高职高专机电类专业规划教材

机电专业英语

谢敏　周爱华◎主编

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本书由机械制造基础、机床、机电一体化基础、机电一体化技术、工程应用和文献检索6个部分组成，分成26个单元，包括：工程材料的分类，极限尺寸、配合与公差，金属的热处理，成形，车床，铣床，磨削分类与无心磨削，铣削，钻头与钻床，电工技术，电子技术，自动控制系统，机电一体化系统，AT89S51介绍，西门子可编程序控制器介绍，液压技术，气动技术，电气工程，数控技术简介，WinCC flexible介绍，CAD/CAM/CAPP，IRB 140工业机器人数据手册，机器视觉，自动装配线，信息检索简介，专业文献的检索等。

本书可以作为高职高专院校机电类、自动化类等专业的专业英语教材，也可作为相关专业技术人员和行业英语爱好者的学习参考书。

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前　言

PREFACE

为了适应高等职业教育的不断发展，针对高职高专院校机电类、自动化类专业学生的培养目标和岗位技能要求，在充分体现理论内容“必须、够用”的原则和突出应用能力及综合素质培养的前提下，本书通过专业英语和专业课程内容的相互融合，介绍了本专业的基本理论、应用技术、产品及应用软件的英文陈述与表达和机电一体化技术的前沿应用。

本书以现代机电一体化技术为背景，在教材中充分体现专业特色，尽可能兼顾机电专业的各个技术侧面，对机电一体化技术专业涉及的理论知识与技术、产品、应用软件进行了有侧重的选择和精简，并循序渐进、由浅入深、由简到繁地进行了陈述，使读者能得到较为全面的现代机电技术专业英语的阅读、词汇和知识扩充。全书由6部分组成，包括机械制造基础、机床、机电一体化基础、机电一体化技术、工程应用和文献检索，共分成26个单元，每个单元由课文、单词与词组、课文注释、练习等组成。书后附有课文译文及练习答案、常用专业词汇。

本书力求做到内容正确、全面，从理论基础到技术应用和产品介绍，各单元安排和内容组成充分考虑了专业基础技术、工程实际应用技术和最新技术的实际特点。

本书由南京化工职业技术学院谢敏、甘肃机电职业技术学院周爱华、南京化工职业技术学院郭燕、苏州工业园区职业技术学院王寿斌和苏州农业职业技术学院秦培亮编写。本书的编写分工是：谢敏编写Unit 13、14、19、20、22、23、24以及Part Ⅳ的阅读材料A、B和Part Ⅴ的阅读材料A～D；周爱华编写Unit 1～4及Part Ⅰ的阅读材料A～D，Unit5～8及Part Ⅱ的阅读材料A～D；郭燕编写Unit 9～12及Part Ⅲ中的阅读材料A～D；王寿斌编写Unit 21、25、26；秦培亮编写Unit 15～18及Part Ⅳ的阅读材料C、D。谢敏、周爱华担任主编，负责全书的统稿工作。南京航空航天大学楼佩煌教授担任主审，他对本教材提出了许多宝贵的意见和建议。

本书在编写时，参考了大量的文献资料及国外公司的技术资料，在此向这些文献的作者深表谢意。

由于编者水平有限，书中难免存在不足之处，恳请读者批评指正。

编　者

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Part Ⅰ Fundamentals of Manufacturing

Unit 1 Classification of Materials

Materials may be grouped in several ways. Scientists often classify materials by there state: solid, liquid, or gas. They also separate them into organic (once living) and inorganic (never living) materials. For industrial purposes, materials are divided into engineering materials or nonengineering materials. Engineering materials are those used in manufacture and become parts of products. Nonengineering materials are the chemicals, fuels, lubricants, and other materials used in the manufacturing process which do not become part of the product.

Engineering materials may be classified into four groups: metals, ceramics, polymers, and composite materials.

1. Metals

Metals are generally defined as those elements whose hydroxides form bases (such as sodium or potassium). Metals may exist as pure elements. When two or more metallic elements are combined, they form a mixture called an alloy.

The term alloy is used to identify any metallic system. In metallurgy, it is a substance with metallic properties, that is composed of two or more elements, intimately mixed. Of these elements, one must be a metal. Plain carbon steel, in the sense, is basically an alloy of iron and carbon. Other elements are present in the form of impurities. However, for commercial purposes, plain carbon steel is not classified as an alloy steel.

