

UNIT 1

Qualities and qualifications needed for a car mechanic

Learning objectives

Reading comprehension: Understanding texts related to the car mechanic's job, application letters and CVs.

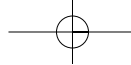
Vocabulary: Words related to qualifications, qualities, education, training, car mechanics, application letters and CVs.

Language functions: Expressing obligation and / or necessity.

Use of English: Word formation (Derivatives).

Writing: Writing a letter of application and filling in a CV.





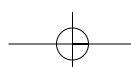
The car mechanic's job is well-paid and includes lots of advantages and career opportunities, although no academic qualifications are needed.

After having finished their nine-year compulsory education in Greece, young people who want to become car mechanics have to attend special subjects at a vocational school. There, trainers provide trainees with technical knowledge related to their particular area. The occupation of a car mechanic requires vocational training and skills based on empirical information that depends on observation and experience rather than theoretical knowledge. However, they are expected to have a good knowledge of mathematics and physics, as these subjects are useful tools for any technician and find practical application in the work place. A relatively good knowledge of English is also important to technicians working in this field for two main reasons. First, because most operation manuals, parts catalogues and car-guide books are written in English and second, because they should be able to communicate with tourists or foreigners who want their car to be checked or repaired.

To achieve your aim of being a successful car mechanic, you should be well aware of the construction, components and function of the car engine and its systems. You should also know to read diagrams with numbered parts so that you can deal with regular car checks and identify faults and malfunctions in the car systems. In addition, you should be able to choose and use skillfully the suitable tools and devices for any adjustment, maintenance and repair of the various car types.

To have a good reputation in this competitive career field, you need to have some specific qualities. Patience and persistence in solving complicated technical problems are of primary importance. You should also be polite to customers and colleagues, cooperative, responsible, reliable, honest, accurate in your diagnosis and able to take initiative to perform your tasks.

Last but not least, a conscientious technician should be prepared to attend seminars and spend some time reading technical magazines, newspapers and books, so as to keep well informed of the technological developments in the field of car mechanics.



1. Reading comprehension

Based on the text, underline or circle the correct items in italics.

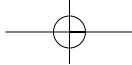
1. To be a car mechanic you *need academic qualifications* / *don't need academic qualifications*.
2. Compulsory education in Greece lasts for *six years* / *nine years*.
3. Car mechanics have to attend *a vocational school* / *a college*.
4. The job of a car mechanic requires training and skills based on empirical information that depends on *observation and experience* / *theoretical knowledge*.
5. *Mathematics and physics* / *Music and history* are useful tools for technicians.
6. Car mechanics must have a relatively good knowledge of *English* / *Greek grammar*.
7. To be a successful car mechanic you should know a lot about the construction, components and function of *the car engine* / *any kind of machine*.
8. You should also be able to deal with the *maintenance and repair* / *the construction* of the car.
9. You should also be *impolite* / *polite* to customers and colleagues.
10. Technicians should be well aware of the *new car models* / *technological developments* in the field of car mechanics.

2. Vocabulary practice

- 2A** In your opinion, match the job of the car mechanic with the suitable workplace. Then make sentences to say where he can work.

Job	Workplaces
Car mechanic	Supermarket Workshop Company of car dealers Customs office Car factory Department store Car service - center

e.g. *A car mechanic can work in/for a car service-center.*



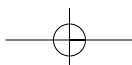
2B Match the words in column A with their definitions in column B.

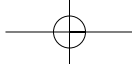
A	B
a. field	1. connected with occupation or profession
b. vocational	2. a person who instructs sb in the performance of tasks
c. qualification	3. a person's usual or principal work
d. trainer	4. apprentice; a person being trained
e. trainee	5. derived from experience or experiment
f. occupation	6. an area of study or activity
g. empirical	7. a diploma, degree etc that proves a person has trained for something
h. observation	8. a book giving explanation of how to do something
i. checking	9. the act of keeping (a machine, building etc) in good repair or working order
j. malfunction	10. the state of noticing, watching or paying attention to (rules etc)
k. manual	11. examination to learn if something is OK
l. component	12. part of a larger or more complex object (esp. a machine)
m. repair	13. failure to function properly
n. accurate	14. free from error; careful and exact
o. maintenance	15. restore to good condition; put right again

3. Useful phrases

How do you say the following phrases in English?

1. ακαδημαϊκά προσόντα / τίτλοι, πτυχία
2. εννιάχρονη υποχρεωτική εκπαίδευση
3. παρακολουθώ ειδικά μαθήματα
4. επαγγελματική κατάρτιση
5. παρατήρηση και εμπειρία
6. γνώση (της) θεωρίας / θεωρητική γνώση
7. τεχνίτης που εργάζεται σ'αυτόν τον τομέα / επάγγελμα
8. φυλλάδιο / οδηγός λειτουργίας (μηχανημάτων κ.λπ.)
9. θα'πρεπε να είσαι καλά πληροφορημένος για
10. τα εξαρτήματα της μηχανής του αυτοκινήτου
11. περίπλοκα τεχνικά προβλήματα
12. τεχνολογικές εξελίξεις





4. Language functions

Expressing obligation and/or necessity.

What are the qualities and qualifications a car mechanic must have?

To answer the above question you must know how to express obligation. Study the patterns that follow and then make your own sentences expressing *obligation* or no *obligation*, using the cues.

- Patterns:
- a. (To be) a car mechanic (you) **should / need to / must / have to** be patient. (*obligation to do sth*)
 - or** (To be) a car mechanic (you) **should / need to / must / have to** have patience. (*obligation to do sth*)
 - b. To be a car mechanic you **mustn't / can't / are not allowed to / are not permitted to** be impolite. (*obliged not to do sth*)
 - c. To be a car mechanic you **don't need** academic qualifications. (*not obliged*)
 - or** A car mechanic **doesn't need to / doesn't have to** get academic qualifications. (*not obliged*)

Cues: polite / politeness, able to read manuals, honest, reliable / reliability, responsible, irresponsible, go to university, properly trained, clumsy.

5. Use of English

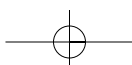
Word formation

Formation of nouns: To form nouns from other words you can follow some techniques:

Make no change (e.g. to design → a design)

Add a suffix (e.g. electric → electricity)

Make another kind of spelling change (e.g. to move → a motor / motion)



Practice

5A Using the above techniques, form nouns (you have already found in the text) from the words below:

- | | |
|-------------------|---------------------|
| 1. qualify | 12. construct |
| 2. educate | 13. suitable |
| 3. attend | 14. regular |
| 4. know | 15. maintain |
| 5. train | 16. repair |
| 6. occupy | 17. persist |
| 7. observe | 18. polite |
| 8. require | 19. perform |
| 9. achieve | 20. deal |
| 10. apply | 21. fail |
| 11. operate | 22. oblige |

5B Use the word in the parenthesis at the end of each sentence, to form a word that fits in the gaps.

- A technician is a person with practical, or industrial skills. (mechanic)
- What's his? He's a car mechanic. (occupy)
- He is in the use of tools. (skill)
- You must choose the tools to perform this task. (suit)
- A competent of English terminology is important. (know)
- To some extent, prevention from car accidents depends on cars' good (maintain)
- To be a car mechanic you should have some qualifications and qualities. (succeed)
- It's a career field. (compete)
- To be a good professional you must be (rely)
- A car buys and sells cars. (deal)
- advances are being developed day by day, lately. (technology)
- If you belong to a working team you should be (cooperate)
- A technician must behave towards his customers. (polite).

6. Writing activity

Before practising writing application letters and CV forms, study the following:

■ Applying for a job ■

In reply to an advertisement that appeared in the local newspaper, John Karas decided to write an application letter for the post of a car mechanic in the DAX car service center. He enclosed it with his curriculum vitae (CV) and a testimonial from his present employer. Here follows his letter of application.

37 Myronos st
 Athens, 178 32

23rd November, 2001

The Personnel Manager
 DAX car service centre
 14 Metsovou st
 Athens 156 87

Dear Sir,

With reference to your advertisement for the vacancy in your car service centre, I would like to apply for this post.

I am at present employed by the 'ACC car dealers' in Megara, but it's not convenient for me, as it is a long distance from my house. Moreover, the areas of work a technician deals with, when working for a car dealers company, are limited as he doesn't have the opportunity to practise all the technical knowledge he's got. These are the reasons why I'd like to find another job that suits me better.

On finishing my studies at a vocational school in Athens, I joined the Army, where I worked at the military car service centre for twenty months. When I was discharged from the Army, I started working for the ACC car dealers where I have gained two more years' experience in the field of car mechanics.

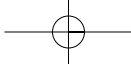
Furthermore, as you can also see in the testimonial from my present employer, I can guarantee that I am a reliable, trustworthy, patient and cooperative person.

I enclose my CV, the reference letter concerning my character and abilities from my employer and a copy of the university of Cambridge First Certificate in English. If required, I would attend with pleasure an interview at any time you like.

Hoping that I will meet all your requirements and looking forward to hearing from you soon,

Yours sincerely,

John Karas

**Practice**

In response to an ad for the post of a technician in the “Michael’s car repair workshop” write a letter of application and fill in the CV form that follows.

CURRICULUM VITAE**Surname:****First name:****Nationality:****Address:****Telephone No:****Marital status:****Education and qualifications:**

.....

.....

.....

.....

Languages:

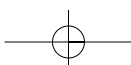
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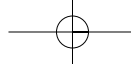
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Previous experience:

.....

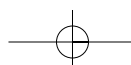
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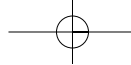
Referee:



Vocabulary – Terminology

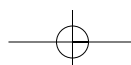
quality ιδιότητα, ποιότητα, (έμφυτη) ικανότητα, αρετή	adjustment ρύθμιση, προσαρμογή, εφαρμογή
qualification προσόν, τίτλος σπουδών, (επίκτητη) ικανότητα	type τύπος
car mechanic μηχανικός αυτοκινήτων	reputation υπόληψη, φήμη
compulsory education υποχρεωτική εκπαίδευση	competitive ανταγωνιστικός
subject θέμα, μάθημα	career καριέρα
special subjects μαθήματα ειδικότητας	patience υπομονή
vocational επαγγελματικός	persistence επιμονή, σταθερότητα, συνέχιση
trainer εκπαιδευτής	solve λύνω, επιλύω
trainee εκπαιδευόμενος	complicated περίπλοκος
occupation απασχόληση, εργασία, επάγγελμα	primary αρχικός, πρωταρχικός
require ζητώ, απαιτώ	polite ευγενικός
training κατάρτιση, εκπαίδευση	customer πελάτης
empirical εμπειρικός, που αποκτάται με πείρα	colleague συνάδελφος
observation παρατήρηση	cooperative συνεργάσιμος
experience πείρα, εμπειρία	responsible υπεύθυνος
theoretical θεωρητικός, της θεωρίας	reliable αξιόπιστος
tool εργαλείο, μέσο	honest έντιμος, τίμιος
technician τεχνίτης, (ο) τεχνικός	accurate ακριβής, σαφής
practical πρακτικός, χρήσιμος	diagnosis διάγνωση
application εφαρμογή, χρήση	initiative πρωτοβουλία
field τομέας, πεδίο	perform , εκτελώ, διεκπεραιώνω
operation λειτουργία, χειρισμός	task έργο, εργασία, καθήκον
manual εγχειρίδιο, φυλλάδιο	conscientious ευσυνείδητος
part τμήμα, μέρος, εξάρτημα, τεμάχιο	seminar σεμινάριο
guide book οδηγός, βιβλίο οδηγιών	spend αφιερώνω, ξοδεύω
check ελέγχω, έλεγχο	technological τεχνολογικός
repair (επί)διορθώνω, επισκευάζω, επισκευή	development εξέλιξη, ανάπτυξη
achieve επιτυγχάνω, καταφέρνω	car mechanics μηχανική αυτοκινήτου (τεχν.)
aware ενήμερος, πληροφορημένος	last διαρκώ
construction κατασκευή, δομή, διαμόρφωση κατασκευής	skill ικανότητα, επιδεξιότητα
component εξάρτημα, απαρτίζουν τμήμα / μέρος	maintenance συντήρηση, διατήρηση
function λειτουργία, έργο	apprentice εκπαιδευόμενος
engine κινητήρας, μηχανή (κίνησης)	complex περίπλοκος, σύνθετος
diagram διάγραμμα, σχηματική παράσταση	failure αποτυχία
numbered αριθμημένος	error λάθος, σφάλμα,
regular τακτικός, κανονικός	restore αποκαθιστώ, επισκευάζω, επαναφέρω
identify προσδιορίζω, αναγνωρίζω	workshop συνεργείο, εργαστήριο
fault βλάβη, ελάττωμα	car dealer αντιπρόσωπος / έμπορος αυτοκινήτων
malfunction δυσλειτουργία, βλάβη, κακή λειτουργία	customs office τελωνείο
skil(l)fully επιδέξια, ικανά, επιτήδεια	service-center κέντρο ελέγχου / σέρβις
suitable κατάλληλος, αρμόδιος	clumsy αδέξιος
device μηχανισμός, μέσο, μαραφέτι, μηχανήμα, συσκευή	industrial βιομηχανικός
	terminology ορολογία
	prevention πρόληψη





professional επαγγελματίας
advance πρόοδος
apply (for) αιτούμαι / κάνω αίτηση (για)
reply απάντηση, απαντώ
advertisement (ad) αγγελία, διαφήμιση
local τοπικός
application αίτηση
post θέση, πόστο (εργασίας)
enclose εσωκλείω
curriculum vitae (CV) βιογραφικό σημείωμα
testimonial συστατική επιστολή
employer εργοδότης
personnel (το) προσωπικό, υπάλληλοι
reference αναφορά, σύσταση (απο πρόσωπο ή πιστοποιητικό)
with reference to αναφορικά / σχετικά με, όσον αφορά (σε)
vacancy κενή θέση εργασίας
employ εργοδοτώ, παρέχω εργασία (σε κάποιον)
convenient βολικός, άνετος
distance απόσταση
area περιοχή, πεδίο, τομέας
deal (with) ασχολούμαι
limited περιορισμένος
opportunity ευκαιρία
practise εξασκώ, εφαρμόζω στην πράξη
reason λόγος, αιτία
suit ταιριάζω

army στρατός
military στρατιωτικός
discharge απολύω, απαλλάσσω
gain κερδίζω, αποκτώ
guarantee εγγυώμαι
trustworthy αξιόπιστος, άξιος εμπιστοσύνης
patient υπομονετικός
enclose εσωκλείω
reference letter συστατική επιστολή
concern αφορώ
ability ικανότητα
copy αντίγραφο
university πανεπιστήμιο
certificate βεβαίωση, πιστοποιητικό
attend παρακολουθώ, προσέχω
interview συνέντευξη
attend an interview πάω / έρχομαι για συνέντευξη
pleasure ευχαρίστηση
requirement απαίτηση, ζήτηση
look forward to (+ gerund) αναμένω, περιμένω (εναγωνίως)
meet one's requirements ικανοποιώ / ανταποκρίνομαι στις απαιτήσεις κάποιου
sincerely ειλικρινά
response απόκριση, απάντηση
fill in συμπληρώνω
marital status οικογενειακή κατάσταση
referee εγγυητής, αυτός που δίνει συστάσεις



UNIT 2

Vehicles on wheels

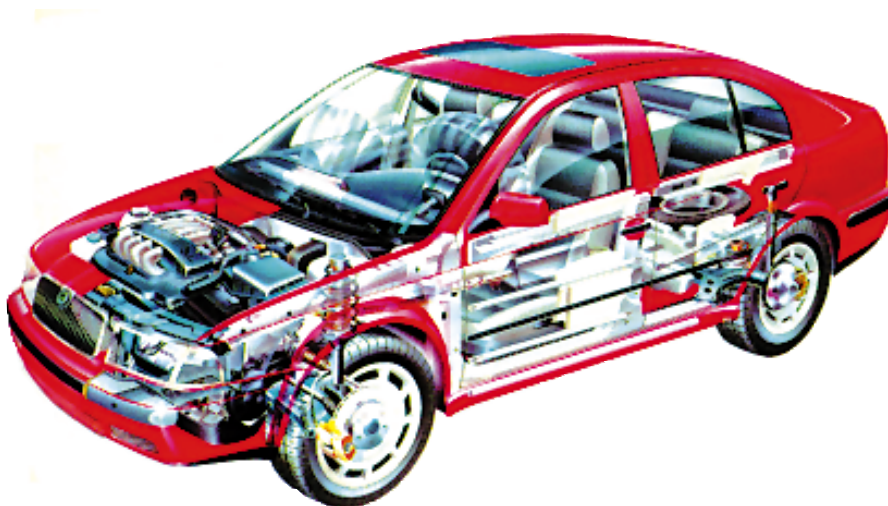
Learning objectives

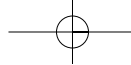
Reading comprehension: Understanding texts related to the kinds of cars.

Vocabulary: Kinds of vehicles, environment and pollution.

Language functions: Expressing advice, suggestions and recommendations.

Use of English: Simple Present (in the passive voice), describing uses and utilities.



**Warm up**

Try to form meaningful phrases by matching words from the two lists below.

A

pollution
necessary
mechanical
farm
internal
car
urban
electric
exhaust
poisonous

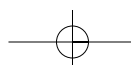
B

tools
levels
device
smog
machinery
power
combustion
environment
fumes
plants

Although the motor vehicle (also known as motor car and more usually as car) is blamed, among other factors, for rising pollution levels, it's certain that it is one of the most necessary tools of our modern lives.

The motor vehicle was not just an invention of putting power on wheels. It was and still is a result of more inventions and discoveries than any other mechanical device. Motor vehicles such as private cars, lorries, vans, buses, coaches etc, are designed for operation on roads and for carrying things or people. Tractors also belong to the powerful motor-driven vehicles. They are designed for running on farms and / or rough soils and for pulling farm machinery or other vehicles. Whatever the motor vehicle is, it has usually got four wheels and a gasoline or diesel internal combustion engine.

Nowadays, motor vehicles and especially private cars are being re-designed to make driving safer and their space more comfortable for both drivers and passengers. They are also designed to be less damaging to the environment. Motor companies do their best to reach the result of a smog-free urban environment. Many people claim that we are approaching the age of substituting the conventional and the catalytic cars with ones which will not need fuels to operate, but electric or sun or hydrogen power. Then, it is certain that exhaust fumes, which are emitted in the air and transformed into poisonous smog and pollutants, will belong to history.



1. Reading Comprehension

Answer T (true), F (false) or DK (don't know).

1. Motor vehicles keep the environment clean.
2. In spite of the pollution they cause, we cannot live without motor vehicles.
3. Motor cars are just an invention of putting power on wheels.
4. Vans and coaches are not a variety of motor vehicles.
5. Only some motor vehicles have a combustion engine.
6. An on-board computer will monitor driving in the future.
7. Private cars are re-designed to make driving safer and their space more comfortable.
8. Fuels in the future are expected to be replaced by electric or sun or hydrogen power.
9. When exhaust fumes are emitted in the air, they are transformed into poisonous smog.

		
<i>motor bicycle</i>	<i>hatchback</i>	<i>family saloon (sedan)</i>
		
<i>open-top convertible</i>	<i>jeep</i>	<i>sports car</i>
		
<i>executive car</i>	<i>estate car (station wagon)</i>	<i>van</i>



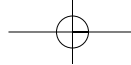
2. Vocabulary practice

Kinds of vehicles

Using your experience, complete each gap in the sentences below with a word from the list in its suitable form.

<i>jeep</i>	<i>bus</i>	<i>lorry</i>	<i>coach</i>	<i>tanker</i>	<i>sports car</i>	<i>estate car</i>	<i>hatchback</i>
<i>tractor</i>	<i>van</i>	<i>(family) saloon</i>	<i>pick-up truck</i>	<i>motor-bike</i>	<i>transporter</i>		
		<i>open-top convertible</i>	<i>fire-engine</i>	<i>ambulance</i>			

1. A is a vehicle on two wheels, like a bicycle with a motor.
2. Big goods carried by road are loaded on, which consist either



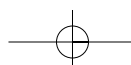
of a single self-propelled unit with an open back or of a trailer vehicle hauled by a tractor unit.

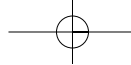
3. Most in London are double deckers.
4. A farmer gave me a lift across the field on his
5. A bus used for long distance travel or touring is known as a
6. are roofed vehicles used for carrying and delivering goods.
7. The is developed for military use and / or for travelling over rough ground.
8. The normal cars, with four or five seats, four doors and fixed roofs are called cars.
9. The style of automobile, which has a door at the back, opening upwards, is known as
10. Drivers who want to carry both people and goods should buy an, which has a space behind the folding or removable back seats.
11. The roof of an can be folded back.
12. are low, usually open-top cars designed for travelling fast.
13. are equipped with machines for putting out a fire.
14. The injured man was carried to hospital by an
15. Liquids are carried by heavy road vehicles known as
16. The long vehicles used for carrying cars from a factory are called
17. have a low-sided open body and are used for deliveries and light hauling.

NOTE



- The *motorbike* is also called the *motor-cycle* or the *motor-bicycle*.
- In the USA: the *car* is called the *automobile*
the *estate car* is called the *station-wagon*
the *lorry* is called the *truck*
the *(family) saloon* is called the *sedan*.





3. Language functions

Advising

Suggesting

Recommending

There are various ways of expressing the above mentioned language functions. Study the possible forms you should use to recommend a car –let's say– for a couple with three children.

- *I think you should buy* a family saloon
- *Why don't you buy* a family saloon?
- *How / What about buying* a family saloon?
- *I suggest (you buy)* a family saloon.
- *I (would) advise you to buy* a family saloon.
- *I (would) recommend (you to buy)* a family saloon.
- *I recommend that you buy* a family saloon.
- *If I were you I would buy* a family saloon.

Practice

Which kind of vehicle would you recommend for:

- ➡ a photojournalist
- ➡ a farmer
- ➡ a plumber

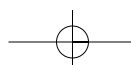
4. Use of English

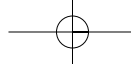
Active or Passive Voice?

If we are not interested in the doer but in the description of something, the purpose of an action or the way sth is done and the agent is obvious or unknown, we use the **passive voice**.

Examples

- **Tractors are designed** for running on farms.
- Nowadays, **cars are designed** to be less damaging to the environment.
- **Big goods** carried by road **are loaded** on lorries.



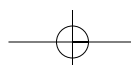


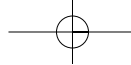
Bearing the above in mind, put the verbs in the parenthesis in their correct form.

1. This car (design) to make driving safer.
2. Cars (manufacture) in car plants.
3. Electric energy (expect) to replace fuels.
4. When exhaust fumes (emit) in the air, they
(transform) into poisonous smog.
5. A coach (use) for long distance travel or touring.
6. The jeep (develop) for military use or for travelling over
rough ground.
7. Fire engines (equip) with machines for putting out a fire.
8. Long vehicles carrying cars (call) transporters.

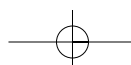
Vocabulary – Terminology

vehicle όχημα	pull τραβώ
wheel τροχός	machinery μηχανήματα
motor κινητήρας, μοτέρ	farm machinery αγροτικά μηχανήματα
motor vehicle αυτοκίνητο, αυτοκινούμενο τροχο- φόρο	gasoline βενζίνη
factor παράγοντας	diesel πετρέλαιο κίνησης
rise αυξάνω	engine κινητήρας, μηχανή (κίνησης)
pollution μόλυνση (ατμόσφαιρας, υδάτων κλπ)	internal εσωτερικός
level επίπεδο	combustion καύση
invention επινόηση, εφεύρεση	driving οδήγηση
power ενέργεια, δύναμη, ισχύς	safe ασφαλής
discovery ανακάλυψη	comfortable άνετος
mechanical μηχανικός	driver οδηγός
private car Ι.Χ., αυτοκίνητο ιδιωτικής χρήσης	passenger επιβάτης
lorry φορτηγό (μεγάλο)	environment περιβάλλον
van φορτηγό (μικρό) με σκεπή	at least τουλάχιστον
bus λεωφορείο	generate παράγω, προκαλώ
coach πούλμαν, (λεωφορείο μακρινών αποστάσεων)	area περιοχή
design σχεδιάζω (επαγγελματ.)	central κεντρικός
carry (μετα)φέρω	plant εργοστάσιο
tractor τρακτέρ, γεωργικός ελκυστήρας, ερπύστρια, παρελκόμενο	manufacture παράγω, κατασκευάζω
powerful ισχυρός, δυνατός	company εταιρεία
farm αγρός	smog «νέφος», ομίχλη και καπνιά
rough σκληρός, τραχύς, ανώμαλος	smog-free χωρίς «νέφος»
soil έδαφος, χώμα	urban αστικός, της πόλης
	claim δηλώνω
	approach πλησιάζω, προσεγγίζω





age εποχή, αιώνας	fire-engine πυροσβεστικό όχημα
substitute αντικαθιστώ, υποκαθιστώ	ambulance νοσοκομειακό αυτοκίνητο
conventional συμβατικός	transporter νταλικά μεταφοράς αυτοκινήτων, οχηματοφόρο
catalytic καταλυτικός, με καταλύτη	self-propelled αυτοκινούμενος, αυτοπρωθούμενος
fuel καύσιμη ύλη, (το) καύσιμο	unit μονάδα, συσκευή
operate λειτουργώ, χειρίζομαι	haul έλκω, ρυμουλκώ
electric ηλεκτρικός	trailer ρυμούλκα
sun power ηλιακή ενέργεια	double-decker διώροφο λεωφορείο
hydrogen υδρογόνο	distance απόσταση
exhaust εξάτμιση	travel ταξίδι
exhaust fumes καυσαέρια	roofed σκεπαστός, με σκεπή
emit εκπέμπω, αναδίδω	military στρατιωτικός
transform μετατρέπω, μεταβάλλω	use χρήση
poisonous δηλητηριώδης	seat θέση, κάθισμα
pollutant μολυσματικός παράγοντας, ρυπαντής	fixed σταθερός, στερεωμένος
clean καθαρός	automobile αυτοκίνητο
on-board πάνω στο ταμπλό	upwards προς τα πάνω
monitor παρακολουθώ (μέσω κάποιου μηχανήματος)	goods εμπορεύματα
produce παράγω	folding που διπλώνει, πτυσσόμενος
consist (of) αποτελείται (από)	removable που μπορεί να μετακινηθεί / αποσπασθεί / αφαιρεθεί, μεταθετός
jeep τζιπ	fold διπλώνω
tanker βυτιοφόρο	equip εξοπλίζω
estate car / station wagon στέσιον βάγκον	put out (a fire) σβήνω φωτιά
hatchback τρίθυρο ή πεντάθυρο (με τη μια πόρτα στο πίσω μέρος)	low-sided με χαμηλά πλαϊνά
(family) saloon / sedan οικογενειακό / τετράθυρο αυτοκίνητο	body (of the car) σώμα (αυτοκινήτου), καροσερί
pick up truck φορτηγάκι με χαμηλή ανοιχτή καρότσα	plumber (ο) υδραυλικός
motor-bike μοτοσυκλέτα	by road οδικώς
open-top convertible αυτοκίνητο με πτυσσόμενη οροφή	



UNIT 3

The development of the car engine

Learning objectives

Reading comprehension: Presenting the developments in the field of the ICEs.

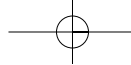
Vocabulary: Related to engine types, their construction, manufacture, etc.

Language functions: Classifying, talking about the past, emphasizing the action.

Use of English: Simple Past tense in active and passive voice.



Ford T-model , USA 1908

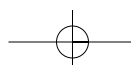
**Warm up**

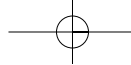
Could you imagine the contemporary world without cars? What about the transportation of products and the commerce, tourism, vacations and travelling? Our everyday life without them would be hardly imaginable...

How much do you know about their development? Check your knowledge.

Chose the correct alternative to complete the statements below.

1. The car engine belongs to
 - a) electrical machines.
 - b) internal combustion engines (ICEs).
 - c) external combustion engines (ECEs).
2. It uses
 - a) mechanical energy to produce heat.
 - b) electrical energy to produce mechanical energy.
 - c) the energy of heat to produce mechanical energy.
3. Experiments with internal combustion started in the
 - a) 15th century.
 - b) 17th century.
 - c) 18th century.
4. The first ICE was designed
 - a) in 1776, by the French inventor Leon Serpollet.
 - b) in 1678, by the Dutch scientist Christiaan Huygens.
 - c) in 1769, by the British technician James Watt.
5. The first marketable four-cylinder ICE was made
 - a) in 1734 by the German mechanical engineer Karl Benz.
 - b) in 1902 by the Scottish inventor, Logie Baird.
 - c) in 1876 by a German technician, Nikolaus August Otto.
6. Otto's engine was adapted so that it could be used for moving vehicles
 - a) in 1887 by the American inventor Alexander Graham Bell.
 - b) in 1885 and 1887 by the German engineers Karl Benz and Gottlieb Daimler.
 - c) in 1893, by the American engineer and industrialist Henry Ford.





