EDITOR'S NOTE:
This issue of the World of Composites begins with an overview of upcoming activities of ASTM's Committee D-30 on High Modulus Fibers and Their Composites. Activities at the Suppliers of Advanced Composite Materials Association will then be reviewed. This will be followed by news from the American Society for Composites. Finally, two recent composites publications will be outlined.

ASTM COMPOSITES ACTIVITIES

Twelfth Symposium on Composite Materials: Testing and Design

Committee D-30 will hold the Twelfth Symposium on Composite Materials: Testing and Design on 16 and 17 May 1994 in Montreal, Quebec, Canada. Charles R. Saff of McDonnell Douglas Aerospace East and Ravi B. Deo of the Northrop Corporation will serve as the symposium co-chairmen. The symposium will feature 31 papers. A Special Technical Publication (STP) based on the symposium proceedings is anticipated. A preliminary list of papers and authors is included below.

Session I—Environmental Effects Testing

Development of Accelerated Test Methods for Predicting Long Term Durability Performance—R. C. Hipp, M. A. Grayson, and P. S. McClellan, McDonnell Douglas Aerospace

The Effects of Physical Aging at Elevated Temperatures on the Viscoelastic Creep of IM7/K3B—T. S. Gates and M. Feldman, NASA Langley Research Center

Characterization of Incipient Heat Damage In Graphite Epoxy Composites—E. Armstrong-Carroll, P. Mehrkam, and R. Cochran, Naval Air Warfare Center

Environmental Effects and Delamination Growth in Graphite/ Epoxy Laminates—J. P. Komorowski and T. Benak, National Research Council Canada


Environmental Stress Cracking and Solvent Effects in Composites and Adhesives—D. A. Dillard, P. Clifton, and P. Parvatereddy, Virginia Polytechnic Institute and State University


Session II—Design Allowables and Damage Tolerance Testing

Compressive Modulus Measurements of Thick Composites—E. C. Goeke, U.S. Army Research Laboratory


Testing of Composite Joint Under Biaxial Bearing/Bypass Loading—S. V. Hoa, Concordia University

Fatigue of Silicon Carbide Fiber Reinforced Silicon Carbide Matrix Composite—M. Elahi, W. W. Stinchcomb, and K. L. Reifsnider, Virginia Polytechnic Institute and State University, and T. J. Dunyak, General Electric Aircraft Engines

Pressurized Ring Test for Composite Pressure Vessel Hoop Strength and Stiffness Evaluation—D. Cohen, T. Y. Toombes, A. K. Johnson, and M. F. Hansen, Hercules Aerospace Company

Mechanical Characterization of a Composite Sandwich Beam with Syntactic Foam Cores—N. Jize, C. Hiel, and O. Ishai, Calspan-NASA Ames Research Center

On the Use of Indentation Versus Impact Testing to Characterize Honeycomb Sandwich Panels—T. K. Tsotsis, Ciba Composites

Analysis of Mode III Delamination Fracture Testing Using a Mid-Plane Edge Crack Torsion Specimen—J. Li and Y. Wang, Georgia Institute of Technology

Comparison of Static and Impact Energy Absorption of Carbon/Peek Composite Tubes—H. Hamada, M. Nakamura, S. Ramakrishna, and Z. Maekawa, Kyoto Institute of Technology; H. Sato, Yokohama Rubber Company, Ltd.; and D. Hull, University of Liverpool

Session III—Textile and Other Advanced Composites

Effect of Preform Architecture on Modulus and Strength of 2-D Triaxially Braided Textile Composite Materials—J. E.
Masters, Lockheed Engineering and Sciences and M. J. Fedro, Boeing

Through-the-Thickness Tensile Strength of Textile Composites—W. C. Jackson, U.S. Army Vehicle Structures Directorate and P. Ifju, Virginia Polytechnic Institute and State University

Z-Fiber Reinforcement for Improved Composite Structures—K. K. Burris and R. Bott, McDonnell Douglas Aerospace

Fatigue Resistance of a 3-D Braided Composite with Both Impact Damage and Open Holes—M. A. Portanova, Lockheed Engineering and Sciences

Analysis of Woven and Braided Fabric Reinforced Composites—R. A. Naik, Analytical Services & Materials

Deformation and Damage Mechanisms in MMC Under Isothermal and TMF Loading—G. M. Newaz, Battelle Memorial Institute and B. S. Majumdar, Universal Energy Systems


Session IV—Design, Analysis and Test Techniques

Micromechanical Characterization of Nonlinear Behavior of Advanced Polymer Matrix Composites—T. S. Gates, NASA Langley Research Center, and J. L. Chen and C. T. Sun, Purdue University

Analysis of the Short Beam Shear Test for Unidirectional Composites—S. N. Chatterjee, Materials Sciences Corporation

Stiffener Termination Testing in Cocured Composite Stiffened Panels—N. M. Bhatia and C. H. Shah, Northrop Corporation

Examination of Three Methods for Testing Extension-Twist Coupled Laminates—E. A. Armanios and D. A. Hooke, Georgia Institute of Technology

An Advanced Testing Technique to Quantify Thermomechanical Fatigue Damage Accumulation in Composite Materials—M. G. Castelli, Sverdrup Technology, Inc.

