

# Test Methods for Composite Materials

## About the Seminar:

Composite materials, whether for use in high performance structures or in commodity applications, present many unique mechanical testing problems. Thus, this two-day seminar will be directed toward the proper selection of a test method for each specific application, from the many methods currently available. Examples will include properties characterization for mechanical design, and evaluations of manufacturing quality control. Although many test methods have been standardized by ASTM, ISO and other groups, some have not, having been developed as company standards over the years. Thus, it is important to be able to decide which test to use in a particular situation, and which composite characteristics are to be determined. The goal is to understand what needs to be done, and the required facilities, time, and costs involved in doing so. As will be demonstrated, mechanical testing can be very time consuming and expensive. Thus, it is especially important to do it correctly the first time. This is a particular challenge because of the wide range of test methods often available and in common use for determining the same composite property. Tensile, compressive, flexure, shear and fracture toughness test methods for unidirectional, laminate, random-fiber-reinforced, and sandwich panel composites will be evaluated. This will include the special problems involved when making evaluations at temperatures above and below ambient, and when testing moisture-conditioned specimens. In all cases, proper specimen preparation techniques and test procedures will be emphasized.

## Who Should Attend:

This two-day seminar is intended both as an introduction for the novice and as a refresher for the experienced individual involved in any way with the design, manufacturing, and testing of composite components. This involvement may range from being the technician actually performing the testing, the engineer designing the test matrix and defining the test procedures, the manager overseeing the work, and the customer who must be sufficiently knowledgeable to accept or question the test results.

## Benefits of Attending

- ▶ Review, or be introduced to, the basic characteristics of composite materials
- ▶ Become familiar with the many properties of (orthotropic) composite materials
- ▶ Understand the historical development of composites and their associated test methods
- ▶ Appreciate the importance of properly interpreting test data
- ▶ Understand the roles of corporate, national and international standards organizations
- ▶ Gain an overall view of the many test methods available
- ▶ Evaluate specific test methods and compare competing methods
- ▶ Receive recommendations for the “best” test method in various applications

## Concepts Covered

- ▶ Introduction to composite materials testing
- ▶ Properties of orthotropic materials
- ▶ Available test methods and standards
- ▶ Tensile testing
- ▶ Compression testing
- ▶ Flexure test methods
- ▶ Shear test methods
- ▶ Multi-axial and fracture toughness testing
- ▶ Testing of fibers, the matrix, and the interface
- ▶ Fatigue, impact, and creep testing
- ▶ Testing equipment and data reduction



# Test Methods for Composite Materials

## Course Syllabus

### DAY 1

#### Introduction to Composite Materials Testing

Stress-Strain Relations for Anisotropic Materials

Material Properties to be Measured

#### Laminate Orientation Codes

#### Typical Experimental Data

#### Proper Interpretation of Test Results

#### Available Test Methods

#### Governing Standards and Their Use

#### Test Specimen Preparation and Inspection

Specimen Cutting Equipment, Tabbing Methods

Tabbing Materials and Geometries, Adhesives

Specimen Conditioning

#### Types of Testing Equipment Commonly Used

#### Strain Measuring Instrumentation

#### Static Tensile Testing

Specimen Sizes and Configurations

Standards and Their Variations

Helpful Testing Tips

#### Static Compression Testing

Types of Load Application and Corresponding Fixtures

Typical Test Results and Potential Problems

Selection of a Standard Test Method

Specific Purpose Test Methods

### DAY 2

#### Flexure Test Methods

Three- vs. Four-Point Flexure, Quarter-

vs. Third-Point Loading

Support Span Length-to-Specimen Thickness Ratio

Loading/Support Cylinder Diameters

#### Shear Test Methods

In-Plane vs. Interlaminar Shear

Evaluation of Available Test Methods

Typical Test Results

#### Biaxial and Triaxial Loading – Verification of Failure Criteria

#### Fracture Toughness Testing

Fracture Modes I, II, III, and Mixed Mode

Commonly Used Test Methods

#### Fatigue, Impact, and Creep Testing

Special Equipment and Data Acquisition

#### Testing of Single Fibers, the Matrix, and the Interface

Specimen Preparation

Loading Techniques

Micromechanical Relations to Composite Properties

#### Physical Properties Testing of Composites

Fiber and Void Volume Contents

Thermal Expansion

Moisture Expansion