7. Cars appeared
- first in Europe and next in the USA by 1900.
 - first in Australia and next in the USA by 1850.
 - first in the USA and next in Europe by 1930.
8. According to the type of motion of their principal parts, ICEs are classed as



*Internal combustion
reciprocating engine*

- reciprocating and rotary engines.
- Benz and Wankel engines.
- Otto and Diesel engines.



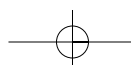
*Internal combustion
rotary engine (Wankel)*

9. According to the type of fuel used, ICEs are classified into
- gasoline and petrol engines.
 - petrol and diesel engines.
 - diesel and oil engines.
10. Diesel engines were named so
- after the city where they were first constructed in 1832.
 - because they use a special type of oil called diesel oil.
 - after the German engineer Rudolf Christian Karl Diesel who patented them in 1892.

Now, read the text below, check your answers and correct the mistakes.

The engine of the car is a type of heat engine. Heat engines use the energy of heat to produce mechanical energy in the form of rotary motion. They are classified into two main categories: the internal combustion engines (ICEs), and the external combustion engines (ECEs). In an external combustion engine, combustion takes place outside the engine (externally). In an internal combustion engine, on the other hand, combustion takes place inside the engine (internally). The car's engine is a typical internal combustion engine. It uses the energy of the heat produced by combustion to move the wheels.

The first experiments with internal combustion started in the 17th century. The first fuel that the various inventors tried was the gunpowder. In 1678, the Dutch scientist Christiaan Huygens designed the first ICE. However, it was never built.



The development of the various petroleum products in the 19th century opened new horizons and lead to the construction of a primary internal combustion engine in 1860 by Etienne Lenoir in Paris. It was powered by illuminating gas. In 1876, there occurred the most important event in the development of the internal combustion engine: the German engineer Nikolaus August Otto made the first marketable four-cylinder ICE powered by petrol. His engine was to be the basis for nearly all the internal combustion engines that followed.

The combination of engine with vehicle took place in 1885 and 1887, when first Karl Benz and then Gottlieb Daimler introduced the first successful petrol-engined cars. Benz went into limited production of his vehicle in 1888 and so, the modern motor industry was born. However, the Daimler engine was revolutionary and changed the face of car industry. From then on, the development was very rapid. By 1900, the first cars appeared on the streets of Europe and soon after on the streets of America.



According to the type of motion of their principal parts, ICEs are classified as reciprocating, such as the piston engine used in most cars, and rotary, such as the Wankel rotary engine. According to the type of fuel they use, ICEs are distinguished into petrol* and oil or diesel (-oil) engines, named so after Rudolf Christian Karl Diesel, the German engineer who in 1892, patented an ICE that used oil instead of petrol and employed the auto-ignition of fuel. Nowadays, most passenger cars have a petrol engine whereas trucks, tractors and other heavy vehicles have a diesel engine, instead.



Petrol/gasoline engine



Diesel (-oil) engine

* gas or gasoline in American English

The economical growth after the 2nd World War was accompanied by an increase in demand for motor cars and also by the development of more efficient mass-production techniques. These factors have made car industry the world's largest manufacturing industry with a strong impact on employment, investment, trade and the environment. As a result, it is of major economic, political and social importance.



Rover, England 1909.

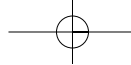
1. Reading Comprehension

1A Give a suitable heading to the paragraphs of the text. Choose from the ones below.

1. Types of internal combustion engines.
2. An I.C.E. on wheels and the car industry.
3. Heat engines.
4. The development and importance of the modern car industry.
5. Early developments in internal combustion engines.
6. The first experiments with I.C.E.

1B Answer the questions.

1. What is the form of the mechanical energy produced by heat engines?
2. What is the difference between internal and external combustion engines?
3. What was the first fuel used in internal combustion engines?
4. Who started the modern car industry? When?
5. How are the ICEs categorized depending on the type of motion of their principal parts? Give examples.
6. What kind of fuel do cars designed to carry products use?
7. Which factors led to the recent great development of the car industry?
8. Why is motor manufacturing industry of great importance?



2. Vocabulary Practice

2A Identify the defined item . Choose from the list.

passenger car - gunpowder - internal combustion engine - heat engines
reciprocating engine - rotary engine - illuminating gas - fuel

- engines that convert the energy produced by combustion into mechanical work, which is usually delivered in the form of rotary motion on a shaft. They are classified as steam, compressed air and gasoline/petrol
- a substance that reacts chemically with another substance to produce the heat used for powering internal combustion engines
- a substance in the form of a black powder used to make fireworks or to produce explosions
- any type of machine that produces mechanical energy directly from the burning of fuel in a combustion chamber
- a kind of oil used to produce light
- an engine that uses pistons which move up and down in cylinders
- the type of engine that uses a three-cornered rotor turning in a roughly oval chamber
- a type of vehicle used to carry people

2B Replace words in the text with their synonyms below.

First paragraph

- | | |
|---|-------------------|
| 1. kind - | 2. power - |
| 3. divided - | 4. occurs - |
| 5. representative; characteristic - | |

Second paragraph

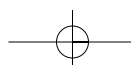
- | | |
|------------------------------|-----------------|
| 1. began - | 2. used - |
| 3. constructed; made - | |

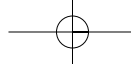
Third paragraph

- | | |
|------------------------------------|---------------------|
| 1. early; original ; basic - | 2. happened - |
| 3. significant - | 4. almost - |

Fourth paragraph

- | | |
|----------------------|------------------------|
| 1. presented - | 2. effective - |
| 3. quick - | 4. automobiles - |





Fifth paragraph

- | | |
|----------------------------|-----------------------|
| 1. main; essential - | 2. components - |
| 3. used; applied - | 4. lorries - |

Sixth paragraph

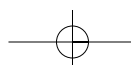
- | | |
|------------------------------------|--------------------------------|
| 1. development ; expansion - | 2. was followed - |
| 3. effective - | 4. effect ; influence - |
| 5. commerce - | 6. great ; significant - |

2C Match words with definitions.

- | | |
|-------------------|---|
| 1. motor industry | a) the process or result of making something gradually better and more advanced, e.g. a product, a technological field, etc. |
| 2. commerce | b) get the official right to be the only person or company allowed to make or sell a new product for a certain period of time |
| 3. development | c) the area of commerce that deals with the design, manufacturing and marketing of cars |
| 4. patent | d) a machine with an engine, e.g. a bus, that carries people and things from place to place |
| 5. vehicle | e) the activities and procedures involved in buying and selling things |

2D Write the English equivalent to the following Greek terms.

1. κίνηση:
2. καύση:
3. αυτοανάφλεξη καυσίμου:
4. μαζική παραγωγή:
5. εμπόριο:
6. επένδυση:
7. επίπτωση:
8. ζήτηση:



3. Language functions

Classifying

In the table below you can see the most common sentence patterns used to classify an item in the category it belongs to, or to present the various classifications of a general category.

1.	can be / could be may/might be should be	categorized as (a) / into... grouped as (a) / into... classified as (a) / into... classed as (a)... divided into... subdivided into...
2.	belong(s) to	
3.	is / are a category type kind form example (sub)division	of (an)

Examples

- Diesel engines *are a type* of heat engines.
- ECEs *can be divided into / classed as* turbine steam engines and reciprocating steam engines.
- Wood, coal, lignite, turf and oil *can be classified / classed as* fossil fuels.
- Diesel engines *belong to* internal combustion reciprocating engines.
- A parallelogram *is an example of* planes.

Practice

Use expressions from the table to make sentences out of the prompts below.

1. Electric drill — power(ed) tool
2. Tools — hand tools and machine tools
3. Metals — ferrous and non-ferrous
4. Internal combustion engines — heat engines

5. Heat engines — ECEs and ICEs
6. Reciprocating and rotary engines — internal combustion engines
7. A triangle — geometrical shape
8. Wankel and Otto engines — ICEs
9. Car engines — petrol and diesel-oil engines
10. Oxygen — gas

4. Use of English

Simple Past Tense in Active and Passive Voice

USE

We use the Simple Past Tense to talk about **actions or situations completed in the past**. The exact time is often given.

Time markers: yesterday (morning, afternoon), last (night, week), (two days, years) ago.

IN THE ACTIVE VOICE

FORM

Affirmative form: a) Regular Verbs → verb + **-ed** e.g. live → *lived*

b) Irregular Verbs → verb in **2nd column** e.g. buy → *bought*

e.g. John Lambert *designed* the first America's petrol-driven engine.
Peter *sold* his car to his cousin.

Interrogative form: Did + subject + **verb in basic form**?

e.g. What *did* Lambert *design*? *Did* he *design* the first ICE?
Did Peter *sell* his car to his sister? How much *did* he *sell* it?

Negative form: Subject + **did not / didn't** + **verb in basic form**...

e.g. Lambert *didn't design* the first ICE.
Peter *didn't sell* his car to his sister.

Practice

4A Pair work

Choose six of the sentences below. On a piece of paper, form questions out of these sentences. Exchange papers with one of your classmates. Write the answers to his questions on his piece of paper and return it to him. Check in class.

You want to know:

1. When experiments with internal combustion started.
2. What kind of fuel the various inventors tried in the first ICE.
3. When Huygens designed the first ICE.
4. If Huygens managed to build his engine.
5. If the development of petroleum products influenced the construction of the ICEs.
6. a) When and b) where Etienne Lenoir constructed/ built his engine.
7. When the most important event in the history of the ICEs occurred.
8. When the combination of engine and vehicle took place.
9. What Diesel constructed and patented in 1892.
10. Why the demand for motor cars increased after World War II.

4B Correct the wrong information in the sentences below. The correct answer is given in the parentheses at the end of the sentences.

1. The first experiments with internal combustion started in the 15th century. (17th)
e.g. They didn't start in the 15th century, they started in the 17th century.
2. The development of the various petroleum products led to the construction of the ECEs. (ICEs)
3. Lenoir used natural gas as a fuel for his engine. (illuminating gas)
4. Eugene Langen made a diesel engine in cooperation with August Otto. (gas / gasoline engine)
5. Benz built the first marketable ICE. (Otto)
6. Daimler put his engine on a tricycle. (Benz)
7. The French Bouton and Trepardoux built excellent diesel engines at about 1875. (steam vehicles)
8. The Duryea brothers started their motor manufacturing company in America 20 years before Benz. (7 years after Benz)
9. Karl Diesel patented an engine that used petrol instead of oil as a fuel. (oil instead of petrol)
10. The first cars appeared on the streets of Europe by 1930. (1900)

IN THE PASSIVE VOICE

**Don't
forget**



When you want to **emphasise the action** rather than the person who made it (= the agent*), you use the Passive Voice.

FORM

Affirmative form: Subject + **was / were** + **verb in past participle** (p.p.)**...

Interrogative form: **Was / were** + subject. + **verb in p.p.** ...?

Negative form: Subject + **was / were not** + **verb in p.p.** ...

Examples

- Was Citroen *bought* by Honda in 1980? No, Citroen *wasn't bought* by Honda. It was bought by Peugeot in 1940.
- Was the television *invented* by a German? No, it *wasn't invented* by a German. It *was invented* by a Scot called Logie Baird.
- Was the first America's petrol-driven engine *designed* by Henry Ford? No, it *wasn't designed* by Henry Ford. The first America's petrol-driven engine *was designed* by John Lambert.
- Was the first four-cylinder petrol engine *built* by Karl Benz? No, it *wasn't built* by Karl Benz. It *was built* by Karl August Otto.

Practice

4C Use the prompts below to make passive sentences in S. Past.

1. The first potatoes / bring / from America in the 15th century.
e.g. *The first potatoes were brought from America in the 15th century.*
2. The right to use Daimler's engines in vehicles / give / to the Peugeot firm in 1890.
3. The first American car-manufacturing company / establish / by the Duryea brothers.
4. The first oil-driven engine / make / by Diesel / in 1892.
5. 2,500 cars / make / by Benz's car-manufacturing company / by 1900.

* In most passive sentences the **agent** is omitted. If it is mentioned, it is introduced with **by** (to show who or what performs the action) or **with** (to show the means that performs it).

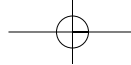
** **past participle** = **a)** a regular verb + -ed, or **b)** an irregular verb in third column.

6. Mass production / not invent / Henry Ford. A musket* production / standardise / by Eli Whitney / in North America / as early as 1798.
7. All British vehicle companies / merge / to form British Leyland / in the 1960s (which became Rover in 1986) and / buy / by BMW / in 1994.
8. How many cars / manufacture / in Japan / last year?
9. The carburettor / not adjust / properly.
10. When / the first catalytic converters / install?
11. Before World War I, / world trade in cars / dominate / by Americans.



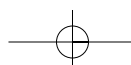
The horseless carriage built by the Duryea brothers, USA 1893

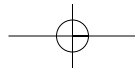
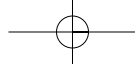
* a musket is a type of gun



Vocabulary – Terminology

contemporary σύγχρονος	efficient αποδοτικός, ικανός, αποτελεσματικός, βελτιωτικός
commerce εμπόριο (η διαδικασία ανταλλαγής προϊόντων)	demand ζητώ, απαιτώ, απαίτηση, ζήτηση (εμπορικός όρος)
transportation μεταφορά	mass production μαζική (βιομηχανοποιημένη) παραγωγή
alternative εναλλακτικός (εναλλακτική λύση, επιλογή, μορφή ενέργειας)	impact επίπτωση, επίδραση, αντίκτυπος
engine κινητήρας, μηχανή	trade εμπόριο (οι δραστηριότητες ανταλλαγής προϊόντων)
combustion καύση	investment επένδυση
internal combustion engine μηχανή / κινητήρας εσωτερικής καύσης	deliver παραδίδω, παρέχω, απελευθερώνω
external combustion engine μηχανή / κινητήρας εξωτερικής καύσης	convert μετατρέπω
experiment πείραμα	shaft άξονας
design σχεδιάζω, (κατασκευαστικό) σχέδιο	steam ατμός
inventor εφευρέτης	react αντιδρώ
scientist επιστήμονας	powder σκόνη
marketable εμπορεύσιμος	substance ουσία
adapt (ανα-)προσαρμόζω	fireworks πυροτεχνήματα
industrialist μεγαλοβιομήχανος	explosion έκρηξη
construct κατασκευάζω	rotor ρότορας
patent κατοχυρώνω μια ευρεσιτεχνία, ευρεσιτεχνία	representative αντιπρόσωπος, αντιπροσωπευτικός
heat engine θερμική μηχανή	essential βασικός, ουσιαστικός, απαραίτητος
rotary περιστροφικός	significant σημαντικός
motion κίνηση	significance σημασία, σπουδαιότητα
fuel καύσιμο	effect επίδραση, συνέπεια, επίπτωση, αποτέλεσμα, εντύπωση
gunpowder πυρίτις, μπαρούτι	effective αποτελεσματικός
construction κατασκευή, δομή, διάταξη	influence επίδραση, επιρροή
power ισχύς, ενέργεια (π.χ. ηλεκτρική)	process διαδικασία, σταδιακή εξέλιξη, μέθοδος
primary πρώτος, αρχικός, βασικός, πρωταρχικός	advanced προωθημένος, προχωρημένος, εξελιγμένος, προοδευμένος
illuminating gas φωτιστικό πετρέλαιο	official επίσημος
introduce εισάγω, παρουσιάζω, συστήνω	procedure διαδικασία, πορεία εργασίας, ακολουθία ενεργειών
petrol (gas / gasoline in American English) βενζίνη	subdivision υποδιαίρεση
limited περιορισμένος	time markers χρονικοί προσδιορισμοί
industry βιομηχανία	grant (the right) εκχωρώ, παραχωρώ (το δικαίωμα)
motor/ car industry αυτοκινητοβιομηχανία	establish ιδρύω, εγκαθιδρύω, καθιερώνω
development ανάπτυξη	musket μουσκέτο (είδος όπλου)
principal κυριότερος, σημαντικός, πρωταρχικός	standardize τυποποιώ
employ χρησιμοποιώ, απασχολώ, προσλαμβάνω	merge συγχωνεύω
auto-ignition αυτο-ανάφλεξη	adjust ρυθμίζω, προσαρμόζω, τροποποιώ, τακτοποιώ
reciprocating παλινδρομικός	install εγκαθιστώ
oil/ diesel oil πετρέλαιο κίνησης	dominate κυριαρχώ
increase αυξάνω, αύξηση	
accompany συνοδεύω, ακολουθώ, έπομαι, συντροφεύω	





UNIT 4

New developments in the car industry

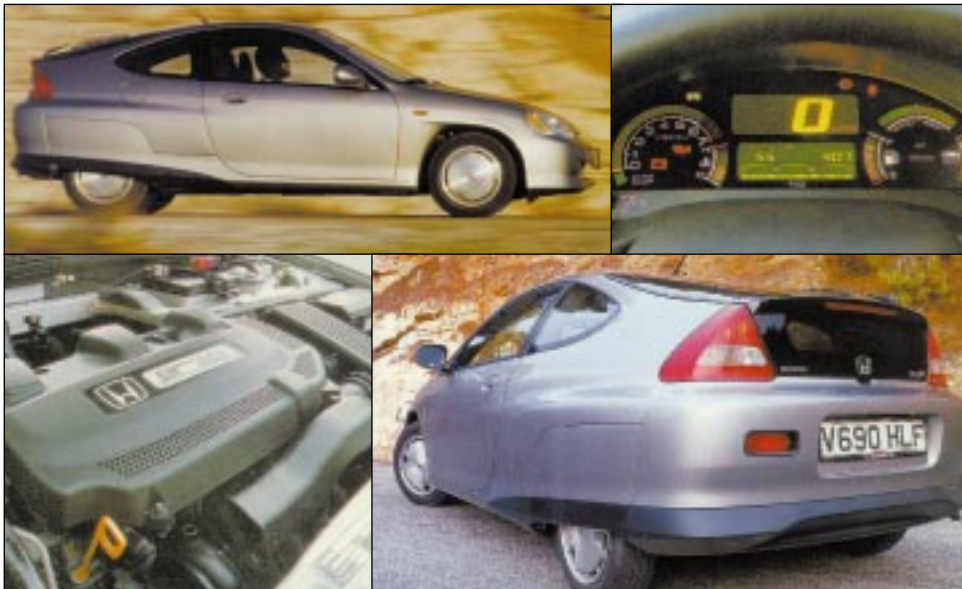
Learning objectives

Reading comprehension: Presenting the recent developments in car manufacturing.

Vocabulary: related to new types of fuels, materials and technological solutions in car industry - Definitions, synonyms, antonyms, prepositions

Use of English: Simple Present Perfect and Future tenses

Listening: Correction of mistakes in a text



A Fuel-cell hybrid car, Honda, Insight, Japan 2000

1. Listening activity

Your teacher prepared the following text to give you an idea of the new developments in car manufacturing. However, as he/she was typing it in a hurry, he/she made some mistakes in the first part of the text. To understand it, these mistakes must be corrected. To help you in this task, your teacher is going to read the correct version of the text.

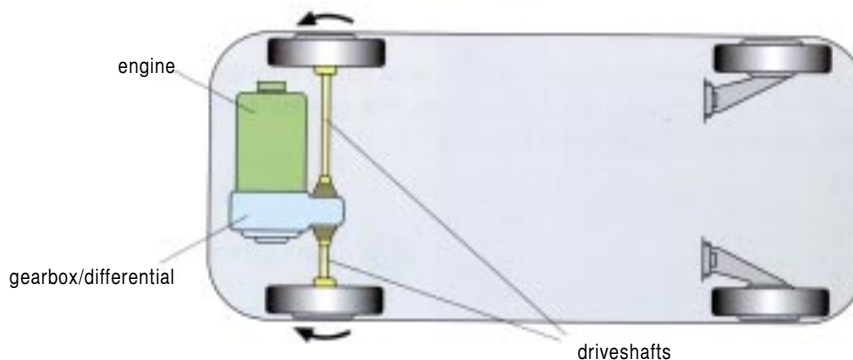
STEP 1



While listening to your teacher, underline the wrong words.

The two oil crimes of the '70s that were accompanied by decreases in the price of oil, as well as the concerns about the environmental delusion have had a major impact on the rotor industry.

In an effort to develop energy-solving vehicles, car manufacturers have drastically reduced the weight of their cars by using tighter materials in their construction, such as lightweight steel, aluminium, elastics, and magnesium. They have also reduced the rise of their models. Front-wheel drive technology, which allows more passenger and cargo place in the interior of smaller cars, has been adopted by canmakers worldwide, replacing the rear-drive arrangement which was commonly used in the motor industry's earlier bays.



Typical front-wheel-drive layout

In an attempt to reduce dependence on oil, new tyres of fuel have been used. Such fuels are the butane, the natural gas and the bio-gas. Their use, however, is limited as they are rightly explosive. Among alternatives to petrol engines, Wankel and diesel

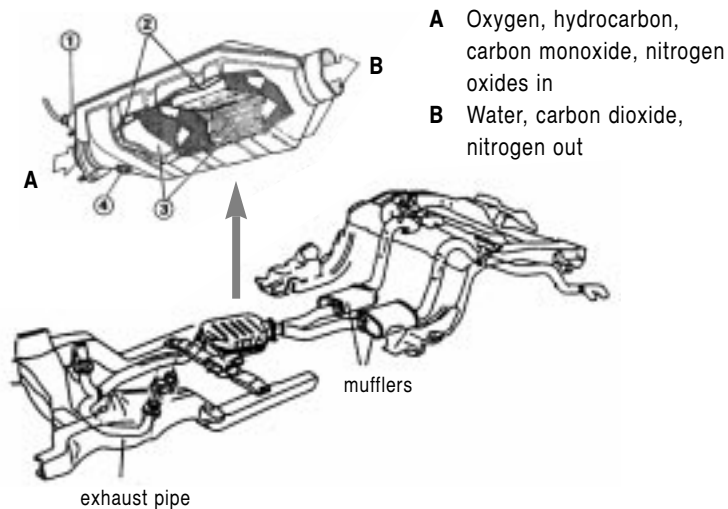
engines appealed the most promising. The Wankel rotary engine, however, remained a row-production as it was less fuel-efficient. The production of Diesel V-8, V-10 and V-12 engines, which appeared in the date '70s and were used increasingly during the early '80s because of the engine's inferior fuel economy, also remained low due to the concern that diesel exhaust may complain carcinogens.



The cylinder block of a V-8 engine

In addition, the increasing environmental concerns over the useful gas emissions led up to the use of unleaded fuel and the installation of emission petrois and catalytic converters to all cars produced after 1985.

- 1 Oxygen sensor
- 2 Insulation
- 3 Catalyst elements
- 4 Emission test point



STEP 2

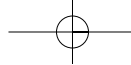


Work with your partner and try to correct as many of the underlined words as you can.

STEP 3



Listen to the text again and correct the rest of the mistakes. Check.



Now that the first part of the text has been corrected, read the second part of it.

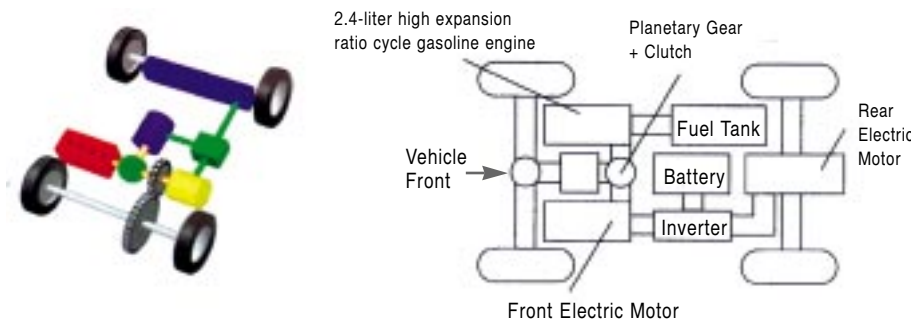
The important advances in battery technology have led up to the construction of electric cars that would serve both aims: they would reduce dependence on oil and, at the same time, eliminate the harmful effect of gas emissions on the environment.



An electric car

Electric cars are equipped with engines that run with electric energy supplied by a rechargeable battery. However, they are relatively slow (max. speed 80-100 km), expensive and impractical as their battery needs frequent recharging (every 160-200 km) and the passenger and luggage compartment is quite small due to the large battery size. So, for the time being, batteries are used only in small city cars.

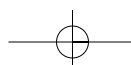
To overcome the drawbacks of electric cars, manufacturers have started experimenting with fuel-cell hybrid cars, which would be powered with a combination of an ICE and an electric motor.



Schematic diagram of the power sources on a fuel-cell hybrid car (Toyota)

They also started research on various new fuel sources, such as liquid and pure hydrogen, and on the development of a clean hydrocarbon fuel (CHF), which is an evolved form of petrol.

The first mass-produced hybrid car was launched in 2000 by Toyota. It uses computer software to control a combination of its electric and petrol motors and to match the power source to the driving conditions. When running at high speed or accelerating,



for instance, the car uses the petrol engine. When pulling away or running at low speed, it uses electric power which eliminates the harmful emissions in cities.

The combination of the petrol engine and the electric motor results in a vehicle that is much faster than the electric cars (max. speed 160 km), with a battery that requires no external charging. It is charged by the petrol engine and also when the car is braking. Because of the smaller battery size, the car has enough space for five passengers and their luggage. Another advantage is that it costs only a little more than a family saloon.

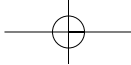
The first fuel-cell hybrid vehicle was a great challenge to all car manufacturers and will hopefully lead to the construction of an increasing number of “green” cars in the future. The production of such vehicles will reduce our dependence on oil and contribute to a much cleaner environment.



The engine of a fuel-cell hybrid car (Toyota, Prius)



The first fuel-cell hybrid car (Prius) launched by Toyota.



2. Reading comprehension

2A Look through the text to find the English equivalent to the following Greek terms and expressions. Write them in the spaces provided.

1st and 2nd paragraphs

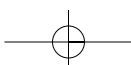
1. πετρελαϊκές κρίσεις:
2. ανησυχίες σχετικά με τη μόλυνση του περιβάλλοντος:
3. οχήματα που εξοικονομούν ενέργεια:
4. τεχνολογία (αυτοκινήτων) με μπροστινή / πίσω κίνηση:
5. χώρος επιβατών και φορτίου:
6. ...υιοθετήθηκε από τους κατασκευαστές αυτοκινήτων σε ολόκληρο τον κόσμο:

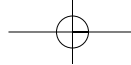
3rd and 4th paragraphs

1. σε μια προσπάθεια μείωσης της εξάρτησης από το πετρέλαιο...:
2. ανάμεσα στα πιθανά υποκατάστατα / τις πιθανές εναλλακτικές λύσεις υποκατάστασης της βενζινομηχανής...:
3. ... φαίνονταν οι πιο πολλά υποσχόμενοι / ελπιδοφόροι:
4. η παραγωγή του παρέμεινε σε χαμηλά επίπεδα:
5. βλαβερές εκπομπές καυσαερίων:
6. αμόλυβδη βενζίνη:
7. εγκατάσταση συστημάτων ελέγχου εκπομπών καυσαερίων και καταλυτών:

5th and 6th paragraphs

1. να εξαλείψει τις βλαβερές επιπτώσεις των εκπομπών καυσαερίων στο περιβάλλον:
2. επαναφορτιζόμενη μπαταρία:
3. αυτοκίνητα πόλης:
4. για να ξεπεραστούν τα μειονεκτήματα:
5. υβριδικά οχήματα καυσίμου-μπαταρίας:
6. ηλεκτρικός κινητήρας:





7th and 8th paragraphs

1. το πρώτο υβριδικό αυτοκίνητο μαζικής παραγωγής προωθήθηκε/λανσαρίστηκε στην αγορά:
2. λογισμικό / πρόγραμμα ηλεκτρονικού υπολογιστή:
3. πηγή ενέργειας / ισχύος:
4. το αυτοκίνητο επιταχύνει:
5. το αυτοκίνητο ξεκινά:
6. μέγιστη ταχύτητα:
7. το αυτοκίνητο φρενάρει:
8. ... αποτελεί / είναι μια μεγάλη πρόκληση:
9. Τα οικολογικά αυτοκίνητα θα συμβάλλουν σε ένα καθαρότερο περιβάλλον:

2B Answer the questions.