D-30 Committee Activities

In addition to the symposium listed above, Committee D-30 will conduct a full schedule of subcommittee meetings. A roster of Subcommittees, their chairmen, and task groups are listed below.

D30.01 EDITORIAL—Elizabeth C. Goeke, Army Materials Technology Laboratory

D30.02 RESEARCH AND MECHANICS—Rod H. Martin, Analytical Services and Materials

Task Group on International Standards Harmonization
Task Group on Long Term Durability
Task Group on Textile Composites
Task Group on Symposium Planning
Task Group on Round Robin Testing
Task Group on Impact

D30.03 CONSTITUENT PROPERTIES—Christopher J. Spragg, Amoco Performance Products

Task Group on NDE

D30.04 LAMINA/LAMINATE PROPERTIES—Richard E. Fields, Martin Marietta

D30.04.01 Tension Test Methods
D30.04.02 Compression Test Methods
D30.04.03 Shear Test Methods
D30.04.04 Fatigue
D30.04.05 Ring/Filament Wound Composites Test Methods
D30.04.06 Guides
D30.04.07 Data Reporting
D30.04.08 Specimen Preparation

D30.05 STRUCTURAL PROPERTIES—Ronald F. Zabora, Boeing Commercial Airplane Co.

D30.06 INTERLAMINAR PROPERTIES—T. Kevin O’Brien, U.S. Army Aerostructures Dir.

D30.06.01 Mode I Testing
D30.06.02 Mode II Testing
D30.06.03 Mixed Mode Testing
D30.06.04 Fatigue
D30.06.05 Interlaminar Shear Strength
D30.06.06 Interlaminar Tension Strength

D30.07 METAL MATRIX COMPOSITES—W. Steven Johnson, NASA Langley Research Center

D30.07.01 Tension Testing
D30.07.02 Fatigue Testing

D30.08 THERMO-PHYSICAL PROPERTIES—Thomas S. Gates, NASA Langley Research Center and Scott E. Groves, Lawrence Livermore National Labs.

For further information on Committee activities, please contact Kathie Schaaf, ASTM, 1916 Race St., Philadelphia, PA 19103; Tel. 215-299-5529, FAX 215-299-2630.
Two years ago, SACMA, through its Technical Affairs Committee and Methodology Task Force, undertook a major initiative to upgrade all existing SACMA Recommended Test Methods (SRMs), plus develop ten new composite physical and chemical analysis procedures. The Methodology Task Force consisted of quality control and technical specialists who represented most of the major domestic and international composite material suppliers. The culmination of this team’s efforts has resulted in a combined total of 26 new or revised SRMs being readied for publication and sale by SACMA in April 1994. A descriptive list of the new and revised SRMs appears in the table below.

### SACMA Recommended Methods

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<tr>
<th>Category</th>
<th>SRM #</th>
<th>Description</th>
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<tbody>
<tr>
<td><strong>Laminate Mechanical Testing</strong></td>
<td>1</td>
<td>SACMA Recommended Test Method for Compressive Properties of Oriented Fiber-Resin Composites</td>
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<td>SACMA Recommended Test Method for Compression After Impact Properties of Oriented Fiber-Resin Composites</td>
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<td>SACMA Recommended Test Method for Open-Hole Compression Properties of Oriented Fiber-Resin Composites</td>
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<td>SACMA Recommended Test Method for Tensile Properties of Oriented Fiber-Resin Composites</td>
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<td>SACMA Recommended Test Method for Open-Hole Tensile Properties of Oriented Fiber-Resin Composites</td>
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<td>SACMA Recommended Test Method for Compressive Properties of Oriented Cross-Plied Fiber-Resin Composites</td>
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<td>SACMA Recommended Test Method for Apparent Interlaminar Shear Strength of Oriented Fiber-Resin Composites by the Short-Beam Method</td>
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<td>SACMA Recommended Test Method for Tensile Properties of Oriented Cross-Plied Fiber-Resin Composites</td>
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<td>SACMA Recommended Test Method for Glass Transition Temperature (T_g) Determination of Oriented Fiber-Resin Composites</td>
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<td>19</td>
<td>SACMA Recommended Test Method for Viscosity Characteristics of Matrix Resins</td>
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<td>SACMA Recommended Test Method for High Performance Liquid Chromatography of Thermoset Resins</td>
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<td>SACMA Recommended Test Method for Fluid Resistance Evaluation of Composite Materials</td>
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<td>SACMA Recommended Method for Determining the Resin Flow or Preimpregnated “B” Staged Material</td>
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<td>SACMA Recommended Method for Determination of Resin Content, Fiber Areal Weight and Flow of Thermoset Prepreg by Combined Mechanical and Ultrasonic Methods</td>
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<td>SACMA Recommended Method for Hear of Reaction, Onset Temperature and Peak Temperature for Composite System Resins Using Differential Scanning Calorimetry (DSC)</td>
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With the rapidly increasing usage of advanced composite materials in industrial, commercial, medical, infrastructure, civil engineering, and transportation applications, as well as continued use in aerospace and defense sectors, comes a corresponding increase in the need for materials standardization. As engineers strive to enlarge the performance envelope of their product design through the use of advanced composite materials, it becomes imperative that they be able to directly compare the physical, mechanical and chemical characteristics of the wide array of advanced composite materials currently available. The lack of a comprehensive set of standardized test methods for composites has been a barrier to their acceptance and increased usage in the past. This problem still exists today and will become
even more critical in the future as new or potential markets and applications for advanced composites are identified. Simply stated, suppliers and end users must be able to characterize composites by the same methods to facilitate material selection and to develop appropriate design allowables.

