

NASA CR-172562  
(SER-510117)

NASA-CR-172562  
19850025909

# **FLIGHT SERVICE EVALUATION OF COMPOSITE HELICOPTER COMPONENTS**

Second Annual Report  
MAY 1982 through September 1983

LIBRARY COPY

Melvin J. Rich and David W. Lowry

1985  
LANGLEY RESEARCH CENTER  
LIBRARY, NASA  
HAMPTON, VIRGINIA

SIKORSKY AIRCRAFT  
DIVISION OF UNITED TECHNOLOGIES CORPORATION  
Stratford, Conn.

CONTRACT NO. NAS1-16542  
APRIL 1985

**FOR REFERENCE**  
**NOT TO BE TAKEN FROM THIS ROOM**

**NASA**

National Aeronautics and  
Space Administration

Langley Research Center  
Hampton, Virginia 23665

2

2

1

2

NASA CR-172562  
(SER-510117)

# **FLIGHT SERVICE EVALUATION OF COMPOSITE HELICOPTER COMPONENTS**

Second Annual Report  
MAY 1982 through September 1983

M. J. Rich, and D. W. Lowry  
April, 1985

Prepared under Contract No. NAS1-16542

by

**SIKORSKY AIRCRAFT  
DIVISION OF UNITED TECHNOLOGIES CORPORATION  
Stratford, Conn.**

for

**NASA**

National Aeronautics and  
Space Administration

**Langley Research Center**  
Hampton, Virginia 23665

N85-34222#



## FOREWORD

This report was prepared by Sikorsky Aircraft, Division of United Technologies Corporation, under NASA Contract NAS1-16542 and covers the work performed during the period of May 1982 through September 1983. This program was jointly funded by the Materials Division of NASA-Langley Research Center and Structures Laboratory, U.S. Army Research and Technology Laboratory (AVSCOM). The contract is monitored by Mr. Donald Baker of the Applied Materials Branch.

The authors wish to acknowledge the contributions of the following Sikorsky personnel: R. Gallagher, and T. Gilbertson, component testing; B. Ching environmental analysis; M.B. Ezzo, material coupon evaluation and M. Rogers, graphical presentations.

## TABLE OF CONTENTS

| SECTION                                         | PAGE |
|-------------------------------------------------|------|
| SUMMARY                                         | 1    |
| 1.0 INTRODUCTION AND BACKGROUND                 | 2    |
| 2.0 IN-SERVICE COMPONENT SELECTION              | 5    |
| 3.0 TESTS OF IN-SERVICE COMPONENTS              | 6    |
| 3.1 Horizontal Stabilizers                      | 6    |
| 3.2 Tail Rotor Spars                            | 6    |
| 3.3 Spar Moisture Measurements                  | 6    |
| 3.4 Spar Environmental Analysis and Correlation | 11   |
| 3.5 Spar Tests                                  | 19   |
| 4.0 MATERIAL EVALUATION                         | 25   |
| 4.1 Exposed Composite Panel Data                | 25   |
| 4.2 Moisture Measurements                       | 25   |
| 4.3 Analysis and Correlation                    | 28   |
| 4.4 Coupon Strength Tests                       | 32   |
| 5.0 ANALYSIS OF TEST RESULTS                    | 45   |
| 5.1 Exposed Panel Data                          | 45   |
| 5.2 In-Service Component Data                   | 45   |
| 6.0 CONCLUSIONS                                 | 48   |
| 7.0 APPENDIX                                    | 49   |
| 8.0 REFERENCES                                  | 103  |

LIST OF TABLES

| <u>TABLE</u> |                                                                                              | <u>PAGE</u> |
|--------------|----------------------------------------------------------------------------------------------|-------------|
| I            | Schedule for Evaluation of In-Service Environmental Effects on Advanced Composite Structures | 4           |
| II           | Summary of Returned In-Service Spars                                                         | 7           |
| III          | Fatigue Test and Data Summary for Tail Rotor Spars                                           | 21          |
| IV           | Summary of Tail Rotor Spare Fatigue Tests                                                    | 23          |
| V            | Exposed Panel and In-Service Spar Coupon Moisture Values                                     | 27          |
| VI           | Summary of Coupon Test Results                                                               | 33          |
| VII          | Summary of Exposed Panel Strength, Environmental Factors                                     | 34          |
| VIII         | Spar S/N A-116-00150                                                                         | 50          |
| IX           | Spar S/N A-116-00283,                                                                        | 52          |
| X            | Spar S/N A-116-00237                                                                         | 54          |
| XI           | Spar S/N A-116-00172                                                                         | 56          |
| XII          | Moisture Desorption Measurements of Twelve Exposed Panels, Stratford and West Palm Beach     | 59          |
| XIII         | Average Moisture Value of Desorption Coupons                                                 | 87          |
| XIV          | Weather Bureau Data, West Palm Beach, Florida                                                | 99          |
| XV           | Summary of Coupon Test Results                                                               | 101         |

LIST OF ILLUSTRATIONS

| <u>FIGURE</u> |                                                                                                        | <u>PAGE</u> |
|---------------|--------------------------------------------------------------------------------------------------------|-------------|
| 1             | S-76 Tail Rotor Spar - Location of Moisture Measurement Coupons                                        | 8           |
| 2             | Desorption Time History of Coupon from Tail Rotor Spar, S/N A-116-00094 (Station 6-7 LE, End B)        | 9           |
| 3             | Sketch of Coupon Locations from Spars A-116-00150 and A-116-00283                                      | 10          |
| 4             | Moisture Absorption for Tail Rotor Spar A-116-00094                                                    | 12          |
| 5             | Moisture Absorption for Tail Rotor Spar A-116-00150                                                    | 13          |
| 6             | Moisture Absorption for Tail Rotor Spar A-116-00283                                                    | 14          |
| 7             | Moisture Absorption for Tail Rotor Spar A-116-00237                                                    | 15          |
| 8             | Moisture Absorption for Tail Rotor Spar A-116-00172                                                    | 16          |
| 9             | Predicted Moisture Absorption for Tail Rotor Spar A-116-00114                                          | 17          |
| 10            | Measured vs Analysis Moisture Contents of In-Service S-76 Spars                                        | 18          |
| 11            | Shear Stress - Fatigue Cycle Results for S-76 Tail Rotor Spars                                         | 22          |
| 12            | Comparison of Environmental Factors for In-Service Tail Rotor Spars and Laboratory Conditioned Coupons | 24          |
| 13            | Moisture Desorption, 6 Ply Graphite/Epoxy Specimens from WPB                                           | 26          |
| 14            | Moisture Absorption, 6 Ply Graphite/Epoxy Panel Exposed at WPB                                         | 29          |
| 15            | Moisture Absorption, 33 Ply Graphite/Epoxy Panel Exposed at WPB                                        | 30          |

LIST OF ILLUSTRATIONS (Cont'd)

| <u>FIGURE</u> |                                                                                          | <u>PAGE</u> |
|---------------|------------------------------------------------------------------------------------------|-------------|
| 16            | Moisture Absorption for Kevlar/Epoxy Panels, WPB                                         | 31          |
| 17            | Reduction of SBS Static Strength with Moisture, Graphite/Epoxy                           | 35          |
| 18            | Affect of Moisture Content on Bending Strength, Graphite/Epoxy                           | 36          |
| 19            | SBS Fatigue Strength, 33 Ply Panels, Baseline                                            | 37          |
| 20            | SBS Fatigue Strength, 33 Ply Panels, Exposed 2 years, WPB                                | 38          |
| 21            | SBS Fatigue Strength, 33 Ply Panels, Exposed 3 Years, WPB                                | 39          |
| 22            | Coupon Fatigue Strength, Spar A-116-00150, A End                                         | 40          |
| 23            | Coupon Fatigue Strength, Spar A-116-00150, B End                                         | 41          |
| 24            | Coupon Fatigue Strength, Spar A-116-00283, A End                                         | 42          |
| 25            | Coupon Fatigue Strength, Spar A-116-00283, B End                                         | 43          |
| 26            | Correlation of SBS Fatigue Environmental Factor                                          | 44          |
| 27            | Comparison of Environmental Factors for Field Exposed and Laboratory Conditioned Coupons | 47          |



FLIGHT SERVICE EVALUATION OF COMPOSITE  
HELICOPTER COMPONENTS  
(Second Annual Report)

by  
M.J. Rich and D.W. Lowry  
Sikorsky Aircraft  
Division of United Technologies Corporation  
Stratford, Connecticut

SUMMARY

This second annual report presents the environmental effects data for up to four years service operation of S-76 tail rotor spars and three years for field exposed composite panels.

Four S-76 tail rotor spars were returned after three and four years of commercial operation in the Louisiana Gulf Coast region. Full scale fatigue tests were conducted on three and four year service spars. Two three year service spars were cut up for coupon testing. The full scale fatigue strengths of the three and four year spars were of equal strength and close to the baseline spar fatigue data.

Panels exposed for three years were returned for moisture measurements and strength tests. Environmental analyses were made of the returned tail rotor spars and composite panels. Both moisture and strength predictions were compared with measured data. The moisture absorption was close to the predictions. The affect on strength was close to laboratory conditioned strength data.

## SECTION 1.0 INTRODUCTION AND BACKGROUND

The environmental effects program for composite structures was instituted to assess the affects of environment on selected composite materials. The program includes evaluation of in-service components and of field exposed panels. The in-service components are obtained from commercial S-76 operations in the Gulf Coast Region. The field exposed panels are obtained from locations in West Palm Beach (WPB), Florida and Stratford (STFD), Connecticut. The data is used to compare with laboratory test/and analytical methods.

The objective of this eight year program is to derive procedures for establishing in-service environmental factors for both design and component test verification.

The tasks for this program are: (1) determine the strength of composite structural components after in-service use, (2) compare such results with initial certification tests, (3) evaluate the effects of component moisture content, and (4) compare coupon test results for real time and accelerated environmental conditioning.

The schedule for this program is shown in Table I. The components selected for in-service evaluation are the tail rotor spar and the horizontal stabilizer. The tail rotor spar is an all graphite/epoxy structure (AS1/6350 Ciba-Geigy System) designed by cyclic loads. The horizontal stabilizer is a full depth sandwich structure with crossplied Kevlar/epoxy (285/5143 Dupont, American Cyanamid System) skins on a Nomex honeycomb core. Each stabilizer is joined by a full depth aluminum honeycomb core spar that has unidirectional graphite/epoxy (AS1/6350) caps and overwrapped with Kevlar/epoxy (285/5143) fabric. The stabilizer is designed by static loads but will also be cyclicly tested under this program to ascertain in-service environmental effects on fatigue strength.

This second annual report is a continuation of the efforts reported for two year commercial operation of S-76 spars and field exposed panels (Reference 1). The technical background on moisture absorption characteristics, the test data for the two year exposures, and baseline test data are contained in Reference 1.

The continuation of the program provides tail rotor spars with increasing calendar time and absorbed moisture. It is expected that the environmental effects will increase with time.

To assess the affect of moisture and flight loads on tail rotor spars, four were returned during this reporting period. Full scale fatigue tests were conducted on a three and a four year service spar. Two three year service spars were cut up into coupons for testing. The spar coupons are to provide more detailed moisture absorption data as well as to provide static and fatigue strengths.

The three year field exposed composite panels data are now available for this reporting period. Both moisture and strength tests of three years exposure can now be compared with the previous period reported.

TABLE I

SCHEDULE FOR EVALUATION OF IN-SERVICE ENVIRONMENTAL EFFECTS ON  
 ADVANCED COMPOSITE STRUCTURES

S-76 HELICOPTER  
 CONTRACT EFFECTIVE DATE 2-9-81

| <u>TASK</u>                                    | <u>CALENDAR YEAR</u> |    |    |    |    |    |    |    |
|------------------------------------------------|----------------------|----|----|----|----|----|----|----|
|                                                | 81                   | 82 | 83 | 84 | 85 | 86 | 87 | 88 |
| 1.0 <u>In-Service Component Selection</u>      |                      |    |    |    |    |    |    |    |
| 1.1    Tracking                                | X                    | X  | X  | X  | X  | X  | X  | X  |
| 1.2    Selection:                              |                      |    |    |    |    |    |    |    |
| - Horizontal Stabilizer                        | X                    |    | X  |    | X  |    | X  |    |
| - Tail Rotor Spar                              | X                    | X  | X  | X  | X  | X  | X  | X  |
| 4    2.0 <u>Tests of In-Service Components</u> |                      |    |    |    |    |    |    |    |
| 2.1    Horizontal Stabilizers:                 |                      |    |    |    |    |    |    |    |
| - Fatigue Tests, Full Scale*                   |                      |    | X  |    |    |    | X  |    |
| - Static Tests, Full Scale*                    | X                    |    | X  |    | X  |    | X  |    |
| 2.2    Tail Rotor Spars:                       |                      |    |    |    |    |    |    |    |
| - Fatigue Tests, Full Scale*                   | X                    | X  | X  | X  |    | X  |    | X  |
| - Coupon Static/Fatigue Tests*                 |                      | XX |    | X  |    | X  |    |    |
| 3.0 <u>Material Evaluation</u>                 | X                    | X  | X  | X  | X  | X  | X  | X  |
| 4.0 <u>Analysis of test Results</u>            | X                    | X  | X  | X  | X  | X  | X  | X  |
| 5.0 <u>Reports</u>                             |                      |    |    |    |    |    |    |    |
| 5.1    Technical Letter Reports (Quarterly)    |                      |    |    |    |    |    |    |    |
| 5.2    Oral Presentations                      |                      | X  | X  | X  | X  | X  | X  | X  |
| 5.3    NASA Reports                            |                      | X  | X  | X  | X  | X  | X  | X  |

\*Actual Times in Each Year Are Approximate

## SECTION 2.0 IN-SERVICE COMPONENT SELECTION

The selection of components under NASA Contract NAS1-16542 are from aircraft operating in a humid hot region, generally located in the Gulf Coast Louisiana Region of the United States. Additional component data is available and will be referenced in this report.

Components are selected from high time helicopters. However, the commercial operator may not keep the same components on the aircraft and therefore, calendar and flight hours are specified for the components. The stabilizer and tail rotor spars are serialized and the operational data are obtained from their individual log cards.

The components selected for testing are from a commercial operator (Air Logistics), located in Louisiana.

| <u>COMPONENT</u>                                     | <u>TOTAL OPERATING<br/>TIME</u> | <u>CALENDAR TIME<br/>IN FIELD</u> |
|------------------------------------------------------|---------------------------------|-----------------------------------|
| Stabilizer B-157-00076                               | 1600 Hrs                        | 17 Months*                        |
| Tail Rotor Paddle<br>A-137-00034<br>Spar A-116-00094 | 2390 Hrs                        | 29 Months*                        |
| Tail Rotor Paddle<br>A-137-00085<br>Spar A-116-00150 | 2385 Hrs                        | 37 Months                         |
| Tail Rotor Paddle<br>A-137-00099<br>Spar A-116-00283 | 1884 Hrs                        | 37 Months                         |
| Tail Rotor Paddle<br>A-137-00068<br>Spar A-116-00237 | 1596 Hrs                        | 41 Months**                       |
| Tail Rotor Paddle<br>A-137-00031<br>Spar A-116-00114 | 3350 Hrs                        | 49 Months                         |

The environmental histories of components tested during this reporting period are documented in Section 7.

\*Tested and reported in Reference 1.

\*\*Reference Table X for environmental history.

## SECTION 3.0 TESTS OF IN-SERVICE COMPONENTS

### 3.1 Horizontal Stabilizer

The first static tested horizontal stabilizer is reported in Reference (1). The second horizontal stabilizer, with four years service, has been returned to Sikorsky. This component will be checked for stiffness before fatigue and residual strength tests are conducted. Tests are scheduled for late 1983.

### 3.2 Tail Rotor Spars

To date, there have been eight tail rotor spars returned from service. Table II lists the spars and their test conditions. Moisture measurements and environmental analysis are reported for the spars with service in the Louisiana Gulf Coast region. These spars are first inspected and then fatigue tested. Moisture measurements are taken from coupons removed near the zone of crack initiation. In addition, two spars, S/N A116-00150 and 00283, were used only for moisture measurements and coupon strength testing.

### 3.3 Spar Moisture Measurements

Coupons were taken from the tail rotor spars for the purpose of determining the moisture contents. Locations are shown in Figure 1 for full scale fatigue tested spars.

The coupons taken from the tail rotor spar were between stations 5 to 7, the region of spar fatigue cracking. To accelerate the desorption tests some of the tail rotor coupons (from leading edge) were fragmented. The results of the fragmented desorption tests will be reported. Past desorption testing of tail rotor spar coupons have shown no final difference in desorption results whether the coupons are fragmented or not. However, the second set, solids, are being desorbed as a backup for data.

The desorption time history of the coupon for the B end at Sta. 6-7 leading edge Tail Rotor Spar S/N 00094 is typical and shown in Figure 2. The projected moisture absorbed is .26 percent weight. As illustrated in Figure 2, Fick's Law, used for moisture analysis, agrees closely with the experimental data.

TABLE II  
 SUMMARY OF RETURNED IN-SERVICE SPARS

| Tail Rotor<br>Spar S/N<br>(Year Returned) | In-Service<br>Location     | In-Service Time <sup>(1)</sup><br>Months/Flight Hrs. | Status                 |
|-------------------------------------------|----------------------------|------------------------------------------------------|------------------------|
| A-116-00046*<br>(1980)                    | WPB<br>(Flight Test)       | 25 Months<br>150 Flight Hrs.                         | Spar fatigue<br>tested |
| 00064*<br>(1980)                          | As Above                   | 25 Months<br>150 Flight Hrs.                         | Spar fatigue<br>tested |
| 00094<br>(1981)                           | Gulf Coast<br>(Commercial) | 29 Months<br>2390 Flight Hrs.                        | Spar fatigue<br>tested |
| 00150<br>(1982)                           | As Above                   | 37 Months<br>2385 Flight Hrs.                        | Coupons tested<br>only |
| 00283<br>(1982)                           | As Above                   | 37 Months<br>1884 Flight Hrs.                        | Coupons tested<br>only |
| 00172*<br>(1982)                          | As Above                   | 39 Months<br>2533 Flight Hrs.                        | Spar fatigue<br>tested |
| 00237<br>(1982)                           | As Above                   | 28 Months**<br>1596 Flight Hrs.                      | Spar fatigue<br>tested |
| 00114<br>(1983)                           | As Above                   | 49 Months<br>3550 Flight Hrs.                        | Spar fatigue<br>tested |

NOTES:

(1) In some instances there is additional calendar exposure time and is so listed in the tail rotor spar history. Total exposure time is used for environmental analyses.

\* Designates additional spars tested.

\*\* Reference Table X for Environmental History.

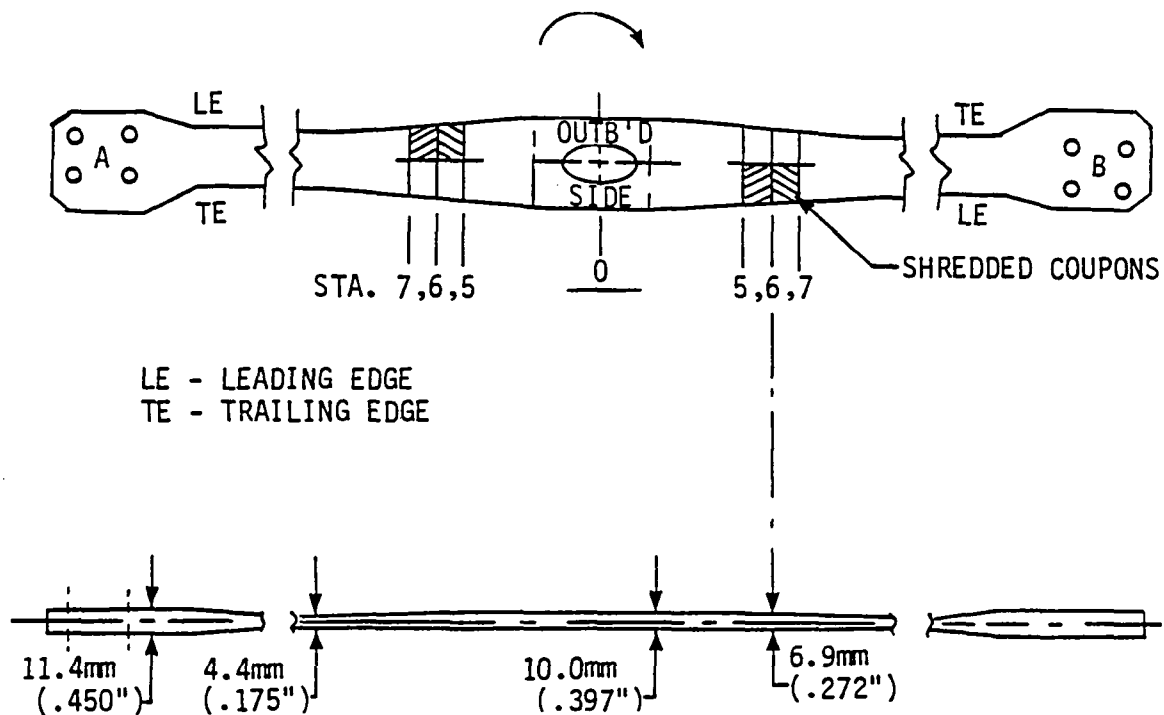


FIGURE 1. S-76 TAIL ROTOR SPAR - LOCATION OF MOISTURE MEASUREMENT COUPONS

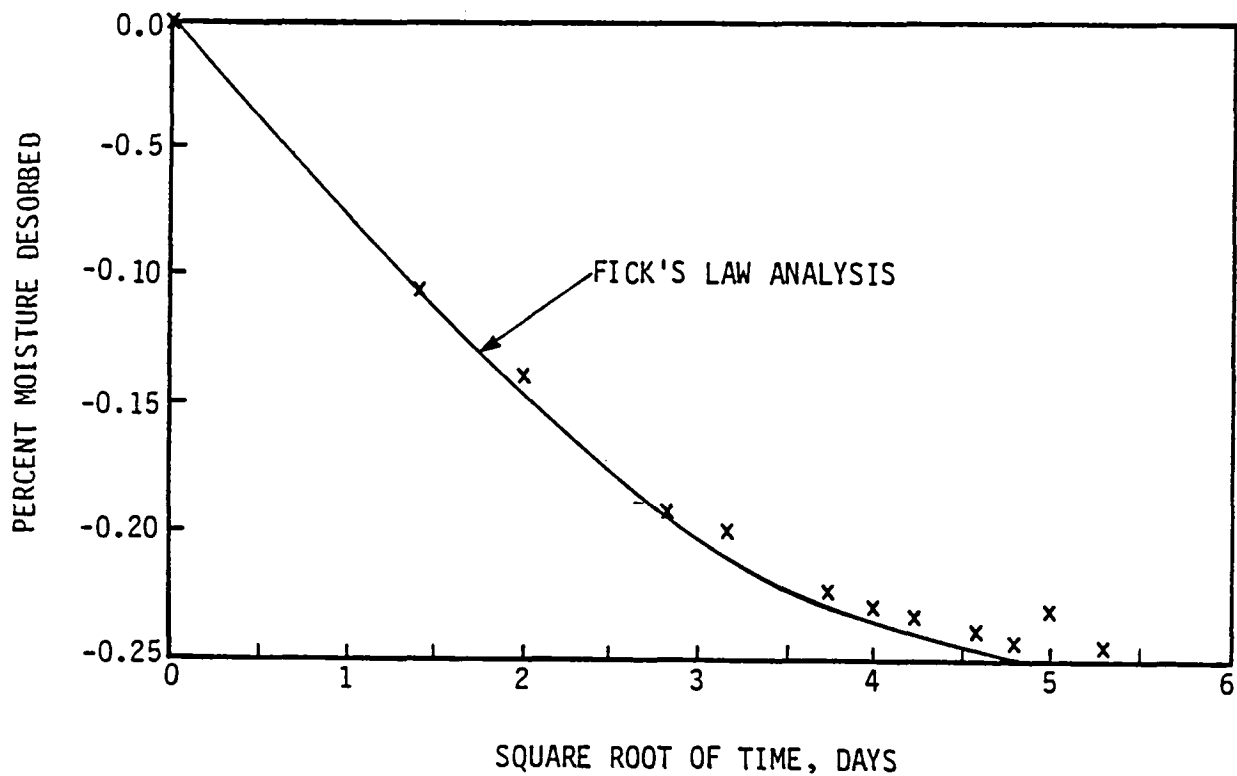


FIGURE 2. DESORPTION TIME HISTORY OF COUPON FROM TAIL ROTOR SPAR. S/N A-116-00094. (STATION 6-7 LE, END B).

The procedure for all the fatigue tested spars was to determine the moisture at the stations 5 to 7 and to average the data. The averaged moisture contents for the spars returned from commercial service in the Gulf Coast region are as follows:

| Spar<br>S/N | In-Service Time<br>(Months) | Average Moisture (STA 5-7)<br>Content, percent Weight |
|-------------|-----------------------------|-------------------------------------------------------|
| 00094       | 29                          | .26                                                   |
| 00150       | 37                          | .40                                                   |
| 00283       | 37                          | .36                                                   |
| 00172       | 39                          | .42                                                   |
| 00237       | 28                          | .50                                                   |
| 00114       | 49                          | Still being desorbed                                  |

In addition, moisture measurements were taken from STA 12.5-13.5 (two ends) for spars S/N 00150 and 00283. That data is to be used for spar coupon strength data in region STA 9.75 to 12.25 (constant thickness). Figure 3 presents the sketch of coupon locations for these spars.

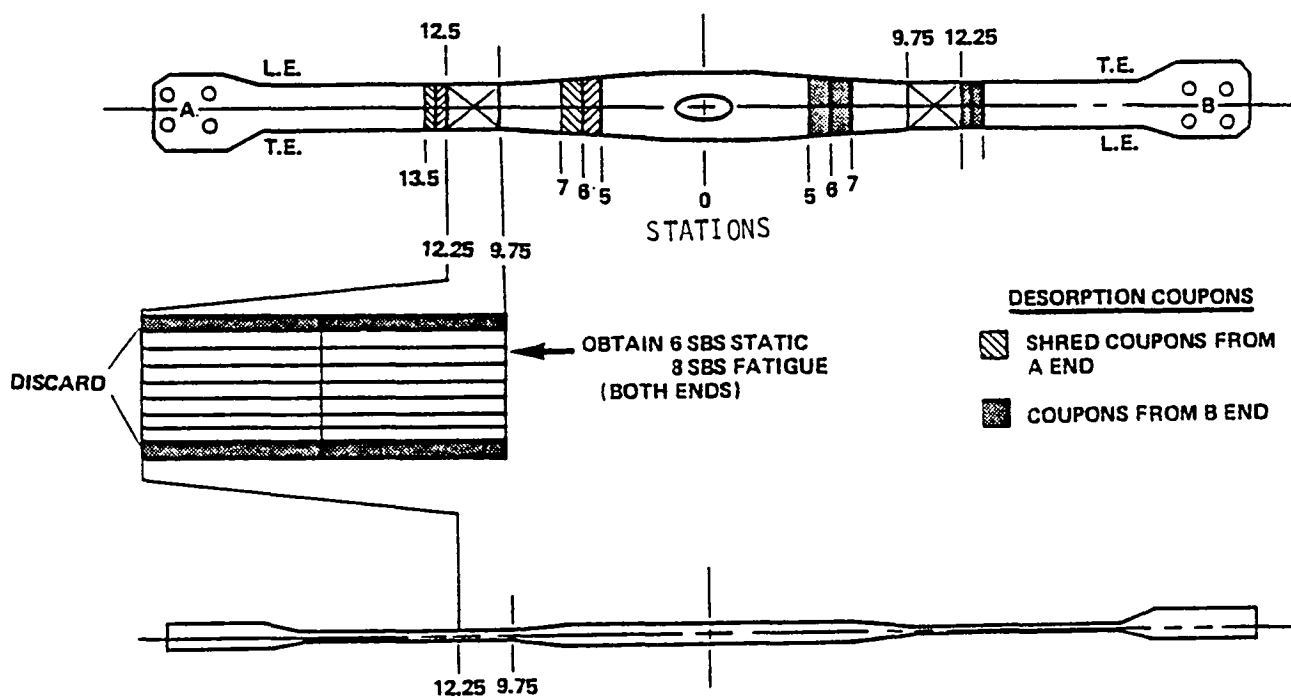


FIGURE 3. SKETCH OF COUPON LOCATIONS FROM SPARS A-116-00150 and A-116-00283

### 3.4 Spar Environmental Analysis and Correlation

The analysis and correlation is presented for in-service commercial operation in the Gulf Coast region.

The environmental histories for the spars is documented in Section 7. The analysis method is a computerized solution using Fick's Law with experimentally determined diffusion constants. The environmental data\* was obtained from Reference (2).

The analysis time histories for each spar and the test measured moisture values are presented in Figures 4 through 9. Coupons from the tail rotor spar S/N 00114 are currently being desorbed to determine the moisture content. The results show that the measured (test) moisture level is slightly less than predicted without solar radiation effects. The comparison trend is illustrated in Figure 10.

\*Solar radiation data was not available from Gulf Coast region (Lake Charles area). Therefore, all analysis is for ambient temperature and relative humidity (RH).

