

# ASM Specialty Handbook<sup>®</sup>

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## Copper and Copper Alloys

Edited by  
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Davis & Associates

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# Preface

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Copper is mankind's oldest metal, dating back some 10,000 years. All of the great civilizations of the past, including the Sumerian, Egyptian, Greek, Roman, and Chinese, used copper and copper alloys (principally bronze and later brass) for both decorative and utilitarian purposes. From antiquity through the Middle Ages and the Renaissance, copper was used for military purposes, artistic applications such as church bells and statuary, tools, and numerous other functional objects. However, it was the Industrial Revolution that brought about a tremendous change in the production and consumption of copper and copper alloys. Electrical engineering in the modern industrial sense followed from Michael Faraday's discovery of electromagnetic induction in 1831, Werner von Siemens' invention of the electric dynamo in 1866, and Thomas Edison's invention of the electric light bulb in 1878 and his construction of the first electrical power generating plant in 1882. To this day, copper remains the key to modern power generation.

The industrial importance of copper in the 20th and 21st centuries has been extended by the ease with which it combines with other metals. Tin and zinc are and always have been the principal alloying elements, but many others—aluminum, nickel, beryllium, chromium, cadmium, manganese, etc.—form alloys with unique combinations of mechanical and physical properties and excellent corrosion and wear resistance. These attributes have contributed toward copper and its alloys being the material of choice for building construction (e.g., plumbing, wiring, and roofing), but have also led to the use of copper in many demanding engineering applications in the marine, automotive, chemical, and electronics industries. Continuing developments in superconductors, electric vehicles, solar heating, and large-scale desalination of water should ensure that copper remains an essential material in the future.

Recognizing the industrial importance of this metal, ASM International has devoted the eighth volume of the ASM Specialty Handbook series to the engineering aspects of copper and copper alloys. Divided into four major sections, this book describes the metallurgy and applications of wrought, cast, and powder metallurgy alloys; fabrication and finishing procedures; metallography, microstructures, and phase diagrams; and engineering properties and service characteristics. Although several excellent texts have been published on copper during the past 25 years, none can match the breadth of coverage offered in this Handbook.

The sustained growth and development of the copper industry can be attributed in large part to the following technical organizations: the Copper Development Association Inc. (CDA), the International Copper Association, Ltd. (ICA), and the Canadian Copper & Brass Development Association (CCBDA). ASM International wishes to express its thanks for the cooperation it received from these organizations during the course of this project. The editor also extends his appreciation to these organizations as well as the hard working and cooperative ASM Editorial and Library staffs. Lastly, the contributions of the many authors who have written articles on copper and copper alloys published in the ASM Handbook should also be recognized. Their respective works are acknowledged throughout this Handbook.

Joseph R. Davis  
Davis & Associates  
Chagrin Falls, Ohio



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