260	3.55	1.07	3.55	-	0.00350	168		50% Saturated
A24-2	06 ا	260	2.86	1.08	2.86		0.00290	168	0.73	
Avg			3.44	1.10	3.44	1	0.00350		•	
Std Dev			0.41	0.07	0.41	-	0.00039		0.01	
A26-9	900	72	- 4	1.27	3,33		0.00315	1990	1.52	Saturated
A25-3	80°	72	3.75	1.29	-	1	0.00295	1990	1.55	Saturated
A31-3	80،	72	3.83	1.29	3.35	1	0.00300	1990	1.58	Saturated
A21-8	900	72	4.29		3.71	-	0.00330	1990	1.46	Saturated
A28-5	90。	72	3.86	1,25	3.86	-	0.00313	1990	1.55	Saturated
Avg			3.94		3.57		0.00311		1.53	
Std Dev			0.21	0.03	0.23		0.00014		0.05	
A21-1	900	260	c	during in	installation	r.		1990		Saturated
A21-2	06 ا	260		1.00	0.67	-	0.00223	1990	1.45	Saturated
A24-7	•06 •	260	1.59	16.0	0.89	-	00188	1990		Saturated
A25-4	ا 60ء	260	1.56	0.87	19.0		0.00181	1990	1.55	Saturated
A25-7	06ء	092	1.57	0.93	0.64)	0.00206	1990	•	Saturated
Avg			1.63	0.93	0.70	-	0.00200		1.49	
Std Dev	~		0.11	0.05	0.13		0.00019		0.06	

70 a t	Tonoion	n after	Post of G	ronmontal	a	2 20021	1		ļ	
	Tellet		TATE	umenrar	v	O.J. F. 64	TOUS K.H.	•	material: SP.	SP313
		Test	Ult.	Init.	Stress at		Ult.	Exposure	Weight	
Spec.	Fiber	Temp.		Mod.	Prop.Lim.	Pois.	Strain	Time	Gain	
NC:	Orien.	(e)	(ksi)	(10°psi)	(ksi)	Ratio	(1n/in)	(hrs)	(&)	Remarks
A48-2	±45°	72	21.4	2.61	5.15	1	*	48	0.78	50% Saturated
A48-9		72	21.4	2.30		0.71	*	48	0.81	ŧ
A55-11	±450	7.2	21.3	2,19	5.24	0.78	0.0152	48	• •	•
A52-10		72	22.1	2.76	•	• •	•	48		
A52-4	±45°	72	22.0	2.81	٠		0.0158	48		
Avg			21.6	2.53	5.26	0.78	0.0155			
Std Dev	>		0.4	0.28	0.74	0.05	ı		0.02	
									ersthandrennentsternamente van	
A55-4	±450	260	14.7	1.95	3.87	0.76	*	48	0.84	50% Saturated
A54-1	±45°	260	13.3	1.89	3.92	0.75	je I	48	Į.	50% Saturated
A53-3	±45°	260	15.1	1.75	3.64	0.85	k i	48	0.73	50% Saturated
A52-8	±45b	260	15.9	2.05	4.09	0.78	×	48	1 .	50% Saturated
A53-7	+45°	260	14.5	ì	1	•	*	48	0.84	50% Saturated
AVG			14.7	1.91	3.88	0.79	1			I
Std Dev	>		1.0	6.13	0.19				0.05	
A48-8	±45°	72	20.9	2.78	4.45	0.75	t i	1512	1.61	Saturated
A52-9	+45°	72	21.8	2.65	4.09	_	0.0270	1512	•	Saturated
A54-9	± 45°	72	21.3	2.37	6.45	_	ŧ.	1512	1.54	Saturated
A55-2	± 45°	72	21.4	2.59	5.42	0.75	# ##	1512		Saturated
A53-4	± 45°	72	21.1	2.64	6.67	0.71	ak I	1512	1.51	Saturated
			21.1	2.61		75	0.0270		٠ ،	
Std Dev	_		0.3	0.15	1.15	Γ-	1		0.04	
					•			-	ı	
A52-2		260	12.7	1.43			*	1536	1.56	Saturated
A52-11	+1	260	13.4	2.12	2.44		*	1536	1.64	Saturated
A55-7	±45°	260	12.9	1.48	2.21	0.79	¥	1536	•	Saturated
A52-7	+1	260	13.5	1.59			*	1536	1.59	Saturated
A54-7	± 45°	260	14.1	1.84	3.04	0.77	* -	1536	٠,	Saturated
Avg			13.3	1.69	2.53	0.78	•		5	
Std Dev	4		0.5	0.29	0.32	0.02	1		0.04	

* Surface plies cracked prior to failure, breaking strain gages.

