

Electrical  
Engineering  
English

# 电气工程 专业英语

薛士龙 主编  
黄建忠 许晓彦 副主编

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电子工业出版社  
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## 内 容 简 介

本书较系统地介绍了电气技术的英文知识点,全书共分为4部分,主要内容包括船舶电气技术领域的22篇英文文章、船用单证、海外操作人员日常用语,以及英文译文、常用词和词组。本书使用学时为36~48学时,可作为本科、高职相关专业船舶电气方面课程的辅助教材。内容深入浅出,便于自学,也可作为工程技术人员和一般读者的自学参考书。

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# 前 言

电气工程专业英语是电气类专业的一门专业必修课，通过对本课程的学习，可以获得电气技术方面的英语知识和英语使用能力，了解电气方面中外用语间的相互联系，并为今后从事电气工程领域的技术工作打下基础。

自教育改革以来，国内大部分院校对专业基础课程在学时上进行了一定程度的压缩，同时，教育的理念和对象均发生了较大变化，在这种新形势下，作者在精简内容的同时扩大了知识涵盖面，使学生在有限的学时内拓展知识面并加深理解。另外，本书附有所有课文的中文翻译，常用词、词组，以及常用缩写词，供学生参考。本书内容可根据读者自身特点分层次安排。

本书供普通高校电气类本科专业使用，总学时为 36~48 学时。各部分的讲课时数大致分配为：第 1 部分“课文” 30~38 学时，第 2 部分“单证” 2~4 学时，第 3 部分“日常用语” 4~6 学时。

本书由薛士龙担任主编并统稿，黄建忠、许晓彦为副主编，王晓兰、浦文英、刘伟、刘以建、刘中伟、郑凯宇、王东、宗艳玲等参与了本书的编写工作。

本书的编写得到了上海海事大学教务处，特别是电气自动化系各位同仁的支持与帮助，以及上海市第 4 期本科教育高地建设项目“电气工程及其自动化项目”的支持，在此表示由衷的感谢。

由于作者水平有限，编写时间仓促，书中难免有错误或不妥之处，敬请读者批评指正。

编 者

2011.2

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# Part | Text

## Lesson One

## Prime Mover

The source for power is most often a generator set driven by a combustion engine which is fueled with diesel or heavy fuel oil. Occasionally one can find gas engines, and also gas turbines, steam turbines or combined cycle turbines, especially for higher power levels, in light high-speed vessels, or where gas is a cheap alternative (e.g. waste product in oil production, boil-off in LNG carriers, etc.).

In a diesel-electric propulsion system, the diesel engines are normally medium to high-speed engines, with lower weight and costs than similar rated low speed engines that are used for direct mechanical propulsion. Availability to the power plant is of high concern, and in a diesel electric system with a number of diesel engines in a redundant network; this means high reliability but also sophisticated diagnostics and short repair times.

The combustion engines are continuously being developed for higher efficiency and reduced emissions, and at present, a medium speed diesel engine has a fuel consumption of less than 200g per produced kWh at the optimum operation point as seen in Fig.1-1. Even though this is regarded to be a high utilization factor of fuel, it represents only about 40% of the energy in the fuel, the rest of the energy being removed by the exhaust or heat dissipation.

Moreover, the efficiency drops fast as the load becomes lower than 50% of MCR (Max Continuous Rating). At this working condition, the combustion is inefficient, with high NO<sub>x</sub> and SO<sub>x</sub> content, and with a high degree of soot which increases the need for maintenance. In a

diesel electric system with several diesel engines it is hence an aim to keep the diesel engines loaded at their optimum operating conditions by starting and stopping generator sets dependent on the load, with an aim to keep the average loading of each running diesel engine closest possible to its optimum load point.

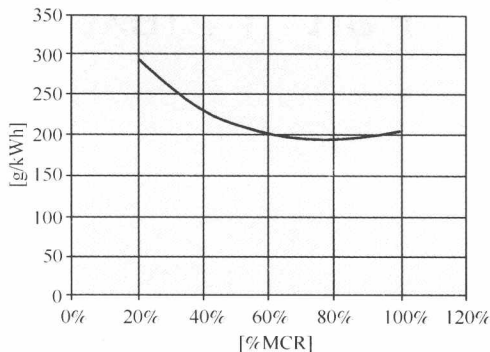


Fig.1-1 Example fuel consumption for a medium speed diesel engine

### New Words and Expressions

combustion [kəm'bʌstʃən]  
 diesel ['di:zəl]  
 turbine ['tə:bin, -bain]  
 redundant [ri'dʌndənt]  
 diagnostics [ˌdaɪəg'nɒstiks]  
 sophisticated [sə'fɪstɪkeɪtɪd]  
 emission [i'mɪʃən]  
 utilization [ˌju:tilaɪ'zeɪʃən]  
 dissipation [ˌdɪsɪ'peɪʃən]

