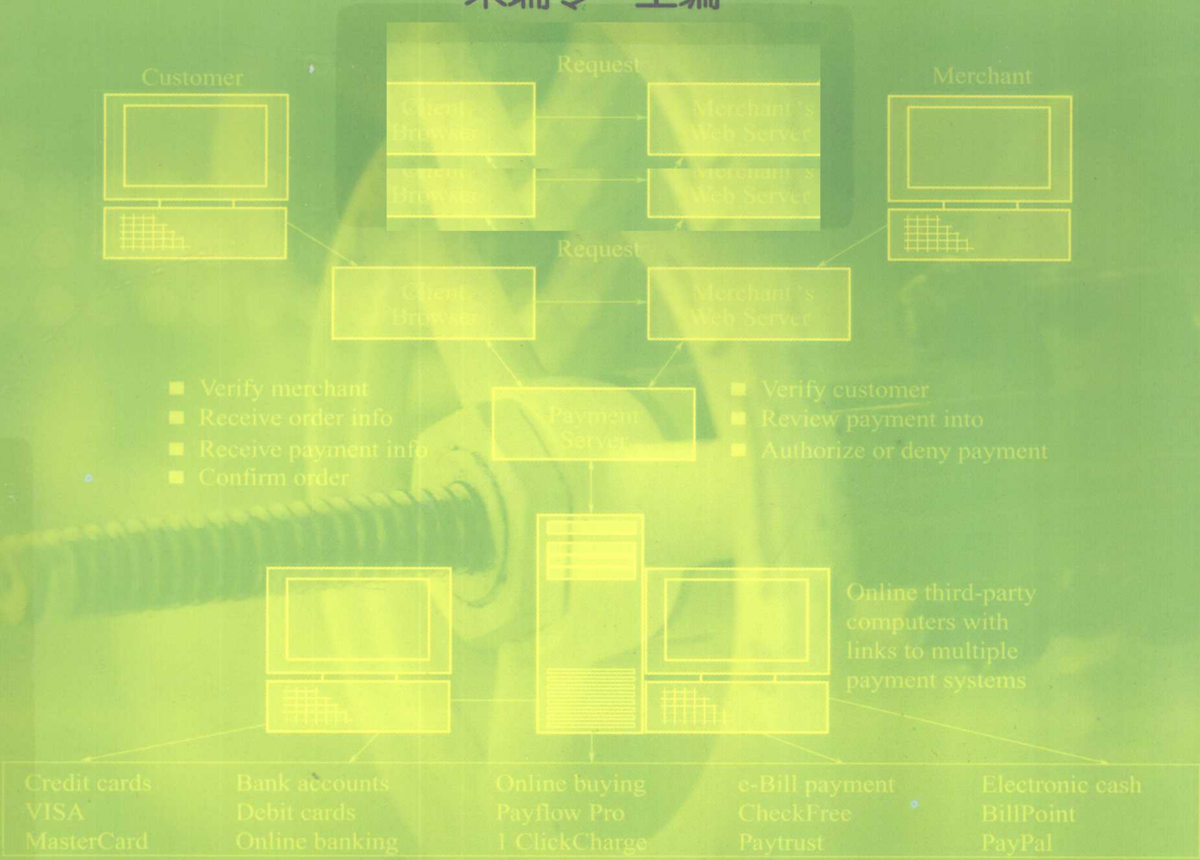
普通高等教育“十一五”国家级规划教材

# 机电工程专业英语

**第二版**

宋瑞苓　主编

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# 机电工程专业英语

## 第二版

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·北京·

本书共分为8章，内容包括制造导论、机械工程基础、机械制造技术、电子及控制技术、数控技术、数控操作、现代制造技术、现代管理和互联网及应用等，每章含有课文正文、生词词组、难点注释、理解练习、阅读材料等部分，各章节内容上彼此独立，难度上循序渐进。

本书内容新颖，覆盖面广，且有一定的专业针对性和实用性。

本书的教学资料：包括PPT教学课件，词汇测试系统等，是教师教学和学生学习的好帮手，并将免费提供给采用本书作为教材的院校使用。如有需要，请发电子邮件至cipedu@163.com 获取，或登录 www.cipedu.com.cn 免费下载。

