Preface

From the preceding Volume 5 (1970) of the 8th Edition *Metals Handbook* and the 9th Edition *Metals Handbook* Volume 15 (1988) on casting, this Handbook provides an update on the continuing advances in casting technologies and applications. Casting, as both a science and practical tool in art and technology, is enormously varied in scope. It is impossible to capture the full scope of casting technology in one volume.

The main focus of this Volume is on the products and processes of foundry (shape) casting, although primary (ingot or continuous casting) of steel and aluminum are also covered. In addition, continuous casting of copper is described in an article, as copper continuous casting was a precursor to steel and aluminum continuous casting in some respects. Some of the articles on melt processing, such as the articles on "Electric Arc Furnace Melting" and "Steel Melt Processing," also briefly describe primary production of cast metal.

Shape casting of metal is dominated by cast iron, which constitutes just over 70% of the worldwide production of castings on a tonnage basis (See Table 2 in the first article "History and Trends of Metal Casting"). This is followed by steel, copper-alloy, and aluminum-alloy castings, which make up about 25% on the worldwide tonnage of casting production. Magnesium and zinc are on the order of 1% or less. The dominance of just a few alloys in shape casting is due to the fact that successful and economic shape casting typically involves alloy compositions near a eutectic. The lower melting points and narrower freezing range of near-eutectic compositions promote better castability.

Since the 1988 edition of Volume15, several developments have occurred (see Table 5 in the first article "History and Trends of Metal Casting"). Of these developments, computer technology continues to shorten development time and help simulate the casting process. Automation and robotic technology also has improved the productivity and process control of casting. In terms of processes, semisolid processing, squeeze casting, lost-foam, vacuum molding, and various dies casting technologies continue to improve and finds new applications. These important topics are updated in this Volume. For nonferrous alloys, high-pressure die casting of aluminum is a major area of expansion and update in this volume.

In addition, coverage on sand casting is expanded and consolidated in this Volume with major articles on "Green Sand Molding," No-Bake Sand Molding," and "Shell Molding and Shell Coremaking." Bonded sand mold casting, although well-established for many years, is the most widely used method of casting on a tonnage basis. Improvement in methods and materials continue to provide better yields, productivity, and product quality. The sand system is also a major factor in the economics of large-volume, production casting. Coverage on sand casting is expanded relative to the previous edition with the intention of providing a reference that may be helpful as a communication tool between product designers and metalcasters in developing successful and economical products.

This Volume consists of 18 sections. The first section introduces the historical development of metal casting, as well as to the advantages of castings over parts produced by other manufacturing processes, their applications, and the current market size of the industry. This includes an article on "Metalcasting Technology and the Purchasing Process" written by Al Spada and the technical staff of the American Foundry Society. Then, the principles and practice of melt processing are described in the next three sections followed by a section on principles of solidification including nucleation kinetics, fundamentals of growth, transformation behavior, and microstructure development. Solid-state processing of casting, such as heat treat treatment and hot isostatic pressing, are also introduced. This is followed by a section on the "Modeling and Analysis of Casting Processes."

Like the previous edition, traditional subjects such as patterns, molding and casting processes, foundry equipment, and processing considerations are extensively covered in the next sections. As noted, coverage on sand casting has been consolidated and expanded. For example, the major method of shell molding is described in an article—based on an update of a still largely valid 1970 handbook (Volume 5) article. New updates are also provided on processes growing in use, such as squeeze casting, lost-foam casting, semisolid metal forming, and low-pressure casting. The latter is particularly important in producing quality products, as described by John Campbell in the article "Filling and Feeding Concepts."

Finally, the last five sections describe the major types of cast alloys in term of processing and the properties and characteristics of cast ferrous and nonferrous alloys. Emphasis is placed on cast iron, cast steel, aluminum, copper, and zinc. The last section covers the quality aspects of cast products and the processing of castings.

It is hoped that this Handbook is a useful work of peer-consensus reference information for the producers, designers, and buyers of castings. Many thanks are extended to all the contributors and the editors who worked on this Volume. This publication would not have been possible without their commitment and effort.

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