*n.* 燃烧, 发火, 点火  
*n.* 柴油机, 内燃机  
*n.* (涡)轮机, 叶轮机, 汽轮机, 透平机  
*adj.* 过多的, 冗余的, 冗长的(文章等); 累赘的  
*n.* 征候, 特征  
*adj.* 复杂的, 尖端的, 高级的; 微妙的  
*n.* 发出, 发射, 射出, 放射; 传播  
*n.* 利用; 效用  
*n.* 消散, 分散

### Notes

(1) "...as seen in Fig..." as (表示方式、程度、情况等)如同; 像; 按照例如:

1) I work as others do.

我跟别人一样工作。

2) I remember it as it were but yesterday.

我想起这件事就仿佛是昨天发生的一样。

3) Parks are to the city as lungs are to the body.

公园对于都市来说就如同肺部对于身体一样。

“as”在英语里是一个比较常见、用法繁多的词。本课“as”的用法比较集中，为方便学习，特把几种基本用法归纳如下：

1) 引出同位语，常与“such”连用

We call such metals as copper and silver good conductors.

我们称这些金属，例如铜和银，为良导体。

There are different forms of energy, such as heat energy, sound energy and electric energy.

有各种不同的能，例如热能、声能和电能。

2) 用做介词

Electronics is regarded as an applied science.

电子学被认为是一门应用科学。

Electricity is especially convenient as a source of mechanical power.

电作为机械的动力源特别方便。

3) 用做关系代词或关系副词，引出定语从句

This is the same material as is used in the diode.

这和用在二极管中的材料是一样的。

I want to get such a tool as he is using.

我想得到一把像他正在使用的那种工具。

He repaired the machine in the same way as we did. (这句“in the same way”所代替的是介词短语“as”，而该介词短语在主句中作状语，所以“as”作关系副词。) 他采取和我们同样的方法修理机器。

4) 用做从属连词，引出时间、原因、方式、比较等状语从句

As the piston moves down, the pressure in the cylinder decreases. (时间状语从句)

当活塞下移时，汽缸里的压力就减小。

As the question is of importance, we should tell the chief engineer at once. (原因状语从句)

因为这个问题很重要，所以我们必须立即告诉轮机长。

Light waves are different in frequency just as sound waves are. (方式状语从句)

正如声波一样，光波也有不同的频率。

This generator is as effective as that one (is). (比较状语从句)

这台发电机和那台发电机效率一样。

(2) “...to its optimum load point” to (表示范围、程度) 到，达到；……到，……得。

例如：

1) The room was hot to suffocation.

房间热得闷人。

2) to his name be it said

(虽说是敌人然而) 真是名不虚传。



## Lesson Two

# Transformers

The purpose of the transformer is to isolate the different parts of the electric power distribution system into several partitions, normally in order to obtain different voltage levels and sometimes also for phase shift. Phase shifting transformers can be used to feed frequency converters, e.g. for variable speed propulsion drives, in order to reduce the injection of distorted currents into the electric power network by canceling the most dominant harmonic currents. This reduces the voltage distortion for generators and other consumers. The transformers also have a damping effect of high frequency conductor emitted noise, especially if the transformer is equipped with a grounded copper shield between primary and secondary windings.

There are numerous different transformer designs in use, and the most common types are; air insulated dry type, resin insulated (cast or wound), or oil/fluid insulated. Regulations, ambient conditions, and user's, yard's, or supplier's preferences govern the selection of type, material, and design of the transformer.

Physically, the transformer is normally built as three-phase units, with three-phase primary coils and three-phase secondary coils around a common magnetic core. The magnetic iron core constitutes a closed path for magnetic flux, normally with three vertical legs and two horizontal yokes; one in bottom and one at top. The inner winding constitutes the low voltage or secondary windings, and the outer is the primary or high voltage winding. The ratio of primary to secondary windings gives the transformation ratio. The coils may be connected as a Y-connection or  $\Delta$ -connection (also called D-connection). The connection may be different on primary and secondary sides, and in such transformers, not only the voltage amplitude will be converted, but there will also be introduced a phase shift between the primary and secondary voltages. The phase shift can also be adjusted by use of Z-connected windings, normally in the primary, where the phase shift angle can be accurately determined by the ratio of turns in the segments of the Z-windings. Three or four winding transformers with multiple secondary windings are also in use, e.g. for multi-pulse drive applications.

