Composites Contents

Listing of current literature of interest to the composites community as a service to our readers.

Introduction

In this section, the relevant portions of the tables of contents of current journals that publish composites articles are reproduced. The entire tables of contents are reproduced for dedicated composites journals, but only the composites-related articles of nondedicated journals are shown. At this time, permission to reproduce the tables of contents has been granted by the following journals:

- AIAA Journal
- Cement and Concrete Composites
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- Composites Science and Technology
- Composite Structures
- Computers and Structures
- Engineering Fracture Mechanics
- Experimental Mechanics
- Experimental Techniques
- International Journal of Fracture
- International Journal of Solids and Structures
- Journal of Adhesion
- Journal of Advanced Materials
- Journal of Applied Mechanics
- Journal of Composite Materials
- Journal of Engineering Materials and Technology
- Journal of Materials Science
- Journal of Reinforced Plastics and Composites
- Journal of Sound and Vibration
- Journal of Testing and Evaluation
- Mechanics of Composite Materials
- Modal Analysis: The International Journal of Analytical and Experimental Modal Analysis
- Polymer Composites
- Polymers and Polymer Composites
- SAMPE Journal
- The Shock and Vibration Digest

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Dr. Ronald F. Gibson, Contents Editor
Advanced Composites Research Laboratory
Department of Mechanical Engineering
Wayne State University
Detroit, MI 48202

James R. Ruffner, Contents Source
Science and Engineering Library
Wayne State University

AIAA Journal

Vol. 32, No. 6, June 1994
Transverse Shear Stresses and Their Sensitivity Coefficients in Multilayered Composite Panels—A. K. Noor, Y. H. Kim, and J. M. Peters, pp. 1259–1269

Vol. 32, No. 7, July 1994
Thermomechanical Buckling of Multilayered Composite Panels with Cutouts—A. K. Noor, J. H. Starnes, Jr., and J. M. Peters, pp. 1507–1519
Local Buckling of Honeycomb Sandwich Plates Under Action of Transverse Shear Forces—G. Shi and P. Tong, pp. 1520–1548

Vol. 32, No. 8, Aug. 1994
New Higher Order Plate Theory in Modeling Delamination Buckling of Composite Laminates—A. Chattopadhyay and H. Gu, pp. 1709–1716

Vol. 32, No. 9, Sept. 1994
Stationary Natural Frequencies and Mode Shapes of Composite Laminates—X. Zhang and N. Hasebe, pp. 2061–2062
The Use of Compression-Splitting Tests in Evaluating the Fracture Toughness of Concrete—B. B. Sabir, pp. 83–92

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Interfacial and Mechanical Behavior of Fiber-Reinforced Calcium Phosphate Cement Composites—T. Sugama and M. Taylor, pp. 93–106
Crack Space and Crack Width of Weldmesh Ferrocement Under Cyclic Loading—G. J. Xiong and G. Singh, pp. 107–114
Effect of Increased Tensile Strength and Toughness on Reinforcing-Bar Bond Behavior—N. Krstulovic-Opata, K. A. Watson, and J. M. Lafave, pp. 129–142

Composites
Vol. 25, No. 6, July 1994
Modeling of Stable and Unstable Fracture of Short Beam Shear Specimens—M. R. Wisnom, pp. 394–400
Strength Studies of Single Carbon Fibers in Model Composite Fragmentation Tests—C. A. Baillie and M. G. Bader, pp. 401–406
Design and Mechanical Aspects of Composite Materials for Light Rail Vehicle Tracks—M. O. W. Richardson and A. M. Robinson, pp. 438–442
Measurement of the Internal Local Stress Distribution of Composite Materials by Means of Laser Imaging Methods—X. Yan and T. Ohsawa, pp. 443–450
Is There a Size Effect in Composites?—C. Zweben, pp. 451–454

Vol. 25, No. 7, Aug. 1994
The Interface and Interphase in Carbon Fiber-Reinforced Composites—M. Guigon and E. Klinklin, pp. 534–539
Interface in Metal- and Intermetallic-Matrix Composites—R. J. Arsenault, pp. 540–548
A New Model for the Pull-Out of Single Fibers From Low Density Polyethylene—J.-X. Li, pp. 558–562
Micromechanics of Imperfect Interfaces in Heterogeneous Materials—G. Laird II and T. C. Kennedy, pp. 593–603
The Use of a Single-Fiber Fragmentation Test to Study Environmental Durability of Interfaces/Interphases Between DGEBA/mPDA Epoxy and Glass Fiber: The Effect of Moisture—C. L. Schutte, W. McDonough, M. Shioya, M. McAuliffe, and M. Greenwood, pp. 617–624
Chemistry Effects on Interface Microstructure and Reaction in Titanium-Based Composites—Z. X. Guo and B. Derby, pp. 630–636
Crosslinking of Vinyl Ester Matrix in Contact with Different Surfaces—X. Dirand, B. Hilaire, E. Lafontaine, B. Mortaigne, and M. Nardin, pp. 645–652
The Fiber/Matrix Interphase and Adhesion Mechanism of Surface-Treated Twaron Aramid Fiber—J. Mahly, L. W. Jenneskens, and O. Grabandt, pp. 653–660


Protective Coatings for Commercial Particulates—B. Kindl, Y. H. Teng, and Y. L. Liu, pp. 671–676


The Role of Sizing Resins in Carbon Fiber-Reinforced Polyethersulfone (PES)—S. Yumitori, D. Wang, and F. R. Jones, pp. 698–704

Transcrystallinity in Nylon 66 Composites and Its Influence on Thermal Expansivity—N. Klein and G. Marom, pp. 706–710


Vol. 25, No. 8, Sept. 1994

Influence of Clamping Method on Tensile Properties of Unidirectional CFRP in 0° and 90° Directions—Round Robin Activity for International Standardization in Japan—M. Hojo, Y. Sawada, and H. Miyairi, pp. 786–796

Thermal Residual Microstress Generation During the Processing of Unidirectional Carbon Fiber/Epoxy Resin Composites: Regular Fiber Arrays—A. J. Fletcher and J. L. Oakeshott


Machining-Induced Surface Texture Effects on the Flexural Properties of a Graphite/Epoxy Laminate—D. Arola and M. Ramulu, pp. 822–834

The Key to Designing Efficient Bolted Composite Joints—L. J. Hart-Smith, pp. 835–837

Vol. 25, No. 9, Oct. 1994

The Non-Destructive Assessment of Porosity in Composite Repairs—N. Guo and P. Cawley, pp. 842–850

Strain Energy Release Rate Associated with Local Delamination in Cracked Composite Laminates—J. Zhang, C. Soutis, and J. Fan, pp. 851–862


Fracture of Glass/Polypropylene Laminates: Influence of Cooling Rate After Moulding—P. Davies and W. J. Cantwell, pp. 869–877


The Key to Designing Durable Adhesively Bonded Joints—L. J. Hart-Smith, pp. 895–898

Vol. 25, No. 10, Nov. 1994


Effect of Stress Ratio on the Fatigue of Unidirectional Glass Fiber/ Epoxy Composite Laminate—H. El Kadi and F. Ellyin, pp. 917–924

Development of a Simulation Procedure for the Analysis of Three-Dimensional Fiber-Reinforced Composites—A. K. Soh, pp. 925–934

Constitutive Modelling of Fiber-Reinforced Concrete Under Uniaxial Tensile Loading—J. Kullaa, pp. 935–944

Inclined Tensile Strength of Steel Fibers in a Cement-Based Com-posite—P. J. M. Bartos and M. Duris, pp. 945–952

Initial-Stage Hot-Pressing of SiC Fiber/Ti Monotapes—P. A. Noel, D. C. Dunand, and A. Mortensen, pp. 953–956
Is There a Size Effect in Composites? Comments on Designer’s Corner by Carl Zweben—E. C. Edge, pp. 957–958

Composites Engineering

Vol. 4, No. 4, 1994

Static and Dynamic Response of Moderately Thick Laminated Beams with Damage—R. C. Averill, pp. 381–396


Three-Dimensional Vibration of Laminated Cylinders and Cylindrical Panels with Symmetric or Antisymmetric Cross-Ply Lay-Up—J. Ye and K. P. Soldatos, pp. 429–444


Vol. 4, No. 5, 1994


Progressive Failure Analysis of Composite Structures Made of Thermo-Elastic Solids—M. E. Pachajoa, K.-Y. Lee, and J. D. Lee, pp. 503–524


Manufacturing Tolerances to Meet Laminate CTE Design Criteria—X. Liang and G. R. Heppler, pp. 537–548


Vol. 4, No. 6, 1994

Optimal Vibration Control of NITINOL-Reinforced Composites—A. Baz and J. Ro, pp. 567–576

Optimal Control of Infinite-Order Smart Composite Structural Systems Using Distributed Sensors—R. Butler and V. Rao, pp. 577–590


Vol. 4, No. 7, 1994


Prediction of Crack Initiation of Unidirectional Composite Beams Subject to Four-Point Bending—E. S. Reddy and W. K. Binendra, pp. 703–714


Buckling-Load Interaction in Tailored Composite Plates—S. B. Biggers, Jr. and T. M. Browder, Jr., pp. 745–762

A Transformation-Field Analysis of Thermomechanical Stresses in Particulate Metal-Matrix Composites—T. Chen and S.-H. Liu, pp. 763–774

Modeling Thermal Fatigue Damage in Metal-Matrix Composites—T. Nicholas and Lt. J. J. Updegraff, pp. 775–786

Vol. 4, No. 8, 1994


Continuum-Based Theoretical and Experimental Studies in Deformation and Damage of MMCs at NASA-Lewis: Progress and Trends—S. M. Arnold and M. G. Castelli, pp. 811–828

Engineering Research in Composite and Smart Structures—K. P. Chong, O. W. Dillon, J. B. Scalzi, and W. A. Spitzig, pp. 829–852

Research on Composites in Germany—K. Schulte, pp. 853–856


Vol. 4, No. 9, 1994


Thermomechanical Fatigue Damage/Failure Mechanisms in SCS-6/Ti Metal 21S [0/90] Composite—M. G. Castelli, pp. 931–946

Effect of Fiber Length Variation on Tensile Properties of Carbon-Fiber Cement Composites—V. C. Li and K. H. Obla, pp. 947–964

Composites Science and Technology

Vol. 51, No. 3, 1994

- Thermal Expansion Coefficients of Fiber Composites Defined by the Concept of the Interphase—E. Sideridis, pp. 301-318
- Fracture of Fibers with Barrier Oxide Coatings—M. E. Krison, S. P. Listovnichaya, Y. L. Pilipovsky, and Y. M. Vasilenkov, pp. 319-324
- On The Effect of Stitching on Mode I Delamination Toughness of Laminated Composites—L. K. Jain and Y.-W. Mai, pp. 331-346
- Effect of Strain Rate on the Interlaminar Shear Strength of Carbon-Fiber-Reinforced Laminates—J. Harding and L. Dong, pp. 347-358
- Failure of Unnotched and Notched Composites with Adhesive Strips—I. Varellis and T. L. Norman, pp. 367-376
- Thermal Expansion Coefficients of Plain-Weave Fabric Laminates—V. K. Ganesh and N. K. Naik, pp. 387-408
- The Losipescu In-Plane Shear Test Applied to Composites: A New Approach Based on Displacement Field Processing—M. Grediac, F. Pierron, and A. Vautrin, pp. 409-418
- Thermally Induced Vibration of Laminated Cylindrical Shell Panels—J.-S. Chang and J.-W. Shyong, pp. 419-428
- Natural Frequencies for Cantilevered Laminated Composite Right Triangular and Trapezoidal Plates—M. S. Qatu, pp. 441-450
- Free Vibration of Prebuckled and Postbuckled Plates With Delamination—H. P. Chen, pp. 451-462

