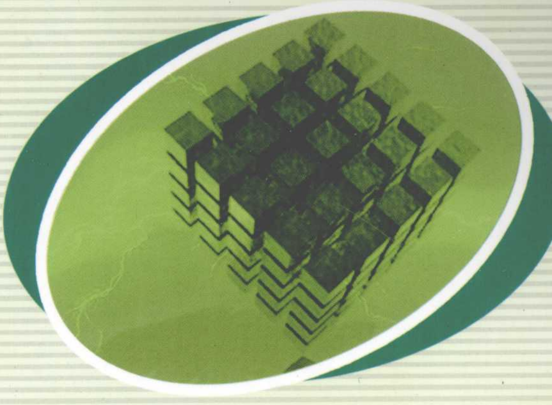
实用专业英语规划教材



机电工程英语

English for Mechanical and Electrical Engineering

冯 宁 主编

華中科技大學出版社
http://www.hustp.com

机电工程英语

主　编　冯　宁

编　者　宋春华　苏　雪

华中科技大学出版社

中国·武汉

图书在版编目(CIP)数据

机电工程英语/冯　宁　主编. —武汉:华中科技大学出版社,2009年2月
ISBN 978-7-5609-5062-4

Ⅰ.机…　Ⅱ.冯…　Ⅲ.机电工程-英语-高等学校-教材　Ⅳ.H31

中国版本图书馆CIP数据核字(2009)第001563号

机电工程英语　　**冯　宁　主编**

策划编辑:杨　欧
责任编辑:汪　漾　　封面设计:潘　群
责任校对:张　琳　　责任监印:熊庆玉

出版发行:华中科技大学出版社(中国·武汉)
武昌喻家山　邮编:430074　电话:(027)87557437

录　排:武汉正风图文照排中心
印　刷:荆州市今印印务有限公司

开本:787mm×1092mm　1/16　印张:9.5　字数:210 000
版次:2009年2月第1版　印次:2009年2月第1次印刷　定价:16.80元
ISBN 978-7-5609-5062-4/H·646

内容简介

本书是一本实用的机电专业英语教程，内容涵盖了机电专业基础理论和应用领域的相关知识，既考虑到机电专业的基本体系结构，又体现了机电领域的部分最新技术及发展方向。全书共分为6个部分，包括机械基础、机构知识、电学知识、自动化技术、数控和计算机数控等内容。每个部分还配有相关的阅读材料。

本书旨在提高学生的专业英语阅读能力，掌握机电专业常用的英语词汇，以及了解机电领域的最新技术应用。本书不但可用作高职高专机电类专业英语的教学用书，还可作为相关工程技术人员的参考用书。

前　　言

本书编写的目的是指导学生阅读与机电专业相关的英语书刊、文选，使学生在将来的工作中能够以英语为工具，获得相关的专业知识和产品信息，并在完成基础英语课程后，通过学习本教材保持英语学习的连续性，使英语水平再上一个台阶。

本书根据机电专业本身的特点，在选材上注重代表性和广泛性，涵盖了机械工程、电子电气、自动化控制、数控与计算机数控等几个部分的内容。每个部分又分为基本单元和阅读材料两部分，基本单元的选材主要体现专业英语的基本特点以及机电专业所涉及的主要专业知识和应用领域；阅读材料部分的选材涉及机电领域的一些最新技术应用，主要是为了扩展学生的视野。

作为专业英语教材，本书重点在于帮助学生在专业英语词汇的学习过程中提高科技英语阅读能力，力求做到专业性、科普性、趣味性的统一，尽量减少阅读中的专业知识障碍。

参与本书编写的有广东机电职业技术学院冯宁，广东交通职业技术学院宋春华，武汉铁路职业技术学院苏雪。其中 Part Ⅰ、Part Ⅱ、Part Ⅲ、Part Ⅳ 由冯宁编写，Part Ⅴ 由宋春华编写，Part Ⅵ 由苏雪编写。

