

BOOK REVIEWS

Reliability Engineering Handbook: Vol. 1

Reviewed by Timothy L. Jacobs, Department of Civil and Environmental Engineering, Duke University, Durham, NC 27706.

REFERENCE: Kececioglu, D., *Reliability Engineering Handbook Volume 1*, Prentice-Hall, Englewood Cliffs, N.J., 1991, ISBN: 0-13-77294-X (v. 1).

The objective of this book is to provide an introduction and overview of the concepts and mathematical tools of reliability engineering. This book is intended as a first text in reliability engineering for upper level undergraduate students or graduate students. The problems and examples presented in this book are generally not engineering discipline specific. Each chapter begins with a list of objectives that are to be covered. This is followed by the actual development of specific concepts, presentation of examples, and a discussion of applications and extensions.

The first two chapters outline the objectives of reliability engineering and present a short history of reliability engineering. Chapter 1 presents a general overview of reliability engineering, applications, benefits and the role of reliability engineering in modern industry. In addition, this chapter provides a short list of case histories in which reliability engineering has proved successful. Chapter 2 presents a brief history of reliability engineering in the form of a listing of events that played in the development of this engineering discipline from 1941 to 1986. This is followed by a future outlook of the use of reliability engineering in industry.

Chapter 3 defines the basic concepts of reliability engineering. This chapter begins with an introduction of the mathematical concepts of reliability. This is followed by a brief discussion of the concept of confidence levels, failure causes and types, and the effects of aging. This chapter concludes with short discussions of ten case histories.

Chapter 4 presents an overview of the analytical methods used in probability and reliability analysis. Topics covered in Chapter 4 include: distribution functions, cumulative distributions, distribution parameters such as the mean, variance, and coefficient of variation, moment generating functions, and the reliability function.

Chapters 5 through 11 cover many of the distributions most commonly used in reliability engineering and include the exponential, Weibull, normal, lognormal, Rayleigh, and uniform distributions. In addition, Chapter 9 is devoted to distributions of extreme values that are vital in accurately considering extreme values from observational data. Chapters 12 through 14 consider early, chance and wear-out reliability, multiple failure modes, and the quantification of failure rates with respect to time.

In general, the examples presented throughout the text clearly illustrate the author's point and the mechanics of finding the solution. However, they are quite abstract and generally do not provide the reader with a realistic impression of the problems encountered in practice. In many cases, readers may find them-

selves bogged down with the mathematics without a realistic feel for how or when the method should be implemented in practice. Although the author states that this book is intended as a first text in reliability engineering as well as a reference, the true value is as a technical handbook for the practicing engineer who must deal with reliability and quality issues on a daily basis.

International Symposium on Fracture Mechanics

Reviewed by J. C. Newman, Jr., Mechanics of Materials Branch, Materials Division, NASA Langley Research Center, Hampton, VA 23665.

REFERENCE: *Proceedings of the International Symposium on Fracture Mechanics*, W. R. Tyson and B. Mukherjee, Eds., Pergamon Press, New York, 1988, ISBN 0-08-035764-4.

This volume contains the proceedings of a symposium held as part of the 26th Annual Conference of Metallurgists held in Winnipeg, Manitoba, Canada, on 23-26 August 1987. The conference was co-sponsored by the Basic Sciences and Materials Engineering Sections of the Metallurgical Society of the Canadian Institute of Mining and Metallurgy and the Canadian Committee for Research on the Strength and Fracture of Materials.

The 27 papers were divided into five major sections: (1) Tutorial, (2) Testing and Materials-Metals, (3) Testing and Mechanics-Nonmetals, (4) Fatigue and Fracture of Weldments, and (5) Material Development and Microstructure-Property Relationship. At first glance, I had expected to see a large "international" participation in the conference. However, there were only two participants from the United States and one from Belgium. Twenty-three papers were from organizations in Canada. Thus it would have been appropriate to have called this the "National" Symposium on Fracture Mechanics in Canada. But this does not distract from the papers in this volume. The papers that were presented cover a wide range in subject matter that have been associated with international symposia on fatigue and fracture mechanics. The book will be of most interest to current researchers in fatigue and fracture mechanics. Most of the subject matter is presented with an emphasis on metallurgical behavior.

In the tutorial section, five papers reviewed the state of the art in key areas related to micromechanics of fracture of metals and ceramics, elastic-plastic fracture of metals and weldments, and fatigue crack initiation and growth. This section would be of interest to new researchers or managers in mechanics of materials. The next two sections concentrated on the fracture behavior of metals and nonmetals. Most of the papers in the metals section presented results on fracture toughness behavior of various steels under a wide range of environmental and loading conditions. The nonmetallic section was primarily concerned with fracture behavior of ceramics. Substantial improvements in the strength and toughness of ceramics have been made through an

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understanding of the micromechanisms involved in crack formation. For a practicing engineer, the section on fatigue and fracture of weldments provides a useful series of papers in making life assessments and fracture analyses of welded joint connections. The last section presents a series of papers on the influence of microstructure on material development. Relationships between microstructural features and fracture toughness are presented.