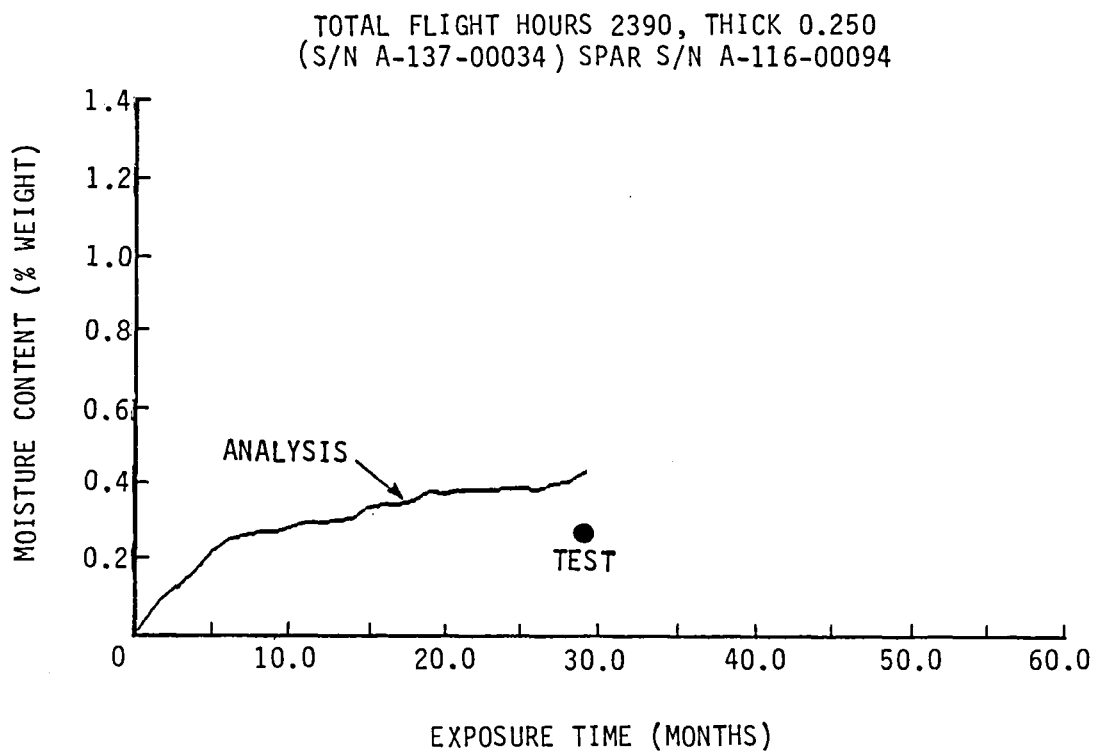


FIGURE 4. MOISTURE ABSORPTION FOR TAIL ROTOR SPAR A-116-00094

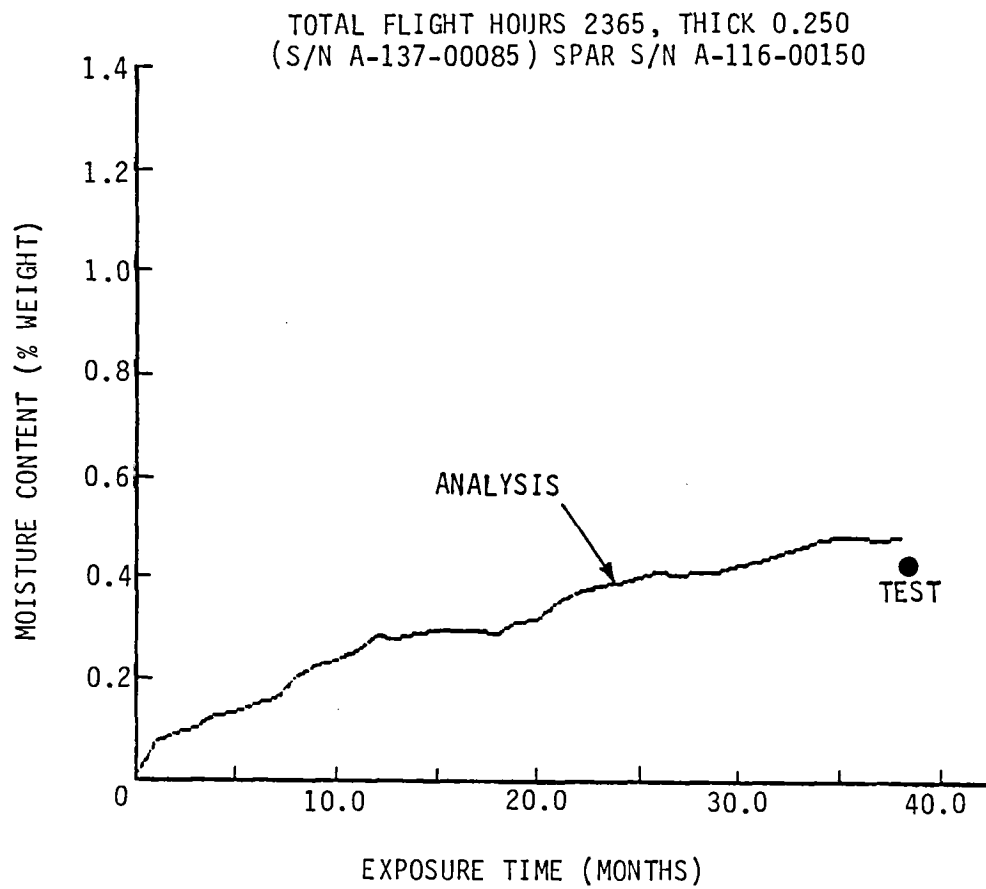


FIGURE 5. MOISTURE ABSORPTION FOR TAIL ROTOR SPAR A-116-00150

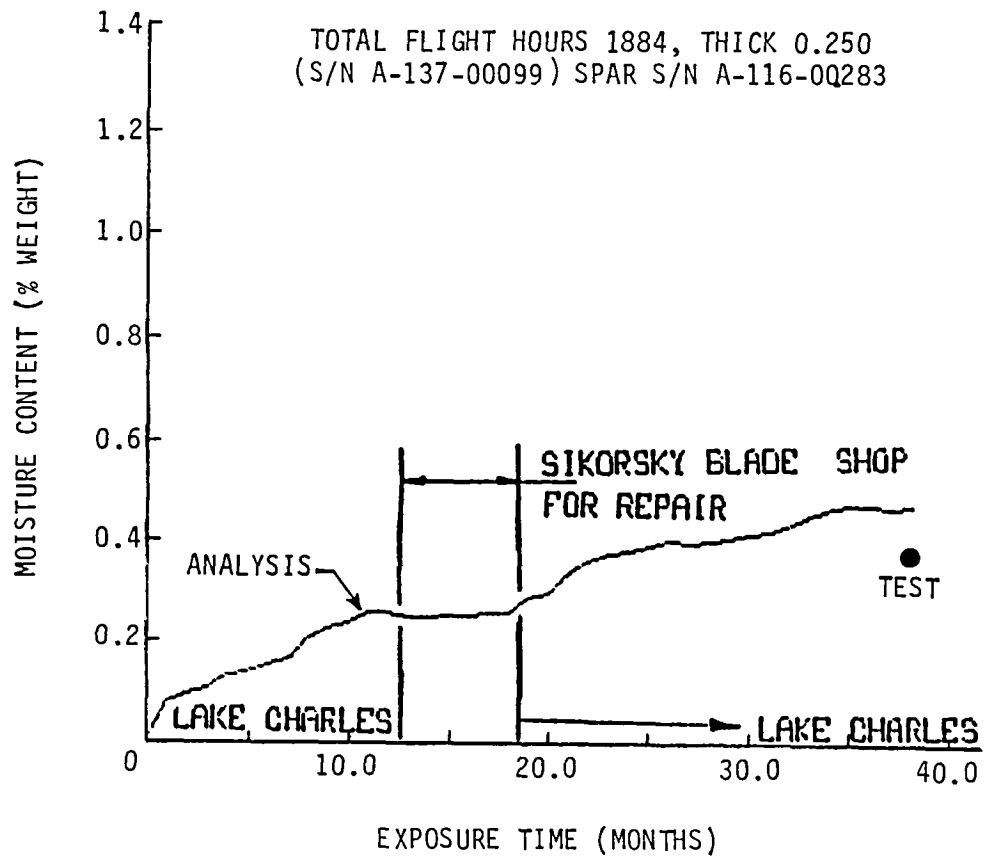


FIGURE 6. MOISTURE ABSORPTION FOR TAIL ROTOR SPAR A-116-00283

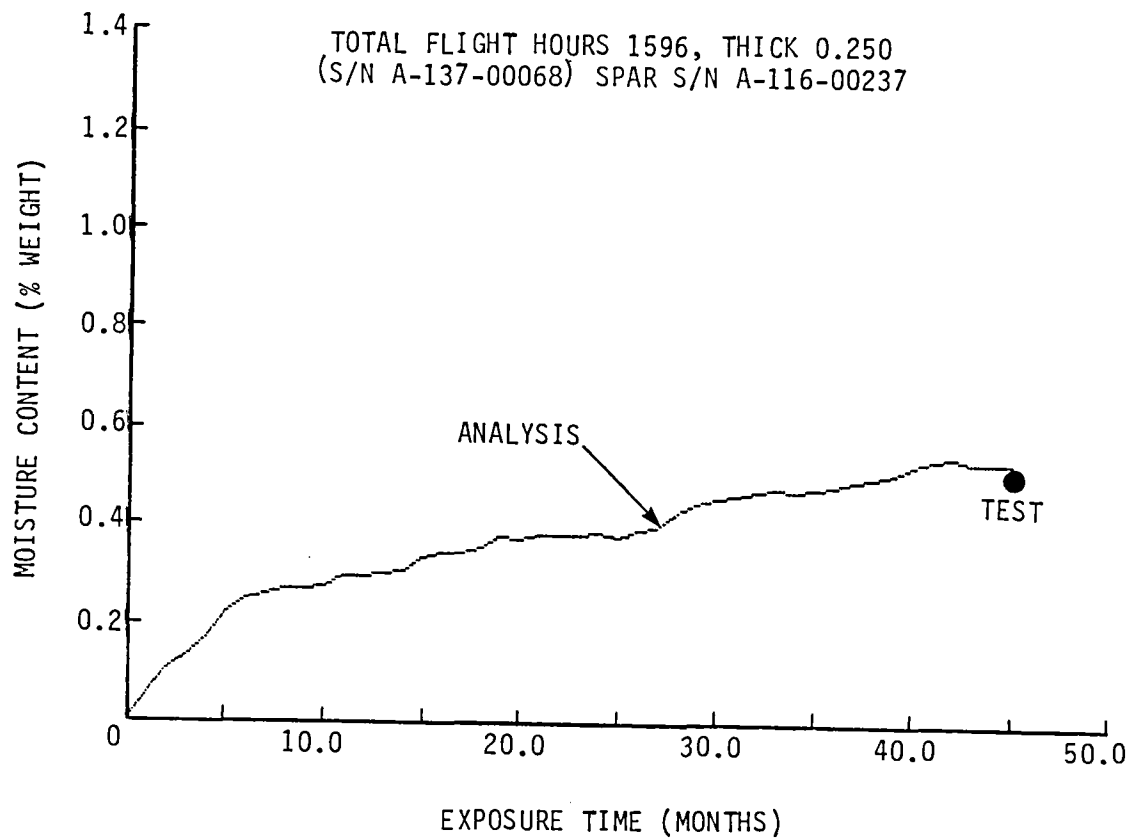


FIGURE 7. MOISTURE ABSORPTION FOR TAIL ROTOR SPAR A-116-00237

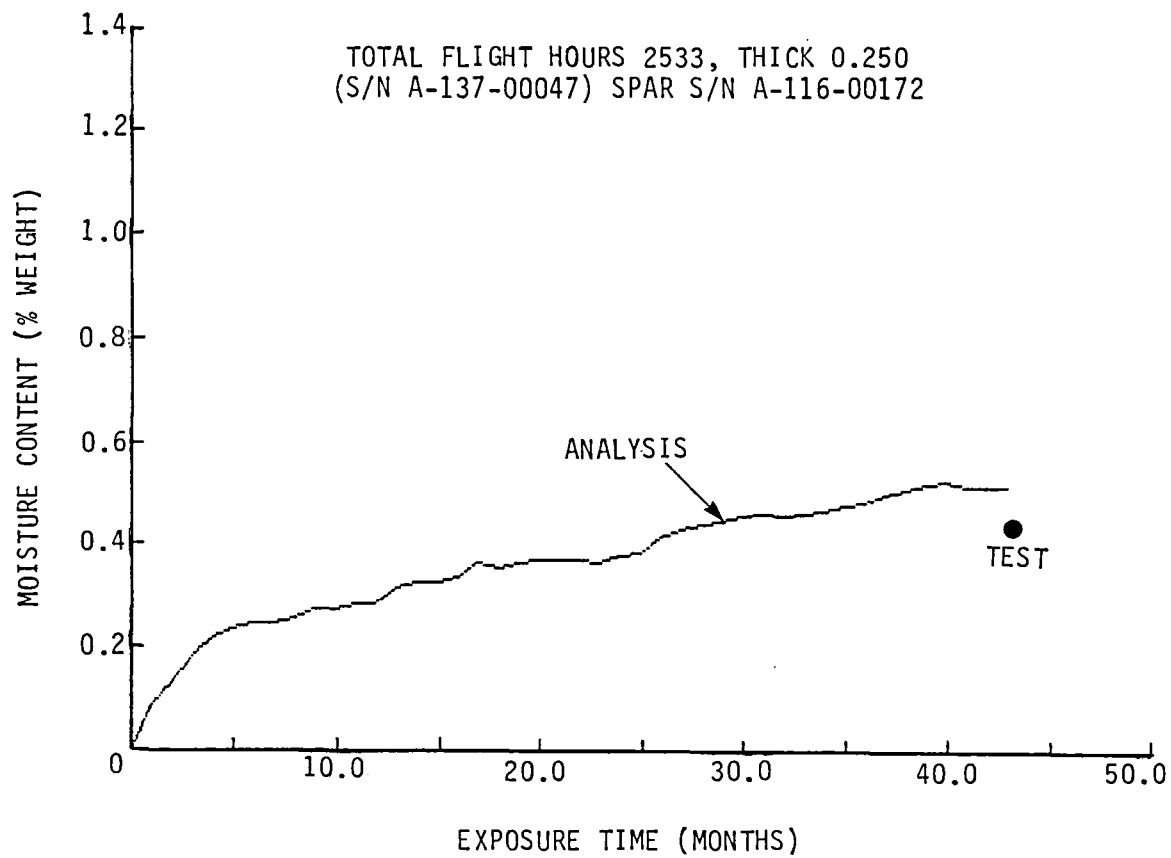


FIGURE 8. MOISTURE ABSORPTION FOR TAIL ROTOR SPAR A-116-00172

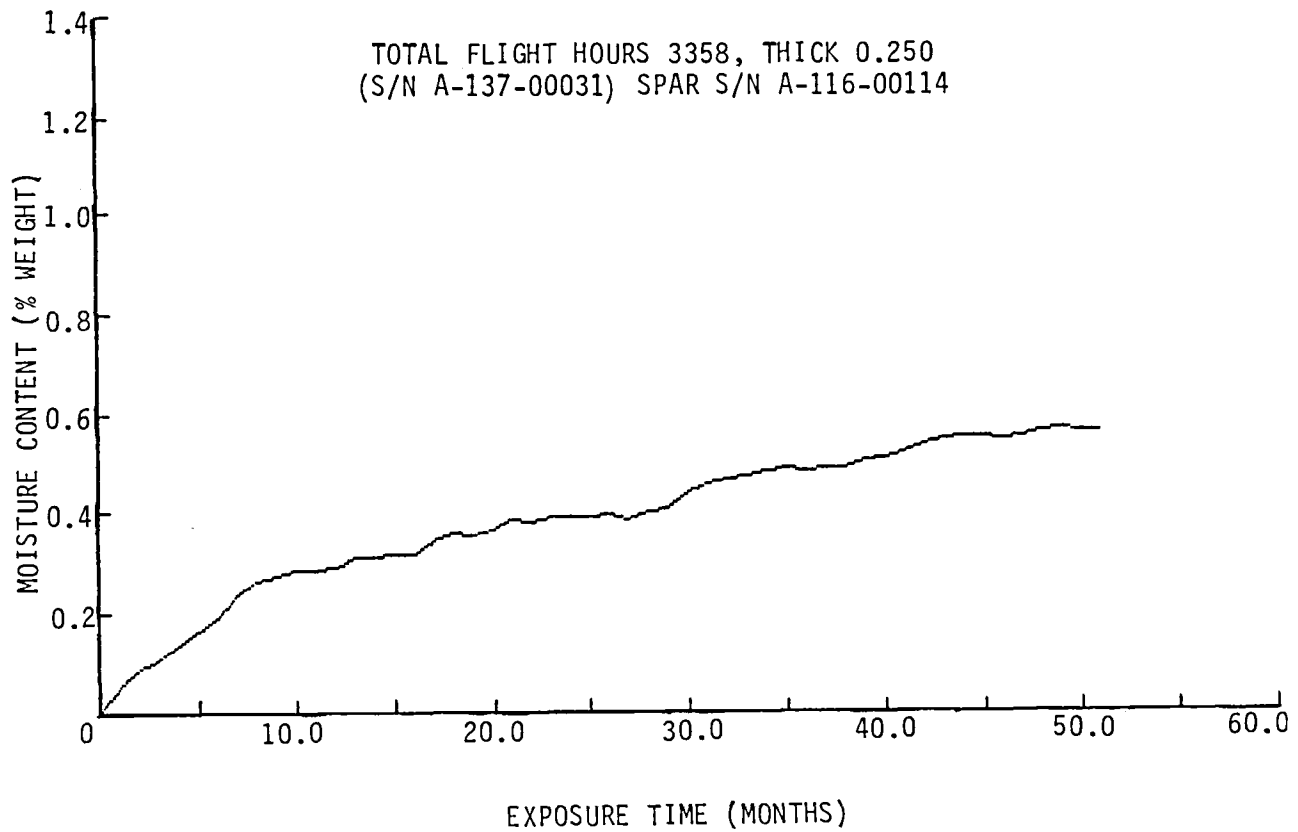


FIGURE 9. PREDICTED MOISTURE ABSORPTION FOR TAIL ROTOR  
SPAR A-116-00114

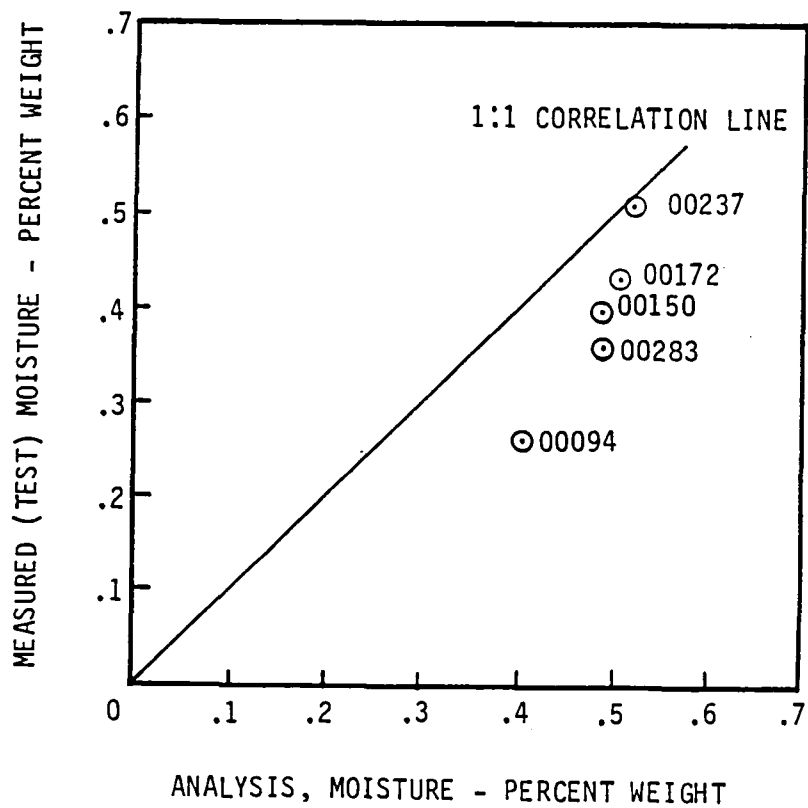


FIGURE 10. MEASURED VS. ANALYSIS MOISTURE CONTENTS OF IN-SERVICE S-76 SPARS

### 3.5 Spar Tests

The tail rotor spars are cyclicly loaded for combined edgewise (inplane) and flatwise bending with a steady centrifugal (axial) loading. The spars are clamped between an aircraft flange and retention plate. A short stub spar is used to take the place normally occupied by another blade spar (perpendicular to the test spar). The tail rotor combined load fatigue test setup and a schematic diagram of the methods for load introduction are those shown in Reference 1.

The load magnitudes are those stated in Table VIII of Reference 1. The steady centrifugal loading is kept constant for all tests and represents the centrifugal force developed at 110 percent of normal rotor speed. The cyclic loadings, edgewise and flatwise bending and torsional, are in phase and held in proportion. Absolute test levels are varied for the specific test so that fatigue fractures can be obtained between the range of  $10^5$  to  $5 \times 10^6$  cycles. The resultant cyclic moment at strain gage location EB2S (Reference 1, Figure 19) is measured and monitored by calibrated strain gages.

The fatigue tests of a spar can produce two test points. The first (designated A) is the first fracture on one side of the spar. The other side (designated B) can continue to be tested until its fracture.

The full scale fatigue test results are listed in Table III along with the service history and measured moisture. A cyclic shear stress - cycles (S-N) diagram is shown in Figure 11. The fatigue curve shape was based on short beam shear (SBS) coupon tests. The mode of fracture of the tail rotor spars appears to start from an interlaminar shear delamination. The curve shape constants were derived from the following formula:

$$\frac{f_s(N)}{d_a(E)} = 1 + \frac{\beta}{N^\gamma}$$

where:  $f_s$  is the cyclic shear stress, a crack origin, and is the combination of shears from flatwise and edgewise bending and torsion.

$f_s(N)$  is the cyclic shear stress for  $N$  cycles.

$d_a(E)$  is the cyclic shear stress at endurance.

$\beta$ ,  $\gamma$  are empirical constants and equal 0.138 for the SBS coupons and the full scale tail rotor spar tests.

$N$  is in  $10^6$  cycles

Initially the tail rotor spar fatigue parameter was the edgewise bending moment (Figure 20, Reference 1). Further investigation disclosed a shear stress combination which resulted in improved curve fitting of data and reduced the coefficient of variation. A constant, steady, centrifugal load, applied during the tests, was not a variable. The lower S-N curve line was fitted to the approximately 2 year WPB service time spar tests.

The 3 year service spars appear to show more scatter than for previous years. S/N 00237 is well above the mean of exposed blades while S/N 00172 is just about on the two year WPB trend line.

The fatigue test of the four year exposed spar S/N 00114 shows no strength reduction from the mean RTD baseline curve.

Table IV presents the environmental factors for the in-service tail rotor full scale fatigue tests. A comparison of environmental factors derived from lab conditions (Figure 7 Reference 1) and in-service spars is presented in Figure 12.

Data for coupons taken from spars S/N 00150 and 00283 are reported under Material Evaluation, Section 4.0.

TABLE III. FATIGUE TEST AND DATA SUMMARY FOR TAIL ROTOR SPARS

| Tail Rotor<br>Serial<br>Number | In-Service<br>Location                    | In-Service<br>Time<br>Months/Flt. Hrs.       | Shear Stress<br>MP <sub>a</sub> (psi) |                            | Cycles to<br>Fracture  | Moisture,<br>Percent<br>Weight |
|--------------------------------|-------------------------------------------|----------------------------------------------|---------------------------------------|----------------------------|------------------------|--------------------------------|
| 00046                          | West Palm<br>Beach, Fla.<br>(Flight Test) | 25 Months<br>150 Flight Hrs.                 | A                                     | 27.4 (3978)                | .25 x 10 <sup>6</sup>  | .29 <sup>(1)</sup>             |
|                                |                                           |                                              | B                                     | 27.4 (3986)                | .38 x 10 <sup>6</sup>  |                                |
| 00064                          | West Palm<br>Beach, Fla.<br>(Flight Test) | 25 Months,<br>150 Flight Hrs.                | A                                     | 29.8 (4320)                | .035 x 10 <sup>6</sup> | .32 <sup>(1)</sup>             |
|                                |                                           |                                              | B                                     | 29.8 (4320)                | .071 x 10 <sup>6</sup> |                                |
| 00094                          | Gulf Coast<br>Region, La.<br>(Commercial) | 29 Months,<br>2390 Flight Hrs.               | A                                     | 26.8 (3892)                | .286 x 10 <sup>6</sup> | .26 <sup>(2)</sup>             |
|                                |                                           |                                              | B                                     | 27.0 (3922)                | .170 x 10 <sup>6</sup> |                                |
| 00172                          | Gulf Coast<br>Region, La.<br>(Commercial) | 39 Months<br>2533 Flight Hrs.                | A                                     | 29.5 (4272)                | .218 x 10 <sup>6</sup> | .42 <sup>(2)</sup>             |
|                                |                                           |                                              | B                                     | 29.5 (4272)                | .218 x 10 <sup>6</sup> |                                |
| 00237                          | Gulf Coast<br>Region, La.<br>(Commercial) | 28 Months <sup>(3)</sup><br>1596 Flight Hrs. | A                                     | 31.2 (4518) <sup>(4)</sup> | .267 x 10 <sup>6</sup> | .50 <sup>(2)</sup>             |
| 00114                          | Gulf Coast<br>Region, La.<br>(Commercial) | 49 Months<br>3350 Flight Hrs.                | A                                     | 30.5 (4416) <sup>(4)</sup> | .839 x 10 <sup>6</sup> | To be determined               |

- NOTES:
- (1) Calculated from moisture measurements of spar
  - (2) Average of moisture measurements near fracture zone.
  - (3) 14 months spare, 28 months of flight service, 3 months lost by shipper.  
(Reference Table X)
  - (4) Fracture recorded on one side only.

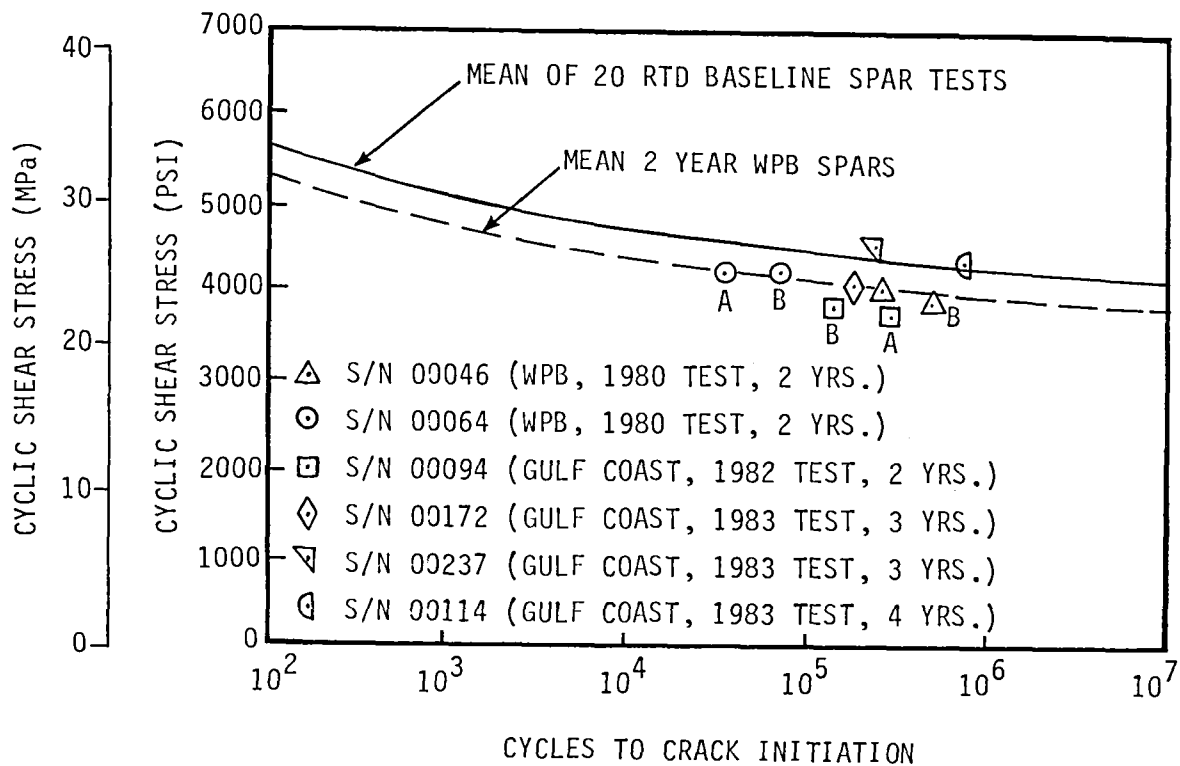


FIGURE 11. SHEAR STRESS-FATIGUE CYCLE RESULTS FOR S-76 TAIL ROTOR SPARS

TABLE IV. SUMMARY OF TAIL ROTOR SPAR FATIGUE TESTS

| Tail Rotor Spar<br>Tests and Service<br>Data                                       | Moisture<br>Content, %<br>WGT Near<br>Fracture Zone | Cyclic Shear<br>Stress at 10 <sup>7</sup><br>Cycles (Fig. 11)<br>MP <sub>a</sub> (psi) | Environmental Factor                               |                              |
|------------------------------------------------------------------------------------|-----------------------------------------------------|----------------------------------------------------------------------------------------|----------------------------------------------------|------------------------------|
|                                                                                    |                                                     |                                                                                        | Projected from<br>Coupon Tests<br>(Fig. 7, Ref. 1) | In-Service Component<br>Test |
| Initial Certification<br>Zero Time Structure                                       | ~0                                                  | 28.6 (4150)                                                                            | -                                                  | -                            |
| S/N 00094, 29 Months<br>and 2390 Flight Hrs.<br>in Gulf Coast Region,<br>Louisiana | .26 at<br>Station 6                                 | 26.9 (3900)                                                                            | .95                                                | .94                          |
| S/N 00237, 41 Months<br>and 1596 Flight Hrs.<br>in Gulf Coast Region,<br>Louisiana | .50 at<br>Station 6                                 | 29.5 (4275)                                                                            | .93                                                | 1.03                         |
| S/N 00172, 39 Months<br>and 2533 Flight Hrs.<br>in Gulf Coast Region,<br>Louisiana | .42 at<br>Station 6                                 | 26.6 (3860)                                                                            | .95                                                | .93                          |
| S/N 00114, 49 Months<br>and 3350 Flight Hrs.<br>in Gulf Coast Region,<br>Louisiana | To Be Determined<br>(.56 Predicted)                 | 29.1 (4233)                                                                            | .91<br>(Predicted)                                 | 1.02                         |

$$\text{ENVIRONMENTAL FACTOR} = \frac{\text{FIELD OR LAB STRENGTH}}{\text{RTD STRENGTH}}$$

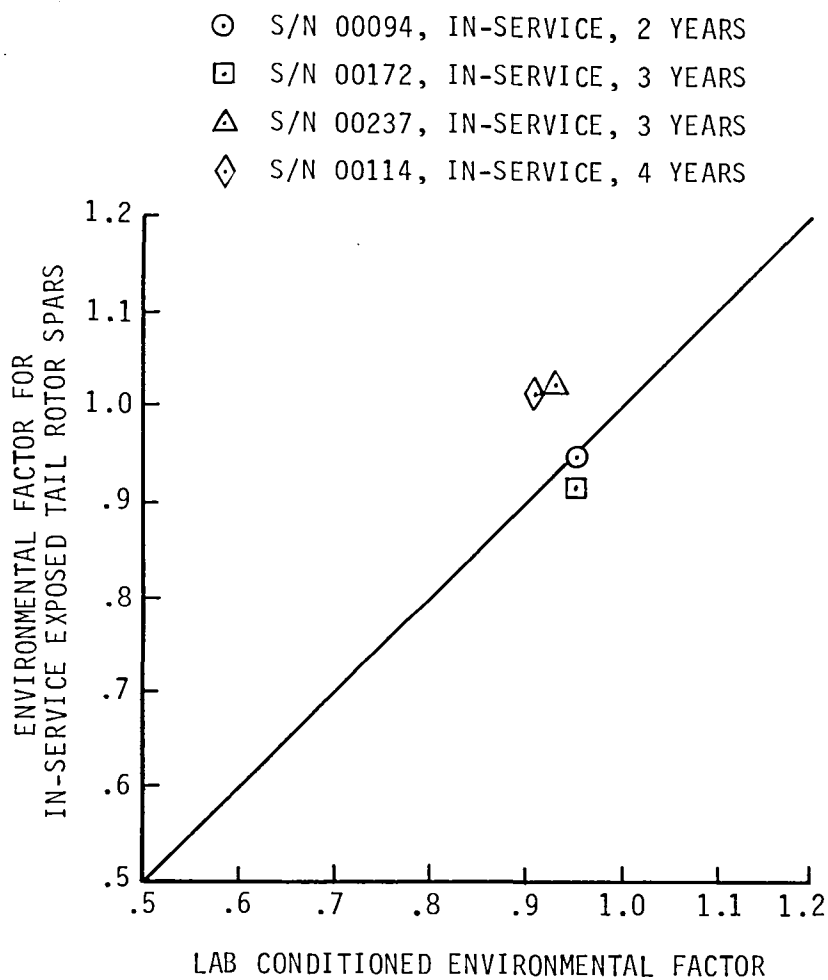


FIGURE 12. COMPARISON OF ENVIRONMENTAL FACTORS FOR IN-SERVICE TAIL ROTOR SPARS AND LABORATORY CONDITIONED COUPONS

## SECTION 4.0 MATERIAL EVALUATION

### 4.1 Exposed Composite Panel Data

AS1/6350 graphite/epoxy and 285/5143 Kevlar/epoxy panels have been exposed to the outdoor environments at Stratford, Connecticut and West Palm Beach, Florida. Each year panels are returned and cut up into coupons for desorption and testing (Reference 1).

The graphite/epoxy panels are 6, 14, and 33 plies. Each ply is nominally .305 mm (12 mils) thick. The Kevlar/epoxy panels are 5 plies. Each ply is nominally .228 mm (9 mils) thick.

Static and fatigue tests are conducted on coupons from exposed panels and compared with baseline RTD data. The data available at this time (up to three years exposure) are reported.

### 4.2 Moisture Measurements

The coupons were desorbed at 150°F and a typical average desorption time history is presented in Figure 13 for the six ply graphite/epoxy coupon. Generally, there are 4 coupons taken from two panels and the data is averaged. The environmental history for the West Palm Beach exposed composite panels is listed in Section 7.2. The data for the three year exposed panels is documented in Section 7.2 for properties that will be referenced in this report. Section 7.2 (Table XV) contains the weather bureau data for WPB.

A summary of the moisture measurements for panels with two and three years exposure is presented in Table V. The desorption data for the tail rotor spar coupon is also listed in Table V for comparison.

