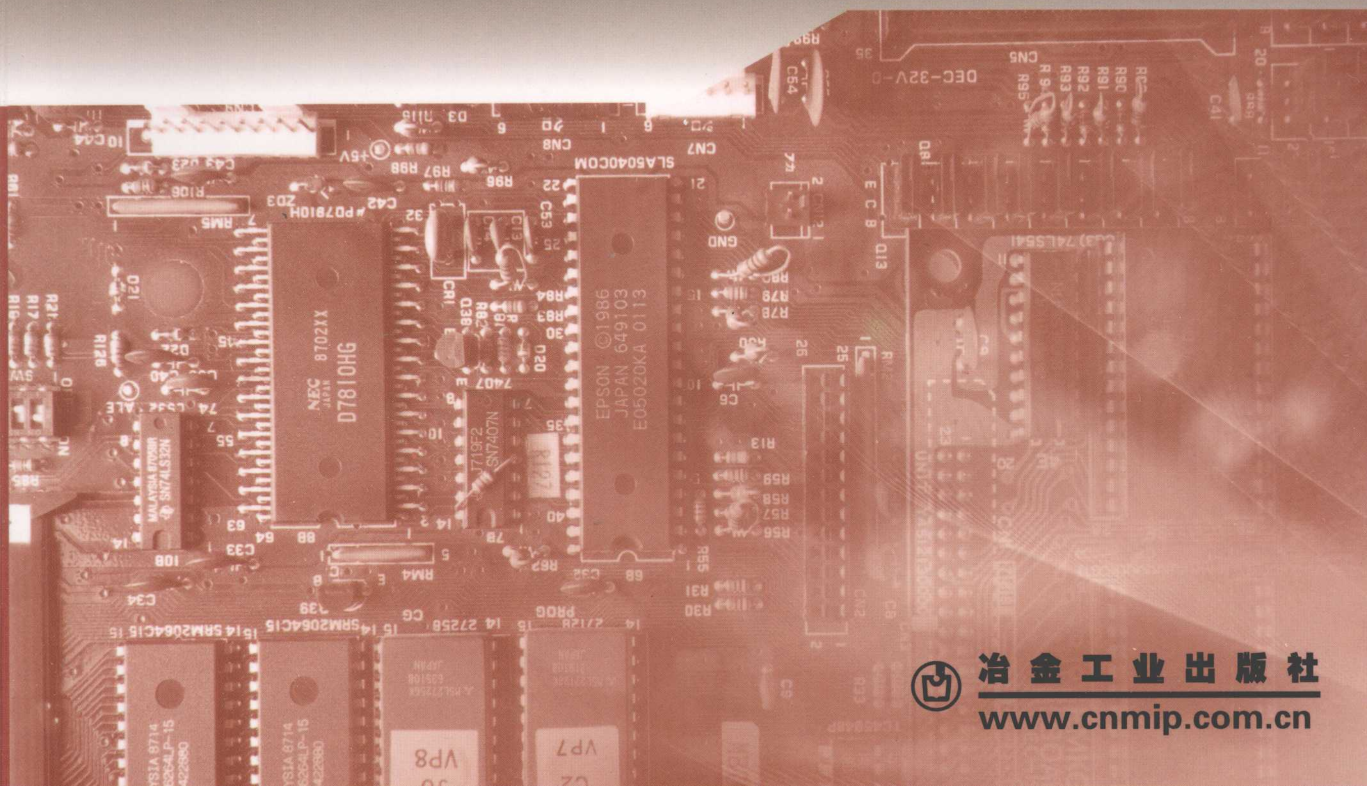
高职高专"十一五"规划教材

机械电子类

机电工程专业英语

王磊 涂杰 主编



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机电工程专业英语

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内 容 简 介

本书以机械、机电类英语文献为教学内容，专业涉及机械制造、数控应用技术、机电一体化技术、模具设计与制造、化工设备维修技术等专业。全书各部分内容相对独立，各专业可以根据具体情况自行选择教学内容。

全书共分五个部分 25 个单元，每个单元包括课文、阅读材料以及相关的词汇表、注释和参考译文，以便于教师教学和学生自学；课文内容涉及到机械工程基础知识、CAD/CAM 技术应用、计算机制造和控制系统、数控机床、机电一体化技术、可编程逻辑控制器、模具加工技术与成型方法、典型过程装备等。

