高等院校车辆工程专业系列教材

汽车工程专业英语

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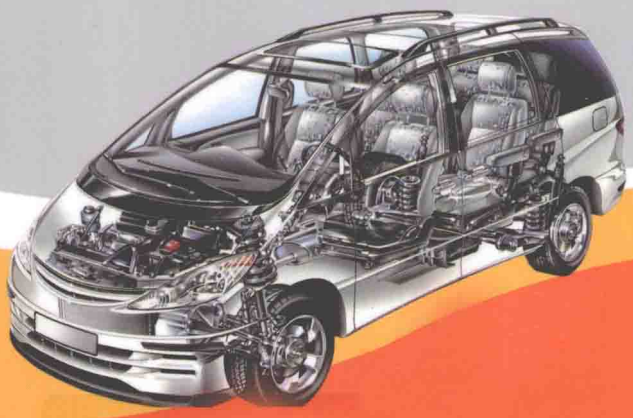

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Automotive Engineering English

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内容简介

本书用英文全面介绍了汽车基本构造和工作原理，同时涵盖了该领域的一些新技术内容，其中包括汽油直喷、柴油共轨、自动变速、ESP、EPS、线控转向及制动、自动巡航、新能源汽车等。全书共分8个单元，论述时尽量采用英文专业术语，避免过多强调繁杂的语法，并采用图文并茂的形式以方便读者快速掌握汽车工程专业英语知识。同时在每个单元后面还对生词、难词及专业词汇作了注释，并配有一定数量的思考题。在书后还附有汽车工程常用词汇缩写及其注释和总词汇表。

本书既可作为高等院校汽车类专业的专业英语教材或汽车构造课程的双语教学辅助教材，也可作为汽车企业和科研单位的技术人员的英文阅读参考书。

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前　言

汽车作为重要的运输工具，其诞生和发展对人类社会的进步和繁荣有着重要的意义。对于我国来说，汽车属于“舶来品”，虽然我国汽车工业早期曾借鉴了前苏联的许多经验，但自20世纪50年代以来，由于汽车工业的新技术往往产生于欧美，其技术文献也多用英语来表述，因此对我国汽车工程技术人员及相关技术人员来说，熟练运用汽车专业英语知识来阅读相应的英文版技术资料就显得非常重要与迫切。虽然在我国很多地方人们从幼儿园阶段就开始接受英语教育，但是要在工程中真正应用英语，则必须结合具体专业，尤其是在新技术日新月异发展的汽车工业领域更需要掌握汽车专业英语。因此，我们特组织相关专业教师编写了这本《汽车工程专业英语》，旨在帮助具有一定英语基础，同时又想进一步学习汽车专业英语的读者尽快熟悉常见的汽车专业英语用语和知识，以达到最终能够直接阅读汽车工程专业的英文科技文献资料的目的，从而促进我国汽车工业的快速发展。

本书用英文全面介绍了汽车基本构造和工作原理，同时涵盖了该领域的一些新技术内容，其中包括汽油直喷、柴油共轨、自动变速、ESP、EPS、线控转向及制动、自动巡航、新能源汽车等。全书共分8个单元，论述时尽量采用英文专业术语，避免过多强调繁杂的语法，并采用图文并茂的形式以方便读者快速掌握汽车工程专业英语知识。同时在每个单元后面还对生词、难词及专业词汇作了注释，并配有一定数量的思考题。在书后还附有汽车工程常用词汇缩写及其注释和总词汇表。

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本书由祝安定主编，胡伟龙参与编写。其中第7章、第8章由胡伟龙编写，其余各章由祝安定编写。全书合肥工业大学卢剑伟教授主审。在编写本书过程中，我们参考了大量文献，并在书后面注明了主要参考文献的来源，在此对以上参考文献、图表的原作者表示衷心感谢。研究生程伟等同学参与了本书的校对工作，在此一并表示感谢。

