普通高等教育“十五”规划教材

PRACTICAL SCIENTIFIC ENGLISH READING AND WRITING FOR THE MAJOR IN THERMAL ENGINEERING SCIENCE

热能专业英语阅读与写作

程乐鸣 王树荣 合 编

中国电力出版社
http://jc.cepp.com.cn

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《热能专业英语阅读与写作》	**程乐鸣等合编**

ISBN 7-5083-2605-9

9 787508 326054 >

ISBN 7-5083-2605-9
定价：26.00 元

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内 容 提 要

本书在阅读典型热能专业范文的基础上，介绍科技英文写作基础，包括科技英文写作的基本句式，物品大小尺寸和特性的描写方法，比较句型和情态动词在科技英文中的应用和意义，科技英文中常用被动语态的使用；科学定义的描述；科学实验和理论研究中有关系统、方法、过程和结果分析的描写方法，科技英文中有关图、表、数学公式的使用和表述；常用英文文章的写作要点和写作方法，包括英文报告、会议备忘录、项目建议书和杂志科技文章等，讨论科技英文写作过程中应注意和防止的错误，并配以阅读和写作练习。通过学习本书，可以提高学生在科技与工程领域内的英文写作和阅读能力，学会用简单清晰的方法表达科技与工程研究结果，克服“中式英文”，与英文惯用法接轨，为在国际英文杂志上发表专业文章打下写作基础。

本书以实践写作为目的，各单元列有相关主题范文，覆盖目前热能专业的相关主题，写作训练以练习为主，语法简单易掌握。

本书主要作为热能与动力工程专业的本科、研究生教学和自学辅导用书，同时也可作为相关行业工程技术人员的参考用书。

图书在版编目（CIP）数据

热能专业英语阅读与写作 / 程乐鸣，王树荣合编. —北京：中国电力出版社，2004
普通高等教育“十五”规划教材
ISBN 7-5083-2605-9

Ⅰ. 热… Ⅱ.①程…②王… Ⅲ. ①热能-英语-阅读教学-高等学校-教材②热能-英语-写作-高等学校-教材 Ⅳ. H31

中国版本图书馆 CIP 数据核字（2004）第 095538 号

中国电力出版社出版、发行
（北京三里河路 6 号 100044 http://jc.cepp.com.cn）
汇鑫印务有限公司印刷
各地新华书店经售
*
2005 年 1 月第一版 2005 年 1 月北京第一次印刷
787 毫米×1092 毫米 16 开本 17.75 印张 410 千字
印数 0001—3000 册 定价 26.00 元

序

由中国电力教育协会组织的普通高等教育“十五”规划教材，经过各方的努力与协作，现在陆续出版发行了。这些教材既是有关高等院校教学改革成果的体现，也是各位专家教授丰富的教学经验的结晶。这些教材的出版，必将对培养和造就我国 21 世纪高级专门人才发挥十分重要的作用。

自 1978 年以来，原水利电力部、原能源部、原电力工业部相继规划了一至四轮统编教材，共计出版了各类教材 1000 余种。这些教材在改革开放以来的社会主义经济建设中，为深化教育教学改革，全面推进素质教育，为培养一批批优秀的专业人才，提供了重要保证。原全国高等学校电力、热动、水电类专业教学指导委员会在此间的教材建设工作中，发挥了极其重要的历史性作用。

特别需要指出的是，“九五”期间出版的很多高等学校教材，经过多年的教学实践检验，现在已经成为广泛使用的精品教材。这批教材的出版，对于高等教育教材建设起到了很好的指导和推动作用。同时，我们也应该看到，现用教材中有不少内容陈旧，未能反映当前科技发展的最新成果，不能满足按新的专业目录修订的教学计划和课程设置的需要，而且一些课程的教材可供选择的品种太少。此外，随着电力体制的改革和电力工业的快速发展，对于高级专门人才的需求格局和素质要求也发生了很大变化，新的学科门类也在不断发展。所有这些，都要求我们的高等教育教材建设必须与时俱进，开拓创新，要求我们尽快出版一批内容新、体系新、方法新、手段新，在内容质量上、出版质量上有突破的高水平教材。