Spec. Fiber Test Ult. Stress at Ult. Exposure Weight No. Origin Cain Time Gain Remarks No. Origin Carl Test:	Tension	n After	E	nvironmental	Aging @ 10	160°F &	100% R.H		Material: AS/3004	3004		
Orien, (*F) (*Ri) (106psi) (Rsi) (Rsi) (hrsi) (hr	Spec.		Test Temp.	Ult. Strath.	ئ ئو	Stress at Prop.Lim.	Pois	Ult. Strain	Exposure	Weight		
90° 72 6-93 1.20 3.09 — 0.0061 9 0.18 608 90° 72 5.00 1.19 2.84 — 0.0044 9 0.18 608 90° 72 6.01 1.21 1.21 2.84 — 0.0046 9 0.18 608 90° 72 5.32 1.22 2.44 — 0.0046 9 0.19 608 90° 72 5.32 1.22 2.44 — 0.0046 9 0.19 608 90° 250 4.80 1.13 3.82 — 0.0047 9 0.19 608 90° 250 4.22 0.96 2.99 — 0.0047 9 0.19 608 90° 250 4.22 0.96 2.99 — 0.0046 9 0.19 608 90° 250 4.22 0.96 2.99 — 0.0046 <th< td=""><td>No.</td><td></td><td>(°F)</td><td>(ksi)</td><td>0⁶psi</td><td>(ksi)</td><td>- 1</td><td>(in/in)</td><td>(hrs)</td><td>(%)</td><td>Remarks</td><td></td></th<>	No.		(°F)	(ksi)	0 ⁶ psi	(ksi)	- 1	(in/in)	(hrs)	(%)	Remarks	
90° 72 5.00 1.19 2.84 - 0.0046 9 0.20 608 90° 72 6.01 1.21 3.84 - 0.0046 9 0.20 6.08 90° 72 5.37 1.22 2.44 - 0.0046 9 0.19 608 90° 72 5.72 1.20 3.00 - 0.0046 9 0.19 608 90° 250 4.80 1.13 3.82 - 0.0047 9 0.19 608 90° 250 4.22 1.14 2.84 - 0.0046 9 0.19 608 90° 250 4.22 1.14 2.84 - 0.0046 9 0.19 608 90° 250 4.78 1.13 3.06 - 0.0046 9 0.19 608 90° 250 4.08 1.13 2.84 - 0.0046 9	C53-6	900	72	6.93	•	•	į		Ø			
90° 72 6.01 1.21 3.84 - 0.0045 9 0.18 608 90° 72 5.37 1.20 2.78 - 0.0046 9 0.19 608 90° 72 5.37 1.20 2.78 - 0.0050 9 0.19 608 90° 25.72 1.20 3.00 - 0.0057 0.01 608 90° 250 4.80 1.13 3.82 - 0.0047 9 0.19 608 90° 250 4.22 0.96 2.99 - 0.0047 9 0.19 608 90° 250 4.78 1.13 3.06 - 0.0042 9 0.19 608 90° 250 4.13 1.09 2.99 - 0.0042 9 0.17 608 90° 72 3.58 1.11 2.35 - 0.0042 9 0.17 0.03 <td>C52-6</td> <td>-06</td> <td>72</td> <td>5.00</td> <td>١.</td> <td>1 .</td> <td></td> <td>•</td> <td>6</td> <td></td> <td></td> <td>,,</td>	C52-6	-06	72	5.00	١.	1 .		•	6			,,
90° 72 5.37 1.20 2.78 - 0.0046 9 0.19 608 90° 72 5.32 1.20 2.44 - 0.0045 9 0.18 608 90° 7.7 1.20 2.04 - 0.0047 9 0.19 608 90° 250 4.20 0.96 2.99 - 0.0046 9 0.19 608 90° 250 4.27 1.13 3.82 - 0.0046 9 0.19 608 90° 250 4.27 1.11 2.22 - 0.0046 9 0.13 608 90° 250 4.27 1.11 2.22 - 0.0040 0.23 0.18 608 90° 72 4.13 1.09 2.99 - 0.0040 0.03 0.17 608 90° 72 4.13 1.10 2.31 1.11 2.84 - 0.0040	C53-3	06	72	6.01	•	•			6			_
90° 72 5.32 1.22 2.44 - 0.045 9 0.18 608 40° 5.72 1.20 3.00 - 0.0050 0.019 608 5.72 1.20 3.00 - 0.0050 0.019 0.19 608 90° 250 4.80 1.13 3.82 - 0.0046 9 0.19 608 90° 250 4.27 1.14 2.84 - 0.0046 9 0.19 608 90° 250 4.27 1.13 3.06 - 0.0046 9 0.17 608 90° 250 4.13 1.09 2.99 - 0.0040 744 0.29 5att 90° 72 4.31 1.10 2.35 - 0.0034 744 0.35 5att 90° 72 4.48 1.13 2.84 - 0.0034 744 0.32 90° 72	C53-8	°06	72	5.37	1.20	•	•		6	٠		
90° 250 4.80 1.12 3.00 - 0.0050 0.019 608 90° 250 4.80 1.13 3.82 - 0.0047 9 0.19 608 90° 250 4.29 1.14 2.84 - 0.0046 9 0.19 608 90° 250 4.22 0.96 2.99 - 0.0042 9 0.19 608 90° 250 4.28 1.13 3.22 - 0.0042 9 0.17 608 90° 250 4.48 1.13 3.06 - 0.0042 9 0.17 608 90° 25 4.48 1.13 3.06 - 0.0042 9 0.17 608 90° 72 3.58 1.07 2.35 - 0.0038 744 0.35 8att 90° 72 4.31 1.10 2.84 - 0.0034 744 0.35	C53-2	906	72	5.32			ï		6	•		_
by 0.77 0.02 0.52 0.0007 0.019 608 90° 250 4.80 1.13 3.82 0.0047 9 0.19 608 90° 250 4.22 0.96 2.99 0.0046 9 0.19 608 90° 250 4.27 1.11 2.22 0.0042 9 0.18 608 90° 250 4.27 1.11 2.22 0.0042 9 0.18 608 90° 250 4.13 1.03 2.99 0.0040 0.21 608 90° 72 3.96 1.15 2.31 0.0040 0.03 8att 90° 72 4.48 1.09 2.99 0.0040 0.35 8att 90° 72 4.48 1.09 2.99 0.003 0.35 8att 90° 72 4.	AVG			5.72	1.20		ŀ			•		
90° 250 4.80 1.13 3.82 - 0.0047 9 0.19 60% 90° 250 2.90 1.14 2.84 - 0.0046 9 0.19 60% 90° 250 4.22 0.96 2.99 - 0.0046 9 0.19 60% 90° 250 4.27 1.11 2.22 - 0.0046 9 0.19 60% 90° 250 4.27 1.11 2.22 - 0.0041 9 0.18 60% 90° 72 4.48 1.13 2.84 - 0.0040 0.03 0.20 90° 72 4.31 1.10 2.35 - 0.0040 744 0.35 Satt 90° 72 4.48 1.09 2.99 - 0.0042 744 0.35 Satt 90° 72 4.48 1.09 2.99 - 0.0042 744 0.32	Std De	12		0.77	•	• • I	Ł	• • •		-1		
90° 250 4.80 1.13 3.82 - 0.0047 9 0.19 608 90° 250 2.90 1.14 2.84 - 0.0046 9 0.19 608 90° 250 4.22 0.96 - 0.0040 9 0.18 608 90° 250 4.48 1.13 3.06 - 0.0040 9 0.17 608 90° 250 4.48 1.13 3.06 - 0.0040 0.20 0.17 608 90° 72 3.96 1.15 2.31 - 0.003 744 0.23 321 90° 72 4.31 1.10 3.30 - 0.003 744 0.35 321 90° 72 4.48 1.03 2.99 - 0.003 744 0.35 321 90° 72 4.48 1.03 2.99 - 0.003 744 0.35												
90° 250 2.90 1.14 2.84 - 0.0026 9 0.19 60% 90° 250 4.22 0.96 2.99 - 0.0046 9 0.18 60% 90° 250 4.27 1.11 2.22 - 0.0041 9 0.18 60% 90° 250 4.48 1.13 2.99 - 0.0040 0.20 0.17 60% 90° 72 3.96 1.15 2.31 - 0.0036 744 0.20 5att 90° 72 4.31 1.10 2.35 - 0.0034 744 0.35 5att 90° 72 4.48 1.07 2.35 - 0.0042 744 0.30 5att 90° 72 4.48 1.09 2.76 - 0.0042 744 0.30 5att 90° 250 2.74 1.10 2.65 - 0.0035 744 </td <td>C52-5</td> <td></td> <td>250</td> <td>4.80</td> <td>۲.</td> <td>3.82</td> <td></td> <td>0.0047</td> <td>6</td> <td>0.19</td> <td></td> <td></td>	C52-5		250	4.80	۲.	3.82		0.0047	6	0.19		
90° 250 4.22 0.96 2.99 0.0046 9 0.25 60% 90° 250 4.27 1.11 2.22 0.0040 9 0.18 60% 90° 250 4.13 1.13 3.06 0.0040 0.20 0.17 60% 90° 72 3.58 1.15 2.31 0.0036 744 0.29 Sate 90° 72 3.58 1.07 2.35 0.0034 744 0.35 Sate 90° 72 3.45 1.13 2.84 0.0034 744 0.35 Sate 90° 72 4.48 1.10 2.84 0.0036 744 0.30 Sate 90° 72 1.13 2.79 0.0036 744 0.30 Sate 90° 250 2.80 1.11 2.76 0.0036 744	C53-1	ا 60ء	250	2.90	•	2.84		0.0026	6	0.19		·,
90° 250 4.27 1.11 2.22 - 0.0042 9 0.18 60% 90° 250 4.48 1.13 3.06 - 0.0041 9 0.17 60% 90° 250 4.48 1.19 2.99 - 0.0040 0.20 90° 72 3.96 1.15 2.31 - 0.0034 744 0.35 Sate 90° 72 3.45 1.13 2.84 - 0.0040 744 0.35 Sate 90° 72 4.48 1.07 2.39 - 0.0040 744 0.35 Sate 90° 72 4.48 1.09 2.99 - 0.0042 744 0.35 Sate 90° 72 4.48 1.09 2.99 - 0.0042 744 0.02 90° 2.74 1.11 2.65 - 0.0025 744 0.30 90° 2.50 </td <td>C52-8</td> <td>06</td> <td>250</td> <td>4.22</td> <td>96.0</td> <td>2.99</td> <td></td> <td>0.0046</td> <td>6</td> <td>0.25</td> <td></td> <td>·</td>	C52-8	06	250	4.22	96.0	2.99		0.0046	6	0.25		·
90° 250 4.48 1.13 3.06 0.0041 9 0.17 60% 10	C52-4	-06	250	4.27	1.11	2.22		0.0042	6	0.18		-