A transformer with  $\Delta$ -connected primary and Y-connected secondary is called a Dy type

transformer. The first and capital letter describes the primary winding, and the second and small letter describes the secondary winding. The letter n is used to describe if the common point in a Y-connection is grounded, e.g. Dyn or Ynyn.

Transformers may be designed according to IEC standards. For converter transformers, it is essential that the design accounts for the additional thermal losses due to the high content of harmonic currents. IEC also gives design rules and guidelines for such applications.

### New Words and Expressions

partition [pɑ:'tɪʃən]  
 harmonic [hɑ:'mɒnik]  
 damping ['dæmpɪŋ]  
 insulate ['ɪnsjuleɪt]  
 ambient ['æmbiənt]  
 magnetic [mæg'netɪk]  
 flux [flʌks]  
 horizontal [hɒrɪ'zɒntl]  
 yoke [jəuk]  
 thermal ['θɜ:məl]

*n.* 分割; 分开; 被分开; 区分, 划分, 配分  
*n.* 谐波; 谐音  
*n.* 阻尼, 减幅, 衰减  
*vt.* 使绝缘; 使绝热  
*adj.* 包围着的, 周围的  
*adj.* 磁(性)的; (可)磁化的  
*n.* 流量, 通量, 电通量, 磁通量  
*adj.* 地平的, 地平线的  
*n.* 轭状物  
*adj.* 热的, 热量的, 温热的; 由热造成的

### Notes

(1) "...not only the voltage amplitude will be converted, but there will..."

not only... but... 不但……而且…… 这里 but 后省略了 also, "not only ...but also..."是并列连词, 通常连接两个等同的成分。它所连接的两个等同成分强调后者。

例如:

1) Furthermore, education is not only just about knowledge but also about values.

此外, 教育并不只求知识的传授, 也重视价值观的培养。

2) We will protect not only individual rights, but also must shoulder collective responsibilities.

我们保障个人权利, 但也应该承担集体责任。

(2) "... for the additional thermal losses due to the high content of harmonic currents."

due to 由于, 应归于

例如:

1) Inability to stand due to muscular incoordination.

由于肌肉不协调而不能站立。

2) His illness was due to overwork.

他的病起因于过度劳累。



## Lesson Three

## A.C. Generator

---

Synchronous A.C. generators for auxiliary supplies are usually of the type having a rotating field and with the armature winding on the stationary frame. Inverted constructions are also available and in this type the armature is rotating. Limitations in the size and complexity of the slip rings and brush-gears limit the invented construction to about 150 kVA.

On generators used for marine installations the field system may be of the salient-pole type in which the field-poles will be similar to those of a D.C. generator. Alternatively generators of the non-salient or cylindrical construction with distributed field windings embedded in slots may be used. The cylindrical type is generally used in high speed turbo-generators but some manufacturers now prefer them for all speed.

The physical size of the machine is influenced by the power factor of the system, and it is usual to base the rating on a power factor of 0.8 lagging which represents average operating conditions. The kVA rating is proportionately higher watts to be dissipated in the stator windings (usually referred to as the “copper losses”).

The power factor (p.f.) of the system is dependent on the type of load. Filament lighting, heating and cooking will be at unity power factor but induction motors, fluorescent lighting and transformers will take less than unity. Motors running at less than their full load rating will generally have a lower power factor than at full load, so the load current is not strictly proportional to the output. As it is desirable to keep the p.f. as high as possible it is therefore important not to install over-size motors. Cage type induction motors also have a very poor power factor which may be as low as 0.3~0.4, when starting, the current is 5~7 times the full load current.

The characteristic load-voltage current of an A.C. generator is very similar to that of a shunt wound D.C. generator, although the cause of the voltage drop is caused by stator resistance and by distortion of the flux path. With lagging power factors, there is a further loss of voltage caused by stator leakage reactance and by the fact that a component of stator m.m.f. has a directly demagnetizing action. The lower the p.f. the greater will these effects become.

In machines of normal design the drop between no load and full load with 0.8 p.f. will be of the order of 25%~35%, assuming constant excitation. In practice the voltage is restored to normal by increasing the excitation, and it will be seen that as the p.f. gets worse, more and more excitation is required, thus increasing the amount of heat dissipated in the field windings.

