TENSILE PROPERTIES OF AXF-5Q GRAPHITE

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The tensile properties of AXF-5Q Graphite have been determined at 70°F, 2000°F and 3000°F. The specimens used in tensile property evaluation were taken from two manufactured parts, two inch thick plates and aeroshells (eight inch diameter cylinders). The bulk of the data presented here was obtained from specimens removed from plates.

The tensile measurements were made in a Southern Research Institute (SoRI) gas bearing facility. Two types of specimens, shown in Figure 1, were used in plate tensile property evaluations. Thickness, or "c", direction specimens were 1.70 inches in length and were used for strength determination at room temperature, only. Three inch specimens taken in the "a" or "b" directions, were used to determine stress-strain behavior at 70°F, 2000°F and 3000°F.

Nondestructive characterization, consisting of measurements of bulk density and sonic velocity for each specimen, was performed prior to testing. In addition, the three inch specimens were X-rayed.

After mechanical testing, fracture faces of all specimens were inspected in order to check for material anomalies, such as voids, cracks or pore clusters. Where these were found, both their size and location were recorded.

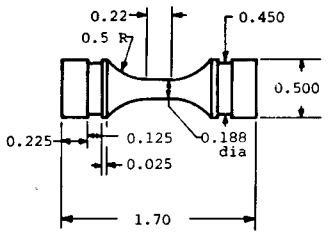
Figures 2, 3 and 4 are composite plots of stress-strain curves obtained in tensile evaluations of the three inch specimen from 70°F, 2000°F and 3000°F, respectively. These show the variability encountered in the stress-strain response of the plate material.

Figure 5 shows the probability of failure at a given stress level for both "a" and "c" direction specimens at 70°F and for "a" direction specimens only at 2000°F. The similarity of the two 70°F populations indicates that results obtained are essentially the same for both of "a" and "c" direction specimens. The fact that no volume effect is observed was expected since the gage volume of the two specimen types differs by only about a factor of four. The figure supports the conclusion that strength data obtained using the smaller specimen are valid. That the material is isotropic for strength is also inferred by the results shown on this figure.

The curve shown for 2000°F tensile evaluations of "a" direction specimen reveals the expected strength increase at the higher temperature.

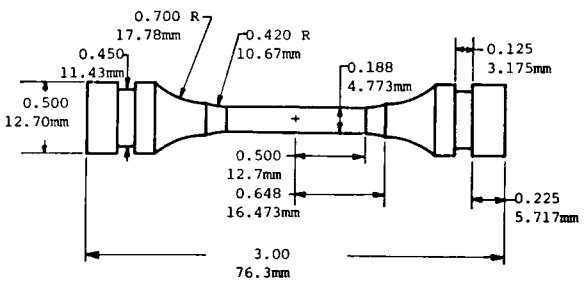
Figures 6 and 7 are plots of ultimate tensile strength at 70°F versus density and sonic velocity, respectively. The correlation between both density and sonic velocity and the ultimate strength indicate the suitability of these two monitors for possible use in quality control.

Figure 8 is a plot of ultimate tensile strength versus fracture face anomaly size. Anomalies greater than seven or eight mils in major diameter act as strength reducers. This result sets the required level of sensitivity for any nondestructive test which would be used to inspect the materials prior to use in hardware. For example, use of NDT to detect flaws of the type observed in Specimen BS-83-T-2 could be used to increase design allowables or reliability. This specimen has the low strength value shown in Figure 5.