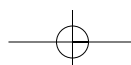
1. Which factors influenced the car manufacturers and led to the developments mentioned in the two texts above?
2. Which changes are related to each of these factors?
3. Why has the front-wheel arrangement replaced the rear-wheel one?
4. What is the problem with butane, gas and bio-gas?
5. Why has the production of Wankel and Diesel engines remained low?
6. Which are the advantages of the fuel-cell hybrid cars over the electric ones?
7. Mention some characteristics of the first mass-produced hybrid car.

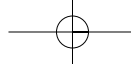
3. Vocabulary practice

3A Match words with definitions.

a. Verbs

- | | |
|---------------|--|
| 1. overcome | a) take an idea, plan, way of behaviour, etc. and use it |
| 2. evolve | b) help something, e.g. the environment, a common cause, become better, more successful, safe, clean, etc. |
| 3. adopt | c) continue to be |
| 4. eliminate | d) make a new product available to the public |
| 5. contribute | e) develop |
| 6. launch | f) remove something you don't want completely; get rid of it; reduce it |
| 7. remain | g) deal successfully with a problem, situation, feeling and control it |





b. Nouns

Group A

- | | |
|----------------|--|
| 1. concern | a) work that involves studying something and trying to discover facts about it |
| 2. source | b) the release of something, e.g. gas or radiation into the atmosphere |
| 3. alternative | c) something new and difficult that requires great effort |
| 4. emission | d) worry; anxiety about a situation |
| 5. research | e) a thing that can be found, used or done instead of another; an option |
| 6. challenge | f) where the energy or force that can be used to do work comes from |

Group B

- | | |
|---------------|---|
| 1. advance | a) the activity of putting an electrical charge back into a battery by connecting it to a source of electricity |
| 2. dependence | b) a powerful effect on a situation, process or person |
| 3. recharging | c) the gas produced when the engine of a vehicle is running |
| 4. exhaust | d) state of being in need for something in order to succeed or survive |
| 5. impact | e) the goods that a plane, ship or car is carrying |
| 6. cargo | f) a progress in understanding a subject or doing well an activity |

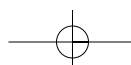
3B Make pairs of antonyms by matching words from the two columns in each group below.

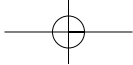
Group A

maximum	cheap
quick; rapid	old
practical	rear
expensive	minimum
frequent	slow
front	low
high	impractical
new	rare

Group B

leaded	inferior
light	exterior
small	harmless
early	internal
superior	unleaded
harmful	late
external	heavy
interior	big; large





3C Make pairs of synonyms out of the two lists below.

effort - disadvantage - impact - luggage - cell - space - advance - aim

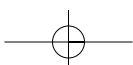
room - battery - purpose; goal - effect - attempt - baggage - development - drawback

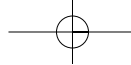
.....	-	-
.....	-	-
.....	-	-
.....	-	-

3D The sentences below are taken from the two texts in this unit. Fill in the gaps choosing the appropriate preposition from the list.

for - by - in - to - of - with - about - over - at

- To reduce dependence oil, car manufacturers have started experimenting new sources fuel.
- The developments battery technology have led up the construction of electric cars.
- The increasing concerns environmental pollution have had a great impact the motor industry.
- Fuel-cell hybrid cars are powered a combination a petrol engine and an electric motor.
- addition other measures taken to reduce environmental pollution, all cars are equipped emission controls and catalytic converters.
- When running high speed, fuel-cell hybrid cars use the petrol engine.
- Nowadays there is a great concern the harmful gas emissions and their effects the environment.
- the interior the first mass produced fuel-cell hybrid car, there is enough space five passengers and their luggage. This type of cars will contribute a much cleaner environment.
- Due the large battery size and their need frequent recharging, electric cars are impractical.
- The rear-wheel drive technology was replaced the front-wheel drive arrangement that resulted smaller cars that have enough passenger and cargo space.
- Because the new materials used their construction, modern cars have become much lighter.





4. Use of English

Simple Present Perfect Tense

The Simple Present Perfect is the tense that confuses most people who learn English. It is used in many cases. The sentences below are taken from the texts in this unit. **Study them.**

Examples

- Manufacturers *have equipped* modern cars with an electronic control unit. (When? It is not defined.)
- In an attempt to produce energy-saving vehicles, car manufacturers *have reduced* the weight and size of their cars. (The attempt started in the past and continues up to the present.)
- They *have* recently *launched* a new fuel-cell hybrid car. (It happened in the near past.)
- The advances in battery technology *have led up* to the construction of electric cars. (It happened in the past but with a result affecting the present)

USES

The S. Present Perfect tense connects the past to the future. It is used to talk about actions or situations that:

- happened in an indefinit time in the past,
- happened in the near past,
- happened in the past but with a result to the present,
- happened in a period of time that is not finished and as a result they may continue or recur,
- started in the past and continue up to the present.

Time markers: ever, never, just, already, yet, recently, lately, so far, since, for, how long

FORM

Affirmative form: Subject + **have/has** + **past participle** (= regular verb + -ed or 3rd column of irregular verbs)

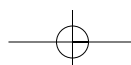
e.g. He *has* just *arrived*. They *have* *bought* a new car.

Interrogative form: **Have/has** + subject + **p.p.** ...?

e.g. *Has* he *arrived* already? *Have* they *bought* a new car?

Negative form: Subject + **have not** (haven't) / **has not** (hasn't) + **p.p.** ...

e.g. He *hasn't* *arrived* yet. They *haven't* *bought* a new car.



Practice

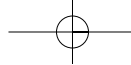
4A Choose verbs from the list and form them appropriately to complete the sentences.

arrive - go - know - finish - think - replace - drive - sell - take - visit

1. How long your brother the owner of this garage?
2. The technician the spark plugs yet.
3. Someone the impact wrench. It was on the bench five minutes ago.
4. you with the carburettor adjustment already?
5. The supervisor just He is talking with Mr. Green at the entrance.
6. you ever a car manufacturing company before?
7. I five batteries so far this morning.
8. I'm sorry. He isn't here at the moment. He to buy a spare part.
9. you ever of starting your own car-repair workshop?
10. I never a car with such a powerful engine before.

4B Which is the correct verb tense to use in the sentences below? Underline it.

1. He *studies* / *studied* / *has studied* for three hours this evening. He *finished* / *has finished* half an hour ago and *went* / *has gone* for a walk in the park.
2. What time *did you go* / *have you gone* to bed last night?
3. Paul *left* / *has left* school last year. He recently *found* / *has recently found* a well-paid job in a big company.
4. *Did you see* / *Have you seen* Paul since last Thursday? *No, I didn't* / *haven't*, but he is O.K. John *met* / *has met* him at the bus stop this morning.
5. Kevin and Mike *know* / *have known* each other since they *were* / *have been* children. They *lived* / *have lived* in the same neighbourhood.
6. He *found* / *has found* the advertisement in the "Athens News" interesting, so he *went* / *has gone* to the post office to send an application letter to the company. He'll be back soon.



Simple Future Tense

USE

We use the Simple Future tense:

- a) to predict the future
- b) to describe future situations
- c) when we decide to do something at the moment of speaking, and
- d) with certain phrases and adverbs expressing possibility, probability, doubt and prediction, such as: probably, possibly, maybe, or I expect, I hope, I doubt, I imagine, I believe.

Time markers: tomorrow (morning, afternoon,...), next (week, month, year...), soon, by (... o'clock), before (midnight, noon...)

Examples

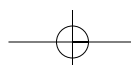
- a) The use of new fuels *will reduce* our dependence on oil.
We *won't arrive* home before midnight.
In the future, machines *will do* many of the jobs that people do today.
- b) *Will he be* 50 next week? No, *he'll be* 52.
The new car repair workshop *will open* next week.
- c) The brake shoes are binding. *I'll re-adjust* them first thing tomorrow morning.
It's too hot in here. *I'll open* the window.
- d) I hope the technician *will fix* the malfunction before noon.
I doubt it *will be* ready so soon.
Maybe *he'll come* on time.

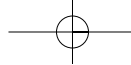
FORM

Affirmative form: Subject + will (... 'll) + infinitive **e.g.** *I'll see* you tomorrow.

Interrogative form: Will + subject + infinitive? **e.g.** *Will you return* before 8:00?

Negative form: subject + will not + infinitive **e.g.** I *will not (won't) arrive* before 11:00.





■ Practice ■

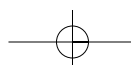
4C Fill in the gaps with the appropriate verb from the list in the Simple Future tense.

increase - replace - pass - take - finish - arrive - phone
last - buy - switch off - fall - do - fly

1. The new car repairshop is very expensive. I don't think I my car there again.
2. In the next twenty years, the "green cars" those powered by petrol engines.
3. This programme isn't very good. I the television.
4. Perhaps he the exams on Monday.
5. We you tomorrow morning, okay?
6. I know she hasn't done her homework yet, but I believe she do it later.
7. I think he to Crete on Wednesday. He is ill.
8. Unemployment dramatically in the next five years.
9. "What time they ?" "Not before lunch, I think."
10. We the house. It's too small for us.
11. In the next decade, working hours to under 35 a week and holidays longer.
12. Maybe he the repair before 6:00 this afternoon.

4D Put the verbs in parentheses in the correct verb form. Choose among S. Present, S. Past, S. Present Perfect or S. Future.

1. How long you ill? (be)
2. I expect my son the exam next week. (not fail)
3. She usually to work by bus, but today she her car. (come - take)
4. In the next decade, new professions others (emerge - disappear)
5. We a holiday last year. (not have)
6. I just my car. I think I a new one the soonest possible. (sell - buy)
7. What time you to bed last night? (go)
8. I hope they soon. (finish)



9. you ever the brakes since you the car last year? (check - buy)
10. She usually the 8:30 bus and at her work late. Her employer warned her that he her. (miss - arrive - fire)
11. Where do you think they tonight? (go)
12. My parents in this house since they married. My sister in Scotland with her husband and I recently to a new house in the suburbs. (live - get - live - move)
13. I hope John the job. (get)
14. you how the disc brake? (know - operate)

Vocabulary / Terminology

accompany συνοδεύω, ακολουθώ

decrease μειώνω

concern νοιάζομαι, ανησυχώ, ανησυχία, έγνοια, ενδιαφέρον

pollution μόλυνση

impact επίπτωση, επίδραση

energy saving που εξοικονομεί ενέργεια

reduce μειώνω, λιγοστεύω

weight βάρος

lightweight ελαφρύς

cargo φορτίο

space χώρος, διάστημα

adopt υιοθετώ

front-wheel drive με κίνηση στους μπροστινούς τροχούς

rear-wheel drive με κίνηση στους πίσω τροχούς

dependence εξάρτηση

limited περιορισμένος

explosive εκρηκτικός

promising ελπιδοφόρος, (ο πολλά) υποσχόμενος

remain παραμένω, απομένω

low-production χαμηλής παραγωγής, που παράγεται σε μικρούς αριθμούς

efficient αποδοτικός

exhaust εξαγωγή (καυσαερίων)

carcinogens καρκινογόνες ουσίες

emissions εκπομπές (π.χ. καυσαερίων)

unleaded αμόλυβδος, που δεν περιέχει μόλυβδο (π.χ. αμόλυβδη βενζίνη)

installation εγκατάσταση

emission control (σύστημα) ελέγχου καυσαερίων

catalytic converter καταλυτικός μετατροπέας, «καταλύτης»

advance εξέλιξη, πρόοδος

lead (up to) οδηγώ σε

aim στοχεύω, σκοπεύω, σκοπός

dependence εξάρτηση

eliminate εξαλείφω, ελαχιστοποιώ μέχρις εξαφάνισης

harmful επιβλαβής, βλαβερός

effect αποτέλεσμα, επίπτωση

equip εφοδιάζω, εξοπλίζω

supply προμηθεύω, εφοδιάζω

(re-) charge (ξανα-) φορτώνω / γεμίζω (π.χ. την μπαταρία του αυτοκινήτου)

frequent συχνός

luggage / baggages αποσκευές

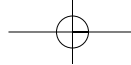
compartment ξεχωριστό τμήμα, διαμέρισμα (π.χ. χώρος αποσκευών, βαγόνι τραίνου)

overcome ξεπερνάω, υπερπηδώ (δυσκολίες, προβλήματα)

drawback / disadvantage μειονέκτημα

cell στοιχείο μπαταρίας, μπαταρία, κελί (φυλακής, κηρήθρας)

research έρευνα



source πηγή

liquid υγρός

pure καθαρός, αγνός, χωρίς προσμίξεις

hydrocarbon υδρογονάνθρακας

evolved εξελιγμένος, προωθημένος

launch προωθώ ένα καινούριο προϊόν στην αγορά, λανσάρω

software πρόγραμμα ηλεκτρονικού υπολογιστή, το λογισμικό

accelerate επιταχύνω

pull away ξεκινάω (για αυτοκίνητο)

result in καταλήγω σε, έχω σαν αποτέλεσμα

require ζητώ, απαιτώ

brake φρενάρω, φρένο

challenge πρόκληση

contribute συνεισφέρω, συντελώ

available διαθέσιμος (στην αγορά)

remove αποσύρω, μετακινώ

get rid of απαλλάσσομαι από κάτι, το πετάω

deal with ασχολούμαι με

involve εμπλέκω

release απελευθερώνω

radiation ακτινοβολία

electrical charge ηλεκτρικό φορτίο

process διαδικασία

survive επιβιώνω

impact wrench αερόκλειδο

bench πάγκος

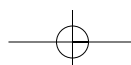
supervisor επόπτης

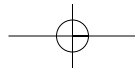
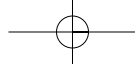
spark plug σπινθηριστής, μπουζί

spare part ανταλλακτικό



A Fuel-cell hybrid car, Honda, Insight, Japan 2000





UNIT 5

The petrol reciprocating engine

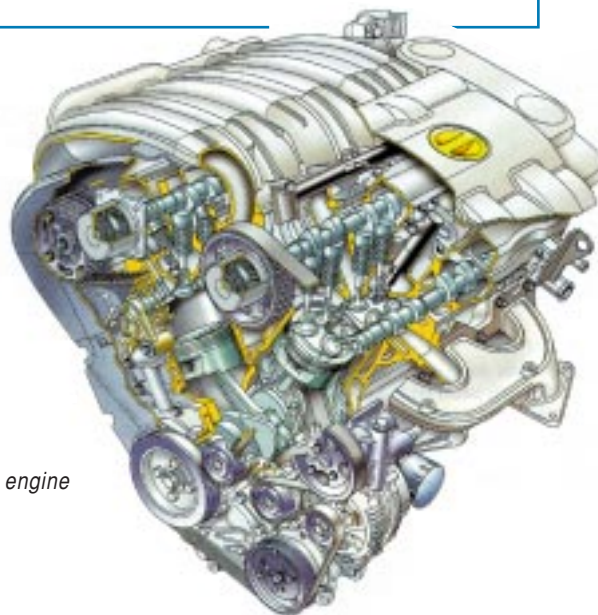
Learning objectives

Reading comprehension: Presenting the structure and parts of the petrol engine, their location, function operation and properties.

Vocabulary: related to the location, construction material, function and operation of the engine's parts. - Definitions, synonyms and antonyms, word formation (verb↔noun), prepositions.

Language functions: Expressing: a) alternatives (either... or and neither... nor), b) how something is done / the means/instrument (by, by means of, via, through).

Use of English: a) The Simple Present Tense (for general truths) in Active and Passive Voice, b) Wh_ questions.



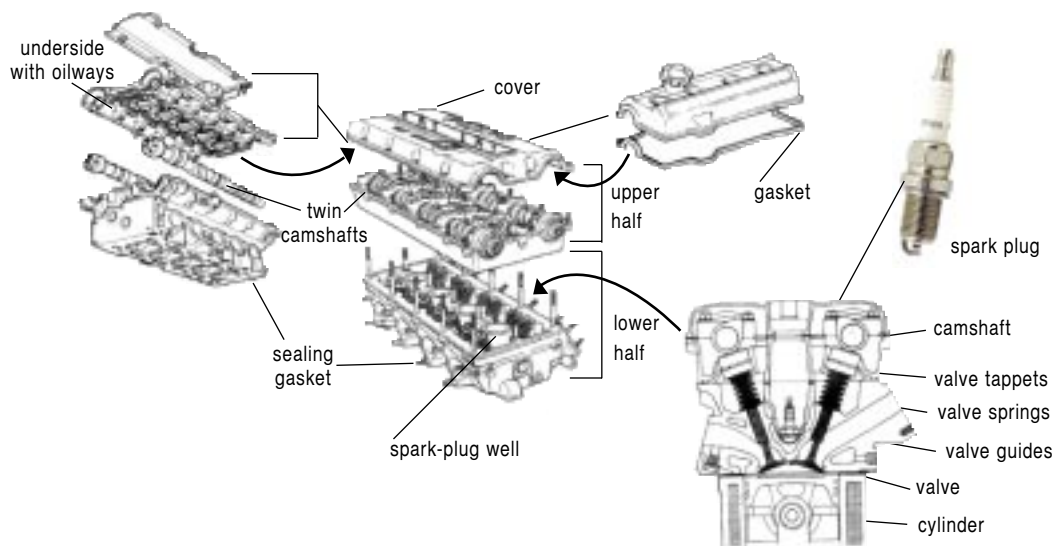
*A V-6 petrol reciprocating engine
(Renault, sport Clio)*

A. The structure of the petrol reciprocating engine

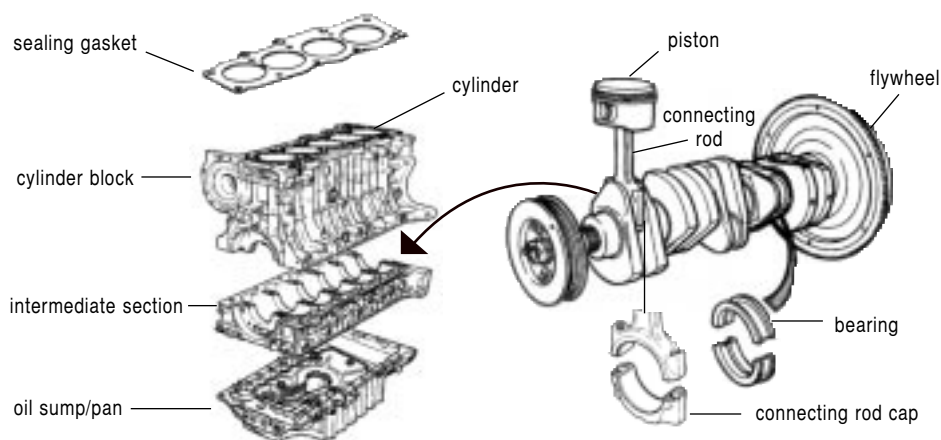
The engine of most passenger cars is of the reciprocating type and uses petrol as a fuel. It is manufactured of light aluminium alloy and is divided into two parts: the cylinder head and the cylinder block.

The pictures below illustrate the structure and main components of the two engine parts.

The upper engine or the cylinder head



The lower engine



TASK 1

Study the pictures and say the Greek equivalent term for each English part and component illustrated.

TASK 2

Use your knowledge and, drawing your information from the pictures above, fill in the gaps in the text which follows.

A. The upper engine or the cylinder head

In most modern cars, the cylinder head is made of aluminium and is divided into two halves. Its main parts are the twin, the assembly and the

The spark plugs and the valves assembly, which includes: the, the, the and the themselves, are located in the lower half of the cylinder

The two camshafts are located in the upper half of the cylinder head. They are installed on the camshaft carrier, in six bearing caps each, over the valves

The upper half of the cylinder head also functions as a cover for the valves and the spark plugs. In most cars, its has oilways on the underside that guarantee good oil supply to the valves assembly and the camshafts. There is also another cover over the spark-plug wells to protect the spark plugs from dirt and water. The cylinder head is separated from the cylinder block by a sealing gasket.



Petrol/gasoline engine

B. The lower engine

The lower engine* is divided into three sections: a) the, b) the intermediate, which includes the, and c) the **

The cylinder block, which is made either of cast iron or of aluminium, has the cut directly in it. Each cylinder contains a piston. The reciprocate, that is they move up and down, in the cylinders. At the lower part of the pistons are the and their caps which connect the pistons to the Like the camshaft, the crankshaft is installed in six

When the pistons reciprocate, the connecting rods turn the crankshaft which is free to rotate. In this way, the pistons reciprocating motion is converted into rotary The rotary motion of the crankshaft is transferred outside the engine, to the wheels, by means of the

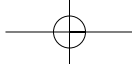
On the upper side of the intermediate section, there are cast oilways that distribute oil to the bearings via the crankshaft.

At the bottom of the engine, under the crankshaft, is the It contains the oil which is pumped inside the engine to lubricate its moving parts in order to reduce friction.



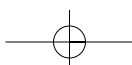
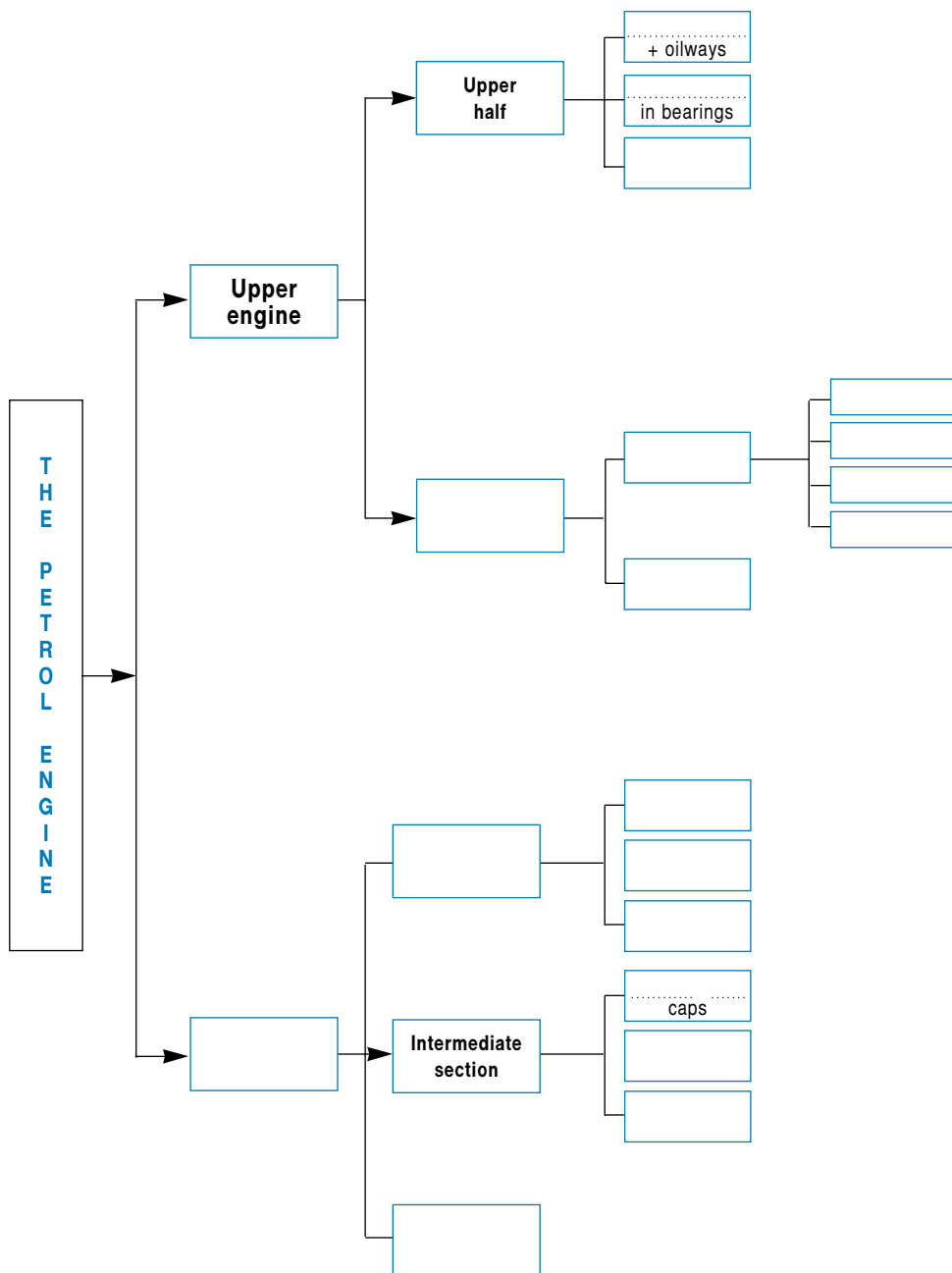
* Sometimes all three parts of the lower engine are referred to as "the cylinder block"

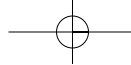
** Oil sump or oil pan



1. Reading Comprehension

1A Complete the diagram with the components of a reciprocating petrol engine.



**1B Answer the questions:****a) About the upper engine**

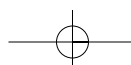
1. What is the cylinder head in most modern cars made of?
2. How many camshafts do most cars have nowadays and where are they located?
3. What is the function of the upper half of the cylinder head?
4. How are the spark plugs protected from dirt and water?

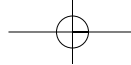
b) About the lower engine

1. How is the lower engine separated from the upper engine?
2. What is the upper section of the lower engine made of?
3. Is the motion of the pistons rotary or reciprocating? What about the motion of the crankshaft?
4. What is the function of the connecting rods and their caps?
5. How is the motion of the crankshaft transmitted outside the engine?
6. Why is it necessary to lubricate the moving parts of the engine?
7. Where is the oil sump located and what is its function?

2. Vocabulary practice**2A Match words with definitions. Give the Greek equivalent for each verb.**

- | | |
|---------------|--|
| 1. install | a) hand or deliver things to a number of people |
| 2. protect | b) give someone something that he wants or needs, e.g. food, equipment |
| 3. distribute | c) put something somewhere so that it is ready to be used |
| 4. function | d) move or keep apart; end a connection |
| 5. supply | e) prevent someone or something from being harmed or damaged |
| 6. separate | f) cover something or close it tightly to prevent liquids or other material from getting in or out |
| 7. seal | g) do the work or fulfil the purpose for what something was made |





2B Make pairs of synonyms

A. Verbs

guarantee	change; transform
supply	link; join
connect	assure; secure
reduce	transmit; carry
include	act; work; operate
install	decrease; lessen
convert	contain; comprise
function	provide; give
transfer	fix; locate

B. Nouns – Adjectives

axle; shaft	twin
part; compartment	rod
double	part
oil pan	direct
basic; essential	section
component; element	main
straight	oil sump

2C Use the two lists below to make pairs of antonyms.

a. distribute	separate	bottom	lower	reduce
b. top	join; link	increase	upper	gather; collect

..... - -

..... - -

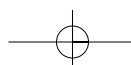
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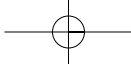
2D Word Formation

a. Derivatives

Complete the missing word.

Verb	Noun	Verb	Noun
cover	.....	move	.....
.....	conversion	.....	connection
.....	distribution	install	.....
.....	function	supply	.....
protect	.....	guarantee	.....
pump	.....	.....	lubrication
.....	spark	.....	seal
.....	transfer, transference	.....	reduction





b. The prefix trans-

You have often come across words beginning with trans-, e.g. transport, transfer. Have you ever thought what it means?

1. Choose the correct alternative.

- a) far, off
trans- = b) across; on the other side of; beyond
 c) in the interior; inside

2. Form as many words as you can beginning with trans- .

.....

3. Language functions

Either ... or..., neither ... nor...

They are both used with positive verbs to express two alternatives or to combine two negatives, sometimes placing emphasis.

a. Study the examples below.

- The cylinder block is made *either* of cast iron *or* of aluminium.
- *Neither* Tom *nor* George passed the exams.
- You can have *either* orange juice *or* coke. (not both)
- The car engine was *neither* strong *nor* well adjusted.
- The technician has *neither* come *nor* phoned till now.
- The camshaft is driven by the crankshaft by *either* a rubber belt *or* a chain.

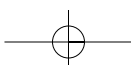
b. Complete the sentences

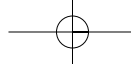
- a. The equivalent Greek expression for...either... or ...is:
 b. The equivalent Greek expression for...neither... nor ...is:

Practice

Fill in the gaps in the sentences below.