In summary, the book provides an overview of microstructural damage mechanics, modelling, and nonlinearities associated with metallic and ceramic materials. The text, illustrations, and photographs are clear and very informative. This volume is an excellent addition to the growing library of reference material on the failure of materials.

Quality Control of Packaging Materials in the Pharmaceutical Industry

Reviewed by Ronald G. McManus, *Package Evaluation Coordinator, Eli Lilly and Company, Indianapolis, IN 46285.*

REFERENCE: Harburn, K., *Quality Control of Packaging Materials in the Pharmaceutical Industry*, Marcel Dekker, New York, ASQC Quality Press, 1991.

This work is the fourth in a series of reference books relating to the broader category of "Packaging and Converting Technology." Other volumes are in preparation. The targeted audience is the pharmaceutical package engineer, production equipment and incoming quality control personnel, and component and packaging machinery manufacturers.

The book is divided into chapters that follow the logical flow of material/quality design. The chapter headings include:

- Packaging Design and Specifications.
- Supplier Quality Auditing.
- Quality Control at the Supplier's Premises.
- The Packaging Material Quality Control Laboratory on the Pharmaceutical Premises.
- Packaging and Filling Equipment.
- Pharmaceutical Packaging.
- Customer Complaints.

The book succeeds well in providing a very readable overview of the quality issues relating to the pharmaceutical packaging process. Emphasis was placed on issues relating to parenteral packaging, and rightly so, as this is one of the industry's most challenging areas. A number of handling operations are encountered here that are not required for other package types (e.g., blisters, powders, tablets, creams, and aerosols). Additions of all these package types would have made the book more complete and helpful.

The table of contents and index are very comprehensive and

make for easy reference. Throughout the book there are a number of simple summary charts that also aid the review process.

Overall the book is an excellent reference work for bringing one into the thinking and planning process relating to pharmaceutical packaging and quality.

Handbook of Tribology: Materials, Coatings, and Surface Treatments

Reviewed by R. G. Bayer, *IBM Corporation, Endicott, NY 13760.*

REFERENCE: Bhushan, B. and Gupta, B. K., *Handbook of Tribology: Materials, Coatings, and Surface Treatments*, 1168 pages, 564 illustrations, \$92.50, McGraw-Hill, New York, 1991.

I have had the occasion to use this handbook several times while searching for alternative coatings and processes that could be used in specific applications to provide equivalent or improved tribological performance. I found this book to be well suited for this purpose. It is an impressive compendium of information on coatings, surface treatments, and related processes. Virtually all such processes are covered, from case hardening and electroplating to ion implantation and ion plating. Each of these processes is described in terms of the physics and chemistry involved. Physical properties of the resulting surface layer or coating, as well as those of bulk materials, are provided. Of more significance is the fact that relevant and extensive tribological information is also provided in a consolidated manner for virtually all bulk materials, coatings, and surface treatments.

This compilation of information comprises the bulk of this book and is most useful to tribologists. The authors address three other aspects of tribology that are useful to the nontribologist. One is a discussion and summary of fundamental mechanisms of friction, wear, and lubrication. Another is a discussion of screening and evaluation techniques appropriate to tribological applications. The third addresses typical tribological uses of various materials, coatings, and surface treatments. While the treatment of these aspects is brief, they do provide a good overview that should be useful to the nonspecialist.

The focus of this handbook is clearly on the material aspects of tribological behavior. It is well organized and extremely complete from that standpoint. However, the treatment of other aspects of tribo-systems that can be of importance in resolving and addressing friction and wear concerns is minimal. As a result this book can not be viewed as, nor was it intended to be, a complete handbook of tribology.

In summary, this book is an excellent reference for those concerned with tribology. The authors should be congratulated for their monumental and successful effort.

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Dictionary of Plastics Testing

Reviewed by Leonard J. Meraw, EuroPal, Madison Heights, MI 48071.

REFERENCE: Durzok, J., *Dictionary of Plastics Testing*. VCH Verlagsgesellschaft mbH, Weinheim, Germany, 1991, 200 pp.

The bilingual *Dictionary of Plastics Testing* contains some 6000 entries covering primarily testing methods, conditions, and equipment, as well as sample preparation. The book is alphabetically arranged in two sections: English/German and German/English. The word or phrase in question, or in the source language, appears in bold type, while its translated equivalent is in standard type. Remarks clarifying entries are in italic type within brackets. The gender of German nouns is also noted with the standard symbols *f*, *m* and *n* (feminine, masculine and neuter). Accordingly, a typical entry looks like the following:

Arc resistance Lichtbogenfestigkeit *f* {Pruefung von Isolierstoffen}

This nice arrangement makes the dictionary easy to use when one skims down the vertical columns of terms in search of an unknown word or phrase. The book does not contain any illustrations, diagrams or the like.

Interestingly, the dictionary contains a disclaimer on the back of the title page which states, in part, that the author and publishers do not warrant the information contained therein to be free of errors. However, such a disclaimer is not uncommon in the field of translations.

Overall, the dictionary is highly accurate and contains a wide array of words and phrases found in the plastics industry. There is little or no filler material evident in the text.

This hardcover reference book will certainly benefit academia, business men and women, and specialists active in the field. The *Dictionary of Plastics Testing* makes a valuable addition to any reference library and should gain wide acceptance.