本书可作为高职高专机械、机电、数控、工业工程及相关专业的教材，也可供工程技术人员参考。

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# 第二版前言

本书第一版是根据全国高职高专专门课开发指导委员会确定的机电工程专业课程体系中的“机电工程专业英语”课程基本要求编写的，其出版发行六年以来因其专业针对性强，覆盖面广受到广大师生的好评。但是作为教材，其内容特点必须与时俱进。应出版社要求，编者做了局部的修订。

本教材在修订编写时，有以下几个方面的特点。

（1）保留原教材专业针对性强的特点：修订版保留了原书中机械电子技术的基本内容：工程材料、机械零件、切削机床、液压传动、电子线路、模数转换、接口技术、可编程控制器和数控技术等。

（2）更新近年来发展比较快的新技术内容：如快速成型技术、互联网技术、光刻复印技术、电子商务模式等，即便是相同的内容，取材也选自更新的国外原版教材及论文。

（3）增加现代管理一章：考虑到现代科技与管理学的密切联系，选编了组织管理、机构优势、市场计划、广告功能等，扩大学生视野，增长人文知识。

（4）取消较为难懂的篇目，如并行设计、软件工程等，增加了与日常生活有关的互联网应用、网上购物等，降低了课程难度，增加了学习的趣味性。

（5）排版风格独特：本书采用外国教材常用的旁注方式，理解难点随课文旁注，增加了阅读的方便性。

（6）本书的教学资料：包括 PPT 教学课件，词汇测试系统等，是教师教学和学生学习的好帮手，将免费提供给采用本书作为教材的院校使用。如有需要，请发电子邮件至 cipedu@163.com 获取，或登录 www.cipedu.com.cn 免费下载。

本书中的现代管理篇由余健华编写，其余由宋瑞苓编写与修订，全书由宋瑞苓主编。

由于编者水平与经验所限，书中难免有不妥与疏漏之处，敬请读者批评指正。

编者

2010 年 4 月

# 第一版前言

本书是根据全国高职高专专门课开发指导委员会确定的机电工程专业课程体系中的《机电工程专业英语》课程基本要求编写的。本书在编写时，突出了以下几个方面的特点。

（1）专业针对性强：本书力图与现行的机电类专业的教学内容保持同步，内容涉及机械电子技术的各个方面，包括工程材料、机械零件、切削机床、液压传动、电子线路、模数转换、接口技术、可编程控制器和数控技术等。

（2）内容新颖：选材包括近年来出现的高新技术和现代制造技术，柔性加工、工业机器人、计算机集成制造、并行设计、专家系统和人工智能等，且材料全部选自国外原版教材及论文，不与其他同类教材雷同。

（3）覆盖面广：考虑到现代科技与计算机、网络技术的密切关系，选编了互联网、通信、软件工程、数据库等内容，可扩大学生知识面。

（4）选材风格独特：本书第一部分：机械制造导论，行文流畅，既是对机制、机电专业已学课程的总结，又是对本书各章节的导读，可读性强。

（5）兼顾实用：考虑高职高专学生的就业岗位特点，编入了数控机床的故障诊断、数控操作及维修等部分，有一定的实用性。

本书由宋瑞苓、赵继永担任主编，其中现代制造技术篇由宋瑞苓编写，制造导论和电子篇由赵继永编写，机械工程基础篇由冯锦春编写，机械制造技术篇由冯锦春、宋瑞苓、马晓明编写，数控技术篇由郑为编写，数控操作篇由蔡霞编写，计算机应用篇由郝红武编写。全书由西安航空高等专科学校宋瑞苓统稿和定稿。

由于编者水平与经验所限，书中难免有不妥与错误之处，敬请读者批评指正。

编者

2003 年 2 月

# CONTENTS


Chapter One Fundamentals of Mechanical Engineering ........ 1

Lesson 1 Properties of Materials ........ 1
Reading Metals and Alloys ........ 3
Lesson 2 Classification of Steels ........ 4
Reading Machinability of Metals ........ 6
Lesson 3 Heat Treatment ........ 10
Reading Materials Used for Shafting ........ 14
Lesson 4 Types of Gear ........ 16
Reading Cams ........ 19
Lesson 5 Rolling-Type (Antifriction) Bearings ........ 22
Reading Clutch, Rack and Worm ........ 26

