



Journal of Testing and Evaluation

A Multidisciplinary Forum
for Applied Sciences and Engineering

Editorial Objectives

The **Journal of Testing and Evaluation** is published bimonthly by ASTM, a nonprofit technical organization that develops and publishes voluntary consensus standards and related information for materials, products, systems, and services. Contributions are peer reviewed prior to publication.

The editorial objectives of this journal are to serve a broad-based audience by:

1. Publishing new technical information derived from the field and laboratory testing, performance, quantitative characterization, and evaluation of these materials, products, systems, and services.
2. Presenting new methods and data and critical evaluations of these methods and data.
3. Reporting the users' experience with test methods and the results of interlaboratory testing and analysis.
4. Providing the scientific basis for both new and improved ASTM standards.
5. Stimulating new ideas in the fields of testing and evaluation.

Editor-in-Chief

Donald R. Petersen

ASTM Journals
100 Barr Harbor Drive
West Conshohocken, PA 19428-2959

Editorial Board

Ray Bartnikas

Institut de Recherche
d'Hydro-Quebec
1800 Descente, Ste-Julie,
P.O. Box 1000
Varennes, Quebec, Canada
J3X 1S1

Susan Butts

The Dow Chemical Company
Analytical Sciences Laboratory
1897 B Building
Midland, MI 48667

Brigitte Decamps

Universite de Paris Sud
URA 1107
Laboratoire de Metallurgie
Structurale
Bâtiment 413
91405 Orsay Cedex, France

Harvey P. Hack

Northrop Grumman Corp.
Electric Sensors & Systems
Division
M.S. 9105, P.O. Box 1488
Annapolis, MD 21404

Marcelo M. Hirschler

2 Friar's Lane
Mill Valley, CA 94941

Edward J. Kikta, Jr.

FMC Corporation
Agricultural Products Group
Analytical Sciences, Box 8
Princeton, NJ 08543

Arthur H. Landrock

285 E. Shore Trail
Sparta, NJ 07871

Theodore J. Louzon

Lucent Eng. Res. Ctr.
569 Carter Rd.
Rm. 5-3104
P.O. Box 900
Princeton, NJ 085420

Golam M. Newaz

Mechanical Engineering
Department
Wayne State University
Detroit, MI 48202

Thomas F. O'Connor

Smith Hinchman & Grylls
Associates, Inc.
150 W. Jefferson Avenue
Detroit, MI 48226

Andrew W. Phelps

University of Dayton Research
Institute
300 College Park
Dayton, OH 45469-0130

Alan Riga

Lubrizol Corporation
29400 Lakeland Blvd.
Wickliffe, OH 44092

Christopher G. Scott

Lubrizol Corporation
29400 Lakeland Blvd.
Wickliffe, OH 44092

Richard L. Sheehan, Jr.

3M Company
Masking and Packaging Systems
Division
3M Center 230-1E-04
St. Paul, MN 55144

Thomas Varga

Technische Versuchs-und
Forschungsanstalt
Technische Universität Wien
Karlsplatz 13
A-1040 Wien
Austria

Ulf Wickström

Statens Provningsanstalt
P.O. Box 857
S-50115 Borås
Sweden

Associate Editor

Richard E. Link

US Naval Academy
Mechanical Engineering Department
590 Holloway Road
Annapolis, MD 21402-5042

Journal of Testing and Evaluation (ISSN 0090-3973) is published bimonthly by ASTM as part of the Testing and Evaluation Series, which includes the *Geotechnical Testing Journal* (published quarterly), *Journal of Composites Technology & Research* (published quarterly), and *Cement, Concrete, and Aggregates* (published semi-annually). Publication and editorial offices are located at ASTM Headquarters, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959.

Subscriptions. United States and Canada for 1 year \$129.00 (members \$116.00), for 2 years \$219.00 (members \$197.00), and for 3 years \$290.00 (members \$261.00). Foreign for 1 year \$142.00 (members \$128.00), for 2 years \$241.00 (members \$217.00), and for 3 years \$319.00 (members \$287.00). Single copies are \$35.00. To subscribe, please send prepaid order to ASTM, Subscription Dept.—JTE, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959. *Journal of Testing and Evaluation* is indexed regularly by Engineering Index, Inc. and Applied Science & Technology Index. The *Journal* is abstracted by Wilson Applied Science & Technology Abstracts and is available on microfilm from University Microfilms, a Xerox Co., Ann Arbor, MI. Periodicals postage paid at West Conshohocken, PA and additional mailing offices.