Metals and alloys, which include steel, aluminum, magnesium, zinc, cast iron, titanium, copper, nickel, and many others, have the general characteristics of good electrical and thermal conductivity, relatively high strength, high stiffness, ductility or formability, and shock resistance. They are particularly useful for structural or load-bearing applications. Although pure metals are occasionally used, alloys are normally designed to provide improvement in a particular desirable property or permit better combinations of properties.

2. Ceramics

Ceramics, such as brick, glass, tableware, insulators, and abrasives, have poor electrical and thermal conductivity. Although ceramics may have good strength and hardness, their ductility, formability, and shock resistance are poor. Consequently, ceramics are less often used for structural or load-bearing applications than metals. However, many ceramics have excellent resistance to high temperatures and certain corrosive media and have a number of unusual and desirable optical, electrical, and thermal properties.

3. Polymers

Polymers include rubber, plastics, and many types of adhesives. They are produced by creating large molecular structures from organic moleculars, obtained from petroleum or agricultural products, in a process known as polymerization. Polymers have poor electrical and thermal conductivity, low strengths, and are not suitable for use at high temperatures. Some polymers have excellent ductility, formability, and shock resistance while others have the opposite properties. Polymers are lightweight and frequently have excellent resistance to corrosion.

4. Composite Materials

Composite materials are formed from two or more materials, whose properties cannot be obtained by any single material. Concrete, plywood, and fiberglass are typical, although crude, examples of composite materials. With composite materials, we can produce lightweight, strong, ductile, high heat-resistant materials that are otherwise unobtainable, or produce hard yet shock resistant cutting tools that would otherwise shatter.

New Words and Phrases

1. lubricant [ˈluːbrikənt] *n.* 润滑剂
2. ceramic [siˈræmik] *n.* 陶瓷，陶瓷制品
3. polymer [ˈpɔlimə] *n.* 聚合物
4. composite [ˈkɔmpəzit] *adj.* 合成的，复合的，混合物
5. sodium [ˈsəudiːəm] *n.* 钠
6. potassium [pəˈtæsiːəm] *n.* 钾
7. zinc [ziŋk] *n.* 锌
8. cast iron 铸铁
9. titanium [taiˈteiniəm] *n.* 钛
10. nickel [ˈnikəl] *n.* 镍
11. stiffness [ˈstifnis] *n.* 硬度，刚度
12. ductility [dʌkˈtiliti] *n.* 韧性，可延展性
13. formability [ˈfɔːməˈbiliti] *n.* 可成型性
14. shock resistance 抗冲击性
15. load-bearing 承载
16. tableware [ˈteib(ə)lweə] *n.* 餐具
17. abrasive [əˈbreisiv] *n.* 研磨剂，磨料（具）；*adj.* 研磨的
18. thermal conductivity 导热性
19. adhesive [ædˈhiːsiv] *n.* 黏结剂，黏胶剂
20. molecular [məuˈlekjuːlə] *adj.* 分子的
21. molecule [ˈmɔlikjuːl] *n.* 分子
22. polymerization [ˈpɔliməraiˈziʃən] *n.* 聚合
23. corrosion [kəˈrəuʒən] *n.* 腐蚀
24. plywood [ˈplaiwud] *n.* 夹板

25. fiberglass [ˈfaibəglɑːs] *n.* 玻璃纤维
26. crude [kruːd] *adj.* 天然的，未经加工的
27. heat-resistant material 耐热材料
28. shatter [ˈʃætə] *v.* 粉碎，破坏
29. be used for... 用于……
30. be formed from... 由……组成

Notes

1. Consequently, ceramics are less often used for structural or load-bearing applications than metals.

因此，与金属相比，陶瓷很少用于结构件或承载件。

less... than = not so... as 比……少

be used for... 是"用于……"的

例如：A hammer is used for driving in nails。

2. They are produced by creating large molecular structures from organic molecules, obtained from petroleum or agricultural products, in a process known as polymerization.

它们是由来自石油或农产品的有机分子通过聚合形成的巨大分子结构所产生的。

3. Composite materials are formed from two or more materials, whose properties cannot be obtained by any single material.

复合材料由两种或两种以上的材料组成，其性能绝非任何一种单一材料所能拥有。

be formed from... 由……组成

"whose properties cannot be obtained by any single material"的"whose"指的是复合材料。

Exercises

1. Answer the following questions according to the text.

a) What is metal? Try to describe it using the words in this passage or of your own.

b) What is polymer? Try to describe it using the words in this passage or of your own.