Chapter Two Technique of Manufacturing Engineering ........ 29

Lesson 1 Mechanism of Chip Formation ........ 29
Reading Cutting Fluids and Their Importance ........ 33
Lesson 2 Engine Lathe ........ 35
Reading Lathe Work ........ 40
Lesson 3 The Hydraulic System ........ 41
Reading Hydraulic Pumps ........ 43
Lesson 4 Electric Discharge Machining ........ 46
Reading Laser Beam Machining ........ 49
Lesson 5 Benefits of A Quality System ........ 51
Reading Introduction to ISO 9000 Basics ........ 53

Chapter Three Electronics Technology And Automation ........ 55

Lesson 1 Types of Integrated Circuits ........ 55
Reading Optoelectronics ........ 59
Lesson 2 Printed Circuit ........ 63
Reading Repair of Printed Circuit ........ 66

Lesson 3 Alternating-Current Motors ······ 68
Reading Motor& Motor Care and Maintenance ······ 72
Lesson 4 Interfacing ······ 74
Reading A/D&D/A Converter ······ 77
Lesson 5 Controllers ······ 79
Reading Guidelines for Designing a PLC System ······ 81

**Chapter Four CNC Machines ······ 85**

Lesson 1 The Fundamentals of CNC ······ 85
Reading The Concepts of Computer Numerical Control ······ 89
Lesson 2 Types of CNC Machines ······ 90
Reading Laser Cutting ······ 93
Lesson 3 The CNC Control ······ 94
Reading Components of CNC Machine ······ 99
Lesson 4 Methods for CNC Programming ······ 101
Reading Manual Programming ······ 105
Lesson 5 CAD/CAM ······ 107
Reading CAD/ CAM Integration ······ 111

**Chapter Five CNC Machine Operating ······ 113**

Lesson 1 Explanation of the Keyboard ······ 113
Reading FANUC—BESK NC System ······ 115
Lesson 2 Tilting NC-Rotary table ······ 116
Reading Employment Opportunities in NC ······ 118
Lesson 3 Handling and Operation ······ 120
Reading Chart ······ 122
Lesson 4 Failures and Breakdowns ······ 123
Reading Position Detectors- Opto-Electronical Rotary Encoders ······ 126
Lesson 5 Service and Maintenance ······ 127
Reading Error Search and Repair ······ 129

**Chapter Six Modern Manufacturing Technology ······ 130**

Lesson 1 Flexible Manufacturing Systems ······ 130
Reading Robotics ······ 134
Lesson 2 Expert Systems ······ 135
Reading Decision Support Systems ······ 139
Lesson 3 Computer Aided Process Planning ······ 143
Reading Artificial Intelligence & Expert System ······ 147

Lesson 4 Rapid Prototyping and Freeform Fabrication ······ 152
Reading Stereolithography ······ 154
Lesson 5 From the Present to the Future ······ 155
Reading Aesthetics in Design ······ 160

**Chapter Seven Modern Management ······ 162**

Lesson 1 Managers, Management, and Organizations ······ 162
Reading Success for an Organization ······ 164
Lesson 2 Identifying Competitive Advantages ······ 166
Reading Absolute Advantage and Comparative Advantage ······ 169
Lesson 3 Types of Advertisements ······ 172
Reading The Important Advertising Media ······ 174
Lesson 4 Developing a Marketing Plan ······ 176
Reading Primary and Secondary Research ······ 180
Lesson 5 International Cultural Sensitivity and Awareness ······ 182
Reading Culture and International Trade ······ 185

**Chapter Eight Computer and Application ······ 187**

Lesson 1 Computer basic ······ 187
Reading Software ······ 190
Lesson 2 Internet Basic ······ 192
Reading Network advantages and challenges ······ 195
Lesson 3 The Future of Wireless Communications ······ 196
Reading Technological Basics of Using Computers to Communicate ······ 200
Lesson 4 E-Commerce Basics ······ 202
Reading Electronic wallets ······ 205
Lesson 5 Features of a DBMS ······ 207
Reading New Approaches for DBSM: Mining, Warehouses ······ 211

