
Preface to First Edition

Grinding, once considered primarily a finishing operation involving low rates of removal, has evolved as a major competitor to cutting, as the term “abrasive machining” suggests. This is what Milton Shaw was saying about 10 years ago, the man who is considered the great pioneer and father of American grinding. Milton led the development of grinding in the United States over the past 50 years.

We named this book *Handbook of Machining with Grinding Wheels* because the borders between grinding and other operations like superfinishing, lapping, polishing, and flat honing are no longer distinct. Machining with grinding wheels extends from high-removal rate processes into the domains of ultrahigh accuracy and superfinishing. This book aims to explore some of the new “transition operations,” and for this reason we chose this title.

This book presents a wide range of abrasive machining technology in fundamental and application terms. The emphasis is on why things happen as they do, rather than a how-to-do-it approach. The topics detailed in this book cover a range of abrasive machining processes with grinding wheels, making this probably the most complete book regarding all kinds of grinding operations.

The aim of this monograph is to present a unified approach to machining with grinding wheels that will be useful in solving new grinding problems of the future. It should be of value to engineers and technicians involved in solving problems in industry and to those doing research on machining with grinding wheels in universities and research organizations.

The team of authors is composed of famous researchers who have devoted their entire lives to doing research in this field and who are still actively contributing to new research and development. The authors represent a large region of the world where abrasive machining with grinding wheels are most advanced: the United States, Great Britain, Japan, and Germany. I would like to take this opportunity to thank my coauthors for taking time from their busy activities to write and review this book over a period of two years.

All the coauthors are my long time friends, and with some of them I have previously published, or we are still in the process of finishing other books. I would like to make a short presentation of them:

Professor Brian Rowe is considered the world’s Father of Centerless Grinding in addition to other notable research concerning grinding aspects: thermal aspects, dynamic aspects, fluid-film bearings, etc. He established a great laboratory and school in manufacturing processes at Liverpool John Moores University. As an emeritus professor, Brian is busier than before retirement. Being a native English speaker he spent a lot of time polishing our English in order to have a unitary book. I thank him for similar great work on our previous book: *Tribology of Abrasive Machining Processes*.

Professor Ichiro Inasaki is the leading figure in grinding in Japan. As dean of the Graduate School of Science and Technology at Keio University, he developed a great laboratory with outstanding research activities. His “intelligent grinding wheel” is featured in the Noritake Museum and represents one of his best accomplishments and contributions. He led CIRP in 2004/2005 as the president and was granted several awards including an SME award. With Ichiro-san I have already written two books: *Handbook of Ceramic Grinding and Polishing* and *Tribology of Abrasive Machining Processes*.

Professor Eckart Uhlmann is professor and director of the Institute for Machine-Tools and Management at Technical University of Berlin. Dr. Uhlmann earned this chaired professorship after a very successful industrial career with Hermes Abrasive in Germany. His main research is on one of these transition processes: grinding with lapping kinematics. As the head of his Institute, one of the largest in Germany, he holds the leading position in research on all aspects of abrasive machining with grinding wheels. A future book with Dr. Uhlmann will be published this year: *Handbook of Lapping and Polishing/CMP*.

Dr. Mike Hitchiner is manager of precision technology at Saint Gobain Abrasives Co., the largest grinding wheel company in the world. Mike has devoted all his life to research and development of grinding processes. He started this activity during his PhD at Oxford University in England, and today he is considered "Mr. CBN Grinding" by the automotive industry. He has brought an important industrial perspective to this book, as well as hundreds of applications.

As leading author, my own experience in abrasive machining research complements and extends the experience of the other authors, widely across industrial and fundamental areas of investigation. My research has focused on new and challenging techniques of abrasive machining particularly for new materials. I have been fortunate to have studied the latest technologies developed in countries across the world first hand and have contributed to developing new techniques for application in industry and in research.

The main aim of this book is to present abrasive machining processes as a science more than an art. Research and development on abrasive machining processes have greatly increased the level of science compared to 25 years ago, when many aspects of abrasive machining processes still depended largely on the expertise of individual technicians, engineers, and scientists.

The book has two sections: The Basic Process of Grinding and Application of Grinding Processes. This structure allows us to present more about *understanding of grinding behavior* in Section I and more about *industrial application* in Section II.

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Toledo, Ohio

Preface to Second Edition

Today many machining operations are considered “old fashioned” processes. The last decade has brought new fashionable research topics including nanotechnology, alternative energy, and the latest is “additive manufacturing.”

Even additive manufacturing requires a finishing process as the dimensions and surface quality of the parts are not final due to the limitation of the process itself. This means that abrasive processes, and especially grinding, are still necessary for these new processes. At the same time the bulk of manufacturing processes for automotive industry and aerospace industry have not changed too much during the past 10 years.

Writing the second edition of the book, *Handbook of Machining with Grinding Wheels*, has been a challenge due to the fact that I insisted on keeping the same team of authors. Some of them retired, some received even more demanding responsibilities, and I am thankful that they agreed to work on the second edition of the book.

As you can see from the Preface to the First Edition, the team is well-known internationally and one with a reputation difficult to match. They brought to this book experience from their laboratories and from their work with industry, and this is a combination that makes this book useful for industry and academia.

Regarding the contents of the second edition, there is a significant new work on Abrasives in Chapter 5, on Bonds in Chapter 6, and Dressing in Chapter 7. In Chapter 8, Dynamics, there is a new figure showing classic stability lobes for grinding. Also a new method for tracking dynamic instability in centerless grinding is presented in Chapter 19. Chapter 20, on Ultrasonic-Assisted Grinding, includes a new section that contains recent work on modelling of the process. In Chapter 11, Process Monitoring, new material showing experimental results for in-process feedback to the grinding process was added. There are also changes in some other chapters. Some work on fluid cooling was added to Chapter 10, Coolants. Chapter 15, Grinding Machine Technology, presents many new examples, particularly for dressing. We appreciate very much the work Dr. Mike Hitchiner did on these chapters while facing conditions of serious illness.

I am particularly thankful to Dr. Brian Rowe who agreed in his retirement to put together and review all the chapters using his tremendous experience. Brian worked with the team for many years and he was also instrumental in putting together *Tribology of Abrasive Machining Processes*, which was published in 2013 (second edition).

The first edition of the *Handbook of Machining with Grinding Wheels* was reviewed by the Abrasive Engineering Society and was considered the best comprehensive book on grinding after the Milton Shaw 1996 book. We are very proud of this review, and the second edition aims to be a better and more complete book.

Again, I would like to thank my coauthors and their families for taking the time to work on this second edition, at the time when all of us are getting older and having different priorities in our lives. But writing a new book makes each of us feel younger and useful to our profession and we hope to leave a good legacy.

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White Lake, Michigan