

COMPOSITES Technology Review

EDITORS

T. T. Chiao, *Coeditor*
Lawrence Livermore
National Laboratory
Livermore, CA 94550

K. L. Reifsnider, *Coeditor*
Virginia Polytechnic Institute
and State University
Blacksburg, VA 24061

G. P. Sendeckyj, *Coeditor*
Air Force Wright
Aeronautical Laboratories
Dayton, OH 45433

R. J. Morgan, *Associate Editor*
Lawrence Livermore
National Laboratory
Livermore, CA 94550

P. L. Lien, *Associate Editor
for Production*
Lawrence Livermore
National Laboratory
Livermore, CA 94550

EDITORIAL BOARD

C. E. Browning
Air Force Wright
Aeronautical Laboratories
Dayton, OH 45433

C. C. Chamis
NASA-Lewis Research Center
Cleveland, OH 44135

T. T. Chiao
Lawrence Livermore
National Laboratory
Livermore, CA 94550

S. J. Dastin
Grumman Aerospace Corp.
Bethpage, NY 11714

I. M. Daniel
IIT Research Institute
Chicago, IL 60616

K. L. Reifsnider
Virginia Polytechnic Institute
and State University
Blacksburg, VA 24061

G. P. Sendeckyj
Air Force Wright
Aeronautical Laboratories
Dayton, OH 45433

R. A. Schapery
Texas A&M University
College Station, TX 77843

C. T. Sun
Purdue University
West Lafayette, IN 47907

J. M. Whitney
Air Force Wright
Aeronautical Laboratories
Dayton, OH 45433

ADVISORY BOARD

H. T. Hahn
Washington University
St. Louis, MO 63130

Phil Leopold
Babcock and Wilcox Co.
Alliance, OH 44601

George Lubin
Grumman Aerospace Corp.
Bethpage, NY 11714

P. K. Mallick
University of Michigan-Dearborn
Dearborn, MI 48128

Edgar Morris
Structural Composites
Industries, Inc.
Azusa, CA 91702

Daniel R. Mulville
Naval Research Laboratory
Washington, D.C., 20375

T. K. O'Brien
NASA-Langley Research Center
Hampton, VA 23665

K. M. Prewo
United Technologies Research Center
East Hartford, CT 06108

Barbara A. Sanders
General Motors Technical Center
Warren, MI 48090

F. Schmeideshoff
U.S. Army Research Office
Research Triangle Park, NC 27709

R. L. Sierakowski
University of Florida
Gainesville, FL 32611

Robert M. Stemmler
NARMCO Materials Corp.
Costa Mesa, CA 92627

S. W. Tsai
Air Force Materials Laboratory
Wright-Patterson AFB, OH 45433

Dick Wilkins
General Dynamics Corp.
Fort Worth, TX 76101

Carl Zweben
General Electric Space Center
Philadelphia, PA 19101

Purpose and Scope

The objectives of *Composites Technology Review* are (1) to provide a forum for the presentation, discussion, and dissemination of information on composite materials and their response to the environments in which they are used, especially the engineering and technology of their application to components and structures, and (2) to provide a means of communication for researchers, developers, producers, users, suppliers, and professional organizations concerned with composite materials.

The editorial scope includes full-length technical articles, technical notes (Composites Review), preliminary technical communications (Research Briefs), news articles and announcements (World of Composites), book reviews, letters, and discussions of previously published work.

The American Society for Testing and Materials is not responsible, as a body, for the statements and opinions advanced in this publication.

Composites Technology Review is published quarterly by the American Society for Testing and Materials. Technical support is provided by the Lawrence Livermore National Laboratory, University of California. Editorial office at the Headquarters of the Society, 1916 Race St., Philadelphia, Pa. 19103. Subscriptions: for four consecutive issues, \$27.00 (\$14.00 to ASTM members). Single copies, \$9.00. *Composites Technology Review* is indexed regularly by Engineering Index, Inc., and is available on microfilm from University Microfilms, a Xerox company, Ann Arbor, Mich. Copyright 1982 by the American Society for Testing and Materials.

