ESHBACH'S HANDBOOK OF ENGINEERING FUNDAMENTALS

Eshbach's Handbook of Engineering Fundamentals, Fifth Edition Edited by Myer Kutz
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Edited by
Myer Kutz

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To Ovid W. Eshbach (1893–1958), educator and editor

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PREFACE

In the years 1934–1936, when Ovid Wallace Eshbach (1893–1958) was preparing the first edition of the handbook that still bears his name, he was employed as special assistant in the Personnel Relations Department of AT&T. An electrical engineering graduate with honors from Lehigh University in 1915, he was well known in engineering education circles, particularly at schools which offered a cooperative option to their undergraduates. He coordinated the Bell System–MIT Cooperative Plan, an option in the Electrical Engineering Department at MIT, which permitted selected students to alternate study terms at MIT with terms of work, either with the Bell System or with the General Electric Company. In a memoir (available on the Northwestern University web site), to which I am indebted for this information, Eshbach's son wrote that his father, in addition to interviewing, hiring, and placing students within the Bell System, monitored their progress, counseled them, and followed their careers. He was also an adjunct MIT professor and taught electrical engineering courses for students co-oping at Bell. Eshbach served on committees of the Society for the Promotion of Engineering Education and the American Institute of Electrical Engineers. He was a member of the Regional Accrediting Committee of the Engineers' Council for Professional Development as well as the Special Advisory Committee to the President's Committee on Civil Service Improvement. In 1932 he had directed a survey of adult technical education for the Chamber of Commerce of the State of New York.

Several years after he published his handbook, Eshbach was approached to become dean of the Northwestern engineering school. Northwestern had established a new engineering school in the early 1900s, initially as a department within the College of Liberal Arts. In the mid-1920s the College of Engineering became the autonomous School of Engineering, with faculty members devoted exclusively to engineering. There was a crisis in engineering education at Northwestern in 1937 when, after years of declining enrollments, the school was denied accreditation during a national survey of engineering schools carried out by the Engineers' Council for Professional Development. A major criticism was that the curriculum was too heavily weighted with nonprofessional courses. But in 1939, Walter P. Murphy, a wealthy inventor of railroad equipment, donated $6.7 million for the construction of Northwestern's Technological Institute building. When the construction of Tech, as the engineering school was then known, was completed in 1942, Northwestern received an additional bequest of $28 million from Murphy's estate to provide for an engineering school "second to none." Although Murphy insisted that the school not be named for him—he would not appear in public or on programs of ceremonies, such as at the cornerstone laying or the dedication of the new building—the cooperative engineering education program bears his name to commemorate his interest in "practical education." Over the next 45 years cooperative engineering education remained a constant requirement at Tech, now known as the Robert R. McCormick School of Engineering and Applied Science.

Eshbach remained Tech's dean for the rest of his life as far as I can tell. His son reports in his memoir that Eshbach always had himself assigned to teach an undergraduate quiz section, usually in physics. And his name lives on at Northwestern. There is the Ovid W. Eshbach Society, in which alumni and other donors provide funds to strengthen undergraduate engineering education through support for such needs as laboratory equipment, undergraduate research, design competitions, and instructional software. There is also the Ovid W. Eshbach Award, established in 1948 by Tech's first graduating class, which is awarded for overall excellence in scholarship and leadership. Each spring, nominations are accepted from the graduating class on who they feel most closely typifies the ideal engineering student.

The team that Ovid W. Eshbach put together for the first edition of his handbook, which was called *Handbook of Engineering Fundamentals*, included 40 representatives from academia, industry, and government, most of them based in the northeast and some in the midwest. The handbook was the first volume in the **Wiley Engineering Handbook Series**, which also included the eleventh edition of the two-volume *Kent's Mechanical Engineers' Handbook* (one volume covered power, the second design and shop practice); the third edition of the two-volume *Handbook for Electrical Engineers* (one volume covered electric power, the second communications and electronics); and the third edition of the one-volume *Mining Engineers' Handbook*. Tables of contents for all handbooks in the series

were included on pages following the index of the Eshbach volume.

The *Handbook of Engineering Fundamentals*, published in 1936 jointly by Wiley in New York and Chapman & Hall in London, contains 13 sections (chapters) and 1081 pages. Eshbach wrote in the Editor's Preface: "This handbook has been prepared for the purpose of embodying in a single volume those fundamental laws and theories of science which are basic to engineering practice. It is essentially a summary of the principles of mathematics, physics, and chemistry, the properties and uses of engineering materials, the mechanics of solids and fluids, and the commonly used mathematics and physical tables, to which has been added a discussion of contract relations. Thus, with the exception of the technics of surveying and drawing, there is included the fundamental technology common to all engineering curricula."

The **second edition** of *Handbook of Engineering Fundamentals* was published in 1952. It was still part of the **Wiley Engineering Handbook Series**, to which had been added *Handbook of Mineral Dressing*. Again, it was jointly published by Wiley and Chapman & Hall. The copy that I have is from the fourth printing, May 1954. On the front cover, COLLEGE EDITION is stamped underneath the name ESHBACH.

Eshbach made numerous changes for the **second edition**. He went west to find contributors—one from Texas and four from California were among the 38 contributors to this edition. With a new section on aerodynamics, he increased the number of sections to 14. He expanded the contracts section and renamed it Engineering Law. In addition, he enlarged the engineering tables to include standard structural sizes for aluminum and data on tangents and offsets for civil engineers; revised the mathematics section to eliminate "simple and commonly known items previously introduced for completeness" and put greater stress on "statistics, determinants, and vector analysis"; thoroughly revised the sections on solid and fluid mechanics; completely revised the section on electricity and magnetism; and in the sections on metallic and nonmetallic materials, "much material, more detailed, and of interest to special groups, has been eliminated to keep the volume within practical size."