90° 72 3.96 1.09 2.99 - 0.0040 0.20 90° 72 3.96 1.15 2.31 - 0.0035 744 0.29 90° 72 3.58 1.07 2.35 - 0.0034 744 0.35 90° 72 4.48 1.10 3.30 - 0.0040 744 0.35 90° 72 4.48 1.09 2.99 - 0.0042 744 0.35 90° 72 4.48 1.10 2.99 - 0.0042 744 0.35 90° 72 4.48 1.10 2.65 - 0.0036 0.32 90° 250 2.74 1.10 2.65 - 0.0035 744 0.30 90° 250 2.80 1.05 2.16 - 0.0025 744 0.29 90° 250 2.79 - 0.0036 744 0.29 <tr< td=""><td>C53-5</td><td>606</td><td>250</td><td>4.48</td><td>1.13</td><td>3.06</td><td></td><td>0.0041</td><td>6</td><td>0.17</td><td></td><td></td></tr<>	C53-5	606	250	4.48	1.13	3.06		0.0041	6	0.17		
90° 72 3.96 1.15 2.31 - 0.0035 744 0.29 90° 72 3.58 1.07 2.35 - 0.0034 744 0.35 90° 72 4.31 1.10 3.30 - 0.0040 744 0.35 90° 72 4.48 1.09 2.84 - 0.0040 744 0.35 90° 72 4.48 1.09 2.99 - 0.0042 744 0.35 90° 72 4.48 1.09 2.99 - 0.0042 744 0.32 90° 250 2.74 1.10 2.65 - 0.0025 744 0.30 90° 250 2.80 1.05 2.16 - 0.0025 744 0.29 90° 250 2.80 1.05 2.16 - 0.0036 744 0.29 90° 250 2.79 1.11 1.24 - <td>Avg</td> <td></td> <td></td> <td>4.13</td> <td>1.09</td> <td></td> <td></td> <td>0.0040</td> <td></td> <td>0.20</td> <td></td> <td></td>	Avg			4.13	1.09			0.0040		0.20		
90° 72 3.96 1.15 2.31 - 0.0035 744 0.29 90° 72 3.58 1.07 2.35 - 0.0034 744 0.35 90° 72 4.31 1.10 3.30 - 0.0040 744 0.31 90° 72 3.45 1.13 2.84 - 0.0042 744 0.35 90° 72 4.48 1.09 2.99 - 0.0042 744 0.35 90° 75 1.11 2.76 - 0.0036 744 0.30 90° 250 2.74 1.10 2.65 - 0.0036 744 0.29 90° 250 2.80 1.05 2.16 - 0.0036 744 0.29 90° 250 2.79 1.11 1.24 - 0.0036 744 0.31 90° 250 2.79 1.11 1.24 - 0.0036<	Std De	يد		0.73	0.08	ů.	ı			•		
90° 72 3.96 1.15 2.31 - 0.0035 744 0.29 90° 72 3.58 1.07 2.35 - 0.0040 744 0.35 90° 72 4.31 1.10 3.30 - 0.0040 744 0.35 90° 72 4.48 1.09 2.99 - 0.0042 744 0.35 3v 72 4.48 1.09 2.99 - 0.0042 744 0.35 3v 0.45 0.03 0.42 - 0.0036 744 0.30 3v 250 2.74 1.10 2.65 - 0.0035 744 0.29 90° 250 3.21 1.07 1.91 - 0.0035 744 0.29 90° 250 2.79 1.11 1.24 - 0.0035 744 0.31 90° 250 2.79 1.11 1.24 - 0.0030 </td <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td>												
90° 72 3.58 1.07 2.35 - 0.0034 744 0.35 90° 72 4.31 1.10 3.30 - 0.0040 744 0.31 90° 72 4.48 1.09 2.99 - 0.0042 744 0.35 90° 72 4.48 1.09 2.99 - 0.0042 744 0.35 3v 0.45 0.03 0.42 - 0.0036 744 0.30 9v 250 2.74 1.10 2.65 - 0.0036 744 0.29 9v 250 2.80 1.07 1.91 - 0.0037 744 0.29 9v 250 2.80 1.08 2.16 - 0.0037 744 0.29 9v 250 2.79 1.11 1.24 - 0.0030 744 0.31 9v 250 2.79 1.11 1.24 - 0.0030 <td>C51-4</td> <td>°06</td> <td>72</td> <td>3.96</td> <td>-</td> <td>•</td> <td></td> <td>0.0035</td> <td>744</td> <td>0.29</td> <td>Saturated</td> <td></td>	C51-4	°06	72	3.96	-	•		0.0035	744	0.29	Saturated	
90° 72 4.31 1.10 3.30 - 0.0040 744 0.31 90° 72 3.45 1.13 2.84 - 0.0042 744 0.35 90° 72 4.48 1.09 2.99 - 0.0042 744 0.35 9v 250 1.11 2.76 - 0.0036 0.32 90° 250 2.74 1.10 2.65 - 0.0025 744 0.29 90° 250 3.21 1.07 1.91 - 0.0025 744 0.29 90° 250 2.80 1.05 2.16 - 0.0031 744 0.29 90° 250 2.79 1.11 1.24 - 0.0036 744 0.29 90° 250 2.79 1.11 1.24 - 0.0036 744 0.31 90° 250 2.79 1.11 1.24 - 0.0036 744 0.31 90° 250 2.79 1.11 1.24 -	C52-1	•06	72	3.58				0.0034	744	0.35	Saturated	 ,
90° 72 3.45 1.13 2.84 - 0.0031 744 0.35 90° 72 4.48 1.09 2.99 - 0.0042 744 0.30 90° 72 4.48 1.09 2.99 - 0.0036 0.32 90° 250 2.74 1.10 2.65 - 0.0025 744 0.30 90° 250 3.21 1.07 1.91 - 0.0031 744 0.39 90° 250 3.62 1.08 2.22 - 0.0036 744 0.31 90° 250 2.79 1.11 1.24 - 0.0030 744 0.31 90° 250 2.79 1.11 1.24 - 0.0030 0.37 90° 250 2.79 1.11 1.24 - 0.0030 0.33	C51-8	60ء	72	4.31	٠.	٠.		0.0040	744	0.31	Saturated	
90° 72 4.48 1.09 2.99 - 0.0042 744 0.30 yv 0.45 0.03 0.42 - 0.0036 0.32 yv 0.45 0.03 0.42 - 0.0004 0.32 90° 250 2.74 1.10 2.65 - 0.0025 744 0.30 90° 250 3.21 1.07 1.91 - 0.0031 744 0.39 90° 250 3.62 1.08 2.22 - 0.0036 744 0.31 90° 250 2.79 1.11 1.24 - 0.0030 744 0.31 90° 0.25 0.29 0.02 0.02 0.029 744 0.31	C52-2	06	72	3.45	•	٠.		0.0031	744	0.35	Saturated	
90° 250 2.74 1.11 2.76 - 0.0036 0.32 90° 250 2.74 1.10 2.65 - 0.0025 744 0.30 90° 250 3.21 1.07 1.91 - 0.0031 744 0.39 90° 250 3.62 1.05 2.16 - 0.0031 744 0.29 90° 250 3.62 1.08 2.22 - 0.0037 744 0.29 90° 250 3.03 1.11 1.24 - 0.0036 744 0.29 90° 250 2.79 1.11 1.24 - 0.0036 744 0.37 90° 250 2.79 1.11 1.24 - 0.0039 744 0.37 90° 250 2.79 1.11 1.24 - 0.0039 744 0.31 90° 250 2.78 0.002 0.0030 0.31 </td <td>C51-6</td> <td>-06</td> <td>72</td> <td>4.48</td> <td>1.09</td> <td>•</td> <td></td> <td>0.0042</td> <td>744</td> <td>0:30</td> <td>Saturated</td> <td></td>	C51-6	-06	72	4.48	1.09	•		0.0042	744	0:30	Saturated	
90° 250 2.74 1.10 2.65 - 0.0025 744 0.30 90° 250 2.74 1.10 2.65 - 0.0025 744 0.30 90° 250 2.80 1.07 1.91 - 0.0031 744 0.29 90° 250 2.80 1.05 2.16 - 0.0027 744 0.31 90° 250 2.79 1.11 1.24 - 0.0036 744 0.39 90° 250 2.79 1.11 1.24 - 0.0036 744 0.37 8V 0.38 0.02 0.52 - 0.0030 744 0.37	Avg			3.96	1.1	•	1			0.32		
90° 250 2.74 1.10 2.65 0.0025 744 0.30 90° 250 3.21 1.07 1.91 0.0031 744 0.29 90° 250 2.80 1.05 2.16 0.0027 744 0.31 90° 250 3.62 1.08 2.22 0.0036 744 0.29 90° 250 2.79 1.11 1.24 0.0039 744 0.37 3.03 1.08 2.04 0.0039 744 0.31 8V 0.38 0.02 0.52 0.0004 0.02		Ą		0.45		•	3	0.0004		0.02		
90° 250 2.74 1.10 2.65 - 0.0025 744 0.29 90° 250 3.21 1.07 1.91 - 0.0031 744 0.29 90° 250 2.80 1.05 2.16 - 0.0027 744 0.29 90° 250 3.62 1.08 2.22 - 0.0036 744 0.29 90° 250 2.79 1.11 1.24 - 0.0039 744 0.37 90° 250 2.79 1.11 1.24 - 0.0039 744 0.37 90° 250 2.79 1.11 1.24 - 0.0039 744 0.37 90° 250 2.04 - 0.0030 0.31		,		- 1	k	1		A W W X		2	(A. L	
90° 250 3.21 1.07 1.91 - 0.0031 744 0.29 90° 250 2.80 1.05 2.16 - 0.0027 744 0.31 90° 250 3.62 1.08 2.22 - 0.0036 744 0.29 90° 250 2.79 1.11 1.24 - 0.0029 744 0.37 8V 0.38 0.02 0.05 - 0.0030 744 0.37	C21-7	906	250	•	1.10	•	_	0.0025	##/	• 1	saturated	
90° 250 2.80 1.05 2.16 - 0.0027 744 0.31 90° 250 3.62 1.08 2.22 - 0.0036 744 0.29 90° 250 2.79 1.11 1.24 - 0.0029 744 0.39 a 3.03 1.08 2.04 - 0.0030 744 0.31 a 0.38 0.02 0.52 - 0.0030 0.31	C51-5	90ء	250	3.21		•		0.0031	744	* }	Saturated	
90° 250 3.62 1.08 2.22 - 0.0036 744 0.29 90° 250 2.79 1.11 1.24 - 0.0029 744 0.37 100 2.04 - 0.0030 0.37 100 0.02 0.05 0.003 100 0.00 0.00	C51-1	900	250	2.80				0.0027	744		Saturated	
90° 250 2.79 1.11 1.24 - 0.0029 744 0.37 3.03 1.08 2.04 - 0.0030 0.31 0.32 0.0004 0.02	C51-3	06	250	3.62	٠.	٠ ا		0.0036	744		Saturated	
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	C52-3	900	250	2.79	٠.			0.0029		•	Saturated	
0.38 0.02 0.52 - 0.0004 0.0	Avg			3.03	•	•						
	Std De	Ą		0.38	0	٠		•		•		