本书由冯宁担任主编。在编写、整理和定稿过程中，得到了许多同行的指点，特别是得到了华中科技大学出版社杨鸥副编审的支持和帮助，在此表示衷心的感谢！本书参考了大量的国内外文献，对提供文献的作者，我们表示最诚挚的谢意！

由于作者水平有限，本书错误和不当之处在所难免，敬请读者批评指正！

编　者

2008 年 12 月

目 录

Part Ⅰ Fundamentals of Machinery

Unit 1 Engineering Drawing ······ (1)
Unit 2 Tolerances and Surface Roughness ······ (7)
Unit 3 Mechanical Properties of Metals ······ (10)
Unit 4 Hydraulic System ······ (15)
Reading Materials Ⅰ ······ (18)
1. Heat Treatment of Steel ······ (18)
2. Classification of Steels ······ (20)
3. Pressure-Control Valves and Flow-Control Valves ······ (22)
4. Benefits of a Quality System ······ (23)

Part Ⅱ The Knowledge of Mechanisms

Unit 5 Mechanisms ······ (25)
Unit 6 Mechanical Components ······ (29)
Unit 7 Engine Lathe ······ (36)
Reading Materials Ⅱ ······ (40)
5. Types of Gear ······ (40)
6. Ball and Roller Bearings ······ (42)
7. Milling Machines ······ (45)

Part Ⅲ The Knowledge of Electric Circuits

Unit 8 Circuit Elements and Parameters ······ (50)
Unit 9 Alternating Current ······ (54)
Unit 10 Types of the DC Motor ······ (60)
Reading Materials Ⅲ ······ (63)
8. Three-phase Circuits ······ (63)
9. Integrated Circuit ······ (65)
10. Printed Circuit ······ (69)

Part Ⅳ Technique of Automation

Unit 11 Fundamental of Computer and Networks ······ (71)
Unit 12 Fundamentals of Single-chip Microcomputers ······ (75)
Unit 13 Control Devices and PLC ······ (79)
Unit 14 Sensors and Transmitters ······ (84)

Reading Materials Ⅳ …… (86)
11. Fieldbus …… (86)
12. Open-Loop and Closed-Loop Control …… (88)
13. Computer-control …… (90)

Part Ⅴ NC and CNC

Unit 15 Construction of CNC Machines …… (94)
Unit 16 NC Programming …… (100)
Unit 17 Safety and Maintenance of CNC Machine …… (105)
Reading Materials …… (108)
14. CAD/CAM …… (108)
15. Industrial Robots …… (109)
16. FMS …… (111)
17. CIMS …… (112)

Part Ⅵ Writing and Grammar for Science and Technology in English

Unit 18 Writing …… (114)
Unit 19 Grammar …… (124)
附录 词汇表 …… (136)
参考文献 …… (144)

Part Ⅰ Fundamentals of Machinery

Unit 1 Engineering Drawing

An engineering drawing is a type of drawing that is technical in nature, used to fully and clearly define requirements for engineered items, and is usually created in accordance with standardized conventions for layout, nomenclature, interpretation, appearance (such as typefaces and line styles), size, etc. [1] Its purpose is to accurately and unambiguously capture all the geometric features of a product or a component. The end goal of an engineering drawing is to convey all the required information that will allow a manufacturer to produce that component.

Engineering drawings are often referred to as "blueprints" or "bluelines". However, the terms are rapidly becoming an anachronism, since most copies of engineering drawings that were formerly made using a chemical-printing process that yielded graphics on blue-colored paper or, alternatively, of blue-lines on white paper, have been superseded by more modern reproduction processes that yield black or multicolour lines on white paper.

The process of producing engineering drawings (Fig. 1-1), and the skill of producing them is often referred to as technical drawing, although technical drawings are also required for disciplines that would not ordinarily be thought of as parts of engineering.