Vol. 51, No. 4, 1994

- Evaluation of Creep Compliances of Unidirectional Fiber-Reinforced Composites—P. LeMoal and D. Perreux, pp. 469-478
- The Formation of Residual Stresses in Laminated Thermoplastic Composites—J. A. Barnes and G. E. Byerly, pp. 479-494
- The Interaction Between Matrix Cracks and Delaminations During Quasi-Static Impact of Composites—L. Lammerant and I. Verpoest, pp. 505-516
- Three-Dimensional Finite Element Analysis of the Stress Concentration at a Single Fiber Break—M. R. Nedele and M. R. Wisnom, pp. 517-524
- Use of Tensorial Polynomial Strength Function for Strength Prediction in Laminated Polymeric Composites—A. P. Wilczynski, pp. 525-530
- Experimental Testing of Thick-Walled Graphite Fiber Composite Rings—R. N. Headifen, S. Gupta, and D. Okey, pp. 531-536
- The Effect of Hydrostatic Pressure and Loading Rate on compressive Failure of Fiber-Reinforced Ceramic-Matrix Composites—J. Lankford, pp. 537-544
- Finite Element Micromechanical Modelling of Unidirectional Fiber-Reinforced Metal-Matrix Composites—D. S. Li and M. R. Wisnom, pp. 545-564
- A Theoretical Model for the Evaluation of Interfacial Properties of Fiber-Reinforced Ceramics with the Slice Compression Test—G.-Y. Lu and Y.-W. Mai, pp. 565-574
- Fracture Load Predictions for Adhesive Joints—G. Fernlund, M. Papini, D. McCammond, and J. K. Spelt, pp. 587-600
- Effect of Stacking Sequence and Thickness on the Interlaminar Stresses for Quasi-Isotropic Laminated Plates with a Hole—C. Jayatheertha and J. P. H. Webber, pp. 601-612

Vol. 52, No. 1, 1994

- Acoustic Emission Monitoring of Damage in Metal-Matrix Composites Subjected to Thermomechanical Fatigue—R. W. Neu and I. Roman, pp. 1-8
- Shear Fracture of Unidirectional Composites Without Initial Cracks—M. R. Wisnom, pp. 9-18
- Several Variations of the Generalized Self-Consistent Method for Hybrid Composites—Y. Huang, K. X. Hu, and A. Chandra, pp. 19-28
- Modeling Fiber Breakage in a Metal-Matrix Composite—T. Nicholas and J. Ahmad, pp. 29-38
- Effect of Step Spacing on Delamination of Tapered Laminates—W. Cui, M. R. Wisnom, and M. Jones, pp. 39-46
- Accurate Comparative Determination of the In-Plane Shear Modulus of T300/914 by the Losipescu and 45° Off-Axis Tests—F. Pierron and V. Vautrin, pp. 61-72
- Axisymmetric Buckling of Moderately Thick Polar Orthotropic Annular Plates—J.-S. Chang, pp. 73-84
- Fatigue Fracture Behavior of Carbon-Fiber-Reinforced Modified Bismaleimide Composites—X. J. Xian and C. L. Choy, pp. 93-98
Stiffness Reduction in Laminate Coupons Due to the Free-Edge Effect—W. Becker and G. Kress, pp. 109–116
Short Crack Trapping/Untrapping in Particle-Reinforced Metal-Matrix Composites—C. Li and F. Ellyin, pp. 117–124

Composite Structures
Vol. 28, No. 3, 1994
Observations of a Pressurized Hydraulic Hose Under Lateral Liquid Impacts—C. D. Stewart and D. G. Gorman, pp. 255–268
Propagation of Leaky Plate Waves in Fluid-Loaded Composite Laminates—J. Lee, pp. 295–306
Analysis of a Sublamine in Compressively Loaded Laminate Under a Transverse Loading at its Center—J. Y. Huang, pp. 315–322
A Post-Failure Model for Composite Laminates Based on Phenomenologic Aspects of Damage—A. Mazzeranghi and D. Vangi, pp. 323–332

Vol. 28, No. 2, 1994
Residual Strength of Composites with Multiple Impact Damage—R. Jones, pp. 347–356
A High-Order Finite Element for Analysis of Composite Laminated Structures—H. Yu, pp. 375–384
A Hybrid Force/Stiffness Matrix Method for the Analysis of Thin-Walled Composite Frames—L. C. Bank and E. Cofie, pp. 391–404
A Finite Element for the Nonlinear Analysis of Laminated Circular Plates—R. E. Miller and G. H. Thiel, pp. 405–432
Three-Dimensional Stress Analysis of Two-Ply Cord-Rubber Composite Laminates—R. M. V. Pidaparti and V. P. Kakarla, pp. 433–440
Tensile Fracture Behavior of Notched Fiber Reinforced Titanium Metal Matrix Composite—S. Mall and J. Rattray, pp. 471–480
Foam Core Sandwich Panels with Interface Disbands—L. Falk, pp. 481–490

Vol. 29, No. 1, 1994
On the Numerical Analysis of Local Effects in Composite Structures—F. Gruttman and W. Wagner, pp. 1–12
Factors Influencing Nonlinear Static Response Prediction and Test-Analysis Correlation for Composite Panels—N. F. Knight, Jr., pp. 13–26
Nonlinear Analysis of Orthotropic Beams of Solid Cross-Sections—O. Rand, pp. 27–46
Design of Thick Laminated Composite Plates for Maximum Damping—T. Y. Kam and R. R. Chang, pp. 57–68
A Local High-Order Deformable Theory for Thick Laminated Cylindrical Shells—C.-P. Wu and C.-C. Liu, pp. 68–88
An Efficient Static Analysis of Sandwich Beams—N. S. Bardell and G. J. Gange, pp. 107–118

Vol. 29, No. 2, 1994
Three-Dimensional Static, Dynamic, Thermoeelastic and Buckling Analysis of Homogeneous and Laminated Composite Cylinders—K. P. Soldatos and J.-Q. Ye, pp. 131–144
Minimum Weight and Deflection Design of Thick Sandwich Laminates via Symbolic Computation—S. Adali, E. B. Summers, and V. E. Verijenko, pp. 145–160
Geometrically Nonlinear Higher Order Theory of Laminated Plates and Shells with Shear and Normal Deformation—V. E. Verijenko, pp. 161–180
Evaluative Eigen Analysis of Composite Structures—A. Maher, pp. 191–196
The Buckling Performance of Composite Stiffened Panel Structures Subjected to Combined In-Plane Compression and Shear Loading—J. Loughlan, pp. 197–212
Finite Element Analysis of Composite Structures—J. Wood, pp. 219–230
Vol. 29, No. 3, 1994
Free Vibration of Generally Laminated Composite Plates with Various Edge Support Conditions—G. B. Chai, pp. 249–258
Optimal Design of Laminated Plates and Shells—S. Abrate, pp. 269–286
Intraply Crack and Delamination Interaction in Lamine Beams Under Transverse Loading—Y.-B. Shi and A. F. Yee, pp. 287–298
Buckling of Generally Laminated Composite Plates with Various Edge Support Conditions—G. B. Chia, pp. 299–310
Static and Dynamic Behaviour of a Sandwich Composite Machine Component—B. Vedy and A. Venkatesh, p. 341

Computers & Structures

Vol. 51, No. 2, 1994
Buckling Analysis of Clamped Sandwich Plates by the Reciprocal Theorem Method—N. Li and S. Mirza, pp. 137–142
Micromechanics-Based Structural Analysis of Thick Laminated Composites—D. A. Pecknold and S. Rahman, pp. 163–180
DENA: A finite element Program for the Non-Linear Stress Analysis of Two-Dimensional, Metallic and Reinforced Concrete, Structures—A. Ranjbaran and M. E. Phipps, pp. 191–212

Vol. 51, No. 3, 1994
Modified Three-Dimensional Finite Element for General and Composite Shells—D. N. Buragohain and P. K. Ravichandran, pp. 289–298
Analysis of a Simply Supported Plate with Symmetric Angle-Ply Laminations—H. R. H. Kabir, pp. 299–308

Vol. 51, No. 4, 1994
Nonlinear Large Displacement and Moderate Rotational Characteristics of Composite Beams Incorporating Transverse Shear Strain—S. G. Creaghann and A. N. Palazotto, pp. 357–372

Vol. 51, No. 5, 1994
Calculation of Transient State Response of Machine Members Made of Composite Materials and of Sandwich Panels—T. Kucharski, pp. 495–502

Vol. 51, No. 6, 1994
Static Stress Analysis of a Composite Bevel Gear Using a Three-Dimensional Finite Element Method—S. Vijayarangan and N. Ganesan, pp. 771–784

Vol. 52, No. 1, 1994
Boundary Element Model for Bond Problems in Reinforced Concrete Members—G. Davi, L. LaMendola, and M. Papa, pp. 49–60
Plate Finite Element Modeling of Laminated Plates—C. K. Gim, pp. 157–168
Three-Dimensional Stress Field Analysis in Uniformly Loaded, Simply Supported Composite Plates—A. E. Bogdanovich and A. B. Birger, pp. 237–258

Vol. 52, No. 2, 1994
Bending Analysis of Laminated Plates and Shells by Different Methods—M. S. Qatu and A. Algoban, pp. 529–540
A New Finite Element for the Static and Dynamic Analysis of Cracked Composite Beams—M. Krawczuk, pp. 551–562

Vol. 52, No. 3, 1994
An Error Analysis Approach for Laminated Composite Plate Finite Element Models—J. E. Abdalla Filho and J. O. Dow, pp. 611–616

Vol. 52, No. 4, 1994
Thermal Stress Analysis of Laminated Doubly Curved Shells Using a Shear Flexible Finite Element—K. Chandrashekhara and A. Bhimaraddi, pp. 1023–1030
Calculations of the Flow-Induced Residual Stress Development in the Injection Moulded Plate—S.-C. Chen and Y.-C. Chen, pp. 1043–1050

Vol. 52, No. 6, 1994

Reduced Basis Technique for Evaluating the Sensitivity of the Nonlinear Vibrational Response of Composite Plates—A. K. Noor, M. J. Hadian, and J. M. Peters, pp. 1097–1106

Geometrically Non-Linear Transient Analysis of Laminated Composite and Sandwich Shells with a Refined Theory and C0 Finite Elements—T. Kant and J. R. Kommineni, pp. 1243–1260


Vol. 53, No. 1, 1994

Thermomechanical Buckling of Laminated Composite Plates with Higher-Order Transverse Shear Deformation—S. Xiaoping and S. Liangxin, pp. 1–8

An Effective Curved Composite Beam Finite Element Based on the Hybrid-Mixed Formulation—H. R. Dorfi and H. R. Busby, pp. 43–52

Dynamic Analysis of Laminated Composite Plates Subjected to Transverse Impact Using a Partial Mixed 3-D Finite Element—C.-L. Liao and J.-S. Tsai, pp. 53–62


Static Response of Anti-Symmetric Angle-Ply Laminated Shear-Flexible Clamped Plates—H. R. H. Kabir, pp. 201–208

Vol. 53, No. 2, 1994

Finite Element Flutter Analysis of Laminated Composite Panels—T. V. R. Chowdary, S. Parthan, and P. K. Sinha, pp. 245–252


Vol. 53, No. 3, 1994

A Least Squares Finite Element Formulation for Plane Elastostatics Based on p-Version with Applicatins to Laminated Composites—P. Fadum and K. S. Surana, pp. 491–508


Simple Programmes on Thermoelastic Analysis of Composite Laminate Materials—F. Cesari, pp. 551–568


An Improved Nonlinear Analysis of Reinforced Concrete Frames—H. A. S. Rasheed and K. S. Dinno, pp. 625–636

Vol. 53, No. 4, 1994

Active and Passive Control of a Revolute-Prismatic Flexible Composite-Material Robot Arm—F. Gordaninejad and S. Vaidyaraman, pp. 867–876

A Parametric Study of Bi-Material Bond Response to Wave Excitation—C. J. Younis and D. A. Sotiropoulos, pp. 1007–1014

Vol. 53, No. 5, 1994


A Laminated Composite Beam Element Separately Interpolated for the Bending and Shearing Deletions Without Increase in Nodal DOF—J. S. Koo and B. M. Kwak, pp. 1091–1098

Nonlinear Modelling of Reinforced Concrete Structures—H. C. Chan, Y. K. Cheung, and Y. P. Huang, pp. 1099–1108

A Computational Procedure to Calculate Stress-Strain Field Around Simple Shape Holes in Composite Laminates—N. Bonora, M. Costanzi, and M. Marchetti, pp. 1167–1180

Thermal Buckling of Laminated Composite Plates—M. Prabhu and R. Dhanaraj, pp. 1193–1204


Engineering Fracture Mechanics

Vol. 48, No. 3, 1994


Bonded Composite Repair of Cracked Load-Bearing Holes—J. Paul, R. A. Bartholomeusz, R. Jones, and M. Ekstrom, pp. 455–462

Vol. 48, No. 4, 1994

Prediction of Edge Stresses in Layered Media Using the Surface Integral-Finite Element Technique—M. Bak and H. A. Koenig, pp. 583–594