Test:	Tension	on After	ы	nvironmental	Aging @ 1	160°F &	100% R.H		Material: AS,	AS/3004	ł
		Test	Ult.	Init.	Stress at		Ult.	Exposure	Weight		ł.
Spec.		Temp.	Strgth.	Mod.	Prop.Lim.		Strain	Time	Gain		
No.	Orien.	(cF)	(ksi)	(10°psi)	(ksi)	Ratio	(in/in)	(hrs)	(8)	Remarks	
C42-8	±45°	72	45.23	1.95	•	0.81	0.0462+	3	0.23	55% Saturated	
C55-1	+450		31.07	1.95	3.56	0.85	0.0553+	3	0.28	55% Saturated	
C26-6	+45°	72	•	16.1	•	•	0.0640+	3	0.26	ł	1
C54-8	±45°	72	39.37	1.73	3.56	0.70	+0190.0	3	0.24	55% Saturated	1
C55-7	±45°		27.08	-	3.31	0.81	0.0643+	3	0.26	55% Saturated	1
Avg			37.48	1.94	3.46	0.79	0.0582+		0.25		1
Std Dev	Ω		8.13	• •	0.10	1 •1	0.0076		C		
									Į.		•
C41-6	±45°	250	22.02	2.09	2.32	0.92	0.0381+	3	0.20	•	1
C43-2	±45°	250	21.61		2.60		0.0508+	3	0.20	55% Saturated	
C42-5	±45°	250	20.21	2.09	2.56	0.92	0.0424+	3	0.18		•
C44-5	±456	250	17.99		1.96	96.0	0.0244+	3	0.22	55% Saturated	ł
Avg			20.46	•	2.36		0.0389+		0.20		ŧ
Std Dev	2		1.82	0.29	0.29	90.0	0.010		0.02		8
											. ,
ŧ						1			•		ı
C47-4	±45°		31.22	2.13	4.27	0.76	0.0500+	276	0.44	Saturated	
C46-2	+45°	72	33.64	2.33	4.27	08.0	0.0565+	576	0.39	Saturated	•
C45-4	±45°		31.82	2.21	4.26	0.89	0.0410+	576	0.45	Saturated	•
C45-3	+45°	72	31,48	2.14	4.26	0.81	0.0445+	576	0.42	Saturated	
050-6	+45°	72	34.45	2.18	4.95	. 75	0.0605+	576	0.43	Saturated	
Avo			32.52	2.20	4.40	08.0	0.0505+		7.		ł
Std Dev	Δ		1.44	0.08	0.30	• 1	0.0081		0.02		
C50-7	± 45°	250	26.56	2.17	2.63	0.84	+01.05.0	576	0.41	Saturated	,
C50-2		250	23.56	1.93	2.63	1	+0791.0	576	0.45	Saturated	
C45-1	+ 450	250		2.08	2.00		0.0155+	576	0.46	Saturated	
C505	± 450	250	. 4		2.63	0.84		576	0,42	Saturated	,
AVG				2.07	2.47	•	0.0562+		0.43		
Std Dev	, Kr		2.47	01.0		2	0.0403				
Note:	Surface	se plies	ບ	pr	to failure	١.	breaking the	strain			l .
									,		