Unfortunately, many of the existing composite test methods and standards in circulation today are outdated, obsolete, or so awkward that they are impractical to use. In some cases, standardized test procedures for critical composite properties simply do not exist. In other instances, a multitude of slightly different methods exist for the same characteristic, but because of differences in equipment, fixtures, or procedures, or a combination thereof, different values are generated for the same property for the same material. In today's world of high performance design, this dilemma is simply an intolerable situation.

SACMA has recognized this dilemma and has taken on the challenge to promote the use of common, practical, and responsible test methods for advanced composite materials. SACMA's position is that it is incumbent upon suppliers of these advanced materials to standardize product descriptions through the use of common specifications, lot acceptance criteria, and test methods. Where methods already existed, SACMA tried to identify the best one for common industry use and/or modified the procedure to make it more meaningful. Where no standardized procedures existed, SACMA developed and is promoting the use of an appropriate SRM.

The SRMs to be published in April represent, from the suppliers perspective, a common set of responsible methods by which manufacturers, designers, and end users can accurately, efficiently, and cost effectively evaluate advanced composite products. It must be recognized that SACMA Recommended Methods are not "national or international consensus standards." However, they do represent an "association consensus." SACMA continues to coordinate with ASTM, SAE, ISO, and MIL HBB-17 to obtain approval from these societies/agencies for the new methods as well as modification of existing standards where better definition is warranted.

For more details about the SACMA SRMs, contact the Suppliers of Advanced Composite Materials Association (SACMA) at 703-841-1556, or by FAX at 703-841-1559.

AMERICAN SOCIETY FOR COMPOSITES

Call Issued for Ninth Technical Conference

The University of Delaware has been selected as the site of the ASC Ninth Technical Conference, to be held from 20-22 September 1994, in conjunction with the University's Center for Composite Materials (CCM's) 20th Anniversary Research Symposium. Tsu-Wei Chou, Jerzy L. Nowinski Professor of Mechanical Engineering, and Jack R. Vinson, H. Fletcher Brown Professor of Mechanical Engineering, will serve as co-chairs. CCM and the Department of Mechanical Engineering will co-host the meeting.

Call for Papers

The theme of this joint conference is Composites Science and Technology for the 21st Century. Research papers addressing challenges and opportunities in composite materials are sought for presentation at the conference and publication in the conference proceedings. Plenary sessions are also planned.

Areas of interest include but are not limited to the following:

- **Mechanics**
  Constitutive modeling; damage mechanics; life prediction; high-strain-rate effects
- **Durability**
  Failure mechanisms; damage tolerance; nondestructive evaluation; environmental degradation; creep; fatigue
- **Design and Applications**
  Design methodologies; intelligent composites; automotive, aerospace, aircraft, marine, transportation, power generation, construction, and biomedical applications

All types of composites—including polymer matrix, metal matrix, ceramic matrix, and intermetallic composites—are of interest.

Abstracts of 300 words should be sent to:

Dr. Tsu-Wei Chou  
Center for Composite Materials  
University of Delaware  
Newark, DE 19716-3144

by 10 January 1994. Notifications of acceptance will be mailed by 15 February 1994. Mats and instructions will be mailed to authors by 1 March 1994, and final papers (10 pages) must be received no later than 16 May 1994.

For more information, contact Dr. Chou at 302-831-2904 or Dr. Vinson at 302-831-2338.
RECENT COMPOSITES PUBLICATIONS

ASTM Publishes Two Special Technical Publications (STPs)

Composite Materials: Fatigue and Fracture, Fourth Volume


Fatigue and fracture are topics of primary importance to the development of damage-tolerant composite materials, to the design of high-performance composite components and structures, and to the certification of composite products. STP 1156 addresses current issues related to fatigue and fracture of composites.