Vol. 48, No. 5, 1994

Stiffness Reduction Due to Multiple Microcracks in Transverse Isotropic Media—S. Nomura and D. L. Ball, pp. 649–654

Vol. 48, No. 6, 1994

Three-Dimensional Thermoelastic Problems of Interface Cracks in Periodic Two-Layered Composites—A. Kaczynski, pp. 783–800

Analysis of Matrix Damage Evolution in Laminated Composite Plate—Y. W. Kwon and J. Berner, pp. 811–818

Experimental Mechanics

Vol. 34, No. 2, June 1994


Vol. 34, No. 3, Sept. 1994

Experimental Techniques
Vol. 18, No. 4, July/Aug. 1994
Measurement of the Length of Fracture Process Zone in Fiber-Reinforced Concrete Using Holographic Moiré—P. K. Rastogi and E. Denairie, pp. 11–18

Vol. 18, No. 5, Sept./Oct. 1994
Performance Characterization and Modeling of a Composite Hip Prostheses—K. Liao, pp. 33

Vol. 18, No. 6, Nov./Dec. 1994
Ski Vibrations and Damping—B. Glenne, J. E. Jorgensen, and J. D. Chalupnik, pp. 19–22
A Crush Test Fixture for Investigating Energy Absorption of Flat Composite Plates—J. A. Lavoie and J. Morton, pp. 23–26

International Journal of Fracture
Vol. 65, No. 2, Jan. 1994
Anisotropic Material with Interacting Arbitrarily Oriented Cracks—Stress Intensity Factors and Crack Microcrack Interactions—C. Mauge and M. Kachanov, pp. 115–139

Vol. 65, No. 3, Feb. 1994

Vol. 65, No. 4, Feb. 1994
Crack-Particle Interaction in 2-Phase Composites—1. Particle-Shape Effects—P. Lipetzky and S. Schmauder, pp. 345–358

Vol. 66, No. 1, March 1994
The Compressive Failure of Notched Composites—The Effects of Geometry and Microbuckling Softening Law—E. Smith, pp. 33–44
The Peeling of Flexible Laminates—A. J. Kinloch, C. C. Lau, and J. G. Williams, pp. 45–70

Vol. 66, No. 2, March 1994

Vol. 66, No. 3, April 1994

Vol. 66, No. 4, April 1994
Stresses in Coated Fiber-Reinforced Composites with Interface Flaw—X. L. Han and D. Wang, pp. R67–R72

Vol. 67, No. 1, May 1994
A Generalized Coimou Contact Model for Interface Cracks in Anisotropic Elastic Solids—J. Lee and H. Gao, pp. 53–68

Vol. 67, No. 1, May 1994

Vol. 67, No. 3, June 1994
Prediction of Branching (or Relaxation) Angle in Anisotropic or Isotropic Elastic Bimaterials with Rigid Substrate—C. Atkinson, C. Bastero, and M. I. Sanchez, pp. 231–262

Vol. 67, No. 4, June 1994
T-Shaped Crack Problem for Bonded Orthotropic Layers—F. Erdogan and S. Kadioglu, pp. 273–300

International Journal of Solids and Structures
Vol. 31, No. 11, June 1994
Interlaminar Stress Analysis of Composite Laminates Using a Sublaminate/Layer Model—W.-L. Yin, pp. 1549–1564

Vol. 31, No. 14, July 1994
Interaction Between a Main-Crack and a Parallel Micro-Crack in an Orthotropic Plane Elastic Solid—Y.-H. Chen and N. Hasebe, pp. 1877–1890
On Circumferential Splitting of a Laminated Cylindrical Shell—W. J. Bottega, pp. 1891–1910

Vol. 31, No. 15, Aug. 1994
Mechanics of Splitting in Orthotropic Materials—Y. L. Cui, pp. 2015–2034

Vol. 31, No. 16, Aug. 1994

Buckling of Thick Orthotropic Cylindrical Shells Under External Pressure Based on Non-Planar Equilibrium Modes—G. A. Kardomeas and C. B. Chung, pp. 2195–2310

Vol. 31, No. 18, Sept. 1994

Incipient Separation Between a Frictionless Flat Punch and an Anisotropic Multilayered Half Plane—E. E. Urquhart and M.-J. Pindera, pp. 2449–2508

Bending Solution of High-Order Refined Shear Deformation Theory for Rectangular Composite Plates—L. Ping, Z. Yongwei, and Z. Kai, pp. 2491–2508

A Mechanics Model for the Compressive Response of Fiber Reinforced Composites—I. Chung and Y. Weitsman, pp. 2519–2536

Vol. 31, No. 19, Oct. 1994


Vol. 31, No. 20, Oct. 1994

Multiple Cracking in Metal-Ceramic Laminates—Y. Huang, H. W. Zhang, and F. Wu, pp. 2753–2768

An Improved In-Plane Thermomechanical Model for Laminated Composite Plates—L. Ping, Z. Yongwei, and Z. Xiangzhou, pp. 2867–2882

Vol. 31, No. 21, Nov. 1994

Formulas for the Stiffness of Composites with Periodic Microstructure—R. Luciano and E. J. Barbero, pp. 2933–2944

Characterization of a Horizontal Crack in Anisotropic Laminated Plates—G. R. Liu and K. Y. Lam, pp. 2965–2978

Vol. 31, No. 22, Nov. 1994

Quasi-Impact Damage Initiation and Growth of Thick-Section and Toughened Composite Materials—S. Liu, pp. 3079–2098


Vol. 31, No. 23, Dec. 1994


Vol. 31, No. 24, Dec. 1994


Composites with Symmetry and their Extremal Properties—R. Lipton, pp. 3407–3418

A Method of Strain and Stress Analysis of Composites for Nonlinear Strain Distribution Case—E. S. Ardic, C. Bolcan, and A. Kayran, pp. 3457–3474

Analysis of Crack Moving and Curving in Anisotropic Solids—Y. Xu and L. M. Keer, pp. 3475

Journal of Adhesion

Vol. 42, Nos. 1 and 2, 1993

Thermo-Mechanical Study of Some Epoxy Adhesives Subjected to Combined Dynamic and Static Stresses—S. Bron and D. Katz, pp. 1–23

Pressure Sensitive Adhesive Properties and Miscibility in Blends of Poly(Vinyl Ethylene-Co-1,4-Butadiene) with Hydrogenated Terpene Resin—Y. Kano, S. Kawahara, and S. Akiiyama, pp. 25–37


Effect of Stress Whitening on Moisture Diffusion in Thermosetting Polymers—E. Sancaktar and D. R. Baechtle, pp. 65–85


Use of Thin Film Thermocouples to Determine the Thermal Conductivity and Young’s Modulus of Coatings and Interfaces—S. Krishnan, S. V. Babu, R. Bowen, L. P. Demeio, H. Osterhoudt, and D. S. Rimai, pp. 103–112


Vol. 42, No. 3, 1993

The Effect of Aging and Environment on the Static and Fatigue-Strength of Adhesive Joints—R. I. Mackie and N. Su, pp. 191–207

Vol. 43, Nos. 1 and 2, 1993

The Effect of Temperature on the Strength of Adhesively-Bonded Composite-Aluminum Joints—R. D. Adams and V. Mallick, pp. 17–33

The Effect of Superimposed Dynamic and Static Stresses on the Stress-Relaxation Rates of Model Epoxy-Resins—S. Bron and D. Katz, pp. 35–53

Determination of the Contact Angle of a Liquid Droplet on a Carbon Fiber—T. Ogawa and M. Ikeda, pp. 69–78

Predicting the Fatigue Life of Adhesively-Bonded Joints—A. J. Kimloch and S. O. Osijemi, pp. 79–90
Journal of Advanced Materials (formerly SAMPE Quarterly)

Vol. 25, No. 1, Oct. 1993

The Effect of Molecular Weight on Transverse Microcracking in High-Temperature LaRC-RP46T Polyimide Composites—B. D. Poter, F. G. Yuan, and R. H. Pater, pp. 30–34
The Influence of Test Method on The Compressive Strength of Several Fiber-Reinforced Plastics—J. G. Haberle and F. L. Matthews, pp. 35–45
A Generalized Model for Flow of Polymer Fluids Through Fibrous Media—Z. Cai, pp. 58–63

Vol. 25, No. 2, Jan. 1994


Vol. 25, No. 3, April 1994

Advancements in Welding Technology for Composite-To-Metallic Joints—J. M. Marinelli and C. L. T. Lambing, pp. 20–27
Multi-Core Composite Laminates—C. A. Weeks and C. T. Sun, pp. 28–37
A Semi-Analytical One-Dimensional Model for Viscoelastic Impregnation of Fibrous Media—L. Skartsis, B. Khomami, and J. L. Kardos, pp. 38–44
Manufacturing and Testing of Graphite/Epoxy Box Beams—R. M. V. Pidaparti, pp. 49–52
A Simplified Flow Model for Resin Transfer Molding of Polymer Composites—W.-B. Young, pp. 60

Vol. 25, No. 4, July 1994

Mechanical Properties of Aluminum Coupled Graphite Composites Exposed to Aircraft Test Environments—A. S. Postyn and M. L. Rommel, pp. 2–12
The Effect of Porosity on Elastic Constants of Representative Aircraft Laminates—A. M. Rubin and K. L. Jerina, pp. 21–30

Journal of Applied Mechanics

Vol. 61, No. 2, June 1994

Two-Dimensional Contact on an Anisotropic Elastic Half-Space—H. Fan and L. M. Keer, pp. 250–255
Ultrasonic Evaluations of Stiffness Tensor Changes and Associated Anisotropic Damage in a Ceramic Matrix Composite—B. Audoin and S. Baste, pp. 309–316
<table>
<thead>
<tr>
<th>Journal of Composite Materials</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Vol. 28, No. 7, 1994</strong></td>
</tr>
<tr>
<td>Short-Fiber Polymer Composites—A Fracture-Based Theory of Fiber-Reinforcement—M. R. Piggott, pp. 588–606</td>
</tr>
<tr>
<td>Macro Finite-Element for Analysis of Textile Composites—J. Whitcomb, K. Woo and S. Gundapaneni, pp. 607–618</td>
</tr>
<tr>
<td>Quantification of Unidirectional Fiber Bed Permeability—J. Vandenwusthuizen and J. P. Duplesis, pp. 619–637</td>
</tr>
<tr>
<td>On The Prediction of Failure at a Fiber-Matrix Interface in a Composite Subjected to a Transverse Tensile Load (Vol 25, Pg 869, 1991)—p. 682</td>
</tr>
</tbody>
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<table>
<thead>
<tr>
<th>Vol. 28, No. 8, 1994</th>
</tr>
</thead>
<tbody>
<tr>
<td>A Laminate Design for Elastic Properties of Symmetrical Laminates with Extension-Shear or Bending-Twisting Coupling—H. Fukunaga and H. Sekine, pp. 708–731</td>
</tr>
</tbody>
</table>


<table>
<thead>
<tr>
<th>Vol. 28, No. 9, 1994</th>
</tr>
</thead>
<tbody>
<tr>
<td>Micromechanics Characterization of Unidirectional Composites During Multiaxial Plastic Deformation—T. C. Tseng, pp. 800–820</td>
</tr>
<tr>
<td>Strain Rate and Coupling Agent Effects in Discontinuous Glass Fiber-Reinforced Polypropylene Matrix—A. Agbossou, P. Mele, and N. Alberola, pp. 821–836</td>
</tr>
<tr>
<td>A Numerical and Experimental Study of Delaminated Layered Composites—Y. X. Mukherjee, S. N. Gulrajani, S. Mukherjee, and A. N. Netravali, pp. 837–870</td>
</tr>
<tr>
<td>Solid Particle Erosion of Thermoplastic Resins Reinforced by Short Fibers—N. Miyazaki and T. Hamao, pp. 871–883</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Vol. 28, No. 10, 1994</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deformation-Induced Degradation of Thermal Conductivity in Cracked Solids—D. Y. Tzou, pp. 886–901</td>
</tr>
<tr>
<td>Matrix Cracking Effect on Delamination Growth in Composite Laminates Induced by a Spherical Indenter—S. Liu and F. K. Chang, pp. 940–977</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Vol. 28, No. 1, 1994</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thermomechanical Modeling of Irradiated Polymer Composites—S. K. Chaturvedi and C. P. Chao, pp. 980–1008</td>
</tr>
<tr>
<td>Energy-Release Rate Determination for Edge Delamination Under Combined Inplane, Bending and Hygrothermal Loading—J. Delamination at a Single Interface—B. D. Davidson, pp. 1009–1031</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Vol. 28, No. 12, 1994</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gate Location Optimization in Liquid Composite Molding Using Genetic Algorithms—W. B. Young, pp. 1098–1113</td>
</tr>
<tr>
<td>Delamination and Buckling in 3D Composites—B. N. Cox, pp. 1114–1126</td>
</tr>
<tr>
<td>Fatigue Damage and Fracture Mechanism of Notched Woven Laminates—J. Y. Xiao and C. Bathias, pp. 1127–1139</td>
</tr>
<tr>
<td>Role of Interphase on the Elastic Behavior of Composite Materials—Theoretical and Experimental Analysis—M. Lagache, A. Agbossou, J. Pastor, and D. Muller, pp. 1140–1157</td>
</tr>
</tbody>
</table>
Failure of Braided Carbon/Epoxy Composites Under Biaxial Compression—L. V. Smith and S. R. Swanson, pp. 1158–1178

