

REFRIGERATION

高等职业教育制冷技术系列规划教材

制冷与空调 专业英语

王静波 主 编

张国东 陶 洁 副主编

<http://www.phei.com.cn>



电子工业出版社
PUBLISHING HOUSE OF ELECTRONICS INDUSTRY

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北京 • BEIJING

内 容 简 介

本书共分7个单元：第1单元，介绍热力学和热传递基本理论知识；第2单元，介绍流体力学和流体机械；第3单元，介绍制冷剂 and 制冷方式；第4单元，介绍压缩机和制冷设备等相关知识；第5单元，介绍制冷附属设备；第6、7单元，分别介绍锅炉和涡轮机及空调方面等内容。本书内容翔实，图文并茂，理论联系实际，便于读者理解和参考。

本书既可作为高等职业院校的制冷与空调专业英语教材，也可作为广大从业人员的实用参考书。

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图书在版编目(CIP)数据

制冷与空调专业英语/王静波主编. —北京：电子工业出版社，2008.4

（高等职业教育制冷技术系列规划教材）

ISBN 978-7-121-06260-5

I. 制… II. 王… III. ①制冷—英语—高等学校：技术学校—教材②空气调节器—英语—高等学校：技术学校—教材 IV. H31

中国版本图书馆 CIP 数据核字（2008）第 038700 号

策划编辑：程超群

责任编辑：宋兆武 侯丽平

印 刷：北京市天竺颖华印刷厂

装 订：三河市金马印装有限公司

出版发行：电子工业出版社

北京市海淀区万寿路 173 信箱 邮编 100036

开 本：787×1092 1/16 印张：19.25 字数：492.8 千字

印 次：2008 年 4 月第 1 次印刷

印 数：4 000 册 定价：28.00 元

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前 言

目前,制冷与空调作为一门独立的学科和技术,已被广泛地应用于工业、农业、建筑、交通、航空、航天等许多领域。随着制冷与空调工业的蓬勃发展,新理论、新技术、新产品、新设备、新材料不断地涌现,国际交流日益频繁,这就要求从业人员除掌握专业知识外,还需具备一定的英语水平和较强的持续学习能力。“专业英语”已成为我国高等职业院校“不断线”外语教学课程之一。

为体现高等职业教育特色,本书精心选材,采用在实际工作中广泛应用、与学习者关系最为密切的相关英语专业文献和素材,强调理论与实践、机械与电气、制冷与空调、深度与广度、基础知识与最新成果之间的关系,力求反映本行业工程方面的现状和发展趋势。

本书涵盖制冷与空调、能源和动力等领域的多门分支学科内容,可用于热力学、传热学、热工学、流体力学与流体机械、制冷与空调设备、锅炉设备与涡轮机等相关专业教学。

本书选材广泛、内容新颖、图文并茂、文体规范、难度适中,注重语言教学服务于实际应用,使学生具备阅读专业英语书刊的能力。

为便于学生学习,教材中的单词有较高频率的重复,参考译文多采用相对直译的方式。每个单元均对重点和难点句子做了注释,并配有适量习题供读者巩固已学知识。书末有多个附录,便于读者阅读其他英文资料。

全书共分7个单元:第1单元,介绍热力学和热传递基本理论知识;第2单元,介绍流体力学和流体机械;第3单元,介绍制冷剂 and 制冷方式;第4单元,介绍压缩机和制冷设备等相关知识;第5单元,介绍制冷附属设备;第6、7单元,介绍锅炉和涡轮机及空调方面的内容,为方便读者理解和参考,在这两章中采用了结合专业知识的大量句子。其中第1、6单元及第5单元27课由王静波编写;第2单元由赵霞编写;第3单元由陶洁编写;第4单元由张国东编写;第5单元23~26课由李丹编写;第7单元由黄晶编写。本书由辽宁石油化工大学职业技术学院王静波任主编并统稿,张国东、陶洁任副主编,抚顺教师进修学院赵凡负责校对及单词表和书末附录部分的编写。

本书既可作为一本教学内容较完整的专业教材,也可作为广大从事制冷行业人员的实用参考书。全书参考授课时间为80学时,各专业可根据实际情况对讲授内容进行取舍或增删。如果条件允许,可适当安排学生上机做情报检索等实践练习。

本书在编写过程中得到了多位专家和学者的支持及指导,并提出了许多宝贵的意见。在此谨向关心和支持本书编写的同事及参考文献的作者,致以最诚挚的感谢。

由于时间仓促,以及编者水平所限,纰漏和错误在所难免,敬请读者批评指正。

编 者
2008年2月

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Unit 1 Thermodynamics and Heat Transfer

This unit introduces the basic and elementary knowledge of thermodynamics and heat transfer.

