FRACTURE TOUGHNESS

Proceedings of the
1971 National Symposium
on Fracture Mechanics
PART II

STP 514

AMERICAN SOCIETY FOR TESTING AND MATERIALS

FRACTURE TOUGHNESS

Proceedings of the 1971 National Symposium on Fracture Mechanics

PART II

Proceedings of the 1971
National Symposium on
Fracture Mechanics
University of Illinois
Urbana-Champaign, Ill., 31 Aug.-2 Sept. 1971

ASTM SPECIAL TECHNICAL PUBLICATION 514
H. T. Corten, general chairman
J. P. Gallagher, arrangements chairman

List price $18.25
04-514000-30

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

Library of Congress Catalog Card Number: 72-78745

NOTE

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

Printed in Philadelphia, Pa.
September 1972

FOREWORD

The 1971 National Symposium on Fracture Mechanics was held at the University of Illinois, Urbana-Champaign, Ill., 31 August through 2 September 1971. H. T. Corten, Department of Theoretical and Applied Mechanics, University of Illinois, presided as general chairman. J. P. Gallagher, Experimental Mechanics Branch, Air Force Flight Dynamics Laboratory, Wright-Patterson AFB, served as arrangements chairman.

The proceedings have been subjectively divided into complementary volumes: Part I – *Stress Analysis and Growth of Cracks* and Part II – *Fracture Toughness.* Part II is contained herein.

Related
ASTM Publications

Current Status of Plane Strain Crack Toughness Testing of High Strength Metallic Materials, STP 410, (1967), $5.50, 04-410000-30

Electron Fractography, STP 436, (1968), $11.00, 04-436000-30

Fracture Toughness Testing at Cryogenic Temperatures, STP 496, (1971), $5.00, 04-496000-30

CONTENTS

Introduction vi

The J Integral as a Fracture Criterion – J. A. BEGLEY AND J. D. LANDES 1

Discussion 21

The Effect of Specimen Geometry on J_{Ic} – J. D. LANDES AND J. A. BEGLEY 24

J Integral Estimation Procedures – R. J. BUCCI, P. C. PARIS, J. D. LANDES, AND J. R. RICE 40

Ductile Fracture Initiation, Propagation, and Arrest in Cylindrical Vessels – W. A. MAXEY, J. F. KIEFNER, R. J. EIBER, AND A. R. DUFFY 70

Sharp Notch Tension Testing of Thick Aluminum Alloy Plate with Cylindrical Specimens – J. G. KAUFMAN 82

Influence of Dimensions of the Center-Cracked Tension Specimen on K_c – C. N. FREED, A. M. SULLIVAN, AND J. STOOP 98

Fracture Toughness of Duplex Structures: Part I – Tough Fibers in a Brittle Matrix – S. D. ANTOLOVICH, P. M. SHETE, AND G. R. CHANANI 114

Fracture Toughness of Duplex Structures: Part II – Laminates in the Divider Orientation – S. D. ANTOLOVICH, K. KASI, AND G. R. CHANANI 135

Relationship between Charpy V and Fracture Mechanics K_{Ic} Assessments of A533-B Class 2 Pressure Vessel Steel – J. R. HAWTHORNE AND T. R. MAGER 151

Relationship between Material Fracture Toughness using Fracture Mechanics and Transition Temperature Tests – R. H. SAILORS AND H. T. CORTEN 164

INTRODUCTION

The papers in this volume were presented at the Fifth National Symposium on Fracture Mechanics held at the University of Illinois, Urbana, Illinois, 31 August through 2 September 1971. Beginning in 1972, The National Symposium on Fracture Mechanics will be sponsored by ASTM through Committee E-24 on Fracture Testing of Metals.

In this volume, methods of measurement of toughness of high-toughness metals are reported. Attention is focused on a variety of tests including a new fracture criteria for the elastic-plastic and fully plastic realm, the critical value of the J integral, and the relationship between the various toughness measurements.

In the companion volume, *STP 513,* the papers treat crack tip stress analysis and subcritical crack extension caused by repeated loads, environments, and their combination. The threshold level for fatigue crack extension is given particular attention.

H. T. Corten
Department of Theoretical
and Applied Mechanics
College of Engineering
University of Illinois
Urbana, Illinois
general chairman