2. Decide whether the following statements are true (T) or false (F) and put "T" or "F" in the brackets according to the text.

a) Materials are classified into five groups: metals, nonmetals, ceramics, polymers, and composite materials. ( )

b) Metals and alloys have relatively high strength, high stiffness, ductility or formability, but low shock resistance. ( )

c) Ceramics have poor electrical and thermal conductivity, ( ) may have high strength and hardness ( ), and have high ductility, formability, and shock resistance. ( )

d) Polymers are lightweight ( ) and frequently have poor resistance to corrosion. ( )

Unit 2 Limits, Fits and Tolerances

Terminology

Fit: The relation resulting from the difference between the sizes of two mating parts.

Basic Size: The size with reference to which the limits of size are fixed; also termed the nominal size or nominal dimension.

Actual Size: The size of a part as may be found by measurement.

Limits of Size: The two extreme permissible sizes between which the actual size is contained. The two extreme sizes are termed the maximum limit and minimum limit.

Tolerance: The difference between the maximum limit and the minimum limit. (The tolerance is also equal to the algebraic difference between the upper and lower deviations.)

Upper Deviation: The algebraic difference between the maximum limit of basic size and the corresponding basic size.

Lower Deviation: The algebraic difference between the minimum limit of basic size and the corresponding basic size.

Types of Fit

Depending upon the actual limits of the hole or shaft, a fit may be classified as follows.

(1) **Clearance Fit:** A fit that always provides a clearance between the mating parts. In this case, the tolerance zone of the hole is entirely above that of the shaft.

(2) **Interference Fit:** A fit that always provides an interference between the mating parts. Here, the tolerance zone of the hole is entirely below that of the shaft.

(3) **Transition Fit:** A fit that may provide, depending on the actual dimensions of the finished products, either a clearance or an interference between the mating parts.

Of the various methods used to apply the system of fits, the principal ones are the shaft-basis system and hole-basis system. In the shaft-basis system, the different clearances and interferences are obtained by associating various holes with a single basic size of shaft, the upper deviation of which is zero (symbol h). In the hole-basis system, the different clearances and interferences are obtained by associating various shafts with a single basic size of hole, the lower deviation of which is zero (symbol H).

Normally, it is easier to produce a shaft with a specified tolerance than a hole with the same tolerance. Consequently, in modern engineering design, the hole-basis system is most extensively used and our discussion will refer mostly to this system. However, the designer should decide on the adoption of either system to enable general interchangeability.

Symbols for Tolerances and Fits

A tolerance is designated by a letter (in some cases, two letters), a symbol, and a numerical symbol. Capital letters are used for holes and small letters for shafts. The letter symbol indicates the position of the zone of tolerance in relation to the zero line representing the basic size. The numerical symbol represents the value of this zone of tolerance and is called the grade or quality of tolerance.

Both the position and the grade of tolerance are functions of the basic size. A toleranced size is thus defined by its basic value followed by a letter and a number, e. g.

$$\phi 50H7 \quad \text{or} \quad \phi 50g6$$

Fundamental Aspects of Tolerance System

For all industrial measurements, the standard reference temperature is 293K. Basic sizes from 1mm to 500mm have been subdivided into 13 steps or ranges. From 500mm to 3150mm, there are 8 nominal steps. For each nominal step, there are 20 grades of tolerance designated IT01, IT0, and IT1,...... IT17, IT18. These are known as the standard tolerances. (IT stands for ISO Tolerance series, and ISO for the International Organisation for Standardization.)

In engineering drawing, it is necessary to provide the nominal size tolerance.

(a) If the function or the economical aspect of the manufacturing process of the workpieces requires that certain limiting dimensions be maintained;

(b) If the parts are required to have a fit;

(c) If the parts are separately finished and need to be assembled without post-machining;

(d) If the parts are to be interchangeable, e. g. spare parts;

(e) If it is necessary that the part be toleranced so that it can be held in a particular fixture for finishing operations.

In ordinary cases, free measure tolerances should suffice.

The tolerance should be so chosen that it just serves the purpose of the relevant application of the workpieces for which it is meant and also ensures interchangeability. The finer the tolerance, the more is the cost of production.

Choice of Tolerance Grades

Grades IT01 to IT7 are used mainly for gauges. The grades 01 to 4 are achieved through lapping, honing, and the finest grinding.

Grades IT5 to IT11 are primarily for the fit of workpieces and are achieved through metal-cutting machining processes, such as fine turning, milling, shaping, planing, grinding, and reaming.

