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现代机械工程系列精品教材

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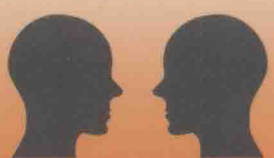

Specialized English for Mechanical Engineers

机械工程专业英语——交流与沟通

第2版

康 兰 ◎ 编著

双色印刷

机械工业出版社
CHINA MACHINE PRESS

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全书共分五部分。第一部分在基于如何表达产品设计信息的基础上，以工程图样内容为核心，以案例分析为主对机械设计的全过程进行了介绍；第二部分介绍了构成一台复杂机器的常用机械零件及机构，重点是描述组成一台复杂机械的基本构件及其表达方法；第三部分介绍了在机械专业领域撰写书面报告、展示口头报告、制作演示文稿等的方法与技巧；第四部分以家用轿车结构及工作原理分析为例，在较高的层次上进一步提高学习者交流与沟通的能力；第五部分详细介绍了如何撰写科技论文。各章附有相关词汇注解。

本书根据教学目标及学时的不同，可满足不同层次的教学需求，不仅适合高等院校机械类专业本科生和研究生使用，也可供高等职业院校相关专业的学生使用，还可以满足各种层次的、希望提高在机械专业领域内跨国界交流与沟通能力的人士的需求。

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第 2 版前言

本书第 1 版自 2012 年 12 月出版以来，承蒙广大高校教师与学生的厚爱，已经连续印刷多次。基于近年来编者在教学中的应用实践及其他院校师生对教材的反馈意见，本次修订在尽量保持原版特色、组织结构和内容体系不变的前提下，本着“面广、实用、管用、够用”的原则，对教材进行修订、更新和完善，修订的主要内容有：

1. 在 Part 1 中增加了与平面连杆机构及凸轮机构相关的内容，并在后面的作业中增加了与新增部分内容相关的若干练习。

2. 在 Part 3 中的 3. 7 案例分析部分增加了 20 多个小型案例分析。这些案例涵盖机械工程中与材料、设计、制造、安全及专利、工作活动交流、翻译相关的许多方面，每一案例的设计以任务驱动的方式布置给学生，先由学生去完成，如果完成有困难，后面有相关的提示、背景资料或实例可以一步步帮助学生去完成相应的任务。任务可由一人完成，也可多人协同完成。这些案例的实用性和可操作性强，主要目的是提高学生在机械工程专业领域内用英文有效地进行交流与沟通的能力。

3. 将第 1 版 Part 4 科技论文写作部分改为 Part 5，新增“Part 4　How does a car work?”。Part 4 中以家用轿车这一常用而复杂的机器为综合实例，对其结构、工作原理及未来的发展方向进行分析，使学生在更高的层次上提高交流与沟通的技能。Part 4 中内容的讲解与传统教材不同，每一部分的内容讲解之后都有与此部分内容相关的任务需要学生去完成，总体设计了 22 个任务，通过任务驱动的方式让学生主动参与到学习的过程中，而不只是被动地看书学习。

4. 删除了第 1 版中“Part 5　先进制造技术”，因为学生可随时在网上搜到这些资料并进行阅读。

另外，本书编者在实际教学中与以英语为母语的专业人士合作，制作了一些全英文教学视频供学生课后学习，学生可随时扫描书中二维码观看这些教学视频。视频以问答的方式来模拟老师与学生间的交流与互动，以提高学生的听说能力，并帮助学生复习相关的专业知识。在观看视频的过程中，当老师提出问题时，学生可暂停视频，自己试着用英文去回答，然后再看视频中另一位老师是如何表达的。编者未来计划制作更多不同风格的机械工程专业领域的全英文教学视频（不一定局限于教材中的内容），逐步提供给学生使用，分享学习的

乐趣。

建议教师在上课过程中通过 Part 1 和 Part 2 的讲解，先让学生掌握基本的专业词汇及表达方法，然后以 Part 3 中的案例分析为主，根据课时及专业特点，选择典型案例与学生进行交互式教学，激励学生多开口讲，这样“所学即所用”，学生更容易掌握。然后以 Part 4 中的轿车结构及工作原理分析为例，进行深度剖析和讲解，在这一过程中注重交互式教学，课堂多提问题，多鼓励学生完全用英文回答。老师在课堂上讲完每一节的内容后，也可播放教材所提供的链接中的视频，再向学生提问，学生回答问题会更容易一些。通过 Part 4，学生可掌握用英文描述一台复杂机械结构及原理的思维方式、技能和方法，并复习和强化已学习过的专业知识。