The technical results contained in this STP provide practical insights on new developments in areas of continuing interest, such as damage and failure analysis and test methods. They also provide new directions for emerging technology areas, such as micromechanics and interfacial analysis, which are applicable to fatigue and fracture of composites. The materials addressed are thermosetting and thermoplastic polymer matrix composites, metal matrix composites, and ceramic matrix composites, as well as a specialty laminate. Results were obtained for several configurations of composites ranging from laboratory specimens to subcomponents to structural elements.

In all, 34 peer-reviewed papers are presented in sections on:
- Strength and Failure Modes
- Damage: Measurement, Analysis, and Modeling
- Intralaminar and Interlaminar Fracture
- Micromechanics and Interfaces
- Fatigue of Polymer Matrix Composites
- Fatigue of Ceramic Matrix, Metal Matrix, and Specialty Composites

For composite material developers; aircraft and space craft designers and manufacturers; materials, mechanics, and mechanical engineering professors and researchers; materials consultants.

CONTENTS

Strength and Failure Modes

Failure of Graphite/Epoxy Panels with Stiffening Strips
Failure Initiation and Ultimate Strength of Composite Laminates Containing a Center Hole
Response of Notched Graphite/Epoxy and Graphite/PEEK Systems
Failure Analysis of Notched Unidirectional Graphite/Epoxy Tubes Under Combined Loading
Matrix/Cracking-Induced Delamination Propagation in Graphite/Epoxy Laminated Composites Due to a Transversely Concentrated Load

Damage: Measurement, Analysis, and Modeling

Damage Prediction in Cross-Plied Curved Composite Laminates
Evaluation of Impact Damage in Composite Materials Using Acoustic Emission
The Change in Thermal Expansion Coefficient as a Damage Parameter During Thermal Cycling of Crossply Laminates

Tensile Deformation of SiC/Ti-15-3 Laminates
Material Modeling for Unidirectional Glass and Glass-Ceramic Matrix Composites with Progressive Matrix Damage
Modeling Ply Crack Growth in Laminates Under Combined Stress States
Assessment of Interlayer Shear Slip Theory for Delamination Modeling
Effect of Initial Delamination on Mode I and Mode II Interlaminar Fracture Toughness and Fatigue Fracture Threshold
Damage and Failure Mechanisms in Scaled Angle-Ply Laminates
Thickness Effect of Double Cantilever Beam Specimen on Interlaminar Fracture Toughness of AS4/PEEK and T800/Epoxy Laminates
The Influence of Interleaf Deformation Behavior and Film-Resin Adhesion on the Fracture Toughness of Interleaved Composites
Effects of Water and Jet Fuel Absorption on Mode I and Mode II Delamination of Graphite/Epoxy Interlaminar Fracture Analysis of Unsymmetrical Laminates

Micromechanics and Interfaces

Some Observations on the Analysis of In-Plane Matrix Failures in Fibrous Composite Laminates
Model Composites: A Novel Approach for the Evaluation of Micromechanical Behavior
Meso-Indentation Testing of Composite Materials as a Tool for Measuring Interfacial Quality
Evaluating Surface Treatment Effects on Interfacial Bond Strength Using Dynamic Mechanical Analysis
Micromechanical Analysis of Fiber Fracture
Micromechanics of Tensile Strength in Composite Systems
Fatigue Damage in Thick, Cross-Ply Laminates with a Center Hole
Local Delamination in Laminates with Angle Ply Matrix Cracks, Part I: Tension Tests and Stress Analysis
Local Delamination in Laminates with Angle Ply Matrix Cracks, Part II: Delamination Fracture Analysis and Fatigue Characterization
Effects of Stress Ratio on Edge Delamination Characteristics in Laminated Composites
Effect of Interleaves on the Damage Mechanisms and Residual Strength of Notched Composite Laminates Subjected to Axial Fatigue Loading
Characterization of Composite Material's Dynamic Response Using Load/Stroke Frequency Response Measurement
Fatigue of Ceramic Matrix, Metal Matrix, and Specialty Composites

Analysis of Thermomechanical Fatigue of Unidirectional Titanium Metal Matrix Composites
High-Temperature Tension-Compression Fatigue Behavior of a Unidirectional Tungsten Copper Composite
Monitoring Fatigue Damage Development in Ceramic Matrix Composite Tubular Specimens by a Thermomechanical Technique
High-Cycle Fatigue Crack Growth Properties of Aramid-Reinforced Aluminum Laminates
High Temperature and Environmental Effects on Polymeric Composites


The aerospace and naval industries both have a need for lightweight materials that can operate under extreme conditions, and yet retain their basic mechanical properties for long duration. Many of the papers presented in STP 1174 address ongoing research in these two industries.