Grades IT12 to IT18 are found suitable for rougher production tolerances in processes not involving metal-cutting, such as forging, rolling, casting, pressing, and drawing.

New Words and Phrases

1. terminology [təːmiˈnɔlədʒi] *n.* 术语，词汇
2. mating [ˈmætiŋ] *n. & adj.* 配合（的），相连（的）
3. permissible [pəˈmisəbl] *adj.* 可允许的，许可的
4. algebraic [ˈældʒiˈbreik] *adj.* 代数的
5. forego [fɔːˈgəu] *v.* 先行，在前，居先
6. interference [ˈintəˈfiərəns] *n.* 过盈
7. finished [ˈfiniʃt] *adj.* 完美的，精加工的，完工的
8. pictorially [pikˈtɔːriːəli] *adv.* 用（插）图地，如绘成图画地
9. depict [diˈpikt] *vt.* 画，叙述

10. designate [ˈdezigneit] *vt.* 标出，把……定义为
11. remoteness [riˈməutnis] *n.* 偏（疏）远
12. closeness [kləuznis] *n.* 接近（程度）
13. subdivide [ˌsʌbdiˈvaid] *v.* 细（区）分，再（划）分
14. empirical [emˈpirikəl] *adj.* 经验（主义）的
15. micrometer [maikrɔˈmitə] *n.* 微米，千分尺
16. post-machining [pəustməˈʃiːniŋ] *n.* 后续（期）加工
17. fixture [ˈfikstʃə] *n.* 夹具，夹紧装置
18. suffix [ˈsʌfiks] *v.* 满足（……的需要）
19. lapping [ˈlæpiŋ] *n.* 研磨，抛（磨）光
20. honing [ˈhəuniŋ] *n.* 珩（搪）磨
21. grinding [ˈgraindiŋ] *n.* 磨削
22. shaping [ˈʃeipiŋ] *n.* 成形加工
23. planning/planing [ˈplæniŋ] *n.* 刨（削，平）
24. ream [riːm] *vt.* 铰孔，铰大……的口径
25. shaft-basis system 基轴制
26. hole-basis system 基孔制
27. grade (quality) of tolerance 公差等级

Notes

The tolerance should be so chosen that it just serves the purpose of the relevant application of the workpieces for which it is meant and also ensures interchangeability.

公差选择时，应使工件满足相关应用场合的需要，并能保证互换性的要求。

so…that 引导的句子为结果状语从句。

for which 引导的句子为定语从句，修饰先行词 the workpieces。

Exercises

1. Translate the following words into Chinese.

a) the nominal size or nominal dimension

b) actual size and limits of size

c) upper deviation and lower deviation

d) clearance fit and interference fit

e) International Organization for Standardization

2. Answer the following questions.

a) What is tolerance?

b) Why is tolerance important in manufacturing?

c) How do you indicate the tolerances on drawing?

d) Why is the hole-basis system used extensively in modern engineering design?

e) How many types of fit are there in this text? Describe three main types of fit in detail.

Unit 3 Heat Treatment of Metal

Heat treatment is the operation of heating and cooling a metal in its solid state to change its physical properties. According to the procedure used, steel can be hardened to resist cutting action and abrasion, or it can be softened to permit machining. With the proper heat treatment, internal stresses may be removed, grain size reduced, toughness increased, or a hard surface produced on a ductile interior.

The following discussion applies principally to the heat treatment of plain-corban steels. With this process, rate of cooling is the controlling factor, rapid cooling from above the critical range results in hard structure, whereas very slow cooling produces the opposite effect.

Hardening: In any heat-treating operation, the rate of heating is important. Heat flows from the exterior to the interior of steel at a definite maximum rate. If steel is heated too fast, the outside of the part becomes hotter than the interior. A uniform structure is hard to obtain.

The hardness that can be obtained from a given treatment depends upon the following three factors:

1. Quenching rate;
2. Carbon content;
3. Workpiece size.

Rapid quenching is needed to harden low carbon and medium plain carbon steels. Water is generally used as a quench for these steels. For high-carbon or alloy steel, oil is used. Its action is not as severe as that of water. Where extreme cooling is desired, brine is used.

The maximum degree of hardness obtainable in steel by direct hardening is determined largely by the carbon content. Steel with a low carbon content will not respond greatly to the hardening process. Carbon steels are generally considered as shallow hardening steels. The hardening temperature varies for different steels. The temperature depends upon the carbon content.

The temperature at which steel is usually quenched for hardening is known as the hardening temperature. It is usually 10℃ to 38℃ above the upper critical temperature at which structural change takes place.

