

DEVELOPMENTS IN FRACTURE MECHANICS TEST METHODS STANDARDIZATION

Brown/Kaufman
editors



STP 632

AMERICAN SOCIETY FOR TESTING AND MATERIALS
NATIONAL AERONAUTICS AND
SPACE ADMINISTRATION

DEVELOPMENTS IN FRACTURE MECHANICS TEST METHODS STANDARDIZATION

A symposium
presented at
St. Louis, Mo., 4 May 1976

ASTM SPECIAL TECHNICAL PUBLICATION 632
W. F. Brown, Jr., NASA-Lewis Research
Center, and J. G. Kaufman, Aluminum
Company of America, editors

List price \$24.75
04-632000-30



AMERICAN SOCIETY FOR TESTING AND MATERIALS
1916 Race Street, Philadelphia, Pa. 19103



NATIONAL AERONAUTICS AND
SPACE ADMINISTRATION

BY AMERICAN SOCIETY FOR TESTING AND MATERIALS 1977
Library of Congress Catalog Card Number: 77-73544

NOTE

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

Printed in Baltimore, Md.
September 1977

Foreword

The symposium on Developments in Fracture Mechanics Test Methods Standardization and this resultant publication were sponsored by ASTM Committee E-24 on Fracture Testing of Metals, in particular Subcommittee E24.01 on Fracture Mechanics Test Methods. To a very significant extent, this symposium and publication were cosponsored by NASA-Lewis Research Center, specifically through the coauthorship or presentation of six of the invited papers or both, and a very substantial amount of the technical effort that went into the developments reported. The symposium itself was held in St. Louis, Missouri at the May 1976 ASTM Committee Week; J. G. Kaufman, Aluminum Company of America, presided as technical chairman. W. F. Brown, Jr., NASA-Lewis Research Center, and J. G. Kaufman are editors of this publication.

Related ASTM Publications

Cracks and Fracture, STP 601 (1976), \$51.75, 04-601000-30

**Fractography-Microscopic Cracking Process, STP 600 (1976), \$27.50,
04-600000-30**

Mechanics of Crack Growth, STP 590 (1976), \$45.25, 04-590000-30

A Note of Appreciation to Reviewers

This publication is made possible by the authors and, also, the unheralded efforts of the reviewers. This body of technical experts whose dedication, sacrifice of time and effort, and collective wisdom in reviewing the papers must be acknowledged. The quality level of ASTM publications is a direct function of their respected opinions. On behalf of ASTM we acknowledge with appreciation their contribution.

ASTM Committee on Publications

Editorial Staff

Jane B. Wheeler, *Managing Editor*

Helen M. Hoersch, *Associate Editor*

Ellen J. McGlinchey, *Senior Assistant Editor*

Kathleen P. Zirbser, *Assistant Editor*

Sheila G. Pulver, *Assistant Editor*

Contents

Introduction	1
Experience in Plane-Strain Fracture Toughness Testing Per ASTM Method E 399—J. G. KAUFMAN	3
Discussion	15
Fracture Toughness Testing Using the C-Shaped Specimen—	
J. H. UNDERWOOD AND D. P. KENDALL	25
Analysis of Radially Cracked Ring Segments Subject to Forces and Couples—BERNARD GROSS AND J. E. SRAWLEY	39
Recent Developments in J_{Ic} Testing—J. D. LANDES AND J. A. BEGLEY	57
Compliance Calibration of Specimens Used in the R-Curve Practice—D. E. MCCABE AND G. T. SHA	82
Heavy-Section Fracture Toughness Screening Specimen—	
J. L. SHANNON, JR., J. K. DONALD, AND W. F. BROWN, JR.	96
Sharply Notch Cylindrical Tension Specimen for Screening Plane-Strain Fracture Toughness. Part I: Influence of Fundamental Testing Variables on Notch Strength—M. H. JONES, R. T. BUBSEY, AND W. F. BROWN, JR. Part II: Applications in Aluminum Alloy Quality Assurance of Fracture Toughness—R. J. BUCCI, S. F. COLLIS, R. F. KOHM, AND J. G. KAUFMAN	115
Investigation of Some Problems in Developing Standards for Pre-cracked Charpy Slow Bend Tests—GEORGE SUCCOP, R. T. BUBSEY, M. H. JONES, AND W. F. BROWN, JR.	153
Estimation of K_{Ic} from Slow Bend Pre-cracked Charpy Specimen Strength Ratios—GEORGE SUCCOP AND W. F. BROWN, JR.	179
Fracture Testing with Surface Crack Specimens—T. W. ORANGE (Reprint from <i>Journal of Testing and Evaluation</i>, Vol. 3, No. 5, Sept. 1975)	193
Appendix I—Standard Method of Sharp-Notch Tension Testing of High-Strength Sheet Materials (E 338-68)	213
Appendix II—Standard Test Method for Plane-Strain Fracture Toughness of Metallic Materials (E 399-74)	221
Appendix III—Tentative Recommended Practice for R-Curve Determination (E 561-76T)	241
Appendix IV—Tentative Method for Sharp-Notch Tension Testing with Cylindrical Specimens (E 602-76T)	260
Summary	269
Index	283