由于编者水平有限，书中难免有不妥之处，敬请读者批评指正。

编　者

CONTENTS

Chapter 1 Automotive basics

1.1 The history of automotive

The automotive industry affects many areas of the economy. Starting with the first patented gasoline-powered Benz Motorwagen in 1886(Figure 1.1), the automotive industry has seen continuous and exciting changes for over a century. The early gasoline-powered automobile generated 1.5hp (1.1kW), it reaches top speed of 3～5mph (5～8km/h). Today's average vehicles have 110～450hp(80～330kW) engines and cruise at 106～120 km/h, depending on the legal speed limit. For many people around the world, automotives are the most important means of personal transportation.

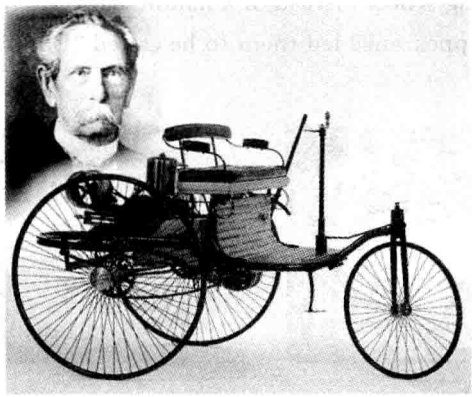

Figure 1.1 First automotive

Modern automotives are highly complex vehicles with multiple computer-controlled systems. A car today has more computers in it than the first spaceship. It may have as many as 15 computers operating everything from the engine to the radio.

Automotives are available in a wide variety of models, sizes, and body styles. Vehicles range from compacts to full-size cars and from minivans to sport utility vehicles (SUV). There are also sedans, station wagons, and light-duty trucks. Luxury models are also available.

Technology has improved vehicles over the past century. Vehicles are designed according to a variety of factors, including the number of engine cylinders, the type of drive train system, and vehicle application.

About 15000 separate parts are assembled to make an automotive vehicle. These components are grouped in to several systems, known as automotive vehicle systems. An automotive system is a system made up of two or more parts that work together to perform a specific task.

1.2 Classification of automotives

Motor vehicles may be classified by a number of different criteria. The most commonly used system of classification is detailed. Where applicable, the equivalent European New Car Assessment Programme (NCAP)classifications are shown. The United States Environmental Protection Agency (EPA)has another set of classification rules based on interior passenger and cargo volumes.

1.Microcar

Microcars are motor vehicles straddling the boundary between cars and motorbikes. These vehicles have engines under 1.0 liter, typically seat only two passengers, and are sometimes unorthodox in construction. Although some microcars are three-wheeled, they are not classified into the category of motorbike. A microcar has seats rather than a saddle and is operated by a steering wheel instead of a handle bar. Microcars were popular in post-war Europe, where their appearance led them to be called "Bubble cars". Figure 1.2 shows examples of the microcar.

(a) Smart For two by Benz

(a) QQ3 by Chery

Figure 1.2 Two typical microcars

2.City car

A city car is a small vehicle intended for use primarily in urban areas. City cars are sold worldwide and most manufacturers have one or two models in their line-up. Unlike microcars, a city car's greater speed, capacity and occupant protection are safer in mixed traffic environments and weather conditions. In Japan, city cars are called kei cars, they have to meet strict size and engine requirements: engines have a maximum displacement of 660cc and the car's length must be less than 3400mm. Examples of city cars are Ford Ka and Citroën C1(Figure 1.3).

(a) Ford Ka

(b) Citroën C1

Figure 1.3 Two typical sity cars

3. Subcompact car

Subcompact car is a term used to describ evehicles whose class size is smaller than that of a compact car, usually not exceeding 4191mm in length, but larger than a microcar. According to EPA, a passenger car is classified as subcompact if it has between 2,407 L and 2,803 L of interior volume. Many contemporary cars branded as "subcompact" fall into either the supermini or the city car category in Europe. Examples of subcompact cars are Peugeot 207 and Ford Fiesta(Figure 1.4).