**References ······ 214**

# *Chapter One*

# Fundamentals of Mechanical Engineering

## Lesson 1  Properties of Materials

### Text

One material can often be distinguished from another ***by means of***[1] physical properties, such as color, density, specific heat, coefficient of thermal expansion, thermal and electrical conductivity, magnetic properties, and melting point. Some of these, for example thermal conductivity, electrical conductivity, and density, may be of prime importance in selecting material for certain specific uses. Those properties that describe how a material reacts to mechanical usage, ***however, are often more important to the engineer in selecting materials in connection with design***[2]***. These mechanical properties relate to how the material will react to the various loadings during service.***[3]

Mechanical properties are the characteristic responses of a material to applied forces. These properties fall into five broad categories: strength, hardness, elasticity, ductility, and toughness.

(1) Strength is the ability of a material to resist applied forces. Bridges girders, elevator cables, and building beams all must have this property.

(2) Hardness is the ability of a material to resist abrasion. Cutting tools, files, and drills must resist abrasion, or wear. Armor plate, crushing machinery, and metal rolls for steel mills all must resist penetration.

(3) Elasticity is the ability to spring back to original shape. Auto bumpers and all springs should have this quality.

(4) Ductility is the ability to undergo permanent changes of shape without

1. 根据……相区别

2. 因此，在选择与设计有关的材料时，（那些）描述材料机械性能的特性对工程师更为重要。

3. 这些机械性能关系到加工时，材料对各种负载的反应。

rupturing. Modern, deep-formed auto bodies and fenders and other stamped and formed products must have this property.

(5) Toughness is the ability to absorb mechanically applied energy. Strength and ductility determine a material's toughness. Toughness is needed in railroad cars, automobile axles, hammers rails and similar products.

## New Words and Phrases

| | | |
|---|---|---|
| fundamental | [ˌfʌndəˈmentl] | *adj.* 基础的，基本的；*n.* 基本原理 |
| distinguish | [disˈtiŋgwiʃ] | *v.* 区别，辨别 |
| density | [ˈdensiti] | *n.* 密度 |
| specific heat | | 比热 |
| coefficient | [kəuiˈfiʃənt] | *n.* 系数 |
| conductivity | [ˌkɔndʌkˈtiviti] | *n.* 传导性，传导率 |
| melt | [melt] | *v.* (使)融化，(使)熔化，使软化 |
| category | [ˈkætigəri] | *n.* 种类 |
| ductility | [dʌkˈtiliti] | *n.* 展延性，柔软性 |
| toughness | [ˈtʌfnis] | *n.* 韧性，坚韧 |
| abrasion | [əˈbreiʒən] | *n.* 磨损 |
| girder | [ˈgəːdə] | *n.* 桁(架)，(大,纵,横)梁 |
| file | [fail] | *n.* 文件，锉刀；*vi.* 用锉刀锉 |
| armor | [ˈɑːmə] | *n.* 装甲 |
| bumper | [ˈbʌmpə] | *n.* 缓冲器，减震器 |
| stamp | [stæmp] | *n.* 邮票，印，图章；*v.* 压印，冲压 |
| penetration | [peniˈtreiʃən] | *n.* 穿过，渗透，突破 |
| fender | [ˈfendə] | *n.* 防卫物，挡泥板 |
| relate to | | 涉及，有关系 |
| mill | [mil] | *n.* 磨粉机，磨床，工厂；*vt.* 碾磨 |
| in connection with | | 与……结合，关于 |

## Exercise

**Ⅰ Match the property with the correct definition by connecting lines.**

| PROPERTY | DEFINITION |
|---|---|
| 1. Strength | a. the ability to absorb mechanically applied energy |
| 2. Hardness | b. the ability of a material to resist applied forces |
| 3. Elasticity | c. the ability to undergo permanent changes of shape without rupturing |
| 4. Ductility | d. the ability to spring back to original shape |
| 5. Toughness | e. the ability of a material to resist penetration and abrasion |

**Ⅱ Choose proper material property to complete the following sentences.**

1. Bridges girders, elevator cables, and building beams all must have ________.

2. Cutting tools, files, and drills must resist abrasion, or wear. Armor plate, crushing machinery, and metal rolls for steel mills all must resist penetration, so they should have ________.
3. Auto bumpers and all springs should have ________.
4. Modern, deep-formed auto bodies and fenders and other stamped and formed products must have ________.
5. ________ and ________ determine a material's toughness. ________ is needed in railroad cars, automobile axles, hammers rails and similar products.
a. Ductility b. Strength c. Hardness d. Toughness e. Elasticity

# Reading Metals and Alloys

The various type of materials used engineering practice include, among others, metals, alloys, and polymers. Of these metals and alloys are commonly used.