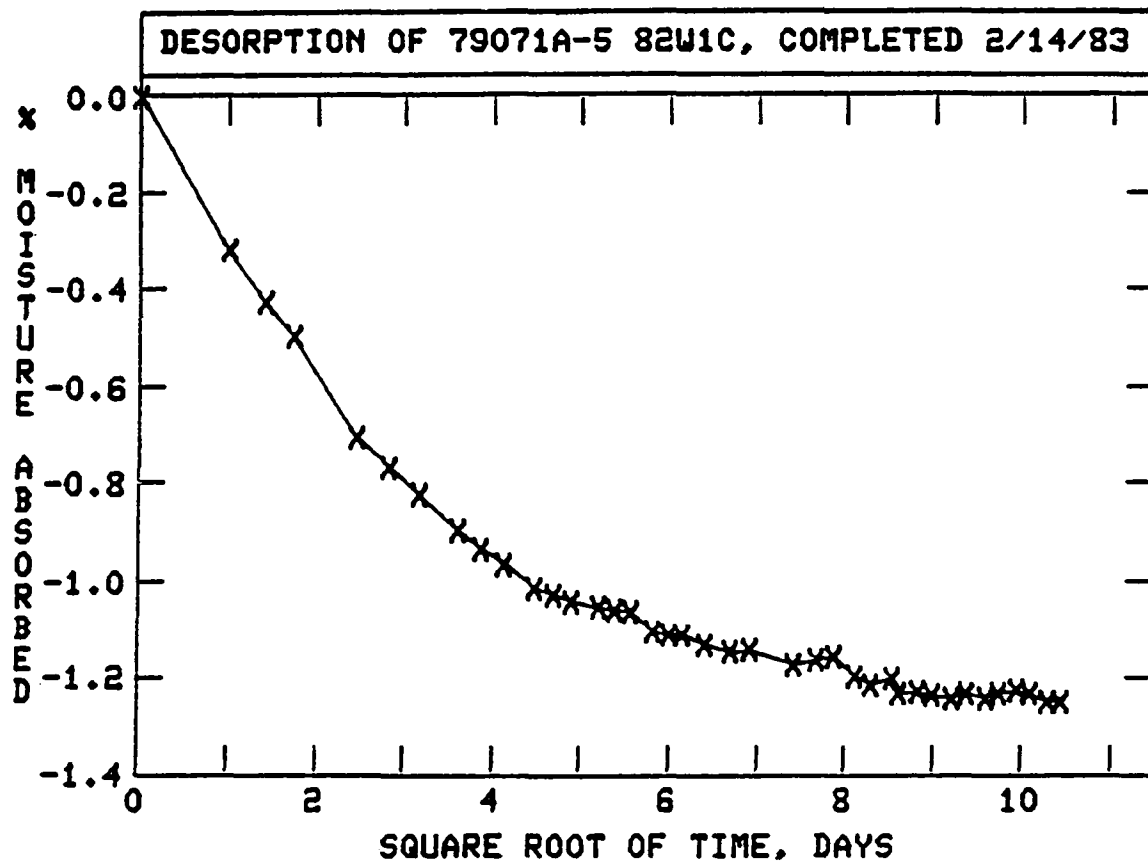


FIGURE 13. MOISTURE DESORPTION, 6 PLY, GRAPHITE/EPOXY SPECIMENS FROM WPB

TABLE V  
 Exposed Panel and In-service Spar Test  
 Coupon Moisture Values

| <u>Number of<br/>Plies</u> | <u>Material</u> | <u>Location</u> | <u>Moisture Absorbed,<br/>% Weight</u> |                |
|----------------------------|-----------------|-----------------|----------------------------------------|----------------|
|                            |                 |                 | <u>2 Years</u>                         | <u>3 Years</u> |
| 6                          | Gr/Ep           | WPB             | 1.02                                   | 1.22           |
| 6                          | Gr/Ep           | STFD            | .86                                    | 1.00           |
| 14                         | Gr/Ep           | STFD            | .37                                    | .46            |
| 33                         | Gr/Ep           | WPB             | .27                                    | .37            |
| 33                         | Gr/Ep           | STFD            | .18                                    | .23            |
| 14 (S/N 00150)*            | Gr/Ep           | Gulf Coast      |                                        | .55            |
| 14 (S/N 00283)*            | Gr/Ep           | Gulf Coast      |                                        | .46            |
| 5                          | Kevlar/Epoxy    | WPB             | 1.60                                   | 2.08           |
| 5                          | Kevlar/Epoxy    | STFD            | 1.53                                   | 1.74           |

\*Spar (S/N)

### 4.3 Analysis and Correlation

Moisture - time profiles were developed for panels and aircraft components. Local climatological data from exposure locations was used in predicting the expected moisture absorption. Figures 14, 15 and 16 show measured moisture values plotted on predicted moisture versus calendar time profiles for representative panel configurations. Solar radiation values were not available for all weathering locations, and were not included in the predicted moisture levels shown in Figures 15 and 16. Including the effects of solar radiation in the moisture prediction generally serves to reduce the local relative humidity, thereby reducing the predicted amount of absorbed moisture, as seen in Figure 14. In practice, there are difficulties collecting precise solar radiation readings and surface wind velocities which are used to determine solar effects. As seen in the figures, using the analysis without solar effects, the measured values when plotted on the curves of predicted moisture versus calendar time fall within an acceptable range of scatter especially for the graphite/epoxy panels. Deviation is expected, owing in part, to variations in flight hours. Larger scatter is exhibited in the profiles for the Stratford weathering locations, which is attributed to the additional factor of snowfall.

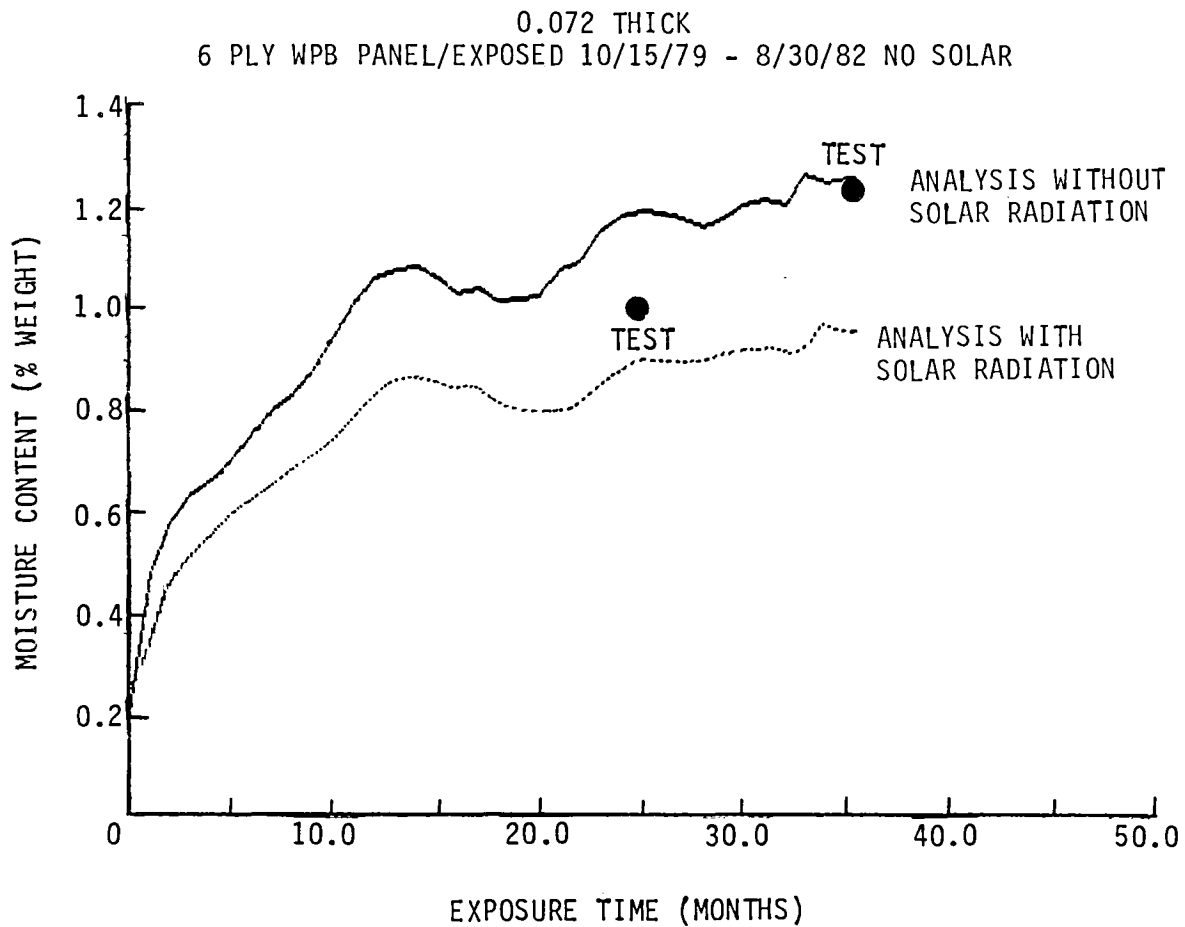


FIGURE 14. MOISTURE ABSORPTION, 6 PLY GRAPHITE/EPOXY  
PANEL EXPOSED AT WPB

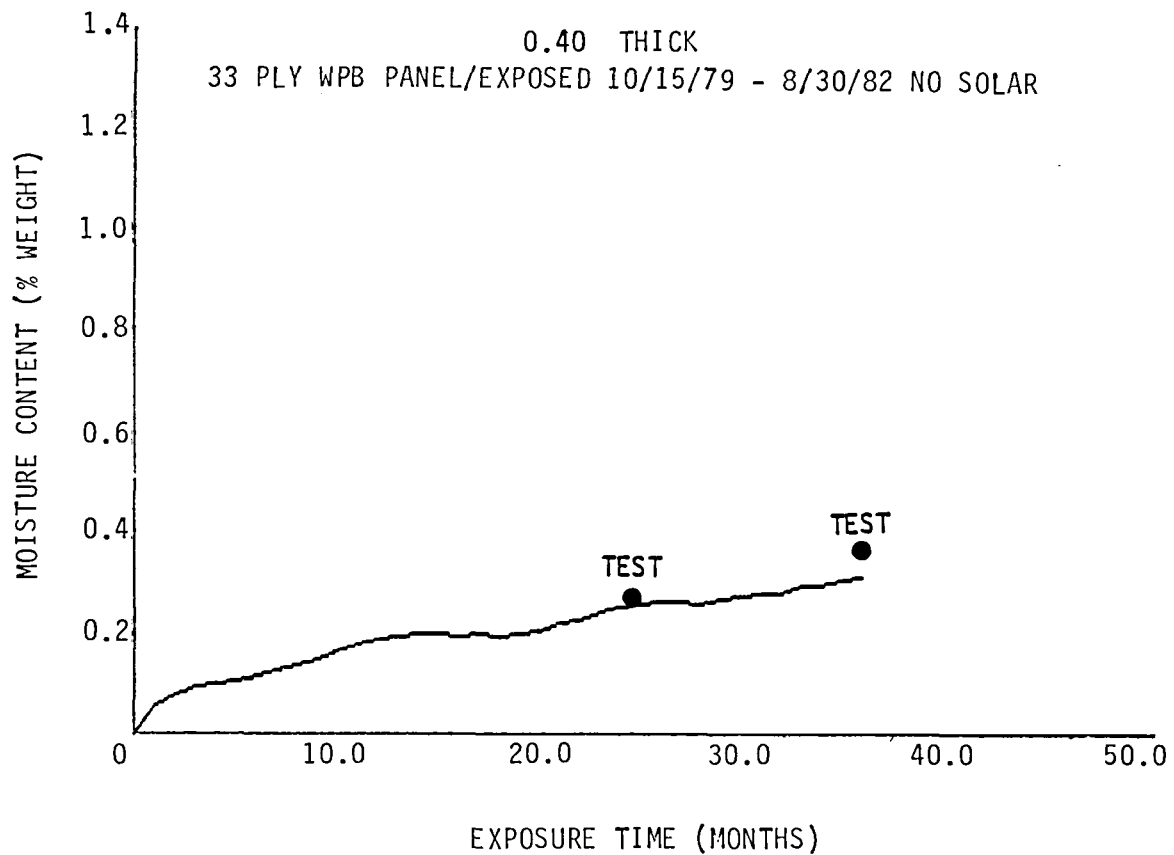


FIGURE 15. MOISTURE ABSORPTION, 33 PLY GRAPHITE/EPOXY  
PANEL EXPOSED AT WPB

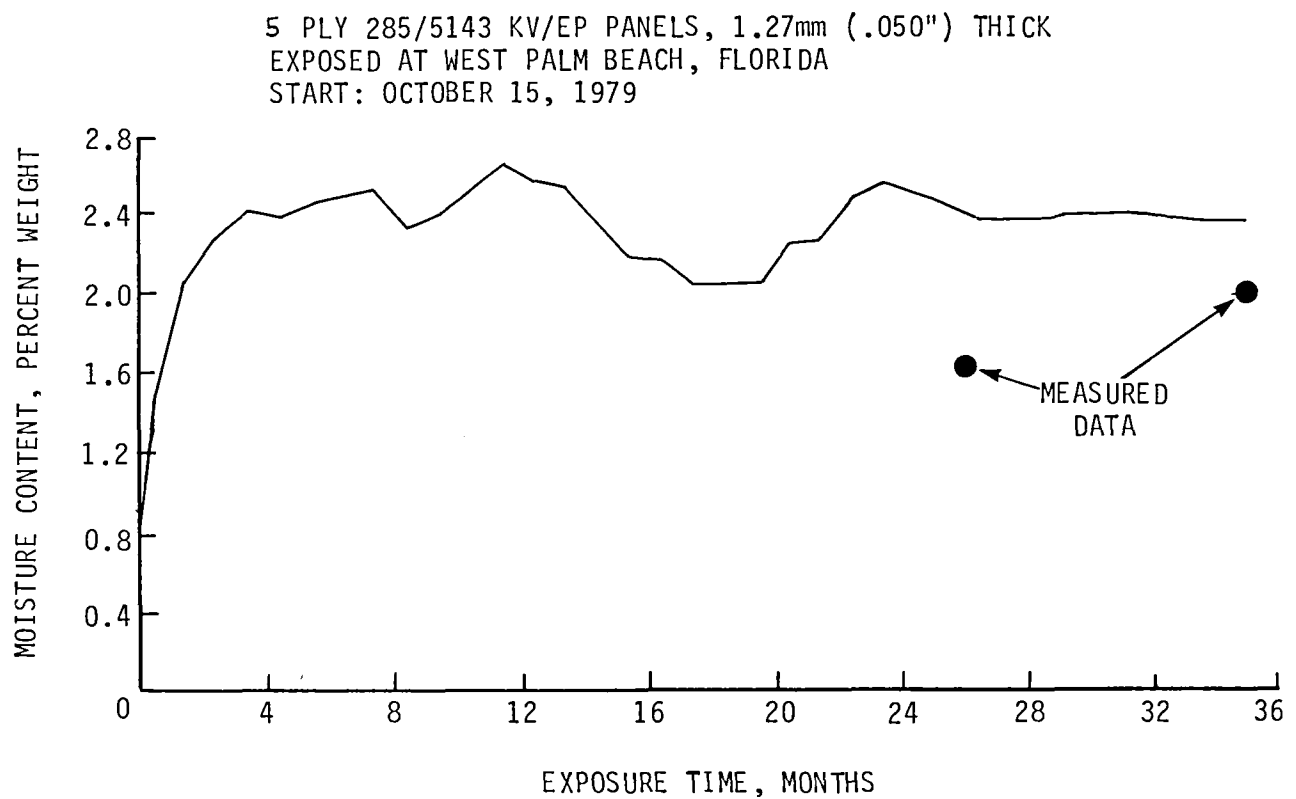


FIGURE 16. MOISTURE ABSORPTION FOR KEVLAR/EPOXY PANELS, WPB

## 4.4 Coupon Strength Tests

### 4.4.1 Static Strength

The static strengths of the graphite/epoxy and Kevlar/epoxy coupons are summarized in Table VI. The important aspects are the trend of strength with absorbed moisture and the comparison with the initial baseline data used for design.

The SBS static strength for the exposed panels closely follows the trend used for design as shown in Figure 17. The flex static strength, shown in Figure 18 indicates a higher strength than predicted.

Overall, the environmental factors for static strength, shown in Table VII, agree closely with predicted values used for design.

### 4.4.2 Fatigue Strength

The SBS fatigue data for the 33 ply coupons is presented in Figures 19 to 21 for the original baseline, two and three years exposure. In addition, coupons were taken from tail rotor spars S/N 00150 and 00283 and such data is presented in Figures 22 to 25. The data is compared in Figure 26 for the fatigue strength versus moisture. A conservative environmental factor of .8 was used for the full scale test evaluation and corresponded to a projected 1.1% moisture content. The environmental factor (EF) line is then a linear reduction from the RTD baseline fatigue strength and the .8 value at 1.1% moisture. The data of coupons from exposed panels and in-service spars lies above the EF line and therefore indicates that the fatigue strength projections are conservative. This environmental factor (EF) line was obtained from interlaminar shear fatigue strength for AS1/6350 Graphite. The strength was found to be a linear function of the absorbed moisture level. The ratio of fatigue strength (at moisture level) to room temperature dry (RTD) fatigue strength is given in Reference 1, Figure 7.

TABLE VI  
 SUMMARY OF COUPON TEST RESULTS

| Test/<br>Number of<br>Specimens,<br>Material | Plies | Strength<br>MP <sub>a</sub> (KSI) |         | ΔM<br>% Wgt | Exposure                          |
|----------------------------------------------|-------|-----------------------------------|---------|-------------|-----------------------------------|
| SBS/23, G/E                                  | 8     | 110.3                             | (16.0)  | .2          | Original RTD Baseline<br>(Design) |
| SBS/19, G/E                                  | 6     | 113.1                             | (16.4)  | .2          | RTD Baseline (Panel<br>Coupons)   |
| SBS/37, G/E                                  | 6     | 93.8                              | (13.6)  | 1.02        | 2 yrs WPB                         |
| SBS/18, G/E                                  | 6     | 100.7                             | (14.6)  | .86         | 2 yrs STFD                        |
| SBS/36, G/E                                  | 6     | 88.3                              | (12.8)  | 1.22        | 3 yrs WPB                         |
| SBS/36, G/E                                  | 6     | 93.8                              | (13.6)  | 1.00        | 3 yrs STFD                        |
| SBS/17, G/E                                  | 33*   | 86.9                              | (12.6)  | 0           | RTD Baseline (Panel<br>Coupons)   |
| SBS/15, G/E                                  | 33*   | 84.1                              | (12.2)  | .27         | 2 yrs WPB                         |
| SBS/15, G/E                                  | 33*   | 83.4                              | (12.1)  | .18         | 2 yrs STFD                        |
| SBS/15, G/E                                  | 33*   | 77.9                              | (11.3)  | .37         | 3 yrs WPB                         |
| SBS/15, G/E                                  | 33*   | 75.9                              | (11.0)  | .23         | 3 yrs STFD                        |
| FLEX/20, G/E                                 | 6     | 1696.5                            | (246.0) | .2          | RTD Baseline (Panel<br>Coupons)   |
| FLEX/33, G/E                                 | 6     | 1897.2                            | (275.1) | 1.02        | 2 yrs WPB                         |
| FLEX/12, G/E                                 | 6     | 1877.2                            | (272.2) | .86         | 2 yrs STFD                        |
| FLEX/36, G/E                                 | 6     | 1698.6                            | (246.3) | 1.22        | 3 yrs WPB                         |
| FLEX/36, G/E                                 | 6     | 1682.7                            | (244.0) | 1.00        | 3 yrs STFD                        |
| FLEX/18, G/E                                 | 33*   | 1209.3                            | (175.4) | 0           | RTD Baseline<br>(Panel Coupons)   |
| FLEX/18, G/E                                 | 33*   | 1246.6                            | (180.8) | .27         | 2 yrs WPB                         |
| FLEX/18, G/E                                 | 33*   | 1260.3                            | (182.8) | .18         | 2 yrs STFD                        |
| FLEX/12, G/E                                 | 33*   | 1185.5                            | (171.9) | .37         | 3 yrs WPB                         |
| FLEX/12, G/E                                 | 33*   | 1235.2                            | (179.1) | .23         | 3 yrs STFD                        |
| TEN./18, K/E                                 | 5     | 631.5                             | (91.6)  | .70         | RTD Baseline (Panel<br>Coupons)   |
| TEN./10, K/E                                 | 5     | 632.4                             | (91.7)  | 1.60        | 2 yrs WPB                         |
| TEN./9, K/E                                  | 5     | 666.9                             | (96.7)  | 1.53        | 2 yrs STFD                        |
| TEN./7, K/E                                  | 5     | 677.0                             | (98.2)  | 2.08        | 3 yrs WPB                         |
| TEN./7, K/E                                  | 5     | 667.3                             | (96.8)  | 1.74        | 3 yrs STFD                        |

\*Includes cross plies

TABLE VII. SUMMARY OF EXPOSED PANEL STRENGTH ENVIRONMENTAL FACTORS

| Exposure Location                | Number of Plies | Material       | Measured Moisture, % Wgt | Environmental Factors, Room Temperature |             |             |                |
|----------------------------------|-----------------|----------------|--------------------------|-----------------------------------------|-------------|-------------|----------------|
|                                  |                 |                |                          | SBS Static                              | SBS Fatigue | Flex Static | Tension Static |
| Stratford Conn.<br>2 Years       | 6               | Graphite/Epoxy | .86                      | .89                                     | -           | .88         | -              |
|                                  | 14              | Graphite/Epoxy | .37                      | .90                                     | .91         | .95         | -              |
|                                  | 33              | Graphite/Epoxy | .18                      | .96                                     | 1.05        | 1.04        | -              |
|                                  | 5               | Kevlar/Epoxy   | 1.53                     | -                                       | -           | -           | 1.05           |
| West Palm Beach, Fla.<br>2 Years | 6               | Graphite/Epoxy | 1.02                     | .86                                     | -           | .84         | -              |
|                                  | 33              | Graphite/Epoxy | .27                      | .97                                     | 1.02        | 1.03        | -              |
|                                  | 5               | Kevlar/Epoxy   | 1.61                     | -                                       | -           | -           | 1.00           |
| Stratford Conn.<br>3 Years       | 6               | Graphite/Epoxy | 1.00                     | .83                                     | -           | .79         | -              |
|                                  | 14              | Graphite/Epoxy | .48                      | .81                                     | -           | 1.02        | -              |
|                                  | 33              | Graphite/Epoxy | .23                      | .87                                     | -           | 1.02        | -              |
|                                  | 5               | Kevlar/Epoxy   | 1.72                     | -                                       | -           | -           | 1.02           |
| West Palm Beach, Fla.<br>3 Years | 6               | Graphite/Epoxy | 1.22                     | .78                                     | -           | .80         | -              |
|                                  | 33              | Graphite/Epoxy | .37                      | .89                                     | .95         | .98         | -              |
|                                  | 5               | Kevlar/Epoxy   | 2.08                     | -                                       | -           | -           | 1.02           |