(a) Peugeot 207

(b) Ford Fiesta

Figure 1.4 Two subcompact cars

4. Compact car

A compact car or small family car is a classification of cars which are larger than a subcompact car but smaller than or equal to a mid-size car.

Current compact car size, for US and international models respectively, is approximately 4100mm and 4450mm long for hatchbacks, or 4400mm and 4750mm long for convertibles, sedans or station wagons. Multi-purpose vehicles and sport utility vehicles based on small family cars (often called compact MPVs and compact SUVs) have similar sizes.

Common engines are 1.5 to 2.4-litre straight-4s, using either gasoline or diesel fuel, with a range between 75kW and 127kW. High-performance versions may have turbocharged 2.0 or 2.5-liter engines, or even V6 3.2-liter units, ranging maximum

outputs from 127kW to 224kW. Examples of compact cars are Volkswagen Golf and Ford Focus(Figure 1.5).

(a) Volkswagen Golf (b) Ford Focus

Figure 1.5 Two typical compact cars

5. Sedan

A sedan or saloon is a passenger car in a three-box configuration with A, B & C-pillars and principal volumes articulated in separate compartments for engine, passenger and cargo. The passenger compartment features two rows of seats and adequate passenger space in the rear compartment for adult passengers. The cargo compartment is typically in the rear, with the exception of some rear-engined models. It is one of the most common car body styles. Figure 1.6 shows the typical pillar configurations of a sedan (three box), station wagon (two box) and hatchback (two box) from the same model range.

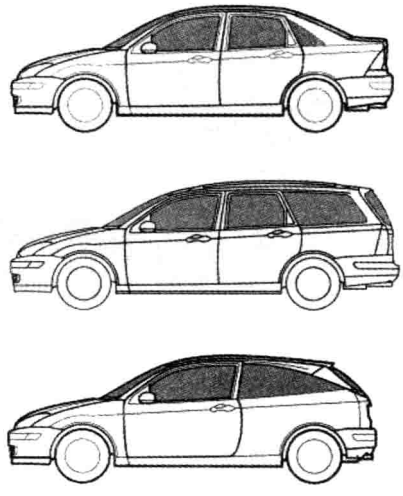

Figure 1.6 Three typical pillar configurations

6. Station wagon(SW)

A station wagon or estate car is a body style variant of a sedan with its roof extended rearward over a shared passenger/cargo volume with access at the back via a third or fifth door, instead of a trunk lid. The body style transforms a standard three-box design into a two-box design — to include an A, B & C-pillar, as well as a D pillar. Station wagons feature flexibility to allow configurations that either favors passenger or cargo volume, e.g., fold-down rear seats.

When a model range includes multiple body styles such as sedan, hatchback and station wagon, the models typically share their platform, drivetrain and bodywork forward of the A-pillar.

7. Truck

A truck or lorry is a motor vehicle designed to transport heavy goods. Trucks vary greatly in size, power and configuration. Modern trucks are powered by either gasoline or diesel engines, with diesel dominant in commercial applications. Commercial trucks can be very large and powerful, and configured to mount specialized equipment, such as in the case of fire trucks , concrete mixers and suction excavators.

The cab of a truck is an enclosed space where the driver is seated. There are several possible configurations of cab in common use: cab over engine (COE) or flat nose, conventional cabs or long nose. In the case of COE, the driver's seat and the control devices are located above the front axle and the engine. This design is almost ubiquitous in Europe and widely used in the rest of the world. To access the engine, the whole cab tilts forward. In the case of conventional cabs, the driver is seated behind the engine, as in most passenger cars or pickup trucks. This type provides some front panels such as a long hood and fender to cover the engine and front wheels. They are the most common in North America. This type is also called cab behind engine (CBE). These trucks provide somewhat poorer visibility than COE counterparts(Figure 1.7).