Strictly speaking, metals are chemical elements. Iron, copper, and aluminum are some examples. Metals are rarely used in pure form, and the desired properties are normally obtained by suitably alloying different metals. An alloy is a mixture of two or more metals. Usually it consists of a base metal (the largest part of the alloy) and a smaller amount of other metals. Brass, for instance, is an alloy of copper (the base metal) and zinc. Steel is an alloy of iron and carbon. In engineering metals and alloys are usually called metals. Materials are divided into two groups: the ferrous, which contain a large percentage of iron, and the nonferrous, which contain no iron.

The most important characteristics of metal are its mechanical properties, such as strength, hardness, elasticity, ductility, and toughness. Strength is the ability of a metal to resist penetration and abrasion. Elasticity is the ability of a metal to return to its original shape after the applied force is removed. Ductility is the ability to undergo permanent change of shape without rupture. Toughness is the ability to absorb mechanically applied energy. Strength and ductility determine a material's toughness.

Metals for any manufactured part or machine have various properties so that it is often difficult to decide the proper metal for a given job. One metal may have higher strength, another better corrosion property, and yet another may be more economical. Hence, most choices are a compromise among a large number of metals, using the best engineering data available.

## New Words and Phrases

ceramics [si'ræmiks] *n.* 陶瓷，制陶业
polymer ['pɔlimə] *n.* 聚合物，聚酯
aluminum [ə'lju:minəm] *n.* 铝
alloy ['ælɔi] *n.* 合金; *vt.* 使成合金
brass [brɑ:s] *n.* 黄铜，黄铜制品
zinc [ziŋk] *n.* 锌; *vt.* 涂锌于

ferrous ['ferəs] *adj*. 含铁的，亚铁的

compromise ['kɔmprəmaiz] *n. v*. 妥协，折中，协调

# Lesson 2 Classification of Steels

## Text

Steel may be classified into two groups: plain carbon steels and alloy steels.

1. Plain carbon steels

Plain carbon steels may be classified as those that contain only carbon and no other major alloying element. They are divided into three categories: low-carbon steel, medium-carbon steel, and high-carbon steel.

Low-carbon steel contains from 0.02 to 0.30 percent carbons by mass. Because of the low carbon content, this type of steel cannot be hardened but can be case-hardened. ***Machine steel and cold-rolled steel, which contain from 0.08 to 0.30 percent carbon, are the most common low-carbon steels.***[1] These steels are commonly used in machine shops for the manufacture of parts that do not have to be hardened. Items such as bolts, nuts, washers, sheet steel, and shafts are made of low-carbon steel.

1. 含碳0.08%~0.3%的机件钢和冷轧钢是最常见的低碳钢。

Medium-carbon steel contains from 0.30 to 0.60 percent carbons and is used where greater tensile strength is required. Because of the higher carbon content, this steel can be hardened, which makes it ideal for steel forging. ***Tools such as wrenches, hammers, and screwdrivers are drop-forged from medium-carbon steel and later heat treated.***[2]

2. 如扳手、锄头以及丝锥这样的工具就是对中碳钢进行锤锻，再进行热处理得来的。

High-carbon steel, also known as tool steel, contains over 0.60 percent carbon and may range as high as 1.7 percent. This type of steel is used for cutting tools, punches, taps, dies, drills, and reamers. It is available in hot-rolled stock or in finish-ground flat stock and drill rod.

2. Alloy Steels

Often certain steels are needed which have special characteristics that a plain carbon steel would not possess. It is then necessary to choose alloy steel.