Change of address: Please return entire addressing label on wrapper to *Composites Technology Review*, P.O. Box 64106, Baltimore, Md. 21264 along with new address.

General Information

This publication is one of many issued by ASTM in connection with its work in promoting knowledge of the properties and performance of materials, products, systems, and services and in developing standard specifications and test measurement techniques. Much of the information results from voluntary contributions of many of the leading technical authorities from industry, scientific agencies, and government. A list of ASTM publications and additional information will be furnished on request.

Information for Authors

All contributions to *Composites Technology Review* are subject to editing to bring them into accordance with ASTM style. Technical articles are also subject to peer review. Emphasis is placed on composites technology that bridges the gap between industry and the research and development community. Papers must contribute to the permanent literature, be of immediate interest to ASTM members, or be of general interest to a substantial part of the technical community. Articles that have been published or submitted for publication elsewhere or papers of an advertising or promotional nature cannot be printed in the *Review*. The paper must not be seriously defective as to literary form and structure, continuity of thought, and clarity of expression. Authors should observe the conventions of style explained in the ASTM Style Manual. Since the journal does not request page charges, the author is expected to conform to these standard conventions. The original manuscript and five clear copies, including original illustrations, should be sent to Rosemary Horstman, Managing Editor, Technical Journals, ASTM, 1916 Race St., Philadelphia, Pa. 19103 (215-299-5421).

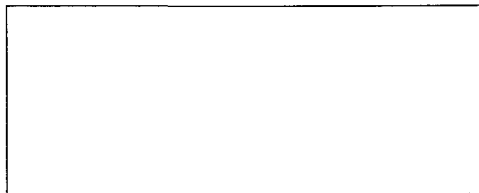
In Appreciation

The high quality of the technical papers in this publication is a tribute not only to the obvious efforts of the authors represented but also to the unheralded, though essential, efforts of their reviewers. It is to the reviewers' dedication to upholding the high standards of their profession that this note pays tribute. On behalf of ASTM and the authors as well, we acknowledge with appreciation their important contribution to the success of this journal.

MOVING?

To insure uninterrupted service on your CTR subscription, please notify us at least six weeks before you move.

1. Attach your address label from a recent issue in the space provided opposite. (If label is not available, be sure to give your old address, including Zip Code)



2. Print your name, membership no., and address below. (Be sure to include Zip Code)

3. Mail entire notice to: **ASTM
Composites Technology Review
P.O. Box 64106
Baltimore, Md. 21264**

Name _____ Membership No. _____

New Address _____

City _____ State _____ Zip Code _____

(please print or type the above information)



EDITORIAL STAFF

Rosemary Horstman, *Managing Editor*
Kathleen A. Peters, *Assistant Editor*
Barbara M. Schindler, *Editorial Assistant*
M. Bruce Vieth, *Manager of Production*
Robert L. Meltzer, *Vice-President,
Publications and Marketing*

ASTM OFFICERS

William A. Goodwin, *Chairman*
Richard A. Goodemote, *Vice-Chairman*
Robert G. Redelfs, *Vice-Chairman*
Gladys B. Berchtold, *Treasurer*
William T. Cavanaugh, *President*

Directors

Robert Baboian
A. J. Bartosic
R. L. Booth
S. E. Chehi
W. P. Dugan
R. B. Elliott
P. F. Finn
D. M. Greason
J. G. Kaufman
F. W. Kunz
J. J. McMahon
W. M. Mueller
W. G. Mullen
L. E. Steele
D. A. Swankin
M. V. White
A. H. Yorkdale

Past Chairman

W. P. Ellis
S. D. Andrews

Committee on Publications

J. A. Gilligan, *Chairman*
E. P. Bartkus
D. D. Bly
S. W. Dean
R. C. Deen
J. G. Kaufman
Richard Kimerle
R. E. Philleo
K. L. Reifsnider
Allan Siegel
A. A. Sinisgalli
M. W. Skougstad
P. G. Sullivan