1. The house was large cheap, so we didn't buy it.
 2. To apply for the job, one should know English German.





3. Fortunately the burglars stole the TV set the video recorder.
4. the valves the oilsump are made of copper.
5. You'd better buy a European a Japanese car; not an American one.
6. He wants to become an electrician a car mechanic.
7. He likes classical folk music. He only listens to "heavy metal".
8. Finally, we went to the cinema to the concert. We went to the new pub.
9. Next summer, they are planning to go to India to China.
10. Experiments with ICE started in the 14th in the 15th century. They started in the 17th.
11. You must come with me now walk home alone later.

4. Use of English

The Simple Present tense in Active and Passive Voice (for general truths)

To talk about activities or situations that are true, in general, we use the Simple Present tense.

IN THE ACTIVE VOICE

FORM

Affirmative form: Subject + **verb in basic form...**

e.g. Petrol engines *belong* to the ICEs.

but 3rd person singular: verb + **s**

e.g. The petrol engine *uses* petrol as a fuel.

Interrogative form: **Do/Does** (3rd person singular) + subject. + **verb in basic form...?**

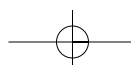
e.g. *Do* petrol engines *belong* to the ECEs?

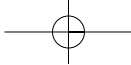
Does the petrol engine *use* petrol as a fuel?

Negative form: Subject + **do not** (don't) / **does not** (doesn't) + **verb in basic form...**

e.g. Petrol engines *don't belong* to the ECEs.

The petrol engine *doesn't use* petrol as a fuel.

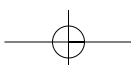


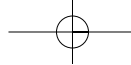
**Practice**

4A Choose verbs from the list and form them appropriately to produce affirmative, interrogative or negative sentences.

function - result - use - pivot - run - pollute - flow - carry
operate - reduce - cost - reciprocate - need - turn

1. a ship's engine petrol as a fuel ? No, it diesel oil.
2. electric car batteries frequent recharging?
3. Car emissions the environment seriously.
4. As the pistons, the connecting rods from side to side and the crankshaft.
5. the increase in the number of valves in better combustion?
6. the valves with the help of the crankshaft? No, they They with the help of the camshafts.
7. Oil though the moving parts of the engine to lubricate them.
8. Catalytic converters the amount of harmful exhaust gases that are released into the atmosphere.
9. The upper half of the cylinder head also as a cover for the valves assembly and the spark plugs.
10. fuel-cell hybrid car at lot? No, they a little more than a family saloon.
11. When a hybrid car at low speed, it its battery.
12. An electron a positive electric charge. It a negative one.





IN THE PASSIVE VOICE

FORM

Passive verb in S. Present tense: to be + p.p.* of the verb

Affirmative form: Subject + **am / is / are** + **verb in p.p....**

e.g. Petrol engines *are equipped* with an ignition system.

Interrogative form: **Am / Is / Are** + subject + **verb in p.p....?**

e.g. *Are* diesel engines *equipped* with an ignition system?

Negative form: Subject + **am / is / are not** + **verb in p.p. ...**

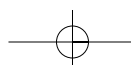
e.g. Diesel engines *are not equipped* with an ignition system.

■ Practice ■

4B Form the verbs in parentheses in their appropriate form in Passive Voice.

- In most cars, the engine (make) of light aluminium alloy.
- The battery of the fuel-cell hybrid cars (charge) by the petrol engine.
- The camshafts (install) in bearings on the camshaft carrier, over the valves assembly.
- How the pressure of combustion (prevent) from escaping past the cylinder walls causing loss of power?
- As they are highly explosive, butane and natural gas (not use) in private passenger cars.
- The rotary motion of the crankshaft (transfer) outside the engine by means of the flywheel.
- Petrol (not self-ignite), so petrol cars need an ignition system.
- transport and motor industry (influence) by increases in the price of oil?
- Modern cars (fit) with an electronic control unit.
- It (not allow) to smoke near a petrol pump.
- How the spark plugs (protect) from dirt and water?
- Valves (operate) by the camshafts with the help of the hydraulic tappets.

* p.p. = past participle (regular verb + -ed or irregular verb in 3rd column)

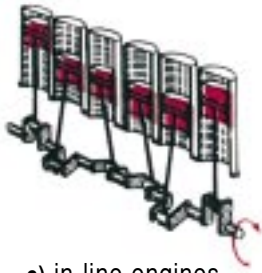


NOTES

According to the **number of cylinders**, engines are classified as:

- a) single-cylinder engines
- b) multi-cylinder engines

According to the **arrangement of cylinders**, engines are classified as:



a) in-line engines



b) horizontally opposed engines



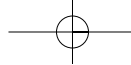
c) radial engines



d) Vee engines

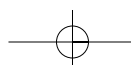
According to the **number of strokes**, engines are classified as:

- a) two-stroke engines
- b) four-stroke engines



Vocabulary - Terminology

alloy μίγμα, κράμα μετάλλων	intermediate section μεσαίο / ενδιάμεσο τμήμα / μέρος
cylinder head κυλινδροκεφαλή	crankshaft στροφαλοφόρος άξονας
cylinder block συγκρότημα κυλίνδρων, το μπλοκ του κινητήρα / της μηχανής	oil sump / oil pan ελαιολεκάνη, κάρτερ
twin διπλός, δίδυμος	piston έμβολο, πιστόνι
camshaft εκκεντροφόρος άξονας	rod ράβδος, άξονας
cover καπάκι, κάλυμμα	connecting rod διωστήρας, μπιέλα
valves assembly συγκρότημα / σύστημα βαλβίδων και πιανόλας	connecting rod cap καπάκι διωστήρα / μπιέλας
(valve) tappet πλήκτρο, ωστήριο, καπελότο βαλβίδας	transfer μεταβιβάζω, μεταβίβαση
valve guide οδηγός βαλβίδας	flywheel σφόνδυλος, βολάν
valve spring ελατήριο βαλβίδας	cast χυτός
spark σπινθηρίζω, δημιουργώ σπινθήρα, σπινθήρας	distribute διανέμω, μοιράζω, διασκορπίζω
plug ρευματολήπτης, πρίζα	pump αντλώ, αντλία
spark plug σπινθηριστής, μπουζί	lubricate λιπαίνω
bearing κουζινέτο, ρουλεμάν, τριβέας, έδρανο (ένσφαιρος = ball bearing)	reduce μειώνω
function λειτουργώ, λειτουργία, λειτουργικός σκοπός	friction τριβή
oilways αύλακες λιπαντικού	link / join ενώνω, συνδέω
guarantee εγγυώμαι, εξασφαλίζω	amount ποσό
supply προμηθεύω, παρέχω, προμήθεια, παροχή	positive θετικός
well πηγάδι, οπή	electric charge ηλεκτρικό φορτίο
spark-plug well υποδοχή, εσοχή του μπουζί	prevent παρεμποδίζω
separate (δια- / ξε-)χωρίζω, (ξε-)χωριστός	loss of power απώλεια ισχύος
seal σφραγίζω, φράζω, σφραγίδα	self-ignite αυτοαναφλέγομαι
gasket παρέμβυσμα, τσιμούχα, φλάντζα	fit τοποθετώ, ταιριάζω, εξοπλίζω, εφοδιάζω ανταποκρίνομαι, κατάλληλος, σε φόρμα
section τμήμα, μέρος	allow επιτρέπω
cylinder κύλινδρος	in-line engine κινητήρας (με τους κυλίνδρους) εν σειρά
	radial engine ακτινωτός / αστεροειδής κινητήρας
	horizontally opposed engine αντικρουστός κινητήρας, Μπόξερ
	Vee engine κινητήρας σχήματος V



B. Extra information about the engine's components

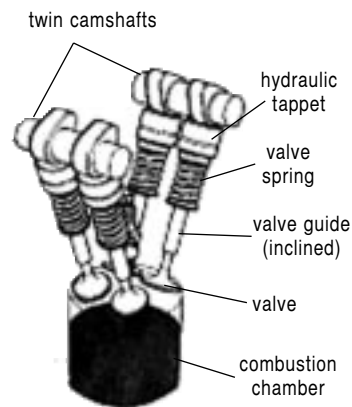
In the paragraphs below, you will find some extra information concerning the components of the engine.

TASK 1

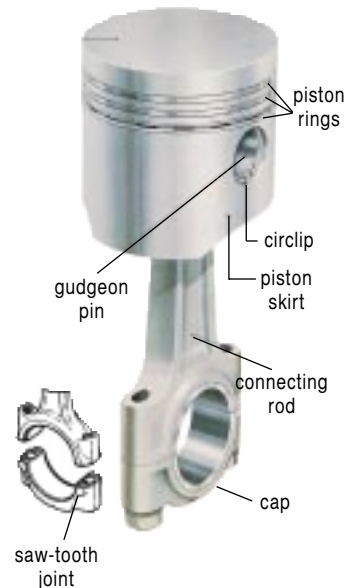


Go through the paragraphs quickly, identify the component the information in each paragraph refers to, and fill in the gaps in the sentences.

1. The are made from a heat-resisting material, usually high-temperature alloy steel. They are guided by their guides, which are inclined at an angle of about 20° to the vertical. They are operated with the help of the twin overhead camshafts through the hydraulic tappets. In the past, cars had only two per cylinder. Most modern cars, however, have three, four or five. The increase in their number improves the engine's breathing producing better combustion of the fuel/air mixture. This improves the efficiency of the engine.

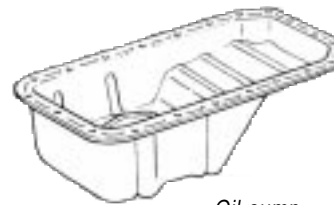


2. Each is equipped with three rings, which are made either of cast iron or of hardened steel. The piston rings fill the gap between the piston and the cylinder wall to prevent the pressure of combustion from escaping past the piston causing loss of power. When the car is running at maximum speed, each reciprocates inside the cylinder about a hundred times a second. As a result, they must be very strong and at the same time light. To satisfy these demands, in most cars, they are made of a light aluminium alloy.



3. The are of forged steel. On their upper end, they are linked to the pistons via the gudgeon pins. The gudgeon pins allow the pistons to move up and down while the pivot from side to side to convert the reciprocating motion of the pistons to the rotary motion of the crankshaft. On their lower end, there is a saw-tooth joint that locates their caps exactly.

4. While flowing through the moving parts of the engine to lubricate them, the oil also absorbs part of the heat produced by combustion, thus cooling the engine. The oil is collected into the, which has a thin casing of pressed steel or cast aluminium with a large surface area to help the oil release the absorbed heat into the surrounding air.

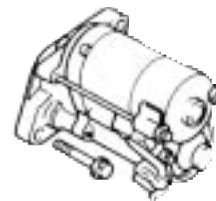


Oil sump

5. One side of the is bolted to the crankshaft. Its other side is connected to the clutch. The outer edge of the wheel has gear teeth which are engaged to the starter motor. The starter motor, receiving its current from the storage battery, turns the which rotates the crankshaft and sets the engine in motion before an explosion in one of the cylinders can take place and power is developed. The is of a special type that operates under a heavy overload, producing high power for very short periods. In modern petrol cars, the starter motor is automatically actuated when the ignition switch is closed.



Flywheel

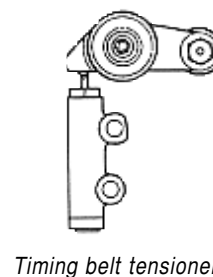
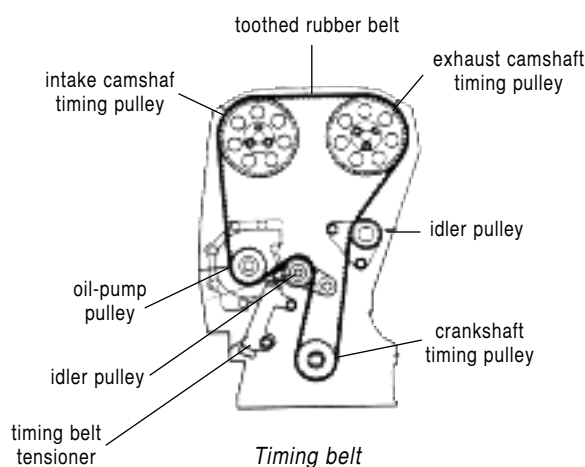


Starter motor



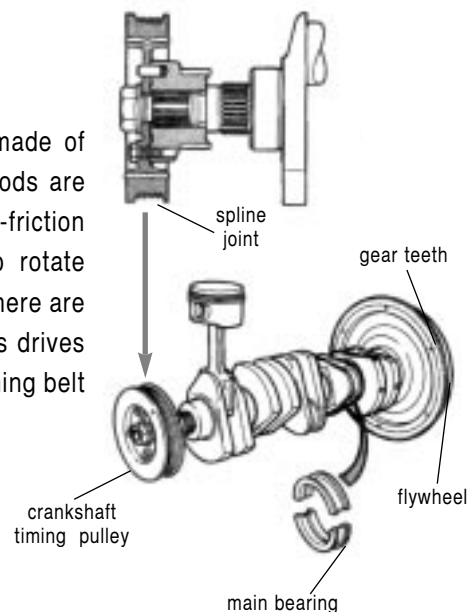
Camshaft

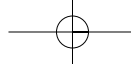
6. In the past, cars had only one Most modern cars have two. They are driven by the crankshaft by means of the timing belt, which is either a chain or a single toothed rubber belt. The timing belt also drives the coolant pump. The correct timing belt tension is achieved using an automatic belt tensioner.



Timing belt tensioner

7. Between the, which is made of cast forged steel, and the connecting rods are six main bearings. They are of the low-friction type and permit the to rotate freely. At the front end of the crankshaft, there are two spline joints. The inner of these joints drives the oil pump; the outer joint carries the timing belt pulley and the vibration damper.





1. Reading comprehension

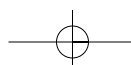
1A Match the parts of the engine with the material they are made of. Say the Greek equivalent term for each material.

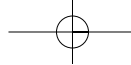
- | | | |
|------------------------|----------------|--|
| 1. The timing belt | is/are made of | a) high-temperature alloy steel. |
| 2. The crankshaft | | b) either cast iron or hardened steel.* |
| 3. The connecting rods | | c) light aluminium alloy. |
| 4. The oil sump casing | | d) forged steel. |
| 5. The piston rings | | e) either pressed steel or cast aluminium. |
| 6. The valves | | f) either metal or rubber. |
| 7. The pistons | | g) cast forged steel. |

1B The information in the sentences below is wrong. Correct it.

- The valves are opened and closed with the help of the crankshaft.
- Since each piston must reciprocate inside the cylinder about 400 times per second when the car runs at maximum speed, it must be strong and heavy.
- On their upper end, the connecting rods are linked to their caps by means of the piston rings; on their lower end, they are bolted to their pistons.
- As it flows through the moving parts of the engine to lubricate them, the oil increases the temperature of the engine.
- One side of the flywheel is bolted to the camshaft; the other side is connected to the starter motor; the gear teeth at the outer edge of the wheel are engaged to the clutch.
- The crankshaft draws power from the starter motor and sets the engine in motion, after combustion can take place in one of the cylinders and power is developed.
- The twin camshafts are driven by the crankshaft by means of the clutch, which also drives the fuel pump.
- Between the connecting rods and the camshaft there are eight main bearings of the high-friction type.

* Steel specially treated (= heated to a certain temperature and then quenched, that is cooled, in a suitable medium such as water, oil, etc) to become harder. The hardness of the metal depends on the temperature of heating and the speed of cooling it, as well as on the amount of carbon it contains.





1C Answer the questions.

1. What is the advantage of installing more than two valves per cylinder?
2. What is the function of the piston rings?
3. What is the usefulness of the gudgeon pins?
4. Why is the casing of the oil pan thin with a large surface area?
5. How is the engine started?
6. How is the correct timing-belt tension maintained?
7. Why do manufacturers install bearings around the crankshaft and the camshafts?
8. What is the function of the two spline joints that are located at the front end of the crankshaft?

2. Vocabulary Practice

2A Choose words from the list to fill in the gaps in the sentences below.

surrounding - inclined - edge - saw - casing - angles - pulley - surface
horizontal - vibration - vertical

1. The line AB
is A B

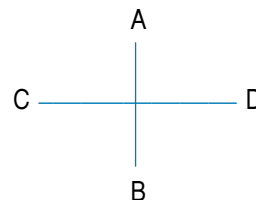
3. The line AB
is



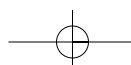
2. The line AB
is A B

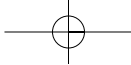


4. The line AB is perpendicular
to CD. They intersect and
form four right



5. The floor is made of stone. Its is hard, rough and cold.
6. The place or line where something, e.g. the desk top, stops is its
7. To cut wood or metal, we use a
8. A heavy vehicle usually causes a to the shop windows.
9. The protective covering of a pump or of the oil pan is its
10. The lubricating oil releases the heat it has absorbed while flowing through the engine to the air.





2B Match the verbs with their definitions.

- | | |
|------------|---|
| 1. improve | a) oppose; use force against someone or something |
| 2. absorb | b) turn on a central pin or point |
| 3. release | c) draw in; take in, e.g. heat, light, knowledge |
| 4. pivot | d) move along as a river does |
| 5. bolt | e) allow to go; set someone or something free |
| 6. resist | f) join with bolts |
| 7. link | g) get or make something better |
| 8. flow | h) join; connect |



A bolt

2C The paragraphs below describe the function of some parts of the engine. Identify the defined item and write it as a heading in the space provided over each paragraph. Say its Greek equivalent.

1.

It is connected to the flywheel. It disconnects the engine from the road wheels when the driver changes gear (speed) or stops the car.

2.

It is an electric motor engaged to the gears of the outer edge of the flywheel. It draws a heavy electric current from the battery and starts the engine.

3.

It links the connecting rods to the pistons. Thanks to it, instead of reciprocating, like the pistons, the connecting rods can pivot from side to side and turn the crankshaft. In other words it helps convert the reciprocating motion of the pistons to the rotary motion of the crankshaft.

4.

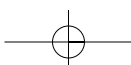
It is a device that pumps the water used to cool the engine in water-cooled cars.

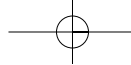
5.

They look like wide metal rings. They are placed around the crankshaft and the camshafts which, thanks to them, can rotate freely.

6.

Its function is to turn the camshafts at a speed that achieves the opening and closing of the valves at the correct time.





7.

It is a pump which, driven by the crankshaft, draws oil from the oil sump and forces it to the moving parts of the engine to lubricate them.

8.

There are two of them at the front end of the crankshaft. One carries the vibration damper and the timing-belt pulley and the other drives the oil pump.

9.

It is a mechanism that automatically checks and maintains the tension of the timing belt.

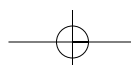
10.

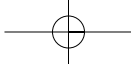
It is a device used to reduce the vibration produced by the moving parts of the engine

2D Fill in the gaps with the appropriate preposition. Choose from the list.

of	by	into	with	per	through	at	on	from	to
----	----	------	------	-----	---------	----	----	------	----

- The pistons reciprocate in the cylinders about 100 times second.
- To convert metres millimetres, you should multiply by 1,000.
- Cylinders may be equipped three, four or five valves each, depending the manufacturer.
- This model has a top speed of 240 km hour.
- The piston rings prevent the pressure of combustion escaping past the piston.
- The lower engine consists three sections.
- The crankshaft is made forged steel.
- The camshaft is driven the crankshaft.
- The lubricating oil flows the moving parts of the engine.
- The spark plugs and the valves are located the lower part the upper engine.





3. Language functions

Expressing how something is done (the means or instrument)

To express how something is done, the means or the instrument by which an activity is achieved, you can use expressions, such as: **by, by means of, via, with, with the help of, through.**

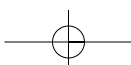
Study the examples below.

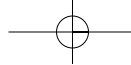
- The cylinder head is separated from the cylinder block *by / by means of* a sealing gasket.
- On the upper side of the intermediate section there are cast oilways that distribute oil to the bearings *via / through* the crankshaft.
- The valves are operated *with the help of* the camshaft.

Practice

Use the above expressions to fill in the gaps in the sentences below.

1. The rotary motion of the crankshaft is transferred outside the engine, to the wheels, the flywheel.
2. The valves are operated the twin camshafts the hydraulic tappets.
3. The oil pump is driven the inner of the two spline joints of the crankshaft.
4. The caps are located at the lower end of the connecting rods a saw tooth joint.
5. The reciprocating motion of the pistons is converted to the rotary motion of the crankshaft the connecting rods.
6. The upper part of the connecting rod is linked to the piston the gudgeon pin.
7. The camshafts are driven the crankshaft the timing belt.
8. The gap between the pistons and the cylinder walls is filled the piston rings.
9. The vibrations of the moving parts of the engine are decreased the vibration damper.
10. In petrol engines, the fuel is ignited a spark.
11. The crankshaft is connected to the pistons the connecting rods.
12. The cast oilways on the upper side of the intermediate section of the lower engine distribute oil to the bearings the crankshaft.
13. He sent his application to the company, electronic mail.





4. Use of English

Wh_ questions

Wh_ questions are questions beginning with: **why, when, where, who, whose, which, what** and **how** (much / many / long...). They are normally **followed by an interrogative verb**.

Examples

- *What* is he?
- *Which* model have they decided to buy?
- *How* do the valve tappets operate ?
- *Why* did you buy a second-hand car?
- *Where* will they repair their car?
- *How much* does the repair cost?

Remember



We **form questions** by:

- changing the position of the subject and the auxiliary verb (be, have, can, must, may, shall/will).
- using do / does in present simple and did in past simple questions

Important

When	who	are used to ask about the subject, they are followed by an affirmative verb, not an interrogative one.
	which	
	what	
	whose	

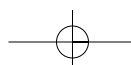
Examples

The personnel manager interviewed Peter

- | | |
|--|--------------------|
| • Who <i>interviewed</i> Peter? | Subject (S) |
| • Who <i>did</i> the personnel manager <i>interview</i> ? | Object (O) |

The micrometer takes both internal and external dimensions.

- | | |
|---|--------------------|
| • Which instrument <i>takes</i> both internal and external dimensions? | Subject (S) |
| • What kind of dimensions <i>does the micrometer take</i> ? | Object (O) |



**Don't
forget**



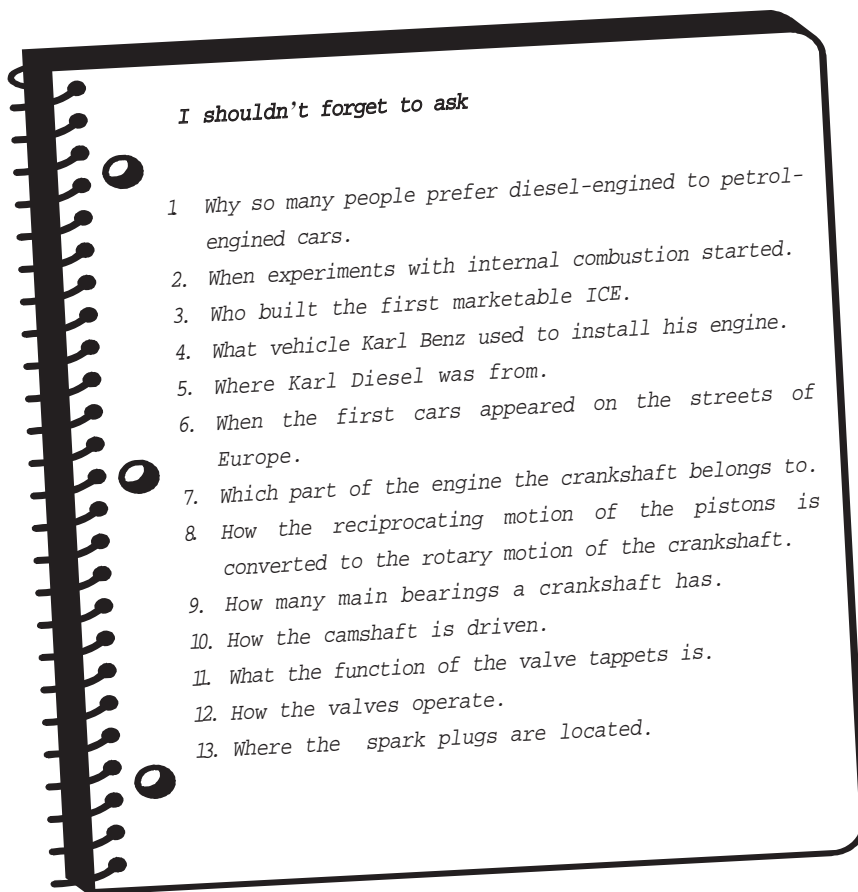
In questions, **prepositions** are usually placed **at the end**.

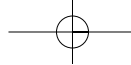
e.g. Which category do they belong *to*?

What are they equipped *with*?

Practice

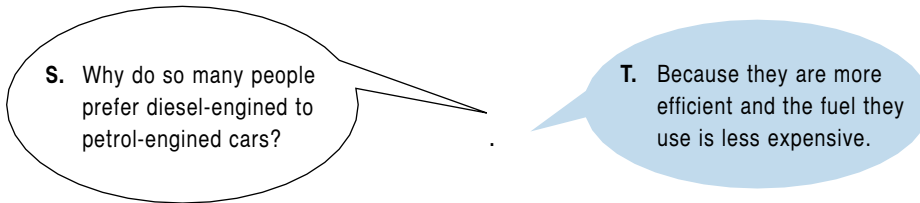
- 4A** At the end of the introductory lesson on the history, structure and operation of the car engine, the teacher encouraged the students to write down any questions they would like to ask him in the next lesson. Here is what a student wrote in his notebook.





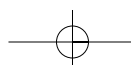
Work in pairs. Imagine that this is the next lesson. One of you is the Student (S) and the other the Teacher (T). Use the Student's notes and perform the exchanges between them.

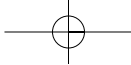
Example



4B Use the information in the sentences below to ask questions. Begin with the words in the parentheses at the end of each sentence.