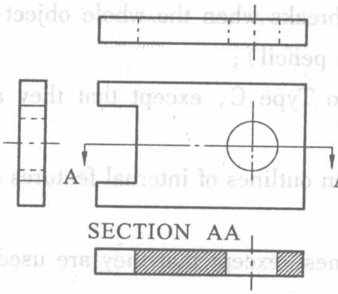


Fig. 1-1 Example of an engineering drawing

Common Features of Engineering Drawings

Drawings convey the following critical information:

- **Geometry** indicates the shape of the object; represented as views; how the object will look when it is viewed from various standard directions, such as front, top, side, etc.;

- **Dimensions** indicate the size of the object is captured in accepted units;
- **Tolerances** indicate the allowable variations for each dimension;
- **Material** represents what the item is made of;
- **Finish** specifies the surface quality of the item, functional or cosmetic. For example, a mass-marketed product usually requires a much higher surface quality than, say, a component that goes inside industrial machinery.

Line Styles and Types

A variety of line styles graphically represent physical objects. Types of lines include the following:

- **Visible** are continuous lines used to depict edges directly visible from a particular angle;
- **Hidden** are short-dashed lines that may be used to represent edges that are not directly visible;
- **Center** are alternately long-and short-dashed lines that may be used to represent the axes of circular features;
- **Cutting plane** are thin, medium-dashed lines, or thick alternately long-and double short-dashed that may be used to define sections for section views;
- **Section** are thin lines in a pattern (pattern determined by the material being "cut" or "sectioned") used to indicate surfaces in section views resulting from "cutting". Section lines are commonly referred to as "cross-hatching".

Lines can also be classified by a letter classification in which each line is given a letter:

- **Type A** lines show the outline of the feature of an object. They are the thickest lines on a drawing and done with a pencil softer than HB;
- **Type B** lines are dimension lines and are used for dimensioning, projecting, extending, or leaders. A harder pencil should be used, such as a 2H;
- **Type C** lines are used for breaks when the whole object is not shown. They are freehand drawn and only for short breaks(2H pencil);
- **Type D** lines are similar to Type C, except that they are zigzagged and only for longer breaks(2H pencil);
- **Type E** lines indicate hidden outlines of internal features of an object. They are dotted lines (2H pencil);
- **Type F** lines are Type F lines, except that they are used for drawings in electrotechnology (2H pencil);
- **Type G** lines are used for centre lines. They are dotted lines, but a long line of 10mm ~ 20mm, then a gap, then a small line of 2mm(2H pencil);
- **Type H** lines are the same as Type G, except that every second long line is thicker. They indicate the cutting plane of an object(2H pencil);
- **Type K** lines indicate the alternate positions of an object and the line taken by that object. They are drawn with a long line of 10mm ~ 20mm, then a small gap, then a small line of 2mm, then

a gap, then another small line(2H pencil).

Multiple Views and Projections

In most cases, a single view is not sufficient to show all necessary features, and several views are used. Types of views include the following.

1. Orthographic projection

The symbols are used to define a projection in first angle (left) or third angle (right). ②

"Orthographic" comes from the Greek word for "straight writing (or drawing)". This projection shows the object as it looks from the front, right, left, top, bottom, or back, and are typically positioned relative to each other according to the rules of either first-angle of third-angle projection.

First angle projection(Fig. 1-2) is the ISO standard and is primarily used in Europe and Asia. The 3D object is projected into 2D "paper" space as if you were looking at an X-ray of the object: the top view is under the front view; the right view is at the left of the front view.

Third angle projection is primarily used in the United States and Canada, where the left view is placed on the left and the top view on the top.

Not all views are necessarily used, and determination of what surface constitutes the front, back, top and bottom varies depending on the projection used.