最后，热忱欢迎读者对本书提出批评和建议，以便我们改进。

编　者

第 1 版前言

众所周知，语言与我们息息相关。尽管全世界的语言有几千种，但无论何种语言，其主要功能都是交流与沟通。英语作为世界范围内通用的语言，为全球范围内的交流与沟通架起了一座桥梁。

目前制造业的全球化使得企业在与国外同行进行合作与谈判时，迫切需要具有良好交流与沟通能力的机械工程师。这一急切的社会需求对高等教育中机械工程专业英语的教学提出了挑战。本书旨在提供一本机械工程专业的英语教材，以培养学生跨国界跨文化进行交流与沟通的能力。

本书的主要特点如下：

1）每一部分包括学习目标、学习主题、任务驱动三方面，课后相关作业或任务的完成注重小组内同学间的协同学习、交互和反思，培养团队合作能力。

2）采用案例教学，书中部分教学案例选自国外一流大学的最新教学素材，部分案例来自学生的设计作品。

3）本书根据教学目标及学时的不同，可满足不同层次的教学需求，不仅适合本科教学，也可作为研究生的学习教材，同时可满足各种层次的希望在机械专业领域内提高跨国界交流与沟通能力的人士的需求。

在学习本书时，我们建议在课程开始之时由 4~5 名同学组成一个协同学习小组，老师给每一小组布置一项课后任务，让每组选择一个与机械工程有关的主题，开展相关的研究工作。在课程结束前留出一定的课堂时间，以小组为单位将口头汇报与演示文稿相结合进行课堂展示，每位同学对自己在团队合作中的工作作一个汇报。这种研讨式的学习会给学生以激励，与别人灌输知识相比，学生记住的往往是通过自己的努力学到的知识。此法值得一试。

本书 Part 1~Part 4 由康兰副教授编写，Part 5 由许焕敏博士和周玉刚编写。在本书编写的过程中，来自澳大利亚的 Richard Porter 先生从英语为母语的读者的角度出发，严谨认真、一丝不苟地详细审阅了本书 Part 1~Part 4 的英文部分，在此表示衷心的感谢！

河海大学机电工程学院机械系主任廖华丽教授为本书在整体内容的编排方面提供了非常好的建议，机械系的王义斌老师和康兰老师指导的学生设计团队为本书的 Part 1 提供了很好的教学案例，研究生李雅编辑了部分图例。本书获河海大学机械工程及自动化专业“教育

部专业综合改革试点”项目资助，在此一并表示衷心的感谢！

感谢机械工业出版社的编审团队所给予的支持。曾在美国留学并任教多年的河海大学费峻涛教授审阅了全部的书稿，在此表示由衷的感谢！

最后，热忱欢迎读者对本书提出批评和建议，以便我们以后进行改进。

编　者

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Communication Matters

Part1 Introduction to Mechanical Engineering

Objective

After completing this part, you should be able to:

- understand the essence of mechanical engineering;
- explore the engineering method for solving a problem;
- understand your responsibility as an engineer;
- clearly define and describe parts or machines by using engineering drawings;
- observe the overall engineering design process and organize your own design process in the future;
- meet the challenges of modern machine design.

1.1 Introduction

1.1.1 What Is Engineering?

Engineering is the practical and creative application of science and mathematics to solve problems, and it is found in the world all around us. Engineering technologies improve the ways that we safely travel, work, communicate and even stay healthy. One who practices engineering is called an engineer. Engineers are the innovators, planners, and problem-solvers of our society. They are always seeking quicker, better, and less expensive ways to benefit mankind. In that sense, the work of an engineer differs from that of a scientist, who would normally emphasize the fundamental discovery of physical laws rather than their application to product development. Engineering serves as the bridge between scientific discovery, commercial application, and business marketing.

机械英语

1.1.2 Main Branches of Engineering

The broad discipline of engineering encompasses a range of more specialized subdisciplines, each with a more specific emphasis on certain fields of application and particular areas of technology. These disciplines concern themselves with differing areas of engineering work. Although initially an engineer will usually be trained in a specific discipline, throughout an engineer's career the engineer may become multi-disciplined, and has worked in several of the outlined areas. Engineering is often characterized as having five main branches.

Chemical engineering: The application of physics, chemistry, biology, and engineering principles in order to carry out chemical processes on a commercial scale.

Civil engineering: The design and construction of public and private works, such as infrastructure (airports, roads, railways, water supply and treatment, etc.), bridges, dams, and buildings.

Electrical engineering: The design and study of various electrical and electronic systems, such as electrical circuits, generators, motors, electromagnetic/electromechanical devices, electronic devices, electronic circuits, optical fibers, optoelectronic devices, computer systems, telecommunications, instrumentation, controls, and electronics.