1. The piston rings fill the gap between the piston and the cylinder wall. (What)
2. The technician has just installed the new oil sump. (Who - What)
3. The flywheel transmits the power of the engine to the clutch. (What / Which part of the engine - Where)
4. The valve tappets are filled with oil. (What)
5. The Duryea brothers started the American motor company. (Who - What)
6. They will take George's car to the Smith's car-repair workshop. (Whose car/What - Where)
7. The Personnel Manager employed Paul. (Who)
8. The repair will cost you 230,000 drachmas (What - How much)
9. My uncle sold his car for 3 million drachmas. (Who - What - How much)
10. He should have bought a pick-up truck. (Who - What [kind of car])
11. The engine of trucks, trains and ships operates on diesel. (What [type of fuel])
12. The Personnel Manager is discussing the matter with the Production Manager in his office. (Who - What - Where)
13. John arrived at work an hour late today. (Who - Where - When - How late)
14. You must check the brakes before your trip to Spain. (What)





Useful tools



Piston-groove cleaner Εργαλείο για τον καθαρισμό των αυλακώσεων του εμβόλου



Piston-ring pliers
Εργαλεία / τσιμπίδες για το άνοιγμα και αφαίρεση των ελατηρίων του εμβόλου



Surface plate Πλάκα εφαρμογής για καπάκια κινητήρα

Piston-ring compressor
Σφιγκτήρας ελατηρίων εμβόλου



Surface gauge
Παχύμετρο ύψους



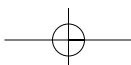
Fly-wheel blocking tool
Εξολκέας που μπλοκάρει το στρόφαλο



Pulley extractor
Εξολκέας για γρανάζια στον καθρέφτη



Pulley stay
Ειδικός εξολκέας για γρανάζια καδένας





Torx sockets and bits for Torx-socket heads Καρυδάκια για βίδες τύπου Torx



Cylinder-pressure tester Μετρητής συμπίεσης κυλίνδρων



Torque meter Ηλεκτρονικό ροπόμετρο



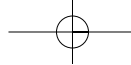
Cylinder-head rest Βάση τοποθέτησης κυλινδροκεφαλής



Torque wrench Δυναμόκλειδο

Flexible magnetic arm for datum point Σπαστό μοιρόκλειδο





Vocabulary – Terminology

resist αντιστέκομαι

material υλικό

heat resisting material υλικό ανθεκτικό σε θερμικές καταπονήσεις

high-temperature alloy steel κράμα χάλυβα υψηλής αντοχής σε θερμική καταπόνηση

(cast) forged steel (χυτό) σφυρήλατο ατσάλι

inclined κεκλιμένος, επικλινής, λοξός

angle γωνία, κορυφή

vertical κατακόρυφος

hydraulic υδραυλικός

improve βελτιώνω, βελτιώνομαι

cast iron χυτοσίδηρος

hardened steel βαμμένο ατσάλι (που έχει υποστεί ειδική θερμική διαδικασία για αύξηση της σκληρότητάς του)

equip εξοπλίζω, προμηθεύω

cylinder wall εμβολοχιτώνιο

prevent παρεμποδίζω (κάτι κακό)

loss of power απώλεια ισχύος

light aluminium alloy ελαφρό κράμα αλουμινίου

forged steel σφυρήλατο ατσάλι

link συνδέω, ενώνω, σύνδεσμος, ένωση

gudgeon pin γόμφωση, θηλυκό βελόνι, γόμφος, πείρος εμβόλου

circlip (ελατηριωτό) ψέλλι, (δαχτυλιδωτή) ασφάλεια

pivot περιστρέφομαι (γύρω από άξονα, πόλο), άξονας περιστροφής, άξονας-οδηγός

saw πριόνι

joint ένωση, αρμός, σύνδεση

flow ρέω

absorb απορροφώ

casing θήκη

pressed steel πρεσαριστός χάλυβας

cast aluminium χυτό αλουμίνιο

surface επιφάνεια

release απελευθερώνω

surrounding ο περιβάλλον

bolt ήλος, μπουλόνι, κοχλίας, συνδέω με μπουλόνια

clutch συμπλέκτης, αμπραγιάζ

edge άκρη

gear συμπλεκόμενος οδοντωτός τροχός, γρανάζι, μηχανισμός, ταχύτητα (για αυτοκίνητο, μοτοσυκλέτα)

gear teeth οδόντες, γρανάζια οδοντωτού τροχού

engage εμπλέκω, συμπλέκω, βάζω ταχύτητα (σε αυτοκίνητο, μοτοσυκλέτα), ασχολούμαι με

starter motor μοτέρ εκκίνησης, μίζα, εκκινητής

overload υπερφόρτιση

actuate ενεργοποιώ

ignition ανάφλεξη, έναυση

ignition switch κεντρικός διακόπτης, μπουτόν εκκίνησης

chain αλυσίδα

toothed οδοντωτός

rubber ελαστικό, καουτσούκ, γόμα, σβήστρα

belt ιμάντας, ζώνη, ταινία

timing belt ιμάντας χρονισμού / εκκεντροφόρου

coolant ψυκτικό υγρό

tension τάση, ένταση, τέντωμα

achieve επιτυγχάνω, καταφέρνω

belt tensioner εντατήρας ιμάντα χρονισμού / εκκεντροφόρου

main bearing κύριο κουζινέτο / έδρανο

spline αυλάκωση, λεπτή οδόντωση, αυλακώνω

spline joint οδοντωτή ένωση, σύνδεση

pulley τροχαλία, καρούλι

vibration κραδασμός

damper διάφραγμα

quench ψύχω

suitable κατάλληλος

carbon άνθρακας

vibration damper αποσβεστήρας κραδασμών, κινητό διάφραγμα απόσβεσης κραδασμών / ήχου κ.λπ.

current ρεύμα, ο τρέχων

maintain συντηρώ, διατηρώ (π.χ. σε καλή κατάσταση)

wear φθορά (λόγω χρήσης)

rough τραχύς, ανώμαλος, τρικυμισμένος

device συσκευή, επινόηση

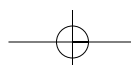
lift σηκώνω, ανυψώνω

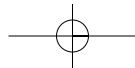
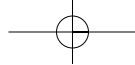
draw τραβώ, σύρω

idler pulley οδηγός ιμάντα

slack χαλαρός

wear φθορά





UNIT 6

The valves and their tappets

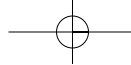
Learning objectives

Reading comprehension: Describing the operation of the valves and tappets; presenting the parts of a tappet and their function.

Vocabulary: related to the parts and operation of the valves and tappets. Definitions.

Use of English: Second Conditional.





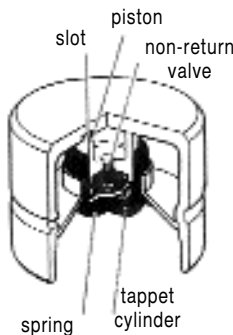
How the valves operate

The valves are opened and closed with the help of the twin overhead camshafts through hydraulic tappets. When the camshaft lobe operates on a valve tappet, the valve is pressed down and opens the port in the engine cylinder, either to let air enter the engine or to let the burnt gases out. When a valve tappet is in contact with the base cycle of the cam, the valve spring draws the valve upwards closing the port in the engine cylinder. To ensure the correct operation of the valves, the distance between the valves and the camshaft must be kept unchanged. This is done by means of the tappets. In other words, the function of the tappets is to maintain the correct distance between the valves and the camshaft. To achieve this, the tappets must be kept continuously in contact with the camshaft.

The hydraulic tappets

The tappets are filled with oil and self-adjusting. There is one tappet for each valve. The main parts of a tappet are the tappet cylinder, a spring, a non-return valve, a piston, and a slot in the top of the tappet.

When the tappet is not operated by the cam, it is held in contact with the camshaft by the spring in the tappet cylinder.

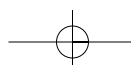


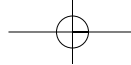
The oil that fills the tappet comes from the camshaft carrier oilways and enters the tappet flowing through a groove and a series of holes in its side. It enters the tappet cylinder flowing through the slot in the top of the tappet and the piston which is located under the slot.

The lower part of the piston in the tappet cylinder is in contact with the upper part of the valve, thus maintaining a steady distance between the valve and the camshaft.

The non-return valve prevents the oil in the tappet cylinder from escaping back to the camshaft carrier oilway when the tappet is operated by the camshaft.

The way the tappets operate is described below.



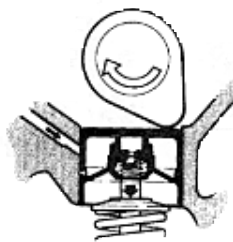


How the valve tappet operates



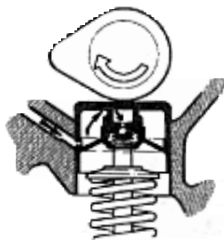
A. First phase

The tappet is in contact with the base cycle of the cam (shaft). The holes in the side of the tappet are open, so that oil from the camshaft carrier oilway is forced into the tappet. Because the oil pressure in the tappet cylinder is lower than the engine oil pressure when the tappet is not operated by the cam, the oil flows through the non-return valve into the tappet cylinder.



B. Second phase

The cam (shaft) lobe presses the tappet down. As a result, the oil pressure in the tappet cylinder is now higher than the engine oil pressure. The non-return valve closes, effectively making the assembly a solid component. The oil flows through a hole in the bottom of the tappet cylinder to the upper part of the valve and lubricates it.



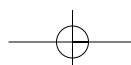
C. Third phase

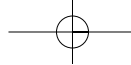
The tappet is back in contact with the camshaft base cycle and the engine oil pressure is higher again than the oil pressure in the tappet cylinder. As a result, the non-return valve opens admitting oil so that the tappet is pressed against the camshaft to maintain the tappet in contact with the cam.

1. Reading comprehension

1A Answer the questions.

1. How are the valves operated?
2. What does "... the cam lobe operates on a tappet" mean?
3. What is the function of the valve tappets?
4. How many tappets are there in an engine?
5. Do the valve tappets need regular adjustment?
6. Describe the structure of a tappet.
7. What is the route of the oil that fills the tappets?
8. How are the tappets kept in contact with the camshafts when they are not operated by the cam (shaft) lobe?





9. What is the function of the piston and the non-return valve in the tappet cylinder?
10. When is the oil allowed to flow into the tappet cylinder?

1B Join items from the two columns to make meaningful sentences according to the text.

- | | |
|--|--|
| 1. The oil pressure in the tappet cylinder is higher than that in the engine | a) when the tappet is in contact with the base cycle of the cam. |
| 2. The oil pressure in the engine is higher than that in the tappet cylinder | b) when the tappet is pressed down by the cam lobe. |
| 3. The non-return valve opens | |
| 4. The non-return valve closes | |
| 5. The valve opens the port in the cylinder | |
| 6. The valve closes the port in the cylinder | |

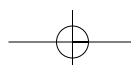
1C Fill in the gaps in the paragraphs of the text below with words from the list on the left of each paragraph.

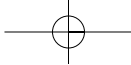
First paragraph

- | | |
|----------|---|
| spring | The (1) are connected to the valves. To ensure |
| contact | the correct operation of the (2), the tappets |
| piston | must be kept always in (3) with the camshaft |
| located | and maintain a steady (4) between the camshaft |
| tappets | and the valves. To achieve this, they are equipped with a |
| oil | (5) which connects them to the valves and a |
| up | (6) that pushes the tappet (7) |
| lobe | when it is not operated by the camshaft (8). |
| valves | The piston and the spring are (9) in a cylinder |
| distance | in the tappet, which is filled with (10). |

Second paragraph

- | | |
|---------|--|
| enters | The oil comes from the camshaft carrier (1). It |
| slot | enters the tappet flowing through a (2) and holes |
| under | in its side. It, then, passes through a (3) in the top |
| oilways | of the tappet, and (4) the tappet cylinder flowing |
| groove | through the piston which is located (5) the slot. |





Third paragraph

closes
holes
increases
down
rotates
oil
open
engine
camshaft

As the camshaft (1), the lobe of the cam presses the tappet (2). The (3) in the tappet's side close, so no more(4) enters the tappet. Because of the pressure exercised on the tappet by the (5) lobe, the oil pressure in the tappet cylinder(6) and becomes higher than the pressure of the oil in the(7). To prevent the oil in the tappet cylinder from escaping, the non-return valve (8) making the tappet assembly a solid unit that pushes the valve down to(9) the port in the engine cylinder.

Fourth paragraph

higher
lobe
tappet cylinder
spring
close
opens
spring
base cycle
non-return

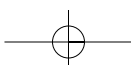
When the tappet, pushed up by the (1) in its cylinder, is in contact with the (2) of the cam, the hole at the side of the tappet (3), and oil flows in the tappet. Because the engine oil pressure is (4) than the pressure of the oil in the tappet cylinder, the (5) valve, which is also located in the (6), opens and oil flows in the cylinder. The valve (7) pushes the valve up to (8) the port in the engine cylinder. The (9) of the rotating camshaft pushes the tappet down again. And the cycle restarts.

2. Vocabulary practice

2A Match words with definitions.

GROUP A (nouns, adjectives)

- | | |
|--------------|---|
| 1. hydraulic | a) a deep line cut into a surface |
| 2. contact | b) a rounded part of something, e.g. the ears, the cam, the lungs |
| 3. slot | c) operated by fluid that is under pressure, such as water or oil |
| 4. lobe | d) an object without holes or gaps in it, a strong structure |
| 5. groove | e) state of touching or coming together; being in touch |
| 6. solid | f) a narrow opening in a machine or container; a hole |

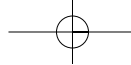


GROUP B (verbs)

- | | |
|-------------|---|
| 1. flow | a) move something in a direction by pulling it |
| 2. adjust | b) correct or change the position or setting of a mechanism so as to work properly or become more effective |
| 3. prevent | c) allow something, e.g. air or liquid, to enter in a place |
| 4. admit | d) make certain that something happens |
| 5. ensure | e) move steadily and continuously somewhere, e.g. as a river or the electric current does |
| 6. maintain | f) continue to have something or to keep it in good condition by regularly checking or repairing it |
| 7. draw | g) make certain that something does not happen |

2B Fill in the gaps in the sentences below with the appropriate form of the words defined in the previous exercise (2A).

1. When a non-return valve closes, it the fluid in it from escaping.
2. The statue is made of brass.
3. The tappets should be in with the camshaft, even when they aren't operated by the camshaft
4. Some years ago, it required skill and experience to the valves in a car. The tappets, the modern cars are equipped with, are self-adjusting and the correct operation of the valves.
5. In cars equipped with fuel injection, the engine only air from the inlet port. The fuel is injected by an injector fixed on top of the cylinder. In conventional cars equipped with a carburettor, the fuel is mixed with air in the carburettor and they into the cylinder intermixed.
6. To make a phone call on a card phone, first insert the phone card in the and then dial the number you are calling.
7. are cut deep in the metal surface. They function as oilways for the lubricating oil.
8. To your car in good condition, you should regularly check and repair it.
9. Do you think that the engine is strong enough to the trailer?



2C Write the equivalent English term.

1. υδραυλικό ωστήριο:
2. καυσαέρια:
3. αυτουθμιζόμενος:
4. βαλβίδα αντεπιστροφής:
5. ο λοβός του έκκεντρου:
6. συμπαγή:

3. Use of English

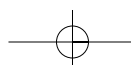
Second conditional

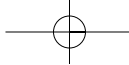
3A Study the examples

- If ***I were*** you, ***I would buy*** a four-wheel drive car. (I recommend it to you.)
- If ***I won*** the first prize, ***I might stop*** working. (but probably I will not win it.)
- If ***I had*** the right tools, ***I could*** fix it. (but unfortunately I don't have them.)
- If ***you got up*** earlier, you ***would be*** in time. (I suggest you should.)

3B Tick the correct of the alternatives below.

1. The above sentences refer to the
 - a) present
 - b) past
 - c) future
2. They express a situation
 - a) real
 - b) unreal
 - c) probable
 - d) improbable
 - e) imaginary
3. They also express
 - a) suggestion
 - b) order
 - c) advice
 - d) refusal





3C Fill in the missing information in the box below.

U S E

The Second Conditional refers to the or the
We use it to talk about, or situations.
It can also be used to make a or give an

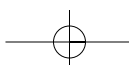
STRUCTURE

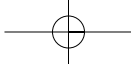
..... would
If +, +
.....

Practice

3D Put the verbs in parentheses in the correct verb tense.

1. If the non-return valve in the tappet cylinder (not close), the oil (escape) back into the camshaft carrier.
2. If the valve spring (not draw) the valve up, the port in the engine cylinder (remain) open.
3. If Peter (have) more experience, he (get) the job.
4. If modern cars (not be fit) with catalytic converters, pollution levels (be) higher.
5. If you (wake up) earlier, you (catch) the 7:30 bus and (not be) late at work every morning.
6. If I (pass) the final exams, I (go) on holydays abroad.
7. If the price of oil (not rise) manufacturers (construct) larger cars.
8. If car emission (not pollute) the atmosphere, car manufacturers (not experiment) with alternative types of fuel.
9. If we (use) public means of transport and bicycles more often, traffic jam and pollution (decrease) in big cities.
10. If people (be not concerned) that diesel-oil emissions contain carcinogens, diesel-engined cars (not remain) a low production.
11. If the connecting rods (not pivot) from side to side, the reciprocating motion of the piston (not become) the rotary motion of the crankshaft.
12. If I (have) more money, I (buy) a sport utility car.





Useful tools



Valve grinder Βαλβιδοτρίφτης



Valve retainer
Εργαλείο συγκράτησης βαλβίδων



Valve-stem seal pliers
Εργαλείο / τσιμπίδα για τα τσιμουχάκια στους οδηγούς των βαλβίδων

Valve lifters

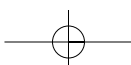
Εργαλεία εξαγωγής βαλβίδων και συγκράτησης βαλβίδων

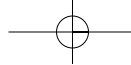


Clamp valve lifters



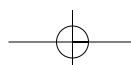
Slide-hammer valve lifter





Vocabulary / Terminology

hydraulic υδραυλικός, που λειτουργεί με υγρό υπό πίεση	force (εξ)αναγκάζω, υποχρεώνω, ισχύς, δύναμη
cam(shaft) lobe ο λοβός του εκκεντροφόρου (άξονα)	pressure πίεση
port θύρα, θυρίδα, στόμιο, οπή, δίοδος, λιμάνι	effectively αποτελεσματικά
burnt gases καυσαέρια	solid συμπαγής, σταθερός
contact επαφή	admit δέχομαι, επιτρέπω την είσοδο
base cycle of the cam βασικός κύκλος του εκκεντροφόρου άξονα	regular κανονικός, τακτικός, συνηθισμένος
draw σύρω, τραβώ	structure δομή, κατασκευή
distance απόσταση	allow επιτρέπω
maintain συντηρώ, διατηρώ, κρατώ	equip εξοπλίζω, εφοδιάζω, προμηθεύω
adjust ρυθμίζω	direction κατεύθυνση
adjustment ρύθμιση	position θέση
self-adjusting αυτορυθμιζόμενος	setting προκαθορισμένη ρύθμιση συσκευής
non-return valve βαλβίδα αντεπιστροφής	liquid / fluid υγρό
tappet piston το πιστόνι του καπελότου, υδραυλικό ωστήριο	steadily σταθερά, συνεχώς
tappet cylinder ο κύλινδρος του καπελότου	rounded στρογγυλεμένος
slot σχισμή	lung πνεύμονας
groove αύλακας, αυλάκωση, χαρακιά, εγκοπή	statue άγαλμα
prevent παρεμποδίζω	brass ορείχαλκος, μπρούτζος
steady σταθερός	conventional συμβατικός
	fuel injection έγχυση καυσίμου
	dial δείκτης, μετρητής, παίρνω αριθμό τηλεφώνου
	trailer συρόμενο όχημα, ρυμούλκα, τροχόσπιτο



UNIT 7

The four-stroke engine operation cycle

Learning objectives

Reading comprehension: Understanding and describing processes and operations.

Vocabulary: Terms related to the parts and operation of the four-stroke engine

Language functions: Connecting and sequencing ideas.

Use of English: Talking about facts, truths, beliefs, permanent or frequent activities (Present Tenses).



Although the four-stroke engine was the first marketable internal combustion engine, invented by Nicolas August Otto, it remains the engine on the principle of which most cars work even nowadays.

The principle of its operation is that each piston moves up and down four times (two strokes up and two strokes down) for each charge of fuel in the cylinder. Vaporized gasoline is drawn into the cylinder, mixed with air, compressed and ignited, burnt and expelled on the exhaust pipe in the following cycle:

1. The induction stroke

The inlet valves open. Driven by the crankshaft, the piston moves down. Air enters the cylinder travelling through the inlet manifold and port, past the open intake valves. At the same time, fuel is injected in the cylinder. As soon as the piston reaches the bottom of its stroke, the inlet valves close again driven by the camshaft. During this stroke the exhaust valves remain closed.

2. The compression stroke

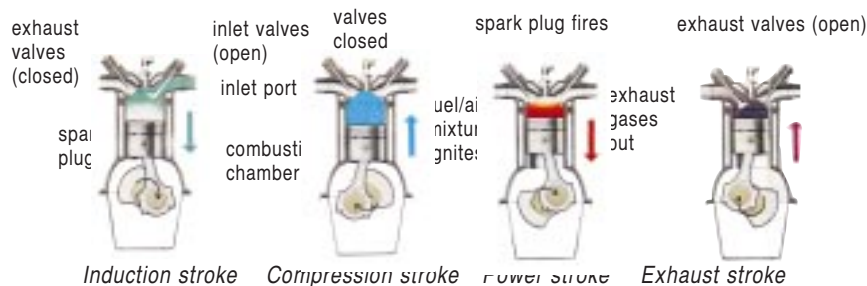
The valves remain closed. The piston moves up compressing the fuel/air mixture in the combustion chamber, while at the same time the heat produced by the compression fully vaporizes the mixture.

3. The power stroke

All the valves are shut. Just before the piston reaches the Top Dead Centre (TDC), which is the top of its stroke, a spark from the spark plug, which is fitted at the top of the cylinder head, ignites the mixture and combustion takes place. The expansion of the burning gases drives the piston down again and rotates the crankshaft half a turn.

4. The exhaust stroke

The inlet valves remain shut. The exhaust valves open and the piston rises to expel the burnt gases from the cylinder through the exhaust port, manifold and pipe. As soon as the piston reaches the top of its stroke, the exhaust valves close while the intake valves open again, and the cycle restarts with another induction stroke.



2. Vocabulary practice

2A Match the words in column A with their synonymous meaning in column B.

A

gasoline
ignited
expelled
induction
inject
vaporize
shut
expansion

B

forced out
inlet/intake
petrol
force (a liquid, gas etc) into
set on fire
closed
the process of expanding/becoming larger
cause (a liquid) to be changed into vapour

2B Find the words in the text meaning the following:

1. made up or thought of sth for the first time:
2. that can be sold:
3. sent out or away by force:
4. any substance used for producing heat or energy:
5. one of a series of regularly repeated movements:
6. pressing sth so as to get into a smaller space:
7. comes up or higher / reaches a higher level or position:
8. a pipe in an engine for gas, vapour etc that is no longer wanted:

2C Match the English terms with the Greek equivalent.

- a. exhaust stroke
- b. combustion chamber
- c. induction stroke
- d. burnt gases
- e. power stroke
- f. ignition
- g. expansion
- h. manifold
- i. compression stroke

1. χρόνος εισαγωγής
2. χρόνος συμπίεσης
3. χρόνος καύσης / εκτόνωσης
4. χρόνος εξαγωγής
5. συλλέκτης, πολλαπλή εισαγωγή
6. θάλαμος καύσης
7. καυσαέρια
8. διαστολή, εκτόνωση
9. ανάφλεξη

3. Language functions

Connecting and sequencing ideas.

Sequence markers such as *first, second, then, after that, next, finally, last(ly), in the end* as well as time expressions such as *when, while, as soon as, till, until, as, before, after, during, at the (same) time, at the moment (that)* are used to show the relationship between earlier and later information or to show that an event/action happens at the same time as another event/action.

Examples

- *First* the induction stroke takes place. *Then* comes the compression stroke. *After that*, the power stroke follows. *Finally*, the exhaust stroke finishes the cycle which restarts with another induction stroke.
- *Before* taking your car to the service center, let me have a look at it.
- *As/While* he was demonstrating his new device, he noticed a design fault.
- *After* the exhaust stroke takes place, the cycle restarts with another induction stroke.

Practice

Fill in the gaps in the paragraph, choosing the proper sequence marker or time expression from the following list.

during - after that - at the same time - while - before - then - as soon as -
at the moment - when - next - first

(1) the inlet valves open. Immediately (2) the piston moves down. (3) its downward movement air enters the cylinder (4) fuel is injected (5). (6) the piston completes this stroke, the inlet valves close again. (7) the piston starts moving up compressing the fuel/air mixture in the combustion chamber. Just (8) the piston reaches the TDC, the mixture is ignited by a spark plug and combustion takes place. (9) the piston moves down again driven by the expanded gases. (10) that the exhaust valves open, the piston starts rising to expel the burnt gases out of the cylinder. (11) the piston reaches the top of its stroke, the exhaust valves close while the inlet valves open again to have another induction stroke.

4. Use of English

**Refresh
your
memory**



Present Tenses uses

The **Simple Present** is used to describe facts, general/permanent/frequent activities, truths, beliefs and fixed schedules in the future.

Examples

- According to the four-stroke principle, *each piston moves* up and down four times for each charge of fuel in the cylinder.
- What *do they manufacture* in this factory?
- *Does she* usually *take* the bus to work?
- *A car mechanic repairs* cars.
- *The new training programme starts* on 3rd March.

The **Present Continuous** is used to describe actions, which are in progress at the time of speaking or around the time of speaking.

Examples

- Where's your car? *The car mechanic is repairing it.*
- *Are they designing* a new sports car this year?

Practice

Put the verbs in brackets in their correct form (Present Simple or Continuous Tenses) in the following sentences.

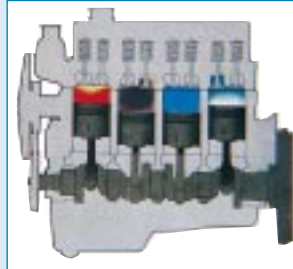
1. Most cars (work) on the principle of the four stroke engine.
2. As soon as the valves open, the piston (move) down injecting vaporized gasoline in the cylinder.
3. Look! They (install) a new catalytic converter in that car.
4. At the moment, he (use) my tools because he lost his yesterday.
5. The cycle of the four-stroke engine operation (restart) with another induction stroke.
6. I usually (take) my car to the service center, if a problem arises.
7. they (produce) spare parts in that factory?
8. When the seminar (start)?
9. Where's the technician? He (check) the engine.
10. they (design) any new models this year?

Do you know this?



Firing order

In a four-cylinder engine, the order the cylinders fire is not 1-2-3-4, but either 1-2-4-3 or 1-3-4-2. In this way, the stress exercised on the crankshaft by the firing cylinders and the vibration of the engine are reduced.



Vocabulary – Terminology

cycle κύκλος

operation λειτουργία

stroke διαδρομή εμβόλου, «χρόνος» κινητήρα, χτύπημα, κίνηση

marketable εμπορεύσιμος

internal εσωτερικός

combustion καύση

invent επινοώ, εφευρίσκω

principle αρχή, νόμος

piston έμβολο, πιστόνι

charge γόμωση, γέμισμα, φόρτιση, παροχή

fuel καύσιμη ύλη, (το) καύσιμο

cylinder κύλινδρος

mixture μίξι, ανάμιξη, μίγμα

mix αναμιγνύω, ανακατεύω

vaporize ατμοποιώ, εξατμίζω, εξαερώνω

gasoline/petrol βενζίνη

compress συμπιέζω

ignite αναφλέγω

burn καίω

expel εξωθώ, αποβάλλω

exhaust (pipe) σωλήνας εξαγωγής καυσαερίων, εξάτμιση

induction εισαγωγή

inlet εισάγω, εισαγωγή

valve βαλβίδα

crankshaft στροφαλοφόρος άξονας

manifold σωλήνας, αγωγός, συγκρότημα σωληνώσε-

ων εισαγωγής (inlet) ή εξαγωγής (exhaust) καυσίμων, συλλέκτης, πολλαπλή εισαγωγή

port στόμιο, δίοδος, οπή

inject εγχέω, εμβάλλω, ψεκάζω

bottom πυθμένας, κάτω άκρο/μέρος

camshaft εκκεντροφόρος άξονας, άτρακτος εκκέντρου, κνωδακοφόρος άτρακτος

chamber θάλαμος

heat θερμότητα

produce παράγω

top dead center σημείο τερματισμού διαδρομής εμβόλου

power stroke χρόνος καύσης/ εκτόνωσης κινητήρα

spark σπινθήρας

spark plug μπουζί, σπινθηριστής, αναφλεκτήρας

fit εφαρμόζω, προσαρμόζω

head κεφαλή, άνω μέρος

expansion διαστολή, εκτόνωση

gas αέριο

rotate περιστρέφω, περιστρέφομαι

rise υψώνω, υψώνομαι, σηκώνω, σηκώνομαι

restart ξαναρχίζω, ξεκινώ και πάλι

by force βίαια, αναγκαστικά

regularly κανονικά, τακτικά

repeat επαναλαμβάνω

press πιέζω

level επίπεδο

vapo(u)r ατμός

sequence διαδοχή, ακολουθία, (βάζω στη) σειρά
scientific επιστημονικός
permanent μόνιμος
manufacture κατασκευάζω, παράγω
current ισχύων, τωρινός
schedule πρόγραμμα, χρονοδιάγραμμα
progress πρόοδος, εξέλιξη

temporary προσωρινός
catalytic converter καταλυτικός μετατροπέας, καταλύτης
spare parts ανταλλακτικά (είδη)
design σχεδιάζω (επαγγ.), εκπονώ σχέδιο
stress φορτίο, πίεση, (έν)ταση
vibration κραδασμός, ταλάντωση, δόνηση

UNIT 8

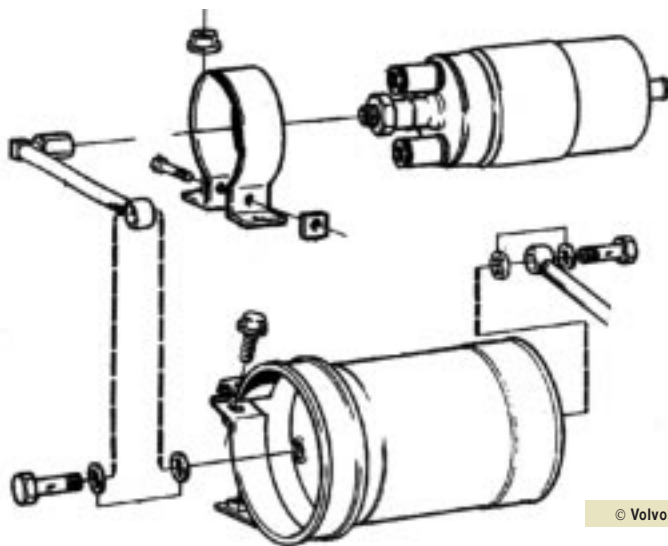
The basic components of the fuel distribution system

Learning objectives

Reading comprehension: Understanding processes, structures, descriptions of systems and their main components.

