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时代教育·国外高校优秀教材精选

制造工程与技术——机加工

（英文版·原书第6版）

MANUFACTURING ENGINEERING AND TECHNOLOGY — MACHINING

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机械工业出版社

CHINA MACHINE PRESS

本影印改编教材《制造工程与技术》取自原版英文教材《Manufacturing Engineering and Technology》（Prentice Hall 2010，第6版，ISBN 978-981-06-8144）中的部分篇章。针对国内教学课程设置，将原书内容改编为机加工和热加工两册，并分别出版，方便学校选用。为保持书籍内容体系，方便读者查找和了解原书全貌，特别在两册中保留完整的改编目录。内容涵盖切削基础，刀具材料与切削液，回转体与非回转体加工，加工中心，机床结构及机加工经济性，磨削与光整加工，先进加工方法与纳米制造，制造工艺过程自动化、计算机集成制造系统和制造的竞争性。

图书在版编目（CIP）数据

制造工程与技术：第6版．机加工：英文/（美）卡尔帕克杰恩（Kalpakjian，S.）著．—北京：机械工业出版社，2011.12

时代教育．国外高校优秀教材精选

ISBN 978-7-111-36305-7

Ⅰ.①制… Ⅱ.①卡… Ⅲ.①机械制造工艺—高等学校—教材—英文②机械加工—高等学校—教材—英文 Ⅳ.①TH16②TG506

中国版本图书馆 CIP 数据核字（2011）第223416号

机械工业出版社（北京市百万庄大街22号 邮政编码100037）

策划编辑：余 皞 责任编辑：余 皞

封面设计：赵颖喆 责任印制：乔 宇

三河市国英印务有限公司印刷

2012年1月第1版第1次印刷

184mm×260mm · 30.5印张 · 755千字

标准书号：ISBN 978-7-111-36305-7

定价：69.00元

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影印改编版序

制造技术是一个永恒的主题，是实现设想、概念、科学技术物质化的基础和手段。其涉及面非常广泛，是所有工业的支柱，是国家经济与国防实力的体现。制造技术在不同的历史时期有不同的发展重点，但需要重视和发展制造技术是永恒的。现代制造技术是当前世界各国研究和发展的主题，是提高生产力，经济竞争，产品革新的重要手段，所有的国家，特别是工业强国，都在寻求获得、开发和利用它，历史证实，它是现代国家经济上获得成功的关键因素。

现代制造工艺技术是先进制造技术的重要组成部分，是其最有活力的部分，也是生产中最活跃的因素，工艺是设计和制造的桥梁，设计的可行性往往会受到工艺的制约，工艺往往会成为设计的“瓶颈”。因此，工艺是制造技术的灵魂、核心和关键。

20世纪50年代，我国在原苏联的援助下，开展了大规模的机械工业建设，教育战线上，同样得到原苏联专家的帮助，在高等学校里开办了机械制造专业，开设了“机械制造工艺学”、“金属切削原理与刀具”、“机床概论与设计”等课程，其后在我国学者的努力下，出版了自己编写的相应教材。改革开放以来，出现了机械制造系统、计算机辅助设计和计算机辅助制造等先进制造技术，形成了机械制造工程与科学，对我国社会主义建设和人才培养发挥了重要作用。

虽然欧美国家在教育制度、教学计划、课程设置、教学方式以及教材等方面与我国有所不同，但具有较强的参考性。摆在我们面前的《制造工程与技术》一书就是美国大学里机械工程学科的教材，本书全面论述了机械制造中的材料、成形加工、计量和发展趋势等工程与技术，涵盖了我国机械制造专业的金属工艺学、公差与技术测量、材料、铸造、锻压、切削原理与刀具、机械制造工艺学、机床概论和设计等多门课程内容，

本书第4版、第5版和第6版分别于2001、2006和2010年由美国培生教育出版股份有限公司出版发行，作者为美国卡尔帕基安教授和施密德教授，深受美国大学生的欢迎。我国已多次引进这本书的版权，由此可见本书水平之高，影响之大。