本书针对高职高专学生的特点，突出专业英语阅读和实际应用能力的培养，题材丰富，实用性、适应性强。本书可用于高职高专院校机械工程和机电工程类专业英语教材或课外阅读材料，也可供电大、各类成人院校及广大专业技术人员学习和参考。

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前　言

本书是根据高职高专机电工程类专业英语教育要求编写而成的。本书在编写过程中，充分汲取高职高专机电工程专业英语的教学改革经验，以能力为本位，突出实用性、适应性和针对性，旨在培养学生掌握科技英语的句法特点与翻译技巧、扩大专业词汇量、提高阅读和使用专业英语的能力，加强综合素质的培养，满足高职高专机电工程专业英语教学改革和培养高素质应用型、技能型人才的需要。

本书的选材是在有限的篇幅内尽可能地涵盖机电工程的相关领域，尽量选编入新技术和新设备内容。全书精选了 25 个单元，每个单元包括课文、阅读材料以及相关的词汇表、注释，并附有课文和阅读材料的全篇译文，以便于教师组织教学和学生自学。全书共分为五个部分，每部分有 4～5 个单元：

第一部分是有关机械、机电工程的基础知识，内容包括材料选用及热处理、机床与加工、CAD/CAM 技术及其应用、表面精加工及粗糙度、焊接、机械传动、机器人、齿轮传动、带和链传动等。

第二～五部分是有关四个专业领域（机械制造及数控技术、机电一体化技术、模具设计与制造、化工过程装备技术）的相关知识，内容包括计算机集成制造系统和控制系统、柔性制造系统、计算机数字控制发展史、计算机数控系统和数控机床、计算机图形学、机电一体化技术、控制装置和控制系统基础、可编程逻辑控制器、现代控制理论、微机控制、压力传感器、电动机、模具基础知识、模具加工技术和成型方法、压力容器基础知识、典型过程设备和典型过程机器等内容。

全书五部分内容既有内在联系又相对独立，教师可针对具体情况有选择性地安排教学。

本书可作为高职高专院校机械制造、数控应用技术、机电一体化技术、模具设计与制造、化工设备维修技术等专业教学用书，也可用于各类成人院校机械、机电类专业英语教学用书，同时可供机械、机电类相关工程技术人员阅读参考。

本书由王磊、涂杰任主编，吴健、王叶萍任副主编，吴丽红、苏冬云、王存琴、孙筱参加编写。本书在编写过程中得到了各院校领导和专家同行的大力支持和帮助，在此一并表示衷心的感谢！同时也感谢编者曾经参阅过的大量中外文献和网络资源的作者们。

由于编者水平所限，书中如有不足之处敬请使用本书的师生与读者批评指正，以便修订时改进。如读者在使用本书的过程中有其他意见或建议，恳请向编者(bjzhangxf@126.com)踊跃提出宝贵意见。

编　者

目　　录

Unit 1 The Roles of Engineers in Manufacturing

Many engineers have as their function the designing of products that are to be brought into reality through the processing or fabrication of materials. In this capacity they are a key factor in the material selection-manufacturing procedure . A design engineer, better than any other person, should know what he or she wants a design to accomplish. He knows what assumptions he has made about service loads and requirements, what service environment the product must withstand, and what appearance he wants the final product to have. In order to meet these requirements he must select and specify the material(s) to be used. In most cases, in order to utilize the material and to enable the product to have the desired form, he knows that certain manufacturing processes will have to be employed. In many instances, the selection of a specific material may dictate what processing must be used. At the same time, when certain processes are to be used, the design may have to be modified in order for the process to be utilized effectively and economically. Certain dimensional tolerances can dictate the processing. In any case, in the sequence of converting the design into reality, such decisions must be made by someone. In most instances they can be made most effectively at the design stage by the designer if he has a reasonably adequate knowledge concerning materials and manufacturing processes. Otherwise, decisions may be made that will detract from the effectiveness of the product, or the product may be needlessly costly. It is thus apparent that design engineers are a vital factor in the manufacturing process, and it is indeed a blessing to the company if they can design for producibility—that is, for efficient production.