Twelve peer-reviewed papers cover:

- Damage Mechanisms and Failure
- Materials Behavior Under Combined Effects
- Constitutive Models

This volume will help establish the state of the art in testing and analysis techniques and provide the basis for further research in this area. For aerospace and marine materials and structures engineers; also for biomedical materials engineers and civil engineers.

CONTENTS

Damage Mechanisms and Failure

Measurement of Stress Corrosion Crack Growth in Sheet Molding Compounds
Mode I Delamination of Carbon Fiber Reinforced Thermoplastic Polymer Under Static and Cyclic Creep at Elevated Temperatures
Delamination Onset and Accumulation in Polymeric Composite Laminates Under Thermal and Mechanical Loads
High Temperature Behaviors of an Innovative Polymeric Matrix Composite

Materials Behavior Under Combined Effects

The Effect of Seawater Environment on the Galvanic Corrosion Behavior of Graphite/Epoxy Composites Coupled to Metals
The Simulation and Detection of Electrochemical Damage in BMI/Graphite Fiber Composites Using Electrochemical Impedance Spectroscopy
The Effect of the Interphase/Interface Region on Creep and Creep Rupture of Thermoplastic Composites
Determination of a Load, Heat, Time-to-Failure Surface of Polymeric Composites
Property Improvements of Polymer Composites After Loading at High Temperatures

Constitutive Models

The Effects of Physical Aging on the Creep Response of a Thermoplastic Composite
The Effects of Moisture Sorption on the Creep Behavior of Fibers
Effects of Elevated Temperature on the Viscoplastic Modeling of Graphite/Polymeric Composites
Assessment of Practices in Supporting Composite Structures in the Current Transport Fleet

by Dr. Charles E. Harris, Head, Mechanics of Materials Branch, NASA Langley Research Center

Over the past several years, the high cost of ownership of commercial transport aircraft with composite structures has emerged as a major barrier preventing the expanded use of composites to primary structure. In addition to the initial acquisition cost of original equipment, the costs to support composite structures in the current fleet have also been identified as not being cost-effective [1]. These high costs include the cost to repair a damaged composite structure and the cost to acquire or lease replacement components. One of the principal goals of the NASA Advanced Composites Technology Program is to develop advanced technology to design and fabricate cost-effective composite wing and fuselage structure. The flight service performance of the composite structural components in the current fleet provide a valuable data base on the cost-effectiveness of composite structures. Therefore, NASA conducted an assessment of the current practices in supporting composite structures in the commercial transport fleet to identify the factors that contribute to the high costs of supporting composite structures.

The assessment was primarily constructed from three sources of information. Statistics were compiled from an International Air Transport Association (IATA) survey [2] of the composite structure maintenance practices of the international airline community. Nineteen airlines from throughout the world completed the lengthy questionnaire in December 1991. The second source of information was visits by an assessment team to four U.S. airline maintenance facilities. The assessment team had personnel from NASA and the FAA representing the materials, structures, and NDI disciplines. At each of the four facilities, the team met with key technical personnel, toured the composite maintenance and repair facilities, and “inspected” aircraft with composite components in the maintenance hangars. The final source of information was the original equipment manufacturers, Boeing and Douglas. Detailed discussions of the airline experiences and the current industry activities in response to the airline problems were discussed with key technical personnel from the airframe manufacturers. These three sources of information together with the perspective of the FAA provided a well-rounded assessment of the current problems and the state of the art practiced by the airlines in supporting composite airframe structures.

The assessment findings were divided into the following categories: costs, maintainability, service history, and current and future needs. There are several obvious conclusions that can be stated from the assessment. First, composite components are damaged and repaired frequently. Most of the damage is a result of foreign object impacts such as runway debris, bird strikes, and ground handling accidents. Moisture and chemical attacks were also significant contributors to damage. Second, many composite repairs are not adequately covered by the standard repair manuals and result in very high repair costs. Third, the airlines have developed an effective infrastructure for making repairs to composite secondary structures. While safety was included in the assessment, safety (structural integrity) was not found to be a major issue because of the types of composite structures in the current fleet that have been in service long enough to provide a basis to assess supportability costs.

A number of current and future technologies needs was identified. These include:

- Increase the shelf-life and lower the number of repair materials (airlines currently may have to stock from 12 to 25 different composite systems for potential repairs)
- Repair materials with lower curing temperatures
- Significant improvements to the Standard Repair Manuals
- NDT to assess damage and to qualify repairs
- Design improvements for lightning strikes, inaccessible areas, and better resistance to FOD, high heat, and hydraulic fluids
- Environmentally sound methods for disposal of waste from repairs and paint removal
- Better training of personnel, especially for NDT.