Tempering: Hardening makes high-carbon steels and tool steels extremely hard and brittle and not suitable for most uses. By tempering or "drawing", internal stresses developed by the hardening process are relieved. Tempering increased the toughness of the hardened piece. It also seems to make them more plastic or ductile.

Annealing: Annealing consists of heating steel slightly above its critical range and cooling very slowly. Annealing relieves internal stresses and strain caused by previous heat treatment, machining, or other cold-working processes. The type of steel governs the temperature to which the steel is heated for the annealing process. The purpose for which annealing is being done also governs the annealing temperature.

There are three different types of annealing processes used in industry: (1) full annealing,

(2) process annealing, (3) spheroidizing.

Full annealing is used to produce maximum softness in steel. Machinability is improved. Internal stresses are relieved. Process annealing is also called stress relieving. It is used for relieving internal stresses that have occurred during cold-working or machining processes. Spheroidizing is used to produce a special kind of grain structure that is relatively soft and machinable. This process is generally used to improve the machinability in high-carbon steels and in wire-drawing processes.

Normalizing: Normalizing is a process used to relieve the internal stresses due to hot-working, cold-working, and machining. The process consists of heating steel slightly above the upper critical range 30℃ to 50℃ and cooling to room temperature after holding for a while. This process is usually used with low and medium-carbon as well as alloy steels. Normalizing removes all previous effects due to heat treatment.

New Words and Phrases

1. anneal [ə'niːl] *n.* 退火
2. heat treatment 热处理
3. quenching [kwentʃiŋ] *n.* 淬火
4. temper ['tempə] *n.* 回火
5. brine [brain] *n.* 盐水
6. medium ['miːdiəm] *adj.* 中等的，中间的；*n.* 介质
7. ductile ['dʌktail] *adj.* 柔软的，易延展的
8. brittle ['britl] *adj.* 易碎的
9. process annealing 低温退火；中间退火
10. full annealing 完全退火
11. machinability [məˈʃiːnəbiliti] *n.* 切削性，机械加工性
12. spheroidizing ['sfiərɔidaiziŋ] *n.* 球化退火
13. normalizing ['nɔːməˌlaiziŋ] *n.* 正火
14. stress relieving 去应力退火

Notes

1. The maximum degree of hardness obtainable in steel by direct hardening is determined largely by the carbon content.

说明：obtainable in steel by direct hardening 做定语修饰 hardness，主语为 The maximum degree of hardness，谓语为 is determined。

2. The temperature at which steel is usually quenched for hardening is known as the hardening temperature.

通常使钢淬火变硬的温度，称为淬火温度。

句中"at which steel is usually quenched for hardening"为定语从句，修饰"The temperature"。

is known as：被称为……。

Exercises

1. Fill in the blanks with the information given in the text.

a) __________ relieves internal stresses and strain, there are __________ types of it used in industry.

b) Tempering increased the __________ of the hardened piece. It also seems to make them more __________ or __________.

2. Translate the following words into Chinese.

a) heat treatment; b) quenching rate; c) process annealing; d) spheroidizing; e) stress relieving

3. Answer the following question according to the text above.

a) How many methods of heat treatment of steel are there in industry? Please try to describe them using the words in this passage or of your own in detail.

b) What does tempering mean?

c) What does normalizing mean?

Unit 4 Forming

Forming can be defined as a process in which the desired size and shape are obtained through the plastic deformations of a material. The stresses induced during the process are greater than the yield strength, but less than the fracture strength of the material. The type of loading may be tensile, compressive, bending, shearing, or a combination of these. This is a very economical process as the desired shape, size, and finish can be obtained without any significant loss of the material. Moreover, a part of the input energy is fruitfully utilized in improving the strength of the product through strain hardening.

The forming processes can be grouped under two broad categories, namely, cold forming and hot forming. If the working temperature is higher than the recrystallization temperature of the material, then the process is called hot forming. Otherwise the process is termed as cold forming. The flow stress behavior of a material is entirely different above and below its recrystallization temperature. During hot working, a large amount of plastic deformation can be imparted without significant strain hardening. This is important because a large amount of strain hardening renders the material brittle. The frictional characteristics of the two forming processes are also entirely different. For example, the coefficient of friction in cold forming is generally of the order of 0.1, whereas that in hot forming can be as high as 0.6. Furthermore, hot forming lowers down the material strength so that a machine with a reasonable capacity can be used even for a product having large dimensions.