Manufacturing engineers select and coordinate specific processes and equipment to be used, or supervise and manage their use. Some design specific tooling that is used so that standard machines can be utilized in producing specific products. These engineers must have a broad knowledge of machine and process capabilities and of materials, so that desired operations can be done effectively and efficiently without overloading or damaging machines and without adversely affecting the materials being processed. These manufacturing engineers also play an important role in manufacturing.

A relatively small group of engineers design the machines and equipment used in manufacturing. They obviously are design engineers and, relative to their products, have the same concerns of the interrelationship of design, materials, and manufacturing processes. However, they have an even greater concern regarding the properties of the materials that their machines are going to process and the interaction of the materials and the machines.

Still another group of engineers—the materials engineers—devote their major efforts to developing new and better materials[1]. They, too, must be concerned with how these materials can be processed and with the effects the processing will have on the properties of the materials.

Although their roles may be quite different, it is apparent that a large proportion of engineers must concern themselves with the interrelationship between materials and manufacturing processes.

Low-cost manufacture does not just happen. There is a close and interdependent relationship between the design of a product, selection of materials, selection of processes and equipment, and tooling selection and design. Each of these steps must be carefully considered, planned, and coordinated before manufacturing starts. This lead time, particularly for complicated products, may take months, even years, and the expenditure of large mount of money may be involved. Typically, the lead time for a completely new model of an automobile is about 2 years. For a modern aircraft it may be 4 years.

With the advent of computers and machines that can be controlled by either tapes made by computers or by the computers themselves, we are entering a new era of production planning. The integration of the design function and the manufacturing function through the computer is called CAD/CAM (computer aided design/computer aided manufacturing). The design is used to determine the manufacturing process planning and the programming information for the manufacturing processes themselves. Detailed drawings can also be made from the central data base used for the design and manufacture, and programs can be generated to make the parts as needed[2]. In addition, extensive computer aided testing and inspection (CATI) of the manufactured parts is taking place. There is no doubt that this trend will continue at ever-accelerating rates as computers become cheaper and smarter.

Words and Expressions

dictate	[dik'teit]	*v.*	指示，规定
procedure	[prə'siːdʒə]	*n.*	(程序，工序)生产过程
sequence	['siːkwəns]	*n.*	顺序，程序，工序
detract	[di'trækt]	*v.*	转移，贬低
coordinate	[kəu'ɔːdinət]	*n.*	坐标；以使协调，整理
tooling	['tuːliŋ]	*n.*	工具，刀具，工艺装备
interdependent	[ˌintədi'pendənt]	*adj.*	相互依赖的，相互影响的，相互关联的
interrelationship	['intəri'leiʃənʃip]	*n.*	相互关系
advent	['ædvənt]	*n.*	到来，出现，来临
integration	[ˌinti'greiʃən]	*n.*	集成，综合，集体化
modify	['mɔdifai]	*v.*	改变，改善，调整
needlessly	['niːdlisli]	*adv.*	不必要地，无用地
complicated	['kɔmplikeitid]	*adj.*	错综复杂的，麻烦的
expenditure	[iks'penditʃə]	*n.*	消费，支出
inspection	[in'spekʃən]	*n.*	检验，观察，验收
ever-accelerating		*adj.*	不断加速
lead time			产品设计至实际投产所需的时间

NOTES

[1]. Still another group of engineers—the materials engineers—devote their major efforts to developing new and better materials.

还有另外一些工程师，即材料工程师，他们致力于开发更好的新型材料。(Devote 是"致力于……"的意思)

[2]. Detailed drawings can also be made from the central data base used for the design and manufacture, and programs can be generated to make the parts as needed.