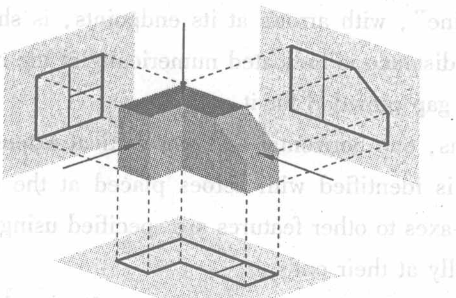


Fig. 1-2 Image of a part represented in first angle projection

2. Section

Depicts what the object would look like if it were cut perfectly along cutting plane lines defined in a particular view, and rotated 90° to directly view the resulting surface(s), which are indicated with section lines. They show features not externally visible, or not clearly visible.

3. Detail

Shows portions of other views, "magnified" for clarity.

4. Auxiliary projection

Similar to orthographic projections, however, the directions of viewing are other than those for orthographic projections.

5. Isometric projection

An isometric view of the object in Fig. 1-1 shows the object from angles in which the scales along each axis of the object are equal(Fig. 1-3). It corresponds to rotation of the object by ±45° about the vertical axis, followed by rotation of approximately ±35.264° [= arcsin(tan(30°))] about the horizontal axis starting from an orthographic projection view. "Isometric" comes from the Greek for "same measure". One of the things that make isometric drawings so attractive is the ease with which 60 degree angles can be constructed with only a compass and straightedge. ③

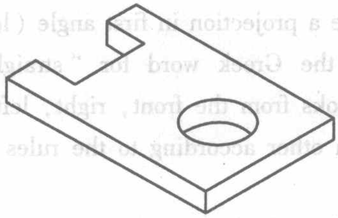


Fig. 1-3 Isometric view of the object in Fig. 1-1

Showing Dimensions

The required sizes of features are conveyed through use of dimensions. Distances may be indicated with either of two standardized forms of dimension: linear and ordinate.

With linear dimensions, two parallel lines, called "extension lines", spaced at the distance between two features, are shown at each of the features. ④ A line perpendicular to the extension lines, called a "dimension line", with arrows at its endpoints, is shown between, and terminating at, the extension lines. The distance is indicated numerically at the midpoint of the dimension line, either adjacent to it, or in a gap provided for it.

With ordinate dimensions, one horizontal and one vertical extension line establish an origin for the entire view. The origin is identified with zeroes placed at the ends of these extension lines. Distances along the x- and y-axes to other features are specified using other extension lines, with the distances indicated numerically at their ends.

Sizes of circular features are indicated using either diametral or radial dimensions. Radial dimensions use an "R" followed by the value for the radius; diametral dimensions use a circle with forward-leaning diagonal line through it, called the diameter symbol, followed by the value for the diameter. A radially-aligned line with arrowhead pointing to the circular feature, called a leader, is used in conjunction with both diametral and radial dimensions. All types of dimensions are typically composed of two parts: the nominal value, which is the "ideal" size of the feature, and the tolerance, which specifies the amount that the value may vary above and below the nominal.

Sizes of Drawings

Sizes of drawings typically comply with either of two different standards, ISO(World Standard) or U. S. customary.

The metric drawing sizes correspond to international paper sizes. These developed further refinements in the second half of the twentieth century, when photocopying became cheap. Engineering drawings could be readily doubled (or halved) in size and put on the next larger (or, respectively, smaller) size of paper with no waste of space. And the metric technical pens were chosen in sizes so that one could add detail or drafting changes with a pen of double (or half) the width to the copy.

The U. S. customary "A-size" corresponds to "letter" size, and "B-size" corresponds to "ledger" or "tabloid" size. There were also once British paper sizes, which went by names rather than alphanumeric designations.