mest:	Tension	n After	Envir	onmental	Aging @ 16	160°F &	100% R.H	•	Material: AS	AS/4397
		Post	+111	Init.	Stress at		ULE.	Exposure	Weight	
Spec.		Temp.	Stroth.	Mod.		Pois.	Strain (in/in)	Time (hrs)	Gain (*)	Remarks
Ol -	Orten	(E)	14041	1 27	2 30		0000	21 5	0.55	45% Saturated
D19-5	90°	77	- (75.7	7.6		-1	21.5	0 49	ı
D18-1	906	12	• (•	3.00		4	21.5		1
D.1.74	906	7.7	4.88	1.44	2.33		4	21.5	0 49	1
D17-2	06	7.5	5.40	• 1	74.7		•1	7	-	
D13-5	06	72	-(•1	3.79		4	71.5	4	1
AVG		- 1	5.13	1.40	3.20	-	003		7	
Std De			0.41	0.04	0.75		0.0003		0.03	Annual free statement of the same of the s
	-				1		- 1	١,		1
D12-10	L	350	3.33	1.12	1.17	1	*	4		
512-4	006	350	2.87	٠.	1.10	ì	*1	21.5	•	1
14-3	900	350	١.	1.21	1.62	1	0.0024	4	0.50	- 1
516-1	006	350	٠.	1.11	١,	-	0.0028	21.5	0.47	- 1
8-816	900	350		1.05	1.92	1	0.0026	- 1	7	45% Saturated
AVG			2.92	17.1	1.52	1	0.0027		0.49	
Std De	-		١.	0.06	0.36	1	0.0003		0.03	
				4						
517-3	600	77		1 .	1 .	-	0.0026	1320	1.09	Saturated
ŀ	000	75	3.68	1 1		1	0.0025	1320	1.02	Saturated
1	909	12	4.15	1.66	1.84	1		1320	1.09	Saturated
019-4	06	72	4.47	1.43	2.09	•	0.0032	1320	17.7	Saturated
9-619	06	72	3.47	1.51	1.83		0.0025	1320	111	Saturated
Brrg	+		1	§ •	1.99	1	0.0027		1.10	
E+3 Dex	+	-	•	_	0.32	i	0.0003		0.04	
- 1	Ì	-	-	T.						
0 0 1	000	350	1,66	0.84	1.05	i	0.0022	1320		Saturated
2-070	\downarrow	350	1 57	0.75	9	1	0.0022	1320	1.13	Saturated
5-717	+	2000	1 10	0 78		1	0.0018	1320	1.13	Saturated
210	+	350				-	0.0021	1320	1,11	Saturated
7-010	900	350	101			-	0.0025	1320	•	Saturated
And	+		1.55	0.82	0.84	•	0.0022		1.10	
STA DOU	126	1	10.27		١.	i	0.0002		* (
ן ג ער				-	and property of the second second					

