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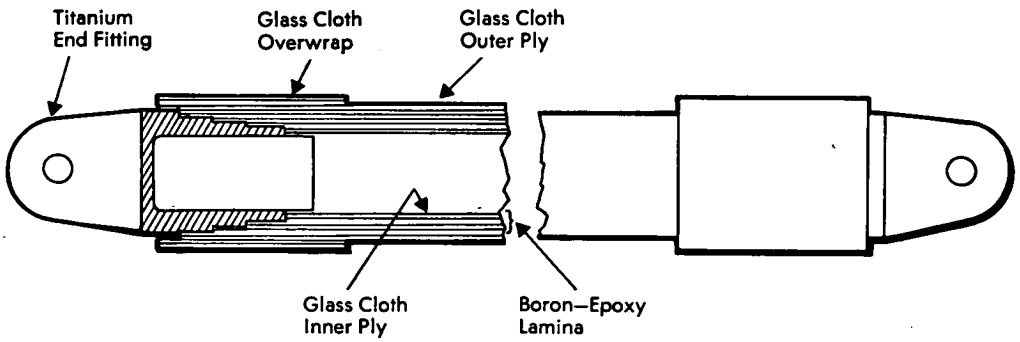
NASA TECH BRIEF

Ames Research Center

Boron—Epoxy Tubular Structure Members



Composite materials, particularly boron—epoxy and graphite—epoxy laminates have been used to fabricate thin-walled tubular members which have the same load-carrying capabilities as aluminum, titanium, or other metals, but are lighter.

For example, the platform-support strut depicted in the diagram is a pin-jointed member which is subjected to high axial compression and tension. The tubular section is a four-ply laminate of unidirectional boron—epoxy with fibers that are essentially axial in orientation. The laminate is stabilized on the inside and on the outside by one-ply glass cloth with circumferential warp direction. Two additional plies of glass cloth are provided for short distances at each tube end to give greater hoop strength at the transition to the end fittings. The end fittings are machined titanium parts shaped with circular stepped ends to match similar steps formed by the individual boron—epoxy plies.

The composite tube is layed-up and cured on a thin-walled aluminum mandrel which is dissolved in a sodium hydroxide bath after curing. The titanium end fittings are attached to the tube by a secondary bonding operation, utilizing a room-temperature-curing adhesive mixed with miniature glass beads for control of bond line thickness.

The interface between the stepped end fitting and the tube lends itself to attachments by primary as well as secondary bonding; with either bonding technique, load transfer takes place from the individual boron—epoxy laminates through shear in the bond line to the particular step on the end fitting to which the laminates are bonded; thus, interlaminar shear and hoop stress buildup in the attachment at the end fitting is avoided. Primary bonding, which involves lay-up of the boron—epoxy B-staged prepreg directly over the steps in the end fittings and subsequent dissolution of the mandrel through access holes in the end fittings, has been found adequate. The resin in the prepreg acts as the adhesive for bonding the boron—epoxy laminates to the end fittings.

(continued overleaf)

Note:

Requests for further information may be directed to:

Technology Utilization Officer
Ames Research Center
Moffett Field, California 94035
Reference: TSP 73-10265

Patent status:

NASA has decided not to apply for a patent.

Source: William B. J. Shakespeare, Paul T. Nelson, and Eric C. Lindkvist of TRW Systems Group under contract to Ames Research Center (ARC-10737)