***Alloy steel may be defined as steel containing other elements, in addition to carbon, that produce the desired qualities in the steel.***[3] The addition of alloying elements may impart one or more of the following properties to the steel:

3. 合金钢可以定义为含有除碳元素以外的其他元素的钢，这些元素使钢具有了（人们）想要的性能。

(1) Increase in tensile strength

(2) Increase in hardness

(3) Increase in toughness

(4) Alteration of the critical temperature of the steel

(5) Increase in wear abrasion

(6) Red hardness

(7) Corrosion resistance

(8) High-strength, low-alloy steels

A recent development in the steelmaking industry is that of the high-strength, low-alloy (HSLA) steels. ***These steels, containing a maximum carbon content of 0.28 percent and small amounts of vanadium, columbium, copper, and other alloying elements, offer many advantages over the regular low-carbon construction steels.***[4] Some of these advantages are:

4. 这些钢，其最大含碳量可达 0.28%，并含有少量的钒、铌、铜和其他元素，其许多优点超过普通低碳结构钢。

(1) Higher strength than medium-carbon steels.

(2) Less expensive than other alloy steels.

(3) Strength properties are "built into" the steel, and no further heat treating is needed.

(4) Bars of smaller cross-sections can do the work of larger, regular-carbon steel bars.

(5) Higher hardness, toughness (impact strength), and fatigue failure limits than carbon steel bars.

(6) May be used unpainted because they develop a protective oxide coating on exposure to the atmosphere.

## New Words and Phrases

| | |
|---|---|
| carbon ['kɑːbən] | *n.* 碳，石墨 |
| content ['kɔntent] | *n.* 含量，内容，容量 |
| cold-roll | 冷轧 |
| bolt [bəult] | *n.* 螺栓，螺钉；*v.* 用螺栓固定 |
| nut [nʌt] | *n.* 螺母 |
| washer ['wɔʃə(r)] | *n.* 垫圈，垫片 |
| wrench [rentʃ] | *n.* 扳钳，扳手；*v.* 使扭伤 |
| screwdriver ['skruːdraivə(r)] | *n.* 起子，改锥 |
| drop-forge | *v.* 模锻，落锤锻 |
| tap [tæp] | *n.* 丝锥，螺丝攻 |
| die [dai] | *n.* 板牙，冲模 |
| reamer ['riːmə(r)] | *n.* 铰刀 |
| stock [stɔk] | *n.* 料，轧件，毛坯 |
| hot-rolled | 热轧 |
| tensile ['tensail] | *adj.* 张力的，拉力的 |
| alteration [ɔːltə'reiʃ(ə)n] | *n.* 变更，改造 |
| corrosion [kə'rəuʒ(ə)n] | *n.* 侵蚀，腐蚀状态 |
| vanadium [və'neidiəm] | *n.* 钒，铅矿 |
| columbium [kə'lʌmbiəm] | *n.* 铌 |
| bar [bɑː(r)] | *n.* 条，棒 |
| cross-section | *n.* 横截面 |
| copper ['kɔpə(r)] | *n.* 铜 |
| oxide ['ɔksaid] | *n.* 氧化物 |

exposure [ik'spəuʒə(r)] n. 暴露

atmosphere ['ætməsfiə(r)] n. 大气，空气

red-hardness n. 红热硬性

fatigue [fə'ti:g] n. 疲劳; vt.使疲劳

## Exercises

**I Comprehension.**

1. According to the article, how are the plain carbon steel classified?
2. Describe why low-carbon steel cannot be hardened?
3. State the carbon content of and two uses for: (a) low-carbon steel; (b) high-carbon steel.
4. Define the term "alloy steel".
5. List six properties that alloying elements may impart to steel.

**II From the answers a, b, c or d, choose the best answers to complete the following statements.**

1. Plain carbon steels may be divided into ________.

   a. low-carbon steel    b. medium-carbon steel

   c. super-carbon steel    d. high-carbon steel

2. Medium-carbon steel contains ________ carbon.

   a. from 0.02 to 0.30 percent    b. from 0.02 to 0.60 percent

   c. from 0.03 to 0.60 percent    d. from 0.3 to 0.8 percent

3. ________ is known as tool steel.

   a. Plain carbon steel    b. Low-carbon steel

   c. Medium-carbon steel    d. High-carbon steel

4. When we need certain steels which have special characteristics that a plain carbon steel would not posses, we may ________.

   a. increase the carbon content of steel    b. decrease the carbon content of steel

   c. choose an alloy steel    d. choose one type of plain carbon steels

5. The addition of alloying elements may impart one or more of the following properties to steel, except for ________.

   a. increase in tensile strength    b. red hardness

   c. increase in density    d. increase in toughness

# Reading Machinability of Metals

Machinability describes the ease or difficulty with which a metal can be machined. Such factors as cutting-tool life, surface finish produced, and power required must be considered. Machinabiity has been measured by the length of cutting-tool life in minutes, or by the rate of stock removal in relation to the cutting speed employed, that is, depth of cut. For finish cuts, machinability refers to the life of the cutting tool and the ease with which a good surface finish is produced.