Test:	Tensio	Tension After Envi		conmental	Aging @ 16	160°F &	1008 R.H.		Material: AS/4397	/4397	
S. Act.	Fiber	Test	Ult.		Stress at	Bote	UIE.	Exposure	Weight	AND AND AND AND AND AND AND AND AND AND	T
No.	Orien.	(4e)	: 1	(10 ⁶ ps1)	(ksi)	Ratio	(in/in)	(hrs)	(%)	Remarks	
D31-5	± 45°	72		2.55	8.69	0.77	0.0131	984	1.52	Saturated	
D33-4	+1	72	18.98	2.66	6.26	0.71	0.0151	984	1.31	Saturated	Г
D34-10	41	72	18.05	2.51	8.03	0.72	0.0190	984	1.18	Saturated	_
D35-7	± 45°	72	18.72	2.70	5.11	0.78	0.0189	984	1.26	Saturated	
035-3	± 45°	72	19,29	2.62	80.9	17.0	0.0171	984	1.29	Saturated	
AVG			18,66	2.61	6.83	0.74	0.0166		1.31		
Std Der			0.51	0.08	1.48	0.03	0.0025		0.13		_
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.	Tension Arrei	m Atter	7141	Onmen car	Stream At	1-4	OLE. IE	XDOS	ure Weight	
	Fiber	Test Temp.	Strgth.	Mgd.	5 특	Pols.	Strain	Time	Gain	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
Z.	Orien.	(°F)	(ksi)	(10°psi)	(ksi)	Ratio	(1V/1U)	(nrs)	P	G (
1-	906	72		1.26	0.99	ı		24.5	0.82	- 1
7	06	72	6.00	1.32	3.74	Į		24.5	0.88	208 Saturated
T	06	72	1.12	1.42	1.12	ł		24.5	0.83	- 1
T	006	72	1.56	1.30	٠.	i	0.0012	24.5	0.88	50% Saturated
1			2.42	1.33	1.85	l	0.0019		6.85	A THE PARTY OF THE
Std Dev	>		2.40		. •	1	0.0018		0.03	en en en en en en en en en en en en en e
1										Andre de la companya de la companya de la companya de la companya de la companya de la companya de la companya
							- 1	1	0 10	nos esturated
E51-4	606	350	3.73	0.95	1.26	*	0.000	4	4	1
5-673	06،	350	2.04	0.84	- 4		0.0024	24.2	4	1
F.49-7	906	350	2.72	0.85	2.72	1	0.0032	24.5	08.0	SOL DALLIAGE
51-10	06	350	1.57	1	- 7		0.0018	24.5	0.79	מפרחדמרהם
			2.51	0.85	1.90	1	0.0020		0.80	The second secon
De	1		0.81	•	0.63		0.0010		*	
			ľ	- 1	- }		100	643	1.63	Saturated
4	。 06		4	1.22	• 1		• 1	24.0	1 73	Saturated
	06			•	• •		• :	440	1 50	Saturated
10	06	72	0.75	1.30	0.75		0.0000	770	1.32	Catarateca
-	06	_	0.37	1.47	•	-	~ 1	740	12.4	Catarated
E49-8	06		3.48	1.32	•	-	- 1	770	20.7	322 54 52
Ave			2.16	1.33	2,16	•	0.0017		•	
900			1.55	0	1.55		0.0012		0.07	
				1						
							9000	642	1.61	Saturated
E51-3	900	350	0.46	4	4		4	643	163	Saturated
E51-5	806		0.71	0.64	0.71	1	4	740	•	Saturated
ي	06		Broken	on init	181	<u>bu</u>	1	7.0	22.5	Caturator
E51-9	06	350	0.33	0.60	0.33	-		750	, to to	
Ava		L	0.50	•	•		0.000		1	
١			000	l		ŧ	0.0003			