The behavior of an A.C. generator, when subject to transient load, e.g. starting comparatively large induction motors or when subject to short circuit, is somewhat complicated. There is an instantaneous voltage dip followed by recovery to a final steady state condition. The amount of dip is independent of partly heating and lighting and partly power. Too great a dip with too long a effects on the running of other motors and voltage sensitive equipment such as radar (if operated directly from the supply system) and on the starters for fluorescent lighting. The effect of p.f. of the transient loading on the transient as well as the steady state voltage regulation is important and it is necessary to take these conditions into account in the design of the machines.

### New Words and Expressions

A.C.—alternating current

synchronous ['sɪŋkrənəs]

rotate [rəu'teɪt]

armature ['ɑ:mətjuə]

stationary ['steɪj(ə)nəri]

frame [freɪm]

invert [ɪn've:t]

limitation [lɪmɪ'teɪʃən]

complexity [kəm'pleksɪtɪ]

slip ring [slɪp rɪŋ]

brush-gear [brʌʃ giə]

kVA—kilovolt ampere

salient ['seɪljənt]

nonsalient ['nɒn'seɪljənt]

cylindrical [sɪ'lɪndrɪk(ə)]

distribute [dɪs'trɪbjʊ(:)t]

embed [ɪm'bed]

slot [slɒt]

turbo-generator ['tʊ:bəu'dʒenəreɪtə]

physical ['fɪzɪkəl]

influence ['ɪnfluəns]

lag [læɡ]

represent [ˌrɪ:prɪ'zent]

交流电

*adj.* 同步的

*vi.* 转动, 旋转

*n.* 电枢, 转子

*adj.* 静止的

*n.* 构架, 架, 座, 结构

*vt.* 使反向

*n.* 限制, 局限

*n.* 复杂

*n.* 花环

*n.* 电刷装置

千伏安

*adj.* 凸起的, 显著的

*adj.* 不凸起的

*adj.* 圆柱体的

*vt.* 分配, 分布

*vt.* 把……嵌入

*vt.* 缝, 槽

*n.* 汽轮发电机

*adj.* 物理的, 实际的

*n.* 影响, 感化

*vi.* 滞后

*vt.* 描绘, 阐述, 表示

proportionate [prə'pɔ:ʃənɪt]  
 dissipate ['disɪpeɪt]  
 copper ['kɒpə]  
 filament ['fɪləmənt]  
 unity ['ju:nɪti]  
 induction [ɪn'dʌkʃən]  
 fluorescent [fluə'resənt]  
 strict [strikt]  
 cage [keɪdʒ]  
 distortion [dɪs'tɔ:ʃən]  
 flux [flʌks]  
 leakage ['li:kɪdʒ]  
 reactance [ri'æktəns]  
 component [kəm'pəʊnənt]  
 m.m.f.—magnetic-motive force  
 demagnetize [di:'mægnɪtaɪz]  
 behavior [bi'heɪvjə]  
 subject [sʌbdʒɪkt]  
 transient ['trænzɪənt]  
 somewhat [sʌm(h)wɒt]  
 instantaneous [ɪnstən'teɪnjəs]  
 dip [dɪp]  
 objectionable [əb'dʒekʃənəbl]  
 flicker ['flɪkə]  
 adverse [ædvə:s]  
 sensitive ['sensɪtɪv]  
 starter['stɑ:tə]  
 regulation [regju'leɪʃən]

*adj.* 成比例的, 相对的  
*vt.* 浪费, 使耗散  
*n.* 铜  
*n.* 灯丝  
*n.* 单一, 整体  
*n.* 感应  
*adj.* 荧光的  
*adj.* 精确的  
*n.* 笼  
*n.* 弄歪, 变形, 畸变  
*n.* 磁通量  
*n.* 泄漏  
*n.* 电抗  
*n.* 元件, 组件, 机件  
 磁动势  
*v.* 使退磁  
*n.* 性能, 行为, 特性  
*vt.;adj.* 使受到; 受支配的  
*n.;adj.* 瞬变的, 瞬态值  
*adv.* 有点  
*adj.* 瞬间的, 即刻的  
*n.* 下降, 下沉  
*adj.* 讨厌的, 引起反对的  
*n.* 扑动, 摇曳, 闪烁  
*adj.* 相反的, 不利的  
*adj.* 灵敏的, 敏感的  
*n.* 启动器  
*n.* 调节

## Notes

(1) ...by the fact that a component of stator m. m. f. has a ...

“fact”后面由“that”引导的是一个同位语从句。这种在复合句子中起同位语作用的从句通常由从属连词“that”引出。

例如:

1) The fact that electric currents passing through a wire produce heat is known to all.

电流通过导线时产生热这一事实是大家所知道的。

2) This experiment leads to the conclusion that unlike charges attract each other.