There are task forces within the international community working to develop standard approaches to many of these problems. Also, Boeing and Douglas have several company programs un-
derway to develop solutions to these problems. The voice of the customer has been heard and is being answered.

It was obvious from the assessment that the acquisition cost of replacement parts and the costs to repair composite structures in the current fleet are significantly higher than for comparable metallic components. While this fact suggests that composite structures are not cost-effective to support, acquisition costs and repair costs alone provide an incomplete analysis of the actual economic life cycle costs of operating an airplane with composite structure. The complete analysis to determine the cost-effectiveness of a composite structure should include all factors that contribute to the economic life cycle. These factors include the initial acquisition costs, operational benefit due to aircraft performance, economic life benefit due to enhanced durability, and the cost of maintenance, inspection, and repair. For example, the composite structural components in the current jet transport fleet have not experienced degradation problems due to fatigue or corrosion. This should be a clear cost benefit over conventional metallic components.

In order to realize more use of composites in subsonic transport aircraft, the cost affordability issue must be addressed so that composite structures are cost effective. The consensus recommendation of all parties participating in this assessment is that the cost-effective technology to support the composite structure must be developed in concert with the advanced technology to design and build the cost-effective structure. This, of course, means that the structure must be designed with the end objective of cost-effective supportability. It also means that the technology necessary to identify, characterize, and assess damage and the technology to repair a damaged structure are essential partners in aircraft supportability and cost-effective fleet management. Fortunately, the voice of the customer has been heard. Aggressive programs are underway in industry, and in some cases sponsored by the U.S. government, to produce advanced composites technology that is cost-effective.

References


About the Author

Dr. Charles E. Harris has been the Head of the Mechanics of Materials Branch at NASA Langley Research Center since 1987. He directs research in the area of materials characterization and the development of mechanics models that describe the deformation, strength, durability, and damage tolerance of advanced materials for airframe and space transportation structures. Charlie is also the Technical Manager of the NASA Aging Aircraft Research Program, a cooperative research program with the FAA and the U.S. aeronautical industry to develop advanced NDE and fracture mechanics technologies to support the continued airworthiness assurance of the aging commercial jet transport fleet. Charlie has published over 80 papers pertaining to his research on the mechanics of damage in metals and composites. This research includes studies of the translaminate fracture of laminated composites, models of damage progression in laminates, micromechanics models of the effects of fiber and ply waviness, and fracture mechanics of metallic structures. Prior to joining NASA, Charlie was a professor of aerospace engineering at Texas A&M University. Charlie began his career as a structural engineer for the Babcock & Wilcox Company (B&W) in the Nuclear Power Generation Division. Charlie has a B.S. in Aerospace Engineering and a Ph.D. in Engineering Mechanics from Virginia Polytechnic Institute and State University and is a Registered Professional Engineer.
Calendar on Composites

The following meetings may be of interest to researchers in the field of composite materials.

18–20 January 1994
Second Asia Pacific Conference on Materials Processing
Singapore

23–26 January 1994
ASME-ETCE Composites Symposium
New Orleans, Louisiana
Contact: Prof. David Hui, University of New Orleans, Department of Mechanical Engineering, New Orleans, LA 70148; FAX: 504-286-7413, E-MAIL: dxhme@uno.edu

27 February–3 March 1994
San Francisco, California
Contact: TMS Annual Meeting, 420 Commonwealth Dr., Warrendale, PA 15086; Telephone: 412-776-9050, FAX: 412-776-3770

13–18 March 1994
Symposium on High-Temperature Properties and Applications of Polymers and Polymer Composites
San Diego, California
Contact: Martin R. Tant, Research Laboratories, Eastman Chemical Co., P.O. Box 1972, Kingsport, TN 37662; Telephone: 615-229-2147, FAX: 615-229-4558

21–24 March 1994
ASTM Committees D-30 and E-08 Symposium on Life Prediction Methodology for Titanium Matrix Composites
Hilton Head Island, South Carolina
Contact: W. Steven Johnson, NASA Langley Research Center, Mail Stop 188E, Hampton, VA 23681-0001; Telephone: 804-864-3463

11–14 April 1994
9th International Conference on Deformation, Yield and Fracture of Polymers
Cambridge, United Kingdom
Contact: Mrs. Debbie Schorer, Conference Department (C406), The Institute of Materials, 1 Carlton House Terrace, London SW1Y 5DB, United Kingdom; Telephone: 071-839-4071, 071-976-1339, FAX: 071-839-3576, Telex: 881-4813

12–14 April 1994
Fifth International Conference on Marine Applications of Composite Materials (MACM-5)
Melbourne, Florida
Contact: Composites Education Assn./MACM-5, P.O. Box 130, Melbourne, FL 32902-0130; FAX: 407-728-9071