根据教育部《关于“十五”期间普通高等教育教材建设与改革的意见》的精神，“十五”期间普通高等教育教材建设的工作任务就是通过多层次的教材建设，逐步建立起多学科、多类型、多层次、多品种系列配套的教材体系。为此，中国电力教育协会在充分发挥各有关高校学科优势的基础上，组织制订了反映电力行业特点的“十五”教材规划。“十五”规划教材包括修订教材和新编教材。对于原能源部、电力工业部组织原全国高等学校电力、热动、水电类专业教学指导委员会编写出版的第一至四轮全国统编教材、“九五”国家重点教材和其他已出版的各类教材，根据教学需要进行修订。对于新编教材，要求体现电力及相关行业发展对人才素质的要求，反映相关专业科技发展的最新成就和教学内容、课程体系的改革成果，在教材内容和编写体系的选择上不仅要有本学科（专业）的特色，而且注意体现素质教育和创新能力与实践能力的培养，为学生知识、能力、素质协调发展创造条件。考虑到各校办学特色和培养目标不同，同一门课程可以有多本教材供选择使用。上述教材经中国电力教育协会电气工程学科教学委员会、能源

动力工程学科教学委员会、电力经济管理学科教学委员会的有关专家评审，推荐作为高等学校教材。

在“十五”教材规划的组织实施过程中，得到了教育部、国家经贸委、国家电力公司、中国电力企业联合会、有关高等院校和广大教师的大力支持，在此一并表示衷心的感谢。

教材建设是一项长期而艰巨的任务，不可能一蹴而就，需要不断完善。因此，在教材的使用过程中，请大家随时提出宝贵的意见和建议，以便今后修订或增补。（联系方式：100761 北京市宣武区白广路二条 1 号综合楼 9 层　中国电力教育协会教材建设办公室 010-63416237）

中国电力教育协会

前　言

随着中国科学技术的迅速发展、全球经济一体化的进一步扩展，国际间各种形式的科技交流日益增加，中国在世界上所扮演的角色也日趋重要。以文字信息交换为例，根据中国科技信息研究所2000年度的一个统计，中国被《SCI》收录的论文数量已从1999年度的第10位跃居世界第8位，《EI》和《ISTP》所收录的中国论文数也都在逐年增加。但与位居前列的国家相比，仍有较大差距，2000年科研与工程人员人均《SCI》收录论文数，日本为0.14篇，美国0.32篇，澳大利亚0.38篇，但中国仅有0.05篇。

究其原因，编者以为，这固然与目前中国科学技术与国际先进水平存在的差距有关，但另一方面，论文撰写中的组织结构、文字调遣、语言运用等表达手段也是一个非常大的影响因素。编者在加拿大三年，参观访问了加拿大和美国的不少著名大学和研究机构，与许多同行交流，以自己从事的热能、工程热物理领域而论，他们的研究设备和水平不少还不如中国一些大学，但在国际上发表的英文论文的数量和质量却甚为领先。编者深感，很多时候，国内研究论文在国际专业刊物上入选率低的原因，并不完全在于研究内容及水平不够，其中部分是因为英文表达欠佳。科技英文阅读写作对于中国科技人员走向世界、加大在当今国际科技交流中的作用实在事关重要。

有感于此，编者特根据自己多年来在国内外从事工程热物理和热能动力专业研究教学的体会编著本书。其目的是帮助读者提高热能领域科技英文的实际写作能力，为在英文专业刊物上发表论文、国际合作中撰写文稿打下写作基础。本书在阅读典型热能专业范文的基础上，介绍科技英文写作基础，包括科技英文写作的基本句式，物品大小尺寸和特性的描写方法，比较句型和情态动词在科技英文中的应用和意义，科技英文中常用被动语态的使用，科学定义的描述，科学实验和理论研究中有关系统、方法、过程和结果分析的描写方法，科技英文中有关图、表、数学公式的使用和表述，常用英文文章的写作要点和写作方法，包括英文报告、会议备忘录、项目建议书和杂志科技文章等，讨论科技英文写作过程中应注意和防止的错误，并配以阅读和写作练习。