本影印改编版具有以下一些特点：

1. 内容丰富全面

主要内容有材料、成形加工、机械加工、微制造和微电子装备制造、表面技术、计量技术和竞争环境下的制造技术等，包含我国机械工程专业的大多数专业课和专业选修课的内容。

2. 体系先进新颖

增加了许多先进制造技术的新内容，如绿色设计与制造、快速原型制造、机械电子装备制造和系统、微制造和微电子装置、纳米尺度制造，以及制造工程的发展趋势等，具有很强的先进性。

3. 自学特色突出

每章之前均有该章的要点和重要内容说明，以及目录和案例名称；每章最后有小结、关

键词、参考文献、思考题、定性分析类习题、定量分析类习题和综合作业，论述深入浅出，问题及习题数量和类型多，具有较大的可选择性，特别适合学生自学。

为了提高学生的学习兴题，在内容上还涉及网球拍、高尔夫球杆、管乐器中“瓣”的摩擦焊、去毛刺机器人、半固态铸造等的介绍。

4. 联系工业实际

实例分析、工程应用案例比较多，有些章节论述中，用一辆汽车或一台汽车发动机作为引例，讲述该章内容的工程实际背景，生动有趣。

5. 印刷质量上乘

印刷质量好，采用双色印刷，重点内容、实例分析内容显现突出。编排上使图或表尽量在同一页，便于阅读。

本书可作为我国高等院校机械工程专业本科生的“金属工艺学”、“机械制造工程基础”、“机械制造工艺学”、“切削原理和刀具”等课程的英语教科书和专业英语教材，也可供教师、研究生和广大工程技术人员作为参考书，具有较高的参考价值。

6. 适合国内教学

针对国内教学课程设置，将原书内容改编为机加工和热加工两册，并分别出版，方便学校选用。为保持书籍内容体系，方便读者查找和了解原书全貌，特别在两册中保留完整的改编目录。

本书可作为我国高等院校机械工程专业本科生的“金属工艺学”、“机械制造工程基础”、“机械制造工艺学”、“切削原理和刀具”等课程的英语教科书和专业英语教材，也可供教师、研究生和广大工程技术人员作为参考书，具有较高的参考价值。

清华大学精密仪器与机械学系制造工程研究所

王先逵

Contents

Machining Processes and Machine Tools

Parts manufactured by the casting, forming, and shaping processes, including many parts made by near-net or net-shape methods, often require further operations before the product is ready for use. Consider, for example, the following features on parts and whether they could be produced by the processes discussed thus far:

- Smooth and shiny surfaces, such as the bearing surfaces of the crankshaft shown in Fig. V.1.
- Small-diameter deep holes in a part such as the injector nozzle shown in Fig. V.2.
- Parts with sharp features, a threaded section, and specified close dimensional tolerances, such as the part shown in Fig. V.3.
- A threaded hole or holes on different surfaces of a part for mechanical assembly with other components.
- Special surface finishes and textures for functional purposes or for appearance.

A brief review will indicate that none of the forming and shaping processes described thus far is capable of producing parts with such specific characteristics and that the parts will require further manufacturing operations. **Machining** is a general term describing a group of processes that consist of the *removal* of material and *modification* of the surfaces of a workpiece after it has been produced by various methods. Thus, machining involves *secondary* and *finishing* operations.

The very wide variety of shapes produced by machining can be seen clearly in an automobile, as shown in Fig. V.4. It also should be recognized that some parts may be produced to final shape (net shape) and at high quantities by forming and shaping processes, such as die casting and powder metallurgy. However, machining may be more economical, provided that the number of parts required is relatively small or the material and shape allow the parts to be machined at high rates and quantities and with high dimensional accuracy. A good example is the production of brass screw-machine parts on multiple-spindle automatic screw machines.

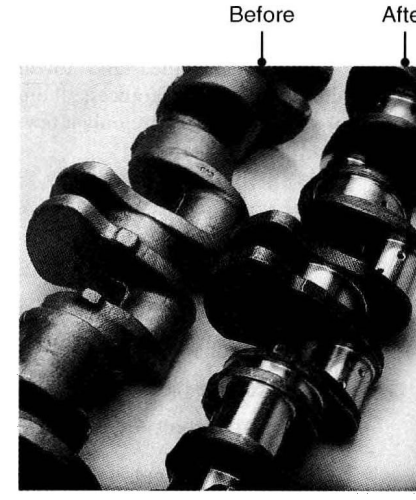

FIGURE V.1 A forged crankshaft before and after machining the bearing surfaces. The shiny bearing surfaces of the part on the right cannot be made to their final dimensions and surface finish by any of the processes described in previous chapters of this book. *Source*: Courtesy of Wyman-Gordon Company.