Journal of Engineering Materials and Technology

Vol. 116, No. 3, July 1994

Exact Results Concerning the Local Fields and Effective Properties in Piezoelectric Composites—Y. Benveniste, pp. 260–267
Micromechanical Approach of the Coated Inclusion Problem and Applications to Composite Materials—M. Cherkauoi, H. Sabar, and M. Berreilla, pp. 274–278
Aspects of Heterogenization—E. Honein, T. Honein, and G. Herrmann, pp. 298–304
Double-Inclusion Model and Overall Moduli of Multi-Phase Composites—M. Hori and S. Nemati-Nasser, pp. 305–309
Micromechanics and Effective Elastoplastic Behavior of Two-Phase Metal Matrix Composites—J. W. Ju and T.-M. Chen, pp. 310–318
Damage Mechanism in Ti, Al Matrix Composites—D. Kouris and D. Marshall, pp. 319–324
Micromechanics of Active Composites With SMA Fibers—D. C. Lagoudas, J. G. Boyd, and Z. Bo, pp. 337–347
Stress Fields in a Continuous Fiber Composite With a Variable Interphase Under Thermo-Mechanical Loadings—Y. Mikata, pp. 367–377
Matrix Crack Extension at a Frictionally Constrained Fiber—A. P. S. Selvadurai, pp. 398–402
The Effective Properties of Composite Materials with Constant Reinforcement Density by the Linear Mori-Tanaka Method—J. R. Zuiker and G. J. Dvorak, pp. 428


Strain-Rate Sensitivity, Relaxation Behavior, and Complex Moduli of a Class of Isotropic Viscoelastic Composites—J. Li and G. J. Weng, pp. 495–504
The Effect of Matrix Constitutive Model on Residual Thermal Stresses in MMC—J. B. Brayshaw and M.-J. Pindera, pp. 505–511
A Spring Foundation Model for Mode-I Failure of Laminated Composites Based on an Energy Criterion—S. J. Song and A. M. Waas, pp. 512–516

Journal of Materials Science

Vol. 29, No. 10, May 1994

Particulate Silicon Nitride-Based Composites—Y. G. Gogotsi, pp. 2541–2556
A Functionally Gradient Coating on Carbon-Fiber for C/Al Composites—J. K. Yu, H. L. Li, and B. L. Shang, pp. 2641–2647
Microstructural Properties of BI1, 7PB0, 4SR1, 6CA2, 4CU3, 6OY, AG20, Composites—Y. D. Chiu, T. S. Lei and C. H. Kao, pp. 2678–2682
Experimental Determination of the Stress-Crack Opening Relation in Fiber Cementitious Composites with a Crack-Tip Singularity—V. C. Li, M. Maalej, and T. Hashida, pp. 2719–2724
Stress Distribution in Discontinuous Fibers in a Model Composite—S. Ochiai and M. Hojo, pp. 2754–2760

Vol. 29, No. 11, June 1994

Corrosion Behavior of Aluminum-Based Metal-Matrix Composites—S. L. Coleman, V. D. Scott, and B. McEnaney, pp. 2826–2834
Dielectric Study of Hollow Microsphere Composites—J. P. Ansermet and E. Baeriswyl, pp. 2841–2846
A Synthesis of Mono-Crystalline Silicon-Nitride Filaments—K. J. Huttoner and T. W. Pieschel, pp. 2879–2883
Interlaminar Fracture of Carbon Thermoplastic Polyimide Composites—J. Zhou, T. B. He, J. Zhang, and M. X. Ding, pp. 2916–2920


Fractography of Interlaminar Fracture Surfaces of CF/PI and CF/BMI Composites—R. Selzer and J. Krey, pp. 2951–2956


Amorphous Phase Growth by Isothermal Annealing-Induced Interdiffusion Reactions in Mechanically Deformed Ni/Ti Multilayered Composites—T. D. Shen, M. X. Quan, J. T. Wang, and Z. Q. Hu, pp. 2982–2986


Phase Distribution and Associated Mechanical Property Distribution in Silicon-Carbide Particle-Reinforced Aluminum Fabricated by Liquid-Metal Infiltration—S. W. Lai and D. D. L. Chung, pp. 2998–3016


The Failure of Composite Tubes Due to Combinine Compression and Torsion—P. M. Jelf and N. A. Fleck, pp. 3080–3084

Vol. 29, No. 12, June 1994

Structure and Mechanical-Properties of Nanocrystalline Ag/MgO Composites—T. Kizuka, H. Ichinose, and Y. Ishida, pp. 3107–3112

Preparation of YBCO-AG Composites with Low-Carbon Contents by a Wet Method—A. Mariani and P. L. Villa, pp. 3113–3120


Fabrication and Mechanical-Behavior of Al2O3/Mo Nanocomposites—M. Nawa, T. Sekino and K. Niihara, pp. 3185–3192

Effects of Amorphous Silica Coatings on the Sintering Behaviors of SiC Whisker-Reinforced Al2O3 Composites—C. C. Chen and F. S. Yen, pp. 3215–3220


An Internal Synthesis Method for Mullite Chromium Carbide Composite in a Vacuum System—C. T. Ho, pp. 3309–3315

2 Stages of Interfacial Reaction in B-Al Composite—V. V. Astanin and L. A. Imayeva, pp. 3351–3357

Vol. 29, No. 13, July 1994


The Relevance of the Surface Structure and Surface Chemistry of Carbon Fibers in Their Adhesion to High-Temperature Thermoplastics .2. Surface Chemistry—G. Krekel, K. J. Huttinger, and W. P. Hoffman, pp. 3461–3468

Preparation of C-Fiber Borosilicate Glass Composites—Influence of the Fiber Distribution on Mechanical-Properties—T. Klug and R. Bruckner, pp. 3469–3476


Vol. 29, No. 14, July 1994

Influence of Casting and Heat-Treatment Parameters in Controlling the Properties of an Al-10 wt-Percent Si-0.6 wt-Percent Mg/SiC/20P Composite—A. M. Samuel and F. H. Samuel, pp. 3591–3600


Temperature-Dependent Torsional Properties of High-Performance Fibers and Their Relevance to Compressive Strength—V. R. Mehta and S. Kumar, pp. 3658–3664


Vol. 29, No. 15, Aug. 1994


Preparation of C-Fiber Borosilicate Glass Composites—Influence of the Fiber-Type on Mechanical-Properties—T. Klug, pp. 4013–4021
Interfacial Fracture-Toughness Measurement Using Indentation—J. Zhang and J. J. Lewandowski, pp. 4022-4026
Microstructure and Mechanical Properties of Pitch-Based Carbon Fibers—Y. L. Huang and R. J. Young, pp. 4027-4036
A Bioactive Composite Material Produced by the Sol-Gel Method—S. M. Jones, S. E. Friberg, and J. Sjoblom, pp. 4075-4080

Vol. 29, No. 16, Aug. 1994
The Influence of Powder Packing on the Rheology of Fiber-Loaded Pastes—S. Blackburn and H. Bohm, pp. 4157-4166
Direct Observation of the Fracture of CAS-Glass SiC Composites
Interfacial Stability, Oxidation Response and Mechanical Properties of a Nicalon (TM) Fiber-Reinforced Chemical Bonded Ceramic-Matrix Composite—A. Bandyopadhyay and P. B. Aswath, pp. 4205-4215
Strength Variability and Size Effect of Nicalon Fiber Bundles—H. F. Wu and L. L. Wu, pp. 4232-4237
Sintering of Glass Matrix Composites Containing Al2O3 Platelet Inclusions—A. R. Boccaccini, pp. 4273-4278
Strength Distribution of Carborundum Polycrystalline SiC Fibers as Derived from the Single-Fiber-Composite Test—W. A. Curtin, A. N. Netravali, and J. M. Park, pp. 4718-4728
Effect of Moisture Absorption on Damping Performance and Dynamic Stiffness of NY-6/CF Commingled Yarn Composite—A. Djurnaev and K. Takahashi, pp. 4736-4741
Densification and Mechanical Properties of Shock-Treated Alumina and Its Composites—M. Bengisu and O. T. Inal, pp. 4824-4838
Thermal Stability of Interfaces in Ti-6Al-4V Reinforced by SiC Sigma Fibers—C. Badini, M. Ferraris, and F. Marchetti, pp. 4840-4846
Young's Modulus of Cold- and Hot-Rolled (Al5O3)1-Al Composite—J. C. Lee and K. N. Subramanian, pp. 4901-4905

Vol. 29, No. 19, Oct. 1994
Degradation of SiC Particles in Aluminium-Based Composites—G. Carotenuto, A. Gallo, and L. Nicolais, pp. 4967-4974
Microscopy of Impact Damage in Particulate-Filled Glass-Epoxy Laminates—G. Pritchard and Q. Yang, pp. 5047-5053
Activation Theory for Creep of Matrix Resin and Carbon Fiber-Reinforced Polymer Composite—J. Raghavan and M. Meshii, pp. 5078-5084
Statistical Variability in the Strength and Failure Strain of Aramid and Polyester Yarns—G. Amaniampong and C. J. Burgoyne, pp. 5141-5152

Vol. 29, No. 20, Oct. 1994
The Toughening and Strengthening of Ceramic Materials Through Discontinuous Reinforcement—K. Xia and T. G. Langdon, pp. 5219-5231
Liquid-Phase Sintering of Chemically Unstable Silicon Carbide-Lithium/Magnesium Aluminosilicate-Titania Composites—Z. Panek, pp. 5383-5389

Journal of Reinforced Plastics and Composites
Vol. 13, June 1994
The Mixed Mode Fracture Analysis of Unidirectional Composites—H.-Y. Yeh and C. H. Kim, pp. 498-508
An Energy Balance Based Approach to the End-Notched Flexure Test—S. A. Laman and M. Vedula, pp. 541-554
Stress Determination at Skin-Stiffener Interfaces of Composite Stiffened Panels Under Generalized Loading—C. Kassapoglou, pp. 555-573
Finite Element Analysis of Laminated Composite Stiffened Shell—S. Goswami and M. Mukhopadhyay, pp. 574–616

Tension-Compression Fatigue Behavior of a Silicon Carbide Calcium-Aluminosilicate Ceramic Matrix Composite—F. A. Opsalski and S. Mall, pp. 617–636


High-Pressure/High-Temperature Dilatometry of SMC Low Profile Additives—H. G. Kia and P. V. Viscomi, pp. 666–680


Stress-Softening Effects in Elastomeric Networks—E. Kontou, pp. 756–767

Failure Mode and Damage Zone Development in a GMT-PP by Acoustic Emission and Thermography—J. Karger-Kocsis and Zs. Fejes-Kozma, pp. 768–792


Bond Strength of FRP-Wood Interface—E. Barbero, J. Davalos, and U. Munipalle, pp. 835–855


An Introduction to Taguchi Techniques Applied to Pultrusion Resins and Processing—C. Smith and J. Taylor, pp. 871–879

Interlaminar Normal Stiffness and Strength of Thick Orthotropic Laminates: An Experimental Study—A. K. Roy and R. Y. Kim, pp. 880–894

Flexural Properties of Reinforced Polyester Concrete Made with Recycled PET—K. S. Rebeiz and D. W. Fowler, pp. 895–907

Just How Good are Knitted Fabrics—P. L. DeWalt and R. P. Reichard, pp. 908–917

Cure Characterization of Thick SMC Parts Using Dielectric and Finite Differences Analysis—D. R. Day, pp. 918–926

The Potential for Low Cost Thermoplastic Pultrusion—M. L. Wilson and J. D. Buckley, pp. 927–941

