**PACIFIC TESTING LABORATORIES, INC.**

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# TEST REPORT

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|---|---|---|
| LAWRENCE BERKELEY LABORATORY<br>One Cyclotron Road<br>Berkeley, CA 94720<br><br>Attn: Eric Anderssen | W.O. Number<br>37363 | Specification<br>None Specified |
| | P.O.No.<br>6855472 | Received<br>08-08-2008 |

**IDENTIFICATION** : One (1) panel was submitted for testing in accordance with ASTM and Pacific Testing Laboratories methods. The samples were identified as follows:

**IDENTIFICATION**

**PHENIX Stave Material**

M55J UDT 72gsm, 41.3% EX1515, Net Resin, No Bleed, O-Degree Panel

**SPECIFICATION** : None specified.

**REFERENCE** : Lawrence Berkley purchase order 6855472.

**TESTING** : Density, Fiber Content, and Resin Content per ASTM D 3171-99(Reapproved 2004);
Tensile Strength, Young's Modulus & Poisson's Ratio in accordance with ASTM D 3039-00.

**SUMMARY** : The test results, reported herein, are submitted for customer evaluation.

Respectfully submitted,
PACIFIC TESTING LABORATORIES, INC.

Michael Shin
Laboratory Director

Donald W. Belanger
Staff Engineer

## TENSILE STRENGTH, YOUNG'S MODULUS AND POISSON'S RATIO

**REFERENCE** : ASTM D 3039-00

**REQUIREMENT** : Not Specified.

**TEST METHOD** : Seven test specimens were extracted from the received panel in the long direction orientation. Fiberglass tabs were bonded to the ends of the specimens to facilitate gripping without damage to the specimen. One T-strain gage was bonded to each of the specimens surface at the middle of each specimen along the centerline in the axial direction.

Each specimen was then individually placed in the grips of a United Testing Machine, ID# EC0387. Care was taken to insure that the long axis of the specimen coincides with the direction of the applied pull through the center line of the grip assembly. A load was continuosly applied to the specimen at a constant crosshead speed of 0.05 inches per minute until failure of the specimen was observed. The axial strain, transverse strain and load were recorded throughout the test. The stress, Poisson's Ratio, and Modulus were then calculated for each specimen.

The following test equipment was used for the purpose of conducting the Test:

United Testing Machine Model SFM-20, ID# EC0387
United Load Cell Model 10,000lb, ID# EC0010
United Strain Gage Box, ID# EC0939
United Strain Gage Box, ID# EC0940
Brown Sharp Micrometer Model MM2000, ID# EC0889
Digit-Cal Caliper Model 0-6 inch, ID# EC0899

**RESULTS** : The Tensile Strength, Young's Modulus, and Poisson's Ratio results are as follows:

| Specimen | Width | Thickness | Maximum Load | Maximum Stress | Poisson's Ratio | Modulus | Ultimate Extension |
|---|---|---|---|---|---|---|---|
| | (inches) | (inches) | (pounds) | (psi) | | (X $10^6$ psi) | % |
| Material: PHENIX Stave Material | | | | | | | |
| 1 | 0.500 | 0.0395 | 3,423 | 173,300 | 0.290 | 37.2 | 0.47 |
| 2 | 0.499 | 0.0391 | 3,955 | 202,700 | 0.356 | 37.4 | 0.55 |
| 3 | 0.500 | 0.0396 | 2,327 | 117,500 | 0.258 | 35.7 | 0.33 |
| 4 | 0.500 | 0.0391 | 3,935 | 201,300 | 0.283 | 36.9 | 0.55 |
| 5 | 0.499 | 0.0391 | 4,089 | 209,600 | 0.297 | 37.6 | 0.56 |
| 6 | 0.499 | 0.0393 | 3,659 | 186,600 | 0.324 | 37.0 | 0.51 |
| 7 | 0.500 | 0.0400 | 3,432 | 171,600 | 0.268 | 37.1 | 0.47 |
| | | | Average : | 180,400 | 0.297 | 37.0 | 0.49 |

**NOTE 1** : See "Stress vs. Strain" graphs included at the end of this report.

**REMARKS** : The test results are reported for customer evaluation.

## RESIN, FIBER and VOID CONTENT

**REFERENCE** : ASTM 792-00, "Test methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement";

ASTM D 3171-99(Reapproved 2004), "Test Method for Constituent Content of Composite Materials";

ASTM D 3529-97(2003), "Test Method for Resin Solids Content of Epoxy-Matrix Prepreg by Matrix Dissolution";

Pacific Testing Laboratories TP2001, "Test Procedure for the Determination of Specific Gravity and Density of Solid Materials";

Pacific Testing Laboratories TP2002, "Acid Digestion Test for the Determination of Fiber Volume, Resin Solids Content, and Nickel Content".

**REQUIREMENT** : None Specified

**TEST METHOD** : Density

Three (3) 1.0-inch by 0.5-inch (nominal) specimens were cut from the submitted panel. The specimens were dried for one hour at 100°C then cooled in a desiccator. The density of each specimen was determined using PTL TP2001 and ASTM D 792-00.

Fiber Volume and Resin Content

The same specimens used for density determination were then subjected to the acid digestion test per PTL TP2002, ASTM D 3171-99(Reapproved 2004), and ASTM D 3529-97(2003).

**RESULTS :**

| Specimen ID | Specimen Weight | Specimen Density | Fiber Content Volume | Resin Content Weight | Resin Content Volume | Void Content |
|---|---|---|---|---|---|---|
| (Units) | (g) | (g/cc) | % | % | % | % |
| Material: PHENIX Stave Material | | | | | | |
| 1 | 0.4934 | 1.534 | 47.46 | 40.74 | 53.26 | -0.72 |
| 2 | 0.4878 | 1.524 | 46.50 | 41.57 | 54.02 | -0.52 |
| 3 | 0.4723 | 1.527 | 46.54 | 41.65 | 54.23 | -0.77 |

**Notes: The following density data was used for the calculations above:**

**Resin Density(EX1515) : 1.17 grams/cm$^3$ (Provided by the customer)**

**Fiber Density(M55J) : 1.91 grams/cm$^3$ (Provided by the customer)**

**Note: Per ASTM D 3171-99(Reapproved 2004), paragraph 6.3 states that for a typical carbon/epoxy laminate, uncertainty in the void volume because of the limitation of the constituent density measurement would be approximately 1.0%.**

**RESULTS : The test results, reported herein, are submitted for customer evaluation.**

# Stress vs. Strain Graphs