18–20 April 1994
35th AIAA Structures, Structural Dynamics, and Materials Conference
Hilton Head, South Carolina
Contact: Meetings Department, AIAA, 370 L'Enfant Promenade, SW, Washington, DC 20024; Telephone: 202-646-7463

4–6 May 1994
International Meeting on Composite Materials
Milan, Italy
Contact: A. Langella, Meeting Secretariat, University of Naples, Dept. of Materials and Production Engineering, Piazzale Tecnico-80125 Naples, Italy; Telephone: 39-81-768.2373/2399/2366, FAX: 39-81-768.2362/768.2399/7614212

16–17 May 1994
ASTM Committee D-30 12th Symposium on Composite Materials: Testing and Design
Montreal, Canada

18–19 May 1994
ASTM Committee D-30 on High Modulus Fibers and Their Composites Meeting
Montreal, Canada
Contact: Katharine Schaaf, ASTM, 1916 Race St., Philadelphia, PA 19103; Telephone: 215-299-5529

6–8 June 1994
1994 SEM Spring Conference on Experimental Mechanics
Baltimore, Maryland
Contact: Kathy Ramsay, SEM, 7 School St., Bethel, CT 06801; Telephone: 203-790-6373, FAX: 203-790-4472

26 June–1 July 1994
Twelfth U.S. National Congress of Applied Mechanics
27–29 June 1994
ASTM Committee E-08 26th National Symposium on Fracture Mechanics
Idaho Falls, Idaho
Contact: Dr. Walter G. Reuter, EG&G Idaho, Inc., P.O. Box 1625, Idaho Falls, ID 83415-2281; Telephone: 208-526-1708, FAX: 208-526-0690

18–22 July 1994
10th International Conference on Experimental Mechanics
Lisbon, Portugal
Contact: Secretariat 10th Intl. Conf. on Exp. Mech. APAET, Laboratorio Nacional de Engenharia Civil, Av. do Brasil, 101, 1799 Lisboa Codex, Portugal; Telephone: 351-1-848-21-31/7, FAX: 351-1-849-76-60

29 August–1 September 1994
First International Conference on Composites Engineering (ICCE/1)
New Orleans, Louisiana
Contact: Prof. David Hui, University of New Orleans, Department of Mechanical Engineering, New Orleans, LA 70148; FAX: 504-286-7413, E-MAIL: dxhme@uno.edu

13–15 September 1994
2nd European Conference on Composites (ECCM CTS 2) Testing and Standardization
Hamburg, Germany
Contact: EACM, 2, Place de la Bourse, 33076 Bordeaux Cedex, France

20–22 September 1994
American Society for Composites' Ninth Technical Conference and the Center for Composite Materials’ Twentieth Anniversary Research Symposium
Newark, Delaware
Contact: Dr. Tsu-Wei Chou, Center for Composite Materials, University of Delaware, Newark, DE 19716; Telephone: 302-831-2904, FAX: 302-831-8525

10–12 October 1994
SES 31st Annual Meeting
College Station, Texas
Contact: Dr. David H. Allen, Dept. of Aerospace Engineering, Texas A & M University, College Station, TX 77843; Telephone: 409-845-1669, FAX: 409-845-6051, E-MAIL: dha6186@zeus.tamu.edu

13–18 November 1994
ASME Winter Annual Meeting
Chicago, Illinois
Contact: ASME, 345 E. 47th St., New York, NY 10017; Telephone: 212-705-7722

14 November 1994
ASTM Committee D-30 Symposium on Fiber Matrix and Interface Properties

Phoenix, Arizona
Contact: Katharine Schaaf, ASTM, 1916 Race St., Philadelphia, PA 19103; Telephone: 215-299-5529

14–15 November 1994
ASTM Committee E-8 Second Symposium on Thermomechanical Fatigue Behavior of Materials
Phoenix, Arizona
Contact: Michael J. Verrilli, Co-Chairman, NASA, Lewis Research Center, 2100 Brookpark Rd., Cleveland, OH 44135; Telephone: 216-433-3337, FAX: 216-433-8011, or Michael G. Castelli, Co-Chairman, Sverdrup Technology, NASA, Lewis Research Center, Telephone: 216-433-8464

14–16 November 1994
ASTM Committee D-30 on High Modulus Fibers and Their Composites Meeting
Phoenix, Arizona
Contact: Katharine Schaaf, ASTM, 1916 Race St., Philadelphia, PA 19103; Telephone: 215-299-5529

1995
SES 32nd Annual Meeting
New Orleans, Louisiana
Contact: Dr. David Hui, Dept. of Mechanical Engineering, University of New Orleans, New Orleans, LA; Telephone: 504-286-6192, FAX: 504-286-7413, E-MAIL: DXHME@jazz.ucc.uno.edu