After learning, you will be able to understand:

1. The basic concepts and terminology in thermodynamics and heat transfer.
2. The three ways of thermal transmission.
3. The composition of thermal systems.
4. The thermodynamic cycle principle.

There are six texts in this unit, they are:

Text 1 Some Basic Concepts of Thermodynamics

Text 2 Thermodynamic System

Text 3 General Characteristics of Heat Transfer

Text 4 Conduction

Text 5 Convection

Text 6 Radiation

Text 1 Some Basic Concepts of Thermodynamics

In a thermal equipment, the energy inter-conversion based on the heat absorption process, the exothermic process, expansion and compression process to be completed. Studying these processes requires us to know what are the system and its surroundings. A thermodynamic system is a region in space or a quantity of matter bounded by a closed surface.¹ And the surroundings is the conditions, objects and so on, it includes everything external to the system, and the system is separated from the surroundings by the system boundaries that could be either movable or fixed, either real or imaginary.

There are two important concepts in any thermodynamic system, they are entropy and energy. Entropy is used to measure the molecular disorder of a given system, and the more shuffled a system is, the greater its entropy.²

Energy is the power which can do work, it is the capacity for producing an effect. And it can be categorized into two kinds, stored form and transient form energies.

Stored form energies are the following:

Thermal energy, or internal energy, u —the energy a system possessed and it is caused by the motion of the molecules or any intermolecular forces.

Potential energy, P.E.—the energy a system possessed and it is caused by the inter-attractive forces of molecules, or by the elevation of the system.³

$$\text{P.E.} = mgz \quad (1.1)$$

where m = the mass of the system

g = the local acceleration of gravity

z = the elevation above a horizontal reference plane

Kinetic energy, K.E.—the energy a system possessed and it is caused by the velocity of the molecules.

$$\text{K.E.} = (mv^2)/2 \quad (1.2)$$

where m = the mass of the system

v = the velocity of fluid streams when crossing the system boundaries

Chemical energy, E_c —the energy a system possessed and it is caused by the arrangement of atoms composing the molecules.

Nuclear energy, or atomic energy, E_a —the energy a system possessed and it is the cohesive forces holding the protons and neutrons together to be an atom nucleus.⁴

Transient form energies are the following:

Heat, Q —the force produced by the movement of groups of atoms. In a system, it is the transfer energy across the boundary of system, and it's always in the direction of the lower temperature.

Work, W —the transference of energy from one body or system to another, the work causes a motion of the body acted upon in the direction of the force producing it and against resistances. It is

equal to the product of the force and the distance through which the force moves. In a system, it is the transfer energy across the boundary of systems, and it is always in the direction of the lower pressure. Mechanical or shaft work, W , is the energy delivered or absorbed by a mechanism, such as a turbine, air compressor or internal combustion engine etc.

Flow work, F.W.—it is the energy carried into the system or transmitted across boundary. In a system, it is produced by a pumping process somewhere outside the system, and causes the fluid enter into or leave the system.⁵

$$\text{F.W.} = pv \quad (1.3)$$

where p = the pressure

v = the specific volume, or the volume displaced per unit mass.

A property is used to describe an inherent quality of a system. It is an observable characteristic of the system. The state of a system is defined by a series of properties. The following are some of the most common thermodynamic properties: temperature (T), pressure (p), specific volume (v), density (ρ) and so on. And there are additional thermodynamic properties such as entropy and enthalpy etc.

Enthalpy, h —a result of combining properties, is defined as:

$$h = u + pv \quad (1.4)$$

where u = the internal energy

p = the pressure

v = the specific volume

A process is the change of the state in a system. It is defined as any change of the properties in the system. A process can be described by a specifying initial and final equilibrium states.

A cycle may be a process, or a series of processes. At last of a cycle, all the properties are as the same as the values that they are at the beginning.