Words and Expressions

layout *n.* 布局图,设计图案,版面设计,规划
nomenclature *n.* 命名法,术语
typeface *n.* 字体,字样
unambiguously *adv.* 明白地,不含糊地
blueprint *n.* 蓝图, 设计图, 计划
view *n.* 视图
tolerance *n.* 公差,容忍,容许量
depict *vt.* 描述, 描写
visible *adj.* 看得见的, 明显的, 显著的
section *n.* 截面,部分, 断片, 部件
freehand *n.* 徒手画
zigzagged *adj.* 呈"之"字形移动的
electrotechnology *n.* 电工学
projection *n.* 投影,发射
orthographic *adj.* 正交的,[语]正字法的,拼字正确的
auxiliary *adj.* 辅助的,补助的
isometric *adj.* 等大的,等容积的
horizontal *adj.* 水平的,地平线的
straightedge *n.* 画直线用尺
compass *n.* 罗盘,指南针,圆规
dimension *n.* 尺寸,尺度,维(数),度(数),元
linear *adj.* 线的,直线的,线性的
ordinate *n.* [数]纵线,纵坐标
parallel *adj.* 平行的,相同的
perpendicular *adj.* 垂直的,正交的; *n.* 垂线
vertical *adj.* 垂直的, 直立的, 顶点的; *n.* 垂直线, 垂直面
diametral *adj.* 直径的
radial *adj.* 光线的, 光线状的, 放射状的, 半径的; *n.* 光线, 射线

Notes

1. An engineering drawing is a type of drawing that is technical in nature, used to fully and clearly define requirements for engineered items, and is usually created in accordance with standardized conventions for layout, nomenclature, interpretation, appearance (such as typefaces and line styles), size, etc.

   译文: 工程制图本质上是一种技术制图,它通常在(图纸的)布局、名词术语、(技术)说明、外观(比如字体和线型等)、尺寸等方面按标准的规范来绘制,用来清楚和全面地定义工程项目的要求。

2. The symbols are used to define a projection in first angle (left) or third angle (right).

   译文: 正交投影是从第一角(从左看)或第三角(从右看)来定义的投影。

3. With linear dimensions, two parallel lines, called "extension lines", spaced at the distance between two features, are shown at each of the features.

   译文: 每一个特征都有一个线性尺寸,它标注在该特征两端的两条平行的尺寸引出线之间。

4. One of the things that make isometric drawings so attractive is the ease with which 60 degree angles can be constructed with only a compass and straightedge.

   译文: 等角投影图如此具有吸引力的一个因素是只用圆规和绘图直尺就能轻松构造 60 度视角的视图。

Exercises

Ⅰ. Translate the following sentences into Chinese.

1. It corresponds to rotation of the object by ± 45° about the vertical axis, followed by rotation of approximately ± 35.264° [= arcsin(tan(30°))] about the horizontal axis starting from an orthographic projection view.
2. Distances may be indicated with either of two standardized forms of dimension: linear and ordinate.
3. A line perpendicular to the extension lines, called a "dimension line", with arrows at its endpoints, is shown between, and terminating at, the extension lines.

Ⅱ. Fill in the missing words according to the text.

1. The end goal of an engineering drawing is to ________ all the required information that will ________ a manufacturer to produce that component.
2. Engineering drawings are often referred to as ________ or ________.
3. First angle projection is the ISO standard and is primarily used in ________ and ________.
4. The required sizes of features are conveyed through use of ________.
5. Sizes of circular features are indicated using either ________ or ________ dimensions.
6. Sizes of drawings typically comply with either of two different standards, the U. S. customary ________ or ________ .

Ⅲ. **Answer the following questions according to the text.**

1. Is it true that blueprints were formerly made only by using a chemical-printing process that yielded graphics on blue-colored paper?
2. What common features do engineering drawings have?
3. Which type of line shows the outline of the feature of an object?
4. Distinguish between first-angle and third-angle projection.
5. What views and projections are mentioned according to the text?

