Machinery’s Handbook 27th Edition

PREFACE

Machinery’s Handbook has served as the principal reference work in metalworking, design and manufacturing facilities, and in technical schools and colleges throughout the world, for more than 90 years of continuous publication. Throughout this period, the intention of the Handbook editors has always been to create a comprehensive and practical tool, combining the most basic and essential aspects of sophisticated manufacturing practice. A tool to be used in much the same way that other tools are used, to make and repair products of high quality, at the lowest cost, and in the shortest time possible.

The essential basics, material that is of proven and everlasting worth, must always be included if the Handbook is to continue to provide for the needs of the manufacturing community. But, it remains a difficult task to select suitable material from the almost unlimited supply of data pertaining to the manufacturing and mechanical engineering fields, and to provide for the needs of design and production departments in all sizes of manufacturing plants and workshops, as well as those of job shops, the hobbyist, and students of trade and technical schools.

The editors rely to a great extent on conversations and written communications with users of the Handbook for guidance on topics to be introduced, revised, lengthened, shortened, or omitted. In response to such suggestions, in recent years material on logarithms, trigonometry, and sine-bar constants have been restored after numerous requests for these topics. Also at the request of users, in 1997 the first ever large-print or “desktop” edition of the Handbook was published, followed in 1998 by the publication of Machinery’s Handbook CD-ROM including hundreds of additional pages of material restored from earlier editions. The large-print and CD-ROM editions have since become permanent additions to the growing family of Machinery’s Handbook products.

Regular users of the Handbook will quickly discover some of the many changes embodied in the present edition. One is the combined Mechanics and Strength of Materials section, arising out of the two former sections of similar name; another is the Index of Standards, intended to assist in locating standards information. “Old style” numerals, in continuous use in the first through twenty-fifth editions, are now used only in the index for page references, and in cross reference throughout the text. The entire text of this edition, including all the tables and equations, has been reset, and a great many of the numerous figures have been redrawn. This edition contains more information than ever before, and sixty-four additional pages brings the total length of the book to 2704 pages, the longest Handbook ever.

The 27th edition of the Handbook contains significant format changes and major revisions of existing content, as well as new material on a variety of topics. The detailed tables of contents located at the beginning of each section have been expanded and fine tuned to simplify locating your topic; numerous major sections have been extensively reworked and renovated throughout, including Mathematics, Mechanics and Strength of Materials, Properties of Materials, Fasteners, Threads and Threading, and Unit Conversions. New material includes fundamentals of basic math operations, engineering economic analysis, matrix operations, disc springs, constants for metric sine-bars, additional screw thread data and information on obscure and historical threads, aerodynamic lubrication, high speed machining, grinding feeds and speeds, machining econometrics, metalworking fluids, ISO surface texture, pipe welding, geometric dimensioning and tolerancing, gearing, and EDM.

Other subjects in the Handbook that are new or have been revised, expanded, or updated are: analytical geometry, formulas for circular segments, construction of four-arc ellipse, geometry of rollers on a shaft, mechanisms, additional constants for measuring weight of piles, Ohm’s law, binary multiples, force on inclined planes, and measurement over pins.

The large-print edition is identical to the traditional toolbox edition, but the size is increased by a comfortable 140% for easier reading, making it ideal as a desktop reference. Other than size, there are no differences between the toolbox and large-print editions.

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The Machinery's Handbook 27 CD-ROM contains the complete contents of the printed edition, presented in Adobe Acrobat PDF format. This popular and well known format enables viewing and printing of pages, identical to those of the printed book, rapid searching, and the ability to magnify the view of any page. Navigation aids in the form of thousands of clickable bookmarks, page cross references, and index entries take you instantly to any page referenced.

The CD contains additional material that is not included in the toolbox or large print editions, including an extensive index of materials referenced in the Handbook, numerous useful mathematical tables, sine-bar constants for sine-bars of various lengths, material on cement and concrete, adhesives and sealants, recipes for coloring and etching metals, forge shop equipment, silent chain, worm gearing and other material on gears, and other topics.

Also new on the CD are numerous interactive math problems. Solutions are accessed from the CD by clicking an icon, located in the page margin adjacent to a covered problem, (see figure shown here). An internet connection is required to use these problems. The list of interactive math solutions currently available can be found in the Index of Interactive Equations, starting on page 2689. Additional interactive solutions will be added from time to time as the need becomes clear.