"c" Direction Tension Specimen

Note: Unless otherwise indicated all dimensions are in inches



"a" or "b" Direction Tensile Specimen

Figure 1. Specimens Used in Plate Tensile Property Evaluations

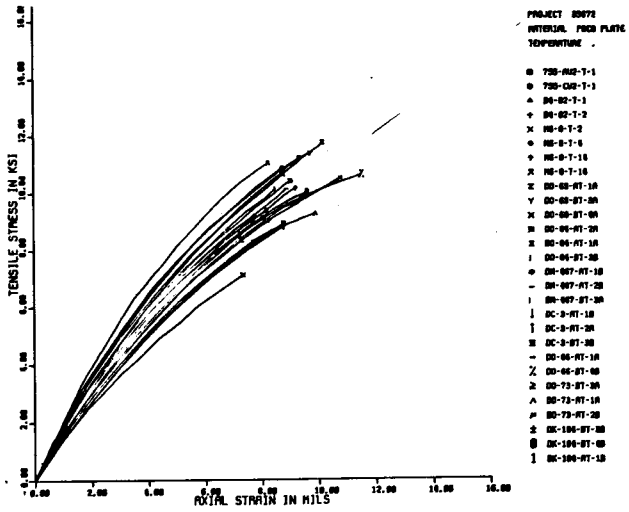


FIG. 2. COMPOSITE PLOT OF STRESS-STRAIN CURVES FOR 70 DEG F TENSILE EVALUATIONS OF VARIOUS POCO PLATE MATERIALS

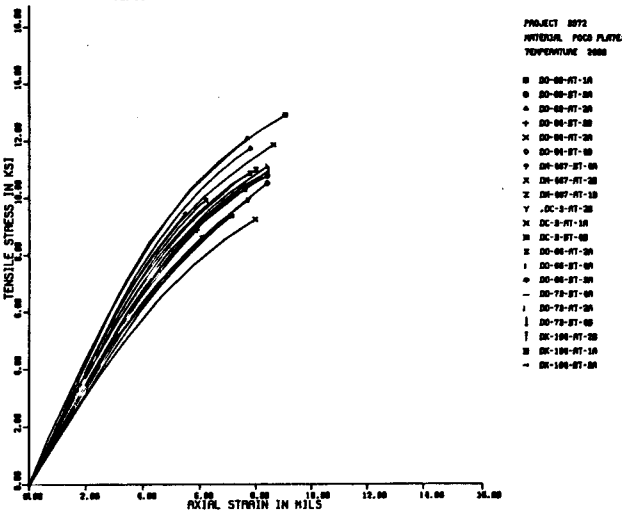


FIG. 3. COMPOSITE PLOT OF STRESS-STRAIN CURVES FOR 2000 DEG F TENSILE EVALUATIONS OF VARIOUS POCO PLATE MATERIALS

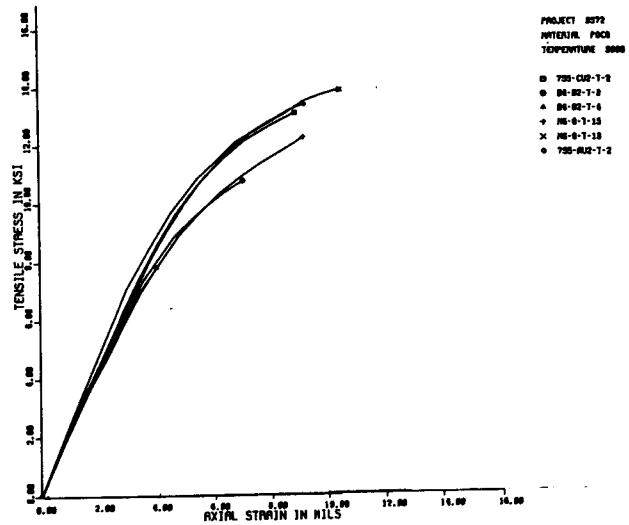


FIG. 4. COMPOSITE PLOT OF STRESS-STRAIN CURVES FOR 3000 DEG F TENSILE EVALUATIONS OF VARIOUS POCO PLATE MATERIALS

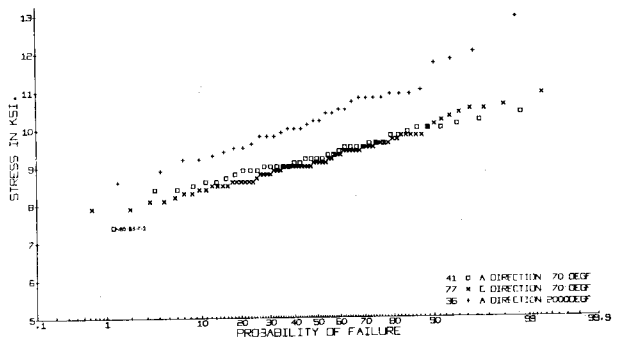


Figure 5. Probability of Failure versus Stress in ksi for Poco Plate Materials

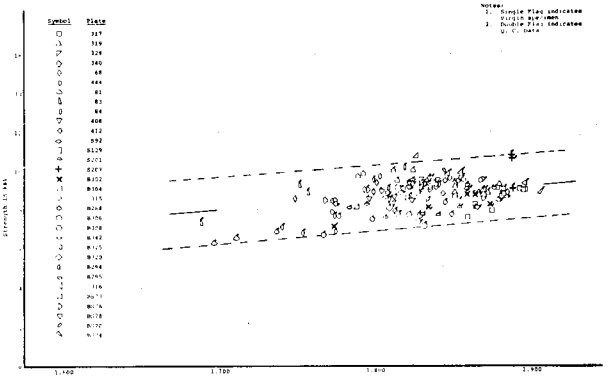


Figure 6. POCO Graphite Strength as a Function of Density

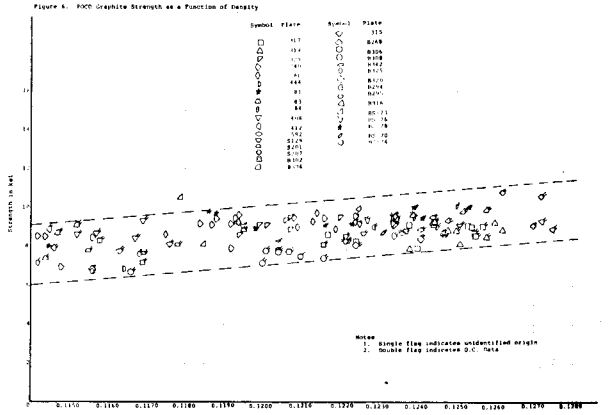


Figure 7. Poco Graphite Strength as a Function of Sonic Velocity

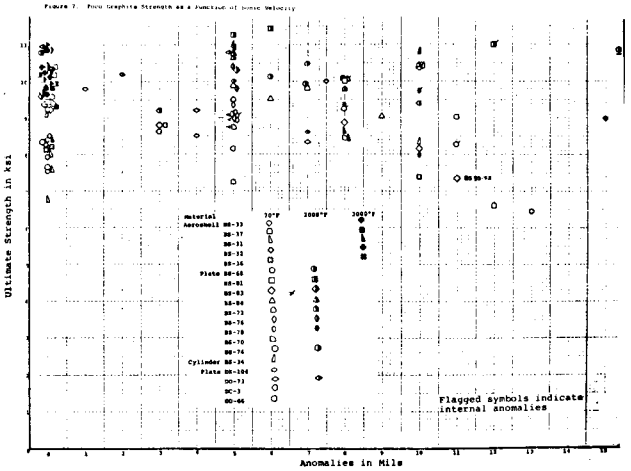


Figure 8. Plot of Tensile Strength versus the Anomaly Size