

普通高等教育“十二五”规划教材



# 机械工程专业英语

## ——交流与沟通

English Communication for  
Mechanical Engineers

康兰 主编

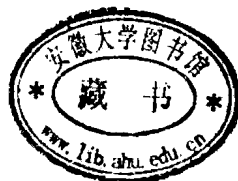


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# 机械工程专业英语 ——交流与沟通

English Communication for Mechanical Engineers

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机械工业出版社

全书共分五部分。第一部分在基于产品设计案例的基础上, 主要对机械工程、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, 重点是熟悉描述组成一台复杂机械的基本构件及其表达方法; 第三部分介绍了如何针对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; 第四部分详细介绍了如何撰写科技论文; 第五部分介绍了先进的制造技术。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, 不仅适合机械类本科学生使用, 也可作为机械类研究生的教材, 亦可供高职、高专等机械类专业的学生使用, 本书也适合各种层次的希望提高在机械专业领域内进行跨国界交流与沟通能力的人士的需求。

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# Preface

As is known to all, we are closely related to language. There are thousands of different languages in the world; however, their main function is: communication. English as a common international language has built up a bridge for global communication.

Currently, the globalization of manufacturing industries leads to a thirst for mechanical engineers with ability to make an effective communication when enterprises cooperate and negotiate with foreign counterparts. This urgent need of our society presents a great challenge for English teaching related to mechanical engineering in higher education. This book is intended to provide an English textbook for mechanical engineering students. The main purpose is to develop their cross-cultural English communication skills.

The book consists of 5 parts. The first part provides a fundamental coverage of mechanical engineering, machine design as well as the overall design process based on the analysis of case study. Some machine elements and mechanisms, which are commonly used in complex machines, are introduced in Part 2 with focus on description of the basic components and their terminologies. Part 3 presents methods and techniques for writing a written report, giving an oral report, and making a technical presentation in mechanical engineering. Some specific approaches and techniques are demonstrated by analyzing several comprehensive exercises and case study. Part 4 demonstrates how to write a scientific paper in detail. The advanced manufacturing technologies are introduced in Part 5; the goal of Part 5 is to equip students with the latest knowledge and help them to gain a competitive edge in international cooperation and communication. In addition, a multimedia tutorial CD is accompanied and the original files related to the cases in Part 1 are also provided.

The main characteristics of this book are as follows: (1) Each part includes the objective, learning contents, task-driven assignment. Homework assignment focuses on collaborative learning and interaction, reflection and teamwork. (2) Case study is used throughout the book: some of the cases are cited from the latest teaching materials of top universities abroad, and others come from the students' design work. (3) The book can meet different levels of teaching needs based on different teaching goals and class hours. The book is suitable for undergraduates and graduate students as well as for those learners who want to improve their cross-culture English communication skills in mechanical engineering.

We suggest four or five students form a collaborative learning group at the beginning of the class and gives a homework assignment to each group. Each group chooses a topic related to mechanical engineering and does some research about it. Before the end of the course, put aside several class hours for students' oral and slide presentation based on their group work. Everyone in a group has to report his or her contribution in teamwork. Students are self-motivated in such discussion learning; they can always remember knowledge learnt by themselves instead of knowledge instilled in them. It



is surely worth a try.

Part 1 through Part 4 were written by associate professor Lan Kang, and Part 5 was written by Dr. Huanmin Xu and Yugang Zhou. During the process of compiling this book, Mr. Richard Porter from Australia checked and refined Part 1 through Part 4 of the book in the view of a native English speaker. His responsible, careful and meticulous work impressed me. We wish to express our sincere gratitude to his work.

It is a pleasure to extend special thanks to the following: Professor Huali Liao, the department head of Mechanical Engineering at Hohai University. Her valuable suggestions enlightened us to refine the contents of the book. Mr. Yibin Wang, an engineer (in Department of Mechanical Engineering of Hohai University) who guided a student group to finish a nice case study along with Lan Kang, which provides a good case for Part 1. Graduate student Ya Li who assisted us in preparation of some graphics, and we also express our thanks to Department of Mechanical Engineering to give financial support to finish this book.

We would like to express our sincere gratitude to the editing and production team at China Machine Press. We would also like to thank Professor Juntao Fei at Hohai University, who had studied and taught in America for several years, for taking the time to review the book carefully and provide valuable suggestions.

Finally, we welcome and appreciate all comments and suggestions from readers to make further improvement on the book.

Authors

# 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。这一急切现实的社会需求对高等教育中机械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。

全书共分五部分。第一部分在基于产品设计案例的基础上，主要对机械工程、机械设计过程进行了介绍。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，重点是学会描述这些基本构件及其表达方法。第三部分介绍了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，并配有课堂综合实例及案例分析。第四部分详细介绍了如何撰写科技论文。第五部分介绍了先进的制造技术，以用前沿的知识武装学生，使学生在国际合作与交流中具有一定的竞争优势。此外，本书还配有多媒体教学课件，并提供了第一部分设计案例中的原始设计文件。

本书的主要特点如下：

1) 每一部分包括学习目标向导、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提高在机械专业领域内进行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。

本书第一至第四部分由康兰副教授编写，第五部分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第一至第四部分的英文部分，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第一部分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，以便我们以后进行更好的改进。

编者

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# Part 1 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.