Pultruded Reinforced Plastics for Civil Engineering Structural Applications—A. Green, T. Bisarnsin, and E. A. Love, p. 942

Journal of Sound and Vibration

Vol. 173, No. 1, May 1994

Acoustic Plane Wave Reflection from a Composite Laminate: Normal Incidence—A. Bagchi and S. K. Bose, pp. 43–56

Vibration Analysis of Orthogonally Stiffened Cylindrical Shells Using Super Finite Elements—J. Jiang and M. D. Olson, pp. 73–84

Vol. 174, No. 3, July 1994


Axisymmetrical Free-Vibrations of Homogeneous and Laminated Piezoelectric Cylinders—N. Kharouf and P. R. Heyliger, pp. 539–561

Vol. 175, No. 2, Aug. 1994

Nonlinear, Free, Damped Vibrations of Sandwich Plates—Z. Q. Xia and S. Lukasiewicz, pp. 219–232

Orthotropic Cylindrical-Shells with a Viscoelastic Core—A Vibrational and Damping Analysis—T. C. Ramesh and N. Ganesan, pp. 535–555

Vol. 175, No. 5, Aug. 1994

Vibration Analysis of Laminated Plates Using a Refined Shear Deformation-Theory—Z.-Q. Xia and S. Lukasiewicz, pp. 693–699

Vol. 176, No. 2, Sept. 1994

Vibration of a Delaminated Beam Plate Relative to Postbuckling States with Shear Deformation-Theory—H. P. Chen and P. J. Goggin, pp. 163–178

Free-Vibrations of Sandwich Beams with a Transversely Flexible Core—A High-Order Approach—Y. Frosting and M. Baruch, pp. 195–208


Orthotropic Plates Again—J. R. Kuttner, pp. 286–288

Vol. 175, No. 5, Oct. 1994
Free-Vibrations of Nonsymmetrical Cross-Ply Laminated Composite Beams—H. Abramovich and A. Livshits, pp. 597–612

Vol. 177, No. 1, Oct. 1994
Sensitivity of Bonded and Composite Beams—N. -E. Kim and J. H. Griffin, pp. 71–92

Vol. 177, No. 4, Nov. 1994
Vibration and Stability of Laminated Plates Based on a Local High Order Plate Theory—C. -P. Wu and W.-Y. Chen, pp. 503–520
A Non-Conforming Approximate Solution to a Specially Orthotropic Axisymmetric Thin Shell Subjected to a Harmonic Displacement Boundary Condition—A. J. Hull, pp. 611–622

Journal of Testing and Evaluation
Vol. 22, No. 4, July 1994

Vol. 22, No. 5, Sept. 1994

Vol. 22, No. 6, Nov. 1994

Mechanics of Composite Materials
Vol. 29, No. 6, Nov.–Dec. 1993
Damage and Failure of Randomly Reinforced Polymer Composites Analysis of Models and Experimental-Data with Nonstationary Proportional Loading—P. A. Pavlov and L. I. Ogorodov, pp. 555–562
Designing a 3D Region of Strength Properties for a Laminate Composite—A. F. Kregers and Y. G. Melbards, pp. 562–566

Vol. 30, No. 1, Jan.–Feb. 1994
Stability of Delaminations in Composite Structural Members Under Bending—V. V. Partsevskii and S. M. Belyaev, pp. 576–580
Optimum Design of a Reinforced Beam Under Dynamic Loading—J. Lellep and E. Sakkov, pp. 596–600
Natural Vibrations of a System with Hysteretic and Viscous Damping—E. N. Barkanov, pp. 613–616
Analysis of the Optimum Heat-Insulating Properties of a 3-Layer Plate with a Honeycomb Filler—V. E. Kryutchenko, pp. 616–620

Damage Zone Development and Failure Sequence in Glass-Fiber Mat-Reinforced Polypropylene Under Static Loading Conditions—J. Kargerkoscs and Z. Fejeskozma, pp. 8–13
Strength and Durability of Mixed Glass-Fiber-Reinforced Laminates—J. Andersons, V. Lomonov, M. Mikelsons, and V. Tamuzs, pp. 22–29
Calculation of Edge Stresses in Multilayer Composite Materials—S. A. Lure, pp. 36–42
Structural Multistage Model of the Bearing Capacity of Carbon-Carbon Laminate Shells—Y. V. Sokolkin, A. G. Kotov, and A. A. Chekalkin, pp. 55–60
Contact Problem for Composite Laminates with Nonlinear Phase Interactions—B. L. Pelekh and N. N. Khomyak, pp. 79–83
Change in the Viscoelastic Properties of an Organic-Fiber-Reinforced Plastic During Loading—K. K. Aniskevich and Y. O. Yanson, pp. 84–89

Generalized Stress-Strain Relationship in a Wide-Range of Temperatures and Draw Ratios for High-Density Polyethylene Materials Produced by Multistate Zone-Drawing and Crystallization of Highly Deformed Melts after Extrusion—Y. M. Boiko, pp. 90–94

Comparative Analysis of Models for Transverse Conductivity for Optimization of Unidirectional Hybrid Composites—A. A. Smerdov, pp. 95–98

Polymer Composites

Vol. 15, No. 3, June 1994


The Fracture Behavior of Rubber-Toughened Short-Fiber Composites of Nylon 6,6—T. J. Pecorini and R. W. Hertzberg, pp. 174–183

The Devolatilization of Polyimide Fiber Composites: Model and Experimental Verification—I. S. Yoon, Y. Yang, M. P. Dudukovic, and J. L. Kardos, pp. 184–196

Interfacial Toughness and its Effect on Compression Strength in Polycarbonate/Carbon Fiber Composites—P. R. Stone and J. A. Nairn, pp. 197–205


Studies on a Fiber Reinforced Plastics Honeycomb Structure—G. S. Mukherjee and M. N. Saraf, pp. 217–222


A Computational Analysis of the Heating of Glass Mat Thermoplastic (GMT) Sheets by Dual Beam Microwave Sources—K. T. O’Brien, S. Kasturi, and A. M. Mekkaoui, pp. 231–239


Vol. 15, No. 4, Aug. 1994

Introduction: Composite Processing—D. E. Hirt and J. D. Muzzy, pp. 253


Applications of a Fiber Orientation Prediction Algorithm for Compression Molded Parts with Multiple Charges—L. G. Steffenhagen and H. U. Akay, pp. 261–269

Predicting Shrinkage and Warpage of Fiber-Reinforced Composite Parts—S.-C. Tseng and T. A. Osswald, pp. 270–277


Coating Carbon Fibers with a Thermoplastic Polymide Using Aqueous Foam—R. R. Chary and D. E. Hirt, pp. 306–312

Polymers & Polymer Composites

Vol. 2, No. 1, 1994


A Review of 129Xe NMR as a Probe of Polymer Morphology—J. H. Walton, pp. 35–43 Novel All-Hydrocarbon Thermosetting Resins as Matrix Materials for Carbon and Glass Fiber Composites Materials I: Reinforcement—J. Muthiah and Dr. L. L. Mathias, pp. 43A–48

The Influence on their Resilience of a Partial Removal of the Deforming Stress on Compressed Elastomers—K. Tobisch, pp. 49A–58

Vol. 2, No. 2, 1994

Fiber Orientation Behaviour of Different Types of Glass Mat Reinforced Thermoplastics (GMT)—A. Meij, O. Munder, and M. Neitzel, pp. 91–98


Radial Diffusion in a Sphere with Subsequent Change in Dimension. Desorption with a Finite Surface Coefficient of Mass Transfer in an Infinite Volume—N. Bakhouya-Sabbahi, J. Bouzon, and J. M. Vergnaud, pp. 105–114

Design Optimisation of FRP Universal Connectors—A. S. Mossalam and N. E. Bedewi, pp. 115A–124


Vol. 2, No. 3, 1994


Experimental Verification on Simulating Shrinkage and Warpage of Thin Compression Moulded DMC Parts—T. A. Osswalt, E. M. Sun, and S.-C. Tseng, pp. 187A–198

Utilisation of Monodisperse Polymer Particles as a Spacer for Liquid Crystal Displays—K. Rindo and A. Yoshimatsu, pp. 199A–204

SAMPE Journal

Vol. 30, No. 4, July/Aug. 1994

Ion Beam Modification of Carbon Fiber—S. S. Lin and P. W. Yip, pp. 52–60

Shielding and Magnification of Loads in Elastic, Unidirectional Composites—A. M. Sastry and S. L. Phoenix, p. 61

Thermosetting Polymides: A Review—R. H. Pater, pp. 29–38

Application of Short Carbon Fiber in Construction—S. S. Lin, pp. 39–45

Charging and Discharging Currents in Composite Polymides—M. S. Sussi and G. R. Govinda Raju, pp. 50

Vol. 30, No. 6, Nov./Dec. 1994
Ultrasonic Testing of Solid Fiber-Reinforced Composite Plate—B. S. Wong, K. S. Tan, and T. G. Tui, pp. 36–40

Composite Polymides: Depolarization (TSD) and Polarization (TSP) Currents—M. A. Sussi and G. R. Govinda Raju, pp. 41–50

Effects of Cross-Section of Polycrylonitrile Fiber on Carbon Fiber Properties—J.-S. Tsai, pp. 51–55
EDITOR’S NOTE:
This issue of the World of Composites begins with a summary of composites activities in ASTM. This will include summaries of pursuits of Committee D-30 on High Modulus Fibers and Their Composites and Committee C-28’s Subcommittee C28.07 on Ceramic Matrix Composites. This will be followed by news from The Adhesion Society.

ASTM COMPOSITES ACTIVITIES
Board of Directors Establishes Wayne W. Stinchcomb Award; D-30’s Fall 1994 Meeting Reviewed; Spring 1995 Symposium Outlined; C-28 Ceramic Matrix Composites Fall 1994 Reviewed

Wayne W. Stinchcomb Memorial Lecture and Award
On 19 Jan. 1995, the ASTM Board of Directors approved Committee D-30’s request to establish The Wayne W. Stinchcomb Memorial Lecture and Award in memory of Wayne W. Stinchcomb. This will be a Society level award.

Background
A Fellow of the Society and past Chairman of Committee D-30, Wayne demonstrated exceptional technical and administrative leadership throughout his 20 years of service to ASTM. Wayne’s leadership was most recognized and will be most remembered as exceptionally humanitarian. He was instrumental in building D-30 as a committee of individuals with a personal and technical comradery that has served the committee, ASTM, and the composites technical community well.

Criteria
The Wayne W. Stinchcomb Memorial Lecture and Award will be presented annually at the spring D-30 symposium. The first award will be present in the spring of 1996. The following criteria shall be considered in selecting an individual for the Lecture and Award:

• Outstanding contributions in research, engineering, or teaching the technology of composite materials.
• Outstanding service to Committee D-30 or any other technical organization with emphasis on the study and advancement of composite materials.
• Other outstanding work or contributions in the area of composite materials.

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In particular, the individual’s role in the mentorship of colleagues involved in these areas is a key consideration.

Rules Governing the Lecture
The D-30 Award Committee shall administer the award. Nominees need not be members of ASTM or Committee D-30. Nominees will be solicited from the D-30 membership at the annual spring committee week and from the Committee at large through a mailing. Deadline for submission of a nominee will be 31 Aug. The Awards Committee will present the nominees to the D-30 Executive Subcommittee at the fall committee meeting and propose a selected nominee for Executive Subcommittee approval. If the Executive Subcommittee does not select a nominee any given year, the lecture will not be presented that year.

The lecture may be on any topic area pertinent to the technology of composite materials.

If the candidate fails to make the presentation at the spring symposium due to extenuating circumstances, the Executive Subcommittee will consider alternate arrangements.

Format of the Award
The individual presenting the annual lecture will be presented with a certificate commemorating the lecture.

After presentation of the lecture, the individual will have his/her name and the date of the lecture engraved on a plaque to be mounted and displayed at ASTM Headquarters.

Financing the Award
Funds for the purchase of the headquarters plaque will be from donations solicited specifically for the establishment of this award.
D-30's Fall 1994 Meeting Reviewed

Committee D-30 on High Modulus Fibers and Their Composites held its last meeting in November 1994 in Phoenix, AZ. In addition to sponsoring a symposium on Fiber, Matrix, and Interphase Properties, the committee held a series of subcommittee meetings to develop and update its test standards. Summaries of the subcommittee meetings follow.