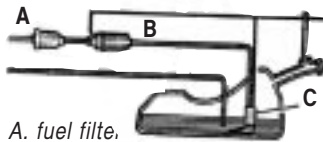
Vocabulary: Words related to the parts and operation of the fuel distribution system. Antonyms.

Use of English: Talking about predictions, events and their consequences. (1st conditional)



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Electronic Fuel Injection (EFI) systems control the precise injection of the quantity of fuel needed for the car engine requirements. For injection to occur, fuel must reach the injectors through a distribution system which consists of the following basic components:



A. fuel filter,
B. fuel pump (FP)
C. tank pump

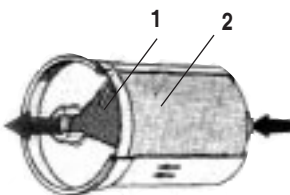
The fuel tank pump

It's an electrical impeller pump which maintains pressure in the line to the main fuel pump (FP) to counteract the negative pressure in the main pump's low side. The tank pump has a coarse strainer filter.

The fuel pump

It's an electrical roller pump which is cooled by the fuel running through it. It has a non-return valve and an overflow valve which opens if the pressure becomes too great.

Both the fuel tank pump and the fuel pump are connected and operate when the starter motor operates or when the engine is running. If the engine stalls and the ignition is on, the control module cuts the power to the pumps so as to minimise the risk of fire in the event of an accident.



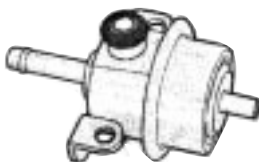
1. strainer
2. paper filter

The fuel filter

The fuel filter has a paper filter with an additional strainer to catch particles which could drop off the paper filter.

The fuel rail

The fuel inlet line, pressure regulator, injectors and cold start injector are connected to the fuel rail.

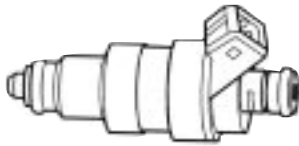


The pressure regulator

It controls the fuel pressure in the injector lines. A vacuum line connected to the engine intake manifold maintains the fuel pressure at a constant level. The pressure drop over the injectors is thus always

constant, irrespective of the throttle position (TP). The quantity of fuel injected is therefore only dependent on how long the injectors are open. Surplus fuel is returned to the fuel tank via a return pipe.

The injectors



These are fitted with a solenoid and a fuel metering needle which open and close a nozzle. The control module grounds the injectors via an auxiliary relay for a certain time so that the valves open injecting atomised fuel. In four-stroke and four-cylinder engines, injection occurs twice per revolution when the starter motor is operating (engine cold), and once per revolution when the engine is running. In most car models, injection takes place in the intake manifold near the intake valves.



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The cold start valve

When the engine is being started from cold, a great deal of fuel condenses into droplets on cold surfaces. A separate cold start valve improves cold starting characteristics. It is located further from the engine than the injectors and supplies fuel in a highly vaporised form instead of in droplet form.

1. Reading comprehension

Draw information from the text to complete the gaps in the following sentences.

1. The maintains pressure in the line to the main fuel pump.
2. The tank pump has a filter.
3. The is an electrical roller pump which is cooled by the fuel running through it.
4. The fuel pump has a valve and an valve which opens if the pressure becomes too great.

5. Both the fuel tank pump and the fuel pump are connected and operate when the operates or when the is running.
6. The control module cuts the power to the pumps if the engine and the
7. The fuel filter has a paper filter with and additional strainer to catch
8. The,, and cold start injector are connected to the fuel rail.
9. The pressure regulator controls the fuel
10. The quantity of fuel injected is dependent on how long the
11. The injectors are fitted with a solenoid and a fuel metering needle which
12. In four-stroke and four-cylinder engines, injection occurs twice per revolution when the, and once per revolution when the
13. Injection takes place in the near the intake valves.
14. The cold start valve supplies fuel in a instead of in droplet form.

2. Vocabulary practice

2A Match the words in list A with their definitions in list B.

- | A | B |
|---------------|--|
| a. main | 1. an apparatus used for holding back solid substances in a liquid passed through it |
| b. counteract | 2. most important |
| c. filter | 3. stop because of insufficient power or speed |
| d. stall | 4. act against and make another action, force etc less strong |
| e. particle | 5. very small bit |
| f. constant | 6. a space completely empty of substance or gas |
| g. atomised | 7. going on all the time |
| h. vacuum | 8. an act of revolving or going round |
| i. revolution | 9. reduced to fine particles |

2B

er/or suffixes are used to form nouns for things and especially for machines, apparatuses and devices. e.g. condenser**er**, converter**er** / convertor**or**

Complete the gaps at the end of each sentence to form the devices deriving from the following: *impel, distribute, inject, roll, start (motion), regulate, strain.*

1. A device in a multicylinder engine that distributes the igniting voltage to the spark plugs:
2. A device for transmitting motion, as in a centrifugal pump etc:
3. A cylindrical object (revolving on a fixed axis, esp one that facilitates the movement of sth passed over it or around it):
4. A device forcing / injecting (a fluid) into a passage, cavity etc:
5. A filter for straining liquids:
6. Any of the various devices designed to control / regulate the flow of liquids, gases or electrical current:
7. A device that starts an internal-combustion engine:

2C Match each word in column A with one in column B to form opposite meanings.

A

negative
low
coarse
cooled
start
operate
inlet
cold
surplus

B

smooth
outlet
positive
shortage
high
stall
heated
stop
hot

3. Use of English

Talking about predictions and showing the relationship between events and their consequences.

When the speaker sees that the event is a real possibility he must use the **1st conditional**. Conditional clauses usually start with the following **markers**: *if, provided (that), as long as, on condition that, unless, in case*. The conditional sentence consists of **a. the if clause** (if + Simple Present) and **b. the main clause** (Simple Present, Future or imperative)

Examples

- *If / as long as / in case the engine stalls and the ignition is on, the control module cuts the power to the pumps.*
- *Unless you replace the old fuel filter, the dirty particles will damage the fuel pump*
- *If / when(ever) you maintain the fuel injection system, remember that the fuel system is under pressure.*

NOTE

In some *if* sentences, like the third one in the above examples, *when(ever)* can be used instead of *if*.

Practice

Match each sentence in group A with one in group B and then join them using an appropriate conditional marker.

GROUP A

- You tighten the fuel line bolts to the fuel filter.
- Some fuel gets in you eyes while changing the fuel filter.
- You maintain the fuel system.
- The pressure becomes too great.
- There is a surplus of fuel.
- You use the suitable tools for fuel system maintenance.
- You ensure that there is sufficient clearance between the fuel filter, lines and any other parts.

GROUP B

1. Have a fire extinguisher within easy reach.
2. Use a torque wrench.
3. The overflow valve opens.
4. Flush them with plenty of clear water.
5. Don't install the new filter.
6. It returns to the fuel tank via the return pipe.
7. You will have the desired result.

4. Useful phrases**How do you say the following in English?**

1. καύσιμη ύλη πρέπει να φθάσει στους ψεκαστήρες μέσω ενός συστήματος διανομής που αποτελείται από:
2. για να εξουδετερώσει την υποπίεση
3. βαλβίδα ανεπιστροφής:
4. όταν η μηχανή λειτουργεί:
5. η μηχανή μπλοκάρει / σταματά:
6. περιορίζω (στο ελάχιστο) τον κίνδυνο φωτιάς:
7. διατηρεί την πίεση του καυσίμου:
8. εξαρτάται από την διάρκεια που είναι ανοιχτοί οι ψεκαστήρες:
9. το στοιχείο ελέγχου γειώνει τους ψεκαστήρες:
10. εκκίνηση με κρύο κινητήρα:
11. καύσιμο με λεπτό διαμελισμό:
12. σε μορφή σταγονιδίων:

Vocabulary – Terminology

component εξάρτημα
distribution διανομή
precise ακριβής
injection ψεκασμός
requirement απαίτηση
injector ψεκαστήρας
consist of αποτελούμαι από
tank ντεπόζιτο, δοχείο

pump, αντλία
impeller pump αντλία προώθησης (καυσίμου)
maintain διατηρώ
pressure πίεση
(in the) line (στη) γραμμή
main βασικός, κύριος
counteract εξουδετερώνω
negative αρνητικός

negative pressure υποπίεση
coarse τραχύς
strainer στραγγιστήρας, σουρωτήρι
strainer filter φίλτρο αποστράγγισης
roller κυλινδρικός, περιστροφικός
non-return valve βαλβίδα ανεπιστροφής
overflow valve βαλβίδα υπερχείλισης
connect συνδέω
operate λειτουργώ
starter (motor) μίζα, ηλεκτροκινητήρας εκκίνησης
run (of a liquid) ρέω
run (of an engine) λειτουργώ
stall μπλοκάρω, σβήνω, σταματώ (λειτουργία)
ignition ανάφλεξη
the ignition is on το κύκλωμα ανάφλεξης είναι κλειστό / λειτουργεί
control έλεγχος
module στοιχείο
cut the power διακόπτω την ισχύ
minimize ελαχιστοποιώ, περιορίζω, μειώνω στο ελάχιστο
risk κίνδυνος
additional πρόσθετος
particle σωματίδιο
drop off διαρρέω, διαρροή
fuel rail, γραμμή καυσίμου
inlet line γραμμή εισόδου
regulator ρυθμιστής
cold start εκκίνηση με κρύο κινητήρα
injector line σειρά ψεκαστήρων
vacuum κενό
vacuum line γραμμή υποπίεσης / κενού
intake manifold σωλήνας (πολλαπλής) εισαγωγής
constant σταθερός
level επίπεδο
pressure drop εφαρμογή πίεσης
irrespective of ανεξάρτητα από
throttle πεταλούδα (εισαγωγής αέρα)
position θέση
quantity ποσότητα
inject ψεκάζω
dependent εξαρτώμενος
surplus πλεόνασμα
via δια μέσου, μέσω
return pipe σωλήνας επιστροφής
fit with συναρμολογώ, συνταιριάζω, ενσωματώνω

solenoid (το) σωληνοειδές, σωληνοειδής
needle βελόνα
metering needle βελόνα μέτρησης / δοσολογίας
nozzle στόμιο
ground γειώνω
auxiliary βοηθητικός
relay ρελέ, αυτόματος διακόπτης
atomize διασπώ, διαμελίζω
atomized fuel καύσιμο διασπασμένο σε μικρά σωματίδια / λεπτή διασπορά
revolution περιστροφή
take place λαμβάνω χώρα, γίνονται
great deal of πολλούς, μεγάλη ποσότητα από
condense συμπυκνώνω
droplet σταγονίδιο
surface επιφάνεια
improve βελτιώνω, καλυτερεύω
characteristic χαρακτηριστικό
locate τοποθετώ
further πιο πέρα / μακριά
supply εφοδιάζω
vaporize ατμοποιώ
form μορφή
apparatus συσκευή
solid στερεός
liquid υγρός
insufficient ανεπαρκής
bit κομματάκι
substance ουσία
device επινόηση, μηχανήμα, συσκευή
spark plug μπουζί, αναφλεκτήρας, σπινθηριστής
transmit μεταδίδω
centrifugal φυγοκεντρικός
facilitate διευκολύνω
fluid ρευστό, υγρό
flow ροή, ρέω
current ρεύμα (ηλεκτρ.)
tighten σφίγγω, δένω
bolt μπουλόνι, κοχλίας
torque wrench κλειδί ρύθμισης ροπής
install εγκαθιστώ, μοντάρω
fire extinguisher πυροσβεστήρας
within easy reach πλησίον, πολύ κοντά, σε εύκολη πρόσβαση
clearance καθαρισμός

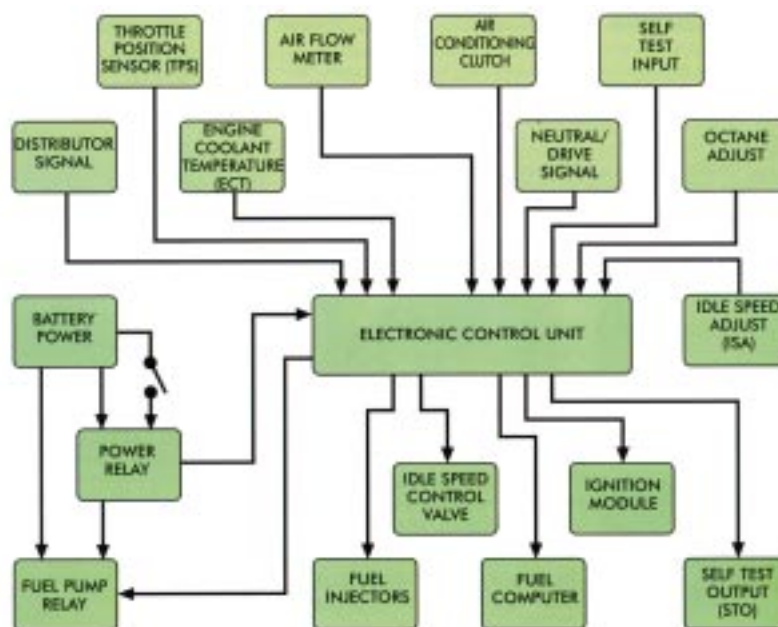
UNIT 9

The engine-management system

Learning objectives

Reading: Presenting the function and operations of the engines management system.

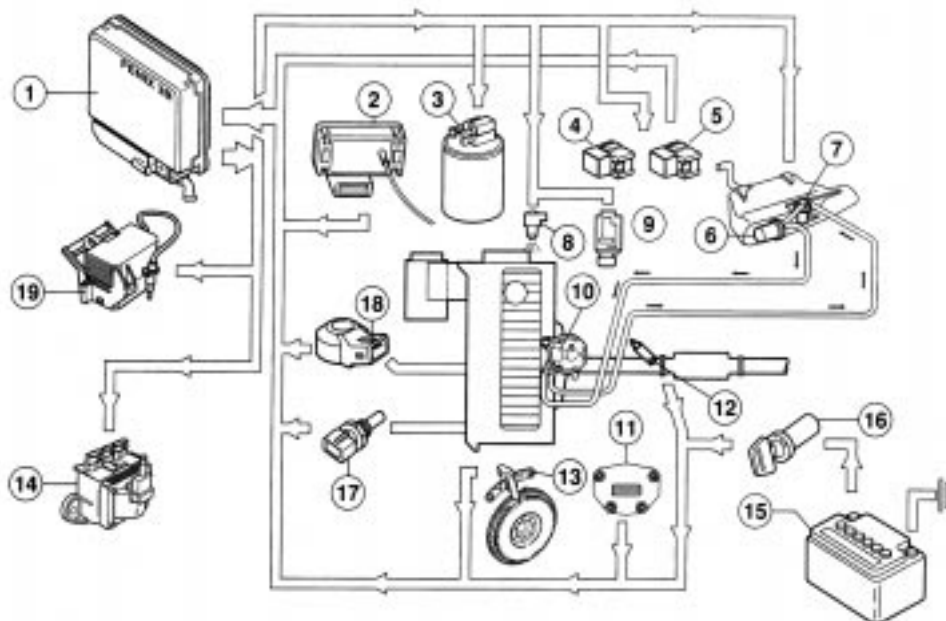
Vocabulary: related to the function, operations and components of the above system. Definitions, synonyms, word formation (prefixes, suffixes: un-, in-, -al, -a/-ible, -ic/-ical).



Typical layout of the engine-management system

Modern engines are equipped with an engine management system, also referred to as electronic control system or electronic control unit (ECU), which, in fact, is a microprocessor* that controls almost all the functions of the car. Some of the functions it controls are the amount of air that enters the cylinder, the amount of fuel injected in it, the correct time for producing the spark that ignites the fuel in the combustion chamber, the temperature and speed (rpm) of the engine, the flow of coolant, etc. To do this, the ECU is connected to various sensors fitted in different positions around the car to collect information about the performance of the engine and the operation of the different car systems, as well as to a number of secondary electronic control modules that control the operation of the engine and the various car systems and their components.

The sensors monitor the functions of the engine and the various car systems and send the collected information to the electronic control unit in the form of electrical signals.



- | | | |
|--|--|-------------------------------|
| 1 ECU | 7 Fuel pump | 13 Flywheel sensor |
| 2 Air pressure sensor | 8 Fuel injector with intake air temperature sensor | 14 Ignition unit |
| 3 Solenoid valve, charcoal absorption canister | 9 Idle speed regulating valve | 15 Battery |
| 4 System relay | 10 Fuel pressure regulator | 16 Ignition switch |
| 5 Main relay | 11 Throttle valve position sensor | 17 Coolant temperature sensor |
| 6 Fuel filter | 12 Oxygen sensor | 18 Knock sensor |
| | | 19 Diagnostic tester |

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* A microprocessor is a computer

As the conditions being monitored by the sensors change, the electrical signals they produce change, as well. The microprocessor refers to its memory, processes the information received and so, it “knows” exactly how the engine is running and the car systems operate. In this way, it is able to “decide” how much air or petrol the engine needs at a particular instant, what the appropriate injection and ignition timing is, whether the battery is low and the various pumps in the engine operate correctly, whether the lubrication, cooling or air-conditioning systems work properly, etc. Then, the ECU sends electrical signals to the electronic modules it is connected to giving them orders on what to do so as to ensure the best performance of the engine and the appropriate operation of the other systems.

The electronic control unit is adaptive, that is, it adapts its calculations to various values as it is “taught” by the manufacturer, depending on the technical features of the car it is fitted in.

Most control units have a special program, commonly known as self- or on-board-diagnostic system, which stores information of any malfunction and indicates which component in the engine is faulty.

A car fitted with an engine management system is characterized by better performance and fuel economy, releases fewer exhaust gases, needs less maintenance and is more reliable compared to a similar engine without it.

1. Reading comprehension

1A Say if the following sentences are true or false. Correct the false ones.

1. The electronic control unit is, in fact, a computer.
2. The ECU monitors only the functions of the engine. The other systems of the car are monitored by another control system.
3. The sensors are placed in the passenger compartment and send the information they collect to the ECU in the form of electrical signals.
4. The various values that are stored in the memory of the microprocessor and according to which the ECU controls the operation of the engine and the other car systems are the same for all cars.
5. The on-board diagnostic system identifies any malfunction and indicates which component has a problem.
6. Engines equipped with an engine management system have a better performance but they consume more fuel and need more maintenance.

1B Answer the questions.

1. What is the function of the sensors and the electronic control modules the ECU is connected to?
2. How does the ECU control the operation of the engine and the various car systems?
3. What does the sentence "the electronic control unit is adaptive" mean?
4. Mention some of the functions and operations controlled by the engine management system.
5. What is the self- or on-board-diagnostic system?

2. Vocabulary practice**2A Match words with definitions.****Verbs**

- | | |
|-------------|--|
| 1. refer | a) attach; put something somewhere carefully and securely |
| 2. indicate | b) change something to make it suitable for a new situation |
| 3. fit | c) show where something, e.g. a fault, is |
| 4. process | d) make a piece of equipment, system or process work in the way someone or something wants it to work |
| 5. control | e) look up at a source of information to find something out |
| 6. adapt | f) regularly check the development or progress of something and report about it |
| 7. monitor | g) carry out a series of calculations in order to achieve a particular result, e.g. to check if something works properly |

Nouns

- | | |
|----------------|---|
| 1. calculation | a) an instrument which reacts to certain physical conditions, i.e. heat, and is used to provide information |
| 2. malfunction | b) the ability of a car to work well, go fast and accelerate quickly |
| 3. sensor | c) the control and way a system, business, etc. are organised |
| 4. management | d) the process of working something out mathematically |
| 5. instant | e) failure of a machine to work properly |
| 6. performance | f) an extremely short period of time |

2B Fill in the gaps in the following sentences with the appropriate form of the words defined in the above exercise (2A).

1. Fortunately, the self-diagnostic system warned us about the in the oil pump immediately.

2. The ECU all the functions of the engine and its performance.
3. The manufactures the engine system to the requirements of the new model.
4. The red light on the left that the temperature of the engine is too high.
5. As soon as the ECU gets a signal from a, it to the values stored in its memory, the information received and determines what the engine needs at that specific
6. The technician who the new lock to the front door, made a rapid and told me the cost.

2C Arrange the words below to form groups of similar in meaning words.

modern - faulty - appropriate - particular - fitted - reliable - up to date - defective
 located - definite - recent - trustworthy - especial - imperfect - dependable
 proper - new - fixed - right - placed - specific - suitable - wrong

modern	faulty	appropriate
.....
.....
.....
particular	fitted	reliable
.....
.....
.....

2D Odd-one out

Cross out the word that has a different meaning to the rest in its group.

1 control govern prevent regulate	2 repair adjust adapt fit	3 calculate compute count determine
4 connect match join link	5 indicate show point out define	6 fix convert alter change

2E Word formation

a. The suffixes -able / -ible, -ive, -al and -ic / -ical

You can form adjectives by adding the above suffixes to verbs or nouns.

Examples: change → *changeable* exhaust → *exhaustible*
 indicate → *indicative* depress → *depressive*
 history → *historic - historical* influence → *influential*

Practice

Use the above suffixes to form adjectives out of the following words.

Verb or noun	Adjective	Verb or noun	Adjective
environment		adjust	
adapt		program	
economy		effect	
control		system	
remove		rely	
progress		depend	
inform		person	
energy		permit	
decide		expense	
combustion		market	
universe		character	
convert		act	

b. The prefixes un- and in-

The above prefixes are added to some adjectives, adverbs and nouns to form adjectives, adverbs and nouns that have the opposite meaning.

Examples: ability → *inability* active → *inactive*
 trustworthy → *untrustworthy* tidy → *untidy*

Don't forget



In- becomes il- before an l (e.g. *illegal*), ir- before an r (e.g. *irrelevant*) and im- before b, m, or p (e.g. *imbalanced*, *immeasurable*, *impassable*).

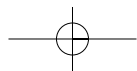
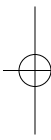
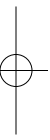
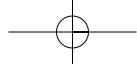
Practice

Form new words having the opposite meaning to the ones below.

practical →	fortunately →
comfortable →	valuable →
reliable →	important →
perfect →	logical →
appropriate →	possible →
pleasant →	safe →
responsible →	polite →
important →	controlled →
successfully →	regularly →

Vocabulary – Terminology

be equipped / fitted with είμαι εξοπλισμένος/ εφοδιασμένος με, έχω	injection έγχυση, ένεση
engine management system σύστημα ελέγχου κινητήρα	ignition ανάφλεξη
electronic control system ηλεκτρονικό σύστημα ελέγχου	timing χρονισμός
electronic control unit ηλεκτρονική μονάδα ελέγχου	whether αν
microprocessor μικροεπεξεργαστής	lubrication system σύστημα λίπανσης
function λειτουργία (μηχανής, συσκευής), λειτουργικός σκοπός	cooling system σύστημα ψύξης
amount ποσό, ποσότητα	air-conditioning system σύστημα κλιματισμού
inject εγχύω, κάνω ένεση	properly σωστά, καλά, όπως αρμόζει / πρέπει
ignite ανάβω, πυροδοτώ, αναφλέγω	order δίνω εντολή/διαταγή, διατάζω, παραγγέλλω, διαταγή, εντολή, παραγγελία, σειρά, τάξη
coolant ψυκτικό (π.χ. υγρό)	adaptive προσαρμοσίμος, ευπροσάρμοστος
sensor αισθητήρας	adapt προσαρμόζω
collect συλλέγω	calculation μέτρηση, υπολογισμός
performance απόδοση, αποδοτική/καλή λειτουργία (μηχανής)	value τιμή (Μαθ/κά), αξία, αξίζω, αξιολογώ
secondary δευτερεύων	feature χαρακτηριστικό (στοιχείο)
module μονάδα, στοιχείο	technical features τεχνικά χαρακτηριστικά / προδιαγραφές
electronic control module ηλεκτρονική μονάδα ελέγχου	on-board / self-diagnostic system σύστημα αυτοδιάγνωσης
monitor ελέγχω, μηχανισμός ελέγχου	store αποθηκεύω, αποθήκη
signal σήμα, κάνω σήμα, σηματοδοτώ	malfunction δυσλειτουργία, βλάβη
conditions συνθήκες	indicate δείχνω, υποδεικνύω
refer αναφέρομαι σε, παραπέμπω	faulty λανθασμένος, ελαττωματικός
memory μνήμη	release απελευθερώνω, αποδεσμεύω
process επεξεργάζομαι (π.χ. στοιχεία)	exhaust gases καυσαέρια
particular ειδικός, ιδιαίτερος, ξεχωριστός	maintenance συντήρηση (μηχανής, εγκατάστασης κλπ)
instant στιγμή	reliable αξιόπιστος
appropriate σωστός, κατάλληλος,	compared to συγκρινόμενος με
	similar (παρ)όμοιος



UNIT 10

The multi-point injection system

Learning objectives

Reading comprehension: Understanding and reproducing processes.

Vocabulary: Words related to the engine's operating conditions, the injection system and its components.

Language functions: Giving essential or extra information about sth.

Use of English: Talking about non-specific time events that took place in the past, happened recently, have a present result or are still in progress (Present Perfect Tenses).



Injector testing

1. Injector test pump
2. Precision pressure-gauge to 10 bar
3. Petrol-injector electronic tester

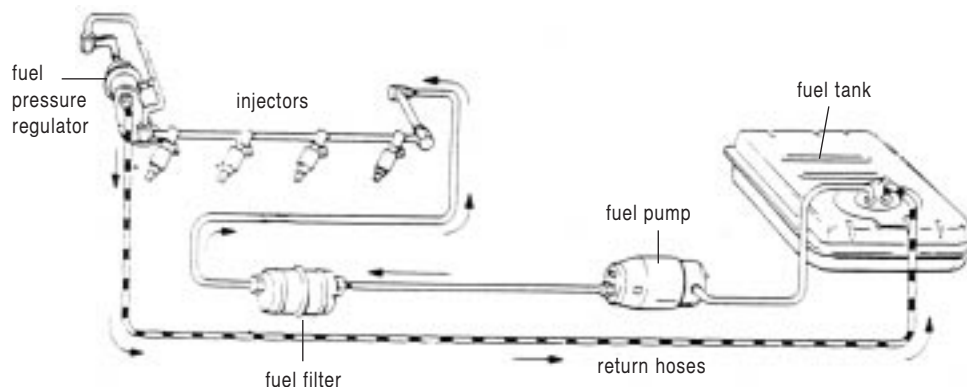
In an attempt to save fuel and reduce air pollution, manufactures have developed new fuel systems which can provide the engine with the exactly correct proportion of fuel/air mixture. This proportion varies according to the engine's operating conditions, such as the cold start, acceleration or idling. For example, a cold start needs a rich mixture, while a weak mixture is required when the engine is idle. This has led to the development of a fuel injection system with injectors, which forcibly spray the required quantity of fuel on the cylinder head.

The multi-point-injection system (MPI) is one of the injection systems which have nowadays taken the place of the carburettor. In this system, each cylinder has an injector. The fuel injection is carried out electronically, ensuring the precise timing of injection and the precise quantity of the injected fuel. All the electronic fuel injection systems (EFI) work on the same principle. There are only a few differences with regard to the cold start engine.

The MPI system is equipped with return hoses, because the fuel pump provides constant pressure (to the system) but, the quantity of fuel needed for combustion differs according to the engine's running conditions.

A computer controls the time in which the injectors' electromagnets receive the signal for fuel injection. Each electromagnet uses a needle which allows the injector's valve to let the fuel flow or to stop it flow.

A diaphragm (damper) located in the inlet pipe of air, which is a pivoted disk –also called *the throttle*– adjusts the mass of air needed for combustion. The required mass of air depends on the way each driver presses the accelerator pedal. It also adjusts the mass of air needed for cold start, eliminating mechanical problems. The angle of the damper, as well as the mass of the injected fuel are controlled by the central control unit of the car.



The MPI fuel flow in four-cylinder engines.

One of the most widespread and improved way of the fuel injection is the injection which takes place at the same time with the time of ignition. The fuel is injected when the intake valves open. In this way, a better air/fuel mixture is obtained and a better combustion is produced improving the efficiency of the engine.

1. Reading comprehension

1A Answer the following questions.