New Words and Expressions

categorize ['kætigəraiz] *vt.* 将……进行分类

cohesive [kəu'hi:siv] *a.* 内聚的

enthalpy [en'θælpɪ] *n.* [物]焓, 热函

entropy ['entropi] *n.* [物]熵, [无]平均信息量

equilibrium [i:kwi'libriəm] *n.* 平衡状态, 均衡

elevation [,eli'veiʃən] *n.* 高度

molecular [məu'lekjulə] *a.* 分子的

potential [pə'tenʃəl] *a.* 潜在的

n. 潜能

shuffle ['ʃʌfl] *vt.* 搅乱, 推开

vi. 蒙混

n. 杂乱的一堆, 混合

thermodynamics ['θe:məudai'næmiks] *n.* [物]热力学

act upon 作用于……

be separated from 与……(相)分离

Technical Terms

a thermodynamic system 热力系统

at last of a cycle 循环结束(后)

cohesive force 内聚力

specific volume 比体积

equilibrium state 平衡状态

Notes to the Texts

1. A thermodynamic system is a region in space or a quantity of matter bounded by a closed surface.
句中的 a region 和 a quantity of matter 是并列成分。

2. The more shuffled a system is, the greater its entropy.
the more...the more... 结构。

3. Potential energy, P.E.—the energy a system possessed and it is caused by the inter-attractive forces of molecules, or by the elevation of the system.

势能, P.E.——由于分子间存在着吸引力或系统的高度, 使系统所具有的能量。

4. Nuclear energy, or atomic energy, E_a —the energy a system possessed and it is the cohesive forces holding the protons and neutrons together to be an atom nucleus.

核, (原子) 能, E_a ——由于质子和中子构成原子核的内聚力, 使系统所具有的能量。

5. Flow work, F.W.—it is the energy carried into the system or transmitted across boundary. In a system, it is produced by a pumping process somewhere outside the system, and causes the fluid enter into or leave the system.

句中 carried into the system or transmitted across boundary 是 energy 的定语, carried into the system 和 transmitted across boundary 是并列结构。

流动功, F.W.——是进入或跨越系统边界的能量。它是由于系统外某处泵的输送作用使流体进入系统或离开系统所引起的。

Practical English

科技英语词汇的来源(一)

英语形式丰富、成分复杂, 是世界上词汇量最大的语种。随着科技的发展, 愈来愈多的科技词汇被创造出来。

英语的科技词汇大多起源于古拉丁语和古希腊语。据统计, 46%的英语词汇直接或间接来源于拉丁语, 7.2%的源自希腊语。在科技词汇中这个比例更高(医学词汇源自希腊语和拉丁语的占其总量的三分之二以上)。到了近代, 从其他语种借用的词汇越来越多。

科技英语更具有国际性, 构成同一语系词汇的词素大多具有相同的语源, 即具有同样可以追溯的国际词。例如:

诱导(感应)	英语	induction (源于拉丁语)
	法语	induction
	德语	induktion

	俄语	индукция	
磁性(铁)的	英语	magnetic(al)	(源于希腊语)
	法语	magnetique	
	德语	magnetisch	
	俄语	магнитный	

科技英语专业词汇来源主要有三：一般英语词汇转义、外来语借用和新创词。

一、一般英语词汇转义

有少量科技英语专业词汇是从日常英语词汇转义而来的，即赋予原来的单词以新的意义。虽然其在整个浩瀚的英语词汇海洋中所占比例不大，但它却象征着英语科技词汇一种重要的来源。例如：

angel	天使 → 雷达反响	base	基础 → 碱，主药
energy	活力，精力 → 能(量)	moment	片刻，瞬间 → 力矩
power	(权)力 → 电能(力)，发动机，放大倍数，幂		

二、外来语借用

英语从其他语言借用了丰富的科技词汇。在这些词汇中，有些是通过书籍输入的纯粹外国词汇(alien)，故保有其原来的形式。例如：

antenna	(天线)	datum	(资料)
formula	(方程)	fungus	(菌类)
maximum	(最大的)	minimum	(最小的)
nucleus	(核)	radius	(半径)

有些是和已有的本族语相结合而成的词汇(denizen)。如，

fellow	(伙伴，同事，会员)	husband	(丈夫，节约)
law	(法律，定律)	skin	(表皮，外壳)

Exercises

1. Answer the following questions according to the text.

- (1) Why energy and entropy operate in any thermodynamic system?
- (2) How many stored form energies are there?
- (3) What is the energy? How many kinds it can be categorized?
- (4) Please write down some thermodynamic properties.

2. Decide whether the following statements are true or false according to the text.

- (1) Most applications of thermodynamics require that the system and its surroundings be defined.
- (2) It isn't right that energy and entropy operate in any thermodynamic system.
- (3) Any property always has the same value for a given state.
- (4) A pure substance has a homogenous and invariable chemical composition.

3. Put the following words into Chinese/English.

- (1) Energy is the capacity for producing an effect, and can be categorized into either stored or transient forms.