Material engineering: The study of the properties of solid materials and how those properties are determined by the material's composition and structure, both macroscopic and microscopic. With a basic understanding of the origins of properties, materials can be selected or designed for an enormous variety of applications, from structural steels to computer microchips. Materials science is therefore important to many engineering fields, including electronics, aerospace, telecommunications, information processing, nuclear power, and energy conversion.

Mechanical engineering: The design of physical or mechanical systems, such as power and energy systems, aerospace/aircraft products, weapon systems, transportation products' engines, compressors, powertrains, kinematic chains, vacuum technology, and vibration isolation equipment, etc.

1.2 Mechanical Engineering

Mechanical engineering is a discipline of engineering that applies the principles of physics and materials science for analysis, design, manufacturing, and maintenance of mechanical systems. Mechanical engineering emerged as a field during the Industrial Revolution in Europe in the 18th century; however, its development can be traced back several thousand years ago around the world. Mechanical engineering has continually evolved to incorporate advancements in technology, and mechanical engineers today are pursuing developments in such fields as composites, mechatronics, and nanotechnology. Mechanical engineering overlaps with aerospace engineering, building services engineering, civil engineering, electrical engineering, petroleum engineering, and chemical engineering to varying amounts. It is one of the oldest and broadest engineering disciplines. Figure 1.1 depicts employment statistics and the distribution of engineers in the five traditional disciplines as well as several others in USA.

Mechanical engineering field requires an understanding of core concepts including mechanics,

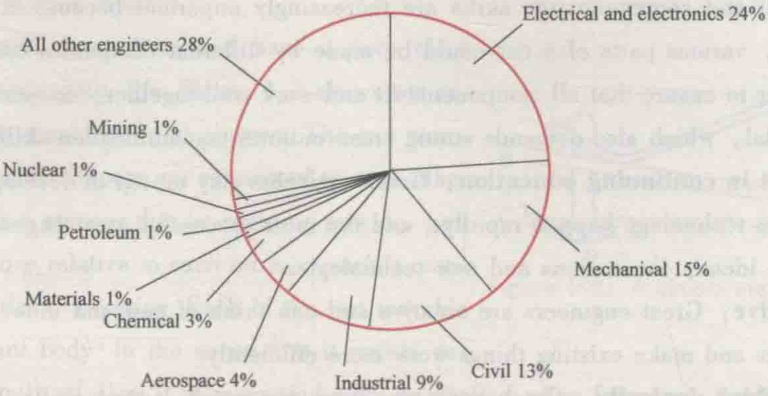

Figure 1.1 Percentages of engineers working in various engineering

kinematics, thermodynamics, materials science, and structural analysis. Mechanical engineers use these core principles along with tools like computer-aided engineering and product lifecycle management to design and analyze manufacturing plants, industrial equipment and machinery, heating and cooling systems, transport systems, aircrafts, watercrafts, robotics, medical devices and more.

In a word, mechanical engineering is all about making useful machines.

1.3 Common Traits of Good Engineers

Engineer is a type of professions which makes society function. Engineers are responsible for some of the greatest inventions and technologies the world depends on. Everything from bridges to air conditioning systems to space shuttles requires the work of an engineer—you could say there's an engineer behind everything in your life. To be successful in the field of engineering, one must have certain qualities. Some of the top qualities include:

Good problem solving skills: Great engineers have sharp problem solving skills. Engineers are frequently called upon solely to address problems, and they must be able to figure out where the problem stems from and quickly develop a solution. Being effective problem solvers, great engineers have a firm grasp of the fundamental principles of engineering, which they can use to solve many different problems.

A strong analytical aptitude: Great engineers have excellent analytical skills and are continually examining things and thinking of ways to help things work better. They are naturally inquisitive.

Attention to detail: Great engineers pay meticulous attention to detail. The slightest error may cause an entire structure to fail, so every detail must be reviewed thoroughly during the course of completing a project.

Good interpersonal and communication skills: Great engineers have good "people skills" and communication skills that allow them to interact and communicate effectively with various people in and out of their organization. They can translate complex technical lingo into plain English and also communicate verbally with clients and other engineers working together on a project. Nowadays, good interpersonal and communication skills are increasingly important because of the global market. For example, various parts of a car could be made by different companies located in different countries. In order to ensure that all components fit and work well together, cooperation and coordination are essential, which also demands strong cross-cultural communication skills.

Taking part in continuing education: Great engineers stay on top of developments in the industry. Changes in technology happen rapidly, and the most successful great engineers keep abreast of new research, ideas, innovations and new technologies.