1. What can the newly developed fuel systems provide the car engine with?
2. Does the engine always need the same proportion of fuel / air mixture?
3. In the MPI system, does each cylinder have an injector?
4. In what way is the injection carried out? Why?
5. Why is the MPI system equipped with return hoses?
6. What's the device that controls the time in which the injectors' electromagnets receive the signal for fuel injection?
7. Which device adjusts the mass of air needed for combustion?
8. What does the required mass of air depend on?
9. By which device are the angle of the damper and the mass of the injected fuel controlled?

1B Multiple choice questions.

Choose the correct item to complete the sentences.

1. The cold start needs
 - a. a rich fuel/air mixture.
 - b. a weak fuel/air mixture.
 - c. sometimes a rich and sometimes a weak fuel/air mixture.
2. The carburettor has nowadays been substituted by
 - a. the fuel pump.
 - b. the fuel tank.
 - c. the multi-point injection system.
3. All the electronic fuel injection systems work on
 - a. different principles.
 - b. the same principle with only a few differences.
 - c. strictly the same principle.

4. Each injector's electromagnet uses a needle which allows the injector's valve
 - a. to let the fuel flow or to stop it flow.
 - b. to stop the fuel flow.
 - c. only to let the fuel flow.
5. The damper (diaphragm) adjusts the mass of air needed for cold start, eliminating
 - a. electronical problems.
 - b. mechanical problems.
 - c. electrical problems.
6. A better combustion is produced if the injection takes place at the same time with
 - a. the ignition.
 - b. the acceleration.
 - c. the pressure.

2. Vocabulary Practice

2A Look through the text and find the words meaning the following.

1. effort:
2. the relation of one thing to another in quantity:
3. amount; total; number:
4. a device forcing fluid into the cylinder:.....
5. exact; accurate; definite:
6. (a length of) rubber or plastic tube for conveying a liquid to a desired point:
.....
7. continuing without pause; not changing:
8. (for liquids) move along; circulate:
9. found, distributed over a wide area:
10. a device operated by the foot, for controlling the speed of a motor vehicle
engine:

2B Complete the gap at the end of each sentence (showing the driving situations) with the engine's operating conditions.

1. The driver wants to pass by another car, so he starts speeding up:
2. The driver is waiting for some people to cross the road while his car's engine is operating:
3. In cold winter mornings drivers turn the ignition switch and the engine starts operating:

2C Form pairs of antonyms by matching words from column A with words from column B.

A

reduce
correct
cold
rich (mixture)
differences
constant
receive
inlet
connected
better

B

weak (mixture)
hot
similarities
instant, instantaneous
increase
wrong
outlet
taken apart; disconnected
worse
send

3. Language functions

Giving extra or essential information about a noun / noun phrase which is the subject or object in the main clause.

- a. To provide extra / additional information you use **non-defining relative clauses** separated by commas in writing, and intonation in speaking.

- e.g.
- The M.P.I. system, *which has substituted the carburetor*, is carried out electronically.
 - Mr. Perkins, *who is our trainer*, will take us to the workshop tomorrow morning.
 - This is Mr Rex, *whose company supplies our valves*.
 - This car factory, *where your car was manufactured*, has been completely redeveloped.

- b. To provide essential information about the thing / person / place / time you refer to, you use **defining relative clauses** (with no commas).

- e.g.
- The mass of air *which / that is required by the engine* depends on the way *in which each driver presses the accelerator pedal*.
 - The car mechanic *who / that repairs the fuel pumps* has just left.
 - Manufacturers have developed new fuel systems *which/that can provide the engine with the exactly correct proportion of fuel/air mixture*.

- I know a good car service center *where they provide excellent service*.
- A computer controls the time *in which/when the injector's electromagnets receive the signal* for fuel injection.
- We are not interested in cars *whose spare parts/the spare parts of which are not available in our country*.

■ Practice ■

3A Complete the gaps with *who, whose, that, which, of which, in which, when, where*.

1. All the electronic fuel injection systems, control the fuel injection to match the car engine requirements, work on the same principle.
2. The fuel pump is the component of the EFI system / has a non-return valve and an overflow valve.
3. I'm afraid I can't inform you of the exact time / the repair of your car will be carried out.
4. The injectors, the valves are solenoid, are controlled by the electronic control unit.
5. Car mechanics specialization is in the maintenance and testing of the EFI system must take the necessary safety precautions.
6. The technician is in charge in our service center is working on that blue car.
7. Work areas / testing and maintenance of the EFI systems are performed must be adequately ventilated.
8. You must always check the expire date of the fire extinguisher you have placed in the work area.

3B Combine the pairs of sentences that follow to form defining or non-defining relative clauses, as in the example. Then, say which of them are defining and which are non-defining relative clauses.

Example

- Manufacturers have lately developed new fuel systems.
The fuel systems can provide the engine with the exactly correct proportion of fuel/air mixture.
- Manufacturers have lately developed new fuel systems *which / that* can provide the engine with the exactly correct proportion of fuel / air mixture.
(defining relative clause)

1. The fuel system includes injectors.
The injectors spray the required quantity of fuel on the cylinder head.
2. Each electromagnet uses a needle.
The needle allows the injector's valve to let the fuel flow or to stop it flow.
3. A diaphragm adjusts the mass of air needed for combustion.
The diaphragm is called "the throttle".
4. He is the car mechanic.
He changed the return hoses of my car, because the old ones were worn out.
5. The central control unit adjusts the angle of the damper and the mass of the injected fuel.
It also regulates all the car operations.
6. I think Mr Kralis is the suitable technician for this job.
His service center is near the bus station.
7. Car factories have their own authorized service centers.
You can trust you car's maintenance there.
8. This site has now become a car park.
The old car factory stood there.
9. You shouldn't buy these models.
Their spare parts are not easily found in the market.
10. The accelerator pedal controls the speed of a motor vehicle's engine.
It is operated by the driver's foot.

4. Use of English

Comparing the uses of the Simple Present Perfect and the Present Perfect Continuous

A. The Simple Present Perfect is used to describe events that: happened recently / took place at a non-specific time in the past / last up to the present or have a present result.

Examples

- **Manufactures have** lately **developed** new fuel systems.
- **He has / He's bought** a new car.
- **They have / They've manufactured** three new models since the beginning of the year.

NOTE

Typical time markers in the Simple Present Perfect uses are: *just, recently, lately, already, ever, never, this morning / week / month / year, so far, up to now, first / second time, for, since.*

Examples

- He has *just* finished his job.
- Have you *ever* ridden a motorbike?
- They haven't raised the car prices *this year*.
- *So far / up to now*, we have tested four new applications.
- He has worked in this department *since* 2001. (starting point)
- He has worked in this department *for* a year. (duration of time)

B. Present Perfect Continuous is used to describe events which last up to the present moment and are still in progress.

Examples

- **Joe has been repairing** the car for two hours. (He is still doing the repair.)
- But Joe has repaired** the car. (He has finished the repair.)
- How long **have you been developing** this product?
 - **We've been developing** it for two years.

Practice

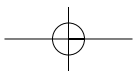
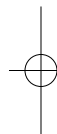
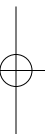
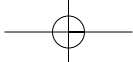
Write complete sentences in the present perfect simple or continuous, using the following prompts:

1. Be / too busy with his studies/this month.
2. You/ever be / a car factory?
3. Car sales / fall / since the beginning of the year. For this reason, you should wait for a sort time before buying a new car.
4. I / turn / ignition switch / the Off position / because I want to disconnect the ECU connectors.
5. How long / he try / install the fuel filter?
6. He / just connect / fuel return hose / the fuel pressure regulator.
7. I / just hear / strange change / the operating sound of the injector.
8. I / already remove / fuel pressure regulator. / What must I do now?

9. The EFI system / reduce emissions / increase driveability.
10. I / never open / ECU cover.
11. He / not smoke / for two hours / as he maintain / fuel injection system of that car.
12. It's the first time / he use this tool / and, he says, / find it very useful.

Vocabulary – Terminology

pressure-gauge μετρητής πίεσης	pump αντλία
bar μπαρ (μονάδα πίεσης)	constant σταθερός
attempt προσπάθεια	pressure πίεση
save εξοικονομώ	combustion καύση
reduce μειώνω, ελαττώνω	running conditions συνθήκες κίνησης / λειτουργίας (μηχανής)
develop αναπτύσσω	electromagnet ηλεκτρομαγνήτης
provide (sb / sth) with (sth) παρέχω (σε)	receive παίρνω, λαμβάνω
proportion αναλογία	signal σήμα
vary ποικίλω	needle βελόνα
operate λειτουργώ	valve βαλβίδα
operating conditions συνθήκες λειτουργίας (μηχανής)	flow ρέω
cold start εκκίνηση με κρύο κινητήρα	diaphragm διάφραγμα
acceleration επιτάχυνση	damper διάφραγμα, ντάμπερ
idle / idling λειτουργία χωρίς φορτίο, ρελαντί, λειτουργώ στο ρελαντί / στη «νεκρά»	inlet pipe σωλήνας εισαγωγής
rich πλούσιος, «δυνατός»	pivoted (περι)στρεφόμενος (γύρω από άξονα)
weak αδύνατος, ασθενής	disk δίσκος
development εξέλιξη, ανάπτυξη	throttle πεταλούδα
injection ψεκασμός	adjust ρυθμίζω
injector ψεκαστήρας	mass μάζα
forcibly υπό / με πίεση	accelerator (pedal) πετάλι γκαζιού / επιτάχυνσης
spray ψεκάζω	eliminate περιορίζω, εξαλείφω
require απαιτώ, ζητώ	angle γωνία
quantity ποσότητα	central control unit κεντρική μονάδα ελέγχου
cylinder head κεφαλή του κυλίνδρου	widespread διαδεδομένος, εξαπλωμένος
multi-point injection system σύστημα ψεκασμού πολλαπλών σημείων	improve βελτιώνω
ensure εξασφαλίζω	ignition ανάφλεξη
precise ακριβής	obtain εξασφαλίζω
timing χρονισμός	intake valve βαλβίδα εισαγωγής
return hose (ελαστικός) σωλήνας επιστροφής	produce παράγω
	efficiency αποδοτικότητα, ικανότητα



UNIT

11

The ignition system

Learning objectives

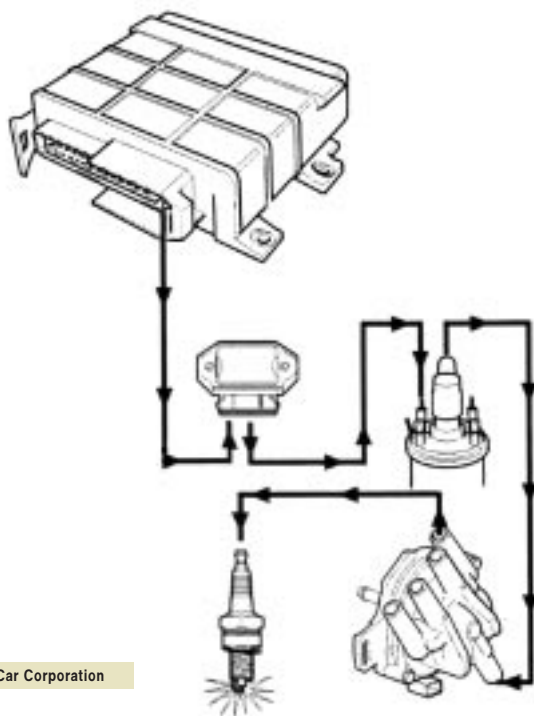
Reading comprehension: Presenting the structure and function of the ignition system on conventional and modern cars.

Vocabulary: Related to the components and function of the older and modern ignition system. Synonyms, antonyms, definitions, word formation.

Language functions: Expressing purpose.

Listening: How the spark is produced (completing missing terms in a picture and information in a text; answering questions as follow up).

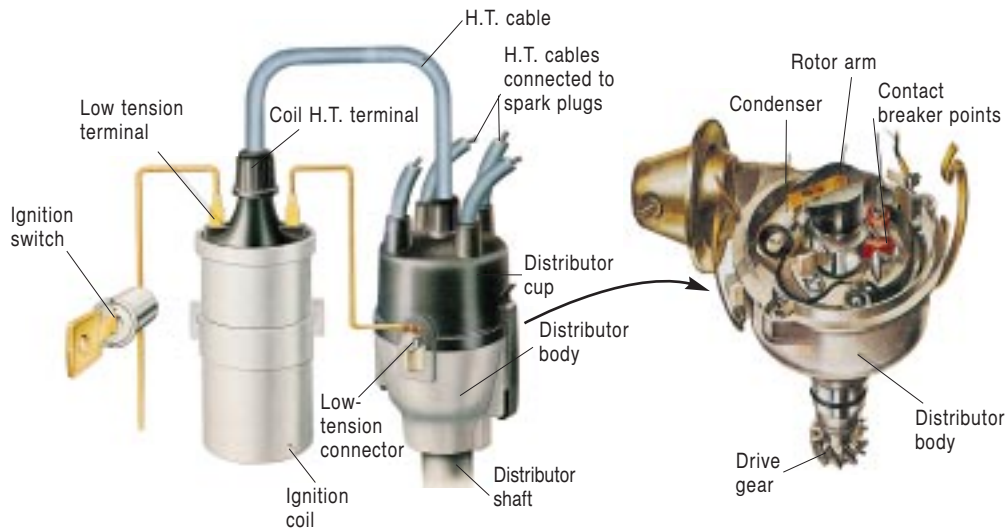
Writing: Definitions; translation.



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The ignition system belongs to the engine's electrical equipment. Its function is to provide the high voltage sparks that ignite the fuel/air mixture in petrol engines.

A. The ignition system on older cars



The parts of the old ignition system

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On older cars that are not equipped with an electronic control unit, the ignition system consists of the ignition coil, the distributor, the high tension (HT) cables and the spark plugs. Its operation is controlled mechanically by the rotating camshaft and is very complicated.

The distributor consists of the rotor arm and the contact breaker. The rotor arm is a shaft that rotates in the centre of the distributor body driven by the camshaft. The contact breaker is an on/off switch fitted inside the distributor cap. As the rotor arm turns, it opens and closes the contact breaker points and also distributes electric current to the spark plugs.

The ignition coil is a step up transformer that converts the low-tension (12 V) current produced by the car's battery to the high-tension current required to produce the electric sparks. The conversion of the low to a very high-voltage current is achieved with the help of the contact breaker that produces pulses of electric current by interrupting the circuit when its contacts are opened by the distributor arm.

The high-tension current, which has been produced in the ignition coil, is sent to the distributor rotor arm through an HT cable, also referred to as HT lead. The HT cable has a thick plastic insulation to prevent a voltage leakage in the engine. The rotating rotor arm distributes the HT current to the spark plugs in the correct firing order. The current flows to the spark plugs through insulated HT cables that are connected to them. The spark plugs convert the HT current into sparks that ignite the fuel/air mixture in the combustion chamber.

B. The modern ignition system

Modern cars are equipped with a full engine-management system. On these cars, the functions of the ignition system are controlled by the electronic control unit (ECU) internally. The various sensors, the ECU is connected to, provide it with information about the engine's speed and temperature, the position of the crankshaft, the throttle opening, the temperature of the engine's coolant and lubrication oil, etc. From these variables, the ECU controls the amount of fuel injected and the injection timing, as well as the ignition advance as required.

The function of the ignition system on modern cars remains the same as in the past, but first the distributor and then the ignition coil have been replaced by electronic modules that perform the functions of the old mechanical components.

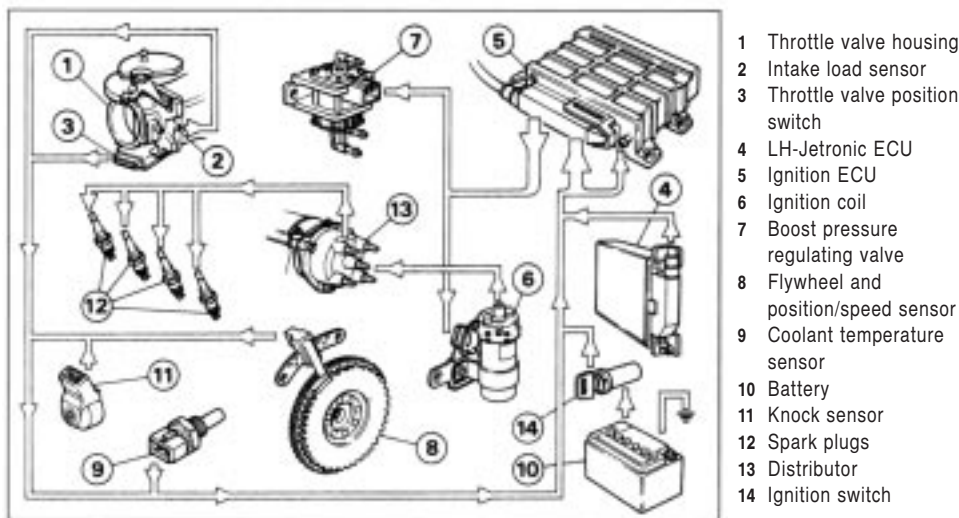


Diagram of a typical ignition system

© Volvo Car Corporation

The latest development in the ignition system is that, instead of the single ignition coil or the single electronic ignition module that supplied the HT current to all the spark plugs, each spark plug is now fitted with its own electronic ignition discharge module. This module, controlled by the ECU, supplies the spark plug, it is dedicated to, with the HT voltage required* to produce the spark in the appropriate firing order and at the correct timing.

The control unit controls the ignition voltage so that it is independent of the battery voltage and the engine speed. At low battery voltage, for instance, the control unit sends a signal to the ignition discharge module (of the spark plug that is going to produce a spark) to start charging earlier; that is, it extends the charging time. When the engine is idling, its temperature is very low or it is over-revving, the ECU adjusts the basic ignition time so as to provide for optimum combustion and operation. For example, if one cylinder begins to knock, the ignition is retarded for that cylinder until the knock stops; and if the engine is overloaded for a long period, the ignition will often be retarded on all cylinders to prevent knocking,

1. Reading comprehension

Answer the questions.

1. What is the main difference between the old and the modern ignition system?
2. Which are the parts of the ignition system in older cars not equipped with full engine-management system?
3. Do modern cars have an ignition coil?
4. What is the function of the ignition coil and the electronic ignition discharge modules?
5. What does the term "ignition advance" mean?
6. How are the ignition timing and the firing order controlled on modern cars? Give examples.
7. What is the tension of the current that is produced by the ignition discharge module?
8. Why does the HT lead have a thick plastic insulation?

* The voltage required to produce the spark that ignites the fuel in the combustion chamber is 20,000-30,000 V.

Nouns

- | | |
|------------------|--|
| | a) a complete route around which the electric current can flow |
| | b) the best level, state or function that something could achieve |
| 1. insulation | c) a temporary increase in the voltage of electric current |
| 2. switch | d) an electrical device that either makes or breaks an electric circuit |
| 3. voltage pulse | e) a material that doesn't permit electric current to flow through it. Such materials are plastic, rubber or porcelain and are used to coat or wrap cables |
| 4. optimum | |
| 5. circuit | |

2C Write the English equivalent to the following Greek terms.

1. διακόπτης κυκλώματος ανάφλεξης μπουτόν εκκίνησης:
2. χρονισμός ανάφλεξης:
3. μετασχηματιστής ανόδου τάσεως:
4. διακόπτης (επαφής) πλατινών:
5. διακόπτης ανάμματος/σβησίματος ηλεκτρικής συσκευής:
6. ρεύμα χαμηλής τάσης:
7. ηλεκτρονικό στοιχείο ανάφλεξης:
8. σειρά, ρύθμιση ανάφλεξης:
9. προπορεία ανάφλεξης:
10. εκτόνωση (ηλεκτρικού φορτίου):
11. ο κινητήρας λειτουργεί με περισσότερες στροφές (από το κανονικό) / υπερ-επιταχύνει:
12. ο κινητήρας λειτουργεί με υπέρβαση φορτίου / έχει υπερφορτιστεί:
.....
13. ο κινητήρας λειτουργεί χωρίς φορτίο (στο ρελαντί):
14. προανάφλεξη (χτύπημα / η μηχανή χτυπάει πειράκια):
15. άνοιγμα δικλείδας αερίων / πεταλούδας:

2D Match words from the two columns in each group to make pairs of synonyms and antonyms.

A. Synonyms

provide	right; appropriate
rotate	element; part
convert	need; demand
produce	give; supply
require	break; stop
achieve	turn; spin
interrupt	function
correct	change
component	fulfil; succeed
operation	generate

B. Antonyms

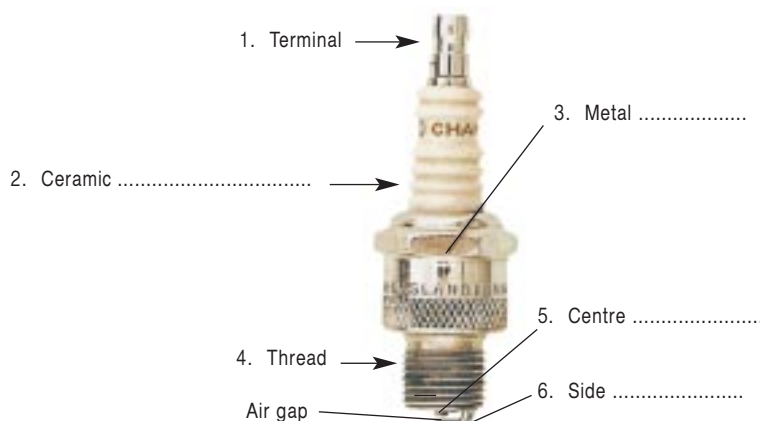
high	advance
complicated	independent
charge	thin
thick	shorten
internally	low
extend	accelerate; rev
retard	simple
dependent	stop
slow down	externally
begin	discharge

3. Listening Activity

The spark plug is the only component in the ignition system, the structure and function of which, remain unchanged. It is important to follow the car manufacturer's instructions and fit the correct spark plugs for each car according to the make, model, size, year of production, etc. If the wrong spark plugs are fitted, the engine may not work properly and this may cause a serious damage.

As the appearance of the spark plugs may warn us about a problem in the engine and prevent a damage, they should be checked regularly.

Familiarize yourself with the picture of the spark plug below.



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STEP 1

Your teacher is going to present the parts and function of the spark plug. Listen to him/her to familiarize yourself with the information provided.

STEP 2

The terms for some parts of the spark plug illustrated in the picture on p.137 are incomplete. Listen to the description of the spark plug and its function again and complete them.

Follow up**1. Answer the questions.**

1. What is the function of the ceramic insulator?
2. Is the spark itself that ignites the fuel or the heat produced by it?
3. What is the function of the metal casing that is fitted around the lower part of the spark plug?
4. What is the route of the HT current that produces the spark?

2. Complete the sentence.

The spark is produced when the (1) flowing down the (2) that passes through the centre of the (3), jumps across the small (4) to the tip of the (5).

4. Language functions**Expressing purpose**

In the table below you can see the patterns most commonly used to express purpose.

To / In order (not) to + infinitive, ... (sentence)

(Sentence) ... to / in order (not) to + infinitive

(Sentence) ... so as (not) to + infinitive

Sentence in Present or Future tense in order / so (that) + $\begin{cases} \text{sentence in S. Present} \\ \text{subject + can / will + inf.} \end{cases}$

Sentence in Past tense in order / so (that) + should / could / would / might + inf.

Examples

- The tappets are used **to keep** the valves in contact with the camshaft.
- **(In order) to reduce** fuel consumption, you should change your driving style.
- The ECU controls the ignition voltage **so that it is** independent of battery charge.
- I'll start the repair first thing tomorrow morning, **so as to have** enough time to finish before noon.
- I gave him the address **so that he could write** to the Personnel Manager.
- He left early **so that he wouldn't arrive** late for the interview.
- I'm going to get up at 6:30 **so that I don't / won't miss** the 7:15 train to work.

Practice

Use patterns from the table to form sentences as in the examples above out of the phrases below.

1. Avoid a damage in the engine — check the oil level regularly
2. Save money for the computer you want to buy — make some minor repairs yourself
3. Pass the final examinations — study harder
4. He drove smoothly — reduce fuel consumption
5. Be at work on time — wake up earlier in the morning
6. Prevent an explosion — it is not allowed to smoke in petrol stations
7. Reduce harmful gas emissions — manufacturers fitted the cars with emission control systems
8. The ECU processes the information received from the sensors — control the injection and ignition timing correctly
9. Replace the valve easily — I need a valve spring compressor
10. He ordered the spare part he needs by e-mail — he gets it the soonest possible
11. As the engine was overloaded, the ECU retarded the ignition on all cylinders — prevent knocking

5. Writing activity

5A Translate the following Greek sentences into English.

1. Το ρεύμα υψηλής τάσης που δημιουργεί η ηλεκτρονική μονάδα ανάφλεξης κατευθύνεται στο μπουζί μέσω ενός καλώδιου με χοντρή πλαστική μόνωση.
2. Κάθε ηλεκτρική συσκευή έχει έναν διακόπτη.
3. Όταν ο οδηγός πατάει το πεντάλι του γκαζιού, η ταχύτητα του κινητήρα αυξάνεται.

4. Μερικές φορές όταν ο κινητήρας είναι υπερπληρωμένος από καύσιμο / υπερφορτίζεται, ένας από τους κυλίνδρους μπορεί να κάνει προανάφλεξη.
5. Αν η τάση του ρεύματος της μπαταρίας είναι χαμηλή, χρειάζεται φόρτιση το συντομότερο δυνατό.
6. Όταν η μηχανή του αυτοκινήτου δουλεύει κάτω από σταθερές συνθήκες φορτίου ή στο ρελαντί, δεν χρειάζεται τόσο πλούσιο μίγμα βενζίνης/αέρα όσο για μια κρύα εκκίνηση ή όταν επιταχύνει.
7. Το άνοιγμα της πεταλούδας μεταβάλλεται ανάλογα με τις συνθήκες λειτουργίας του κινητήρα.
8. Η κεντρική ηλεκτρονική μονάδα συγκεντρώνει πληροφορίες για τη λειτουργία του κινητήρα από τους αισθητήρες με τους οποίους είναι συνδεδεμένη. Από αυτές τις μεταβλητές τιμές, «γνωρίζει» τις ανάγκες του κινητήρα και ρυθμίζει τις λειτουργίες του συστήματος έγχυσης καυσίμου και το χρονισμό της ανάφλεξης.

5B Choose three of the following items and write a brief, but complete definition for each one of them.

The ignition system

.....

The distributor

.....

The contact breaker

.....

The ignition coil

.....

The ignition discharge module

.....

.....

.....

The spark plug is a device

.....

.....

.....