这个实验导致这样一个结论: 异性电荷相吸。

(2) ...“as well as...” 这是一个固定词组，as 和 well 都失去了原有的词汇含义，这个词组起着-一个并列连词的作用，意思是“以及，不仅……而且”。

值得注意的是，as well as 用做并列连词时，着重的不是 as well as 之后的词，而是它之前的词，所以翻译的通常先译 as well as 之后的词，然后再翻译它之前的词。

例如：

Conductors and insulators are of great use in industry as well as in our daily life.

导体和绝缘体不仅在我们日常生活中有很大用处，而且在工业上也用处很大。

另外，当“as well as”用来连接两个主语时，其所谓动词应随前一个主语的人和数的变化而变化。

例如：

He as well as the other students has learned how to install this electric equipment.

他和其他学生一样也学会了如何安装这种电气设备。



## Lesson Four

# Self-excited A.C. Generators and Their Parallel Operation

It has long been known that self-excited generators were feasible but the practical development of sizes suitable for ship's generators was delayed until the advent of the silicon semiconductor rectifier. The copper oxide rectifier was not commercial until 1925 and was unsuitable because of its size. The better performance and efficiency of silicon-junction rectifier made the use of self-excited A.C. generators practical and acceptable.

Many of these generators are also compound and therefore come into the category of voltage regulating schemes (called as "functional"). This term means systems of voltage control are operated by measuring or sensing changes in loading condition and maintain the normal voltage by the use components built into the systems. They differ from "error-operated" systems in which a change of voltage takes place and is then restored to normal.

It follows that functional system will generally respond faster than error-operated systems. Nevertheless most functional systems, because of practical difficulties in maintaining normal voltage within very narrow limits, use an automatic voltage regulator (a.v.r.) for trimming purposes. All the methods normally supplied will maintain the A.C. voltage within  $\pm 2.5\%$  but some work much closer and  $1.5\%$  is attainable with standard equipment.

The systems adopted by manufacturers differ slightly from one another but the following examples demonstrate the general principles in use.

A common principle is the use of terminal A.C. voltage for establishing the no-load voltage and using the load current as a means for providing the extra excitation needed to balance such things as armature reaction and leakage reactance. Where systems differ (and no two systems are alike) is in the trimming necessary to take care of loading conditions, variation of field resistance between cold and hot condition, and power factor.

When paralleling an A.C. generator with other sets already on load the following operations are necessary:

- (1) The speed of the incoming machine must be adjusted until its frequency is approximately

equal to that of the generator already connected to the bus-bars. Ordinary engine tachometers are not suitable for this purpose.

(2) The voltage must be adjusted with that of the bus-bars.

(3) The paralleling switch must be closed as nearly as possible at the moment when the two instantaneous voltages are in phase.

In practice these operations are just as simple as paralleling two D.C. supplies, but they require a little more patience to get the right conditions, as closing the switch when two supplies are approaching  $180^\circ$  phase difference can have disastrous consequences.

To facilitate the operations a synchroscope is provided. This shows by the speed of rotation of the synchroscope pointer the difference between the two frequencies, and together with the lamps indicates when the voltages are in phase. When the conditions are right the circuit breaker must be closed immediately.

It is preferable that before synchronizing the generator voltage and frequency should be not less than those already on the bus-bar so that the incoming machine immediately assumes a certain load.

The p.f. of a single generator supplying a load is determined by the load impedance but when two or more generators are connected in parallel they form a closed circuit in which power or wattless Kvar can circulate while by passing the load. The p.f. of each machine is therefore not a function of load impedance alone. For a given driving torque the kVar output of each generator when synchronized and connected to the system, it does not share the load until its speed has been suitably adjusted. Voltage regulation by adjustment of the a.v.r. affects only the distribution of the wattless load.

## New Words and Expressions

self-excited ['selfik'saitid]

feasible ['fi:zəbl]

advent ['ædvənt]

commercial [kə'mə:ʃəl]

silicon ['silikən]

semiconductor ['semikən'dʌktə]

rectifier ['rektifaɪə]

oxide ['ɒksaɪd]

efficiency [i'fi:ʃənsi]

junction ['dʒʌŋkʃən]

category ['kætigəri]

functional ['fʌŋkʃənl]

sense [sens]

*adj.* 自激的, 自励的

*adj.* 可行的, 可用的

*n.* 出现, 到来

*adj.* 商品化

*n.* 硅

*n.* 半导体

*n.* 整流器

*n.* 氧化物

*n.* 效率, 功效, 效能

*n.* 连接, 结合点, 结

*n.* 种类, 类目

*adj.* 功能的, 函数的

*vt.* 自动检测