7–9 May 1995
International Conference on Composite Materials and Energy (ENERCOMP ’95)
Montreal, Canada
Contact: Hydro-Quebec, 1800, montee Sainte-Julie, Varennes, Quebec, Canada J3X 1S1; FAX: 514-652-8905

14–16 May 1995
ASTM Committee D-30 6th Symposium on Fatigue and Fracture
Denver, Colorado
Contact: Katharine Schaaf, ASTM, 1916 Race St., Philadelphia, PA 19103; Telephone: 215-299-5529

14–17 May 1995
ASTM Committee D-30 on High Modulus Fibers and Their Composites Meeting
Denver, Colorado
Contact: Katharine Schaaf, ASTM, 1916 Race St., Philadelphia, PA 19103; Telephone: 215-299-5529

28 May–2 June 1995
7th International Conference on Mechanical Behavior of Materials
The Hague, The Netherlands
Contact: ICM7 Secretariat, c/o Congress Office ASD, Asvest 22, P.O. Box 40, 2600 AA Delft, The Netherlands; Telephone: 31-15-120234

5–7 June 1995
The First International Symposium on Thermal Stresses and Related Topics
Hamamatsu, Japan
Contact: Prof. N. Noda, Chairman, Thermal Stresses '95,
Dept. of Mechanical Engineering, Shizuoka University, 5-1, Johoku 3 chome, Hamamatsu, 432, Japan; Telephone: 81-53-471-1171, ext. 267, 268, FAX: 81-53-475-4794, E-MAIL: tmnnoda@mm.shizuoka.ac.jp

14-18 August 1995
Tenth International Conference on Composite Materials
Vancouver, Canada
Contact: Dr. Ken Street, Tenth Intl. Conf. on Composite Matls., c/o The University of British Columbia, Dept. of Metals and Materials Engineering, 309-6350 Stores Rd., Vancouver, B.C., Canada V6T 1Z4; Telephone: 613-992-0725, FAX: 613-996-0038

12-17 November 1995
ASME Winter Annual Meeting
San Francisco, California
Contact: ASME, 345 E. 47th St., New York, NY 10017; Telephone: 212-705-7722

14-15 November 1995
ASTM Committee D-30 Symposium on Environmental Effects on Polymeric Composites
Norfolk, Virginia
Contact: Katharine Schaaf, ASTM, 1916 Race St., Philadelphia, PA 19103; Telephone: 215-299-5529

14-16 November 1995
ASTM Committee D-30 on High Modulus Fibers and Their Composites Meeting
Norfolk, Virginia
Contact: Katharine Schaaf, ASTM, 1916 Race St., Philadelphia, PA 19103; Telephone: 215-299-5529

17-22 November 1996
ASME Winter Annual Meeting
Atlanta, Georgia
Contact: ASME, 345 E. 47th St., New York, NY 10017; Telephone: 212-705-7722

Send items for this calendar to:
Prof. M. W. Hyer, Department of Engineering Science and Mechanics
Virginia Polytechnic Institute and State University
Blacksburg, VA 24061-0219
Telephone: 703-231-5372
FAX: 703-231-4574
E-MAIL: HYERM@VTVM1.CC.VT.EDU
Additional Information for Contributors

The Journal of Composites Technology and Research (JCTR) is a quarterly publication sponsored by ASTM technical Committee D-30 on High Modulus Fibers and Their Composites, and E08 on Fatigue and Fracture. Each published paper and technical note has been peer-reviewed. Papers and technical notes are open to brief written comments in the Discussion section of the Journal, which also includes authors' written responses.

While the majority of articles appearing in the journal are full papers, Technical Notes are also welcome. A paper will be considered as a Technical Note if: it gives a reasonably brief description of ongoing studies with or without providing interim, tentative data and/or conclusions; it reports phenomena observed in the course of research requiring further study; it provides mathematical procedures for facilitating reduction and analysis of data; or it reports promising new materials prior to undertaking extensive research to determine their properties. The final decision as to whether a manuscript is published as a paper or a technical note resides with the Editorial Board (an Editor and at least one Board Member is assigned to each paper).

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ASTM receives books from other publishers requesting book reviews. The books are available to potential reviewers in exchange for publishable reviews. Book reviews are screened and edited by the Editor and staff without peer review.

Other Features

World of Composites—Covers ASTM’s Committee D–30 meetings, highlights of other activities in the composite community, summaries of research activities, and outlines of recent composite publications. Please send items of interest to Dr. John Masters.”

Composites Contents—A listing of current literature of interest to the composite community as a service to our readers. Please send items of interest to Dr. Ronald F. Gibson.”

Calendar on Composites—Meetings of interest to researchers in the field of composite materials. Please send items of interest to Dr. Michael W. Hyer.”

W. Steven Johnson, Ph.D.
Editor-In-Chief

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