本书原稿在过去六年中曾作为浙江大学热能专业1996到2001级本科生的教学讲义。为适应增加学分的需要，先后增添过一部分内容。多年来，使用过本书原稿的同学和读者提出了许多宝贵的意见和建议，为本书的编写提供了有益的参考依据。本书是在此基础上予以改进，精选增补阅读文献，加强练习实践，重新编订而成。

感谢旅美学者陆重庆博士在繁忙的事务中审阅本书。陆博士在美获得能源博士，多年来一直在美国从事重要项目的研究开发工作，深知该领域的沿革与动向发展。陆重庆

博士对本书的仔细订正，使本书在专业内容的翔实先进、语言形式的准确可靠等方面得益匪浅。

本书承热能领域著名专家、中国工程院院士岑可法教授和袁镇福教授大力促成而得以顺利出版，特此致谢。本书写作过程中，得到浙江大学热能工程研究所的领导和同事的大力支持，施正展工程师和王则力同学绘制了本书中大部分插图，颜纯平小姐打印了手稿，在此一并感谢。

本书也可供非热能专业的学生和技术人员作为英文写作和阅读的参考书。

本书中的引文，作者尽力与版权所有者取得联系并得到同意，但仍有少部分联系不上，在此编者深表歉意。

限于编者水平和编写时间限制，本书一定存在错误和疏漏之处，欢迎广大读者批评指正。

编　者

2004年5月于浙江大学求是园

目　录

Part 2: Technical Documents Writing

Part 1: Reading and Writing

Unit 1

Reading: Energy

1. Forms of Energy

The word 'energy' has many meanings. Some of these are nebulous — 'nervous energy' for example, whilst others are quite precise such as 'kinetic energy', the energy of motion and 'potential energy', the energy of position, both of which are terms used widely in science and engineering. No matter how basic man's existence, two sources of energy are essential. Firstly food, which contains a chemical form of potential energy, converted by the body into kinetic energy and secondly, shelter from the elements, which in non-temperate climates really means heat or thermal energy. As civilization has developed, demands for energies other than chemical and thermal have increased especially where tasks must be undertaken involving forces normally beyond man's modest abilities. This is particularly true of mechanical energy which is obtained by conversion from some other form of energy since energy like mass is neither created nor destroyed. The usual energy source is of course chemical energy in a fuel. The combustion of fuels thus releasing energy as heat, which can then be converted to mechanical energy, is always accompanied by an exhaust steam, which is usually polluting and undesirable. This, coupled with the need to transmit energy over long distances, has led to the development and utilization of electrical energy, which is probably the most convenient form of energy in modern civilizations.

In essence, then, there are four major forms of energy, chemical, thermal, mechanical and electrical of which thermal and electrical are probably the most convenient and these are produced by conversion from chemical energy which is contained in chemical and nuclear fuels. Chemical fuels may be subdivided into primary fuels, those which are derived from the Earth's crust by physical processes only, and secondary fuels, which involve a chemical reaction at some stage of their manufacture.

Much the largest proportion of all energy on and in the earth has been and is derived from the sun. This solar energy takes two forms: the daily input which manifests itself in solar radiation, the winds and waves and hydropower; and the energy which has come from the sun since the formation of the earth which is stored in the earth's crust primarily as fossil and nuclear fuels together with geothermal energy and vegetation.

2. Energy Conversion

The conversion of chemical and nuclear energy into thermal, mechanical and electrical forms is of prime importance to modern man. The fact that forms of energy may be converted in this way can be illustrated by simple examples. Rubbing hands together makes them warm due to the conversion of mechanical energy into thermal energy by way of friction. Another example is provided by the simple pendulum. At the lowest point of its swing, the bob moves with its maximum velocity and hence its kinetic energy is greatest. As the bob moves to its highest point, this energy is converted to potential energy and when the bob stops, its kinetic energy is zero. In this example, the energy conversion is reversible, though this is not always the case since the laws of thermodynamics must be obeyed. The more important conversion routes between the four forms of energy are shown in Fig.1-1.