Being creative: Great engineers are creative and can think of new and innovative ways to develop new systems and make existing things work more efficiently.

Ability to think logically: Great engineers have top-notch logical skills. They are able to make sense of complex systems and understand how things work and how problems arise.

Excellent math skills: Great engineers have excellent math skills. Engineering is an intricate science that involves complex calculations of varying difficulties.

Good time-management skills: Great engineers have time-management skills that enable them to work productively and efficiently.

Being a team player: Great engineers understand that they are part of a large team working together to make one project a success, therefore, they must work well as part of that team.

11. Excellent technical knowledge. Great engineers have a vast amount of technical knowledge. They understand a variety of computer programs and other systems that are commonly used during an engineering project.

1.4 What Is a Machine

A machine is a tool consisting of two or more parts that is constructed to achieve a particular goal. Machines are powered devices, usually mechanically, chemically, thermally or electrically powered, and are frequently motorized. Historically, a device required moving parts to classify as a machine; however, the advent of electronics technology has led to the development of devices without moving parts that are considered machines.

All machines are made up of elements or parts and units. Each element is a separate part of the machine and it may have to be designed separately and in assembly. Each element in turn can be a complete part or made up of several small pieces which are joined together by riveting, welding, etc. Several machine parts are assembled together to form what we call as a complete machine.

The definition of the term machine will be most useful and frequently referred in subsequent discussions in this book. Each of us is familiar with what he or she considers to be machines, and the above descriptions are our general impression about machines. There are many researchers writing about machines and giving definition of a machine. According to Franz Reuleaux's description, "A machine is a combination of resistant bodies, so interconnected that by applying force or motion to one or more of those bodies, some of those bodies are caused to perform desired work accompanied by desired motions."

Machines exist everywhere and have a very close relationship with our daily life. Figure 1.2 shows an example of a simple machine—nail clippers. The two movable parts of the nail clippers are connected to each other by a pivot in such a manner that by pressing part A, part B is caused to move relative to each other in such a manner as to do the desired cutting. Each of the two movable parts is a "resistant body" in the sense that it resists deformation sufficiently to allow it to move and work as desired when forces are applied to it.

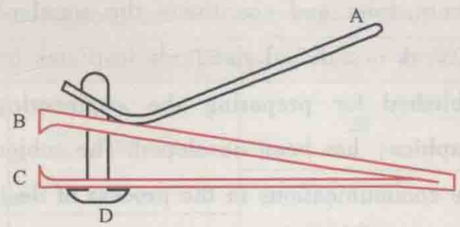

Figure 1.2 A simple machine—nail clippers

When rigid bodies connected by joints in order to accomplish a desired force and/or motion transmission, they form a simple machine or a mechanism.

Here are some examples of other complicated machines:

Lathe: It utilizes mechanical energy to cut the metals. The other types of machine tools also perform the same task.

Turbines: They produce mechanical energy.

Compressors: They use mechanical energy to compress the air.

Engines: They consume the fuel and produce mechanical energy.

Refrigerators and air-conditioners: They use mechanical energy to produce cooling effect.

Washing machines: They use mechanical energy to wash the clothes.

1.5 How to Describe a Machine?

1.5.1 Engineering Drawings

An engineering drawing, a type of technical drawing, is used to fully and clearly describe a part or a machine. The methods of description include two dimensional representation (2D) and three dimensional representation (3D).

2D engineering drawing is a two dimensional representation of three dimensional objects. In general, it provides necessary information about the shape, size, surface quality, material, manufacturing process, etc. Drawings prepared in one country may be utilized in any other country irrespective of the language spoken. Hence, the engineering drawing is called the universal language of engineers—a graphical language that communicates ideas and information from one mind to another. Any language to be communicative should follow certain rules so that it conveys the same meaning to everyone. Similarly, drawing practice must follow certain rules, if it is to serve as a means of communication.

In the United States of America, the American National Standards Institute, or ANSI, is the organization to set up the standards or the rules used in preparing the engineering documents. In the worldwide scale, the International Organization for Standardization, or ISO, is the organization to administrate and coordinate the standardization and conformity assessment system. The ISO is a network of national standards institutes from 154 countries. In order to implement the standards established for preparing the engineering documents, a scientific branch, called engineering graphics, has been developed. The subject of engineering graphics serves such a function of guiding the communications in the process of design information exchange by following the standards set by ANSI and/ or ISO. In China, National Standards (abbreviated GB) is adopted as the standard code of practice for drawings. GB was created based on ISO.