**Low-carbon** (Machine) **Steel**

The microstructure of low-carbon steel may have large areas of ferrite (iron) interspersed with small areas of pearlite [Fig.1-1(a) and (b)]. Ferrite is soft, with high ductility and low strength, whereas pearlite, a combination of ferrite (iron) and iron carbide, has low ductility and high strength. When the amount of ferrite in steel is greater than pearlite—or the ferrite is arranged in alternate layers with pearlite [Fig.1-1(c) and (d))—the amount of power required to remove material increases and the surface finish produced is poor. Fig. 1-2 illustrates a more desirable microstructure in steel because the pearlite is well distributed, and the material is therefore better for machining purposes.

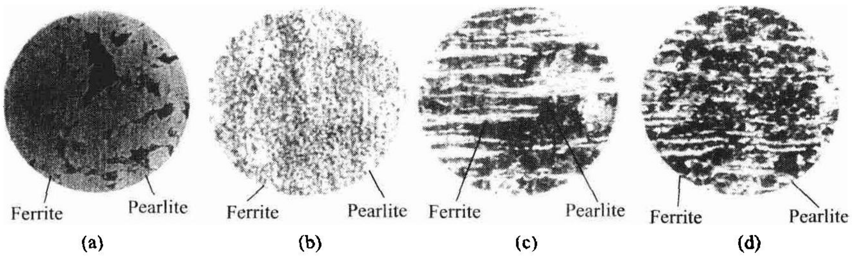


Fig. 1-1 Photomicrographs indicating undesirable steel microstructures

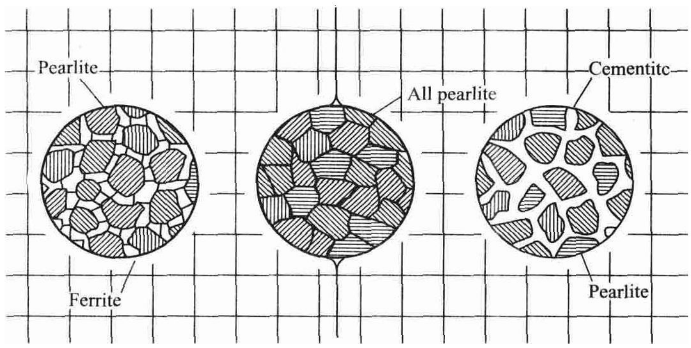


Fig. 1-2 Photomicrographs showing desirable microstructures in steel

**High-carbon** (Machine) **Steel**

A greater amount of pearlite is present in high-carbon (tool) steel because of the higher carbon content. The greater the amount of pearlite (low ductility and high strength) present in the steel, the more difficult it becomes to machine the steel efficiently. It is therefore desirable to anneal these steels to alter their microstructures and, as a result, improve their microstructures and, as a result, improve their machining qualities.

**Alloy Steel**

Alloy steels are combinations of two or more metals. These steels generally are slightly more difficult to machine than low-or high-carbon steels. To improve their machining qualities, combinations of sulfur and lead or sulfur and lead or sulfur and manganese in proper proportions are sometimes added to alloy steels. A combination of normalizing and annealing is also used with some types of alloy steels to create desirable machining characteristics. The machining of stainless steel, generally difficult because of its work-hardening qualities, can be greatly eased by the addition of selenium.

**Cast iron**

Cast iron, consisting generally of ferrite, iron carbide, and free carbon, forms an important group of materials used by industry. The microstructure of alloys, the method of casting, the rate of cooling, and by heat treating. White casting iron [Fig. 1-3(a)], cooled rapidly after casting, is usually hard and brittle because of the formation of hard iron carbide. Gray cast iron [Fig. 1-3(b)] is cooled gradually; its structure is composed of compound pearlite, a mixture of fine ferrite and iron carbide, and flakes of graphite. Because of the gradual cooling, it is softer and therefore easier to machine.