APPENDIX O

HUMIDITY AGED INPLANE SHEAR DATA

All of the inplane shear data generated during this program on specimens which had been humidity aged at 160°F and 100% R.H. are presented in this section. All of the data were obtained using the ±45° tensile coupon (Sec. 3.5.4). Summary tables and stress-strain curves of these data are presented in Section 4. No inplane shear tests after humidity aging were run on the T300/F178 material and only room temperature tests on saturated AS/4397 material were run.

Test:	Inplane	Shear	r After E	nvironment	al Aging	at 160°F	and
Materia	ls: SF	313				**************************************	
	Fiber Orien.	Test Temp.	Ult. Stregth. (ksi)	Inplane Shear Modulus (10 ⁶ psi)	Vlt. Strain (in/in)	Exposure Time (hrs)	Weight Gain (%)
	±45°	72	10.70	0.72	-	48	6.78
A48-2		72	10.68	0.81		48	0.81
A48-9	±45° ±45°	72	10.65	0.76	-	48	0.84
A55-11		72	11.04	0.68		48	0.80
A52-10	±45°	72	11.00		-	48	0.82
A52-4	±45°	14	10.81	0.74	-		0.81
Avg			0.19	0.95	_		0.02
Std De	7						
	4 4 5 4	360	7.33	0.55	_	48	0.84
A55-4	± 45°	260	6.64	0.55		48	0.84
A54-1	± 45°	260	7.55	0.48		48	0.73
A53-3	± 45°	260	7.95	0.59		48	0.82
AF 2-8	± 45°	260	7.27	1		48	0.84
A53-7	±45°	260	7.35	0.55			0.81
AVJ			0.48	0.05	 -		0.05
Std De	γ		0.40	1	 		
	1=0		10.45	0.79		1512	1.61
A48-8	± 45°	72		0.74		1512	1.56
A52-9	± 45°	72	10.90 10.65	0.69		1512	1.54
A54-9	± 45°	72	10.83	U.74		1512	1.52
A55-2	± 45°	72	10.70	0.77		1512	1.51
A53-4	± 45°	72	10.55	0.75	 		1.55
_Avg	↓	 		0.75		1	0.04
Std De	*	 	0.13	1 0.05	 		
	 	 		0.42	+	1536	1.56
A52-2	± 45°	260	6,35	0.51		1536	1.64
A52-11		260	6.70	0.42	 	1536	1.62
A55-7	± 45°	260	6,45	V.#2	-	1536	1.59
A52-7	± 45°	260	6.75	0.49		1536	1.55
A54-7	± 45°	260	7.05	0.46	 		1.59
Avg Std De	 		0.25	0.46			0.04

Test:		e Shea R.H.	r After E	nvironment	al Aging	at 160°F	and
Materia	als: AS	/3004					
				Inplane			
		Test	Ult.	Shear	Ult.	Exposure	Weight
Spec.	Fiber	Temp.	Stregth.	Modulus	Strain	Time	Gain
No.	Orien.	(°F')	(ksi)	(10 ⁶ psi)	(in/in)	(hrs)	(%)
C42-8	±45°	72	22.61	0.54		3	0.23
C55-1	±45°	72	15.53	0.53	_	3	0.28
C56-6	±45°	72	22.33	0.54		3	0.26
C54-8	±45°	72	19.68	0.51		3	0.24
C55-7	±45°	72	13.54	0.60		3	0.26
Ava			16.74	0.54	_		0.25
Std Dev			5.07	0.04	_		0.02
C41-6	±45°	250	11.01	0.55	_	3	0.20
C43-2	+450	250	10.80	0.44	-	3	0.20
C42~5	±45°	250	10.11	0.52	_	3	0.18_
C44-5	±45°	250	8.99	0.41		3	0.22
Ava			10.23	0.48	-		0.22
Std Dev			0.91	0.07			0.02
C47-4	±45°	72	15.61	0.61		576	0.44
C46-2	±45°	72	16.82	0.64		576	0.39
C45-4	±45°	72	15.91	0.59		576	0.45
C45-3	±45°	72	15.74	0.55		576	0.42
<u>C50-6</u>	±45°	72	17.23	0.62		576	0.43
Avg			16.26	0.60		<u> </u>	0.43
Std Dev			0.72	0.03	-		0.02
							<u>]</u>
C50-7	±45°	250	13.28	0.50		576	0.41
C50-2	±45°	250	11.78	-		576	0.45
C45-1	±45°	250	10.38	0.47	-	576	0.46
C50-5	±45°	250	12.50	0.48		576	0.42
Avg			11.98	0.48		<u> </u>	0.43
Std Dev	ļ		1,23	0.02			0.02
					 _		
			L	l	<u></u> _	<u> </u>	1

Test:		e Shea R.H.	r After E	nv.ronment	al Aging	at 160°F	and
Materia	als: AS	/4397		.			
Spec.	Fiber Orien.	Test Temp. (°F)	Ult. Stregth. (ksi)	Inplane Shear Modulus (10 ⁶ psi)	Ult. Strain (in/in)	Exposure Time (hrs)	Weight Gain (%)
D31-5	±45°	72	9.12	0.73	-	984	1.52
D33-4	±45°	72	9.49	0.77		984	1.31
D34-10		72	9.03	0.75		984	1.18
D35-7	±45°	72	9.36	0.75	_	984	1.26
D35-3	±45°	72	9.64	0.74	_	984	1.29
Avg			9.33	0.75			1.31
Std Dev			0.26	0.01			0.13
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APPENDIX P HUMIDITY AGED INTERLAMINAR SHEAR DATA

All of the interlaminar shear data generated during this program on specimens which had been humidity aged at 160°F and 100% R.H. are presented in this section. These data are summarized in Section 4.

