EDITORIAL OBJECTIVES

The Journal of Testing and Evaluation is published bimonthly by ASTM as part of the Testing and Evaluation Series, which includes the Geotechnical Testing Journal (published quarterly) and Cement, Concrete, and Aggregates (published semiannually). ASTM, a nonprofit organization, develops voluntary consensus standards for materials, products, systems, and services.

The objective of ASTM's Journal of Testing and Evaluation is to provide a forum for presenting data derived from the testing and evaluation of materials, products, systems, and services of interest to the practicing engineer. Papers will be accepted on the grounds that they present new techniques or provide new information on existing methods of testing and evaluation, or that they contain new data resulting from testing and evaluation.

The importance of engineering standards to industry, national and international trade, and the protection of the public is now universally recognized. The technical validity of engineering standards—the international vocabulary of practical engineering communication—will be enhanced by continuing advances in methods of testing and evaluation.

Many of the articles appearing in the Journal of Testing and Evaluation are specifically presented to provide the basis for new or improved standard methods and to stimulate new ideas. If you have suggestions for possible areas of standardization, please contact Kenneth C. Pearson, ASTM Standards Development, 1916 Race St., Philadelphia, PA 19103 (215/299-5520).



EDITORIAL STAFF

Kathleen A. Peters, Senior Assistant Editor Susan Gebremedhin, Assistant Editor Robert L. Meltzer, Vice-President of Publications and Marketing M. Bruce Vieth, Manager of Production

ASTM OFFICERS

Robert G. Redelfs, Chairman Lendell E. Steele, Vice-Chairman Gladys B. Berchtold, Vice-Chairman Robert Baboian, Treasurer William T. Cavanaugh, President

DIRECTORS

Albert J. Bartosic John A. Blair Stephen E. Chehi F. Greg Clarke William P. Dugan Robert B. Elliott W. DeWayne France, Jr. John A. Gilligan

Benjamin Levadie John F. McLaughlin Thomas D. Moreland Roman F. Serra Richard O. Simpson Nancy M. Trahey Alan H. Yorkdale

Donald R. Johnson

J. Gilbert Kaufman

PAST CHAIRMEN Richard H. Goodemote

Emanuel Horowitz

William A. Goodwin

COMMITTEE ON **PUBLICATIONS**

Richard Kimerle R. C. Deen, Chairman K. L. Reifsnider, Vice-Chairman J. M. Barsom E. P. Bartkus, Ex-officio S. W. Dean

W. G. Dukek J. H. Kanzelmeyer E. L. Lewis Leonard Mordfin J. S. Perrin C. G. Scott P. G. Sullivan

E. T. Wessel R. E. White

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

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) and Cement, Concrete, and Aggregates (published semiannually). Publication and editorial office at the Headquarters of the Society, 1916 Race St., Philadelphia, PA 19103.

Subscriptions: United States and Canada for 1 year \$40.00 (members \$30.00), for 2 years \$70.00 (members \$52.00), and for 3 years \$90.00 (members \$69.00). Foreign for 1 year \$45.00 (members \$34.00), for 2 years \$80.00 (members \$60.00), and for 3 years \$105.00 (members \$81.00). Single copies are \$14.00. To subscribe, please send prepaid order to ASTM. Subscription Dept.—JTE, 1916 Race St., Philadelphia, PA 19103. 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. Ml. Second class postage paid at Philadelphia, PA and at additional mailing offices. Copyright 1984 by the American Society for Testing and Materials

Permission to Copy: The appearance of the code at the bottom of the first page of an article in this

journal indicates the copyright owner's consent that copies of the article may be made for personal or internal use, or for the personal or internal use of specific clients. This consent is given on the condition, however, that the copier pay the stated per-copy fee through the Copyright Clearance Center. Inc.. Operations Office, P.O. Box 765, Schenectady, NY 12301, for copying beyond that permitted by Sections 107 or 108 of the U.S. Copyright Law. (The per copy fee appears as the last four digits of the code at the bottom of the first page of each article.) This consent does not extend to other kinds of copying, such as copying for general distribution, for advertising or promotional purposes, for creating new collective works, or for resale. Further information may be obtained from the Copyright Clearance Center's Administrative Office, 310 Madison Ave., New York, NY 10017 (212/697-2525).

Postmaster: Send Form 3579 to Subscription Dept., ASTM Headquarters. 1916 Race St.,

Change of Address: Please return entire addressing label on wrapper to ASTM. Subscription Dept. - JTE, 1916 Race St., Philadelphia, PA 19103, along with new address

Information for Authors

Contributions to the Journal of Testing and Evaluation are subject to peer review, in accordance with the policy established by the ASTM Committee on Publications. Papers are reviewed on the basis of the inclusion of experimental data or mathematical derivations, or both, either as original work or as needed to confirm the theoretical conclusions or proposals, and their contribution to the permanent literature. 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 Greene, Manager, Acquisitions and Review, ASTM, 1916 Race St., Philadelphia, PA 19103.

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, as well as in developing standard specifications and test measurement techniques to establish their value. Much of the information results from the voluntary contributions of many of the country's leading technical authorities from industry, scientific agencies, and government. A list of publications and information on the work of ASTM will be furnished on request.

In Appreciation

The quality of the papers that appear in this publication reflects not only the obvious efforts of the authors but also the unheralded, though essential, work of the reviewers. On behalf of ASTM we acknowledge with appreciation their dedication to high professional standards and their sacrifice of time and effort.