(a)

(b)

Figure 1.7 Cab behind engine (CBE) Truck and Cab over engine (COE) Truck

Special vehicles are built on the chassis of mass production motor vehicle to meet particular requirements. Many of them are provided with special equipments for particular purposes.

The first type is used to carry special goods. Such as vehicle with a closed body for easy-contaminated goods, vehicles with a refrigerator body for perishable food stuff, dump truck for sand, soil or stones, flat-bed semi-trailer for large-size cargo and tanker for liquefied loads, dry bulk cargo or gases, powder.

The vehicles for special work have special equipments to meet the specific requirements, such as mobile-shop, ambulance, fire engine and vehicles for urban sanitation and road cleaning.

A modern firetruck(Figure 1.8)is usually a multi-purpose vehicle carrying professionals and equipment for a wide range of firefighting and rescue tasks. Many fire engines are based on standard truck or lorry models with heavy duty suspensions, brakes, tires, alternator,

transmission and cooling systems; audible and visual warnings such as sirens, horns, and flashing lights.

Figure 1.8 A modern fire truck

1.3 Principal Components

The automotive chassis provides the strength necessary to support the vehicular components and the payload placed upon it.

The suspension system contains the springs, the shock absorbers, and other components that allow the vehicle to pass over uneven terrain without an excessive amount of shock reaching the passengers or cargo.

The steering mechanism is an integral portion of the chassis, as it provides the operator with a means of controlling the direction of travel.

The tires grip the road surface to provide good traction that enables the vehicle to accelerate, brake, and make turns without skidding. Working in conjunction with the suspension, the tires absorb most of the shocks caused by road irregularities.

The body of the vehicle encloses the mechanical components and passenger compartment. It is made of relatively light sheet metal or composite plastics. The components that make up the chassis are held together in proper relation to each other by the frame.

1.3.1 Body

An automobile body is a sheet metal shell with windows, doors, a hoodand a trunk deck built into it. It provides a protective covering for the engine, passengers and cargo. It is designed to keep passengers safe and comfortable. The body styling provides an attractive, colorful, modern appearance for the vehicle.

A sedan has an enclosed body with a maximum of 4 doors to allow access to the passenger compartment. The design also allows for storage of luggage or other goods. A sedan can also be referred to as a saloon and traditionally has a fixed roof. There are soft-top versions of the same body design except for having 2 doors, and these are commonly referred to as convertibles.

The utility or pick-up carries goods. Usually it has stronger chassis components and suspension than a sedan to support greater gross vehicle mass.

Light vehicle vans can be based on common sedan designs or redesigns so that maximum cargo is available.

The bodies of commercial vehicles that transport goods are designed for that specific purpose. Tankers transport fluids, tippers carry earth or bulk grains, flatbeds and vans are used for general goods transport.

Buses and coaches are usually 4-wheel rigid vehicles, but a large number of wheels and axles can be used. Sometimes articulated buses are used to increase capacity. Buses and coaches can be single-deck or double-deck. Buses are commonly used in cities as commuter transports while coaches are more luxurious used for long distances.

1.3.2 Engine

The engine acts as the power unit. The internal combustion engine is most common: this obtains its power by burning a liquid fuel inside the engine cylinder. There are two types of engine: gasoline (also called a spark-ignition engine) and diesel (also called compression-ignition engine). Both engines are called heat engines; the burning fuel generates heat which causes the gas inside the cylinder to increase its pressure and supply power to rotate a shaft connected to the power train.

The way engine cylinders are arranged is called the engine configuration. In-line engines have the cylinders in a line. This design creates a simply cast engine block. In vehicle applications, the number of cylinder is normally from 2 to 6. Usually the cylinders are vertical. As the number of the cylinder increases, the length of the block and crankshaft can become a problem. One way to avoid this is with a V configuration. This design makes the engine block and crankshaft shorter and more rigid.