设计与制造的中心数据库可以绘制详细的零件图，生成这些零件所需的加工程序。

第 1 单元 工程师在生产制造中的作用

许多工程师的职责是设计产品，并通过对材料的加工制造出产品。在选择产品的材料和制造方法时，设计工程师起着关键的作用。设计工程师应该比其他人更清楚他的设计目的。他应该对工作载荷和使用要求做出正确的假设，了解产品的使用环境，并确定产品的外观。因此，他必须选择和确定产品使用的材料。通常，为了充分利用材料并加工出理想的产品，他还应该熟悉那些生产制造中必须采用的工艺。许多情况下，选择了材料就决定了使用的加工工艺。同时，采用了某种加工工艺，设计也必须做相应的修改，以确保所采用的工艺能够提高效率、降低成本。尺寸公差也能影响加工方法。任何情况下，要将设计转变为现实，就必须做出这些决断。多数情况下，如果设计人员充分合理地掌握了材料和加工方法的有关知识，他就会做出效率最高的设计。否则，就会使产品的效能降低、价格陡增。显然，设计工程师是制造过程中的重要人物。如果他们的设计面向生产，那确实是公司的幸运，因为这可以提高生产效率。

制造工程师选择并协调将要使用的加工方法和加工设备，或者监督和管理这些加工方法和加工设备的使用。某些工程师设计专用工艺装备，使通用机床也能生产专用产品。这些工程师应该在机器、加工能力及材料方面具有广博的知识，使生产高效进行，既不因过载损坏机器，也不会对加工材料产生不良影响。制造工程师在制造业中也起到重要的作用。

还有一小部分工程师专门设计机床和设备，他们显然属于设计工程师。相对于他们的产品，他们同样关心设计、材料和制造方法之间的相互关系。但是，他们更关心他们的机器将要加工的材料的性能及机器与材料之间的相互作用。

还有另外一些工程师，即材料工程师，他们致力于开发更好的新型材料。他们同样也关心材料的加工方法以及加工对材料性能的影响。

尽管各类工程师的作用千差万别，但显然他们多数都要考虑材料与制造工艺之间的相互关系。

降低制造成本可不是件容易的事情。产品设计、材料选择、加工工艺和设备的选择、工具和设计的选择等之间存在非常密切的相互依赖关系。每一步在制造开始前都必须仔细考虑、精心计划、互相协调。从产品设计到实际投产，特别是复杂产品，可能需要数月甚

至数年的时间，要花费很多钱。例如，对于一种全新的汽车，从产品设计到实际投产需要大约 2 年的时间，而一种现代化飞机则可能需要 4 年。

随着计算机的出现以及由穿孔纸带控制或由计算机本身控制的机器的出现，我们正进入一个生产计划的新时代。采用计算机把产品的设计与制造结合起来，称为 CAD/CAM(计算机辅助设计/计算机辅助制造)。用这种设计方法可以确定加工工艺计划以及与加工工艺本身有关的编程信息。设计与制造的中心数据库可以绘制详细的零件图，生成这些零件所需的加工程序。此外，零件加工还使用了计算机辅助实验与计算机辅助检测。毫无疑问，随着计算机价格的降低和性能的提高，这种趋势将会持续飞速发展。

Reading Material

The Machine Designer's Responsibility

A new machine is born because there is a real or imagined need for it. It evolves from someone's conception of a device with which to accomplish a particular purpose. From the conception follows a study of the arrangement of the parts, the location and length of links (which may include a kinematic study of the linkage), the places for gears, bolts, springs, cams, and other elements of machines. With all ideas subject to change and improvement, several solutions may be and usually are found, the seemingly best one being chosen.

The actual practice of designing is applying a combination of scientific principles and a knowing judgment based on experience. It is seldom that a design problem has only one right answer, a situation that is often annoying to the beginner in machine design.

Engineering practice usually requires compromises. Competition may require a reluctant decision contrary to one's best engineering judgment; production difficulties may force a change of design; etc.

A good designer needs many attributes, for example:

(1) A good background in strength of materials, so that the stress analyses are sound. The parts of the machine should have adequate strength and rigidity, or other characteristics as needed.

(2) A good acquaintance with the properties of materials used in machines.

(3) A familiarity with the major characteristics and economics of various manufacturing processes, because the parts that make up the machine must be manufactured at a competitive cost. It happens that a design that is economic for one manufacturing plant may not be so for another. For example, a plant with a well-developed welding department but no foundry might find that welding is the most economic fabricating method in a particular situation; whereas another plant faced with the same problem might decide upon casting because they have a foundry (and may or may not have a welding department).

