

Overview

This book is a collection of papers presented at the Fourth International Symposium on Bearing Steels sponsored by the American Society for Testing and Materials Committee A01 and its Subcommittee A01.28 on Bearing Steels. In each of the previous symposiums a main theme was chosen and papers were then solicited. The papers were then edited for ASTM Special Technical Publications. Past symposiums and subsequently published STPs are listed as follows:

1974	STP 575	<i>Bearing Steels: The Rating of Nonmetallic Inclusions</i>
1981	STP 771	<i>Rolling Contact Fatigue Testing of Bearing Steels</i>
1986	STP 987	<i>Effect of Steel Manufacturing Processes on the Quality of Bearing Steels</i>
1991	STP 1195	<i>Creative Use of Bearing Steels</i>

In each of these symposiums, we were very grateful that a large number of internationally renowned scientists and engineers brought forth reports of their research, development, and experiences for presentation and publication. Since the first symposium in Boston, Massachusetts in 1974, we have published in these four STPs a total of 79 papers from Canada, China, France, Germany, Italy, Japan, The Netherlands, Sweden, the United Kingdom, and the United States, covering literally all aspects of progress in bearing steels in the last 18 years: from steelmaking technology to methods of vacuum degassing; from rating of nonmetallic inclusions to their removal; from steel billet conditioning to heat treatment; from methods of rolling contact fatigue testing to the basic theory of fatigue; from interpretation of test results to failure analysis; and from exemplar usage to innovative applications. These four STPs form an encyclopedia of bearing steels and together are a unique, valuable reference to the global scientific and engineering community.

The main theme of this book is the creative use of bearing steels. It starts with five papers covering the subjects of carburizing and through-hardening. The merits and demerits of these two methods of heat treatment in rolling bearing applications have been debated since the inception of the modern rolling bearing industry a century ago. With the significant improvement of bearing steel manufacturing technology in the past decade, it is indeed an opportune time to review these two basic methods of heat treatment based on the latest scientific knowledge on the subject. The authors of these five papers, Tsushima, Nakashima, and Maeda; Hengerer, Brockmüller, and Sörström; Böhmer; Braza and Pearson; and Dupen, Morral, and Law all present many hitherto unpublished data. Dr. Hengerer's extensive coverage of the advantages of bainitic treatment of through-hardening bearing steel over conventional martensitic treatment is most thorough. Such information up to now was considered commercially proprietary. We believe the authors' conclusions are untainted by commercial interests, whereas many discussions in the past were biased. These discussions will undoubtedly lead to many creative applications in years to come.

The next section of this book contains five papers covering surface modification and a hot subject of metallurgy in recent years—powder metallurgy. Technology of chemical vapor deposition is not new, but Chen, Pen, Lei, Duan, Song, and Fan present a novel way of applying it to bearing surface. Schreiber, Simon, and Zoch present an interesting paper on improving fatigue life of balls by work-hardening the surfaces. Papers by Tsubota; Chidester, Green, and Corbo; and Buchner show some improvements and practical applications in

powder metallurgy. They also point out, however, that there are realistic limitations of what the present technology of powder metallurgy can accomplish.

The third group of five papers in this book covers two types of newly developed bearing steels and their applications. Carburizing corrosion resistant bearing steels are steels with application at both elevated and cryogenic temperatures. McCaffrey and Wert describe a steel they developed, and Spitzer, Chin, and Haluck present an application of this new steel in cryogenic turbopump bearing. Berns and Trojahn developed a new high-nitrogen corrosion resistant bearing steel that received an award from the Ministry of Industrial Development of the Federal Republic of Germany. The chemistry and properties are published here. Andersson-Drugge and Lund developed a new ferritic-pearlitic steel with eutectoid composition that may have enormous economical ramifications in cost reduction. The new steel has the potential to shorten or eliminate the costly spheroidize annealing process for the high-carbon AISI 52100 steel used for bearings for nearly a century. Chu, Chen, and Yang report a new bearing steel developed for applications at a medium-high temperature range of 120 to 250°C.

The next group of three papers summarize some endeavors to improve the rolling contact fatigue life of bearings. Furumura, Murakami, and Abe and Beswick, Voskamp, v.d. Sanden, Verburch, and Horton present factors that each group believes affect rolling contact fatigue life of bearings. Böhmer presents thought-provoking models to determine the effects of nonmetallic inclusions in bearing steels.

The last five papers continue the discussion of new bearing steel manufacturing processes covered extensively in the 1987 symposium in Phoenix, Arizona. Hengerer, Beswick, and Kerrigan describe the method of evaluation and the limit of acceptance for bearing steels made by the continuous casting method—a new production method for the future from both the quality and economic points of view. Baum, Böhnke, Otto, and Pflipsen and Kremer, Jung, Peschke, and Rakoski report in their respective papers their efforts to further improve the method of secondary ladle refining since they last wrote in *STP 987*. Zhou, Wang, Xie, and Wan present an interesting paper comparing bearing steel made from the ladle refining process under vacuum and without vacuum, as well as from the process of electroslag remelting. Baudry, Duplomb, Giroud, Saleil, and Jacob report a rotary continuous cast process to produce bearing steel for seamless tubes.

The papers in this book represent the latest theory and state-of-the-art technology in many areas of bearing steels. Although in this symposium we try to cover subjects hitherto not published, the progress made in the last five years mandates us to review some topics. Civilization has been moving forward incessantly. Science has been advancing in bold and pompous strides. Periodic reviews of the past can help us to correct and refresh our thoughts. Newly discovered facts must be incorporated into our past beliefs. Correct understanding of the past and present provides us with a clear view of the future.

All foreign authors comment that these international symposiums sponsored by the American Society for Testing and Materials, Committee A01 and its Subcommittee A01.28, are uniquely attractive because these are the only forums in the world where both bearing steel producers and users can present and exchange their views and research results. These symposiums have been scheduled in intervals of approximately five years. Since continuity is another important factor in carrying out scientific development, we intend to uphold this fine tradition in the future.

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