An engine located at the front can be mounted longitudinally and can drive either the front or rear wheels. Rear engine vehicles have the engine mounted behind the rear wheels. The engine can be transverse or longitudinal and usually drives the rear wheels only.

Most small trucks such as pickups, and even light medium-duty truck suse gasoline engines, but many diesel engined models are now being produced. Heavier trucks use four stroke diesel engines with a turbocharger and aftercooler. In the European Union, all new lorry engines must comply with Euro 5 emission regulations.

1.3.3 Chassis

Chassis is the frame on which the engine, body, wheels etc. are built. The chassis is

an assembly of those systems that are the major operating parts of a vehicle. It includes power train which conveys the drive to the wheels, steering which controls the direction of movement, suspension and wheels which absorb the road shocks, and brake whick slows down the vehicle.

1. Power train system

The power train transfers turning effort from the engine to the driving wheels. It include a clutch (manual transmission) or a torque converter (automatic transmission), a transmission drive shaft, final drive and differential gears and driving axles. Alternatively, a transaxle may be used. A transaxle is a self-contained unit with a transmission, final drive gears and differential located in one casing.

A vehicle with a manual transmission uses a clutch to engage and disengage the engine from the power train. Engine torque is transmitted through the clutch to the transmission or transaxle. The transmission contains sets of gears that increase or decreases the torque before it is transmitted to the rest of the power train. The lower the gear ratio selected, the higher the torque transmitted. A vehicle starting from rest needs a lot of torque, but once it is moving, it can maintain speed with only a relatively small amount of torque. A higher gear ratio can then be selected, and engine speed is reduced.

A conventional vehicle with the engine at the front and driving wheels at the rear uses a drive shaft, called a propeller shaft to transmit torque from the transmission to the final drive.

The final drive provides a final gear reduction to multiply the torque before applying to the driving axles. On front engine rear wheels drive vehicles the final drive changes the direction of driven by 90 degrees. Inside the final drive, a differential gear set divides the torque to the axles and allows for the difference in speed of each wheel when cornering. Axle shafts transmit the torque to the driving wheels. In a rear-wheel drive vehicle, the axle can be solid or contain joints to allow for movement of suspension. For a front-wheel drive vehicle, the drive shaft has universal joints to allow for suspension and steering movement.

An automatic transmission or transaxle performs similar functions to a manual transmission or transaxle except that gear selection is controlled either hydraulically or electronically. The automatic transmission uses a torque converter, which acts as a hydraulic coupling to transfer the drive.

Small trucks use the same type of transmissions as almost all cars, having either an automatic transmission or a manual transmission with synchronizers. Larger trucks often use manual transmissions without synchronizers for saving bulk and weight.

Transmissions without synchronizers, known as "crash boxes", require double-clutching for each shift, a method of changing gears which doesn't use the clutch, except for starts and stops.

Automatic and semi-automatic transmissions for heavy trucks are becoming more and

more common, due to advances both in transmission and engine power. Common North American setups include 9, 10, 13, 15 and 18 speeds. In Europe, 8, 10, 12 and 16 gears are common on larger trucks with manual transmission, while automatic or semi-automatic transmissions would have anything from 5 to 12 gears.

2. Steering system

The directional motion of vehicle is controlled by a steering system. A basic steering system has 3 main parts: a steering box connected to the steering wheel, the linkage connecting the steering box to the wheel assembly at the front wheels and front suspension parts to let the wheel assemblies pivot. When the driver turns the steering wheel, a shaft from the steering column turns the steering gear. The steering gear moves tie-rods that connect to the front wheels. The tie-rods move the front wheels to turn the vehicle right or left.

3. Suspension system and wheels

The purpose of the complete suspension system is to isolate the vehicle body from road shocks and vibrations, which will otherwise be transferred to the passengers and load. It must also keep the tires in contact with the road regardless of road surface. A basic suspension system consists of springs, axles, shock absorbers, arms, rods and ball joints.