(4) A specialized knowledge in various circumstances, such as the properties of materials in corrosive atmospheres, at very low (cryogenic) temperatures, or at relatively high temperatures.

(5) A preparation for deciding wisely: ① when to use manufacturers' catalogs, buying

stock or relatively available items, and when custom design is necessary; ② when empirical design is justified; ③ when the design should be tested in service tests before manufacture starts; ④ when special measures should be taken to control vibration and sound (and others).

(6) Some aesthetic sense, because the product must have "customer appeal" if it is to sell.

(7) A knowledge of economics and comparative costs, because the best reason for the existence of engineers is that they save money for those who employ them. Anything that increases the cost should be justified by, for instance, an improvement in performance, the addition of an attractive feature, or greater durability.

(8) Inventiveness and the creative instinct, most important of all for maximum effectiveness. Creativeness may arise because an energetic mind is dissatisfied with something as it is and this mind is willing to act.

Naturally, there are many other important considerations and a host of details. Will the machine be safe to operate? Is the operator protected from his own mistakes and carelessness? Is vibration likely to cause trouble? Will the machine be too noisy? Is the assembly of the parts relatively simple? Will the machine be easy to service and repair?

Of course, no one engineer is likely to have enough expert knowledge concerning the above attributes to make optimum decisions on every question[1]. The larger organizations will have specialists to perform certain functions, and smaller ones can employ consultants. Nevertheless, the more any one engineer knows about all phrases of design, the better. Design is an exacting profession, but highly fascinating when practiced against a broad background of knowledge.

Words and Expressions

arrangement	[ə'reindʒmənt]	*n.*	配置，布局，构造
linkage	['liŋkidʒ]	*n.*	连杆，连杆机构
seemingly	['si:miŋli]	*adv.*	表面上，外观上，看上去
kinematic	[ˌkaini'mætik]	*adj.*	运动学的
annoy	[ə'nɔi]	*vt.*	使……烦恼
compromise	['kɔmprəmaiz]	*n.*	妥协
reluctant	[ri'lʌktənt]	*adj.*	不愿的，勉强的，难得到的
attribute	['ætribju:t]	*n.*	属性，特性，特征
acquaintance	[ə'kweintəns]	*n.*	熟悉，了解
foundry	['faundri]	*n.*	铸造，翻砂
fabricate	['fæbrikeit]	*vt.*	制作，制造
atmosphere	['ætməsfiə]	*n.*	大气层，空气
cryogenic	[ˌkraiə'dʒenik]	*adj.*	冷冻的，低温的
stock	[stɔk]	*n.*	原料，材料
empirical	[em'pirik(ə)l]	*adj.*	经验的，实验的
aesthetic	[i:s'θetik]	*adj.*	审美的，美学的，美术的

appeal	[ə'pi:l]	*n.*	吸引……的注意，有感染力
comparative	[kəm'pærətiv]	*adj.*	比较的，相当的
justify	['dʒʌstifai]	*v.*	证明，认为……有理由
inventiveness	[in'ventivnis]	*n.*	发明创造能力，创造性
instinct	['instiŋkt]	*n.*	本性，本能，直觉
energetic	[enə'dʒetik]	*adj.*	能的，有力的，精力旺盛的
host	[həust]	*n.*	许多，多数
fascinating	['fæsineitiŋ]	*adj.*	引人入胜的，极有趣的

NOTES

[1]. no one engineer is likely to have enough expert knowledge concerning the above attributes to make optimum decisions on every question.

没有一个工程师能够具有上述那些基本素质所应有的充分的专业知识，对每一个问题作出最适宜的解答。(be likely to...是“大概”，“可能”的意思)

阅读材料

机械设计者的责任

新机械产生于实际的或设想的需要。它来自于设计者为了达到某个具体目的而准备设计的机械设施的概念。根据这个概念，继续研究零件的布置，连接件的长度和位置(可能还要包括连杆的运动学研究)，齿轮、螺栓、弹簧、凸轮及其他机械零件的位置。通过修正和改进我们的想法，我们可能并通常可以找到几个解决方案，从中选择一个看起来最好的。