Subcommittee D30.01, Editorial

Chaired by Elizabeth C. Goeke, U.S. Army Materials Technology Laboratory

The subcommittee continues to add definitions to Standard D 3878, Standard Terminology of High Modulus Reinforcing Fibers and Their Composites. Ballot results were discussed at the subcommittee meeting. Work is also underway to ballot several new terms.

Subcommittee D30.02, Research and Mechanics

Chaired by Rod Martin, Materials Engineering Research Laboratory Ltd.

The D30.02.03 Task Group on International Standards Harmonization did not meet. However, Gene Camponeschi, the D-30 liaison to TC61 submitted a synopsis of the recent International Organization for Standardization (ISO) meeting in Tokyo. Included was a list of all test methods that ISO is in the process of developing. Gene stated that a D-30 reviewer’s name is to be selected for each of these test methods.

The Impact Task Group D30.02.06 reviewed the current draft of the test method for quasi-static impact, Standard Test Method for Measuring Impact Damage Resistance of a Fiber Reinforced Polymer Matrix Composite. Since the term “damage resistance” has not been defined by ASTM, the name will be changed to the Standard Test Method for Measuring the Response of a Fiber-Reinforced Polymer-Matrix Composite to a Concentrated Quasi-Static Load. Many test parameters were fixed to expedite the test method development process. A revised version of the draft is currently being prepared.

Larry Casillas of Allied Signal in Phoenix gave a presentation to inform the committee on the Materials Testing Laboratory Accreditation scheme by the National Aerospace and Defense Contractors Accreditation Program (NADCAP), a division of the Performance Review Institute (PRI).

Also, further discussion on the Workshop on Composite Materials in Non-Aerospace Applications was held. The committee was prepared to meet the requirements of non-aerospace industries but the support in terms of personnel to participate in committee activities must come from those industries.

Finally, Karen Jackson of the U.S. Army Aeronautical Directorate, presented work she had completed on a fixture for determination of energy absorption of composite laminates. The fixture and the test specimens it evaluates were designed to replace the more expensive tube crushing test. Either static or dynamic loading may be applied. A new task group was formed to investigate this test method. Karen will Chair.

Subcommittee D30.03, Constituent Properties

Chaired by Christopher J. Spragg, Amoco Performance Products

The subcommittee met to discuss several prepreg characterization methods submitted to ASTM by the Suppliers of Advanced Composite Materials Association (SACMA). Volunteers are being sought to champion these methods through the ASTM process.

The subcommittee decided to relocate its NDE Task Group to Subcommittee D30.04. The task group is investigating C-scan quality control methods of laminates. Volunteers are being sought for this round robin.

Subcommittee D30.04, Lamina/Laminate Properties

Chaired by Richard E. Fields, Martin Marietta

A variety of standard test method actions were taken in the subcommittee’s section meetings. A brief synopsis of key items is as follows.

Several ISO harmonization issues with the D 3039 tensile test method were resolved and approved for a 1995 revision of D 3039. Several others remain outstanding, such as speed of testing and chord modulus end-points, which were changed to a fixed 1000 and 3000 microstrain with special provision for very low strain-to-failure fibers (versus the fixed 500 to 2500 used by ISO). The round-robin testing for this test method is underway.

The major rewrite to D 3410 compression test method was approved. Harmonization with a new ISO document is underway.

The major rewrite to D 3518 shear response by ±45 tensile test was approved. Major changes include the addition of an offset strength and chord modulus end-points between 2000 and 6000 microstrain (twice the tensile modulus end-points).

The specimen preparation guide was approved as a new standard. However, a need for immediate revision was identified and an update is being prepared.

A rewrite of D 3479 tension/tension fatigue test method is being prepared for ballot in Spring 1995.

A rewrite of D 4255 rail shear test method is being prepared for ballot in Spring 1995.

The Automotive Composites Consortium will become involved in a rewrite to D 4762 Guide to Testing Automotive/Industrial Composites.

Subcommittee D30.05, Structural Properties

Chaired by Ron Zabora, Boeing Commercial Airplanes Company

The subcommittee reviewed the status of the four test methods it is developing. The results of the concurrent subcommittee and committee ballot of the Open Hole Tension test method were reviewed. Three editorial changes were incorporated into the document as a result of the ballot. It will be submitted for Main
Committee ballot. The open hole compression method is still in draft form; it was scheduled for completion by February 1995. It will then be circulated within the subcommittee for comments. On a related topic, Ray Adsit reported that he had written a paper on the open hole tension and open hole compression round-robin testing. It has been submitted to ASTM’s Journal of Composites Technology and Research for publication. The subcommittee also discussed several points of the bolt bearing test standard, which is also being drafted. Finally, Sam Garbo of Sikorsky Aircraft reported that a draft of the compression after impact test method should be ready for ballot by the spring meeting.

The efforts of the Task Group established by Bill Bartleson of Gougeon Brothers Inc. to draft the plate flexure test method were also reviewed. The group has obtained funding from the Society of Naval Architect Engineers, Gougeon Brothers Inc., and the state of Michigan to procure materials and to conduct round-robin testing. Preliminary experimental results are expected by the spring meeting.

Subcommittee D30.06, Interlaminar Properties

Chairied by T. Kevin O’Brien, U.S. Army Aeronautical Directorate

The chairman reported that the DCB standard has now been published as D 5528-94a and will appear in the next addition of the ASTM Annual Book of Standards. A round-robin is planned to expand the scope of this standard. Kevin also reported that the DCB standard was submitted to ISO, through ANSI, and was accepted as a new work item. This will be discussed at the ISO meeting in London in September of 1995. It is hoped that because this method was established and approved by JIS, ESIS, and ASTM, and contains precision data from an international round-robin, it will be quickly accepted as an ISO standard.

The status of several additional round-robin activities were also discussed. They will include end notched flexure (ENF) and mixed mode bending (MMB) specimens. Rod Martin summarized the status and quantities of the four materials that will be used in these tests.

The delamination fatigue task group reported on their plans to ballot a draft DCB fatigue standard using the static DCB standard D 5528-94a as a boilerplate and incorporate the test procedure developed in previous fatigue round-robin testing. All fatigue activities will begin once the investigative static round-robins are complete.

The chairman also noted that Jim Whitney had to step down as chairman of the Interlaminar Shear Strength task group. Peter Grant of Boeing Helicopters in Philadelphia will take over as task group chairman. The interlaminar shear task group is responsible for the maintenance of the short beam shear test, ASTM D 2344. This standard is up for renewal. Kevin suggested that it be ballotated as is and that the task group use any negative comments from the ballot as a starting point for revisions.

Subcommittee D30.07, Metal Matrix Composites

Chairied by W. Steven Johnson, Georgia Institute of Technology

The Subcommittee Chair reviewed the progress to date on the titanium matrix composite (TMC) round-robin testing. The final reports on the static and fatigue testing are currently being written and should be available soon. The results will be used to draft a test standard for fatigue testing of TMCs. The draft will then be submitted for subcommittee ballot. The Subcommittee also held discussions to define future standards development activities. The need to identify a source of TMC material to support these activities was also reviewed. Depending of the tests and the test matrix, approximately $40 000 worth of material could be required.

Jennifer Heine of Pratt & Whitney reviewed activities of the MMC Life Prediction Cooperative that consists of U.S. engine manufacturers. It was suggested that ASTM, and perhaps VAMAS, could play a role in helping to develop standards for this effort. The possibility of the MMC Life Prediction Cooperative supplying materials for ASTM was suggested in a follow-up discussion with leaders of the Cooperative in January 1995. However, due to funding cuts in the program, the likelihood of this occurring is remote.

Subcommittee D30.08, Thermo-Physical Properties

Chairied by Ellen G. Kumar, University of Dayton Research Institute

The subcommittee reviewed the status of its current methods (D 4102, D 3171, D 5229, D 792, D 696, and Thermal Oxidative Stability). D 4102, Test Method for Thermal Oxidative Resistance of Carbon Fibers, was reported to be in a rough draft form. Patrick Connelly of Cincinnati Testing Labs has taken responsibility for this standard. Jim Ferrell of Hercules reported on D 3171, Fiber Content of Resin Matrix Composites. He expects to have a Subcommittee ballot completed by the spring meeting. He noted that three different techniques have been added to the six or seven currently included in the standard. Other issues that were brought up on this topic following the meeting include the importance of the number of significant figures on a density measurement necessary to achieve the required number on fiber and resin content measurements. D 5229, Moisture Absorption Properties and Equilibrium Conditions of Polymer Matrix Composites, has no new business at this time. However, an issue that was brought up after the meeting concerns the statement within D 5229 calling for a single specimen size to be used when developing % wt gain versus time curves. It may be more appropriate to use both and the extreme slopes of the curve may be more accurately determined. D 792, Specific Gravity, and D 696, Coefficient of Linear Expansion, standards are actually D-20's responsibility; both passed recent society ballots.

The next agenda item was the new committee responsibility in the long-term durability (LTD) testing area. There is activity and interest in LTD that crosses many areas of composite applications. The discussion of this topic centered on what the Subcommittee can do to find out what standards are needed by the various communities. Further discussion centered around thermal aging and thermo-mechanical fatigue testing as likely areas to concentrate efforts. The group agreed that it would be better to produce guides rather than standards and that several small documents would be preferable to one that tried to be all-encompassing.

The subcommittee decided to sponsor a workshop on Long-Term Durability Testing in Norfolk, VA in November 1995. This would be held in conjunction with the symposium that is to be held at that time. A list of topics and likely presenters will be generated during the May 1995 meeting in Denver.

D-30 Spring Symposium Outlined

Committee D-30 will hold the Sixth Symposium on Composite Materials: Fatigue and Fracture on 16–18 May 1995 in Denver,
CO. Professor Erian A. Armanios of Georgia Institute of Technology will serve as the symposium chairman. The symposium will feature 40 papers. A special technical publication (STP) based on the symposium proceedings is anticipated. A preliminary list of papers and authors is included below.

Environmental Effects on the Isothermal and Thermomechanical Fatigue of SCS-6/TIMETAL® 21S Unidirectional Composites—A. H. Rosenbarger and T. Nicholas


Discrete Fiber Breaks in The Bridging Zone of a Titanium Matrix Composite Fatigue Crack—D. J. Herrmann and B. M. Hillberry

An Experimental Study of Matrix Cracking in Unidirectional Laminates Under Mixed Mode Loading—P. A. Smith, A. Rezaiafard, L. E. Crocker, and M. G. Bader


Delamination Growth of Cross-Plied Composite Materials Under Cyclic Compressive Loading—G. A. Kardomateas and A. A. Pelegri

Energy Absorbing Composite Members with Controlled Progressive Failure—D. S. Dancila and E. A. Armanios


On the Determination of Tensile and Compressive Strengths of Unidirectional Fiber Composites—S. N. Chatterjee, C. F. Yen, and D. W. Oplinger

Residual, Strength Prediction of Center Notched Unstiffened and Bonded Stringer Stiffened Fiber/Meter Laminates Through the R-Curve Approach—M. Wu and D. Wilson

The Influence of Transverse Bearing Loads upon the Bypass Strength of Composite Bolted Joints—A. J. Sawicki and N. Nguyen

Delamination at Transverse Cracks—Consequences for Recommended Layer Thicknesses in CF/EP—J. Varna, and L. A. Berglund

On the Development of Design Allowables for Delamination—B. D. Davidson

The C(T) Specimen in Laminated Composites Testing—L. Minneyan and C. C. Chamis


Damage Tolerance of Pressurized Graphite/Epoxy Cylinders under Uniaxial and Biaxial Loading—P. A. Lagace, and S. M. Priest

Tensile Failure Mechanisms of Woven Glass and Carbon Fiber Composites—N. Alif and L. A. Carisson

Failure of a Ti Metal Matrix Composite Cylindrical Shell under Internal Pressure—E. A. Armanios, D. A. Hooke, D. S. Dancila, A. Thakker, and P. Doorbar

Stress-Ratio Effect on Propagation of Mode II Interlaminar Fatigue Cracks—K. Tanaka and H. Tanaka

Life Prediction Methodology for Composite Laminates—J. R. Schaff and B. D. Davidson

High Cycle Tensile and Compressive Fatigue of Glass Fiber-Dominated Composites—J. F. Mandell, H. J. Sutherland, R. J. Creed, Jr., A. J. Belinsky, and G. Wei


Prediction of Delamination Growth under Cyclic Loading—R. Kruger and M. Konig


Fracture of Carbon/Epoxy Laminates under Torsion Load—K. T. Marcucelli and J. C. Fish

Damage Tolerance and Fracture Analysis Methods Applied to Reconstructive Composite Structures—T. K. Saczalski, B. Luch, and K. J. Saczalski