The spring is the flexible component of the suspension. Basic types are: leaf springs, coil springs and torsion bars. Modern passenger vehicles usually use light coil springs. Light commercial vehicles have heavier springs than passenger vehicles and can have coil springs at the front and leaf springs at the rear. Heavy commercial vehicles usually use leaf springs or air suspension.

Wheels must be strong enough to support the vehicle and withstand the forces caused by normal operation. At the same time, they must be as light as possible to help keep unsprung weight to a minimum. Wheels can be made from pressed-steeling two sections, and also be made from cast aluminum alloy. Alloy wheels are popular because of their appearance and because they are lighter than similar steel wheels. Aluminum is a better conductor of heat, so alloy wheels can dissipate heat from brakes and tires more effectively than steel ones.

The tire provides a cushion between the vehicle and the road to reduce the transmission of road shocks. It also provides friction to allow the vehicle to perform its normal operations. Modern tires are manufactured from a range of materials. The rubber is mainly synthetic. Two types of tire construction are common: cross-ply and radial. Most passenger cars now use radial tires, and radials are replacing cross-ply tires on 4-wheel drives and heavy vehicles.

Tube tires require an inner tube to seal air inside the tire. Tubeless tires are eliminating the inner tube by making the complete wheel and tire assembly airtight. A special airtight valve assembly is needed. This can be a tight fit into the rim or can be held with a nut and sealing washers.

4. Braking system

Drum brakes have a drum attached to the wheel hub, and braking occurs by means of brake shoes expanding against the inside of the drum. With disc brakes, a disc attached to the wheel hub is clenched between two brakepads. On light vehicles, both of these systems are hydraulically operated. The brake pedal operates a master cylinder. Hydraulic lines and hoses connect the master cylinder to brake cylinders at the wheels. Most modern light vehicles have either disc brakes on the front wheels and drum brakes on the rear or disc brakes on all 4 wheels. Disc brakes require greater forces to operate them. A brake booster assists the driver by increasing the force applied to the master cylinder when the brake is operated.

Air operated braking system are used on heavy vehicles. Compressed air operating on large diameter diaphragms provides the large forces to the brake assembly that are needed. An air compressor pumps air to storage tanks. Driver controlled valves then direct the compressed air to different wheel units to operate the friction brakes. On articulated vehicles, any delay in applying the trailer brake should be minimized. This is achieved by using a relay valve and a separate reservoir on the trailer. This arrangement also applies the brakes if the trailer becomes disconnected from the prime mover.

All vehicles must be fitted with at least 2 independent braking systems. They were once called the service brake and the emergency brake. Now they are usually referred to as the foot brake and the park brake. Most light vehicles use a foot brake that operates through a hydraulic system on all wheels and a hand operated brake that acts mechanically on the rear wheels only. One common use of the hand brake system is to hold the vehicle when it is parked. The systems are designed to be independent so that if one fails, the other is still available.

1.3.4 Electrical and electronic system

Electrical is related to the electricity while electronic related to the semi-conductor or microcomputers. The electrical system provides electricity to the starter, ignition, lights and heater. The electricity level is maintained by a charging circuit.

The charging system provides electrical energy for all of the electrical components on the vehicle. A typical charging system includes: a battery, an alternator, a voltage regulator which is usually integral to the alternator, a charging warning or indicator light and wiring that complete the circuits. The battery provides electrical energy for starting, then once the engine is running the alternator powers all the electrical components of the vehicle. The alternator also charges the battery to replace the energy used to start the engine. The voltage regulator prevents overcharging.

The starting system consists of the battery, starter, flywheel ring gear, cables, and the ignition switch. The starter motor is powered by the battery. During starting, the pinion of the starter motor engages with the flywheel ring gear and the starter motor then operates to crank the engine.

A basici gnition system consists of the battery, low-tension cables, the ignition coil,