



ASM Handbook: Volume 19: Fatigue and Fracture

By Steven R. Lampman

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Providing a working knowledge of fatigue and fracture properties in actual engineering practice, this Handbook is especially valuable in evaluating test data and knowing the key variables that affect results. It will also give you a better understanding of fracture mechanics to aid you in life assessment and life extension of components.

Sections include: Fatigue Mechanisms, Crack Growth, Testing, Engineering Aspects of Fatigue Life, Fracture Mechanics of Engineering Materials, Fatigue and Fracture Control, Castings, Weldments, Wrought Steels, Aluminum Alloys, Titanium Alloys and Superalloys. Appendices contain comprehensive coverage of fatigue strength parameters and stress-intensity factors.

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Editorial Review

Review

This volume of the ASM Handbook series, Fatigue and Fracture, marks the first separate Handbook on an important engineering topic of long-standing and continuing interest for both materials and mechanical engineers at many levels. Fatigue and fracture, like other forms of material degradation such as corrosion and wear, are common engineering concerns that often limit the life of engineering materials. This perhaps is illustrated best by the "Directory of Examples of Failure Analysis" contained in Volume 10 of the 8th Edition Metals Handbook. Over a third of all examples listed in that directory are fatigue failures, and well over half of all failures are related to fatigue, brittle fracture, or environmentally-assisted crack growth.

The title Fatigue and Fracture also represents the decision to include fracture mechanics as an integral part in characterizing and understanding not only ultimate fracture but also "subcritical" crack growth processes such as fatigue. The development and application of fracture mechanics has steadily progressed over the last 50 years and is a field of long-standing interest and involvement by ASM members. This perhaps is best typified by the seminal work of George Irwin in Fracturing of Metals (ASM, 1948), which is considered by many as the one of the key beginnings of modern fracture mechanics based from the foundations established by Griffith at the start of this century.

This Handbook has been designed as a resource for basic concepts, alloy property data, and the testing and analysis methods used to characterize the fatigue and fracture behavior of structural materials. The overall intent is to provide coverage for three types of readers: i) metallurgists and materials engineers who need general guidelines on the practical implications of fatigue and fracture in the selection, analysis or application structural materials; ii) mechanical engineers who need information on the relative performance and the mechanistic basis of fatigue and fracture resistance in materials; and iii) experts seeking advanced coverage on the scientific and engineering models of fatigue and fracture.

Major emphasis is placed on providing a multipurpose reference book for both materials and mechanical engineers with varying levels of expertise. For example, several articles address the basic concepts for making estimates of fatigue life, which is often necessary when data are not available for a particular alloy condition, product configuration, or stress conditions. This is further complemented with detailed coverage of fatigue and fracture properties of ferrous, nonferrous, and nonmetallic structural materials. Additional attention also is given to the statistical aspects of fatigue data, the planning and evaluation of fatigue tests, and the characterization of fatigue mechanisms and crack growth. --ASM International

Fracture mechanics is also thoroughly covered in Section 4, from basic concepts to detailed applications for damage tolerance, life assessment, and failure analysis. The basic principles of fracture mechanics are introduced with a minimum of mathematics, followed by practical introductions on the fracture resistance of structural materials and the current methods and requirements for fracture toughness testing. Three authoritative articles further discuss the use of fracture mechanics in fracture control, damage tolerance analysis, and the determination of residual strength in metallic structures. Emphasis is placed on linear-elastic fracture mechanics, although the significance of elastic-plastic fracture mechanics is adequately addressed in these key articles. --ASM International

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Further coverage is devoted to practical applications and examples of fracture control in weldments, process piping, aircraft systems, failure analysis, and more advanced topics such as high-temperature crack growth and thermo-mechanical fatigue. Extensive fatigue and fracture property data are provided in Sections 5 through 7, and the Appendices include a detailed compilation of fatigue strength parameters and an updated summary of commonly used stress-intensity factors.

Once again, completion of this challenging project under the auspices of the Handbook Committee is made possible by the time and patience of authors who have contributed their work. Their efforts are greatly appreciated along with the guidance from reviewers and the Editorial Review Board. --ASM International

From the Publisher

Published: 1996

About the Author

The publication of this Volume marks the first time that the ASM Handbook series has dealt with fatigue and fracture as a distinct topic. Society members and engineers involved in the research, development, application, and analysis of engineering materials have had a long-standing interest and involvement with fatigue and fracture problems, and this reference book is intended to provide practical and comprehensive coverage of all aspects of these subjects.

Publication of Fatigue and Fracture also marks over 50 years of continuing progress in the development and application of modern fracture mechanics. Numerous Society members have been actively involved in this progress, which is typified by the seminal work of George Irwin ("Fracture Dynamics," *Fracturing of Metals*, ASM, 1948). Since that time period, fracture mechanics has become a vital engineering discipline that has been integrally involved in helping to prevent the failure of essentially all types of engineered structures.

Likewise, fatigue and crack growth have also become of primary importance to the development and use of advanced structural materials, and this Volume addresses the wide range of fundamental, as well as practical, issues involved with these disciplines.

We believe that our readers will find this Handbook useful, instructive, and informative at all levels. We also are especially grateful to the authors and reviewers who have made this work possible through their generous commitments of time and technical expertise. To these contributors we offer our special thanks.

Users Review

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