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An Integrated Approach*

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# **Design and Manufacture**

An Integrated Approach

**Rod Black**

*University of Portsmouth*





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To the next generation, particularly Ben, Doug and Alex

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## Preface

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In the early 1980s I worked for an engineering company, designing and manufacturing products. The design office contained the ‘experts’ in design, who created drawings for new products. When complete, these were passed to production engineering, located in a separate building remote from the design offices, where the ‘experts’ in production resided. They then modified the designs, so that they could be more easily manufactured. Much time was lost through the many conflicts over details that were ‘vital’ to the functioning of the final product and at the same time ‘impossible’ to manufacture. The solution was to combine the design and production engineering departments and locate them together, adjacent to the manufacturing plant. The design and production ‘experts’ were both involved in the product development process, working together as a team, rather than blaming each other for shortcomings in the products. The end result for the company was that new products could be introduced more quickly. In addition, they generally had fewer teething problems and tended to be more profitable. The moral is obvious.

The teaching of engineering tends to be very compartmentalised, with different aspects being taught by experts in various fields. Although there are many good reasons for this, I believe that we should never lose sight of the fact that in the real world, engineering problems rarely fit precisely into the compartments of knowledge as taught. It is therefore vital that the importance of integration across the subject boundaries is covered from an early stage in the teaching of engineering.

This book has been written for engineering students, recognising the need both to introduce basics skills and techniques *and* to show how they would be used in an integrated fashion.

Chapter 1 introduces the route by which an idea is converted into a product, using a case

study to highlight the need for an understanding of the process. This is followed by the three main parts of the text.

The first part concentrates on the basics of design. The content includes the engineering drawing, tolerances, a range of standard components, the product design specification, and methods of generating and evaluating ideas. The second part concentrates on basic manufacturing techniques. These include material removal processes, casting, deforming, powder metallurgy, processes for metals and non-metals, joining techniques, processes for altering material properties, and an introduction to the concepts of quality.

The third part builds upon the basics, integrating aspects from the first two parts. Chapter 12, for example, looks at why a particular manufacturing process might be selected, and how the designer might take full advantage of the chosen process. Chapter 13 covers the application of joining techniques, discussing topics such as when and how should an interference joint be selected and designed, and how the use of automated assembly processes can influence the design. The next chapter discusses, largely through case studies, how a variety of influences result in engineering compromises between design and manufacture. Chapter 15 shows, again through the use of case studies, how value analysis can be used to improve both the component design and the manufacturing process. Chapter 16 takes an overall view of an organisation designing and manufacturing products, examining the systems used, how control is maintained, and how computers can be used to help. The final chapter examines the business context, costing systems, and how decisions might be made when selecting a new piece of manufacturing plant, or introducing a new product.

Recognising that units are a common source of error for students, Appendix A includes defini-

tions, conversion factors, and sections on unity brackets and dimensional analysis.

Revision questions are included, where appropriate, at the end of each chapter. Solutions can be found either in the text, as directed, or in appendix D. Throughout there are various references to British Standards. Equivalent, or similar, International Standards are listed in appendix E.

The book builds on much that I have learned working as an engineer over the past two decades, but has only been possible because of

the help, co-operation, suggestions and tolerance from a variety of colleagues, too many to mention individually. I would, however, like to thank, in particular, John Bishop for his general help and advice, and specifically for his contribution, with the assistance of 3M, to the section on adhesives. I would also like to single out Bill Puttick for his helpful comments and advice on the chapter on metal cutting. Many thanks, Bill. Last, but not least, I must also thank my family, who have shown remarkable tolerance whilst I concentrated on 'the book', ignoring them for far too long.

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