(2) 功, W ——从一个系统(或物体)传递给另一系统(或物体)的能量, 在外力作用下使物体沿着该力的方向移动。

(3) A process is the change of the state in a system. It is defined as any change of the properties in the system. A process is described by a specifying initial and final equilibrium states.

(4) 循环是一个过程或一系列的过程。在循环结束时, 所有参数都保持与它们的初态相同的数值。

4. Translate the first paragraph into Chinese.

Text 2 Thermodynamic System

In the thermal engineering, the studied objects normally are isolated from one another and then we try to analysis the change and interaction, the studied objects isolated is named thermodynamic system.¹

The boundary of a system can be either real or imaginary, and either fixed or movable. If the gas in a cylinder is the studying object, then it is the thermodynamic system.²

There may be many objects in an engineering problem. The solution of a system is dependent on which objects are under consideration. In a thermodynamic system, we can do it either by placing an imaginary envelope around the objects under consideration or by using an actual envelope if it exists.³

For example, when dealing with a gas in the cylinder where the boundaries are located on the outside of the cylinder,⁴ the system includes both the cylinder and its contained gas. On the other hand, when the boundaries are placed at the inner face of the cylinder, the system consists solely of the gas itself. So it is very important and essential for us to specify the boundaries of the system carefully⁵.

Based on the difference of the characteristic of the systems, the different systems are named.

(1) When the boundaries of a system would not change with the surroundings, then we can say that it is a closed system. However, it may exchange energy in any form of heat or work with the surroundings. The boundaries of a closed system may be either rigid or may expand or contract,⁶ but its mass will not change. When the energy crossing the boundaries of a closed system is zero, the system may be treated as an isolated system.

(2) Conversely, if there are any matter exchange between the system and the surroundings, then it is an open system. The quantity of the matter in an open system may be either variable or constant. The boundaries of an open system are so placed that their location does not change with time. Thus, the boundaries enclose a fixed volume, commonly known as the control volume.

Sometimes a system may be a closed system at one moment and an open one the next. For example, consider that we would study a cylinder of an internal combustion engine, when the valves close, the system is a closed system. And when either or both of the valves open, the system will become an open system.

In most cases, a studied object would be a large and very complex system. We can break down it into a lot of component parts and then analyze every component part. Then the performance of the entire system can be determined by the summation of the performance of the individual component systems.⁷

For example, consider the liquid-vapor part of a steam power plant as a total system. This closed system contains the steam generator, the steam turbine, the steam condenser, the feed-water pumps, and the feed-water heaters. All of these units may be considered separately by throwing a boundary around them. Since a fluid enters and leaves each of these smaller systems, each one is an open system and must be analyzed as such.

New Words and Expressions

- boundary ['baundəri] *n.* 边界, 分界线
consideration [kənsɪdə'reɪʃən] *n.* 体谅, 考虑, 需要考虑的事项, 报酬
cylinder ['sɪlɪndə] *n.* 圆筒, 圆柱体, 汽缸, 柱面
envelope ['envɪləʊp] *n.* 信封, 封袋, [天]包层, [数]包迹, [生]包膜
imaginary [ɪ'mædʒɪnəri] *a.* 假想的, 想象的, 虚构的
solely ['səʊli] *ad.* 独自地, 单独地
solution [sə'lju:ʃən] *n.* 解答, 解决办法, 溶解, 溶液, 解决方案

- be isolated from 被与……隔绝
either ... or... 或(者)……或(者)……
for example 例如
is dependent on 依靠, 依赖

Technical Terms

- a steam power plant 蒸汽发电厂
an internal combustion engine 内燃机
the feed-water heater 给水加热器
the feed-water pump 给水泵
the steam condenser 冷凝器
the steam generator 蒸汽发生器(锅炉)
the steam turbine 蒸汽轮机

Notes to the Texts

1. In the thermal engineering, the studied objects normally are isolated from one another and then we try to analysis the change and interaction, the studied objects isolated is named thermodynamic system.

句中 the studied objects normally are isolated from one another 与 we try to analysis the change and interaction... 相并列。在热力工程中, 通常将研究对象分离出来再分析其变化及与外界的相互作用, 该对象即热力系统。

2. The boundary of a system can be either real or imaginary, and either fixed or movable. If the gas in a cylinder is the studying object, then it is the thermodynamic system.

句中 and either fixed or movable. 是省略句。全句为 and it can also be either fixed or movable.

3. ... we can do it either by placing an imaginary envelope around the objects under consideration or by using an actual envelope if it exists.

either...or... 结构, 两个介词短语 (by...) 相并列。

4. ...when dealing with a gas in the cylinder where the boundaries are located on the outside of the cylinder, ...