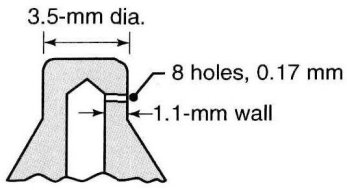

FIGURE V.2 Cross section of a fuel-injection nozzle, showing a small hole made by the electrical-discharge machining process, as described in Section 19.5. The material is heat-treated steel.

In general, however, resorting to machining suggests that a part could not have been produced to the final desired specifications by the primary processes used in making them and that additional operations are necessary. We again emphasize the importance of *net-shape manufacturing*, as described in Section I.5, to avoid these additional steps and reduce production costs.

Furthermore, in spite of their advantages, material-removal processes have the following disadvantages:

- They *waste material* (although the amount may be relatively small).
- The processes generally takes *longer* than other processes.
- They generally require *more energy* than do forming and shaping operations.
- They can have *adverse effects* on the surface quality and properties of the product.

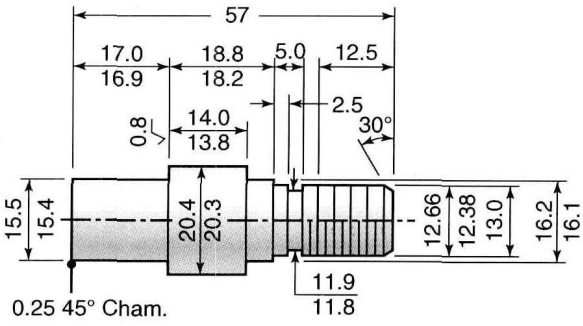

FIGURE V.3 A machined and threaded part, showing various dimensions and tolerances; all dimensions are in mm. Note that some tolerances are only a few tenths of a mm.

As outlined in Fig. I.6e in the General Introduction, machining consists of several major types of material-removal processes:

- **Cutting,** typically involving single-point or multipoint cutting tools, each with a clearly defined shape (Chapters 15 through 17).
- **Abrasive processes,** such as grinding and related processes (Chapter 18).
- **Advanced machining processes** utilizing electrical, chemical, laser, thermal, and hydrodynamic methods to accomplish this task (Chapter 19).

The machines on which these operations are performed are called **machine tools.** As described throughout Chapter 13-19, their construction and characteristics greatly influence these operations, as well as product quality, surface finish, and dimensional accuracy.

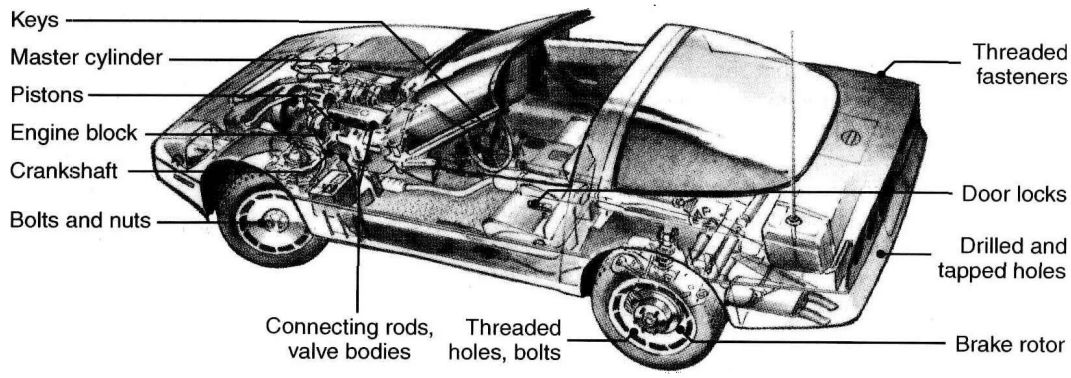

FIGURE V.4 Typical parts on an automobile that require machining operations to impart desirable surface characteristics, dimensions, and tolerances.