Fracture Analysis of Internally Delaminated Unsymmetric Laminated Composite Plates—D. W. Palmer and E. A. Armanios

The Relationship Between Strain Energy Release Rate and Delamination Mode in Carbon Fibre/Epoxy Laminates—G. Trakas and M. T. Kortschot

Unification of Mixed Mode Delamination—R. H. Martin, M. Samulak, and P. Hansen

Modified Mixed-Mode Fracture Test Fixture for Measuring Interlaminar Strength of Composite Laminates—K. N. Shivakumar, J. H. Crews, Jr., and T. C. Emeloh

Separation of Crack Extension Modes in Composite Delamination Problems—J. L. Beuth

Hygrothermal Influence on the Free-Edge Delamination of Composites Under Compressive Loading—R. Y. Kim and A. S. Crasto

Effect of Stitching on the Mechanical and Physical Properties of Uniwoven Graphite/Epoxy Composite Materials—J. E. Masters

Analytical Investigation of the Hygrothermal Effects on the Edge Crack Torsion (ECT) Mode III Test Specimen—J. Li and T. K. O’Brien


Image Analysis Applications for Porosity Effects Assessments in Composite Materials—D. E. Pettit, S. Ellsworth, C. Vaccairo, G. Lyons, and W. Hart

Creep of Bolted Joints in a Polymer Matrix Composite laminate—A. R. Kallmeyer and R. L. Stephen

Moisture Diffusion in Composite Components—G. Zaffaroni

C-28 Ceramic Matrix Composites Fall 1994 Meeting Reviewed

Subcommittee C28.07 held a working meeting on 8 Jan. 1995 in Cocoa Beach, FL as part of Committee C-28's regular meetings. Formal task group meetings of the subcommittee were held on 6 and 7 Jan. The following is a summary of those proceedings. The first order of business was to introduce the new leaders of the subcommittee (effective January 1995):

- M. G. Jenkins, Chair
- S. T. Gonczy, Allied Signal Research, Administrative Vice-Chair
- D. C. Cranmer, NIST, Technical Vice-Chair
- F. Lara-Curzio, Secretary
C28.07.01, Tension Task Group  
*Chaired by Michael G. Jenkins, University of Washington*

Negative ballots of revisions to C 1275-94, Standard Practice for Monotonic Tensile Strength Testing of Continuous Fibre-Reinforced at Ambient Temperatures, were found persuasive. The item was withdrawn from the fall 1994 ballot for revision and resubmission for concurrent main and subcommittee ballots in spring 1995. Negative ballots of the new standard, Standard Test Method for Monotonic Tensile Strength Testing of Continuous Fibre-Reinforced Advanced Ceramics with Solid Rectangular Cross Section Specimens at Elevated Temperatures, were also found persuasive. It too was withdrawn from the fall 1994 ballot to be revised. It will be resubmitted for concurrent main and subcommittee ballots in spring 1995.

C28.07.02, Compression Task Group  
*Chaired by Michael G. Jenkins, University of Washington*

Negative ballots of the new standard, Standard Test Method for Monotonic Compressive Strength Testing of Continuous Fibre-Reinforced Advanced Ceramics with Solid Rectangular Cross Section Specimens at Ambient Temperatures, were found persuasive. The item was withdrawn from the fall 1994 ballot, would be revised, and would be resubmitted for subcommittee ballot in spring 1995.

C28.07.03, Creep/Creep Rupture Task Group  
*Chaired by Edgar Lara-Curzio, Oak Ridge National Laboratory*

A final draft of the standard was announced by the primary author, E. Lara-Curzio. However, members of the task group were still reviewing the document and no comments were forthcoming at the subcommittee meeting. It was proposed that the subcommittee members review the document before placing it on the spring 1995 subcommittee ballot.

C28.07.04, Flexural Properties Task Group  
*Chaired by Steve Gonczy, Allied Signal Corporation*

After discussion, the Standard Test Method for Flexural Properties of Continuous Fibre Ceramic Composites was withdrawn from ballot. It will be resubmitted for subcommittee balloting in spring 1995. This standard addresses the unique aspects of flexural testing CFCCs at both room and elevated temperatures. Serious concerns were raised by the members of the subcommittee in regard to just what property was being measured (interlaminar-shear or outer-fiber tension).

C28.07.05, Shear Properties Task Group  
*Chaired by Edgar Lara-Curzio, Oak Ridge National Laboratory*

No negative ballots were received in the fall 1994 ballot of Standard Test Method for Shear Strength of Continuous Fibre Ceramic Matrix Composites. The document has received an ASTM designation number C 1292, becoming the second official standard of the subcommittee. It will be submitted for concurrent main and subcommittee ballots in spring 1995.

C28.07.06, Tension-Tension Cyclic Task Group  
*Chaired by Michael G. Jenkins, University of Washington*

A final draft of the standard, Standard Practice for Constant-Amplitude, Axial, Tension-Cyclic Fatigue of Continuous Fiber-Reinforced Advanced Ceramics at Ambient Temperatures was distributed by the primary author. This item will be subcommittee balloted in spring 1995.

C28.07.07, Ceramic Fiber Task Group  
*Chaired by John Porter, Rockwell International Science Center*

A draft standard for tensile strength characterization, based somewhat on ASTM D 3379, is still in the preparation stage. Task group leader J. Porter reported on the results of a mini round-robin test for two types of fibres. A major issue appears to the measurement of fibre diameter. A draft of the new standard is anticipated for some time in spring 1995.

C28.07.08, Interfacial Properties Task Group  
*Chaired by Edgar Lara-Curzio, Oak Ridge National Laboratory*

This new task group was officially inaugurated at the subcommittee meeting. Since the damage-tolerant, graceful-failure behavior of CFCCs is dependent on the mechanical behavior of the interface, standardized methods for characterizing this behavior are essential for both the design and use of CFCCs. Dr. Lara-Curzio's initial tasks will be recruiting the appropriate members of the task group and surveying viable interfacial property systems and critical mechanical properties.

Symposium on Thermal and Mechanical Test Methods and Behavior of Continuous Fibre Ceramic Composites (CFCCs)

A C-28/E-8/American Ceramic Society (ACS) jointly sponsored symposium is planned for the January 1996 C-28 committee meetings in Cocoa Beach, FL. This symposium will be held in conjunction with the ACS meeting on ceramic composites. Presentations will consist primarily of nationally and internationally solicited papers and are planned for two full days. Chairs of the symposium are M. Jenkins, E. Lara-Curzio, and S. Gonczy from C-28 and N. Ashbaugh and I. Zawada from E-8. Papers resulting from the presentations will be published by ASTM as a special technical publication (STP).

The next subcommittee meeting is scheduled for 21–23 June 1995 in Denver, CO.
Adhesion Society Annual Meeting

The 18th Annual Meeting of the Adhesion Society will be held at the Crystal Sands Resort, Hilton Head Island, SC, 19–22 Feb. 1995. Conference session topics include new materials for adhesives and coatings, chemical/physical characterization of adhesion-producing interactions in interphases, durability–environmentally-induced adhesion reduction in coatings and adhesives, modeling of the adhesion process, mechanical characterization of coatings and adhesive/substrate interphases, and structure/process/performance relationships in adhesion. Special topics in adhesion science will also be included: bioadhesion, pressure sensitive adhesion, particle adhesion, adhesion in composite material fiber/matrix interphases and adhesion in the microelectronics industry. For more information, including detailed program and registration forms, please contact Kim Linkous, 2 Davidson Hall, Virginia Tech, Blacksburg, VA 24061-0201, (703) 231-7257.

Adhesion Society Short Course: Adhesion Theory and Practice

In conjunction with the 18th Annual Meeting of the Adhesion Society, an excellent short course entitled “Adhesion Theory and Practice” will be offered. The short course will be held 18 and 19 Feb. 1995 at the Crystal Sands Resort, Hilton Head Island, SC. Presentations will outline the various factors affecting adhesion and theories that attempt to explain the phenomenon of adhesion. Sessions dealing with the design, analysis, and testing of adhesive joints, as well as practical aspects of bonding, are also included. The instructors, Dr. Louis Sharpe, Dr. Gary Hamed, Dr. Alan Gent, and Dr. Denis Zalucha have many years of experience in both academic research and industrial application. Please contact Dr. Gary Hamed, Polymer Science Department, The University of Akron, Akron, OH 44325-3909, (216) 972-6831 for more information and registration forms.
ASTM Committee D-30 Best Presentation Award

Thomas S. Gates of NASA Langley Research Center is a recipient of the D-30 Best Presentation Award for his presentation entitled “The Effects of Physical Aging at Elevated Temperatures on the Viscoelastic Creep of IM7/K3B” at the Twelfth Symposium on Composite Materials: Testing and Design held in May 1994 in Montreal with Ravi Deo and Charles Saff as Symposium chairmen. The symposium was sponsored by ASTM Committee D-30. The presented paper was coauthored by Mark Feldman. The recipient of this award is selected based upon evaluations of all the symposium speakers by five members of the audience.

The Effects of Physical Aging at Elevated Temperatures on the Viscoelastic Creep of IM7/K3B

Thomas S. Gates and Mark Feldman

Physical aging at elevated temperature of the advanced composite IM7/K3B was investigated through the use of creep compliance tests. Testing consisted of short-term isothermal, creep/recovery with the creep segments performed at constant load. The matrix dominated transverse tensile and in-plane shear behavior were measured at temperatures ranging from 200 to 230°C. Through the use of time-based shifting procedures, the aging shift factors, shift rates, and momentary master curve parameters were found at each temperature. These material parameters were used as input to a predictive methodology, which was based upon effective time theory and linear viscoelasticity combined with classical lamination theory. Long-term creep compliance test data was compared to predictions to verify the method. The model was then used to predict the long-term creep behavior for several general laminates.

The material momentary master curves (MMCs) indicated the temperature dependency of short-term creep compliance. The ordering of the curves was as expected with the highest temperatures resulting in the highest creep compliance. The directional dependency of the composite was also evident by noting the differences in the compliance between the transverse and shear tests. Aging time shift rates found from the isothermal MMCs showed a clear temperature dependency over the range investigated. As test temperatures approached glass transition \((T_g)\), the shift rate decreased. Additional data over a wider range of temperatures would be required to establish global maximums and minimums. At \(T_g\), the polymer is in equilibrium, and theoretically, a shift rate of zero would indicate a material exhibiting no aging behavior. Although the shift rate was assumed constant over time at a given temperature, results by Lee and McKenna [1] indicated that a polymer may exhibit a change in shift rate as it ages into an equilibrium state. However, to reach this condition would require a long aging time and aging temperatures very close to \(T_g\), or

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both. Modeling of this time-dependent change in shift rate and the implications in regards to the effective time theory were explored in Brinson and Gates [2].

Collapsing the MMCs to form the time-temperature superposition (TTSP) master curves was performed using horizontal shifts only. For the ideal case, these curves should collapse completely. The results demonstrated that TTSP will work satisfactorily on short-term data.

The predictive model provided a means of analytically studying the effects of physical aging on long-term creep compliance. Results indicated that the model did a good job of predicting the long-term creep compliance from short-term data. However, the results also show the long-term predictions to be slightly lower than the test data for all cases investigated. Part of this difference between test and prediction may be due to material inconsistencies. Differences between test and prediction may also be due to slight variations in test temperature within the test chamber. Comparing the extrapolated momentary behavior versus long-term predictions illustrated the large errors that would occur if predictions did not include the effects of aging.

For the cases investigated to date, the coupling of linear viscoelasticity, classical lamination theory, and effective time theory has provided a predictive model for long-term creep. Barring the occurrence of creep rupture or aging into equilibrium, it was not expected that creep compliance data greater than 7 decades of time (seconds) would deviate significantly from the trends indicated by the test data. However, without actual data beyond 7 decades, the complete verification of a prediction spanning years is not feasible. Comparison of the analytical model to test data for 6.6 decades of time provided the confidence to use the model for parametric studies for laminates under constant load and temperature. As indicated by the predictions, even a fiber dominated laminate may exhibit sensitivity of certain material parameters to aging time and temperature.