Those users involved in aspects of machining and grinding will be interested in the topics Machining Econometrics and Grinding Feeds and Speeds, presented in the Machining section. The core of all manufacturing methods start with the cutting edge and the metal removal process. Improving the control of the machining process is a major component necessary to achieve a Lean chain of manufacturing events. These sections describe the means that are necessary to get metal cutting processes under control and how to properly evaluate the decision making.

A major goal of the editors is to make the Handbook easier to use. The 27th edition of the Handbook continues to incorporate the timesaving thumb tabs, much requested by users in the past. The table of contents pages beginning each major section, first introduced for the 25th edition, have proven very useful to readers. Consequently, the number of contents pages has been increased to several pages each for many of the larger sections, to more thoroughly reflect the contents of these sections. In the present edition, the Plastics section, formerly a separate thumb tab, has been incorporated into the Properties of Materials section. A major task in assembling this edition has been the expansion and reorganization of the index. For the first time, most of the many Standards referenced in the Handbook are now included in a separate Index Of Standards starting on page 2677.

The editors are greatly indebted to readers who call attention to possible errors and defects in the Handbook, who offer suggestions concerning the omission of some matter that is considered to be of general value, or who have technical questions concerning the solution of difficult or troublesome Handbook problems. Such dialog is often invaluable and helps to identify topics that require additional clarification or are the source of reader confusion. Queries involving Handbook material usually entail an in-depth review of the topic in question, and may result in the addition of new material to the Handbook intended to resolve or clarify the issue. The new material on the mass moment of inertia of hollow circular rings, page 248, and on the effect of temperature on the radius of thin circular rings, page 405, are good examples.

Our goal is to increase the usefulness of the Handbook to the greatest extent possible. All criticisms and suggestions about revisions, omissions, or inclusion of new material, and requests for assistance with manufacturing problems encountered in the shop are always welcome.

Christopher J. McCauley, Senior Editor

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The editors would like to acknowledge all those who contributed ideas, suggestions, and criticisms concerning the Handbook. Most importantly, we thank the readers who have contacted us with suggestions for new topics to present in this edition of the Handbook. We are grateful for your continuing constructive suggestions and criticisms with regard to Handbook topics and presentation. Your comments for this edition, as well as past and future ones are invaluable, and well appreciated.

Special thanks are also extended to current and former members of our staff, the talented engineers, recent-graduates, who performed much of the fact checking, calculations, artwork, and standards verification involved in preparing the printed and CD-ROM editions of the Handbook. Many thanks to Janet Romano for her great Handbook cover designs. Her printing, packaging, and production expertise are irreplaceable, continuing the long tradition of Handbook quality and ruggedness.

Many of the American National Standards Institute (ANSI) Standards that deal with mechanical engineering, extracts from which are included in the Handbook, are published by the American Society of Mechanical Engineers (ASME), and we are grateful for their permission to quote extracts and to update the information contained in the standards, based on the revisions regularly carried out by the ASME.

ANSI Standards are copyrighted by the publisher. Information regarding current editions of any of these Standards can be obtained from ASME International, Three Park Avenue, New York, NY 10016, or by contacting the American National Standards Institute, West 42nd Street, New York, NY 10017, from whom current copies may be purchased. Additional information concerning Standards nomenclature and other Standards bodies that may be of interest is located on page 2079.

Several individuals in particular, contributed substantial amounts of time and information to this edition.

Mr. David Belforte, for his thorough contribution on lasers.

Manfred K. Brueckner, for his excellent presentation of formulas for circular segments, and for the materials on construction of the four-arc oval.

Dr. Bertil Colding, provided extensive material on grinding speeds, feeds, depths of cut, and tool life for a wide range of materials. He also provided practical information on machining econometrics, including tool wear and tool life and machining cost relationships.

Mr. Edward Craig contributed information on welding.

Dr. Edmund Isakov, contributed material on coned disc springs as well as numerous other suggestions related to hardness scales, material properties, and other topics.

Mr. Sidney Kravitz, a frequent contributor, provided additional data on weight of piles, excellent proof reading assistance, and many useful comments and suggestions concerning many topics throughout the book.

Mr. Richard Kuzmack, for his contributions on the subject of dividing heads, and additions to the tables of dividing head indexing movements.

Mr. Robert E. Green, as editor emeritus, contributed much useful, well organized material to this edition. He also provided invaluable practical guidance to the editorial staff during the Handbook’s compilation.

Finally, Industrial Press is extremely fortunate that Mr. Henry H. Ryffel, author and editor of Machinery’s Handbook, continues to be deeply involved with the Handbook. Henry’s ideas, suggestions, and vision are deeply appreciated by everyone who worked on this book.