Copyright © 1998 by the American Society for Testing and Materials, West Conshohocken, PA. All rights reserved. This material may not be reproduced or copied, in whole or in part, in any printed, mechanical, electronic, film, or other distribution and storage media without the written consent of the publisher.

Photocopy Rights. Authorization to photocopy items for internal, personal, or educational classroom use, or the internal, personal, or educational classroom use of specific clients, is granted by the American Society for Testing and Materials (ASTM) provided that the appropriate fee is paid to the Copyright Clearance Center, 222 Rosewood Drive, Danvers, MA 01923, Tel. (508) 750-8400; online: <http://www.copyright.com/>.

Postmaster. Send Form 3579 to ASTM Journal of Testing and Evaluation, Subscription Dept., 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959.

Change of Address. Please return entire addressing label on wrapper to ASTM, Subscription Dept.—JTE, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959, along with new address.

Printed in the U.S.A.

Editorial Staff

Beverly Hamill, *Editor, Books and Periodical Publications*
Shannon Wainwright, *Administrative Assistant,*
Acquisitions & Review
Kathy Dernoga, *Manager, Acquisitions & Review*
Roberta Storer, *Director, Editorial Services*
M. Bruce Vieth, *Director, Production and Graphic Arts*

ASTM Officers

James E. Bihr, *Chairman*
William M. Edmunds, *Vice-Chairman*
James S. Pierce, *Vice-Chairman*
Donald E. Marlowe, *Chairman of Finance and Audit*
Committee
James A. Thomas, *President*

Directors

W. James Bover	Henry Line
James D. Converse	Hugh C. MacDonald
Thomas R. Doane	Donald E. Marlowe
William M. Edmunds	Gilbert G. McIntee
Lorne G. Everett	Scott Nushart
Joseph P. Gallagher	Jack P. Pekar
Harvey P. Hack	Alexander M. Perritt
Robert R. Hardison	James S. Pierce
Wayne N. Holliday	Richard J. Schulte
Louis C.G. Janke	James A. Thomas
Gary M. Kralik	Kay M. Villa

Past Chairmen

James E. Bihr	Arthur Cohen
---------------	--------------

Committee on Publications

Kenneth R. St. John, <i>Chairman</i>	Mark F. Marcus
Robert J. Goode, <i>Vice-Chairman</i>	John E. Masters
Arthur Cohen, <i>Ex officio</i>	Joseph D. Ritchey
Wayne G. Landis	Roger E. Stoller
	Thomas J. Wallace
	Mona B. Wolf

Information for Authors

The **Journal of Testing and Evaluation** publishes original articles of the following types:

FULL-LENGTH PAPERS (3000–5000 WORDS)

- REPORTS OF ORIGINAL INVESTIGATIONS (RESEARCH AND FIELD APPLICATIONS PAPERS).
- REVIEW ARTICLES (STATE-OF-THE-ART OR LITERATURE REVIEWS).
- INTERLABORATORY RESEARCH REPORTS (INCLUDING DATA AND STATISTICAL ANALYSIS).
- NEW PROCEDURES (CURRENTLY UNDER DEVELOPMENT BY A COMMITTEE OR AUTHORED BY AN INDIVIDUAL).
- CASE STUDIES (REPORTS AND ANALYSES OF NOTEWORTHY EVENTS OR SITUATIONS).

Shorter Technical Communications (500–1500 words)

- Technical Notes (brief papers on specific topics).
- Research Briefs (advance communications that will be followed by full-length papers).
- Conference Reports (extended abstracts).

Commentary (500–1000 words)

- Discussions of Previously Published Papers.
- Letters to the Editor.
- Invited Editorials.
- Reviews of Books and Standards.

The subject matter must not be of a speculative nature and the contents must not include materials of an advertising nature. The paper must not be seriously defective as to literary form and structure, continuity of thought, and clarity of expression. The substance of the paper should not have been published previously in the open literature.

Authors preparing papers for submittal 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 for style. SI units are to be used throughout; if data were not measured in SI units, a note should appear to that effect and the original units should be included in parentheses after the SI units.

The original manuscript and four clear copies, including original illustrations, should be submitted to Kathy Dernoga, Manager, Acquisitions and Review, ASTM, 100 Barr Harbor Drive, West Conshohocken, PA 19428–2959.