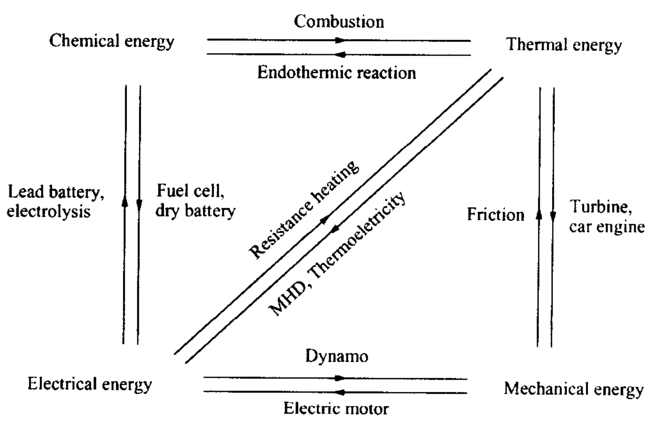

Fig.1-1 Examples of energy conversion

Probably the most familiar conversion process is combustion, in which the chemical energy of a fuel is released as heat (and to some extent as light) in a flame; a process which is of major industrial significance. The thermal energy so released can be transferred to water, thus producing steam as in boiler plant. A nuclear reactor achieves the same end result, since the reactor may be considered as simply replacing the combustion plant. The energy in the steam generated in this way may now be used to drive a steam turbine, thus effecting conversion to mechanical energy. This in turn may be converted to electrical energy by coupling the turbine to a generating set. This sequence of conversions, chemical-thermal-mechanical-electrical, by way of combustion and a turbo-generator is of course combined in a modern power station fuelled by coal, oil, gas or nuclear fuel. As discussed in the next section, the efficiency of this operation is limited and ways have been sought by which thermal energy may be converted directly to electrical energy. Thermoelectrics is one obvious method, in which a loop formed of two dissimilar metals is arranged so that an electrical current flows in the circuit by maintaining one junction at a low temperature and heating the other — the principle of the thermocouple. Magnetohydrodynamics (MHD) provides another direct conversion route between thermal and electrical energies. Faraday's second law states that if a conductor moves in a magnetic field, a current will flow in the conductor in a direction at right angles to both the direction of its motion and the magnetic field. It is not essential that the conductor should be a solid and indeed Lord Kelvin showed that tidal water (salty, and therefore conducting) flowing in a river estuary in the Earth's magnetic field can act as a simple generator. In the modern concept of an MHD generator, the conducting fluid is a high-temperature (ca 3000 K) gas seeded with salts with low ionization potentials to enhance its electrical conductivity. Such methods have the advantage of eliminating moving parts, that is the mechanical energy step.

Chemical energy may be converted directly to electrical energy by means of a fuel cell. In its simplest form, a fuel cell consists of two electrodes separated by an electrolyte arranged such that the fuel, say natural gas, and the oxidant can be supplied to the respective electrodes avoiding direct reaction, and the waste products removed. In this system the principle is essentially that of reversed electrolysis, which is the splitting of water into hydrogen and oxygen by the passage of electrical energy. Indeed all the routes discussed so far can be reversed to some extent or other. In a lead accumulator, for example, electrical energy is converted to chemical energy during charging and the process reversed when a current is drawn from the cell.

A simple example of the conversion from electrical to thermal energy is resistance heating, as in an electric fire, and similarly an electric motor reverses the conversion from mechanical to electrical energy. Mechanical energy is converted to thermal energy by way of friction and indeed most forms of energy usually end up as low-grade heat. An endothermic reaction is the reverse of combustion, which is an exothermic reaction. Fig.1-1 is not complete in that two important forms of energy have been omitted: nuclear energy and light. The former is converted to electrical energy by the conventional route or, in a possible future plant, by MHD power generation. Light may be converted to electrical energy using solar cells and also to thermal energy in a solar panel. In a sense light is also converted to chemical energy by photosynthesis, and is then stored in vegetation. Ultimately this will be converted to fossil fuels thus completing the cycle.