References


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

2-7 April 1995
Symposium on Polymer Matrix Composites: National Meeting-
American Chemical Society
Anaheim, California
Contact: Judy S. Riffle, Department of Chemistry, 3107 Hahn Hall,
VPI&SU, Blacksburg, VA 24061-0212; FAX: 703-231-8517

8-10 May 1995
International Conference on Composite Materials and Energy
(ENERCOMP '95)
Montreal, Canada
Contact: Enercomp 95 Secretariat, 75, boul. de Mortagne, Bou-
cherville, Quebec, Canada J4B 6Y4; Telephone: 514-641-5139,
FAX: 514-641-5117

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

16-18 May 1995
ASTM Committee D-30 6th Symposium on Fatigue and Fracture
Denver, Colorado
Contact: Katharine Morgan, ASTM, 1916 Race St., Philadelphia,
PA 19103; Telephone: 215-299-5529

18-20 May 1995
Symposium of Interfacial Materials Science on Composites (SIMS-
C VI)
Tokyo, Japan
Contact: Dr. Hiroyuki Hamada, Faculty of Textile Science, Kyoto
Institute of Technology, Matsugasaki Sakyō-ku, Kyoto 606, Japan;
Telephone: 81-75-724-7844; FAX: 81-75-724-7710; E-MAIL:
hhamada@ipc.kit.ac.jp

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
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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.shizu-
oka.ac.jp

12-15 June 1995
1995 SEM Spring Conference and Exhibits
Grand Rapids, Michigan
Contact: Society for Experimental Mechanics, Inc., 7 School St.,
Bethel, CT 06801

19-22 June 1995
7th Japan United States Conference on Composite Materials
Kyoto, Japan
Contact: Prof. R. Sierakowski, Chairman, U.S. Organizing Com-
mittee, 7th Japan-U.S. Conference on Composite Materials, Dept.
of Civil Engineering, Ohio State University, 470 Hitchcock Hall,
2070 Neil Ave., Columbus, OH 43210

21-23 June 1995
ASTM Committee C-28 on Advanced Ceramics Meeting
Denver, Colorado
Contact: Gloria Collins, ASTM, 1916 Race St., Philadelphia, PA
19103; Telephone: 215-299-5510

26-29 June 1995
27th National Symposium on Fatigue and Fracture Mechanics
Williamsburg, Virginia
Contact: Rose Tomasello, ASTM, 1916 Race St., Philadelphia, PA
19103; Telephone: 215-299-5487
180  JOURNAL OF COMPOSITES TECHNOLOGY & RESEARCH

28–30 June 1995
Joint Applied Mechanics and Materials Summer Meeting, American Society of Mechanical Engineers (ASME)
Los Angeles, California
Contact: Prof. Ajit K. Mal, MANE Dept., 48-121 Engr., IV, UCLA, 405 Hilgard Avenue, Los Angeles, CA 90024-1597; Telephone: 310-825-5481; FAX: 310-206-4830; E-MAIL: ajit@seas.ucla.edu

16–21 July 1995
International Conference on Progress in Durability Analysis of Composite Systems
Brussels, Belgium
Contact: COSARGUB, c/o Mrs. Myriam BOURLAU, VUB - TW - (KB), Pleinlaan 2, B1050 Brussels - Belgium; Telephone: 32-2-629-29-23; FAX: 32-2-629-29-28; E-MAIL: mbourlau@vnet3.vub.ac.be

17–21 July 1995
Ninth International Conference on Numerical Methods for Thermal Problems
Atlanta, Georgia
Contact: Prof. P. Durbetaki, Thermal Problems Conference, The George W. Woodruff School of Mechanical Engineering, Georgia Institute of Technology, Atlanta, GA 30332-0101; Telephone: 404-894-3282; FAX: 404-894-8336; E-MAIL: pdurbeta@gtme.courier.gatech.edu

14–18 August 1995
Tenth International Conference on Composite Materials (ICCM-10)
Vancouver, Canada
Contact: Anoush Poursartip, Co-Chair, ICCM-10, c/o The University of British Columbia, Dept. of Metals and Materials Engineering, Vancouver, B.C., Canada V6T 1Z4; Telephone: 604-822-3665; FAX: 604-822-3619; E-MAIL: anoush.poursartip@ubc.ca

21–24 August 1995
Second International Conference on Composites Engineering (ICCE/2)
New Orleans, Louisiana
Contact: Dr. David Hui, Department of Mechanical Engineering, University of New Orleans, New Orleans, LA 70148; Telephone: 504-285-6192; FAX: 504-286-5539; E-MAIL: dxhme@uno.edu

11–13 September 1995
The Eighth International Conference on Composite Structures (ICCS/8)
Paisley, Scotland
Contact: Professor I. H. Marshall, Dept. of Mechanical & Manufacturing Engr., University of Paisley, High Street, Paisley PA1 2BE, Scotland; Telephone: 041-848-3562; FAX: 041-848-3555; Telex: 778951 PCT LIBG

12–15 September 1995
Third International Conference on Sandwich Construction
Southampton, England
Contact: Professor Howard G. Allen, Department of Civil and Environmental Engineering, University of Southampton, Southampton, SO17 1BJ, England; Telephone: 0703-592870; FAX: 0703-594986; E-MAIL: h.g.allen@uk.ac.soton

25–28 September 1995
4th Japan International Sampe Symposium & Exhibition (JISSE-4)
Tokyo, Japan
Contact: Prof. H. Hamada, Dept. of Polymer Science & Engineering Faculty of Textile Science, Kyoto Institute of Technology, Matsugasaki, Sakyo-ku, Kyoto 606, Japan; Telephone: 81-75-724-7844; FAX: 81-75-724-7710; E-MAIL: hhamada@ipc.kit.ac.jp

10–12 October 1995
Carbon and Carbonaceous Composite Materials: Structure-Property Relationships
Mařenice, Czech Republic
Contact: Karen Palmer, Materials Technology Center, MC 4303, Southern Illinois University at Carbondale, Carbondale, IL 62901, Telephone: 618 453-1167, E-MAIL: kpalmr@siu.edu

16–20 October 1995
1st International Congress on Adhesion Science & Technology in honor of Dr. Kash Mittal on his 50th birthday
Amsterdam, The Netherlands
Contact: Ms Els van Egmond, ICAST '95, PO Box 346, 3700 AH Zeist, The Netherlands; Telephone: +31 3404 25790; FAX: +31 3404 32081; E-MAIL: 100341.2372@compuserve.com

18–20 October 1995
Tenth Technical Conference on the American Society for Composites
Los Angeles, California
Contact: Prof. H. Thomas Hahn, UCLA, MANE Dept., Engrg. IV, Los Angeles, CA 90024-1597; Telephone: 310-825-2383; FAX: 310-206-2302; E-MAIL: hahn@seas.ucla.edu

29 October–1 November 1995
International Mechanical Engineering Congress and Exposition
San Francisco, California
Contact: ASME, United Engineering Center, 345 East 47th St., New York, NY 10017; Telephone: 212-705-7722

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

12–17 November 1995
International Mechanical Engineering Congress and Exposition
San Francisco, California
Contact: ASME, United Engineering Center, 345 East 47th St., New York, NY 10017; Telephone: 212-705-7722

12–17 November 1995
Symposium on Durability and Damage Tolerance of Composites (WAM of ASME)
San Francisco, California
Contact: Professor Gregory P. Carman, MANE Dept., UCLA, 38-137m Eng. IV, Los Angeles, CA 90024; Telephone: 31-825-6030; FAX: 310-206-2302; E-MAIL: carman@seas.ucla.edu
12-17 November 1995
Symposium on Innovative Processing and Characterization of Composite Materials (WAM of ASME)
San Francisco, California
Contact: Professor Ronald F. Gibson, Department of Mechanical Engineering, Wayne State University, 5050 Anthony Wayne Drive, Detroit, MI 48202; Telephone: 313-577-3702; FAX: 313-577-8789; E-MAIL: ronald_gibson@eng.wayne.edu

13-14 November 1995
ASTM Committee D-30 Second Symposium on High Temperature and Environmental Effects of Polymeric Composites
Norfolk, Virginia
Contact: Katharine Morgan, ASTM, 1916 Race Street, Philadelphia, PA 19103; Telephone: 215-299-5529

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

3-5 July 1996
Computer Aided Design in Composite Material Technology (CAD-COMP '96)
Southampton, United Kingdom
Contact: Susi King, Conference Secretariat, CADCOMP '96, Wessex Institute of Technology, Ashurst Lodge, Ashurst, Southampton, SO40 7AA, United Kingdom; Telephone: 44-0-703-293223; FAX: 44-0-703-292853; E-MAIL: cmi@uk.ac.rl.ib; INTL. E-MAIL: cmi@ib.fl.ac.uk

15-17 January 1996
The First International Conference on Composites in Infrastructure (ICCI '96)
Tucson, Arizona
Contact: Engineering Professional Development, University of Arizona, Box 9 Harvill Building, Room 235, Second and Olive Streets, Tucson, AZ 85721; Telephone: 602-621-3054; FAX: 602-621-1443; E-MAIL: baltes@bigdog.eng.arizona.edu

19-21 May 1996
ASTM Committee D-30 on High Modulus Fibers and Their Composites Meeting
Orlando, Florida
Contact: Katharine Morgan, ASTM, 1916 Race St., Philadelphia, PA 19103; Telephone: 215-299-5529

20-21 May 1996
ASTM Committee D-30 13th Symposium on Composite Materials: Testing and Design
Orlando, Florida
Contact: Katharine Morgan, ASTM, 1916 Race Street, Philadelphia, PA 19103; Telephone: 215-299-5529

7-11 January 1996
20th Annual Cocoa Beach Conference and Exposition on Composites, Advanced Ceramics, Materials, and Structures
Cocoa Beach, Florida
Contact: The American Ceramic Society, 735 Ceramic Place, Westerville, OH 43081; Telephone: 614-840-4700

8-9 January 1996
ASTM Committee C-28/E-8 First Symposium on Thermal and Mechanical Test Methods and Behavior of Continuous Fiber Ceramic Composites (CFCCs)
Cocoa Beach, Florida
Contact: Michael G. Jenkins, University of Washington, Mechanical Engineering, MS F10-10, Seattle, WA 98195; Telephone: 206-685-7061; E-MAIL: jenkinsm@u.washington.edu

8-9 January 1996
20th Annual Conference and Exhibition on Composites and Advanced Ceramics, Materials, and Structures
Cocoa Beach, Florida
Contact: Dorothy Savini, ASTM, 1916 Race St., Philadelphia, PA 19103-1187; Telephone: 215-299-2617

7-9 October 1996
The 11th Technical Conference of the American Society of Composites
Atlanta, Georgia
Contact: Professor Steven Johnson, Composites Education and Research Center, Georgia Tech, Atlanta, GA 30332-0245; Telephone: 404 894-3013, E-MAIL: steve.johnson@mse.gatech.edu

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

17-22 November 1996
International Mechanical Engineering Congress and Exposition
Atlanta, Georgia

25-31 August 1996
19th International Congress of Theoretical and Applied Mechanics
Kyoto, Japan
Contact: Prof. Eiichi Watanabe, Secretary General, ICTAM 1996, Dept. of Civil Engineering, Kyoto University, Sakyo-ku, Kyoto 606-01, Japan; Telephone 81-75-753-5079; FAX: 81-75-752-5296

2-8 November 1996
12th Annual Conference and Exhibition on Advanced Composites, Advanced Ceramics, Materials, and Structures
Cocoa Beach, Florida
Contact: The American Ceramic Society, 735 Ceramic Place, Westerville, OH 43081; Telephone: 614-840-4700

17-22 November 1996
International Mechanical Engineering Congress and Exposition
Atlanta, Georgia
19–21 November 1996
ASTM Committee D-30 on High Modulus Fibers and Their Composites Meeting
New Orleans, Louisiana
Contact: Katharine Morgan, ASTM, 1916 Race St., Philadelphia, PA 19103; Telephone: 215-299-5529

6–8 May 1997
ASTM Committee D-30 Seventh Symposium on Composite Materials—Fatigue and Fracture
St. Louis, Missouri
Contact: Katherine Morgan, ASTM, 1916 Race St., Philadelphia, PA 19103; Telephone: 215-299-5529

7–9 May 1997
ASTM Committee D-30 on High Modulus Fibers and Their Composites Meeting

10–11 November 1997
ASTM Committee D-30 Symposium on Time-Dependent Effects
San Diego, California
Contact: Katherine Morgan, ASTM, 1916 Race St., Philadelphia, PA 19103; Telephone: 215-299-5529

11–13 November 1997
ASTM Committee D-30 on High Modulus Fibers and Their Composites Meeting
San Diego, California
Contact: Katherine Morgan, ASTM, 1916 Race St., Philadelphia, PA 19103; Telephone: 215-299-5529

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