### 1.1.2 Main Branches of Engineering

Engineering, much like other science, is a broad discipline which is often broken down into several subdisciplines. 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 have 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.

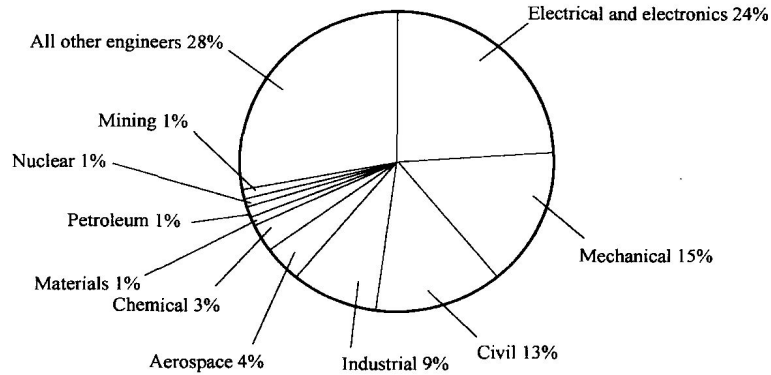
**Mechanical engineering:** The design of physical or mechanical systems, such as power and energy systems, aerospace/aircraft products, weapon systems, transportation products' engines, compressors, powertrains, kinematic chains, vacuum technology, and vibration isolation equipment.

## 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 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, 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, aircraft, watercraft, robotics, medical devices and more.

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



**Figure 1.1 Percentages of engineers working in various engineering**

### 1.3 Common Traits of Good Engineers

Although the activities of engineers are quite varied, there are some personality traits and work habits that typify most of today's successful engineers. The following is common traits of good engineers:

1. Engineers are problem solvers.
2. Good engineers have a firm grasp of the fundamental principal of engineering, which they can use to solve many different problems.
3. Good engineers are analytical, detailed oriented, and creative.
4. Good engineers have a desire to be lifelong learners. For example, they take continuing education classes, seminars, and workshops to stay abreast of innovations and new technologies. This is particularly important in today's world because the rapid changes in technology will require you as an engineer to keep pace with new technologies. Moreover, you will risk being laid off or denied promotion if you are not continually improving your engineering education.
5. Good engineers, regardless of their area of specialization, have a core knowledge that can be applied to many areas. Therefore, well-trained engineers are able to work outside their area of specialization in other related fields. For example, a good mechanical engineer with a well rounded knowledge base can work as an automotive engineer, an aerospace engineer, or as a chemical engineer.
6. Good engineers have written and oral communication skills that equip them to work well with their colleagues and to convey their expertise to a wide range of clients.
7. Good engineers have time-management skills that enable them to work productively and efficiently.
8. Good engineers have good "people skills" that allow them to interact and communicate effectively with various people in their organization. For example, they are able to communicate equally well with the sales and marketing experts and their own colleagues.
9. Engineers are required to write reports. These reports might be lengthy, detailed technical

reports containing graphs, charts, and engineering drawings, or they may take the form of brief memoranda or executive summaries.

10. Engineers are adept at using computers in many different ways to model and analyze various practical problems.

11. Good engineers actively participate in local and national discipline-specific organizations by attending seminars, workshops and meetings. Many even make presentations at professional meetings.

12. Engineers generally work in a team environment where they consult each other to solve complex problems. They divide up the task into smaller, manageable problems among themselves; consequently, productive engineers must be good team players. Good interpersonal and communication skills are increasingly important now 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 demands strong cross-culture communication skills.

## 1.4 What Is a Machine?

A machine is a tool consisting of one 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 the 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 that 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

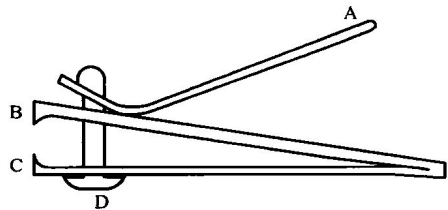


Figure 1.2 A simple machine — nail clippers

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.

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 engineering 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 to guide 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 drawing, 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 drawing was done manually by using pencil and pen on paper or other substrate (e. g. vellum, mylar). Since the advent of computer-aided design (CAD), engineering drawing has been done more and more in the electronic medium forms. Today most engineering drawing is 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 from the understanding of not only 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.

Table 1.1 Sheet sizes

Code	Size $B \times L$ (mm)	Margin (mm)		
		$a$	$c$	$e$
A0	841 × 1189	25	10	20
A1	594 × 841			
A2	420 × 594		5	10
A3	297 × 420			
A4	210 × 297			

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