Unit 2 Tolerances and Surface Roughness

Today's technology requires that parts be specified with increasingly exact dimensions. Many parts made by different companies at widely separated locations must be interchangeable, which requires precise size specifications and production.①

The technique of dimensioning parts within a required range of variation to ensure interchangeability is called tolerance. ② Each dimension is allowed a certain degree of variation within a specified zone, or tolerance. For example, a part's dimension might be expressed as 20 ± 0.50, which allows a tolerance (variation in size) of 1.00mm.

A tolerance should be as large as possible without interfering with the function of the part to minimize production costs. Manufacturing costs increase as tolerance became smaller.

There are three methods of specifying tolerance on dimensions: unilateral, bilateral and limit forms. When plus-or-minus tolerance is used, it is applied to a theoretical dimension called the basic dimension. When dimensions can vary in only one direction from the basic dimension (either larger or smaller), tolerancing is unilateral. Tolerancing that permits its variation in both directions from the basic dimension (larger and smaller) is bilateral.

Tolerances may also be given in limit form, with dimensions representing the largest and smallest sizes for a feature. ③

Some tolerancing terminology and definitions are given below:

- **Tolerance** is the difference between the limits prescribed for a single feature;
- **Basic size** is the theoretical size, from which limits or deviations are calculated;
- **Deviation** is the difference between the hole or shaft size and the basic size;
- **Upper deviation** is the difference between the maximum permissible size of a part and its basic size;
- **Lower deviation** is the difference between the minimum permissible size of a part and its basic size;
- **Actual size** is the measured size of the finished part;
- **Fit** is the tightness between two assembled parts. The three types of fit are: clearance, interference and transition;
- **Clearance fit** is the clearance between two assembled mating parts;

• **Interference fit** results in an interference between the two assembled parts—the shaft is larger than the hole, requiring a force or press fit, an effect similar to welding the two parts;

• **Transition fit** may result in either an interference or a clearance between the assembled parts—the shaft may be either smaller or larger than the hole and still be within the prescribed tolerances;

• **Selective assembly** is a method of selecting and assembling parts by trial and error and by hand, allowing parts to be made with greater tolerances at less cost as a compromise between a high manufacturing accuracy and ease of assembly.

The basic hole system utilizes the smallest hole size as the basic diameter for calculating tolerances and allowances. The basic hole system is efficient when standard drills, reamers and machine tools are available to give precise hole sizes. The smallest hole size is the basic diameter because a hole can be enlarged by machining but not reduced in size.④

The basic shaft system is applicable when shafts are available in highly precise standard sizes. The largest diameter of the shaft is the basic diameter for applying tolerances and allowances. The largest shaft size is used as the basic diameter because shafts can be machined to a smaller size but not enlarged.

• **International Tolerance (IT) grade**: a series of tolerances that vary with basic size to provide a uniform level of accuracy within a given grade. There are 18 IT grades.

• **Tolerance symbols**: notes giving the specifications of tolerances and fits, the basic size is a number, followed by the fundamental deviation letter and the IT number, which combined give the tolerance zone, uppercase letters indicate the fundamental deviations for holes, and lowercase letters indicate fundamental deviations for shafts.

Because the surface texture (or surface finish) of a part affects its function, it must be precisely specified. Surface texture is the variation in a surface, including roughness, waviness, lay and flaws.

• **Roughness**: the finest of the irregularities in the surface caused by the manufacturing process used to smooth the surface. Roughness height is measured in micrometers (μm) or microinches (μin).

• **Waviness**: a widely spaced variation that exceeds the roughness width cutoff measured in inches or millimeters, roughness may be regarded as a surface variation superimposed on a wavy surface.

• **Lay**: the direction of the surface pattern caused by the production method used.

• **Flaws**: defects occurring infrequently or at widely varying intervals on a surface, including cracks, blow holes, checks, scratches and the like; the effect of flaws is usually omitted in roughness height measurements.