3. Efficiency of Energy Conversion

Whilst the routes by which energy may be converted as described in the previous section are all feasible, in many cases the efficiency of conversion is low and the conversion processes are of limited commercial interest, especially on a large scale. The other factor is, of course, capital cost. These two considerations, cost and efficiency, limit the choice of conversion route and, for the large-scale generation of electrical power, the prime choice of system is a boiler followed by a turbo-generator. Typical conversion efficiencies are shown in Table 1-1 and it is seen that for a power station the boiler has an efficiency of 88%; the remainder being losses in the flue gases and some radiation to the surroundings. The steam turbine has an efficiency of around 45%, the losses here being the enormous amount of low grade heat in the condensers.

The generator is of high efficiency and yet the overall efficiency for the complete conversion from chemical to electrical energy is around 35%, which although apparently wasteful is still the cheapest way of producing electricity on the large scale, regardless of whether the fuel is coal, oil, gas or indeed a nuclear fuel. There seems much to be said for omitting the mechanical energy stage, that is avoiding moving parts, and using a direct thermal-electrical conversion route such as MHD. In theory this is an excellent scheme since the waste gases from the MHD duct may be fed to a conventional boiler plus turbo-generating set. In this way the overall efficiency of generation would be 'topped-up' above the 35% level to possibly 60%~65%. The problem, however, is finding suitable construction materials and so far the net output of an MHD generator, for any length of time, is around 10 kW. There are similar problems with thermoelectric devices, as not only is the conversion efficiency low at around 10%, but also the n-type and p-type semiconductors which are proving to be the best material are very expensive.

Table 1-1 Typical efficiencies (%) in energy conversion

TO:	Chemical	Thermal	Electrical	Mechanical
FROM:				
Chemical		power station boiler (88)	dry battery (90)	
		domestic oil boiler (65)	car battery (74)	
		space rocket (50)	fuel cell (70)	
		steam turbine (45)		
		thermal power plant (41)		
		diesel engine (38)		
		gas turbine (35)		
		car engine (25)		
		steam engine (8)		
Nuclear		nuclear power plant (30)		
		nuclear battery (5)		

续表

TO:	Chemical	Thermal	Electrical	Mechanical
Thermal		–	nuclear battery (5)	steam turbine (45)
			MHD (10)	thermal power plant (41)
			thermoelectrics (10)	diesel engine (38)
			thermoionics (15)	gas turbine (35)
				nuclear power plant (30)
				car engine (25)
				steam engine (8)
Mechanical			electrical generator (98)	–
			pumped storage (75)	
			thermal power plant (41)	
			nuclear power plant (30)	
Electrical	car battery (74)		–	large electric motor (93)
				pumped storage (75)
				small electric motor (65)
Light			solar cell (10)	

It has been seen that, although a conversion route is feasible, the efficiency of conversion and the costs are the overriding factors as far as commercial exploitation is concerned and as is so often the case, a compromise solution has to be adopted. With the increasing development of new materials and techniques, alternative methods of energy conversion are likely to become commercially viable in the not too-distant future.

Source: J.H. Harker and J. R. Backhurst. Fuel and Energy. NY: Academic Press Inc. Ltd, 1981.

Words and Expressions

(1) nebulous: **adj.** vague or ill-defined

(2) nervous: **adj.** apprehensive or anxious

(3) kinetic energy: **n.** energy associated with motion

(4) potential energy: **n.** the energy that a piece of matter has because of its position or because of the arrangement of parts

(5) essential: **a.** absolutely necessary; **n.** things that are absolutely necessary

(6) shelter: **n.** a shielded condition; protection

(7) temperate: **adj.** relating or referring to a region or climate characterized by mild temperatures

(8) modest: **adj.** unassuming in the estimation of one's abilities or achievements

(9) essence: **n.** the intrinsic nature of something; the quality which determines something's character