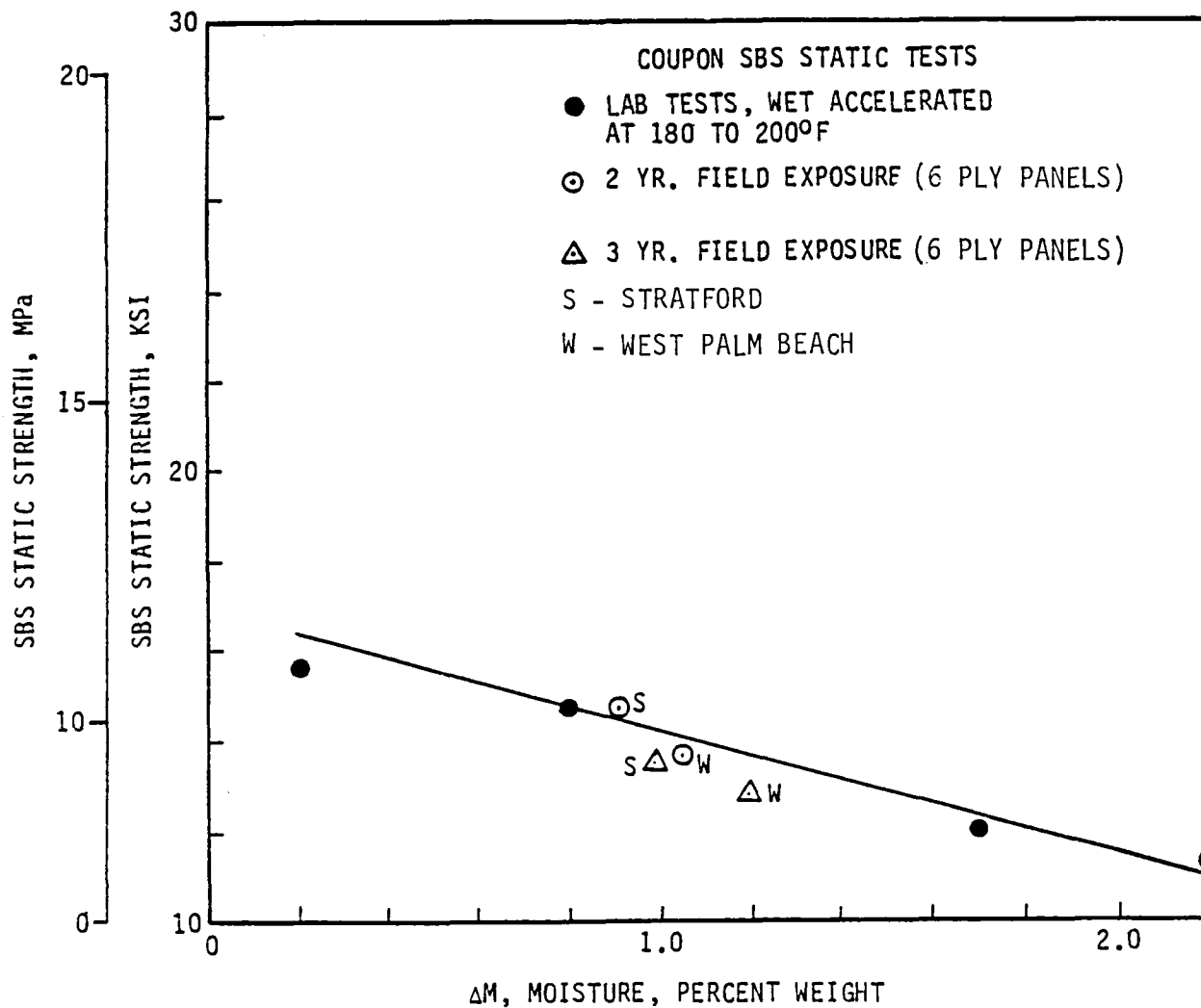


FIGURE 17. REDUCTION OF SBS STATIC STRENGTH WITH MOISTURE, GRAPHITE/EPOXY

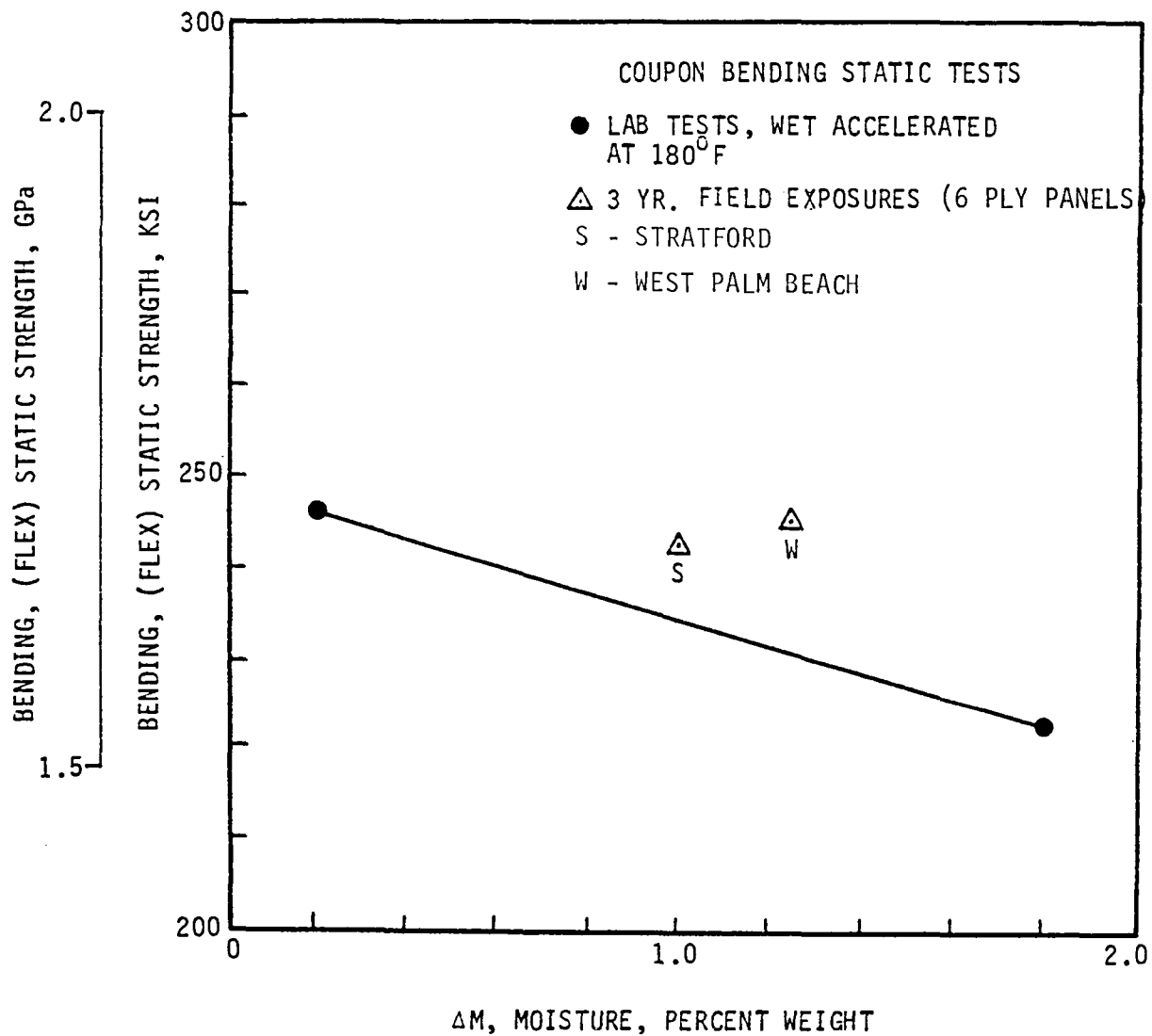


FIGURE 18. AFFECT OF MOISTURE CONTENT ON BENDING STRENGTH, GRAPHITE/EPOXY

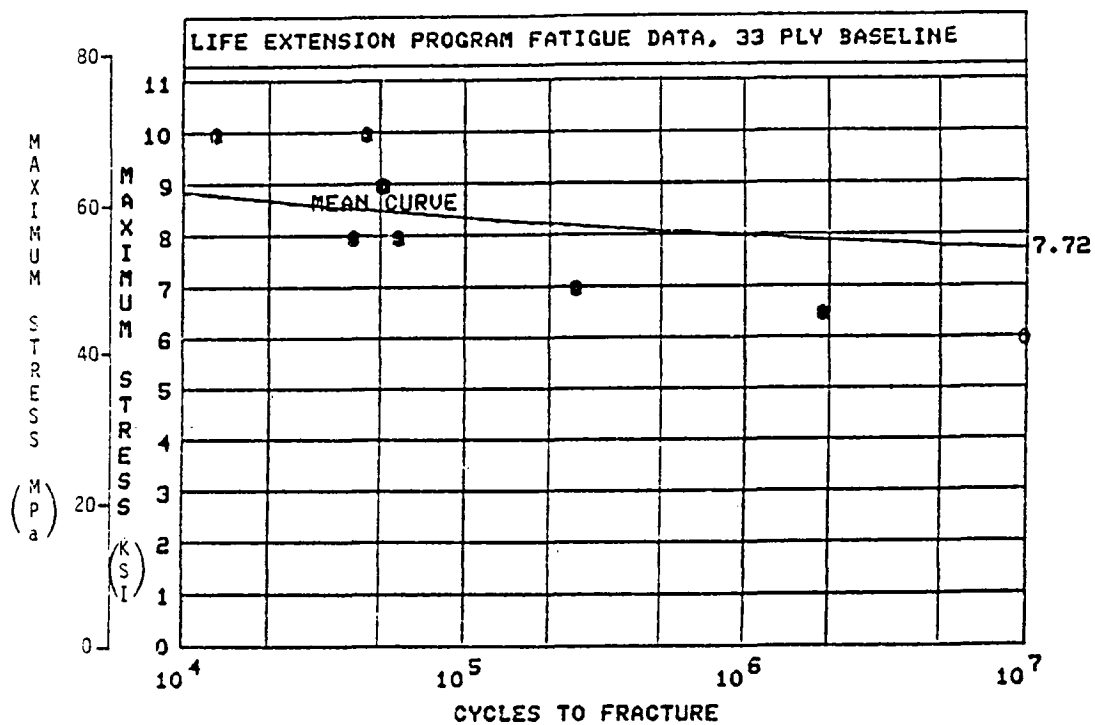


FIGURE 19. SBS FATIGUE STRENGTH, 33 PLY PANELS, BASELINE

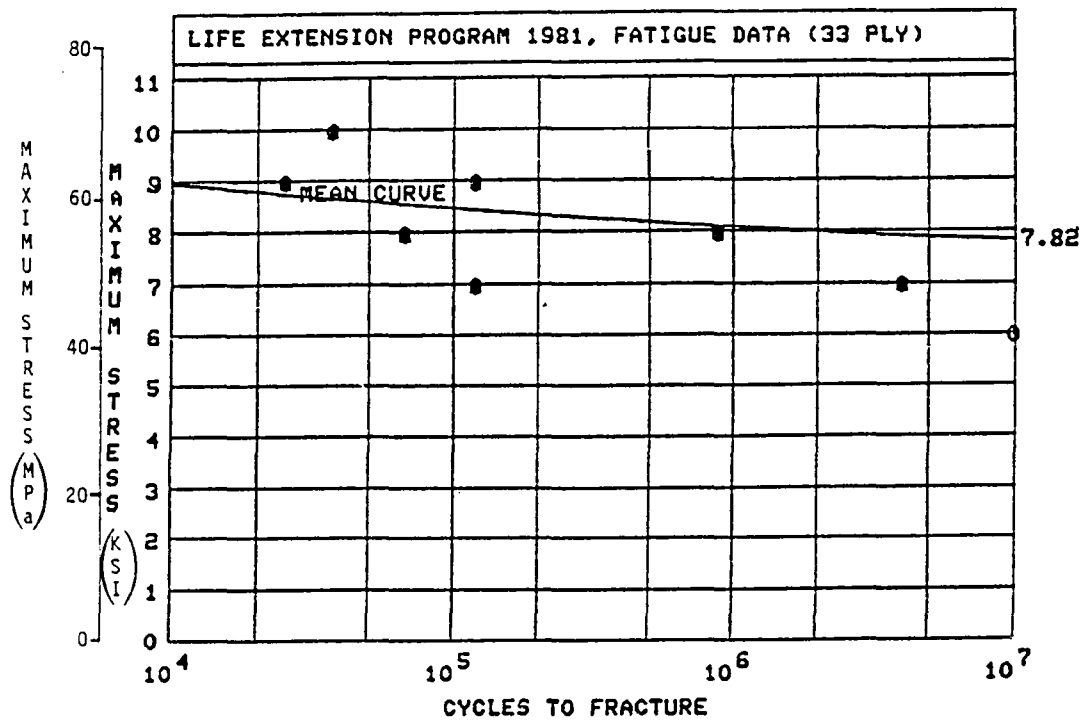


FIGURE 20. SBS FATIGUE STRENGTH, 33 PLY PANELS, EXPOSED 2 YEARS, WPB

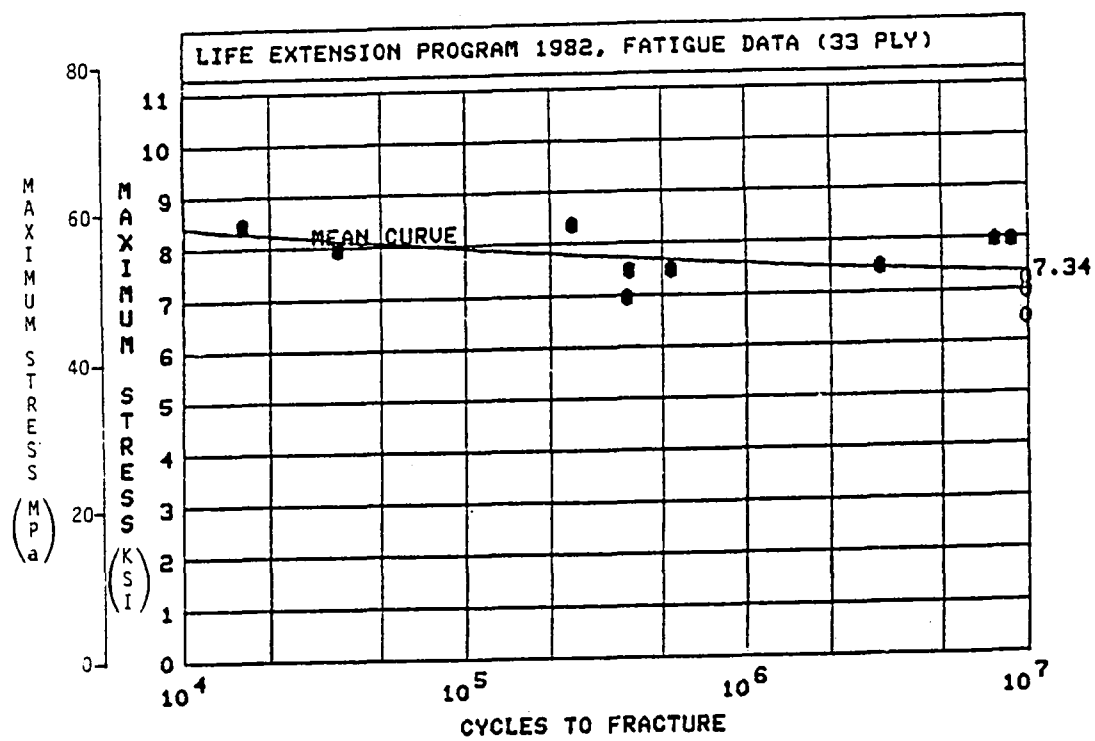


FIGURE 21. SBS FATIGUE STRENGTH, 33 PLY PANELS, EXPOSED 3 YEARS, WPB

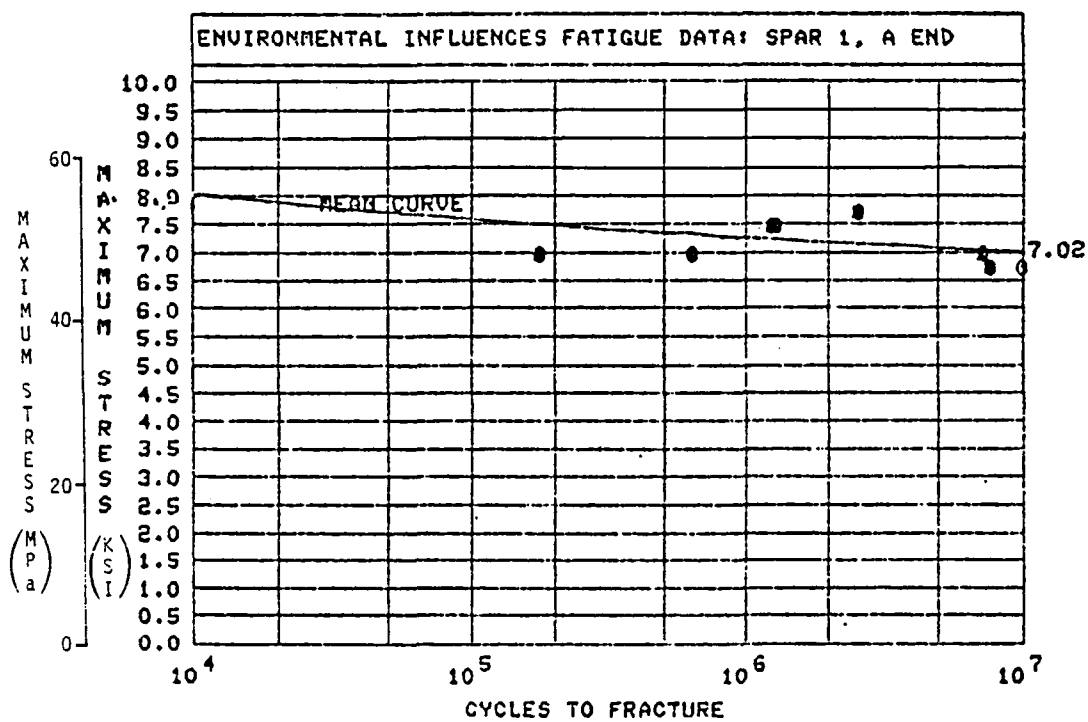


FIGURE 22. COUPON FATIGUE STRENGTH, SPAR A-116-00150, A END

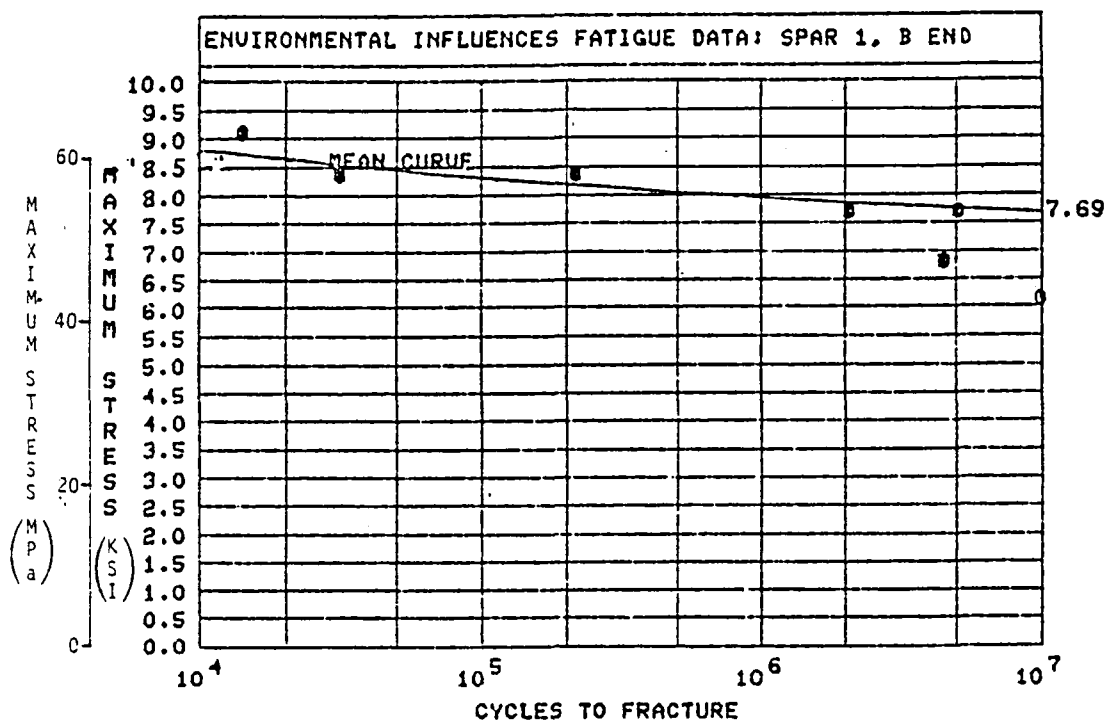


FIGURE 23. COUPON FATIGUE STRENGTH, SPAR A-116-00150, B END

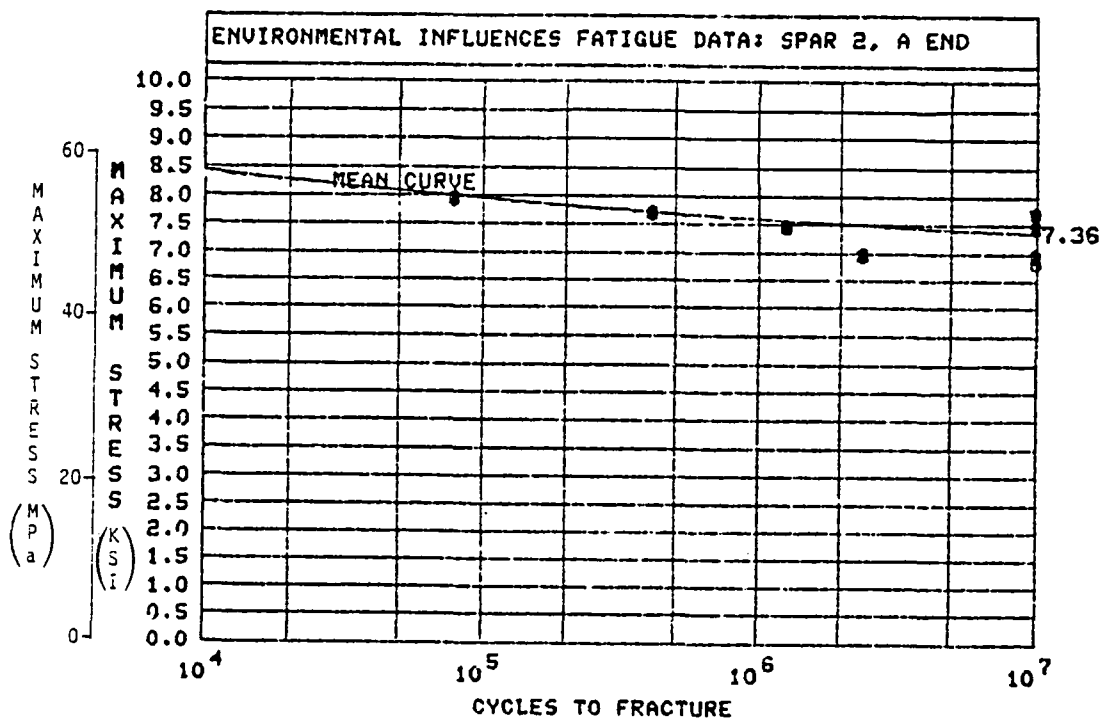


FIGURE 24. COUPON FATIGUE STRENGTH, SPAR A-116-00283, A END

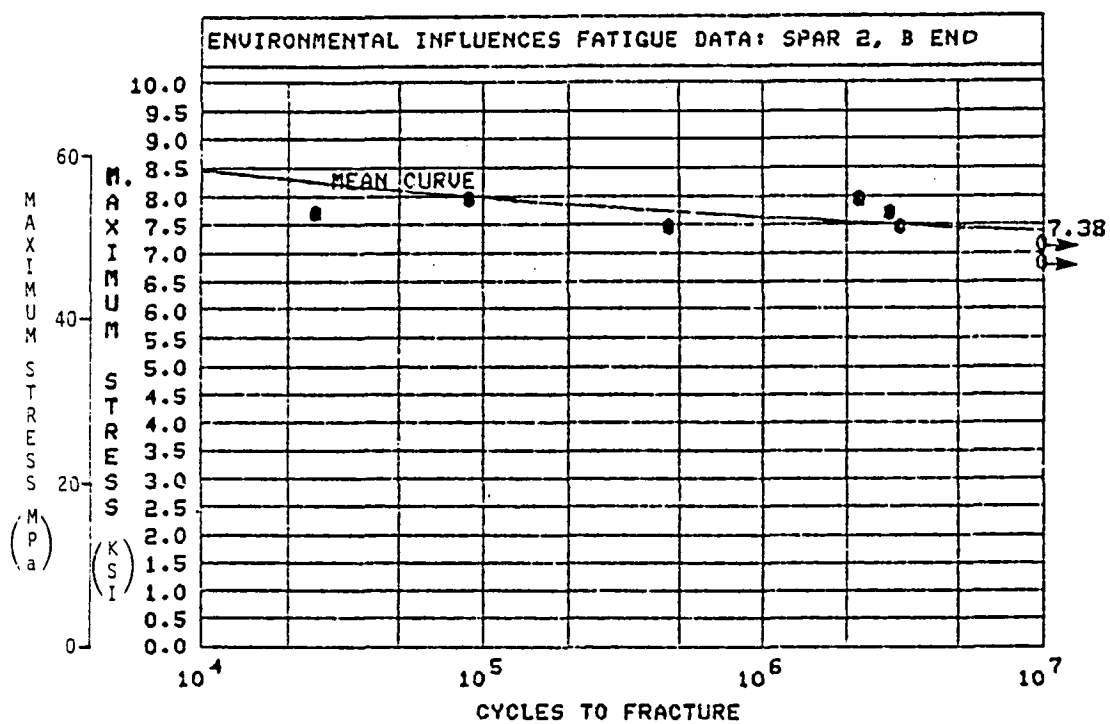


FIGURE 25. COUPON FATIGUE STRENGTH, SPAR A-116-00283, B END

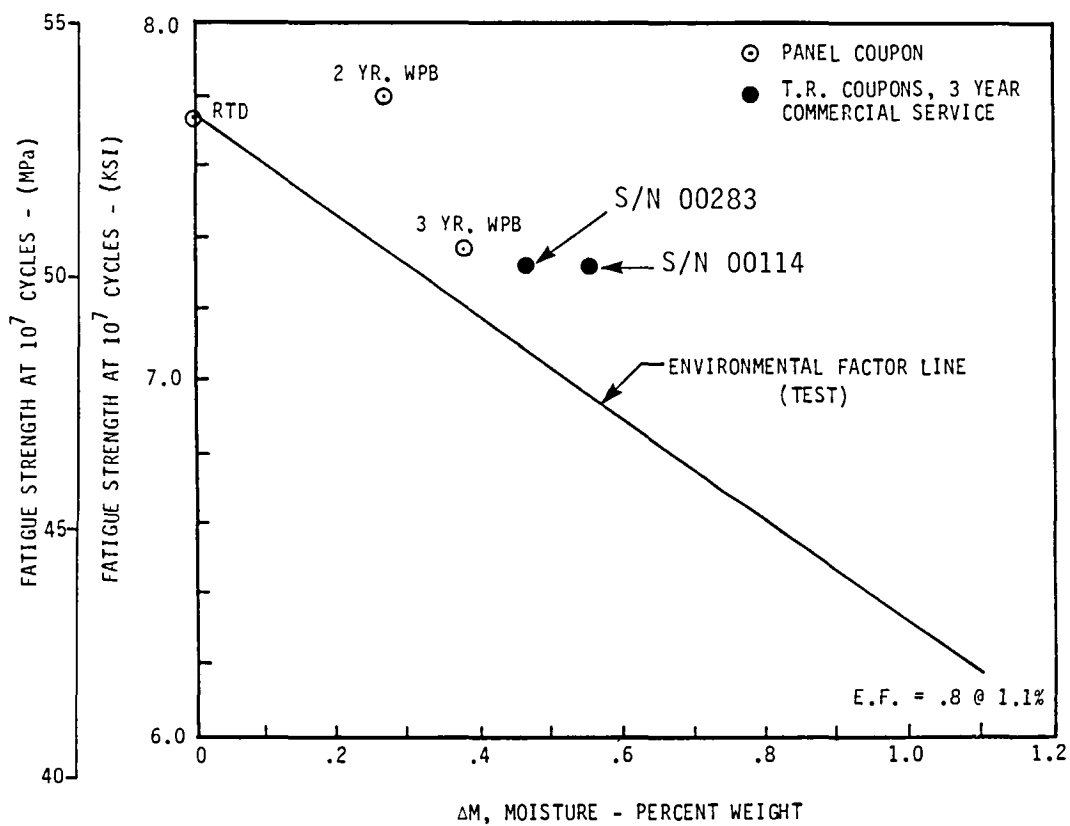


FIGURE 26. CORRELATION OF SBS FATIGUE ENVIRONMENTAL FACTOR

## SECTION 5.0 ANALYSIS OF TEST RESULTS

The three year exposed panels at Stratford, Connecticut and West Palm Beach, Florida have provided real time moisture contents. Coupon tests from the exposed panels have been compared with RTD unexposed tests to determine environmental factors. The in-service components have provided measurements of moisture contents and strength tests for comparison with initial unexposed tested components. These data are assessed in the following paragraphs for their implications regarding environmental factors previously described.

The analysis of test results will be limited, at this time, due to the calendar life and service time of the in-service components. However, the available data will indicate trends. Future work in this program is expected to form a more quantitative relationship on the effects of environment on in-service components.

### 5.1 Exposed Panel Data

In general, the exposed panels appear to absorb moisture close to that predicted by an environmental analysis using ambient RH only, as shown in Figures 14, 15, and 16 for the West Palm Beach Region.

A comparison of environmental factors derived from lab conditions and field exposure is presented in Figure 27.

The environmental factor (EF) is defined as the ratio of conditioned (field or lab) strength to the RTD strength. Figure 27 compares the field exposed EF with those determined from accelerated lab conditioning.

### 5.2 In-Service Component Data

The tail rotor spar fatigue test data for the three year in-service spar, S/N 00172, closely groups with previous two year field exposed components as illustrated in Figure 11. For spar S/N 00237, also a three year in-service spar, the fatigue test data is slightly above the mean of 20 RTD baseline spar tests as shown in Figure 11. The fatigue data for the four year in-service spar, S/N 00114, is also slightly above the mean baseline data.

The environmental factors for graphite/epoxy panels, exposed for three years, compares well with the environmental factors for two year exposed panels shown in Reference 1, Figure 31. The environmental factors for the Kevlar/epoxy panels, exposed for three years also compares well with the panels exposed for two years.

The strength graphite/epoxy panels exposed two and three years is groups close to the field exposed-lab environmental line. The Kevlar strength for two and three year exposures are grouped slightly above the line.

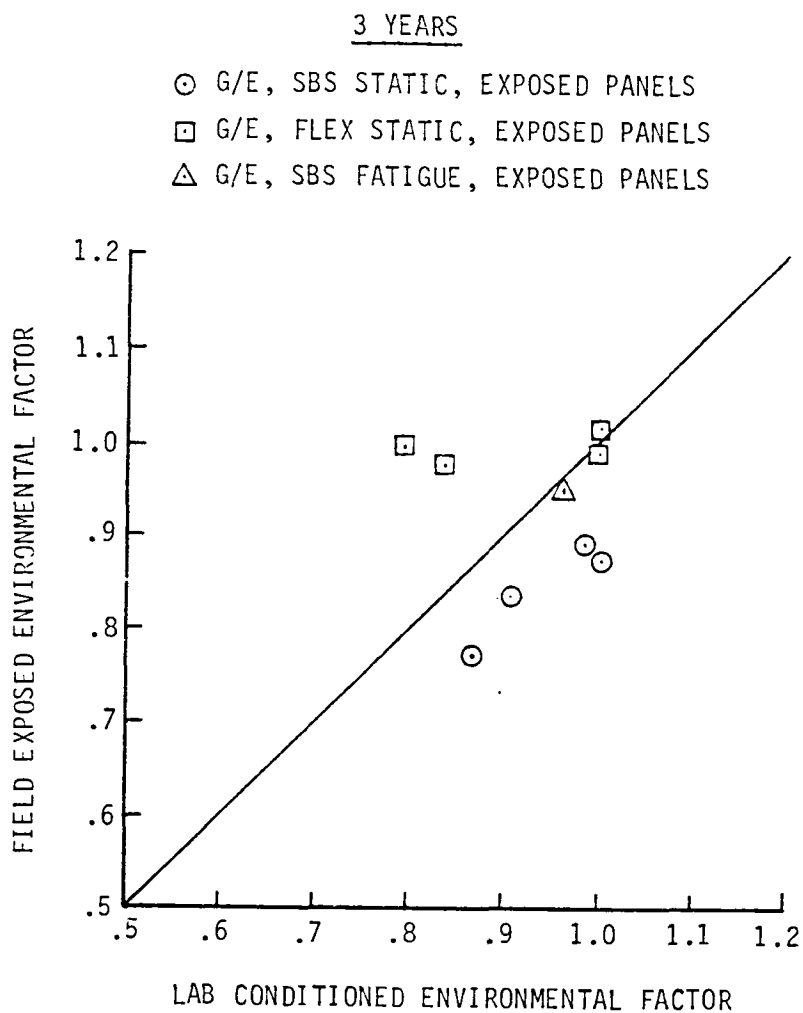


FIGURE 27. COMPARISON OF ENVIRONMENTAL FACTORS FOR FIELD EXPOSED AND LABORATORY CONDITIONED COUPONS.

## SECTION 6.0 CONCLUSIONS

### 6.1 Conclusions

The following conclusions are based on the results of approximately three and four year in-service tail rotor spars and three year exposed panel.

1. The fatigue strength retention for the three year tail rotor spars (S/N 00172 and 00237) appears to be the same as the laboratory conditioned coupons. The fatigue strengths for the three year tail rotor (S/N 00237) and the four year tail rotor spar (S/N 00114) appear to be of equal fatigue strength and close to the baseline spar fatigue data.
2. From the three year exposed material evaluation tests, it is concluded that the moisture absorption (in the most humid region) is close to the predictions using ambient RH alone. The affect on strength varies. Graphite/epoxy fatigue strength retention appears to be the same for lab condition coupons. Graphite/epoxy static shear strength is a little less than expected and the flexure strength is slightly higher than expected. Kevlar/epoxy static strength is also slightly higher than expected.

## SECTION 7.0 APPENDIX

Detailed data is contained in this appendix for future reference or analysis review.

### 7.1 Environmental Histories, Tail Rotor Spars

|            |                  |
|------------|------------------|
| Table VIII | Spar A-116-00150 |
| Table IX   | Spar A-116-00283 |
| Table X    | Spar A-116-00237 |
| Table XI   | Spar A-116-00172 |

TABLE VIII

SPAR S/N A-116-00150 (PADDLE S/N A-137-00085)

SUMMARY OF ENVIRONMENTAL HISTORY

Total Hours 2385

| DATE                | AVERAGE<br>TEMPERATURE |      | AVERAGE<br>RELATIVE HUMIDITY<br>% |
|---------------------|------------------------|------|-----------------------------------|
|                     | °C                     | °F   |                                   |
| 10/01/79 - 10/30/79 | 20.4                   | 68.9 | 79.0 installed<br>10/22/79        |
| 11/01/79 - 11/31/79 | 12.4                   | 54.4 | 75.4                              |
| 12/01/79 - 12/31/79 | 10.3                   | 50.5 | 78.1                              |
| 1/01/80 - 1/31/80   | 11.9                   | 53.4 | 86.4                              |
| 2/01/80 - 2/29/80   | 10.3                   | 50.6 | 80.5                              |
| 3/01/80 - 3/31/80   | 15.2                   | 59.4 | 81.4                              |
| 4/01/80 - 4/30/80   | 18.4                   | 65.1 | 76.5                              |
| 5/01/80 - 5/31/80   | 23.7                   | 74.8 | 83.9                              |
| 6/01/80 - 6/30/80   | 27.0                   | 80.8 | 80.3                              |
| 7/01/80 - 7/31/80   | 28.2                   | 82.8 | 72.5                              |
| 8/01/80 - 8/31/80   | 27.4                   | 81.3 | 74.0                              |
| 9/01/80 - 9/30/80   | 26.3                   | 79.4 | 79.3                              |
| 10/01/80 - 10/30/80 | 18.0                   | 64.4 | 69.8                              |
| 11/01/80 - 11/30/80 | 12.6                   | 54.8 | 78.0                              |
| 12/01/80 - 12/31/80 | 10.7                   | 51.3 | 75.0                              |

TABLE VIII (Cont'd)

SPAR S/N A-116-00150 (PADDLE S/N A-137-00085)

| DATE                | AVERAGE<br>TEMPERATURE |      | AVERAGE<br>RELATIVE HUMIDITY |                     |
|---------------------|------------------------|------|------------------------------|---------------------|
|                     | °C                     | °F   | %                            |                     |
| 1/01/81 - 1/31/81   | 8.2                    | 46.8 | 73.5                         |                     |
| 2/01/81 - 2/28/81   | 11.1                   | 52.0 | 74.0                         |                     |
| 3/01/81 - 3/31/81   | 14.9                   | 58.9 | 66.4                         |                     |
| 4/01/81 - 4/30/81   | 21.4                   | 70.5 | 76.1                         |                     |
| 5/01/81 - 5/31/81   | 22.5                   | 72.6 | 73.3                         |                     |
| 6/01/81 - 6/31/81   | 26.8                   | 80.3 | 82.1                         |                     |
| 7/01/81 - 7/31/81   | 27.3                   | 81.1 | 81.8                         |                     |
| 8/01/81 - 8/31/81   | 26.9                   | 80.5 | 79.3                         |                     |
| 9/01/81 - 9/30/81   | 23.8                   | 74.8 | 77.3                         |                     |
| 10/01/81 - 10/31/81 | 20.0                   | 68.1 | 79.1                         |                     |
| 11/01/81 - 11/30/81 | 16.3                   | 60.9 | 80.9                         |                     |
| 12/01/81 - 12/31/81 | 11.4                   | 52.5 | 73.4                         |                     |
| 1/01/82 - 1/31/82   | 11.1                   | 51.9 | 76.9                         |                     |
| 2/01/82 - 2/28/82   | 10.8                   | 51.4 | 78.4                         |                     |
| 3/01/82 - 3/31/82   | 16.9                   | 62.5 | 82.6                         |                     |
| 4/01/82 - 4/30/82   | 18.9                   | 66.1 | 80.1                         |                     |
| 5/01/82 - 5/31/82   | 23.2                   | 73.8 | 82.1                         | Removed<br>5/18/82. |
| 6/01/82 - 6/30/82   | 26.4                   | 79.6 | 82.4                         | Kept out-<br>side.  |
| 7/01/82 - 7/31/82   | 27.2                   | 80.9 | 80.8                         |                     |
| 8/01/82 - 8/31/82   | 26.9                   | 80.5 | 78.8                         |                     |
| 9/01/82 - 9/30/82   | 24.2                   | 75.6 | 75.5                         | Shipped<br>11/16/82 |
| 10/01/82 - 10/30/82 | 21.2                   | 68.3 | 70.9                         |                     |
| 11/01/82 - 11/30/82 | 16.4                   | 61.5 | 74.3                         |                     |

Shipped by Air Log to Sikorsky 11/16/82  
 Received at Sikorsky 12/6/82

TABLE IX

SPAR S/N A-116-00283 (PADDLE S/N A-137-00099)

SUMMARY OF ENVIRONMENTAL HISTORY

Total Hours 1884

| DATE                | AVERAGE<br>TEMPERATURE             |      | AVERAGE<br>RELATIVE HUMIDITY<br>% |
|---------------------|------------------------------------|------|-----------------------------------|
|                     | °C                                 | °F   |                                   |
| 10/01/79 - 10/30/79 | 20.4                               | 68.9 | 79.0 Installed<br>10/23/79.       |
| 11/01/79 - 11/31/79 | 12.4                               | 54.4 | 75.4                              |
| 12/01/79 - 12/31/79 | 10.3                               | 50.5 | 78.1                              |
| 1/01/80 - 1/31/80   | 11.9                               | 53.4 | 86.4                              |
| 2/01/80 - 2/29/80   | 10.3                               | 50.6 | 80.5                              |
| 3/01/80 - 3/31/80   | 15.2                               | 59.4 | 81.4                              |
| 4/01/80 - 4/30/80   | 18.4                               | 65.1 | 76.5                              |
| 5/01/80 - 5/31/80   | 23.7                               | 74.8 | 83.9                              |
| 6/01/80 - 6/30/80   | 27.0                               | 80.8 | 80.3                              |
| 7/01/80 - 7/31/80   | 28.2                               | 82.8 | 72.5 Removed for<br>repair.       |
| 8/01/80 - 8/31/80   | 27.4                               | 81.3 | 74.0 Shipped<br>8/22/80.          |
| 9/01/80 - 9/30/80   | 20.3                               | 68.6 | 68.4 Held in Bpt.<br>9/23/80.     |
| 10/01/80 - 10/30/80 | 65-80°F, R.H. not to<br>exceed 60% |      | In repair station.                |
| 11/01/80 - 11/30/80 |                                    |      |                                   |
| 12/01/80 - 12/31/80 |                                    |      |                                   |

TABLE IX (Cont'd)

SPAR S/N A-116-00283 (PADDLE S/N A-137-00099)

| DATE                | AVERAGE<br>TEMPERATURE        |      | AVERAGE<br>RELATIVE HUMIDITY<br>%                         |
|---------------------|-------------------------------|------|-----------------------------------------------------------|
|                     | °C                            | °F   |                                                           |
| 1/01/81 - 1/31/81   | Use blade shop<br>conditions. |      | In blade repair<br>station.                               |
| 2/01/81 - 2/28/81   |                               |      |                                                           |
| 3/01/81 - 3/31/81   |                               |      |                                                           |
| 4/01/81 - 4/30/81   | 21.4                          | 70.5 | 76.1 Repair com-<br>plete 4/10/81,<br>shipped<br>4/25/81. |
| 5/01/81 - 5/31/81   | 22.5                          | 72.6 | 73.3                                                      |
| 6/01/81 - 6/31/81   | 26.8                          | 80.3 | 82.1                                                      |
| 7/01/81 - 7/31/81   | 27.3                          | 81.1 | 81.8                                                      |
| 8/01/81 - 8/31/81   | 26.9                          | 80.5 | 79.3                                                      |
| 9/01/81 - 9/30/81   | 23.8                          | 74.8 | 77.3                                                      |
| 10/01/81 - 10/31/81 | 20.0                          | 68.1 | 79.1                                                      |
| 11/01/81 - 11/30/81 | 16.3                          | 60.9 | 80.9                                                      |
| 12/01/81 - 12/31/81 | 11.4                          | 52.5 | 73.4                                                      |
| 1/01/82 - 1/31/82   | 11.1                          | 51.9 | 76.9                                                      |
| 2/01/82 - 2/28/82   | 10.8                          | 51.4 | 78.4                                                      |
| 3/01/82 - 3/31/82   | 16.9                          | 62.5 | 82.6                                                      |
| 4/01/82 - 4/30/82   | 18.9                          | 66.1 | 80.1                                                      |
| 5/01/82 - 5/31/82   | 23.2                          | 73.8 | 82.1                                                      |
| 6/01/82 - 6/30/82   | 26.4                          | 79.6 | 82.4                                                      |
| 7/01/82 - 7/31/82   | 27.2                          | 80.9 | 80.8                                                      |
| 8/01/82 - 8/31/82   | 26.9                          | 80.5 | 78.8                                                      |
| 9/01/82 - 9/30/82   | 24.2                          | 75.6 | 75.5                                                      |
| 10/01/82 - 10/30/82 | 21.2                          | 68.3 | 70.9                                                      |
| 11/01/82 - 11/30/82 | 16.4                          | 61.5 | 74.3 Shipped<br>11/16/82.                                 |

