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# NASA TECH BRIEF

## *Marshall Space Flight Center*



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### Evaluation of Omniweave Reinforcement for Composite Fabrication

Experimentation and structural analyses indicate that molded composites incorporating omniweave fabrics, made from type-II Morganite and/or boron, are suitable for structural skins. Compared with conventional high-strength, lightweight skins, the omniweave skins save from 30% (pressurized applications) to 60% (unpressurized applications) in weight.

Twenty-two omniweave fabrics made from S-glass (20-filament end roving), type-II Morganite (10,000-filament end roving), Thornel-50S (two-ply yarn), boron (tungsten-cored, 0.32 cm wide filament tape), and mixtures of these materials, all of which were preimpregnated with epoxy resins, were woven and tested. Four different omniweave geometries were employed. Difficulties were experienced in weaving wide specimens with Thornel and boron, but all materials can be woven. The weaving was done primarily to test the manufacturing feasibility of the omniweave method.

In the composites molded from all of these multidirectional fabrics, the level of porosity was generally lower than 5%. Selected composites were evaluated for flexural, tensile, compression, interlaminar, and shear properties, and the effects of weave geometry and type of fiber on mechanical properties were noted. The OMNI computer code was used for analytically estimating the composites' properties.

Composites made from boron preimpregnated with HT424 epoxy-phenolic resin showed tensile properties comparable to those of a unidirectional composite having a similar volume fraction of fiber. The fact that composites of S-glass and Morganite showed slightly poorer mechanical properties than those pre-

dicted by structural analysis indicates that processing techniques could be improved.

Data trends indicate that the layered-in-depth omniweave construction yields higher in-plane strength characteristics than the fiber-pitch-angle construction, and that strength and moduli data varied with fiber orientation, as had been predicted. The transverse-compression properties of several S-glass and Morganite composites were significantly higher than expected. Values for interlaminar shear failure could not be obtained by the short-beam-shear approach, and the primary mode of failure was predominantly flexural stress.

Mechanical-property prediction curves for S-glass, Morganite, Thornel, and boron composites were generated by the OMNI computer program as functions of omniweave geometry and fiber-volume fraction. In general, the test data closely followed these predicted curves. Off-axis tensile tests were performed on a unidirectional composite of S-glass and epoxy to furnish realistic inputs for the OMNI computer code.

#### Note:

The following documentation may be obtained from:

National Technical Information Service  
Springfield, Virginia 22151  
Single document price \$3.00  
(or microfiche \$0.95)

#### Reference:

NASA-CR-102916 (N71-11441), Evaluation of Omniweave (GE) Method of Composite Fabrication - Graphite Filament

(continued overleaf)

**Patent status:**

Inquiries about obtaining rights for the commercial use of this invention may be made to:

Patent Counsel

Mail Code A&TS-PAT

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