分词短语做状语, 全句为 ...when we deal with ...

5. So it is very important and essential for us to specify the boundaries of the system carefully.
此句为 it is... for sb to do sth. 结构。

6. The boundaries of a closed system may be either rigid or may expand or contract,...
是 either...or...or...句。

7. In most cases, a studied object would be a large and very complex system. We can break down it into a lot of component parts and analyze every component parts. Then the performance of the entire system can be determined by the summation of the performance of the individual component systems.

大多数情况下, 对象庞大且复杂。我们可将之化整为零再逐件分析。则整个系统的性能取决于各分系统性能的总和。

Practical English

科技英语词汇的来源 (二)

三、新创词

如前所述, 大部分英语科技词汇是将古拉丁语和古希腊语作为词素, 根据所需结合起来构成新的词汇。

1. 单使用希腊语词素

di- (双, 二倍) + -pter (翼, 翅膀) → dipter (双翅目)
photo- (光) + -meter (米, 计) → photometer (光度仪)

2. 单使用拉丁语词素

sub- (次, 亚) + son (声) → subsonic (次声的)
super- (在……上, 超级) + lun (月亮) → superlunar (月亮上的, 天空的)

3. 希腊词素和拉丁词素混用

television 电视 (拉丁词素+希腊词素)
spirometer 肺活量计, 呼吸量测试仪, 煤气表矫正仪 (希腊词素+拉丁词素)
agronomy 农业土壤学 (希腊词素+拉丁词素)

4. 英语、希腊词素和拉丁词素构成混用词

helio-stat 定日镜
subway 地铁
length 长度
weatherometer 老化 (耐风蚀) 测试仪

了解了英语专业词汇构成的基本规律, 就好像拿到打开浩如烟海的英语科技单词宝库的钥匙。遇到生僻的专业术语, 虽不认识, 但可以从单词的构词词素的角度进行分析, 从而起到举一反三、触类旁通和事半功倍的效果。例如:

magnetohydrodynamics → magneto + hydro + dynamics

即 磁流体力学 → 磁铁+水 (流体)+力学

bioelectronics → bio (生物) + electron (电子) + -ics (学科) → 生物电子学

telephotometer → tele (遥远) + photo (光) + -meter (表) → 遥测光度仪

phonophotograph → phono (声音) + photo (光) + -graph (记录) → 声波照相

suprarenalemia → supra (上) + renal (肾) + emia (血症) → 肾上腺素血症

cholecystography → chole (胆) + cysto (囊) + graphy (照相术) → 胆囊照相术

methyltrichlorosilane → methyl (甲基) + tri- (三) + chloro (氯) + silane (硅烷) → 甲基

三氯硅烷

polytetrafluoroethylene → poly (聚) + tetra (四) + fluoro (氟) + ethylene (乙烯) → 聚四氟乙烯

Exercises

1. Answer the following questions according to the text.

(1) How do we usually do when studying a thermal engineering?

(2) How can be the boundary of a system?

(3) What is the solution of a system dependent on?

(4) Based on the difference of the characteristic of the systems, how many the different systems are named?

(5) How do we usually do when a studied object is a large and very complex system?

(6) What is the boundary of an open system?

2. Decide whether the following statements are true or false according to the text.

(1) In the thermal engineering, the studied objects normally are isolated from one another and then we try to analysis the change and interaction.

(2) The boundary of a system can be either real or imaginary, but it can not be either fixed or movable.

(3) In a thermodynamic system, we can do it only by placing an imaginary envelope around the objects under consideration and not by using an actual envelope if it exists.

(4) It is not very important and essential for us to specify the boundaries of the system carefully.

(5) Then the performance of the entire system can be determined by the summation of the performance of the individual component systems.

3. Put the following words into Chinese/English.

(1) If the gas in a cylinder is the studying object, then it is the thermodynamic system.

(2) 当研究汽缸内气体时, 若其 (系统) 边界在汽缸体外, 则系统包含汽缸及缸内气体。另一方面, 若以汽缸内表面为边界时, 则系统只包括 (缸内) 气体。

(3) In most cases, a studied object would be a large and very complex system. We can break down it into a lot of component parts and analyze every component part.

(4) 因为当流体进入或离开这些小系统时, 各部分均为开放系统且应如此分析。

4. Translate the following paragraph into Chinese.

Sometimes a system may be a closed system at one moment and an open one the next. For example, consider that we would study a cylinder of an internal combustion engine, when the valves close, the system is a closed system. And when either or both of the valves open, the system will become an open system.