The typical forming processes are rolling, forging, drawing, deep drawing, bending, and extrusion. For a better understanding of the mechanics of various forming operations, we shall briefly discuss each of these processes.

Rolling

In this process, the job is drawn by means of friction through a regulated opening between two power-driven rolls. The shape and size of the product are decided by the gap between the rolls and their contours. This is a very useful process for the production of sheet metal and various common sections, e. g., rail, channel, angle, and round.

Forging

In forging, the material is squeezed between two or more dies to alter its shape and size. Depending on the situation, the dies may be open or closed.

Drawing

In this process, the cross-section of a wire or that of a bar or tube is reduced by pulling the workpiece through the conical orifice of a die. When high reduction is required, it may be necessary to perform the operation in several passes.

Deep Drawing

In deep drawing, a cup-shaped product is obtained from a flat sheet metal with the help of a punch and a die. The sheet metal is held over the die by means of a blank holder to avoid defects in the product.

Bending

As the name implies, this is a process of bending a metal sheet plastically to obtain the desired shape. This is achieved by a set of suitably designed punch and die.

Extrusion

This is a process basically similar to the closed die forging. But in this operation, the workpiece is compressed in a closed space, forcing the material to flow out through a suitable opening, called a die. In this process, only the shapes with constant cross-sections (die outlet cross-section) can be produced.

Advantages and Disadvantages of Hot and Cold Forming

Now that we have covered the various types of metal working operations, it would only be appropriate that we provide an overall evaluation of the hot and cold working processes. Such a discussion will help in choosing the proper working conditions for a given situation.

During hot working, a proper control of the grain size is possible since active grain growth takes place in the range of the working temperature. As a result, there is no strain hardening, and therefore there is no need of expensive and time-consuming intermediate annealing. Of course, strain hardening is advisable during some operations (viz., drawing) to achieve an improved strength; in such cases, hot working is less advantageous. Apart from this, strain hardening may be essential for a successful completion of some processes (e. g., in deep drawing, strain hardening prevents the rupture of the material around the bottom circumference where the stress is maximum). Large products and high strength materials can be worked upon under hot conditions, since the elevated temperature lowers down the strength and consequently the work load. Moreover, for most materials, the ductility increases with temperature and, as a result, brittle materials can also be worked upon by the hot working operation. It should, however, be remembered that there are certain materials (viz.

, steels containing sulphur) which become more brittle at elevated temperatures. When a very accurate dimensional control is required, hot working is not advised because of shrinkage and loss of surface metal due to scaling. Moreover, surface finish is poor due to oxide formation and scaling.

The major advantages of cold working are that it is economical, quicker, and easier to handle, because here no extra arrangements for heating and handling are necessary. Furthermore, the mechanical properties normally get improved during the process due to strain hardening. What is more, the control of grain flow directions adds to the strength characteristics of the product. However, apart from other limitations of cold working (viz., difficulty with high strength, brittle materials, and large product size), the inability of the process to prevent the significant reduction in corrosion resistance is an undesirable feature.

New Words and Phrases

1. fracture [ˈfræktʃə] *n.* 断裂
2. strain hardening 应变硬化，加工硬化，冷作硬化
3. cold forming 冷成形，冷态成形，冷作成形
4. hot forming 热成形
5. deep drawing 深拉，深冲（压）
6. gap [gæp] *n.* 缺口，裂口，间隙，缝隙，差距
7. channel [ˈtʃænl] *n.* 槽钢
8. superstructure [ˈsjuːpəˌstrʌktʃə] *n.* 上部结构
9. conical [ˈkɔnikəl] *adj.* 圆锥的，圆锥形的
10. orifice [ˈɔːrəfis] *n.* 孔，节流孔
11. shrinkage [ˈʃriŋkidʒ] *n.* 收缩
12. inability [ˈinəˈbiliti] *n.* 无能，无力

Notes

1. Furthermore, hot forming lowers down the material strength so that a machine with a reasonable capacity can be used even for a product having large dimensions.

1) so that 引导一个结果状语从句，表示“以至于……”。

2) having large dimensions 为分词短语作定语，修饰 product。

2. It should, however, be remembered that there are certain materials (viz., steels containing sulphur) which become more brittle at elevated temperatures.

1) 本句中“It”为形式主语，其真正的主语为“that”引导的从句。

2) which 引导的从句为定语从句，修饰先行词“materials”。

Exercises

1. Match the following terms in Column (1) with the descriptions in Column (2).

(1) (2)

( ) 1. drawing a) The shape and size of the product are decided by the gap