Agi	ing at 160	Short-Beam) °F and 100%	R.H.		ironmental
Materials: S			L/D Rat	io: 4/	
Specimen Number	Test Temp. (°F)	Ultimate Strength (psi)	Exposure Time (Hrs)	Weight Gain (%)	Remarks
A35-11	72	11,710	504	0.78	50% Saturated
A35-2	72	11,880	504	0.85	50% Saturated
A35-10	72	12,160	504	0.68	50% Saturated
A35-43	72	12,660	504	0.72	50% Saturated
A35-21	72	12,550	504	0.64	50% Saturated
Avg		12,190		0.74	
Std Dev		410		0.08	
			ra Papagara Maria andrew er Walana		
A35-27	260	6,780	504	0.81	50% Saturated
A35-34	260	6,660	504	0.73	50% Saturated
A35-26	260	6,450	504	0.73	50% Saturated
A35-38	260	6,650	504	0.83	50% Saturated
A35-42	260	6,660	504	0.74	50% Saturated
Avg		6,640		0.77	
Std Dev		120		0.05	
A35-36	72	10,090	1870	1.41	Saturated
A35-24	72	10,250	1870	1.23	Saturated
A35-14	72	9,440	1870	1.54	Saturated
A35-30	72	9,780	1870	1.45	Saturated
A35-19	72	10,180	1870	1.48	Saturated
Avg		9,950		1.42	
Std Dev		340		0.12	
			<u> </u>		
A35-8	260	6,110	1870	1.30	Saturated
A35-23	260	6,080	1870	1.53	Saturated
A35-25	260	6,030	1870	1.53	Saturated
A35-38	260	5,830	1870	1.59	Saturated
A35-44	260	6,050	1870	1.68	Saturated
Avg		6,020		1.53	
Std Dev		110		0.14	

		(Short-Beam) OF and 100%	R.H.		vironmental
Materials:	AS/3004		L/D Rat	io: 4/	
Specimen Number	Test Temp. (°F)	Ultimate Strength (psi)	Exposure Time (Hrs)	Weight Gain (%)	Remarks
C5-13	72	7,350	552	1.51	75% Saturated
C5-30	72	8,640	552	0.48	75% Saturated
C5-23	72	9,370	552	0.50	75% Saturated
C5-15	72	9,330	552	0.44	75% Saturated
C5-10	72	9,320	552	0.51	75% Saturated
Avq		8,800			
Std Dev		870			
C5~25	250	6,300	552	0.46	75% Saturated
C5-22	250	7,400	552	0.47	75% Saturated
C5-31	250	6,550	552	0.92	75% Saturated
C5-38	250	7,610	552	1.39	75% Saturated
C5-28	250	7,430	552	0.20	75% Saturated
Avg		7,060		0.69	
Std Dev		590		0.47	
C5-33	72	8,520	625	0.60	Saturated
C5-37	72	8,080	625	0.82	Saturated
C5-36	72	9,090	625	0.83	Saturated
C5-34	72	8,280	625	1.09	Saturated
C5-16	72	loaded toc fast	625	1.00	Saturated
Avg		8,490		0.87	
Std Dev	<u> </u>	440		0.19	
C5-3	250	6.250	625	1.04	Saturated
C5-40	250	6.450	625	0,87	Saturated
C5-21	250	6,070	625	1.00	Saturated
C5-39	250	6,470	625	0.75	Saturated
C5-6	250	7,420	625	0.70	Saturated
Avq		6,530		0.87	
Std Dev		520		0.15	

Agi	.ng at 160	Short-Beam) °F and 100%	R.H.		ironmental
Materials:	AS/4397		L/D Rat	io: 4/	1
Specimen Number	Test Temp. (°F)	Ultimate Strength (psi)	Exposure Time (Hrs)	Weight Gain (%)	Remarks
D9-18	72	13,450	44	0.66	45% Saturated
D9-24	72	16,000	44	0.58	45% Saturated
D9-29	72	17,930	44	0.67	45% Saturated
D9-32	72	16,130	44	0.58	45% Saturated
D9-43	72	18,350	44	0.64	45% Saturated
Avg		16,370		0.63	
Std Dev		1,940		0.04	
		,			
D9-25	350	11,620	44	0.60	45% Saturated
D9-33	350	11,120	44	0.68	45% Saturated
D9-36	350	12,590	44	0.46	45% Saturated
D9-42	350	12,150	44	0.53	45% Saturated
D9-44	350	12,820	44	0.70	45% Saturated
Avg		12,060		0.59	
Std Dev		700		0.10	
D9-28	72	12,140	840	0.80	Saturated
D9-8	72	12,990	840	1.26	Saturated
D9-3	72	12,710	840	2.85	Saturated
D9-9	72	13,450	840	1.22	Saturated
D9-19	72	9,350	840	1.10	Saturated
Avg		12,130		1.45	
Std Dev		1,620		0.81	
D9-37	350	7,290	840	0.99	Saturated
D9-10	350	6,830	840	1.25	Saturated
D9-31	350	6,680	840	1.26	Saturated
D9-15	350	5,750	840	1.91	Saturated
D9-14	350	5,880	340	1.00	Saturated
Avg		6,490		1.28	
Std Dev		810		0.37	

Agi	ng at 160	Short-Beam) °F and 100%	R.H.		
Materials: '	r300/F178		L/D Rat	io: 4/	1
Specimen Number	Test Temp. (°F)	Ultimate Strength (psi)	Exposure Time (Hrs)	Weight Gain (%)	Remarks
E9-34	72	13,060	21.5	0,84	50% Saturated
E9-41	72	12,240	21.5	0.76	50% Saturated
E9-32	72	13,130	21.5	0.83	50% Saturated
E9-35	72	12,880	21.5	0.62	50% Saturated
E9-42	72	13,950	21.5	0.80	50% Saturated
Avg		13,050		0.77	
Std Dev		610		0.09	
E9-43	350	7,650	21.5	0.75	50% Saturated
E9-24	350	7,430	21.5	0.72	50% Saturated
E9-37	350	8,330	21.5	1.00	50% Saturated
E9-31	350	8,210	21.5	0.65	50% Saturated
E9-39	350	8,400	21.5	0.72	50% Saturated
Avg		8,000		0.77	
Std Dev		440		0.13	
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E9-40	72	11,230	408	1.50	Saturated
E9-8	72	11,660	408	1.33	Saturated
E9-47	72	11,100	408	1,33	Saturated
Avg		11,330		1.39	
Std Dev		290		0.10	
E9-38	350	7,440	408	1.46	Saturated
E9-22	350	6,940	408	1.35	Saturated
E9-30	350	7,760	408	1.42	Saturated
Avg		7,380		1.41	
Std Dev		410		0.06	