Shipped by Air Log to Sikorsky 11/16/82  
 Received at Sikorsky 12/6/82

TABLE X

SPAR S/N A-116-00237 (PADDLE S/N A-137-00068)

SUMMARY OF ENVIRONMENTAL HISTORY

Total Hours 1596. Sent as spare with A/C S/N 760003 3/79, and kept in non-conditioned hangar.

| DATE                | AVERAGE TEMPERATURE |      | AVERAGE RELATIVE HUMIDITY |
|---------------------|---------------------|------|---------------------------|
|                     | °C                  | °F   | %                         |
| 3/01/79 - 3/31/79   | 15.9                | 60.7 | 74.5 shipped as spare     |
| 4/01/79 - 4/30/79   | 20.0                | 68.1 | 80.5                      |
| 5/01/79 - 5/31/79   | 22.4                | 72.3 | 78.6                      |
| 6/01/79 - 6/30/79   | 26.0                | 78.9 | 78.4                      |
| 7/01/79 - 7/31/79   | 26.8                | 80.3 | 85.4                      |
| 8/01/79 - 8/31/79   | 26.6                | 80.0 | 83.8                      |
| 9/01/79 - 9/30/79   | 23.6                | 74.7 | 80.3                      |
| 10/01/79 - 10/30/79 | 20.4                | 68.9 | 79.0                      |
| 11/01/79 - 11/31/79 | 12.4                | 54.4 | 75.4                      |
| 12/01/79 - 12/31/79 | 10.3                | 50.5 | 78.1                      |
| 1/01/80 - 1/31/80   | 11.9                | 53.4 | 86.4                      |
| 2/01/80 - 2/29/80   | 10.3                | 50.6 | 80.5                      |
| 3/01/80 - 3/31/80   | 15.2                | 59.4 | 81.4                      |
| 4/01/80 - 4/30/80   | 18.4                | 65.1 | 76.5                      |
| 5/01/80 - 5/31/80   | 23.7                | 74.8 | 83.9 installed            |
| 6/01/80 - 6/30/80   | 27.0                | 80.8 | 80.3                      |
| 7/01/80 - 7/31/80   | 28.2                | 82.8 | 72.5                      |
| 8/01/80 - 8/31/80   | 27.4                | 81.3 | 74.0                      |
| 9/01/80 - 9/30/80   | 26.3                | 79.4 | 79.3                      |
| 10/01/80 - 10/30/80 | 18.0                | 64.4 | 69.8                      |
| 11/01/80 - 11/30/80 | 12.6                | 54.8 | 78.0                      |
| 12/01/80 - 12/31/80 | 10.7                | 51.3 | 75.0                      |

TABLE X - (Cont'd)

SPAR S/N A-116-00237 (PADDLE S/N A-137-00068)

SUMMARY OF ENVIRONMENTAL HISTORY

| DATE                | AVERAGE<br>TEMPERATURE |      | AVERAGE                |
|---------------------|------------------------|------|------------------------|
|                     | °C                     | °F   | RELATIVE HUMIDITY<br>% |
| 1/01/81 - 1/31/81   | 8.2                    | 46.8 | 73.5                   |
| 2/01/81 - 2/28/81   | 11.1                   | 52.0 | 74.0                   |
| 3/01/81 - 3/31/81   | 14.9                   | 58.9 | 66.4                   |
| 4/01/81 - 4/30/81   | 21.4                   | 70.5 | 76.1                   |
| 5/01/81 - 5/31/81   | 22.5                   | 72.6 | 73.3                   |
| 6/01/81 - 6/31/81   | 26.8                   | 80.3 | 82.1                   |
| 7/01/81 - 7/31/81   | 27.3                   | 81.1 | 81.8                   |
| 8/01/81 - 8/31/81   | 26.9                   | 80.5 | 79.3                   |
| 9/01/81 - 9/30/81   | 23.8                   | 74.8 | 77.3                   |
| 10/01/81 - 10/31/81 | 20.0                   | 68.1 | 79.1                   |
| 11/01/81 - 11/30/81 | 16.3                   | 60.9 | 80.9                   |
| 12/01/81 - 12/31/81 | 11.4                   | 52.5 | 73.4                   |
| 1/01/82 - 1/31/82   | 11.1                   | 51.9 | 76.9                   |
| 2/01/82 - 2/28/82   | 10.8                   | 51.4 | 78.4                   |
| 3/01/82 - 3/31/82   | 16.9                   | 62.5 | 82.6                   |
| 4/01/82 - 4/30/82   | 18.9                   | 66.1 | 80.1                   |
| 5/01/82 - 5/31/82   | 23.2                   | 73.8 | 82.1                   |
| 6/01/82 - 6/30/82   | 26.4                   | 79.6 | 82.4                   |
| 7/01/82 - 7/31/82   | 27.2                   | 80.9 | 80.8                   |
| 8/01/82 - 8/31/82   | 26.9                   | 80.5 | 78.8                   |

Shipped to Sikorsky 8/29/82 - 39 months at Lake Charles  
 Lost at J. F. K. - 3 month, use warehouse conditions  
 Arrived at Sikorsky 12/1/82

TABLE XI

SPAR S/N A-116-00172 (PADDLE S/N A-137-00047)

SUMMARY OF ENVIRONMENTAL HISTORY

Total Hours 2533

| DATE                | AVERAGE<br>TEMPERATURE |      | AVERAGE                |
|---------------------|------------------------|------|------------------------|
|                     | °C                     | °F   | RELATIVE HUMIDITY<br>% |
| 5/01/79 - 5/31/79   | 22.4                   | 72.3 | 78.6                   |
| 6/01/79 - 6/30/79   | 26.0                   | 78.9 | 78.4                   |
| 7/01/79 - 7/31/79   | 26.8                   | 80.3 | 85.4                   |
| 8/01/79 - 8/31/79   | 26.6                   | 80.0 | 83.8                   |
| 9/01/79 - 9/30/79   | 23.6                   | 74.7 | 80.3                   |
| 10/01/79 - 10/30/79 | 20.4                   | 68.9 | 79.0                   |
| 11/01/79 - 11/31/79 | 12.4                   | 54.4 | 75.4                   |
| 12/01/79 - 12/31/79 | 10.3                   | 50.5 | 78.1                   |
| 1/01/80 - 1/31/80   | 11.9                   | 53.4 | 86.4                   |
| 2/01/80 - 2/29/80   | 10.3                   | 50.6 | 80.5                   |
| 3/01/80 - 3/31/80   | 15.2                   | 59.4 | 81.4                   |
| 4/01/80 - 4/30/80   | 18.4                   | 65.1 | 76.5                   |
| 5/01/80 - 5/31/80   | 23.7                   | 74.8 | 83.9                   |
| 6/01/80 - 6/30/80   | 27.0                   | 80.8 | 80.3                   |
| 7/01/80 - 7/31/80   | 28.2                   | 82.8 | 72.5                   |
| 8/01/80 - 8/31/80   | 27.4                   | 81.3 | 74.0                   |
| 9/01/80 - 9/30/80   | 26.3                   | 79.4 | 79.3                   |
| 10/01/80 - 10/30/80 | 18.0                   | 64.4 | 69.8                   |
| 11/01/80 - 11/30/80 | 12.6                   | 54.8 | 78.0                   |
| 12/01/80 - 12/31/80 | 10.7                   | 51.3 | 75.0                   |

TABLE XI (Cont'd)

SPAR S/N A-116-00172 (PADDLE S/N A-137-00047)

SUMMARY OF ENVIRONMENTAL HISTORY

| DATE                                                    | AVERAGE<br>TEMPERATURE   |      | AVERAGE<br>RELATIVE HUMIDITY |
|---------------------------------------------------------|--------------------------|------|------------------------------|
|                                                         | °C                       | °F   | %                            |
| 1/01/81 - 1/31/81                                       | 8.2                      | 46.8 | 73.5                         |
| 2/01/81 - 2/28/81                                       | 11.1                     | 52.0 | 74.0                         |
| 3/01/81 - 3/31/81                                       | 14.9                     | 58.9 | 66.4                         |
| 4/01/81 - 4/30/81                                       | 21.4                     | 70.5 | 76.1                         |
| 5/01/81 - 5/31/81                                       | 22.5                     | 72.6 | 73.3                         |
| 6/01/81 - 6/31/81                                       | 26.8                     | 80.3 | 82.1                         |
| 7/01/81 - 7/31/81                                       | 27.3                     | 81.1 | 81.8                         |
| 8/01/81 - 8/31/81                                       | 26.9                     | 80.5 | 79.3                         |
| 9/01/81 - 9/30/81                                       | 23.8                     | 74.8 | 77.3                         |
| 10/01/81 - 10/31/81                                     | 20.0                     | 68.1 | 79.1                         |
| 11/01/81 - 11/30/81                                     | 16.3                     | 60.9 | 80.9                         |
| 12/01/81 - 12/31/81                                     | 11.4                     | 52.5 | 73.4                         |
| 1/01/82 - 1/31/82                                       | 11.1                     | 51.9 | 76.9                         |
| 2/01/82 - 2/28/82                                       | 10.8                     | 51.4 | 78.4                         |
| 3/01/82 - 3/31/82                                       | 16.9                     | 62.5 | 82.6                         |
| 4/01/82 - 4/30/82                                       | 18.9                     | 66.1 | 80.1                         |
| 5/01/82 - 5/31/82                                       | 23.2                     | 73.8 | 82.1 removed<br>5/28/82      |
| 6/01/82 - 6/30/82                                       | 26.4                     | 79.6 | 82.4                         |
| 7/01/82 - 7/31/82                                       | 27.2                     | 80.9 | 80.8 kept outside            |
| 8/01/82 - 8/31/82                                       | 26.9                     | 80.5 | 78.8                         |
| Shipped to Sikorsky 8/29/82 - 39 months at Lake Charles |                          |      |                              |
| Lost at J.F.K. - 3 months, use warehouse conditions     |                          |      |                              |
| Arrived at Sikorsky 12/1/82                             |                          |      |                              |
| 9/01/82 - 9/30/82                                       | Use Warehouse Conditions |      |                              |
| 10/01/82 - 10/30/82                                     |                          |      |                              |
| 11/01/82 - 11/30/82                                     |                          |      |                              |

## 7.2 Test Data, Field Exposed Panels

|            |                                                                                                                                                       |
|------------|-------------------------------------------------------------------------------------------------------------------------------------------------------|
| Table XII  | Moisture desorption measurements of twelve exposed panels, Stratford and West Palm Beach. Four coupons of each panel were absorbed at 65.5°C (150°F). |
| Table XIII | Average moisture values of coupons from values of Table XII.                                                                                          |
| Table XIV  | WPB Weather Bureau Data                                                                                                                               |
| Table XV   | Summary of Coupon Test Results                                                                                                                        |

TABLE XII.  
 MOISTURE DESORPTION MEASUREMENTS OF TWELVE EXPOSED PANELS,  
 STRATFORD AND WEST PALM BEACH

| MOISTURE DESORBED FROM PANEL #79071A-5 82W1C<br>6 PLY GRAPHITE - WEST PALM BEACH<br>WEATHERED 10-15-79 TO 9-14-82 |             |              |               |              |
|-------------------------------------------------------------------------------------------------------------------|-------------|--------------|---------------|--------------|
| DATE                                                                                                              | COUPON<br>I | COUPON<br>II | COUPON<br>III | COUPON<br>IV |
| 10.5                                                                                                              | 0           | 0            | 0             | 0            |
| 10.6                                                                                                              | .37122      | .37354       | .26392        | .27579       |
| 10.7                                                                                                              | .46591      | .47666       | .38461        | .38662       |
| 10.8                                                                                                              | .5294       | .544         | .45092        | .46008       |
| 10.11                                                                                                             | .73599      | .7555        | .65914        | .67014       |
| 10.13                                                                                                             | .79732      | .81652       | .72545        | .732         |
| 10.15                                                                                                             | .85435      | .87124       | .78116        | .78483       |
| 10.18                                                                                                             | .92752      | .95121       | .84614        | .85571       |
| 10.20                                                                                                             | .97056      | .98909       | .88328        | .89824       |
| 10.22                                                                                                             | 1.0007      | 1.0238       | .91245        | .92402       |
| 10.25                                                                                                             | 1.0556      | 1.0806       | .95489        | .96526       |
| 10.27                                                                                                             | 1.0696      | 1.0943       | .96948        | .98201       |
| 10.29                                                                                                             | 1.0835      | 1.1101       | .98275        | .9949        |
| 11.1                                                                                                              | 1.0997      | 1.1238       | .99203        | 1.0065       |
| 11.3                                                                                                              | 1.1018      | 1.128        | .99601        | 1.0117       |
| 11.5                                                                                                              | 1.1104      | 1.1332       | .99733        | 1.0104       |
| 11.8                                                                                                              | 1.1578      | 1.1806       | 1.0345        | 1.0439       |
| 11.10                                                                                                             | 1.1675      | 1.1922       | 1.0424        | 1.0542       |
| 11.12                                                                                                             | 1.1621      | 1.1911       | 1.0411        | 1.0542       |
| 11.15                                                                                                             | 1.1879      | 1.2143       | 1.0557        | 1.0735       |
| 11.19                                                                                                             | 1.2051      | 1.2343       | 1.069         | 1.0864       |
| 11.22                                                                                                             | 1.2041      | 1.2311       | 1.065         | 1.0812       |
| 11.29                                                                                                             | 1.2385      | 1.2648       | 1.0915        | 1.1057       |
| 12.3                                                                                                              | 1.2331      | 1.2542       | 1.0796        | 1.0941       |
| 12.6                                                                                                              | 1.2245      | 1.249        | 1.0703        | 1.0851       |
| 12.10                                                                                                             | 1.2718      | 1.2911       | 1.1048        | 1.1251       |
| 12.13                                                                                                             | 1.2923      | 1.3121       | 1.1233        | 1.1379       |
| 12.17                                                                                                             | 1.274       | 1.2984       | 1.1087        | 1.1289       |

TABLE XII. CONTINUED

|                                                                                                                                                           |        |        |        |        |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------|--------|--------|--------|--------|
| .....<br>.MOISTURE DESORBED FROM PANEL #79071A-5 82W1C<br>. 6 PLY GRAPHITE - WEST PALM BEACH<br>. WEATHERED 10-15-79 TO 9-14-82<br>. (CONTINUED)<br>..... |        |        |        |        |
| DATE                                                                                                                                                      | COUPON | COUPON | COUPON | COUPON |
|                                                                                                                                                           | I      | II     | III    | IV     |
| 1.10                                                                                                                                                      | 1.3203 | 1.3384 | 1.1273 | 1.1483 |
| 1.14                                                                                                                                                      | 1.3149 | 1.3384 | 1.1273 | 1.1457 |
| 1.17                                                                                                                                                      | 1.3235 | 1.3426 | 1.1353 | 1.1521 |
| 1.21                                                                                                                                                      | 1.3278 | 1.3626 | 1.1353 | 1.1483 |
| 1.24                                                                                                                                                      | 1.3213 | 1.3395 | 1.1286 | 1.1444 |
| 1.28                                                                                                                                                      | 1.3332 | 1.3521 | 1.1353 | 1.1534 |
| 1.31                                                                                                                                                      | 1.3213 | 1.3395 | 1.13   | 1.1444 |
| 2.4                                                                                                                                                       | 1.316  | 1.3363 | 1.1207 | 1.1392 |
| 2.7                                                                                                                                                       | 1.3267 | 1.3405 | 1.1286 | 1.1444 |
| 2.11                                                                                                                                                      | 1.345  | 1.3542 | 1.1392 | 1.1637 |
| 2.14                                                                                                                                                      | 1.3418 | 1.3584 | 1.1419 | 1.1586 |
| .....                                                                                                                                                     |        |        |        |        |

TABLE XII. CONTINUED

| .....<br>. MOISTURE DESORBED FROM PANEL #79070B-6 82W1C-1 .<br>. 6 PLY GRAPHITE - WEST PALM BEACH .<br>. WEATHERED 10-15-79 TO 9-14-82 .<br>..... |             |              |               |              |
|---------------------------------------------------------------------------------------------------------------------------------------------------|-------------|--------------|---------------|--------------|
| DATE                                                                                                                                              | COUPON<br>I | COUPON<br>II | COUPON<br>III | COUPON<br>IV |
| 10.5                                                                                                                                              | 0           | 0            | 0             | 0            |
| 10.6                                                                                                                                              | .36309      | .36524       | .28518        | .28546       |
| 10.7                                                                                                                                              | .46222      | .46535       | .39457        | .39965       |
| 10.8                                                                                                                                              | .52125      | .52915       | .46749        | .4762        |
| 10.11                                                                                                                                             | .72841      | .73377       | .69407        | .71236       |
| 10.13                                                                                                                                             | .78522      | .79318       | .75007        | .76556       |
| 10.15                                                                                                                                             | .83868      | .84268       | .81388        | .82914       |
| 10.18                                                                                                                                             | .89882      | .90759       | .86727        | .89142       |
| 10.20                                                                                                                                             | .94115      | .9505        | .90763        | .92905       |
| 10.22                                                                                                                                             | .97456      | .978         | .93628        | .9576        |
| 10.25                                                                                                                                             | 1.0236      | 1.033        | .99228        | 1.0134       |
| 10.27                                                                                                                                             | 1.0314      | 1.044        | 1.0001        | 1.0225       |
| 10.29                                                                                                                                             | 1.0403      | 1.0561       | 1.0105        | 1.0342       |
| 11.1                                                                                                                                              | 1.0592      | 1.0671       | 1.0222        | 1.0497       |
| 11.3                                                                                                                                              | 1.0659      | 1.0737       | 1.0353        | 1.0549       |
| 11.5                                                                                                                                              | 1.0648      | 1.0737       | 1.0339        | 1.0549       |
| 11.8                                                                                                                                              | 1.106       | 1.1188       | 1.0626        | 1.0912       |
| 11.10                                                                                                                                             | 1.1227      | 1.1375       | 1.0717        | 1.099        |
| 11.12                                                                                                                                             | 1.1071      | 1.1243       | 1.0743        | 1.0912       |
| 11.15                                                                                                                                             | 1.1405      | 1.1551       | 1.0925        | 1.1159       |
| 11.19                                                                                                                                             | 1.1594      | 1.1683       | 1.103         | 1.1237       |
| 11.22                                                                                                                                             | 1.1606      | 1.165        | 1.1017        | 1.125        |
| 11.29                                                                                                                                             | 1.1884      | 1.2013       | 1.1251        | 1.1509       |
| 12.3                                                                                                                                              | 1.1695      | 1.1837       | 1.116         | 1.147        |
| 12.6                                                                                                                                              | 1.1639      | 1.1716       | 1.1043        | 1.1341       |
| 12.10                                                                                                                                             | 1.2029      | 1.2189       | 1.142         | 1.1652       |
| 12.13                                                                                                                                             | 1.2229      | 1.2398       | 1.1577        | 1.1886       |
| 12.17                                                                                                                                             | 1.2151      | 1.2255       | 1.1577        | 1.1834       |
| .....                                                                                                                                             |             |              |               |              |

TABLE XII. CONTINUED

|                                                   |            |            |            |            |
|---------------------------------------------------|------------|------------|------------|------------|
| .....                                             |            |            |            |            |
| .MOISTURE DESORBED FROM PANEL #79070B-6 82W1C-1 . |            |            |            |            |
| . 6 PLY GRAPHITE - WEST PALM BEACH .              |            |            |            |            |
| . WEATHERED 10-15-79 TO 9-14-82 .                 |            |            |            |            |
| . (CONTINUED) .                                   |            |            |            |            |
| .....                                             |            |            |            |            |
| . DATE .                                          | . COUPON . | . COUPON . | . COUPON . | . COUPON . |
| . .                                               | . I .      | . II .     | . III .    | . IV .     |
| .....                                             |            |            |            |            |
| . 1.10 .                                          | . 1.2508 . | . 1.264 .  | . 1.1798 . | . 1.1976 . |
| . 1.14 .                                          | . 1.2452 . | . 1.2607 . | . 1.1668 . | . 1.1912 . |
| . 1.17 .                                          | . 1.2497 . | . 1.2651 . | . 1.1694 . | . 1.1925 . |
| . 1.21 .                                          | . 1.2486 . | . 1.2673 . | . 1.1694 . | . 1.1976 . |
| . 1.24 .                                          | . 1.253 .  | . 1.2684 . | . 1.1759 . | . 1.1976 . |
| . 1.28 .                                          | . 1.2508 . | . 1.2717 . | . 1.1798 . | . 1.2041 . |
| . 1.31 .                                          | . 1.2452 . | . 1.2563 . | . 1.1694 . | . 1.1899 . |
| . 2.4 .                                           | . 1.243 .  | . 1.2563 . | . 1.1629 . | . 1.195 .  |
| . 2.7 .                                           | . 1.2441 . | . 1.2596 . | . 1.1668 . | . 1.1925 . |
| . 2.11 .                                          | . 1.2775 . | . 1.2695 . | . 1.1863 . | . 1.2132 . |
| . 2.14 .                                          | . 1.2586 . | . 1.2794 . | . 1.1785 . | . 1.2041 . |
| .....                                             |            |            |            |            |

TABLE XII. CONTINUED

| .....<br>. MOISTURE DESORBED FROM PANEL #79068B-1 82SIC .<br>. 6 PLY GRAPHITE - STRATFORD .<br>. WEATHERED 9-21-79 TO 9-24-82 .<br>..... |             |              |               |              |
|------------------------------------------------------------------------------------------------------------------------------------------|-------------|--------------|---------------|--------------|
| DATE                                                                                                                                     | COUPON<br>I | COUPON<br>II | COUPON<br>III | COUPON<br>IV |
| 10.5                                                                                                                                     | 0           | 0            | 0             | 0            |
| 10.6                                                                                                                                     | .28932      | .27739       | .19964        | .19117       |
| 10.7                                                                                                                                     | .36864      | .36049       | .28917        | .28192       |
| 10.8                                                                                                                                     | .41667      | .40317       | .34483        | .33637       |
| 10.11                                                                                                                                    | .57753      | .56938       | .51664        | .50455       |
| 10.13                                                                                                                                    | .61663      | .60531       | .56382        | .55537       |
| 10.15                                                                                                                                    | .65796      | .64237       | .6098         | .60135       |
| 10.18                                                                                                                                    | .72275      | .70751       | .67635        | .66547       |
| 10.20                                                                                                                                    | .75068      | .73895       | .71264        | .70056       |
| 10.22                                                                                                                                    | .78084      | .76366       | .74047        | .72839       |
| 10.25                                                                                                                                    | .81659      | .79847       | .77798        | .7659        |
| 10.27                                                                                                                                    | .83669      | .81981       | .80097        | .7901        |
| 10.29                                                                                                                                    | .84786      | .83216       | .81549        | .80341       |
| 11.1                                                                                                                                     | .84898      | .83216       | .82154        | .80946       |
| 11.3                                                                                                                                     | .84675      | .82767       | .82154        | .8143        |
| 11.5                                                                                                                                     | .85457      | .8389        | .83001        | .81793       |
| 11.8                                                                                                                                     | .89255      | .87596       | .8663         | .85302       |
| 11.10                                                                                                                                    | .9093       | .88719       | .87477        | .86269       |
| 11.12                                                                                                                                    | .89813      | .88045       | .8784         | .86874       |
| 11.15                                                                                                                                    | .92159      | .89955       | .8905         | .88568       |
| 11.19                                                                                                                                    | .93723      | .91864       | .91107        | .90383       |
| 11.22                                                                                                                                    | .92606      | .91302       | .91107        | .89899       |
| 11.29                                                                                                                                    | .95622      | .93773       | .93043        | .9244        |
| 12.3                                                                                                                                     | .94282      | .93324       | .92438        | .92077       |
| 12.6                                                                                                                                     | .93388      | .9265        | .9147         | .91109       |
| 12.10                                                                                                                                    | .97856      | .95907       | .951          | .94134       |
| 12.13                                                                                                                                    | .99755      | .97816       | .97157        | .94981       |
| 12.17                                                                                                                                    | .97521      | .95907       | .96068        | .9486        |
| .....                                                                                                                                    |             |              |               |              |

TABLE XII. CONTINUED

|                                                                                                                                                             |        |        |        |        |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|--------|--------|--------|
| .....<br>. MOISTURE DESORBED FROM PANEL #79068B-1 82SIC .<br>. 6 PLY GRAPHITE - STRATFORD .<br>. WEATHERED 9-21-79 TO 9-24-82 .<br>. (CONTINUED) .<br>..... |        |        |        |        |
| DATE                                                                                                                                                        | COUPON | COUPON | COUPON | COUPON |
|                                                                                                                                                             | I      | II     | III    | IV     |
| 1.10                                                                                                                                                        | 1.0065 | .98826 | .98246 | .97038 |
| 1.14                                                                                                                                                        | 1.0054 | .98826 | .98488 | .97764 |
| 1.17                                                                                                                                                        | 1.0132 | .99388 | .98851 | .97764 |
| 1.21                                                                                                                                                        | 1.0177 | .99163 | .98367 | .97401 |
| 1.24                                                                                                                                                        | 1.0065 | .98377 | .98125 | .97401 |
| 1.28                                                                                                                                                        | 1.0188 | .99837 | .99456 | .98974 |
| 1.31                                                                                                                                                        | 1.002  | .98377 | .98367 | .9728  |
| 2.4                                                                                                                                                         | .99979 | .97894 | .97399 | .96796 |
| 2.7                                                                                                                                                         | 1.0054 | .98602 | .98004 | .97643 |
| 2.11                                                                                                                                                        | 1.0367 | .99051 | .99577 | .98611 |
| 2.14                                                                                                                                                        | 1.0221 | 1.0017 | .99698 | .98732 |
| .....                                                                                                                                                       |        |        |        |        |

TABLE XII. CONTINUED

| .....<br>. MOISTURE DESORBED FROM PANEL #79069B-6 82S1C .<br>. 6 PLY GRAPHITE - STRATFORD .<br>. WEATHERED 9-28-79 TO 9-24-82 .<br>..... |             |              |               |              |
|------------------------------------------------------------------------------------------------------------------------------------------|-------------|--------------|---------------|--------------|
| DATE                                                                                                                                     | COUPON<br>I | COUPON<br>II | COUPON<br>III | COUPON<br>IV |
| 10.5                                                                                                                                     | 0           | 0            | 0             | 0            |
| 10.6                                                                                                                                     | .28419      | .29488       | .2097         | .21266       |
| 10.7                                                                                                                                     | .36663      | .37402       | .29513        | .30308       |
| 10.8                                                                                                                                     | .41978      | .4304        | .35467        | .36293       |
| 10.11                                                                                                                                    | .58032      | .59193       | .53589        | .53993       |
| 10.13                                                                                                                                    | .61828      | .63747       | .5799         | .58705       |
| 10.15                                                                                                                                    | .66709      | .683         | .6265         | .63672       |
| 10.18                                                                                                                                    | .7235       | .74263       | .68604        | .69657       |
| 10.20                                                                                                                                    | .76146      | .77949       | .72099        | .71949       |
| 10.22                                                                                                                                    | .78858      | .80442       | .74688        | .75769       |
| 10.25                                                                                                                                    | .83088      | .85104       | .78959        | .79844       |
| 10.27                                                                                                                                    | .84498      | .86622       | .80124        | .8099        |
| 10.29                                                                                                                                    | .85909      | .87814       | .8103         | .82264       |
| 11.1                                                                                                                                     | .86017      | .87923       | .81548        | .82518       |
| 11.3                                                                                                                                     | .86776      | .88248       | .81936        | .829         |
| 11.5                                                                                                                                     | .87319      | .88899       | .82325        | .83028       |
| 11.8                                                                                                                                     | .91224      | .93452       | .85043        | .86339       |
| 11.10                                                                                                                                    | .92417      | .94753       | .86596        | .87867       |
| 11.12                                                                                                                                    | .92308      | .94211       | .86985        | .87485       |
| 11.15                                                                                                                                    | .94478      | .96271       | .87632        | .89522       |
| 11.19                                                                                                                                    | .96647      | .9833        | .89444        | .90668       |
| 11.22                                                                                                                                    | .95888      | .97788       | .89185        | .90159       |
| 11.29                                                                                                                                    | .986        | 1.0082       | .9048         | .91942       |
| 12.3                                                                                                                                     | .9784       | .99306       | .90091        | .91432       |
| 12.6                                                                                                                                     | .96864      | .98764       | .88926        | .90286       |
| 12.10                                                                                                                                    | 1.0088      | 1.0267       | .91774        | .93088       |
| 12.13                                                                                                                                    | 1.0175      | 1.0397       | .92162        | .94616       |
| 12.17                                                                                                                                    | 1.0185      | 1.0332       | .92292        | .93597       |
| .....                                                                                                                                    |             |              |               |              |

TABLE XII. CONTINUED

|                                                 |            |            |            |            |
|-------------------------------------------------|------------|------------|------------|------------|
| .....                                           |            |            |            |            |
| .MOISTURE DESORBED FROM PANEL #79069B-6 82S1C . |            |            |            |            |
| . 6 PLY GRAPHITE - STRATFORD .                  |            |            |            |            |
| . WEATHERED 9-28-79 TO 9-24-82 .                |            |            |            |            |
| . (CONTINUED) .                                 |            |            |            |            |
| .....                                           |            |            |            |            |
| . DATE .                                        | . COUPON . | . COUPON . | . COUPON . | . COUPON . |
| . .                                             | . I .      | . II .     | . III .    | . IV .     |
| .....                                           |            |            |            |            |
| . 1.10 .                                        | . 1.0457 . | . 1.0646 . | . .94363 . | . .95889 . |
| . 1.14 .                                        | . 1.0532 . | . 1.069 .  | . .94881 . | . .95889 . |
| . 1.17 .                                        | . 1.0511 . | . 1.069 .  | . .94622 . | . .96017 . |
| . 1.21 .                                        | . 1.0522 . | . 1.0733 . | . .94881 . | . .95253 . |
| . 1.24 .                                        | . 1.0478 . | . 1.07 .   | . .94363 . | . .9538 .  |
| . 1.28 .                                        | . 1.0598 . | . 1.0776 . | . .95269 . | . .96781 . |
| . 1.31 .                                        | . 1.0446 . | . 1.0635 . | . .93327 . | . .94998 . |
| . 2.4 .                                         | . 1.0435 . | . 1.0614 . | . .93845 . | . .95253 . |
| . 2.7 .                                         | . 1.0532 . | . 1.0711 . | . .93975 . | . .94998 . |
| . 2.11 .                                        | . 1.0565 . | . 1.0679 . | . .96046 . | . .97163 . |
| . 2.14 .                                        | . 1.0673 . | . 1.0863 . | . .95139 . | . .96526 . |
| .....                                           |            |            |            |            |

TABLE XII. CONTINUED

| .....<br>MOISTURE DESORBED FROM PANEL #78263A-5 82S1B-1<br>14 PLY GRAPHITE - STRATFORD<br>WEATHERED 11-6-79 TO 9-24-82<br>..... |             |              |               |              |
|---------------------------------------------------------------------------------------------------------------------------------|-------------|--------------|---------------|--------------|
| DATE                                                                                                                            | COUPON<br>I | COUPON<br>II | COUPON<br>III | COUPON<br>IV |
| 10.5                                                                                                                            | 0           | 0            | 0             | 0            |
| 10.6                                                                                                                            | .12357      | .12632       | .076721       | .07459       |
| 10.7                                                                                                                            | .15519      | .1602        | .10444        | .10144       |
| 10.8                                                                                                                            | .1727       | .17762       | .12127        | .11835       |
| 10.11                                                                                                                           | .23789      | .24344       | .17869        | .17305       |
| 10.13                                                                                                                           | .25006      | .25796       | .19254        | .18896       |
| 10.15                                                                                                                           | .26903      | .2749        | .20739        | .20388       |
| 10.18                                                                                                                           | .2953       | .30297       | .23511        | .22924       |
| 10.20                                                                                                                           | .306        | .31652       | .24452        | .24018       |
| 10.22                                                                                                                           | .32011      | .32959       | .25689        | .25112       |
| 10.25                                                                                                                           | .34103      | .35282       | .27719        | .27151       |
| 10.27                                                                                                                           | .34638      | .35621       | .28362        | .27698       |
| 10.29                                                                                                                           | .35125      | .36395       | .28906        | .28145       |
| 11.1                                                                                                                            | .35806      | .36879       | .295          | .28742       |
| 11.3                                                                                                                            | .36098      | .37218       | .30144        | .29389       |
| 11.5                                                                                                                            | .36536      | .37508       | .30243        | .29488       |
| 11.8                                                                                                                            | .38579      | .3988        | .32223        | .31427       |
| 11.10                                                                                                                           | .39649      | .40945       | .33213        | .32472       |
| 11.12                                                                                                                           | .39357      | .40654       | .33064        | .32223       |
| 11.15                                                                                                                           | .40525      | .41913       | .34153        | .33317       |
| 11.19                                                                                                                           | .42082      | .43268       | .35539        | .34511       |
| 11.22                                                                                                                           | .42228      | .43316       | .35935        | .35157       |
| 11.29                                                                                                                           | .44028      | .45204       | .37371        | .3635        |
| 12.3                                                                                                                            | .44222      | .45397       | .37717        | .36897       |
| 12.6                                                                                                                            | .43736      | .45155       | .37667        | .36649       |
| 12.10                                                                                                                           | .4646       | .47866       | .394          | .38538       |
| 12.13                                                                                                                           | .47044      | .48592       | .40439        | .39235       |
| 12.17                                                                                                                           | .4719       | .48495       | .40291        | .39334       |
| .....                                                                                                                           |             |              |               |              |