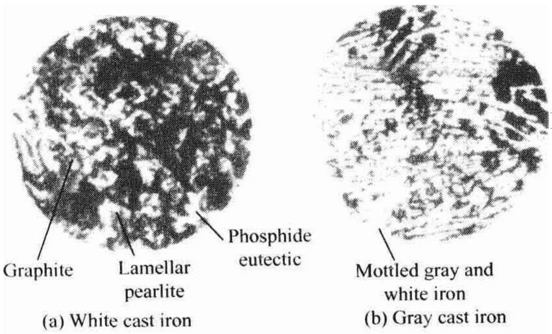


Fig. 1-3 The microstructure of cast iron

Iron carbide and the presence of sand on the outer surface of the casting generally make cast iron a little difficult to machine. Through annealing, the microstructure is altered. The iron carbide is broken down into graphitic carbon and ferrite; thus, the cast iron is easier to machine. The addition of silicon, sulfur, and manganese gives cast iron different qualities and improves its machinability.

**Aluminum**

Pure aluminum is generally more difficult to machine than most aluminum alloys. It produces long, stringy chips and is much harder on the cutting tool because of its abrasive nature.

Most aluminum alloys can be cut at high speeds, yielding a good surface finish and long tool life. Hardened and tempered alloys are generally easier to machine than annealed alloys and produce a better surface finish. Alloys containing silicon are more difficult to machine since the chips tear, rather than shear, from the work, thus producing a poorer surface finish. Cutting fluid is generally used when heavy cuts and feeds are used for machining aluminum or its alloys.

**Copper**

Copper is a heavy, soft, reddish-colored metal refined from copper ore (copper sulfide). It has high electrical and strength, and is easily welded, brazed, or soldered. It is very ductile and easily drawn into wire and tubing. Since copper work hardens readily, it must be heated at about 1200℉ (648.8℃)and quenched in water to anneal.

Because of its softness, copper does not machine well. The long chips produced in drilling and tapping tend to clog the flutes of the cutting tool and they must be cleared frequently. Sawing and milling operations require cutters with good chip clearance. Coolant should be used to minimize heat and aid the cutting action.

## New Words and Phrases

| | |
|---|---|
| machinability [məʃi:nə'biliti] | *n.* 机械加工性，切削性 |
| finish cut | 精加工,精切 |
| measure ['meʒə] | *n. v.* 测量,估量 |
| ferrite ['ferait] | *n.* (正)铁酸盐, (冶)铁素体 |
| intersperse [,intə(:)'spə:s] | *vt.* 散布，点缀 |
| pearlite ['pə:lait] | *n.* 珠光体 |
| brittle ['britl] | *adj.* 易碎的，脆弱的 |
| anneal [ə'ni:l] | *n.* 退火 |
| alter ['ɔ:ltə] | *v. n.* 改变 |
| microstructure ['maikrəu'strʌktʃə] | *n.* 显微结构 |
| sulfur ['sʌlfə] | *n.* 硫 |
| lead [li:d] | *n.* 石墨 |
| manganese [,mæŋgə'ni:z] | *n.* 锰 |
| normalizing ['nɔ:məlaiziŋ] | *n.* 常化，正火 |
| stainless steel | 不锈钢 |
| selenium [si'li:niəm] | *n.* 硒 |
| cast iron | *n.* 铸铁 |
| iron carbide | 渗碳体 |
| flake [fleik] | *n.* 薄片 |
| gradual cooling | 逐渐冷却，分段冷却 |
| aluminum ['lju:minəm] | *n.* 铝 |
| stringy ['striŋi] | *adj.* 纤维的 |
| ore [ɔ:(r)] | *n.* 矿石 |
| sulfide ['sʌlfaid] | *n.* 硫化物 |
| tear [tiə] | *v.* 撕破，拉掉，使分裂 |
| abrasive [ə'breisiv] | *n.* 研磨剂; *adj.* 研磨的 |
| copper ['kɔpə] | *n.* 铜 |