M Journal of and

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

Greenleaf Associates P.O. Box 1785 Midland, MI 48641-1785

Editorial Board

Ray Bartnikas

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

Brigitte Decamps

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

Harvey P. Hack

Naval Surface Warfare Center Marine Corrosion Branch Code 2813 Annapolis, MD 21402

Arthur H. Landrock

285 E. Shore Trail Sparta, NJ 07871

Theodore J. Louzon

AT&T Bell Laboratories 67 Whippany Rd. Whippany, NJ 07981

Golam M. Newaz

Mechanical Engineering Department Wayne State University Detroit, MI 48202

Mervyn S. Paterson

Australian National University Research School of Earth Sciences GPO Box 4 Canberra, ACT 2601 Australia

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-03 St. Paul, MN 55144

Ulf Wickstrom

Statens Provingsanstalt 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

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.

Headquarters, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959. Subscriptions. United States and Canada for 1 year \$109.00 (members \$98.00), for 2 years \$185.00 (members \$167.00), and for 3 years \$245.00 (members \$221.00). Foreign for 1 year \$120.00 (members \$108.00), for 2 years \$204.00 (members \$184.00), and for 3 years \$270.00 (members \$108.00). Single copies are \$35.00. To subscribe, please send prepaid order to ASTM, Subscription pept.—JTE, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959. Journal of Testing and Evaluation is indexed regularly by Engineering Index, Inc., and is available on microfilm from University Microfilms, A Xerox Co., Ann Arbor, MI. Second class postage paid at Philadelphia, PA.
Copyright © 1995 by the American Society for Testing and Materials, Philadelphia, 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 or personal use, or the internal or personal use of specific clients, is granted by the American Society for Testing and Materials for users registered with the Copyright Clearance Center (CCC) Transactional Reporting Service, provided that the base fee of \$2.50 per copy, plus \$0.50 per page, is paid directly to CCC, 222 Rosewood Dr., Danvers, MA 01923; Tel. (508) 750-8400; FAX (508) 750-4744. For those organizations that have been granted a photocopy license by CCC, a separate system of payment has been arranged. The fee code for users of the Transactional Reporting Service is 0090-3973/07-95 \$2.50 + .50.

Postmaster. Send Form 3579 to ASTM Headquarters, 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

Maureen S. Quinn, Editor, Books and Periodical **Publications**

Barbara Stafford, Administrative Assistant, Acquisition & Review

Kathy Dernoga, Manager, Acquisition & Review Susan L. Gebremedhin, Manager, Books and Periodical Publications

Roberta Storer, Director, Editorial Services

M. Bruce Vieth, Director, Production and Graphic Arts

ASTM Officers

George C. Moran, Chairman Arthur Cohen, Vice-Chairman James E. Bihr, Vice-Chairman Sheldon W. Dean Jr., Chairman of Finance and Audit Committee James A. Thomas, President

Directors

Gilbert F. Bourcier Lawrence C. Bradbury Jr. G. Thomas Castino Frances R. Duffev William M. Edmunds John L. Ferrante Harvey P. Hack James L. Hazen Michael L. Italiano

David C. Jeanes Richard S. Ladd Paul H. Langer Donald E. Marlowe Richard M. Park James S. Pierce Charles H. Piersall Jr. Maria Dennison Stefan Don M. von Schriltz

Past Chairmen

C. Ross Thomson

Nancy M. Trahey

Committee on **Publications**

Leonard Mordfin, Chairman Kenneth R. St. John, Vice-Chairman C. Ross Thomson. Ex officio Victor Chaker

Robert J. Goode Douglas R. Hooton Mark F. Marcus John E. Masters Roger E. Stoller 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.