TABLE XII. CONTINUED

| .....<br>.MOISTURE DESORBED FROM PANEL #78263A-5 82S1B-1 .<br>. 14 PLY GRAPHITE - STRATFORD .<br>. WEATHERED 11-6-79 TO 9-24-82 .<br>. (CONTINUED) .<br>..... |             |              |               |              |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|--------------|---------------|--------------|
| DATE                                                                                                                                                          | COUPON<br>I | COUPON<br>II | COUPON<br>III | COUPON<br>IV |
| 1.10                                                                                                                                                          | .52007      | .52028       | .4336         | .42566       |
| 1.14                                                                                                                                                          | .53418      | .52367       | .43558        | .42914       |
| 1.17                                                                                                                                                          | .53077      | .52512       | .43954        | .43163       |
| 1.21                                                                                                                                                          | .52493      | .52802       | .44102        | .43212       |
| 1.24                                                                                                                                                          | .53028      | .5256        | .44152        | .4356        |
| 1.28                                                                                                                                                          | .53077      | .53335       | .44696        | .43909       |
| 1.31                                                                                                                                                          | .52834      | .52851       | .4435         | .4356        |
| 2.4                                                                                                                                                           | .52931      | .53189       | .44597        | .43809       |
| 2.7                                                                                                                                                           | .53028      | .53577       | .45043        | .43909       |
| 2.11                                                                                                                                                          | .53418      | .55125       | .46132        | .4545        |
| 2.14                                                                                                                                                          | .53418      | .54496       | .45785        | .44853       |
| 2.18                                                                                                                                                          | .52883      | .53964       | .45587        | .44754       |
| 2.21                                                                                                                                                          | .53807      | .54496       | .45785        | .45052       |
| 2.25                                                                                                                                                          | .53174      | .54738       | .46132        | .45351       |
| 3.4                                                                                                                                                           | .5371       | .5469        | .45983        | .45251       |
| 3.7                                                                                                                                                           | .5405       | .54787       | .45934        | .45251       |
| 3.11                                                                                                                                                          | .5332       | .54545       | .45934        | .45052       |
| 3.14                                                                                                                                                          | .53612      | .54883       | .4633         | .45301       |
| 3.18                                                                                                                                                          | .54001      | .54835       | .46231        | .4545        |
| 3.21                                                                                                                                                          | .52883      | .54351       | .45637        | .45052       |
| 3.25                                                                                                                                                          | .53807      | .55319       | .46429        | .4545        |
| 3.28                                                                                                                                                          | .53174      | .54787       | .46231        | .45251       |
| 4.4                                                                                                                                                           | .5371       | .55174       | .46429        | .45599       |
| 4.8                                                                                                                                                           | .5405       | .55513       | .46924        | .46047       |
| 4.11                                                                                                                                                          | .5332       | .54835       | .46082        | .45351       |
| 4.15                                                                                                                                                          | .53612      | .55125       | .46478        | .455         |
| .....                                                                                                                                                         |             |              |               |              |

TABLE XII. CONTINUED

|                                                   |          |          |          |          |
|---------------------------------------------------|----------|----------|----------|----------|
| .....                                             |          |          |          |          |
| .MOISTURE DESORBED FROM PANEL #78263A-5 82S1B-1 . |          |          |          |          |
| . 14 PLY GRAPHITE - STRATFORD .                   |          |          |          |          |
| . WEATHERED 11-6-79 TO 9-24-82 .                  |          |          |          |          |
| . (CONTINUED) .                                   |          |          |          |          |
| .....                                             |          |          |          |          |
| . DATE .                                          | COUPON . | COUPON . | COUPON . | COUPON . |
| . .                                               | I .      | II .     | III .    | IV .     |
| .....                                             |          |          |          |          |
| . 4.18 .                                          | .54001 . | .55609 . | .46726 . | .45947 . |
| . 4.22 .                                          | .53661 . | .55319 . | .46429 . | .45649 . |
| . 4.25 .                                          | .53126 . | .54448 . | .46033 . | .45251 . |
| . 4.29 .                                          | .53174 . | .54448 . | .45934 . | .45152 . |
| .....                                             |          |          |          |          |

TABLE XII. CONTINUED

| .....<br>. % MOISTURE DESORBED FROM PANEL #78261B-5 82S1B .<br>. 14 PLY GRAPHITE - STRATFORD .<br>. WEATHERED 11-6-79 TO 9-24-82 .<br>..... |             |              |               |              |
|---------------------------------------------------------------------------------------------------------------------------------------------|-------------|--------------|---------------|--------------|
| DATE                                                                                                                                        | COUPON<br>I | COUPON<br>II | COUPON<br>III | COUPON<br>IV |
| 10.5                                                                                                                                        | 0           | 0            | 0             | 0            |
| 10.6                                                                                                                                        | .11553      | .12085       | .071899       | .07074       |
| 10.7                                                                                                                                        | .1448       | .14832       | .099513       | .094833      |
| 10.8                                                                                                                                        | .16397      | .1678        | .11619        | .11124       |
| 10.11                                                                                                                                       | .22602      | .22623       | .16672        | .1625        |
| 10.13                                                                                                                                       | .23813      | .23871       | .18131        | .17429       |
| 10.15                                                                                                                                       | .25579      | .25719       | .19382        | .18967       |
| 10.18                                                                                                                                       | .28051      | .27966       | .21935        | .21273       |
| 10.20                                                                                                                                       | .29111      | .28865       | .2282         | .22145       |
| 10.22                                                                                                                                       | .30422      | .30263       | .2381         | .23119       |
| 10.25                                                                                                                                       | .32592      | .32311       | .25894        | .25118       |
| 10.27                                                                                                                                       | .32995      | .3266        | .26311        | .25528       |
| 10.29                                                                                                                                       | .3355       | .3306        | .26936        | .25989       |
| 11.1                                                                                                                                        | .33903      | .33559       | .27197        | .26502       |
| 11.3                                                                                                                                        | .34206      | .33759       | .27718        | .26912       |
| 11.5                                                                                                                                        | .3466       | .34308       | .2803         | .2722        |
| 11.8                                                                                                                                        | .3683       | .36306       | .29489        | .28757       |
| 11.10                                                                                                                                       | .37738      | .37005       | .3074         | .29629       |
| 11.12                                                                                                                                       | .37284      | .36606       | .30531        | .29731       |
| 11.15                                                                                                                                       | .38747      | .38353       | .31677        | .30654       |
| 11.19                                                                                                                                       | .39806      | .39202       | .32615        | .31782       |
| 11.22                                                                                                                                       | .39756      | .39402       | .33136        | .31884       |
| 11.29                                                                                                                                       | .41572      | .4115        | .34178        | .33268       |
| 12.3                                                                                                                                        | .41976      | .4145        | .34491        | .33473       |
| 12.6                                                                                                                                        | .4137       | .4095        | .3423         | .33217       |
| 12.10                                                                                                                                       | .4359       | .43347       | .36054        | .34909       |
| 12.13                                                                                                                                       | .44296      | .44046       | .36783        | .35831       |
| 12.17                                                                                                                                       | .44599      | .43747       | .36627        | .35678       |
| .....                                                                                                                                       |             |              |               |              |

TABLE XII. CONTINUED

|                                                                                                                                                |             |              |               |              |
|------------------------------------------------------------------------------------------------------------------------------------------------|-------------|--------------|---------------|--------------|
| .....<br>* MOISTURE DESORBED FROM PANEL #78261B-5 8251B<br>14 PLY GRAPHITE - STRATFORD<br>WEATHERED 11-6-79 TO 9-24-82<br>(CONTINUED)<br>..... |             |              |               |              |
| DATE                                                                                                                                           | COUPON<br>I | COUPON<br>II | COUPON<br>III | COUPON<br>IV |
| 1.10                                                                                                                                           | .47424      | .46694       | .39077        | .38241       |
| 1.14                                                                                                                                           | .47727      | .46944       | .39165        | .38497       |
| 1.17                                                                                                                                           | .47929      | .47243       | .39389        | .38753       |
| 1.21                                                                                                                                           | .48484      | .47443       | .3965         | .38753       |
| 1.24                                                                                                                                           | .4808       | .47343       | .39598        | .38805       |
| 1.28                                                                                                                                           | .49039      | .47893       | .40431        | .39471       |
| 1.31                                                                                                                                           | .48282      | .47393       | .39598        | .38958       |
| 2.4                                                                                                                                            | .48383      | .47843       | .40119        | .39112       |
| 2.7                                                                                                                                            | .48837      | .47992       | .40119        | .3942        |
| 2.11                                                                                                                                           | .49342      | .49491       | .41578        | .40291       |
| 2.14                                                                                                                                           | .49644      | .48791       | .40796        | .39984       |
| 2.18                                                                                                                                           | .49241      | .48542       | .40484        | .39984       |
| 2.21                                                                                                                                           | .49745      | .48941       | .409          | .40086       |
| 2.25                                                                                                                                           | .49745      | .49041       | .41213        | .40342       |
| 3.4                                                                                                                                            | .49897      | .48692       | .409          | .40189       |
| 3.7                                                                                                                                            | .49695      | .48791       | .40952        | .4024        |
| 3.11                                                                                                                                           | .49796      | .48941       | .41005        | .40086       |
| 3.14                                                                                                                                           | .50149      | .49341       | .41265        | .40342       |
| 3.18                                                                                                                                           | .49947      | .48941       | .41109        | .40291       |
| 3.21                                                                                                                                           | .49745      | .48791       | .40796        | .40137       |
| 3.25                                                                                                                                           | .50603      | .4994        | .41369        | .40701       |
| 3.28                                                                                                                                           | .49947      | .48991       | .41161        | .40342       |
| 4.4                                                                                                                                            | .50149      | .49391       | .41369        | .40394       |
| 4.8                                                                                                                                            | .50552      | .4959        | .41578        | .40753       |
| 4.11                                                                                                                                           | .49796      | .48791       | .409          | .40189       |
| 4.15                                                                                                                                           | .50149      | .49141       | .41213        | .40445       |
| .....                                                                                                                                          |             |              |               |              |

TABLE XII. CONTINUED

|                                                   |        |        |        |        |
|---------------------------------------------------|--------|--------|--------|--------|
| .....                                             |        |        |        |        |
| .X MOISTURE DESORBED FROM PANEL #78261B-5 82S1B . |        |        |        |        |
| . 14 PLY GRAPHITE - STRATFORD .                   |        |        |        |        |
| . WEATHERED 11-6-79 TO 9-24-82 .                  |        |        |        |        |
| . (CONTINUED) .                                   |        |        |        |        |
| .....                                             |        |        |        |        |
| DATE                                              | COUPON | COUPON | COUPON | COUPON |
|                                                   | I      | II     | III    | IV     |
| .....                                             |        |        |        |        |
| 4.18                                              | .50552 | .49491 | .41265 | .4065  |
| 4.22                                              | .50149 | .49391 | .41109 | .40496 |
| 4.25                                              | .49443 | .48642 | .40588 | .39984 |
| 4.29                                              | .49392 | .48692 | .40744 | .39984 |
| .....                                             |        |        |        |        |

TABLE XII. CONTINUED

| .....<br>. MOISTURE DESORBED FROM PANEL #79033A-6 82W1A .<br>. 33 PLY GRAPHITE - WEST PALM BEACH .<br>. WEATHERED 10-15-79 TO 9-14-82 .<br>..... |             |              |               |              |
|--------------------------------------------------------------------------------------------------------------------------------------------------|-------------|--------------|---------------|--------------|
| DATE                                                                                                                                             | COUPON<br>I | COUPON<br>II | COUPON<br>III | COUPON<br>IV |
| 10.5                                                                                                                                             | 0           | 0            | 0             | 0            |
| 10.6                                                                                                                                             | .088966     | .089317      | .058714       | .061517      |
| 10.7                                                                                                                                             | .11375      | .11565       | .077426       | .083058      |
| 10.8                                                                                                                                             | .12921      | .13185       | .091405       | .09735       |
| 10.11                                                                                                                                            | .17687      | .18269       | .1327         | .1396        |
| 10.13                                                                                                                                            | .18789      | .19362       | .1413         | .15037       |
| 10.15                                                                                                                                            | .1989       | .20537       | .15033        | .16114       |
| 10.18                                                                                                                                            | .22051      | .22805       | .16776        | .18082       |
| 10.20                                                                                                                                            | .22962      | .23798       | .17593        | .1889        |
| 10.22                                                                                                                                            | .23873      | .2479        | .18367        | .19698       |
| 10.25                                                                                                                                            | .25504      | .26431       | .19701        | .21148       |
| 10.27                                                                                                                                            | .25948      | .26896       | .20066        | .21521       |
| 10.29                                                                                                                                            | .26414      | .27443       | .20453        | .21997       |
| 11.1                                                                                                                                             | .26753      | .27788       | .20819        | .22308       |
| 11.3                                                                                                                                             | .2688       | .28031       | .20969        | .2237        |
| 11.5                                                                                                                                             | .2705       | .28193       | .21034        | .2268        |
| 11.8                                                                                                                                             | .2866       | .29853       | .22346        | .24006       |
| 11.10                                                                                                                                            | .29549      | .30704       | .22991        | .24752       |
| 11.12                                                                                                                                            | .29232      | .30461       | .22841        | .24586       |
| 11.15                                                                                                                                            | .30079      | .31433       | .23529        | .25373       |
| 11.19                                                                                                                                            | .31159      | .32547       | .24432        | .26347       |
| 11.22                                                                                                                                            | .31075      | .32527       | .24432        | .2645        |
| 11.29                                                                                                                                            | .32367      | .33823       | .25421        | .27444       |
| 12.3                                                                                                                                             | .32473      | .34005       | .25572        | .2761        |
| 12.6                                                                                                                                             | .32303      | .33843       | .25357        | .27362       |
| 12.10                                                                                                                                            | .34061      | .35646       | .26733        | .28791       |
| 12.13                                                                                                                                            | .34506      | .36213       | .2712         | .2935        |
| 12.17                                                                                                                                            | .34485      | .36213       | .27207        | .29329       |
| .....                                                                                                                                            |             |              |               |              |

TABLE XII. CONTINUED

|                                                  |        |        |        |        |
|--------------------------------------------------|--------|--------|--------|--------|
| .....                                            |        |        |        |        |
| . MOISTURE DESORBED FROM PANEL #79033A-6 82W1A . |        |        |        |        |
| . 33 PLY GRAPHITE - WEST PALM BEACH .            |        |        |        |        |
| . WEATHERED 10-15-79 TO 9-14-82 .                |        |        |        |        |
| . (CONTINUED) .                                  |        |        |        |        |
| .....                                            |        |        |        |        |
| DATE                                             | COUPON | COUPON | COUPON | COUPON |
|                                                  | I      | II     | III    | IV     |
| .....                                            |        |        |        |        |
| 1.10                                             | .37048 | .38786 | .29164 | .31463 |
| 1.14                                             | .37281 | .39089 | .29357 | .31794 |
| 1.17                                             | .37366 | .39251 | .29465 | .31857 |
| 1.21                                             | .37895 | .3992  | .29981 | .32209 |
| 1.24                                             | .37641 | .39535 | .29981 | .32188 |
| 1.28                                             | .38255 | .40163 | .30282 | .3254  |
| 1.31                                             | .38001 | .39839 | .30003 | .32519 |
| 2.4                                              | .37916 | .39879 | .29981 | .32312 |
| 2.7                                              | .38171 | .40244 | .29981 | .32602 |
| 2.11                                             | .39802 | .41621 | .3168  | .34031 |
| 2.14                                             | .39463 | .415   | .31228 | .33431 |
| 2.18                                             | .39103 | .41155 | .30798 | .33182 |
| 2.21                                             | .39632 | .41419 | .3125  | .33596 |
| 2.25                                             | .39293 | .41378 | .31099 | .33493 |
| 3.4                                              | .39399 | .41419 | .3125  | .33721 |
| 3.7                                              | .39442 | .41621 | .31379 | .337   |
| 3.11                                             | .39463 | .4154  | .31228 | .33638 |
| 3.14                                             | .39844 | .41925 | .3153  | .33928 |
| 3.18                                             | .39802 | .41905 | .31551 | .33949 |
| 3.21                                             | .39611 | .41722 | .31401 | .337   |
| 3.25                                             | .40162 | .42391 | .31831 | .34238 |
| 3.28                                             | .39802 | .42087 | .31487 | .34011 |
| 4.4                                              | .40374 | .42492 | .31745 | .34404 |
| 4.8                                              | .40458 | .42451 | .31938 | .34363 |
| 4.11                                             | .40458 | .4233  | .31659 | .34156 |
| 4.15                                             | .40374 | .42614 | .31981 | .34487 |
| .....                                            |        |        |        |        |

TABLE XII. CONTINUED

|                                                  |            |            |            |            |
|--------------------------------------------------|------------|------------|------------|------------|
| .....                                            |            |            |            |            |
| . MOISTURE DESORBED FROM PANEL #79033A-6 82W1A . |            |            |            |            |
| . 33 PLY GRAPHITE - WEST PALM BEACH .            |            |            |            |            |
| . WEATHERED 10-15-79 TO 9-14-82 .                |            |            |            |            |
| . (CONTINUED) .                                  |            |            |            |            |
| .....                                            |            |            |            |            |
| . DATE .                                         | . COUPON . | . COUPON . | . COUPON . | . COUPON . |
| . .                                              | . I .      | . II .     | . III .    | . IV .     |
| .....                                            |            |            |            |            |
| . 4.18 .                                         | .4067 .    | .42978 .   | .32218 .   | .34694 .   |
| . 4.22 .                                         | .40607 .   | .42877 .   | .32089 .   | .3457 .    |
| . 4.25 .                                         | .40077 .   | .42269 .   | .3168 .    | .34176 .   |
| . 4.29 .                                         | .40458 .   | .42593 .   | .31917 .   | .34508 .   |
| .....                                            |            |            |            |            |

TABLE XII. CONTINUED

| .....<br>. MOISTURE DESORBED FROM PANEL #79030B-6 82S1A .<br>. 33 PLY GRAPHITE - STRATFORD .<br>. WEATHERED 9-14-79 TO 9-24-82 .<br>..... |             |              |               |              |
|-------------------------------------------------------------------------------------------------------------------------------------------|-------------|--------------|---------------|--------------|
| DATE                                                                                                                                      | COUPON<br>I | COUPON<br>II | COUPON<br>III | COUPON<br>IV |
| 10.5                                                                                                                                      | 0           | 0            | 0             | 0            |
| 10.6                                                                                                                                      | .065625     | .062336      | .048247       | .04444       |
| 10.7                                                                                                                                      | .085498     | .081206      | .066394       | .063267      |
| 10.8                                                                                                                                      | .094607     | .09096       | .056573       | .070272      |
| 10.11                                                                                                                                     | .12152      | .11874       | .10567        | .10026       |
| 10.13                                                                                                                                     | .13021      | .12382       | .11187        | .10661       |
| 10.15                                                                                                                                     | .13373      | .12934       | .11784        | .11165       |
| 10.18                                                                                                                                     | .1503       | .14312       | .13193        | .12675       |
| 10.20                                                                                                                                     | .15526      | .14736       | .1362         | .13201       |
| 10.22                                                                                                                                     | .15837      | .15287       | .14047        | .13507       |
| 10.25                                                                                                                                     | .16706      | .16072       | .14944        | .14448       |
| 10.27                                                                                                                                     | .16996      | .16347       | .15328        | .14711       |
| 10.29                                                                                                                                     | .17307      | .16665       | .15478        | .1377        |
| 11.1                                                                                                                                      | .1741       | .16793       | .1567         | .15061       |
| 11.3                                                                                                                                      | .17286      | .16581       | .15627        | .14864       |
| 11.5                                                                                                                                      | .17286      | .16644       | .15584        | .1504        |
| 11.8                                                                                                                                      | .18425      | .17768       | .16566        | .16025       |
| 11.10                                                                                                                                     | .18756      | .1798        | .16759        | .16244       |
| 11.12                                                                                                                                     | .18652      | .17959       | .16929        | .16266       |
| 11.15                                                                                                                                     | .19253      | .1851        | .17399        | .16747       |
| 11.19                                                                                                                                     | .20039      | .19273       | .1821         | .17404       |
| 11.22                                                                                                                                     | .19563      | .18743       | .17826        | .17163       |
| 11.29                                                                                                                                     | .20619      | .19931       | .18701        | .18104       |
| 12.3                                                                                                                                      | .20702      | .19888       | .18829        | .1828        |
| 12.6                                                                                                                                      | .20371      | .19591       | .18573        | .17885       |
| 12.10                                                                                                                                     | .21509      | .20545       | .19512        | .18717       |
| 12.13                                                                                                                                     | .21675      | .20779       | .19726        | .19111       |
| 12.17                                                                                                                                     | .21737      | .20842       | .19705        | .19024       |
| .....                                                                                                                                     |             |              |               |              |

TABLE XII. CONTINUED

| .....<br>. MOISTURE DESORBED FROM PANEL #79030B-6 82S1A .<br>. 33 PLY GRAPHITE - STRATFORD .<br>. WEATHERED 9-14-79 TO 9-24-82 .<br>. (CONTINUED) .<br>..... |             |              |               |              |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|--------------|---------------|--------------|
| DATE                                                                                                                                                         | COUPON<br>I | COUPON<br>II | COUPON<br>III | COUPON<br>IV |
| 1.10                                                                                                                                                         | .23207      | .22263       | .21199        | .20294       |
| 1.14                                                                                                                                                         | .23704      | .22411       | .21391        | .20469       |
| 1.17                                                                                                                                                         | .23497      | .22178       | .21114        | .20272       |
| 1.21                                                                                                                                                         | .23517      | .22369       | .21263        | .20513       |
| 1.24                                                                                                                                                         | .23103      | .22072       | .21135        | .2025        |
| 1.28                                                                                                                                                         | .23621      | .22496       | .21412        | .20469       |
| 1.31                                                                                                                                                         | .23434      | .22369       | .21306        | .20425       |
| 2.4                                                                                                                                                          | .23103      | .2203        | .21049        | .20141       |
| 2.7                                                                                                                                                          | .23455      | .22432       | .21434        | .20425       |
| 2.11                                                                                                                                                         | .2418       | .23047       | .22501        | .21126       |
| 2.14                                                                                                                                                         | .23993      | .22856       | .21733        | .20972       |
| 2.18                                                                                                                                                         | .23393      | .22475       | .21412        | .20447       |
| 2.21                                                                                                                                                         | .23807      | .22708       | .21775        | .20797       |
| 2.25                                                                                                                                                         | .23828      | .22644       | .21626        | .20775       |
| 3.4                                                                                                                                                          | .23766      | .22644       | .2169         | .20688       |
| 3.7                                                                                                                                                          | .2389       | .22814       | .21733        | .20797       |
| 3.11                                                                                                                                                         | .23683      | .22602       | .21583        | .20556       |
| 3.14                                                                                                                                                         | .24014      | .22899       | .21754        | .20819       |
| 3.18                                                                                                                                                         | .23807      | .22772       | .21605        | .20754       |
| 3.21                                                                                                                                                         | .23662      | .22602       | .21476        | .20535       |
| 3.25                                                                                                                                                         | .24076      | .22962       | .21754        | .20929       |
| 3.28                                                                                                                                                         | .23621      | .22602       | .21562        | .20666       |
| 4.4                                                                                                                                                          | .23931      | .22835       | .21775        | .20863       |
| 4.8                                                                                                                                                          | .23807      | .22814       | .21711        | .21082       |
| 4.11                                                                                                                                                         | .23683      | .22729       | .21583        | .206         |
| 4.15                                                                                                                                                         | .23745      | .22708       | .21605        | .20732       |
| .....                                                                                                                                                        |             |              |               |              |

TABLE XII. CONTINUED

|                                                                                                                                                              |        |        |        |        |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|--------|--------|--------|
| .....<br>. MOISTURE DESORBED FROM PANEL #79030B-6 82S1A .<br>. 33 PLY GRAPHITE - STRATFORD .<br>. WEATHERED 9-14-79 TO 9-24-82 .<br>. (CONTINUED) .<br>..... |        |        |        |        |
| DATE                                                                                                                                                         | COUPON | COUPON | COUPON | COUPON |
|                                                                                                                                                              | I      | II     | III    | IV     |
| 4.18                                                                                                                                                         | .24097 | .22899 | .21861 | .20972 |
| 4.22                                                                                                                                                         | .2389  | .22856 | .21775 | .20841 |
| 4.25                                                                                                                                                         | .23414 | .22284 | .21348 | .20381 |
| 4.29                                                                                                                                                         | .23579 | .24129 | .21348 | .20403 |
| .....                                                                                                                                                        |        |        |        |        |

TABLE XII. CONTINUED

|                                                  |            |            |            |            |
|--------------------------------------------------|------------|------------|------------|------------|
| .....                                            |            |            |            |            |
| . MOISTURE DESORBED FROM PANEL #78241-68 82W3D . |            |            |            |            |
| . 5 PLY KEVLAR - WEST PALM BEACH .               |            |            |            |            |
| . WEATHERED 10-15-79 TO 9-14-83 .                |            |            |            |            |
| .....                                            |            |            |            |            |
| . DATE .                                         | . COUPON . | . COUPON . | . COUPON . | . COUPON . |
| . .                                              | . I .      | . II .     | . III .    | . IV .     |
| .....                                            |            |            |            |            |
| . 10.5 .                                         | . 5.7832 . | . 5.7661 . | . 4.3605 . | . 4.4555 . |
| . 10.6 .                                         | . 5.7486 . | . 5.7316 . | . 4.335 .  | . 4.4298 . |
| . 10.7 .                                         | . 5.7337 . | . 5.7171 . | . 4.3215 . | . 4.4164 . |
| . 10.8 .                                         | . 5.7261 . | . 5.7092 . | . 4.3143 . | . 4.4088 . |
| . 10.11 .                                        | . 5.7029 . | . 5.6862 . | . 4.2941 . | . 4.3885 . |
| . 10.13 .                                        | . 5.6962 . | . 5.6793 . | . 4.2891 . | . 4.3831 . |
| . 10.15 .                                        | . 5.6917 . | . 5.6746 . | . 4.2852 . | . 4.3795 . |
| . 10.18 .                                        | . 5.6843 . | . 5.667 .  | . 4.2799 . | . 4.3741 . |
| . 10.20 .                                        | . 5.6815 . | . 5.6641 . | . 4.2785 . | . 4.3724 . |
| . 10.22 .                                        | . 5.6792 . | . 5.6618 . | . 4.2774 . | . 4.3712 . |
| . 10.25 .                                        | . 5.6754 . | . 5.6581 . | . 4.2757 . | . 4.3692 . |
| . 10.27 .                                        | . 5.6747 . | . 5.6575 . | . 4.2752 . | . 4.3686 . |
| . 10.29 .                                        | . 5.6734 . | . 5.6563 . | . 4.2748 . | . 4.368 .  |
| . 11.1 .                                         | . 5.6743 . | . 5.6569 . | . 4.2758 . | . 4.3692 . |
| . 11.3 .                                         | . 5.6757 . | . 5.6584 . | . 4.2773 . | . 4.3699 . |
| . 11.5 .                                         | . 5.6759 . | . 5.6581 . | . 4.2777 . | . 4.3709 . |
| . 11.8 .                                         | . 5.672 .  | . 5.6545 . | . 4.2749 . | . 4.368 .  |
| . 11.10 .                                        | . 5.6713 . | . 5.6539 . | . 4.2741 . | . 4.3671 . |
| . 11.12 .                                        | . 5.6721 . | . 5.6552 . | . 4.2749 . | . 4.3685 . |
| . 11.15 .                                        | . 5.6704 . | . 5.6532 . | . 4.2739 . | . 4.367 .  |
| . 11.19 .                                        | . 5.6695 . | . 5.6527 . | . 4.2732 . | . 4.3666 . |
| . 11.22 .                                        | . 5.6703 . | . 5.6532 . | . 4.2743 . | . 4.3674 . |
| . 11.29 .                                        | . 5.6683 . | . 5.6516 . | . 4.273 .  | . 4.3664 . |
| . 12.3 .                                         | . 5.6693 . | . 5.6529 . | . 4.275 .  | . 4.3679 . |
| . 12.6 .                                         | . 5.671 .  | . 5.6538 . | . 4.2758 . | . 4.3681 . |
| . 12.10 .                                        | . 5.6674 . | . 5.6497 . | . 4.2724 . | . 4.3651 . |
| . 12.13 .                                        | . 5.6663 . | . 5.6492 . | . 4.2727 . | . 4.3647 . |
| . 12.17 .                                        | . 5.6666 . | . 5.6498 . | . 4.2721 . | . 4.3649 . |
| .....                                            |            |            |            |            |

TABLE XII. CONTINUED

|                                                  |          |          |          |          |
|--------------------------------------------------|----------|----------|----------|----------|
| .....                                            |          |          |          |          |
| . MOISTURE DESORBED FROM PANEL #78241-68 82W3D . |          |          |          |          |
| . 5 PLY KEVLAR - WEST PALM BEACH .               |          |          |          |          |
| . WEATHERED 10-15-79 TO 9-14-83 .                |          |          |          |          |
| . (CONTINUED) .                                  |          |          |          |          |
| .....                                            |          |          |          |          |
| . DATE .                                         | COUPON . | COUPON . | COUPON . | COUPON . |
| . .                                              | I .      | II .     | III .    | IV .     |
| .....                                            |          |          |          |          |
| . 1.10 .                                         | 5.6638 . | 5.6473 . | 4.2715 . | 4.364 .  |
| . 1.14 .                                         | 5.6644 . | 5.6481 . | 4.2718 . | 4.3649 . |
| . 1.17 .                                         | 5.6648 . | 5.648 .  | 4.2722 . | 4.3648 . |
| . 1.21 .                                         | 5.665 .  | 5.6483 . | 4.2722 . | 4.3654 . |
| . 1.24 .                                         | 5.6653 . | 5.6489 . | 4.2727 . | 4.3654 . |
| . 1.28 .                                         | 5.6641 . | 5.6482 . | 4.2725 . | 4.365 .  |
| . 1.31 .                                         | 5.6657 . | 5.6494 . | 4.2734 . | 4.366 .  |
| . 2.4 .                                          | 5.6668 . | 5.65 .   | 4.2746 . | 4.3674 . |
| .....                                            |          |          |          |          |