实际的设计活动是各种科学原理的综合应用，是基于已有经验的正确判断。设计问题很少只有一种正确的答案，这一点往往困扰着机械设计新手。

设计经常要向工程实际妥协，满足竞争需要而勉强作出的决定可能与人们最好的工程判断完全相反，生产制造的困难也会使我们不得不改变设计。

优秀的设计者应该具备许多基本素质，包括：

(1) 掌握材料力学方面的知识，以便能够进行充分的应力分析，使机械零件具有足够的强度、刚度及其他所需的特性。

(2) 熟知机械所用材料的特性。

(3) 熟悉各种制造工艺的特点及成本，因为组装机器的零件的制造成本必须具有竞争性。在一个工厂碰巧被证明为经济实用的设计方案，可能并不适用于另一个工厂。例如，有的工厂焊接部门很先进但却没有铸造部门。在这种特殊条件下，他们可能会认为焊接是最经济的制造手段，而对于那些有铸造部门(可能有也可能没有焊接部门)的工厂，面临同样的问题却可能会选择铸造。

(4) 有关各种工作环境的专业知识。例如在腐蚀气体、低温或相对高温下材料的特性。

(5) 精明决断的必要准备。要了解：① 什么时间使用厂商目录购买原料及相关物品；什么时候必须按用户的要求确定设计；② 什么时候根据经验设计；③ 什么时候进行投产

前的实验；④ 什么时候要采取特殊措施控制振动和噪声。

(6) 一定的审美能力，以便产品销售时能够吸引顾客。

(7) 要了解各种经济学和成本比较的知识，因为对雇主来说，雇佣工程师最主要的原因是他们能够为雇主节省费用。成本增加必须有充分的理由，例如，改进性能，增加吸引力，或使产品更经久耐用。

(8) 本能的创造性，这是提高效率的最重要的素质。创造性来源于不满现状，创造性使思想付诸实施。

当然，还有许多其他重要的因素和细节。例如，机器操作是否安全？操作者粗心大意是否会不受到伤害？振动可能引起故障吗？机器的噪声很大吗？零件的装配比较简便吗？机器使用和维修容易吗？

当然，没有一个工程师能够具有上述那些基本素质所应有的充分的专业知识，对每一个问题作出最适宜的解答。大公司有各个行业的专家，小公司可以聘请顾问。但工程师对设计各方面的了解，总是越多越好。设计是一个吃力的行业，但只要具有丰富的知识，设计工作还是十分有趣的。

Unit 2 Selection of Materials

A material is generally used because it offers the required properties at reasonable cost. Appearance is also an important factor. Perhaps the most common classification that is encountered in materials selection is whether the material is metallic or nonmetallic. The common metallic materials are such metals as iron, copper, aluminum, magnesium, nickel, titanium, lead, tin, and zinc and the alloys of these metals, such as steel, brass, and bronze. The metallic material is further classified as ferrous (iron and its alloys) and non-ferrous (all other metallic materials) metal. They possess the metallic properties of luster, thermal conductivity, and electrical conductivity; are relatively ductile; and some have good magnetic properties. The common nonmetals are wood, brick, concrete, glass, rubber, and plastics. Their properties vary widely, but they generally tend to be less ductile, weaker, and less dense than the metals, and they have no electrical conductivity and poor thermal conductivity.

Although it is likely that metals always will be the more important of the two groups, the relative importance of the nonmetallic group is increasing rapidly, and since new nonmetals are being created almost continuously, this trend is certain to continue. In many cases the selection between a metal and nonmetal is determined by a consideration of required properties. Where the required properties are available in both, total cost becomes the determined factor[1].

One material can often be distinguished from another by means of 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 conductivity, electrical conductivity, and density, may be of prime important in selecting material for certain specific uses. However, those properties that describe how a material reacts to mechanical usages are often more important to the engineers in selecting materials in connection with design. These mechanical properties relate to how the material will react to the various loading service.

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

(1) Strength is the ability of a material resist applied forces. Elevator cables and buildings beams all must have this property.

(2) Hardness is the ability of a material resist penetration and abrasion. Cutting tools must resist abrasion, or wear. Metal rolls for steel mills must resist penetration.

(3) Elasticity is the ability to spring back to original shape. All springs should have this quality.

(4) Ductility is the ability to undergo permanent changes of shape without rupturing. 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, ham-