

Overview

The development and analysis of new and innovative test methodologies for composite materials play a key role in our ability to use intelligently and confidently these materials in various structural applications. Defining a test methodology includes the development of testing techniques, such as specimen gripping, specimen design, displacement measurement, and specimen heating to name a few. When properly integrated into a test system and combined with appropriate experimental procedures, meaningful data can be produced for either development or verification. The manuscripts included from this session reflect some of the latest advances in metallic and polymeric composite testing.

“Thermomechanical Testing of High-Temperature Composites: Thermomechanical Fatigue (TMF) Behavior of SiC(SCS-6)/Ti-15-3” by Castelli, Bartolotta, and Ellis addresses the experimental difficulties involved with full thermomechanical testing. Various methods of specimen heating and specimen preparation are investigated to examine their influence on isothermal fatigue life. TMF conditions are shown to reduce drastically the high-temperature fatigue life of this titanium-based metal matrix composite. Damage and failure modes are also shown to be dependent upon the phase relationship between temperature and mechanical load.

“In-Plane Biaxial Compressive Deformation and Failure of E-Glass/Epoxy Laminates” by Doong, Faoro, and Socie introduces a unique test system for in-plane compression testing. Critical issues such as specimen-load alignment, specimen edge reinforcement, and lateral support conditions are discussed in detail. Calculated buckling stresses are compared to experimental results in unidirectional and cross-ply E-glass/epoxy laminates. Compressive strengths obtained from this biaxial test method are found to be much lower than those determined from the commonly used uniaxial IITRI method. Also, the specimens’ compressive strengths were found to be insensitive to the major/minor axis stress ratio.

“The Effect of Tab Orientation on the Distribution of Strains in Composite Specimens” by Foos, Wolfe, and Sandhu presents an experimental technique for minimizing non-uniformities in the stress/strain field of graphite/epoxy tabbed coupon specimens. Large non-uniformities can lead to premature failure outside the gage section and cast doubt on obtained tensile properties. A finite element analysis supported by experimental verification reveals that the strain field uniformity for any given laminate is dependent upon the angle that the tab line forms with the specimen. Tab angles are optimized on the basis of strain field uniformity for several laminates. Results show an increase in experimentally obtained tensile strengths and a reduction in the occurrences of tab region failures.

Thus, thermomechanical fatigue and biaxial compression testing and the effect of tab orientation on the test specimen are the general test methodology topics covered in this session that are important to the testing community.