TABLE XII. CONTINUED

|                                                    |        |        |        |        |
|----------------------------------------------------|--------|--------|--------|--------|
| . . . . .                                          |        |        |        |        |
| . MOISTURE DESORBED FROM PANEL #78241-97 82W3D-1 . |        |        |        |        |
| . 5 PLY KEVLAR - WEST PALM BEACH .                 |        |        |        |        |
| . WEATHERED 10-15-79 TO 9-14-83 .                  |        |        |        |        |
| . . . . .                                          |        |        |        |        |
| DATE                                               | COUPON | COUPON | COUPON | COUPON |
|                                                    | I      | II     | III    | IV     |
| . . . . .                                          |        |        |        |        |
| 10.5                                               | 5.5119 | 5.1901 | 4.1416 | 3.6987 |
| 10.6                                               | 5.4753 | 5.1549 | 4.1158 | 3.6746 |
| 10.7                                               | 5.4628 | 5.1419 | 4.1032 | 3.6631 |
| 10.8                                               | 5.454  | 5.1343 | 4.0959 | 3.6563 |
| 10.11                                              | 5.4328 | 5.1145 | 4.0771 | 3.6396 |
| 10.13                                              | 5.4267 | 5.108  | 4.071  | 3.6342 |
| 10.15                                              | 5.4221 | 5.1037 | 4.0679 | 3.6314 |
| 10.18                                              | 5.4153 | 5.0971 | 4.0623 | 3.6271 |
| 10.20                                              | 5.4129 | 5.096  | 4.06   | 3.6242 |
| 10.22                                              | 5.4107 | 5.0925 | 4.059  | 3.6239 |
| 10.25                                              | 5.407  | 5.0894 | 4.0565 | 3.6216 |
| 10.27                                              | 5.4058 | 5.0889 | 4.056  | 3.6214 |
| 10.29                                              | 5.4046 | 5.0874 | 4.0555 | 3.6208 |
| 11.1                                               | 5.4058 | 5.088  | 4.056  | 3.6214 |
| 11.3                                               | 5.4064 | 5.0898 | 4.0576 | 3.6224 |
| 11.5                                               | 5.4064 | 5.089  | 4.0579 | 3.6231 |
| 11.8                                               | 5.4034 | 5.0859 | 4.0553 | 3.6206 |
| 11.10                                              | 5.4022 | 5.085  | 4.0545 | 3.6197 |
| 11.12                                              | 5.4034 | 5.0864 | 4.0554 | 3.6209 |
| 11.15                                              | 5.4017 | 5.0845 | 4.0539 | 3.6193 |
| 11.19                                              | 5.401  | 5.084  | 4.0534 | 3.6188 |
| 11.22                                              | 5.402  | 5.0848 | 4.0543 | 3.6201 |
| 11.29                                              | 5.4003 | 5.0827 | 4.0536 | 3.6188 |
| 12.3                                               | 5.4021 | 5.084  | 4.0547 | 3.6198 |
| 12.6                                               | 5.403  | 5.0856 | 4.0558 | 3.6214 |
| 12.10                                              | 5.3984 | 5.0814 | 4.052  | 3.6176 |
| 12.13                                              | 5.3974 | 5.0804 | 4.052  | 3.6173 |
| 12.17                                              | 5.3979 | 5.0808 | 4.052  | 3.6178 |
| . . . . .                                          |        |        |        |        |

TABLE XII. CONTINUED

|                                                                                                                                                                   |        |        |        |        |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|--------|--------|--------|
| .....<br>. MOISTURE DESORBED FROM PANEL #78241-97 82W3D-1.<br>. 5 PLY KEVLAR - WEST PALM BEACH .<br>. WEATHERED 10-15-79 TO 9-14-83 .<br>. (CONTINUED) .<br>..... |        |        |        |        |
| DATE                                                                                                                                                              | COUPON | COUPON | COUPON | COUPON |
|                                                                                                                                                                   | I      | II     | III    | IV     |
| 1.10                                                                                                                                                              | 5.3953 | 5.0785 | 4.051  | 3.6164 |
| 1.14                                                                                                                                                              | 5.3964 | 5.0793 | 4.0518 | 3.6173 |
| 1.17                                                                                                                                                              | 5.3962 | 5.0796 | 4.0515 | 3.6175 |
| 1.21                                                                                                                                                              | 5.3961 | 5.0794 | 4.0535 | 3.6183 |
| 1.24                                                                                                                                                              | 5.397  | 5.0799 | 4.0525 | 3.6181 |
| 1.28                                                                                                                                                              | 5.3962 | 5.0792 | 4.0521 | 3.6174 |
| 1.31                                                                                                                                                              | 5.3974 | 5.0804 | 4.0529 | 3.6183 |
| 2.4                                                                                                                                                               | 5.3989 | 5.0816 | 4.0542 | 3.6194 |
| 2.7                                                                                                                                                               | 5.3973 | 5.0802 | 4.0531 | 3.6185 |
| 2.11                                                                                                                                                              | 5.3954 | 5.0786 | 4.0509 | 3.6162 |
| 2.14                                                                                                                                                              | 5.3959 | 5.0792 | 4.0524 | 3.6177 |
| .....                                                                                                                                                             |        |        |        |        |

TABLE XII. CONTINUED

| .....<br>. MOISTURE DESORBED FROM PANEL #78241-58 82S3D .<br>. 5 PLY KEVLAR - STRATFORD .<br>. WEATHERED 8-29-79 TO 9-24-82 .<br>..... |             |              |               |              |
|----------------------------------------------------------------------------------------------------------------------------------------|-------------|--------------|---------------|--------------|
| DATE                                                                                                                                   | COUPON<br>I | COUPON<br>II | COUPON<br>III | COUPON<br>IV |
| 10.5                                                                                                                                   | 5.7333      | 5.7302       | 4.6811        | 4.7217       |
| 10.6                                                                                                                                   | 5.7033      | 5.7001       | 4.6584        | 4.6987       |
| 10.7                                                                                                                                   | 5.6905      | 5.6875       | 4.6469        | 4.6878       |
| 10.8                                                                                                                                   | 5.6841      | 5.6811       | 4.6407        | 4.6817       |
| 10.11                                                                                                                                  | 5.6647      | 5.6618       | 4.6239        | 4.6641       |
| 10.13                                                                                                                                  | 5.6594      | 5.6562       | 4.6188        | 4.6595       |
| 10.15                                                                                                                                  | 5.6557      | 5.653        | 4.616         | 4.6567       |
| 10.18                                                                                                                                  | 5.6491      | 5.6465       | 4.6112        | 4.6513       |
| 10.20                                                                                                                                  | 5.6472      | 5.6443       | 4.609         | 4.6489       |
| 10.22                                                                                                                                  | 5.6454      | 5.6425       | 4.6081        | 4.6482       |
| 10.25                                                                                                                                  | 5.6431      | 5.6406       | 4.6065        | 4.6466       |
| 10.27                                                                                                                                  | 5.6424      | 5.6396       | 4.6061        | 4.6459       |
| 10.29                                                                                                                                  | 5.6414      | 5.6386       | 4.6057        | 4.6454       |
| 11.1                                                                                                                                   | 5.6421      | 5.6395       | 4.6067        | 4.6465       |
| 11.3                                                                                                                                   | 5.644       | 5.6408       | 4.6081        | 4.6477       |
| 11.5                                                                                                                                   | 5.6434      | 5.6404       | 4.6082        | 4.648        |
| 11.8                                                                                                                                   | 5.6406      | 5.6373       | 4.6056        | 4.6457       |
| 11.10                                                                                                                                  | 5.6393      | 5.6367       | 4.6053        | 4.6448       |
| 11.12                                                                                                                                  | 5.641       | 5.6382       | 4.6062        | 4.646        |
| 11.15                                                                                                                                  | 5.6386      | 5.636        | 4.6049        | 4.6446       |
| 11.19                                                                                                                                  | 5.638       | 5.6347       | 4.6041        | 4.6439       |
| 11.22                                                                                                                                  | 5.6392      | 5.6358       | 4.6056        | 4.6452       |
| 11.29                                                                                                                                  | 5.6378      | 5.6341       | 4.6046        | 4.6445       |
| 12.3                                                                                                                                   | 5.6388      | 5.6358       | 4.6057        | 4.6457       |
| 12.6                                                                                                                                   | 5.6404      | 5.6369       | 4.6075        | 4.6467       |
| 12.10                                                                                                                                  | 5.6357      | 5.6323       | 4.6033        | 4.6433       |
| 12.13                                                                                                                                  | 5.635       | 5.6314       | 4.603         | 4.6428       |
| 12.17                                                                                                                                  | 5.6353      | 5.6317       | 4.6034        | 4.643        |
| .....                                                                                                                                  |             |              |               |              |

TABLE XII. CONTINUED

|                                                                                                                                                           |        |        |        |        |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------|--------|--------|--------|--------|
| .....<br>. MOISTURE DESORBED FROM PANEL #78241-58 8253D .<br>. 5 PLY KEVLAR - STRATFORD .<br>. WEATHERED 8-29-79 TO 9-24-82 .<br>. (CONTINUED) .<br>..... |        |        |        |        |
| DATE                                                                                                                                                      | COUPON | COUPON | COUPON | COUPON |
|                                                                                                                                                           | I      | II     | III    | IV     |
| 1.10                                                                                                                                                      | 5.6333 | 5.629  | 4.6023 | 4.642  |
| 1.14                                                                                                                                                      | 5.634  | 5.63   | 4.6037 | 4.6435 |
| 1.17                                                                                                                                                      | 5.6342 | 5.63   | 4.6032 | 4.643  |
| 1.21                                                                                                                                                      | 5.6338 | 5.6295 | 4.6032 | 4.6427 |
| 1.24                                                                                                                                                      | 5.6347 | 5.6299 | 4.6037 | 4.6433 |
| 1.28                                                                                                                                                      | 5.6338 | 5.6298 | 4.6034 | 4.6427 |
| 1.31                                                                                                                                                      | 5.6353 | 5.6308 | 4.6046 | 4.644  |
| 2.4                                                                                                                                                       | 5.6367 | 5.6321 | 4.606  | 4.6452 |
| 2.7                                                                                                                                                       | 5.6354 | 5.631  | 4.605  | 4.6443 |
| 2.11                                                                                                                                                      | 5.6332 | 5.6286 | 4.6032 | 4.6429 |
| 2.14                                                                                                                                                      | 5.634  | 5.6299 | 4.6036 | 4.643  |
| .....                                                                                                                                                     |        |        |        |        |

TABLE XII. CONTINUED

| .....                                            |        |        |        |        |   |
|--------------------------------------------------|--------|--------|--------|--------|---|
| . MOISTURE DESORBED FROM PANEL #78241-88 82S3D . |        |        |        |        |   |
| . 5 PLY KEVLAR - STRATFORD .                     |        |        |        |        |   |
| . WEATHERED 8-29-79 TO 9-24-82 .                 |        |        |        |        |   |
| .....                                            |        |        |        |        |   |
| DATE                                             | COUPON | COUPON | COUPON | COUPON |   |
|                                                  | I      | II     | III    | IV     |   |
| .....                                            |        |        |        |        |   |
| 10.5                                             | 5.91   | 5.9578 | 4.5443 | 4.6485 | . |
| 10.6                                             | 5.8761 | 5.9233 | 4.5216 | 4.6249 | . |
| 10.7                                             | 5.8634 | 5.9117 | 4.5105 | 4.6145 | . |
| 10.8                                             | 5.8573 | 5.9049 | 4.5048 | 4.6083 | . |
| 10.11                                            | 5.8371 | 5.8843 | 4.4873 | 4.591  | . |
| 10.13                                            | 5.8316 | 5.879  | 4.483  | 4.586  | . |
| 10.15                                            | 5.8276 | 5.875  | 4.4801 | 4.5829 | . |
| 10.18                                            | 5.8212 | 5.8681 | 4.4748 | 4.5781 | . |
| 10.20                                            | 5.8187 | 5.8656 | 4.473  | 4.5759 | . |
| 10.22                                            | 5.8164 | 5.8636 | 4.4717 | 4.5745 | . |
| 10.25                                            | 5.8141 | 5.8609 | 4.4703 | 4.5731 | . |
| 10.27                                            | 5.8135 | 5.8605 | 4.4698 | 4.5726 | . |
| 10.29                                            | 5.8126 | 5.86   | 4.4696 | 4.572  | . |
| 11.1                                             | 5.8133 | 5.8605 | 4.4706 | 4.573  | . |
| 11.3                                             | 5.8147 | 5.8617 | 4.4718 | 4.5741 | . |
| 11.5                                             | 5.8145 | 5.8617 | 4.4718 | 4.5742 | . |
| 11.8                                             | 5.8109 | 5.858  | 4.4693 | 4.5718 | . |
| 11.10                                            | 5.8098 | 5.8569 | 4.4686 | 4.5713 | . |
| 11.12                                            | 5.8114 | 5.8587 | 4.47   | 4.5725 | . |
| 11.15                                            | 5.8096 | 5.8569 | 4.4686 | 4.5712 | . |
| 11.19                                            | 5.8082 | 5.8557 | 4.4679 | 4.5702 | . |
| 11.22                                            | 5.8096 | 5.8571 | 4.469  | 4.5716 | . |
| 11.29                                            | 5.8078 | 5.8552 | 4.4685 | 4.5709 | . |
| 12.3                                             | 5.8091 | 5.8565 | 4.4695 | 4.572  | . |
| 12.6                                             | 5.8108 | 5.8581 | 4.4712 | 4.5731 | . |
| 12.10                                            | 5.8055 | 5.853  | 4.4673 | 4.5694 | . |
| 12.13                                            | 5.8047 | 5.8522 | 4.4665 | 4.5687 | . |
| 12.17                                            | 5.8051 | 5.8529 | 4.4671 | 4.5698 | . |
| .....                                            |        |        |        |        |   |

TABLE XII. CONCLUDED

| .....<br>. MOISTURE DESORBED FROM PANEL #78241-88 82S3D .<br>. 5 PLY KEVLAR - STRATFORD .<br>. WEATHERED 8-29-79 TO 9-24-82 .<br>. (CONTINUED) .<br>..... |             |              |               |              |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|--------------|---------------|--------------|
| DATE                                                                                                                                                      | COUPON<br>I | COUPON<br>II | COUPON<br>III | COUPON<br>IV |
| 1.10                                                                                                                                                      | 5.803       | 5.8503       | 4.4665        | 4.5684       |
| 1.14                                                                                                                                                      | 5.8035      | 5.8512       | 4.4673        | 4.569        |
| 1.17                                                                                                                                                      | 5.8034      | 5.851        | 4.467         | 4.5694       |
| 1.21                                                                                                                                                      | 5.8027      | 5.8505       | 4.467         | 4.5694       |
| 1.24                                                                                                                                                      | 5.8037      | 5.8511       | 4.4674        | 4.5699       |
| 1.28                                                                                                                                                      | 5.8029      | 5.85         | 4.4672        | 4.5696       |
| 1.31                                                                                                                                                      | 5.8042      | 5.8516       | 4.4681        | 4.5705       |
| 2.4                                                                                                                                                       | 5.8058      | 5.8531       | 4.4696        | 4.572        |
| 2.7                                                                                                                                                       | 5.8044      | 5.8518       | 4.469         | 4.5709       |
| 2.11                                                                                                                                                      | 5.8022      | 5.8501       | 4.4682        | 4.569        |
| 2.14                                                                                                                                                      | 5.8029      | 5.8504       | 4.4674        | 4.5697       |
| .....                                                                                                                                                     |             |              |               |              |

TABLE XIII.  
 AVERAGE MOISTURE VALUE OF DESORPTION COUPONS

| .....<br>. MOISTURE DESORBED FROM PANEL #79071A-5 82W1C .<br>. 6 PLY GRAPHITE - WEST PALM BEACH .<br>. AVERAGE OF DATA FROM FOUR COUPONS .<br>..... |        |    |       |        |    |       |        |
|-----------------------------------------------------------------------------------------------------------------------------------------------------|--------|----|-------|--------|----|-------|--------|
| DATE                                                                                                                                                | % WT.  | .. | DATE  | % WT.  | .. | DATE  | % WT.  |
|                                                                                                                                                     | CHANGE | .. |       | CHANGE | .. |       | CHANGE |
| 10.5                                                                                                                                                | 0      | .. | 11.1  | 1.0555 | .. | 12.13 | 1.2164 |
| 10.6                                                                                                                                                | .32112 | .. | 11.3  | 1.0594 | .. | 12.17 | 1.2025 |
| 10.7                                                                                                                                                | .42845 | .. | 11.5  | 1.0628 | .. | 1.10  | 1.2336 |
| 10.8                                                                                                                                                | .4961  | .. | 11.8  | 1.1042 | .. | 1.14  | 1.2316 |
| 10.11                                                                                                                                               | .70519 | .. | 11.10 | 1.1141 | .. | 1.17  | 1.2384 |
| 10.13                                                                                                                                               | .76782 | .. | 11.12 | 1.1121 | .. | 1.21  | 1.2435 |
| 10.15                                                                                                                                               | .8229  | .. | 11.15 | 1.1328 | .. | 1.24  | 1.2335 |
| 10.18                                                                                                                                               | .89515 | .. | 11.19 | 1.1487 | .. | 1.28  | 1.2435 |
| 10.20                                                                                                                                               | .93529 | .. | 11.22 | 1.1453 | .. | 1.31  | 1.2338 |
| 10.22                                                                                                                                               | .96524 | .. | 11.29 | 1.1751 | .. | 2.4   | 1.228  |
| 10.25                                                                                                                                               | 1.0141 | .. | 12.3  | 1.1653 | .. | 2.7   | 1.2351 |
| 10.27                                                                                                                                               | 1.0288 | .. | 12.6  | 1.1572 | .. | 2.11  | 1.2505 |
| 10.29                                                                                                                                               | 1.0428 | .. | 12.10 | 1.1982 | .. | 2.14  | 1.2502 |
| .....                                                                                                                                               |        |    |       |        |    |       |        |

TABLE XIII. CONTINUED

| .....<br>. MOISTURE DESORBED FROM PANEL #79070B-6 82W1C-1 .<br>. 6 PLY GRAPHITE - WEST PALM BEACH .<br>. AVERAGE OF DATA FROM FOUR COUPONS .<br>..... |        |       |        |       |        |      |        |
|-------------------------------------------------------------------------------------------------------------------------------------------------------|--------|-------|--------|-------|--------|------|--------|
| DATE                                                                                                                                                  | % WT.  | DATE  | % WT.  | DATE  | % WT.  | DATE | % WT.  |
|                                                                                                                                                       | CHANGE |       | CHANGE |       | CHANGE |      | CHANGE |
| 10.5                                                                                                                                                  | 0      | 11.1  | 1.0496 | 12.13 | 1.2022 |      |        |
| 10.6                                                                                                                                                  | .32474 | 11.3  | 1.0574 | 12.17 | 1.1954 |      |        |
| 10.7                                                                                                                                                  | .43045 | 11.5  | 1.0568 | 1.10  | 1.2231 |      |        |
| 10.8                                                                                                                                                  | .49852 | 11.8  | 1.0947 | 1.14  | 1.216  |      |        |
| 10.11                                                                                                                                                 | .71715 | 11.10 | 1.1077 | 1.17  | 1.2192 |      |        |
| 10.13                                                                                                                                                 | .77351 | 11.12 | 1.0992 | 1.21  | 1.2207 |      |        |
| 10.15                                                                                                                                                 | .83109 | 11.15 | 1.126  | 1.24  | 1.2237 |      |        |
| 10.18                                                                                                                                                 | .89128 | 11.19 | 1.1386 | 1.28  | 1.2266 |      |        |
| 10.20                                                                                                                                                 | .93208 | 11.22 | 1.1381 | 1.31  | 1.2152 |      |        |
| 10.22                                                                                                                                                 | .96161 | 11.29 | 1.1664 | 2.4   | 1.2143 |      |        |
| 10.25                                                                                                                                                 | 1.0156 | 12.3  | 1.1541 | 2.7   | 1.2157 |      |        |
| 10.27                                                                                                                                                 | 1.0245 | 12.6  | 1.1435 | 2.11  | 1.2366 |      |        |
| 10.29                                                                                                                                                 | 1.0353 | 12.10 | 1.1823 | 2.14  | 1.2302 |      |        |
| .....                                                                                                                                                 |        |       |        |       |        |      |        |

TABLE XIII. CONTINUED

| ..... MOISTURE DESORBED FROM PANEL #79068B-1 82S1C .....<br>6 PLY GRAPHITE - STRATFORD .....<br>AVERAGE OF DATA FROM FOUR COUPONS ..... |        |       |        |       |        |      |        |
|-----------------------------------------------------------------------------------------------------------------------------------------|--------|-------|--------|-------|--------|------|--------|
| DATE                                                                                                                                    | % WT.  | DATE  | % WT.  | DATE  | % WT.  | DATE | % WT.  |
|                                                                                                                                         | CHANGE |       | CHANGE |       | CHANGE |      | CHANGE |
| 10.5                                                                                                                                    | 0      | 11.1  | .82803 | 12.13 | .97427 |      |        |
| 10.6                                                                                                                                    | .23938 | 11.3  | .82756 | 12.17 | .96089 |      |        |
| 10.7                                                                                                                                    | .32505 | 11.5  | .83535 | 1.10  | .9869  |      |        |
| 10.8                                                                                                                                    | .37526 | 11.8  | .87196 | 1.14  | .98904 |      |        |
| 10.11                                                                                                                                   | .54202 | 11.10 | .88349 | 1.17  | .9933  |      |        |
| 10.13                                                                                                                                   | .58528 | 11.12 | .88143 | 1.21  | .99174 |      |        |
| 10.15                                                                                                                                   | .62787 | 11.15 | .89933 | 1.24  | .98638 |      |        |
| 10.18                                                                                                                                   | .69302 | 11.19 | .91769 | 1.28  | 1.0004 |      |        |
| 10.20                                                                                                                                   | .72571 | 11.22 | .91229 | 1.31  | .98557 |      |        |
| 10.22                                                                                                                                   | .75334 | 11.29 | .9372  | 2.4   | .98017 |      |        |
| 10.25                                                                                                                                   | .78973 | 12.3  | .9303  | 2.7   | .98696 |      |        |
| 10.27                                                                                                                                   | .81189 | 12.6  | .92154 | 2.11  | 1.0023 |      |        |
| 10.29                                                                                                                                   | .82473 | 12.10 | .95749 | 2.14  | 1.002  |      |        |

TABLE XIII. CONTINUED

| .....<br>. MOISTURE DESORBED FROM PANEL #79069B-6 82S1C .<br>. 6 PLY GRAPHITE - STRATFORD .<br>. AVERAGE OF DATA FROM FOUR COUPONS .<br>..... |        |       |        |       |        |      |        |
|-----------------------------------------------------------------------------------------------------------------------------------------------|--------|-------|--------|-------|--------|------|--------|
| DATE                                                                                                                                          | % WT.  | DATE  | % WT.  | DATE  | % WT.  | DATE | % WT.  |
|                                                                                                                                               | CHANGE |       | CHANGE |       | CHANGE |      | CHANGE |
| 10.5                                                                                                                                          | 0      | 11.1  | .84502 | 12.13 | .98123 |      |        |
| 10.6                                                                                                                                          | .25036 | 11.3  | .84965 | 12.17 | .97765 |      |        |
| 10.7                                                                                                                                          | .33471 | 11.5  | .85392 | 1.10  | 1.0032 |      |        |
| 10.8                                                                                                                                          | .39194 | 11.8  | .89014 | 1.14  | 1.0075 |      |        |
| 10.11                                                                                                                                         | .56202 | 11.10 | .90408 | 1.17  | 1.0066 |      |        |
| 10.13                                                                                                                                         | .60567 | 11.12 | .90247 | 1.21  | 1.0067 |      |        |
| 10.15                                                                                                                                         | .65333 | 11.15 | .91976 | 1.24  | 1.0038 |      |        |
| 10.18                                                                                                                                         | .71218 | 11.19 | .93772 | 1.28  | 1.0145 |      |        |
| 10.20                                                                                                                                         | .74536 | 11.22 | .93255 | 1.31  | .99784 |      |        |
| 10.22                                                                                                                                         | .77439 | 11.29 | .95461 | 2.4   | .99896 |      |        |
| 10.25                                                                                                                                         | .81749 | 12.3  | .94668 | 2.7   | 1.0035 |      |        |
| 10.27                                                                                                                                         | .83059 | 12.6  | .9371  | 2.11  | 1.0141 |      |        |
| 10.29                                                                                                                                         | .84254 | 12.10 | .97102 | 2.14  | 1.0176 |      |        |
| .....                                                                                                                                         |        |       |        |       |        |      |        |

TABLE XIII. CONTINUED

| .....<br>MOISTURE DESORBED FROM PANEL #78263A-5 82S1B-1<br>14 PLY GRAPHITE - STRATFORD<br>AVERAGE OF DATA FROM FOUR COUPONS<br>..... |                 |       |                 |      |                 |      |                 |
|--------------------------------------------------------------------------------------------------------------------------------------|-----------------|-------|-----------------|------|-----------------|------|-----------------|
| DATE                                                                                                                                 | % WT.<br>CHANGE | DATE  | % WT.<br>CHANGE | DATE | % WT.<br>CHANGE | DATE | % WT.<br>CHANGE |
| 10.5                                                                                                                                 | 0               | 11.19 | .3885           | 2.18 | .49297          |      |                 |
| 10.6                                                                                                                                 | .1003           | 11.22 | .39159          | 2.21 | .49785          |      |                 |
| 10.7                                                                                                                                 | .13032          | 11.29 | .40738          | 2.25 | .49849          |      |                 |
| 10.8                                                                                                                                 | .14749          | 12.3  | .41058          | 3.4  | .49908          |      |                 |
| 10.11                                                                                                                                | .20827          | 12.6  | .40802          | 3.7  | .50005          |      |                 |
| 10.13                                                                                                                                | .22238          | 12.10 | .43066          | 3.11 | .49713          |      |                 |
| 10.15                                                                                                                                | .2388           | 12.13 | .43827          | 3.14 | .50032          |      |                 |
| 10.18                                                                                                                                | .26566          | 12.17 | .43827          | 3.18 | .50129          |      |                 |
| 10.20                                                                                                                                | .27681          | 1.10  | .4749           | 3.21 | .49481          |      |                 |
| 10.22                                                                                                                                | .28943          | 1.14  | .48064          | 3.25 | .50251          |      |                 |
| 10.25                                                                                                                                | .31064          | 1.17  | .48176          | 3.28 | .49861          |      |                 |
| 10.27                                                                                                                                | .3158           | 1.21  | .48153          | 4.4  | .50228          |      |                 |
| 10.29                                                                                                                                | .32143          | 1.24  | .48325          | 4.8  | .50633          |      |                 |
| 11.1                                                                                                                                 | .32732          | 1.28  | .48754          | 4.11 | .49897          |      |                 |
| 11.3                                                                                                                                 | .33212          | 1.31  | .48399          | 4.15 | .50179          |      |                 |
| 11.5                                                                                                                                 | .33444          | 2.4   | .48632          | 4.18 | .50571          |      |                 |
| 11.8                                                                                                                                 | .35527          | 2.7   | .48889          | 4.22 | .50264          |      |                 |
| 11.10                                                                                                                                | .3657           | 2.11  | .50031          | 4.25 | .49714          |      |                 |
| 11.12                                                                                                                                | .36325          | 2.14  | .49638          | 4.29 | .49677          |      |                 |
| 11.15                                                                                                                                | .37477          |       |                 |      |                 |      |                 |
|                                                                                                                                      |                 |       |                 |      |                 |      |                 |

TABLE XIII. CONTINUED

| .....<br>* MOISTURE DESORBED FROM PANEL #78261B-5 82S1B<br>14 PLY GRAPHITE - STRATFORD<br>AVERAGE OF DATA FROM FOUR COUPONS<br>..... |         |    |       |        |    |      |        |
|--------------------------------------------------------------------------------------------------------------------------------------|---------|----|-------|--------|----|------|--------|
| DATE                                                                                                                                 | % WT.   | .. | DATE  | % WT.  | .. | DATE | % WT.  |
|                                                                                                                                      | CHANGE  | .. |       | CHANGE | .. |      | CHANGE |
| 10.5                                                                                                                                 | 0       | .. | 11.19 | .35851 | .. | 2.18 | .44562 |
| 10.6                                                                                                                                 | .094757 | .. | 11.22 | .36045 | .. | 2.21 | .44918 |
| 10.7                                                                                                                                 | .12187  | .. | 11.29 | .37542 | .. | 2.25 | .45085 |
| 10.8                                                                                                                                 | .1398   | .. | 12.3  | .37847 | .. | 3.4  | .44919 |
| 10.11                                                                                                                                | .19537  | .. | 12.6  | .37442 | .. | 3.7  | .4492  |
| 10.13                                                                                                                                | .20811  | .. | 12.10 | .39475 | .. | 3.11 | .44957 |
| 10.15                                                                                                                                | .22411  | .. | 12.13 | .40239 | .. | 3.14 | .45274 |
| 10.18                                                                                                                                | .24806  | .. | 12.17 | .40163 | .. | 3.18 | .45072 |
| 10.20                                                                                                                                | .25735  | .. | 1.10  | .42859 | .. | 3.21 | .44868 |
| 10.22                                                                                                                                | .26904  | .. | 1.14  | .43083 | .. | 3.25 | .45653 |
| 10.25                                                                                                                                | .28979  | .. | 1.17  | .43329 | .. | 3.28 | .4511  |
| 10.27                                                                                                                                | .29374  | .. | 1.21  | .43583 | .. | 4.4  | .45326 |
| 10.29                                                                                                                                | .29884  | .. | 1.24  | .43456 | .. | 4.8  | .45618 |
| 11.1                                                                                                                                 | .3029   | .. | 1.28  | .44208 | .. | 4.11 | .44919 |
| 11.3                                                                                                                                 | .30649  | .. | 1.31  | .43558 | .. | 4.15 | .45237 |
| 11.5                                                                                                                                 | .31055  | .. | 2.4   | .43864 | .. | 4.18 | .4549  |
| 11.8                                                                                                                                 | .32846  | .. | 2.7   | .44092 | .. | 4.22 | .45286 |
| 11.10                                                                                                                                | .33778  | .. | 2.11  | .45175 | .. | 4.25 | .44664 |
| 11.12                                                                                                                                | .33538  | .. | 2.14  | .44804 | .. | 4.29 | .44703 |
| 11.15                                                                                                                                | .34858  | .. |       |        | .. |      |        |
| .....                                                                                                                                |         |    |       |        |    |      |        |

TABLE XIII. CONTINUED

| .....<br>MOISTURE DESORBED FROM PANEL #79033A-6 82W1A<br>33 PLY GRAPHITE - WEST PALM BEACH<br>AVERAGE OF DATA FROM FOUR COUPON<br>..... |         |    |       |        |    |      |        |
|-----------------------------------------------------------------------------------------------------------------------------------------|---------|----|-------|--------|----|------|--------|
| DATE                                                                                                                                    | % WT.   | .. | DATE  | % WT.  | .. | DATE | % WT.  |
|                                                                                                                                         | CHANGE  | .. |       | CHANGE | .. |      | CHANGE |
| 10.5                                                                                                                                    | 0       | .. | 11.19 | .28621 | .. | 2.18 | .3606  |
| 10.6                                                                                                                                    | .074629 | .. | 11.22 | .28621 | .. | 2.21 | .36474 |
| 10.7                                                                                                                                    | .09747  | .. | 11.29 | .29764 | .. | 2.25 | .36316 |
| 10.8                                                                                                                                    | .11245  | .. | 12.3  | .29915 | .. | 3.4  | .36447 |
| 10.11                                                                                                                                   | .15797  | .. | 12.6  | .29716 | .. | 3.7  | .36535 |
| 10.13                                                                                                                                   | .1683   | .. | 12.10 | .31308 | .. | 3.11 | .36467 |
| 10.15                                                                                                                                   | .17894  | .. | 12.13 | .31797 | .. | 3.14 | .36807 |
| 10.18                                                                                                                                   | .19928  | .. | 12.17 | .31808 | .. | 3.18 | .36801 |
| 10.20                                                                                                                                   | .20811  | .. | 1.10  | .34115 | .. | 3.21 | .36608 |
| 10.22                                                                                                                                   | .21682  | .. | 1.14  | .34381 | .. | 3.25 | .37155 |
| 10.25                                                                                                                                   | .23196  | .. | 1.17  | .34485 | .. | 3.28 | .36846 |
| 10.27                                                                                                                                   | .23608  | .. | 1.21  | .35001 | .. | 4.4  | .37254 |
| 10.29                                                                                                                                   | .24077  | .. | 1.24  | .34836 | .. | 4.8  | .37303 |
| 11.1                                                                                                                                    | .24417  | .. | 1.28  | .3531  | .. | 4.11 | .37151 |
| 11.3                                                                                                                                    | .24563  | .. | 1.31  | .3509  | .. | 4.15 | .37364 |
| 11.5                                                                                                                                    | .24739  | .. | 2.4   | .35022 | .. | 4.18 | .3764  |
| 11.8                                                                                                                                    | .26216  | .. | 2.7   | .35249 | .. | 4.22 | .37536 |
| 11.10                                                                                                                                   | .26999  | .. | 2.11  | .36784 | .. | 4.25 | .37051 |
| 11.12                                                                                                                                   | .2678   | .. | 2.14  | .36405 | .. | 4.29 | .37369 |
| 11.15                                                                                                                                   | .27604  | .. |       |        | .. |      |        |
| .....                                                                                                                                   |         |    |       |        |    |      |        |

TABLE XIII. CONTINUED

.....  
 MOISTURE DESORBED FROM PANEL #79030B-6 82S1A  
 33 PLY GRAPHITE - STRATFORD  
 AVERAGE OF DATA FROM FOUR COUPON  
 .....