Words and Expressions

surface roughness　表面粗(糙)度

plus-or-minus　*adj.* 正或负

theoretical dimension 理论尺寸
basic dimension 基准尺寸
deviation *n.* 偏差(偏差数)
finished part 加工完的零件,成品零件
interference *n.* 冲突,干涉
by trial and error 用试凑法,用试配法
basic hole system 基孔制
basic shaft system 基轴制
allowance *n.* 容限,(加工)余量
uppercase *n.* 大写
lowercase *n.* 小写
cutoff *n.* 截止,断开,中止
waviness *n.* 波纹形
superimpose *v.* 重叠,叠加

Notes

1. Many parts made by different companies at widely separated locations must be interchangeable, which requires precise size specifications and production.

   译文:由分散在广大地区的不同的公司生产的大量零件必须具有互换性,这就要求这些零件的规格说明和制造必须有精确的尺寸。

2. The technique of dimensioning parts within a required range of variation to ensure interchangeability is called tolerance.

   译文:为了保证互换性而把零件的尺寸限定在要求的变化范围内,这种技术叫公差。

3. Tolerances may also be given in limit form, with dimensions representing the largest and smallest sizes for a feature.

   译文:公差也可以以极限的形式给出,给出一个特征的最大尺寸和最小尺寸。

4. The smallest hole size is the basic diameter because a hole can be enlarged by machining but not reduced in size.

   译文:孔的最小尺寸是基准尺寸,因为一个孔的尺寸可以加工扩大但是不能够缩小。

Exercises

Ⅰ. Translate the following words and phrases into Chinese.

1. Tolerance 2. Basic size 3. Upper deviation
4. Lower deviation 5. Actual size 6. Clearance fit
7. Interference fit 8. Transition fit 9. Selective assembly
10. Roughness 11. International Tolerance (IT) grade

Ⅱ. Translate the following sentences into Chinese.

1. Today's technology requires that parts be specified with increasingly exact dimensions.

2. When plus-or-minus tolerancing is used, it is applied to a theoretical dimension called the basic dimension.
3. The basic hole system utilizes the smallest hole size as the basic diameter for calculating tolerances and allowances.
4. Surface texture is the variation in a surface, including roughness, waviness, lay and flaws.

Ⅲ. Fill in the missing words according to the text.

1. The technique of dimensioning parts within a required range of ________ to ensure ________ is called tolerance.
2. A tolerance should be as ________ as possible without interfering with the function of the part to ________ production costs.
3. Manufacturing costs ________ as tolerance became smaller.
4. Roughness height is measured in ________ or ________.

Ⅳ. Answer the following questions according to the text.

1. Explain the meaning: tolerance 20 ± 0.30.
2. What methods can specify tolerance on dimensions?
3. A part's dimension is expressed as 25 ± 0.6, please figure out the largest and smallest sizes.
4. State the definition of transition fit.

Unit 3　Mechanical Properties of Metals

The mechanical properties of metals determine the range of usefulness of the metal and establish the service that can be expected. Mechanical properties are also used to help specify and identify metals. The most common properties considered are strength, hardness, ductility, and impact resistance.

1. Strength

The strength of a metal is its ability to withstand the action of external forces without breaking. Tensile strength, also called ultimate strength, is the maximum strength developed in a metal in a tension test. The tension test is a method for determining the behavior of a metal under an actual stretch loading. This test provides the elastic limit, elongation, yield point, yield strength, tensile strength, and the reduction in area. Tensile tests are normally taken at standardized room temperatures but may also be made at elevated temperatures.

Many tensile testing machines are equipped to plot a curve which shows the load or stress and the strain or movement that occurs during the test operation (Fig. 3-1). ① In the testing operation the load is increased gradually and the specimen will stretch or elongate in proportion to the tensile load.

The specimen will elongate in direct proportion to the load during the elastic portion of the curve to point A. At this point, the specimen will continue to elongate but without an increase in the load. This is known as the yield point of the steel and is the end of the elastic portion. At any point up to point A if the load is eliminated, the specimen will come back to its original dimension. ②