In service of the goal of unambiguous communication, engineering drawings made professionally today are expected to follow certain well-known and widely followed standards, such as GB, ANSI or a group of ISO standards that are quite similar. This standardization also contributes to internationalization, because people from different countries who speak different languages can share the common language of engineering drawings, and can communicate with each other quite well, at least as concerns the technical details of an object. Consequently, in the field of engineering design, engineering graphics is the primary medium used in developing and communicating design concepts.

For centuries, until the post-World War Ⅱ era, all engineering drawings were done manually by using pencils and pens on paper or other substrate. Since the advent of computer-aided design (CAD), engineering drawings have been done more and more in the electronic medium forms. Today most engineering drawings are done with CAD, but pencil and paper are still used.

Drawings convey the following critical information:

(1) Geometry—the shape of the object; represented as views; how the object will look when it is viewed from various angles, such as front, top, side, etc.

(2) Dimensions—the size of the object is captured in accepted units.

(3) Tolerances—the allowable variations for each dimension.

(4) Material—represents what the item is made of.

(5) Finish—specifies the surface quality of the item, functional or cosmetic.

1.5.2 Drafting Standards

Engineering drawings are prepared on standard-size drawing sheets. The correct shape and size of the object can be visualized not only from the understanding of its views but also from the various types of lines used, dimensions, notes, scale, etc. For uniformity, the drawings must be drawn as per certain standard practice. This section deals with the drawing practices as recommended by GB. These are adapted from what is followed by International Standards Organization (ISO).

1. Sheet sizes and layout

The National Standard establishes five preferred sheet sizes, as shown in Table 1.1.

The layout of a drawing sheet is shown in Figure 1.3.

Table 1.1 Sheet sizes

<table>
<tr><th rowspan="2">Code</th><th rowspan="2">Size(B/mm)×(L/mm)</th><th colspan="3">Margin/mm</th></tr>
<tr><th>a</th><th>c</th><th>e</th></tr>
<tr><td>A0</td><td>841×1189</td><td rowspan="5">25</td><td rowspan="3">10</td><td rowspan="2">20</td></tr>
<tr><td>A1</td><td>594×841</td></tr>
<tr><td>A2</td><td>420×594</td><td rowspan="3">10</td></tr>
<tr><td>A3</td><td>297×420</td><td rowspan="2">5</td></tr>
<tr><td>A4</td><td>210×297</td></tr>
</table>

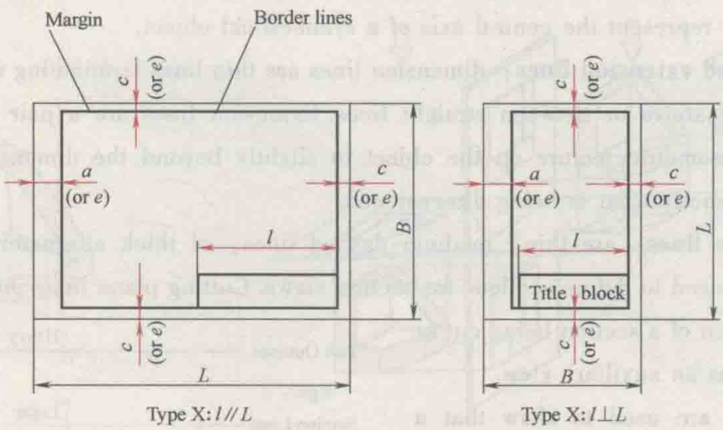

Figure 1.3 Layout of sheet

2. Scales

If the actual linear dimensions of an object are shown in its drawing, the scale used is said to be a full-size scale. Wherever possible, it is desirable to make drawings full-size.

The scale is the ratio between the measurement on the drawing and the actual size. Listed in Table 1.2 are the scales used in technical drawings.

Table 1.2 Scales

Full-size	1 : 1
Reduction scales	(1 : 1.5) 1 : 2 (1 : 2.5) (1 : 3) (1 : 4) 1 : 5 (1 : 6) 1 : 10 etc.
Enlargement scales	2 : 1 (2.5 : 1) (4 : 1) 5 : 1 10 : 1 etc.

Note: It is permissible to choose the scales shown in brackets, if necessary. Whatever scale is used, the dimensions on the drawing indicate the true size of the object, not of the view.

3. Types of lines

Technical drawings use several different line types to help convey the shape and size of a physical object. Types of lines are as follows (see Figure 1.4):

Part outlines (or simply visible lines): are thick (or heavy) solid lines used to depict edges and outlines of geometric features directly visible from a particular angle.

Section lines: are thin (or light) angled lines in a pattern (pattern determined by the mate-