By 1975, when the **third edition** was published, Eshbach had been dead for 17 years. Dr. Mott Souders, a chemical engineer from Piedmont, California, had taken over the editorship, although Eshbach's name was the only one stamped on the spine and front cover of the book. Souders, too, had died, in 1974, before the book was published, this time solely by Wiley, which now had offices in London, Sydney, and Toronto as well as New York. The handbook was still part of the **Wiley Engineering Handbook Series**. The center of gravity of contributor locations had shifted further west. In addition to seven contributors from the West Coast and one from Texas, the roster of 40 contributors included 18 on the staff of the U.S. Air Force Academy, who contributed a section of over 180 pages on aeronautics and astronautics.

The **third edition** has 16 sections and 1562 pages. In his Preface, written in February 1974, Souders noted that the handbook contained new sections on astronautics, heat transfer, electronics, automatic control, and engineering economy. The sections on aeronautics and chemistry had been completely rewritten. New material had been added to the sections on mathematical and physical tables; mathematics, including an article on elements of Fortran; physical units and standards; as well as radiation, light, and acoustics. In the single section on properties of materials, all text was eliminated to provide space for more charts and tables. Souders also eliminated the section on engineering law. But the **third edition** did feature, on two pages following the Preface, canons of ethics of engineers approved by the Engineer's Council for Professional Development on September 30, 1963.

By the latter 1980s, the handbook's editorship had passed to Byron Tapley, a professor in the Department of Aerospace Engineering and Engineering Mechanics at the University of Texas at Austin. The **fourth edition's** size and scope increased dramatically. Whereas the trim size of the previous three editions had been $5\frac{1}{2}$ by $8\frac{3}{8}$ inches, the new edition was 7 by 10. The number of sections remained the same, at 16, but the number of pages increased dramatically to close to 2100. The number of contributors nearly doubled, to 77 and included, for the first time, one from overseas, in Athens, Greece. The rest were located throughout the United States—the East Coast orientation of the first edition was a thing of the distant past. As a result of the increased scope and complexity of the undertaking, a recently retired Wiley employee, Thurman Poston, was brought on board to assist Tapley in preparing the new edition.

The **fourth edition**, published in 1990, also had a new name. It was now called *Eshbach's Handbook of Engineering Fundamentals*. Also, major topic areas were placed into "chapters" and the term "sections" was now being used for subtopics. The most important changes to the handbook were undertaken in "recognition," Tapley wrote in his Preface, in November 1989, "given to the dramatic change that computers and computer technology have made in the way we generate, receive, and display information." Tapley continued: "The handbook has been modified to account for this impact in three substantial ways: (1) the chapter on mathematical and trigonometric tables has been reduced substantially in recognition of the fact that both small handheld computers and desktop personal computers allow a rapid generation of much of the information contained in this chapter, (2) a specific chapter dealing with computers and computer science has been added, and (3) specific applications where computers are useful have been included in many of the chapters." Tapley added sections on differential equations and the finite-element method; expanded the control theory chapter; split the aeronautics and

astronautics chapter into two distinct chapters (due, I have been told, to usage of the handbook by students at the U.S. Air Force Academy for some years); and extensively revised the chapters on electromagnetics and circuits, electronics, radiation, light, acoustics, and engineering economics. In addition, international standard units were adopted throughout the handbook.

My approach to the **fifth edition**, which is being published nearly two decades after the appearance of the previous edition, has been to revise or update the chapters where there has been substantial change over the intervening years, but the scope of those chapters does not require substantial expansion or alteration; add new chapters in areas where the scope was insufficient and engineers need more basic information; and eliminate chapters superseded by the ubiquity of the digital environment. So the overall goal has been to add more knowledge essential to engineers while reducing the size of the handbook. As a result, there are fewer pages but more chapters.

The chapters that have been substantially updated and revised, but where the scope has remained unaltered for the most part, include those on mechanics of incompressible fluids, electromagnetics and circuits, acoustic, and engineering economy. All except the electromagnetics and circuits chapter have new contributors.

There are numerous chapters that either cover topics new to the handbook or replace chapters, or sections of chapters, where more basic information is essential for practicing engineers and students at any level. These chapters include Selection of Metals for Design; Plastics: Thermoplastics, Thermosets, and Elastomers; Ceramics; Nondestructive Testing; Aerodynamics of Wings; Mathematical Models of Dynamic Physical Systems; Basic Control Systems Design; Thermodynamics Fundamentals; Heat Transfer Fundamentals; and Electronics (with sections on bipolar transistors, data acquisition and conversion, data analysis, diodes, electronic components, input devices, instruments, integrated circuits, microprocessors, oscilloscopes, and power devices).

I have eliminated the chapter on computers and computer science, inasmuch as contributors now routinely absorb the digital world into their work whenever appropriate, as well as the over 250 pages of materials properties data, which have been replaced by a chapter, Sources of Materials Data, which is a current description of where and how to find reliable materials properties data on the Internet, the standard practice in this digital age. In addition, I have left alone those chapters which contain basic and theoretical information that does not change.

Eshbach has gone through a great many iterations in its long life, yet the handbook remains true to its creator's original vision. My thanks to him as well as to the legion of contributors whose efforts have graced the pages of the five editions of this great reference work.

Myer Kutz

Delmar, New York

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