| DATE  | % WT.   | DATE  | % WT.  | DATE | % WT.  |
|-------|---------|-------|--------|------|--------|
|       | CHANGE  |       | CHANGE |      | CHANGE |
| 10.5  | 0       | 11.19 | .18732 | 2.18 | .21932 |
| 10.6  | .055162 | 11.22 | .18324 | 2.21 | .22272 |
| 10.7  | .074091 | 11.29 | .19339 | 2.25 | .22218 |
| 10.8  | .078103 | 12.3  | .19425 | 3.4  | .22197 |
| 10.11 | .11155  | 12.6  | .19105 | 3.7  | .22308 |
| 10.13 | .11813  | 12.10 | .20071 | 3.11 | .22106 |
| 10.15 | .12314  | 12.13 | .20323 | 3.14 | .22372 |
| 10.18 | .13802  | 12.17 | .20327 | 3.18 | .22234 |
| 10.20 | .14271  | 1.10  | .21741 | 3.21 | .22069 |
| 10.22 | .1467   | 1.14  | .21994 | 3.25 | .2243  |
| 10.25 | .15543  | 1.17  | .21765 | 3.28 | .22113 |
| 10.27 | .15846  | 1.21  | .21915 | 4.4  | .22351 |
| 10.29 | .15805  | 1.24  | .2164  | 4.8  | .22354 |
| 11.1  | .16233  | 1.28  | .22    | 4.11 | .22149 |
| 11.3  | .16089  | 1.31  | .21883 | 4.15 | .22197 |
| 11.5  | .16139  | 2.4   | .21581 | 4.18 | .22457 |
| 11.8  | .17196  | 2.7   | .21937 | 4.22 | .22341 |
| 11.10 | .17434  | 2.11  | .22713 | 4.25 | .21857 |
| 11.12 | .17451  | 2.14  | .22389 | 4.29 | .22365 |
| 11.15 | .17977  |       |        |      |        |

TABLE XIII. CONTINUED

| .....<br>MOISTURE DESORBED FROM PANEL #78241-68 82W3D<br>5 PLY KEVLAR - WEST PALM BEACH<br>AVERAGE OF DATA FROM FOUR COUPONS<br>..... |        |    |       |        |    |       |        |
|---------------------------------------------------------------------------------------------------------------------------------------|--------|----|-------|--------|----|-------|--------|
| DATE                                                                                                                                  | % WT.  | .. | DATE  | % WT.  | .. | DATE  | % WT.  |
|                                                                                                                                       | CHANGE | .. |       | CHANGE | .. |       | CHANGE |
| 10.5                                                                                                                                  | 0      | .. | 10.29 | 1.933  | .. | 12.6  | 1.9479 |
| 10.6                                                                                                                                  | .58955 | .. | 11.1  | 1.9141 | .. | 12.10 | 2.0176 |
| 10.7                                                                                                                                  | .86942 | .. | 11.3  | 1.889  | .. | 12.13 | 2.0251 |
| 10.8                                                                                                                                  | 1.0204 | .. | 11.5  | 1.8815 | .. | 12.17 | 2.0235 |
| 10.11                                                                                                                                 | 1.4502 | .. | 11.8  | 1.9463 | .. | 1.10  | 2.0549 |
| 10.13                                                                                                                                 | 1.568  | .. | 11.10 | 1.9616 | .. | 1.14  | 2.0421 |
| 10.15                                                                                                                                 | 1.6504 | .. | 11.12 | 1.94   | .. | 1.17  | 2.039  |
| 10.18                                                                                                                                 | 1.776  | .. | 11.15 | 1.9702 | .. | 1.21  | 2.0335 |
| 10.20                                                                                                                                 | 1.8183 | .. | 11.19 | 1.9825 | .. | 1.24  | 2.0267 |
| 10.22                                                                                                                                 | 1.8512 | .. | 11.22 | 1.9661 | .. | 1.28  | 2.0384 |
| 10.25                                                                                                                                 | 1.9047 | .. | 11.29 | 1.9947 | .. | 1.31  | 2.0155 |
| 10.27                                                                                                                                 | 1.9165 | .. | 12.3  | 1.9649 | .. | 2.4   | 1.9934 |
| .....                                                                                                                                 |        |    |       |        |    |       |        |

TABLE XIII. CONTINUED

| .....<br>. MOISTURE DESORBED FROM PANEL #78241-97 82W3D-1 .<br>. 5 PLY KEVLAR - WEST PALM BEACH .<br>. AVERAGE OF DATA FROM FOUR COUPONS .<br>..... |        |    |       |        |    |       |        |
|-----------------------------------------------------------------------------------------------------------------------------------------------------|--------|----|-------|--------|----|-------|--------|
| DATE                                                                                                                                                | % WT.  | .. | DATE  | % WT.  | .. | DATE  | % WT.  |
|                                                                                                                                                     | CHANGE | .. |       | CHANGE | .. |       | CHANGE |
| 10.5                                                                                                                                                | 0      | .. | 11.1  | 2.0122 | .. | 12.13 | 2.1388 |
| 10.6                                                                                                                                                | .65419 | .. | 11.3  | 1.9844 | .. | 12.17 | 2.1312 |
| 10.7                                                                                                                                                | .92729 | .. | 11.5  | 1.9817 | .. | 1.10  | 2.1696 |
| 10.8                                                                                                                                                | 1.0938 | .. | 11.8  | 2.0429 | .. | 1.14  | 2.1498 |
| 10.11                                                                                                                                               | 1.5117 | .. | 11.10 | 2.0635 | .. | 1.17  | 2.1498 |
| 10.13                                                                                                                                               | 1.644  | .. | 11.12 | 2.0378 | .. | 1.21  | 2.1337 |
| 10.15                                                                                                                                               | 1.7232 | .. | 11.15 | 2.0745 | .. | 1.24  | 2.1346 |
| 10.18                                                                                                                                               | 1.8487 | .. | 11.19 | 2.0865 | .. | 1.28  | 2.1487 |
| 10.20                                                                                                                                               | 1.8984 | .. | 11.22 | 2.0639 | .. | 1.31  | 2.1266 |
| 10.22                                                                                                                                               | 1.9333 | .. | 11.29 | 2.0948 | .. | 2.4   | 2.0987 |
| 10.25                                                                                                                                               | 1.9957 | .. | 12.3  | 2.0669 | .. | 2.7   | 2.1255 |
| 10.27                                                                                                                                               | 2.0079 | .. | 12.6  | 2.0377 | .. | 2.11  | 2.1706 |
| 10.29                                                                                                                                               | 2.0276 | .. | 12.10 | 2.1274 | .. | 2.14  | 2.1463 |
| .....                                                                                                                                               |        |    |       |        |    |       |        |

TABLE XIII. CONTINUED

| .....<br>MOISTURE DESORBED FROM PANEL #78241-58 82S3D<br>5 PLY KEVLAR - STRATFORD<br>AVERAGE OF DATA FROM FOUR COUPONS<br>..... |                 |       |                 |       |                 |      |                 |
|---------------------------------------------------------------------------------------------------------------------------------|-----------------|-------|-----------------|-------|-----------------|------|-----------------|
| DATE                                                                                                                            | % WT.<br>CHANGE | DATE  | % WT.<br>CHANGE | DATE  | % WT.<br>CHANGE | DATE | % WT.<br>CHANGE |
| 10.5                                                                                                                            | 0               | 11.1  | 1.5889          | 12.13 | 1.6945          |      |                 |
| 10.6                                                                                                                            | .50515          | 11.3  | 1.5611          | 12.17 | 1.6887          |      |                 |
| 10.7                                                                                                                            | .73506          | 11.5  | 1.5633          | 1.10  | 1.7204          |      |                 |
| 10.8                                                                                                                            | .8563           | 11.8  | 1.6151          | 1.14  | 1.6976          |      |                 |
| 10.11                                                                                                                           | 1.208           | 11.10 | 1.6298          | 1.17  | 1.702           |      |                 |
| 10.13                                                                                                                           | 1.3071          | 11.12 | 1.6047          | 1.21  | 1.7075          |      |                 |
| 10.15                                                                                                                           | 1.367           | 11.15 | 1.6391          | 1.24  | 1.696           |      |                 |
| 10.18                                                                                                                           | 1.4784          | 11.19 | 1.6554          | 1.28  | 1.7051          |      |                 |
| 10.20                                                                                                                           | 1.5207          | 11.22 | 1.6304          | 1.31  | 1.681           |      |                 |
| 10.22                                                                                                                           | 1.5449          | 11.29 | 1.653           | 2.4   | 1.6553          |      |                 |
| 10.25                                                                                                                           | 1.5803          | 12.3  | 1.629           | 2.7   | 1.6759          |      |                 |
| 10.27                                                                                                                           | 1.5935          | 12.6  | 1.6023          | 2.11  | 1.713           |      |                 |
| 10.29                                                                                                                           | 1.607           | 12.10 | 1.6833          | 2.14  | 1.7012          |      |                 |
| .....                                                                                                                           |                 |       |                 |       |                 |      |                 |

TABLE XIII. CONCLUDED

| .....<br>MOISTURE DESORBED FROM PANEL #78241-88 82S3D<br>5 PLY KEVLAR - STRATFORD<br>AVERAGE OF DATA FROM FOUR COUPONS<br>..... |                 |    |       |                 |    |       |                 |
|---------------------------------------------------------------------------------------------------------------------------------|-----------------|----|-------|-----------------|----|-------|-----------------|
| DATE                                                                                                                            | % WT.<br>CHANGE | .. | DATE  | % WT.<br>CHANGE | .. | DATE  | % WT.<br>CHANGE |
| 10.5                                                                                                                            | 0               | .. | 11.1  | 1.6288          | .. | 12.13 | 1.7457          |
| 10.6                                                                                                                            | .53997          | .. | 11.3  | 1.6054          | .. | 12.17 | 1.7319          |
| 10.7                                                                                                                            | .75937          | .. | 11.5  | 1.6057          | .. | 1.10  | 1.7625          |
| 10.8                                                                                                                            | .87841          | .. | 11.8  | 1.6631          | .. | 1.14  | 1.749           |
| 10.11                                                                                                                           | 1.2396          | .. | 11.10 | 1.6789          | .. | 1.17  | 1.7497          |
| 10.13                                                                                                                           | 1.3357          | .. | 11.12 | 1.6504          | .. | 1.21  | 1.7548          |
| 10.15                                                                                                                           | 1.402           | .. | 11.15 | 1.6803          | .. | 1.24  | 1.7432          |
| 10.18                                                                                                                           | 1.513           | .. | 11.19 | 1.7005          | .. | 1.28  | 1.7539          |
| 10.20                                                                                                                           | 1.5558          | .. | 11.22 | 1.6751          | .. | 1.31  | 1.7319          |
| 10.22                                                                                                                           | 1.5886          | .. | 11.29 | 1.6972          | .. | 2.4   | 1.7025          |
| 10.25                                                                                                                           | 1.6249          | .. | 12.3  | 1.6748          | .. | 2.7   | 1.7231          |
| 10.27                                                                                                                           | 1.6345          | .. | 12.6  | 1.6456          | .. | 2.11  | 1.7541          |
| 10.29                                                                                                                           | 1.6448          | .. | 12.10 | 1.7308          | .. | 2.14  | 1.7506          |
| .....                                                                                                                           |                 |    |       |                 |    |       |                 |

TABLE XIV

WEATHER BUREAU DATA, WEST PALM BEACH, FLORIDA

| DATE                | AVERAGE<br>TEMPERATURE |      | AVERAGE<br>RELATIVE HUMIDITY<br>% |
|---------------------|------------------------|------|-----------------------------------|
|                     | °C                     | °F   |                                   |
| 4/01/78 - 4/30/78   | 22.9                   | 73.2 | 67.9                              |
| 5/01/78 - 5/31/78   | 26.0                   | 78.9 | 77.5                              |
| 6/01/78 - 6/30/78   | 27.5                   | 81.6 | 78.3                              |
| 7/01/78 - 7/31/78   | 27.8                   | 82.1 | 76.3                              |
| 8/01/78 - 8/31/78   | 27.9                   | 82.2 | 73.3                              |
| 9/01/78 - 9/30/78   | 27.0                   | 80.7 | 76.4                              |
| 10/01/78 - 10/31/78 | 24.9                   | 77.0 | 74.9                              |
| 11/01/78 - 11/30/78 | 23.1                   | 73.7 | 79.4                              |
| 12/01/78 - 12/31/78 | 20.2                   | 68.4 | 80.1                              |
| 1/01/79 - 1/31/79   | 17.0                   | 62.7 | 66.8                              |
| 2/01/79 - 2/28/79   | 17.6                   | 63.7 | 79.3                              |
| 3/01/79 - 3/31/79   | 20.0                   | 68.0 | 66.8                              |
| 4/01/79 - 4/30/79   | 23.5                   | 74.4 | 68.6                              |
| 5/01/79 - 5/31/79   | 24.4                   | 76.0 | 79.3                              |
| 6/01/79 - 6/30/79   | 26.8                   | 80.2 | 75.4                              |
| 7/01/79 - 7/31/79   | 28.1                   | 82.7 | 75.9                              |
| 8/01/79 - 8/31/79   | 28.0                   | 82.5 | 73.0                              |
| 9/01/79 - 9/30/79   | 27.4                   | 81.3 | 83.5                              |
| 10/01/79 - 10/31/79 | 25.3                   | 77.5 | 77.4                              |
| 11/01/79 - 11/30/79 | 22.9                   | 73.2 | 80.1                              |
| 12/01/79 - 12/31/79 | 19.5                   | 67.1 | 80.3                              |
| 1/01/80 - 1/31/80   | 17.8                   | 64.1 | 80.5                              |
| 2/01/80 - 2/29/80   | 16.0                   | 60.9 | 76.0                              |
| 3/01/80 - 3/31/80   | 21.2                   | 70.2 | 77.3                              |
| 4/01/80 - 4/30/80   | 22.1                   | 71.8 | 77.1                              |
| 5/01/80 - 5/31/80   | 24.8                   | 76.6 | 77.1                              |
| 6/01/80 - 6/30/80   | 27.4                   | 81.3 | 70.9                              |
| 7/01/80 - 7/31/80   | 28.0                   | 82.4 | 75.1                              |
| 8/01/80 - 8/31/80   | 22.4                   | 72.4 | 78.9                              |
| 9/01/80 - 9/30/80   | 26.7                   | 80.1 | 80.3                              |
| 10/01/80 - 10/31/80 | 25.3                   | 77.5 | 76.4                              |
| 11/01/80 - 11/30/80 | 17.6                   | 63.8 | 68.1                              |
| 12/01/80 - 12/31/80 | 18.3                   | 64.9 | 61.4                              |

TABLE XIV. CONCLUDED

| DATE                | AVERAGE<br>TEMPERATURE |      | AVERAGE<br>RELATIVE HUMIDITY<br>% |
|---------------------|------------------------|------|-----------------------------------|
|                     | °C                     | °F   |                                   |
| 1/01/81 - 1/31/81   | 14.4                   | 58.0 | 56.3                              |
| 2/01/81 - 2/29/81   | 19.3                   | 66.8 | 67.9                              |
| 3/01/81 - 3/31/81   | 15.4                   | 59.8 | 63.5                              |
| 4/01/81 - 4/30/81   | 23.9                   | 75.1 | 65.6                              |
| 5/01/81 - 5/31/81   | 25.5                   | 77.9 | 60.1                              |
| 6/01/81 - 6/30/81   | 28.1                   | 82.6 | 72.8                              |
| 7/01/81 - 7/31/81   | 28.7                   | 83.7 | 72.1                              |
| 8/01/81 - 8/31/81   | 27.5                   | 81.5 | 77.9                              |
| 9/01/81 - 9/30/81   | 26.5                   | 79.8 | 77.9                              |
| 10/01/81 - 10/31/81 | 25.2                   | 77.4 | 75.4                              |
| 11/01/81 - 11/30/81 | 19.7                   | 67.5 | 74.4                              |
| 12/01/81 - 12/31/81 | 18.3                   | 65.0 | 73.0                              |
| 1/01/82 - 1/31/82   | 18.8                   | 65.8 | 67.0                              |
| 2/01/82 - 2/28/82   | 22.6                   | 72.6 | 72.8                              |
| 3/01/82 - 3/31/82   | 22.7                   | 72.9 | 75.8                              |
| 4/01/82 - 4/30/82   | 24.2                   | 75.6 | 74.0                              |
| 5/01/82 - 5/31/82   | 24.5                   | 76.3 | 70.9                              |
| 6/01/82 - 6/30/82   | 26.8                   | 80.3 | 80.8                              |
| 7/01/82 - 7/31/82   | 28.1                   | 82.5 | 71.6                              |
| 8/01/82 - 8/31/82   | 27.7                   | 81.9 | 74.8                              |
| 9/01/82 - 9/30/82   | 27.2                   | 80.9 | 75.4                              |
| 10/01/82 - 10/31/82 | 26.5                   | 78.0 | 67.1                              |
| 11/01/82 - 11/30/82 | 24.1                   | 75.3 | 72.8                              |
| 12/01/82 - 12/31/82 | 21.4                   | 70.6 | 71.9                              |
| 1/01/83 - 1/31/83   | 17.9                   | 64.3 | 77.0                              |
| 2/01/83 - 2/28/83   | 18.8                   | 66.0 | 71.8                              |
| 3/01/83 - 3/31/83   | 19.3                   | 66.8 | 69.3                              |
| 4/01/83 - 4/30/83   | 22.4                   | 72.4 | 67.5                              |
| 5/01/83 - 5/31/83   | 25.0                   | 77.0 | 70.3                              |
| 6/01/83 - 6/30/83   | 26.9                   | 80.5 | 81.3                              |
| 7/01/83 - 7/31/83   | 28.7                   | 83.8 | 73.0                              |

TABLE XV. SUMMARY OF COUPON TEST RESULTS

| Material                      | Test            | Ply Orientation                                             | Number<br>of<br>Tests | Test<br>Temperature<br>°C (°F) | Strength<br>MPa (KSI)   | Coefficient<br>of<br>Variation | Exposure                         |
|-------------------------------|-----------------|-------------------------------------------------------------|-----------------------|--------------------------------|-------------------------|--------------------------------|----------------------------------|
| Graphite/<br>Epoxy<br>AS/6350 | SBS, Static     | 0 <sub>8</sub>                                              | 23                    | 23.8 (75)                      | 110.3 (16.0)            | 4.6                            | Qualification baseline, RTD      |
|                               | SBS, Static     | 0 <sub>8</sub>                                              | 3                     | 23.8                           | 110.3 (16.1)            | 2.1                            | 1½ Years, Gulf Coast, Stabilizer |
|                               | SBS, Static     | 0 <sub>6</sub>                                              | 19                    | 23.8                           | 113.1 (16.4)            | 5.7                            | Panel Coupons, Baseline RTD      |
|                               | SBS, Static     | 0 <sub>6</sub>                                              | 18                    | 23.8                           | 100.7 (14.6)            | 5.0                            | 2 Years, Stratford               |
|                               | SBS, Static     | 0 <sub>6</sub>                                              | 18                    | 23.8                           | 96.5 (14.0)             | 3.4                            | 2 Years, West Palm Beach         |
|                               | SBS, Static     | 0 <sub>6</sub>                                              | 19                    | 23.8 (75)                      | 90.9 (13.2)             | 3.0                            | 2 Years, West Palm Beach         |
|                               | SBS, Static     | 0 <sub>14</sub>                                             | 18                    | 23.8 (75)                      | 102.0 (14.8)            | 4.1                            | 2 Years, Stratford               |
|                               | SBS, Static     | 0 <sub>14</sub>                                             | 13                    | 76.6 (170)                     | 73.8 (10.7)             | 2.7                            | 2 Years, Stratford               |
|                               | SBS, Static     | (0 <sub>12</sub> /-20/0/+20/0 <sub>1.5</sub> ) <sub>S</sub> | 17                    | 23.8 (75)                      | 86.9 (12.6)             | 3.6                            | Panel Coupon, Baseline RTD       |
|                               | SBS, Static     | (0 <sub>12</sub> /-20/0/+20/0 <sub>1.5</sub> ) <sub>S</sub> | 15                    | 23.8                           | 83.4 (12.1)             | 5.3                            | 2 Years, Stratford               |
|                               | SBS, Static     | (0 <sub>12</sub> /-20/0/+20/0 <sub>1.5</sub> ) <sub>S</sub> | 15                    | 23.8                           | 84.1 (12.2)             | 5.0                            | 2 Years, West Palm Beach         |
|                               | SBS, Static     | 0 <sub>6</sub>                                              | 18                    | 23.8                           | 91.0 (13.2)             | 3.7                            | 3 Years, Stratford               |
|                               | SBS, Static     | 0 <sub>6</sub>                                              | 18                    | 23.8                           | 95.9 (13.9)             | 2.5                            | 3 Years, Stratford               |
|                               | SBS, Static     | 0 <sub>6</sub>                                              | 18                    | 23.8                           | 89.0 (12.9)             | 3.1                            | 3 Years, West Palm Beach         |
|                               | SBS, Static     | 0 <sub>6</sub>                                              | 18                    | 23.8                           | 88.3 (12.8)             | 3.6                            | 3 Years, West Palm Beach         |
|                               | SBS, Static     | 0 <sub>14</sub>                                             | 18                    | 23.8 (75)                      | 91.7 (13.3)             | 7.0                            | 3 Years, Stratford               |
|                               | SBS, Static     | 0 <sub>14</sub>                                             | 18                    | 76.6 (170)                     | 53.8 (7.8)              | 4.2                            | 3 Years, Stratford               |
|                               | SBS, Static     | (0 <sub>12</sub> /-20/0/+20/0 <sub>1.5</sub> ) <sub>S</sub> | 15                    | 23.8 (75)                      | 75.9 (11.0)             | 4.6                            | 3 Years, Stratford               |
|                               | SBS, Static     | (0 <sub>12</sub> /-20/0/+20/0 <sub>1.5</sub> ) <sub>S</sub> | 15                    | 23.8 (75)                      | 77.9 (11.3)             | 2.6                            | 3 Years, West Palm Beach         |
| Kevlar/<br>Epoxy<br>285/5143  | Tension, Static | (0/90) <sub>5</sub>                                         | 18                    | 23.8 (75)                      | 631.5 (91.6)            | 6.0                            | Panel Coupon, Baseline RTD       |
|                               |                 | (0/90) <sub>5</sub>                                         | 9                     | 23.8 (75)                      | 666.7 (96.7)            | 8.7                            | 2 Years, Stratford               |
|                               |                 | (0/90) <sub>5</sub>                                         | 10                    | 23.8 (75)                      | 632.2 (91.7)            | 6.5                            | 2 Years, West Palm Beach         |
|                               |                 | (0/90) <sub>5</sub>                                         | 10                    | 23.8 (170)                     | 677.7 (98.3)            | 6.6                            | 2 Years, Stratford               |
|                               |                 | (0/90) <sub>5</sub>                                         | 7                     | 23.8 (75)                      | 667.3 (96.8)            | 6.5                            | 3 Years, Stratford               |
|                               |                 | (0/90) <sub>5</sub>                                         | 7                     | 23.8 (75)                      | 646.6 (93.8)            | 12.9                           | 3 Years, West Palm Beach         |
|                               |                 | (0/90) <sub>5</sub>                                         | 7                     | 76.6 (170)                     | 592.2 (85.9)            | 11.7                           | 3 Years, Stratford               |
|                               |                 | (0/90) <sub>5</sub>                                         | 7                     | 76.6 (170)                     | 588.0 (85.3)            | 6.6                            | 3 Years, West Palm Beach         |
|                               | Tension, Static | (0/90) <sub>6</sub>                                         | 14                    | 23.8 (75)                      | 590.2 (85.6)            | 4.4                            | Qualification Baseline RTD       |
|                               | SBS, Fatigue    | (0/90) <sub>6</sub>                                         | 5                     | 23.8 (75)                      | 10.3 (1.5) <sup>1</sup> |                                | 1½ Yrs, Gulf Coast, Stabilizer   |

TABLE XV. CONCLUDED

| Material                      | Test         | Ply Orientation                                             | Number<br>of<br>Tests | Test<br>Temperature<br>°C | (°F) | Strength<br>MPa | (KSI)              | Coefficient<br>of<br>Variation | Exposure                       |
|-------------------------------|--------------|-------------------------------------------------------------|-----------------------|---------------------------|------|-----------------|--------------------|--------------------------------|--------------------------------|
| Grahpite/<br>Epoxy<br>AS/6350 | Flex, Static | 0 <sub>6</sub>                                              | 20                    | 23.8                      | (75) | 1696.5          | (246.0)            | 5.9                            | Panel Coupon Baseline RTD      |
|                               | Flex, Static | 0 <sub>6</sub>                                              | 18                    | 23.8                      | (75) | 1782.3          | (258.5)            | 4.4                            | 2 Years, West Palm Beach       |
|                               | Flex, Static | 0 <sub>6</sub>                                              | 15                    | 23.8                      | (75) | 2011.2          | (291.7)            | 5.8                            | 2 Years, West Palm Beach       |
|                               | Flex, Static | 0 <sub>6</sub>                                              | 12                    | 23.8                      | (75) | 1876.7          | (272.2)            | 7.5                            | 2 Years, Stratford             |
|                               | Flex, Static | 0 <sub>14</sub>                                             | 18                    | 23.8                      | (75) | 1449.9          | (210.3)            | 5.6                            | Panel Coupon Baseline RTD      |
|                               | Flex, Static | 0 <sub>14</sub>                                             | 18                    | 23.8                      | (75) | 1375.5          | (199.5)            | 3.2                            | 2 Years, Stratford             |
|                               | Flex, Static | (0 <sub>12</sub> /-20/0/+20/0 <sub>1.5</sub> ) <sub>S</sub> | 13                    | 23.8                      | (75) | 1209.3          | (175.4)            | 5.5                            | Panel Coupon Baseline RTD      |
|                               | Flex, Static | (0 <sub>12</sub> /-20/0/+20/0 <sub>1.5</sub> ) <sub>S</sub> | 18                    | 23.8                      | (75) | 1260.3          | (182.8)            | 6.7                            | 2 Years, Stratford             |
|                               | Flex, Static | (0 <sub>12</sub> /-20/0/+20/0 <sub>1.5</sub> ) <sub>S</sub> | 18                    | 23.8                      | (75) | 1246.6          | (180.8)            | 5.9                            | 2 Years, West Palm Beach       |
|                               | Flex, Static | 0 <sub>6</sub>                                              | 18                    | 23.8                      | (75) | 1625.5          | (235.7)            | 6.7                            | 3 Years, West Palm Beach       |
|                               | Flex, Static | 0 <sub>6</sub>                                              | 18                    | 23.8                      | (75) | 1771.0          | (256.8)            | 3.4                            | 3 Years, West Palm Beach       |
|                               | Flex, Static | 0 <sub>6</sub>                                              | 18                    | 23.8                      | (75) | 1704.1          | (247.1)            | 3.7                            | 3 Years, Stratford             |
|                               | Flex, Static | 0 <sub>6</sub>                                              | 18                    | 23.8                      | (75) | 1660.7          | (240.8)            | 4.2                            | 3 Years, Stratford             |
|                               | Flex, Static | 0 <sub>14</sub>                                             | 18                    | 23.8                      | (75) | 1433.1          | (207.8)            | 6.2                            | 3 Years, Stratford             |
|                               | Flex, Static | 0 <sub>14</sub>                                             | 18                    | 23.8                      | (75) | 1550.3          | (224.8)            | 8.6                            | 3 Years, Stratford             |
|                               | Flex, Static | (0 <sub>12</sub> /-20/0/+20/0 <sub>1.5</sub> ) <sub>S</sub> | 12                    | 23.8                      | (75) | 1185.5          | (171.9)            | 6.4                            | 3 Years, West Palm Beach       |
|                               | Flex, Static | (0 <sub>12</sub> /-20/0/+20/0 <sub>1.5</sub> ) <sub>S</sub> | 12                    | 23.8                      | (75) | 1235.2          | (179.1)            | 6.0                            | 3 Years, Stratford             |
| Graphite/<br>Epoxy<br>AS/6350 | SBS, Fatigue | 0 <sub>8</sub>                                              | 10                    | 23.8                      | (75) | 64.1            | (9.3) <sup>1</sup> |                                | Qualification Baseline RTD     |
|                               | SBS, Fatigue | 0 <sub>8</sub>                                              | 4                     | 23.8                      | (75) | 58.6            | (8.5) <sup>1</sup> |                                | 2 Years, Stratford             |
|                               | SBS, Fatigue | 0 <sub>14</sub>                                             | 10                    | 23.8                      | (75) | 53.8            | (7.8) <sup>1</sup> |                                | 1½ Yrs, Gulf Coast, Stabilizer |
|                               | SBS, Fatigue | (0 <sub>12</sub> /-20/0/+20/0 <sub>1.5</sub> ) <sub>S</sub> | 9                     | 23.8                      | (75) | 53.4            | (7.7) <sup>1</sup> |                                | Panel Coupon Baseline RTD      |
|                               | SBS, Fatigue | (0 <sub>12</sub> /-20/0/+20/0 <sub>1.5</sub> ) <sub>S</sub> | 12                    | 23.8                      | (75) | 43.4            | (6.3) <sup>1</sup> |                                | 2 Years, Stratford             |
|                               | SBS, Fatigue | (0 <sub>12</sub> /-20/0/+20/0 <sub>1.5</sub> ) <sub>S</sub> | 10                    | 23.8                      | (75) | 42.1            | (6.1) <sup>1</sup> |                                | 2 Years, West Palm Beach       |
|                               | SBS, Fatigue | (0 <sub>12</sub> /-20/0/+20/0 <sub>1.5</sub> ) <sub>S</sub> | 14                    | 23.8                      | (75) | 50.6            | (7.3) <sup>1</sup> |                                | 3 Years, West Palm Beach       |

Note:

1. Maximum stress in cycle, R = 0.1, at 10<sup>7</sup> cycles.

## SECTION 8.0 REFERENCES

- (1) Rich, M. and Lowry, D. "Flight Service Evaluation of Composite Helicopter Components", First Annual Report March 1981 through April 1982, NASA CR-165952, June 1982.
- (2) National Oceanic and Atmospheric Administration "Local Climatological Data, Monthly Summary", United States Department of Commerce, National Climatic Data Center, Federal Building, Asheville, N.C. 28801.



|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |  |                                                      |  |                                                                                     |  |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|------------------------------------------------------|--|-------------------------------------------------------------------------------------|--|
| 1. Report No.<br>NASA CR-172562                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |  | 2. Government Accession No.                          |  | 3. Recipient's Catalog No.                                                          |  |
| 4. Title and Subtitle<br>FLIGHT SERVICE EVALUATION OF COMPOSITE<br>HELICOPTER COMPONENTS                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |  |                                                      |  | 5. Report Date<br>April 1985                                                        |  |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |  |                                                      |  | 6. Performing Organization Code                                                     |  |
| 7. Author(s)<br>MELVIN J. RICH AND DAVID W. LOWRY                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |  |                                                      |  | 8. Performing Organization Report No.<br>SER-510117                                 |  |
| 9. Performing Organization Name and Address<br>SIKORSKY AIRCRAFT<br>DIVISION OF UNITED TECHNOLOGIES<br>STRATFORD CONNECTICUT 06601                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |  |                                                      |  | 10. Work Unit No.                                                                   |  |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |  |                                                      |  | 11. Contract or Grant No.<br>NAS1-16542                                             |  |
| 12. Sponsoring Agency Name and Address<br>NATIONAL AERONAUTICS AND SPACE ADMINISTRATION<br>WASHINGTON, D. C. 20546                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |  |                                                      |  | 13. Type of Report and Period Covered<br>Contractor Report<br>May 1982 - Sept. 1983 |  |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |  |                                                      |  | 14. Sponsoring Agency Code                                                          |  |
| 15. Supplementary Notes<br>LANGLEY TECHNICAL MONITOR: DONALD BAKER<br>FINAL REPORT                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |  |                                                      |  |                                                                                     |  |
| 16. Abstract<br>This report presents an assessment of composite helicopter structures, exposed to environmental effects, after four years of commercial service. This assessment is supported by test results of helicopter components and test panels which have been exposed to environmental effects since late 1979. Full scale static and fatigue tests are being conducted on composite components obtained from S-76 helicopters in commercial operations in the Gulf Coast region of Louisiana. Small scale tests are being conducted on coupons obtained from panels being exposed to outdoor conditions in Stratford, Connecticut and West Palm Beach, Florida. The panel layups represent S-76 components. Moisture evaluations and strength tests are being conducted, on the S-76 components and panels, over a period of eight years. Results are discussed for components and panels with up to four years of exposure. |  |                                                      |  |                                                                                     |  |
| 17. Key Words (Suggested by Author(s))<br>Environmental Influences      Temperature<br>Graphite/epoxy<br>Kevlar/epoxy<br>Moisture                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |  |                                                      |  | 18. Distribution Statement<br>Unclassified - Unlimited                              |  |
| 19. Security Classif. (of this report)<br>Unclassified                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |  | 20. Security Classif. (of this page)<br>Unclassified |  | 21. No. of Pages<br>103                                                             |  |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |  |                                                      |  | 22. Price                                                                           |  |