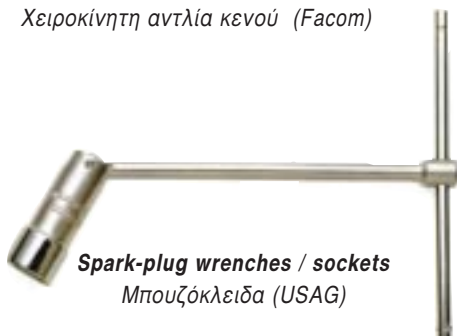
Useful tools



Manual vacuum / pressure pump
Χειροκίνητη αντλία κενού (Facom)



Compression tester
Εργαλείο ελέγχου πίεσης κυλίνδρων (Facom)



Spark-plug wrenches / sockets
Μπουζόκλειδα (USAG)



Digital stroboscopic timing light (Facom)
Ηλεκτρονικό πιστόλι



(Facom)



Flexible spark-plug lifter (Facom)
Σπαστή προέκταση τοποθέτησης μπουζί

Vocabulary – Terminology

ignition system σύστημα ανάφλεξης

ignition coil πηνίο ανάφλεξης

distributor διανομέας, ντιστριμπιτέρ

voltage / tension τάση (ηλ. ρεύματος)

cable καλώδιο

high-tension cable καλώδιο (υψηλής τάσης)

rotor arm ράουλο διανομέα

contact breaker διακόπτης (επαφής) πλατινών

shaft άξονας

on/off switch διακόπτης (ανάμματος/σβυσίματος ηλ. συσκευής)

contact breaker points σημεία (επαφής) πλατινών

(electric) current (ηλεκτρικό) ρεύμα

low-tension current ρεύμα χαμηλής τάσης

pulse παλμός

step-up transformer μετασχηματιστής ανόδου τάσεως

interrupt διακόπτω

circuit κύκλωμα

(HT) lead καλώδιο (υψηλής τάσης)

insulation μόνωση

prevent (παρ)εμποδίζω, αποτρέπω

leakage διαρροή

voltage leakage διαρροή ηλεκτρικού ρεύματος

distribute διανέμω, (δια)μοιράζω

insulated μονωμένος

convert μετατρέπω, μεταστρέφω, αλλάζω

internally εσωτερικά

variable μεταβλητός

ignition advance προπορεία ανάφλεξης

remain παραμένω, απομένω, εξακολουθώ, επιβιώνω

replace αντικαθιστώ, ξανατοποθετώ

(electronic) ignition discharge module ηλεκτρονικό στοιχείο / μονάδα ανάφλεξης

discharge εκκενώνω, αδειάζω, εκτονώνω, εκτόνωση ηλεκτρικού φορτίου

supply προμηθεύω, εφοδιάζω, τροφοδοτώ, παρέχω

dedicated αποκλειστικός, έχει διατεθεί αποκλειστικά, αφιερωμένος

firing order σειρά / ρύθμιση ανάφλεξης

timing χρονισμός

independent ανεξάρτητος

charge φορτίζω, χρεώνω, φόρτιση, χρέωση, επίθεση

extend παρατείνω, επεκτείνω, έκταση

idling (ο κινητήρας) λειτουργεί χωρίς φορτίο / στο ρελαντί

over- revving (ο κινητήρας) λειτουργεί με περισσότερες στροφές από το κανονικό, υπερεπιταχύνει

adjust ρυθμίζω, τροποποιώ, προσαρμόζω

provide παρέχω

optimum ο καλλίτερος, ο άριστος

retard καθυστερώ

overloaded ο κινητήρας λειτουργεί με υπέρβαση φορτίου / έχει υπερφορτιστεί

knocking προανάφλεξη, χτύπημα, η μηχανή χτυπάει πειράκια

throttle δικλείδα αερίων / πεταλούδα

capacitor πυκνωτής

earth γείωση

winding περιέλιξη

live terminal ακροδέκτης θετικού πόλου

ignition switch διακόπτης κυκλώματος ανάφλεξης, μπουτόν εκκίνησης

core πυρήνας

insulator μονωτής

make (of a car) μάρκα (για αυτοκίνητα)

size (of a car) κυβισμός (για αυτοκίνητα), μέγεθος

damage ζημιά, βλάβη, καταστρέφω, προξενώ ζημιά

appearance εμφάνιση

casing κάλυμμα, περιβλήμα

centre electrode κεντρικό ηλεκτρόδιο

side electrode πλευρικό ηλεκτρόδιο

leak διαρρέω, διαρροή

thread σπείρωμα

screw βίδα, βιδώνω

tip άκρη

spare part ανταλλακτικό

appliance συσκευή (ηλεκτρική)

accelerator pedal το πετάλι του γκαζιού

steady-load conditions σταθερές συνθήκες φορτίου

UNIT 12

Air pollution and the catalytic converter

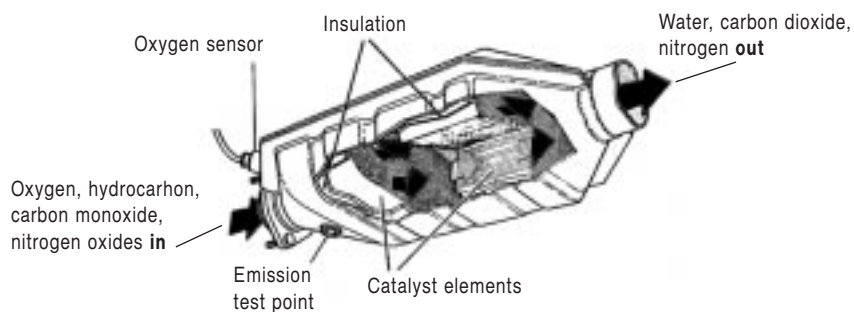
Learning objectives

Reading comprehension: Understanding texts related to pollution, chemicals, facts, functions, solutions to problems.

Vocabulary: Words related to pollution, the catalytic converter and relevant components.

Language functions: Expressing purpose, cause and effect.

Use of English: Formation of adjectives.



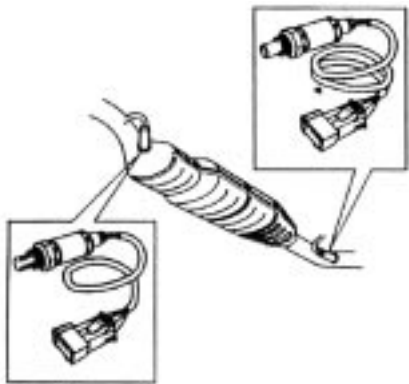
Warm up

Check your knowledge by choosing the correct alternative. Then check your answers with the help of your teacher.

1. The problem of pollution arises from
 - a. cars which emit exhaust fumes.
 - b. factories which emit smoke.
 - c. both cars and factories.
2. Carbon monoxide, which interferes with the ability of blood cells to carry oxygen, is emitted in the air by
 - a. old, damaged conventional cars.
 - b. catalytic converters.
 - c. bicycles.
3. An anti-pollutant device is the
 - a. mass air flow (MAF) sensor.
 - b. three-way catalytic converter (TWC).
 - c. cooling system.
4. The catalytic converter eliminates the emission of poisonous smog in a proportion of
 - a. 20-30%.
 - b. 50-55%.
 - c. 90-95%.
5. Lead-free-petrol is used for the operation of
 - a. steam engines.
 - b. catalytic cars.
 - c. diesel-engine cars.
6. The catalytic converter's service life is usually indicated as a minimum of
 - a. 15,000-20,000 km.
 - b. 30,000-35,000 km.
 - c. 75,000-80,000 km.
7. The elements contained in the catalytic converter, known as **catalyst**, are
 - a. platinum/palladium/rhodium.
 - b. steel/wrought iron/pig iron.
 - c. aluminium / alumina/aluminosilicate.



The three-way catalytic converter.



The TWC converter and the upstream and downstream heated oxygen sensors.



Heated oxygen sensor (HO2S), also called lambda (λ) sensor.

© Volvo Car Corporation

A major problem, which threatens our environment, and especially cities and towns, is the problem of air pollution caused by the exhaust fumes emitted by cars. These fumes contain large quantities of pollutants – such as hydrocarbons (HC), carbon monoxides (CO) and oxides of nitrogen (NOX) – which are caused by fuels not completely burned, and lead to poisonous smog.

One of the solutions to the pollution problem is the establishment of the catalytic converter, which is an antipollutant device. It is inserted into the exhaust system, between the exhaust manifold and the muffler. It ensures continuous burning of the exhaust gases in the following way: As the hot gases pass through the converter, they come into contact with the catalyst. The catalyst causes a rapid rise in the temperature of the exhaust gases converting the harmful substances (contained in the exhaust gases) to non-toxic ones.

The three-way catalytic converter (TWC) is a catalytic converter of the three-way type which stores oxygen found in the exhaust gases and uses it to make toxic gases more environmentally friendly. It is used to purify the exhaust gases of unburned residues by:

- oxidizing unburned hydrocarbons (HC) to water vapour (H₂O) and carbon dioxide (CO₂)
- oxidizing carbon monoxide (CO) to carbon dioxide (CO₂)
- reducing nitrogen oxides (NOX) to nitrogen gas (N₂).

As the TWC becomes older, its ability to store oxygen drops. This reduces its conversion capacity. To avoid dangerous emissions, the contemporary TWC has been manufactured to be diagnostic by the establishment of the engine control module (ECM), which checks the efficiency of the TWC. The check is carried out by the heated oxygen sensor (HO2S). Many TWCs have two heated oxygen sensors; one upstream and one downstream of the

TWC. The main function of the HO₂S is to measure the content of oxygen in the exhaust gases and to ensure that this content is normal. If the TWC is to work properly the HO₂S must be producing the correct signal showing that the ideal air/fuel mixture is achieved and all the fuel is burnt before released in the exhaust gases. If this is not done, the TWC will be damaged by the excessive temperatures generated.

If there is any trace of lead in the fuel, it will damage the catalytic converter beyond repair. To prevent accidental use of leaded petrol, the fuel tank of the car is equipped with a restrictor. In addition, all unleaded fuel pumps have a special small-size nozzle that ensures only the passing of unleaded fuel through the restrictor.

1. Reading comprehension

1A Answer the following questions.

1. Which pollutants lead to poisonous smog?
2. What are these pollutants caused by?
3. Is the catalytic converter a solution to the problem of pollution? Why?
4. Where is the catalytic converter located?
5. Describe the procedure in which the catalytic converter ensures continuous burning and conversion of the fumes' harmful substances into non-toxic ones.
6. Why does the TWC store oxygen in the exhaust gases?
7. Does the TWC's ability to store oxygen remain the same as it becomes older?
8. Which device checks the efficiency of contemporary TWCs?
9. What is the main function of the heated oxygen sensors (HO₂S)?
10. Which are the two devices that prevent accidental use of leaded petrol in catalytic cars?

1B Based on the text complete the following sentences.

1. The TWC purifies the exhaust gases by oxidizing unburned hydrocarbons to and
2. It also purifies the exhaust gases by oxidizing carbon monoxide to and by reducing to nitrogen gas.
3. TWCs which have two heated oxygen sensors, have one sensor and one of the TWC.
4. Any trace of in the will damage the catalytic converter.
5. The small-size nozzle of the fuel ensures only the passing of fuel through the restrictor to the car fuel tank.

2. Vocabulary practice

2A Match the items in list (A) with their synonymous meaning in list (B) which you can find in the text.

A	B
a. amount, number	1. major
b. particular kind of matter	2. quantity
c. causing damage/harm	3. smog
d. more important than others	4. inserted
e. keeps supplies of sth	5. harmful
f. fog with smoke and exhaust fumes	6. substance
g. placed/fitted in or between	7. stores
h. ability/power	8. residue
i. the amount of a substance contained in sth	9. capacity
j. let go/set free	10. content
k. mark/sign to show sth is existed	11. release
l. what is left after treatment	12. trace

2B Complete each gap of the sentences below using one to the following words:
leads to, pollutants, signal, purified, equip, pump.

- make the environment dirty and dangerous to live in.
- The use of leaded fuel the damage of the catalytic converter.
- This alcohol has been specially for use in medicine.
- A red lamp going on and off is usually a of danger.
- The fuel is a device with a tube and a handle for forcing fuel in the car tanks.
- He has spent money and time to his workshop.

3. Language functions

3A Expressing purpose.

In the following sentences there are some of the most common ways to express purpose.

- The TWC is used **(in order) to** purify the exhaust gases of unburned residues.
- The TWC is used **so as to** purify the exhaust gases of unburned residues.
- The HO2S must produce the correct signal **so that/in order that** all the fuel is burned / will be burned before it is released in the exhaust gases.

Practice

Complete the following dialogue.

A: Why does the catalytic converter use the oxygen found in the exhaust gases?

B:

A: Why has the contemporary TWC been diagnostic?

B:

A: What's the main function of the HO2S?

B:

A: Why does the HO2S measure the oxygen content in the exhaust gases?

B:

A: Why are the fuel tanks of the cars equipped with restristors?

B:

A necessary equipment for exhaust fumes measurements



Gasoline and Diesel analysis and inspection station.

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3B Expressing cause and effect.

Commonly used verbs or phrases linking the cause to the effect are: *lead to, result in, be responsible for, because of, since, as, due to.*

Examples

- Pollutants caused by fuels not completely burnt **lead to/result in** poisonous smog.
- Pollutants caused by not completely burnt fuels are **responsible for** the poisonous smog.
- **Because of/due to** the pollutants, the atmosphere is not clean.
- **Since/as** exhaust fumes are emitted by cars, the air is polluted.

Practice

Using the above mentioned verbs and phrases (linking the cause to the effect), express the relationship between the following causes and effects.

Cause	Effect
1. air pollution	→ various diseases
2. the use of leaded petrol	→ the catalytic converters' damage
3. the catalytic converter becomes older	→ its ability to store oxygen drops
4. excessive temperature	→ his car's TCW was destroyed

4. Use of English

Formation of adjectives.

Most adjectives are formed either from nouns or from verbs by adding the suffixes: **al, ic, ive, ful, less, ous, ory, able/ible, y** (and in few cases **ly**)
eg. professional, scientific, expansive, careful, careless, marvelous, explanatory, adjustable, comprehensible, cloudy, lovely

Practice

Add the proper suffix to form adjectives deriving from the following words.

environment	fog
poison	diagnosis
continue	accident
harm	convert
catalyst	correct
friend	market

Vocabulary – Terminology

insulation μόνωση

pollution μόλυνση (ατμόσφαιρας, υδάτων κ.λπ.)

catalytic converter καταλυτικός μετατροπέας

major μείζονος σημασίας, σημαντικότερος, πρωτεύων

threaten απειλώ

cause προκαλώ

exhaust fumes καυσαέρια

emit εκπέμπω, αναδίδω

contain (εμ) περιέχω

quantity ποσότητα

pollutant παράγοντας μόλυνσης, ρυπαντής

hydrocarbon υδρογονάνθρακας

fuel καύσιμο

completely απόλυτα, εντελώς

burn (burned/burnt, burned/burnt) καίω	conversion μετατροπή
lead to καταλήγω σε, έχω σαν αποτέλεσμα	capacity ικανότητα, ισχύς, χωρητικότητα
poisonous δηλητηριώδης	emission εκπομπή, εκροή
smog νέφος, ομίχλη και καπνιά	contemporary σύγχρονος, μοντέρνος
solution (επι)λύση	manufacture κατασκευάζω, παράγω
establishment καθιέρωση, εγκατάσταση	diagnostic διαγνωστικός
anti-pollutant ενάντιος στη μόλυνση, αντιμολυσμα- τικός	module στοιχείο, μονάδα
device μηχανισμός, επινόηση	engine control module στοιχείο ελέγχου μηχανής
insert (into) εισάγω (σε), τοποθετώ ανάμεσα	check ελέγχω, έλεγχος
exhaust εξάτμιση	efficiency συντελεστής απόδοσης, αποδοτικότητα, ικανότητα, αποτελεσματικότητα
manifold σωλήνας, αγωγός	carry out διεξάγω, διεκπεραιώνω
muffler «σιλανσιέ», σιγαστήρας	heat θερμαίνω
ensure εξασφαλίζω, σιγουρεύω	sensor αισθητήρας
contact επαφή	upstream ροή εισόδου, ροή προς τα πάνω
catalyst καταλύτης	downstream ροή εξόδου, ροή προ τα κάτω
rapid ταχύς	function λειτουργία, έργο
rise αύξηση	measure μετρώ
temperature θερμοκρασία	content περιεχόμενο
convert μετατρέπω	normal κανονικός, φυσιολογικός
harmful βλαβερός	properly κατάλληλα
substance ουσία, υλικό, σώμα	produce παράγω
non-toxic μη τοξικός	correct σωστός
three-way τριοδικός	signal σήμα, σηματοδοτώ
store αποθηκεύω	ideal ιδανικός
oxygen οξυγόνο	mixture μίγμα, ανάμιξη
environmentally friendly φιλικός προς το περιβάλλον	achieve επιτυγχάνω, καταφέρνω
purify καθαρίζω (αέρα, ατμόσφαιρα, μέταλλο, κ.λπ.)	release (απ)ελευθερώνω, αφήνω
unburned/ unburnt άκαυστος	damage ζημιά, παθαίνω ζημιά
residue υπόλειμμα, κατάλοιπο	excessive υπερβολικός, πλεονάζων
oxidize οξειδώνω	generate δημιουργώ, παράγω
vapo(u)r ατμός	repair επισκευή
carbon άνθρακας	prevent εμποδίζω
dioxide διοξείδιο	accidental τυχαίος, συμπτωματικός
monoxide μονοξείδιο	lead μόλυβδος
reduce μειώνω, ελαττώνω	tank ντεπόζιτο, δεξαμενή
nitrogen άζωτο	equip εξοπλίζω
ability ικανότητα	restrictor μειωτής, περιοριστής
drop πέφτω, μειώνομαι	nozzle στόμιο

UNIT

13

Cooling system

Learning objectives

Reading comprehension: Understanding and reproducing techniques, methods and operations.

Vocabulary: Words related to the cooling system and its parts.

Language functions: Describing the means by which methods and operations are carried out. Describing devices, and parts of a whole.

Use of English: Forming Adverbs, revising the Active and Passive Simple Present.



Cooling system tester

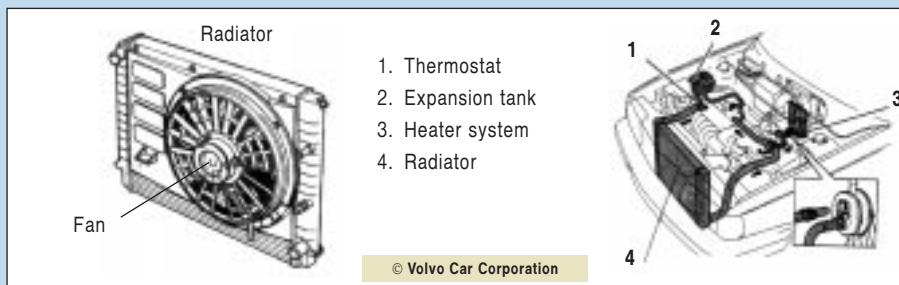
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Manuals are useful to technicians, as they provide necessary information about the different systems' construction and the operation of specific car models. Here follows an extract from a manual concerning the cooling system of a car.

The engine is liquid cooled and equipped with a closed cooling system. The cooling system consists of an inner and an outer circuit. The outer circuit includes the **radiator** and the **expansion tank**. Other components in the cooling system and the car heating system are part of the inner circuit. Circulation is controlled by a **centrifugal pump**, the rear face of which is integrated with the cylinder block. The pump is driven by the timing belt which gives an even loading on the pump bearings. Both filling and topping up are carried out through the expansion tank.

A mixture of genuine coolant diluted with clean water (usually in the ratio of 50/50) prevents corrosion and freezing and raises the boiling point to approximately 135° C.

The coolant does not normally require changing, excepting only when the cooling system is drained for repair or the similar.



The engine has a large cooling system with an electronically controlled **engine cooling fan** (FC). The fan draws air through the **radiator** from behind the radiator.

The engine cooling fan (FC) operates in two stages depending on engine coolant temperature (ECT) and pressure in the air conditioning (A/C) system. The fan is controlled electronically via a fan relay from the fuel/ignition system control module.

1. Reading comprehension

1A Answer T (true), F (false) or DK (Don't know).

1. The engine is equipped with a closed cooling system.
2. The cooling system consists of two circuits; the inner and the outer.
3. The inner circuit includes the radiator and the expansion tank.
4. The rear face of the centrifugal pump is integrated with the cylinder block.
5. The timing belt gives an even loading on the pump bearings.
6. Filling and topping up are carried out through the pump.
7. When the cooling system is drained for repair or the similar, the coolant requires changing.
8. The engine cooling fan is electronically controlled.
9. The two stages of the fan operation depend on the temperature of the coolant and the pressure in the air conditioning system.
10. The engine cooling fan can start without the ignition being switched on.

1B Complete the sentences, drawing information from the text.

1. The and the are included in the outer circuit.
2. Circulation is controlled by a
3. A mixture of genuine coolant with clean prevents corrosion and freezing.
4. The engine fan draws through the radiator.
5. The fan is controlled electronically via a from the fuel/ignition system control

2. Vocabulary Practice

2A Match words from list A with words from list B to form pairs of antonyms.

A

useful
different
rear
cooling
behind
large
inner
include

B

front
small
heating
same
useless
in front of
exclude
outer

2B Complete the blanks with one of the following words: *tank, belt, ratios, radiator, thermostat, corrosion, drained, coolants.*

1. The is an apparatus that controls temperature in tanks, engines, etc.
2. It's a container for liquid or gas:
3. The is a device used for cooling the engine of a car.
4. A circular strap, used to drive machinery is called a
5. The of 1/5 and 2/10 are the same.
6. The process of causing a material to wear away slowly by chemical action is called
7. are substances (usu. liquid) used to cool a mechanical system.
8. The radiator and the expansion tank must be before being repaired.

2C Which verbs correspond with the following nouns?

nouns	verbs
1. equipment
2. expansion
3. heat/heating
4. circulation
5. prevention
6. mixture
7. requirement
8. control
9. pressure
10. ignition

3. Language functions

3A Describing the structure of items/devices/systems and parts of a whole.

In the examples that follow, study the expressions used to show the structure of something or the parts something consists of, and then use them to complete the sentences given for practice.

Examples

- The mixture **consists of/contains** clean water and coolant.
- The cooling system **consists of/is made up of/includes** an inner and an outer circuit.
- These pistons **are made of** cast iron.
- The engine **is equipped with** a closed cooling system.
- Other components are **part of** the inner circuit.

Practice

1. The cooling system is an electronically controlled cooling fan.
2. The outer circuit the radiator and the expansion tank.
3. This apparatus a thermostat, to maintain the desired temperature automatically.
4. What are these valves? They of steel.
5. What the pump is integrated with the cylinder block?

3B Stating the means by which methods/operations/techniques are carried out.

Study the examples showing the means by which methods, operations and techniques are carried out. Then complete the gaps in the sentences given for practice, using the proper preposition or expression.

Examples

- Circulation is controlled **by** a centrifugal pump.
- Both filling and topping up are carried out **through** the expansion tank.
- The fan is controlled electronically **via** a fan relay from the fuel/ignition system control module.
- The radiator is cooled **by means of/with the help of** the fan operation.

Practice

1. The fan draws air the radiator.
2. The pump is driven the timing belt.
3. Corrosion and freezing are prevented a water/coolant mixture.
4. Exhaust fumes are emitted in the air the exhaust pipe.
5. The desired engine's temperature is maintained the thermostat.

4. Use of English

4A Formation of Adverbs.

Adverbs are usually formed from adjectives **+ly** e.g. *politely, carefully*.

Adjectives ending in **ic** form adverbs ending in **ically** e.g. *automatic – automatically*

Practice

Complete the missing adjective or adverb in the following table.

adjective	adverb
1. approximate	
2. normal	
3.	similarly
4.	electronically
5. useful	
6. slow	
7.	chemically
8. mechanical	
9. electric	
10.	specifically

4B Revising the Simple Present Tense in the Active and Passive Voice.

Make the necessary changes and additions to these sets of words to form meaningful sentences.

1. The engine/equip with/closed system.
2. The outer circuit/include/radiator and/expansion tank.
3. Circulation/control/a centrifugal pump.
4. The rear face/the pump/integrate with/cylinder block.
5. The coolant/not normally require changing/excepting only/the cooling system/drain for repair.

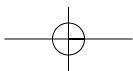
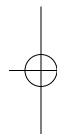
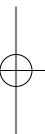
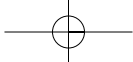
5. Useful phrases

How do you say the following terms in English?

1. κλειστό σύστημα ψύξης
2. εσωτερικό και εξωτερικό κύκλωμα
3. φυγοκεντρική αντλία
4. ιμάντας χρονισμού
5. κουζινέτα/τριβία αντλίας
6. δοχείο υπερχειλίσσης
7. μίγμα αντιψυκτικού αραιωμένου με νερό
8. σύστημα κλιματισμού

Vocabulary – Terminology

cooling system σύστημα ψύξης	carry out διεξάγω, διεκπεραιώνω
heating system σύστημα θέρμανσης	genuine γνήσιος, αυθεντικός
construction δομή, σύνθεση, κατασκευή	coolant (το) ψυκτικό, ψυκτική ουσία/μέσον
specific συγκεκριμένος	dilute αραιώνω (υγρό)
extract απόσπασμα, απόκομμα	ratio αναλογία
concern αφορώ	prevent εμποδίζω, αποτρέπω, προλαμβάνω
liquid υγρό	corrosion διάβρωση, σκούριασμα
closed cooling system κλειστό κύκλωμα ψύξης	freezing πήξη, πάγωμα
circuit κύκλωμα	raise υψώνω, ανεβάζω
radiator ψυγείο αυτοκινήτου	boil βράζω
expansion tank δοχείο υπερχειλίσσης	boiling point σημείο βρασμού
component εξάρτημα, συστατικό μέρος, απαρτίζουν τμήμα	require ζητώ, απαιτώ
circulation κυκλοφορία	change αλλάζω
centrifugal φυγόκεντρος, φυγοκεντρικός	changing αλλαγή
pump αντλία	drain (απο)στραγγίζω
rear πίσω, οπίσθιος	fan ανεμιστήρας
face όψη, επιφάνεια	draw τραβώ, σύρω
integrate ολοκληρώνω, ενοποιώ, συγκροτώ σε σύνολο	stage στάδιο, φάση
cylinder block κορμός (μπλοκ) μηχανής, συγκρότημα κυλίνδρων	depend (on) εξαρτώμαι (από)
belt ιμάντας, λουρί	temperature θερμοκρασία
timing belt ιμάντας χρονισμού/εκκεντροφόρου	pressure πίεση
even κανονικός, ομαλός	air conditioning κλιματισμός
loading φόρτιση, φορτίο	electronically ηλεκτρονικά, με ηλεκτρονικό τρόπο
bearing ρουλεμάν, κουζινέτο	via μέσω
filling γέμισμα, γέμιση, (συμ)πλήρωση	relay επαναπροσδιορισμός, ρελέ
topping up υπερχειλίσση, γέμισμα μέχρι πάνω	ignition ανάφλεξη
	module στοιχείο
	fuel/ignition system control module στοιχείο ελέγχου (του) συστήματος καυσίμου/ανάφλεξης



UNIT

14

The diesel (-oil) engine

Learning objectives

Reading: Presenting the structure, operation, parts and properties of the diesel engine. Comparing diesel to petrol engines.

Vocabulary: Related to the parts, operation and properties of the diesel engine. Synonyms and definitions.

Language functions: Presenting similarities and differences; comparing; contrasting.

Listening: The operation of the glow plugs. (Listening for gist and specific information. Multiple choices and gap filling.)

Writing: Comparison of petrol to diesel engines.



Volvo 2.4-litre, 5-cylinder, Common Rail Diesel

© Volvo Car Corporation

UNIT 15

The transmission system

Learning objectives

Reading: Presenting the function, parts, operation and types of the elements that constitute the transmission system.

Vocabulary: Related to the above. Definitions, synonyms, antonyms, prepositions. Word formation (Prefixes: semi-, self-, multi-, re-, pre-; Suffixes: -ful, -less, -ly).

Language functions: Expressing Cause/reason → Effect/result

Use of English: S. Future, S. Present Perfect and the modals in passive voice.

Listening: a) The fluid coupling, b) How the differential works. (Gap filling; arranging the missing information; giving the text a title; comprehension questions and vocabulary practice as follow up).



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Introduction

The transmission system (also referred to as power-transmission system or the driven train) in a vehicle is a complicated system of disks, shafts, gearwheels of various diameters, joints of various types, and axles. Its function is to transfer the power from the engine to the driving or driven (road) wheels. This is done in three stages. First, the engine power is transferred to the flywheel and the clutch. From the clutch, the power flows through the gear box, also referred to as transmission, and is delivered to the final drive, usually referred to as the differential, that is, into the drive gears of either the front- or the rear-drive shafts, depending on the type of vehicle. The differential delivers the power to each of the front or rear road wheels through either the front or the rear drive (half)shafts. On four-wheel drive vehicles, the power is transmitted to all four road wheels.

TASK 1



As you have already noticed, more than one terms are used for the same item. To facilitate your understanding of the texts that follow, after reading each chapter, make lists of these similar in meaning terms.

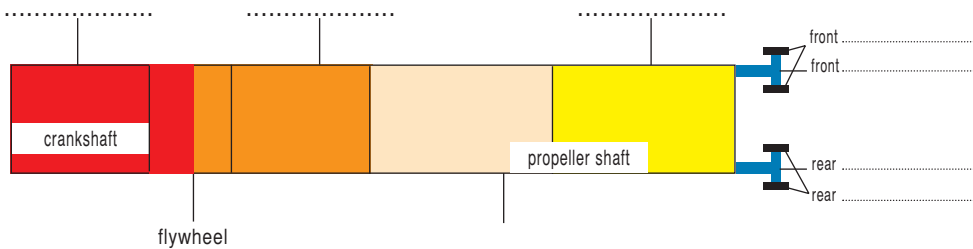
Alternative terms

1. σύστημα μετάδοσης κίνησης /
2. κιβώτιο ταχυτήτων /
3. τελική μετάδοση κίνησης / διαφορικό /
4. κινητήριои τροχοί /

TASK 2

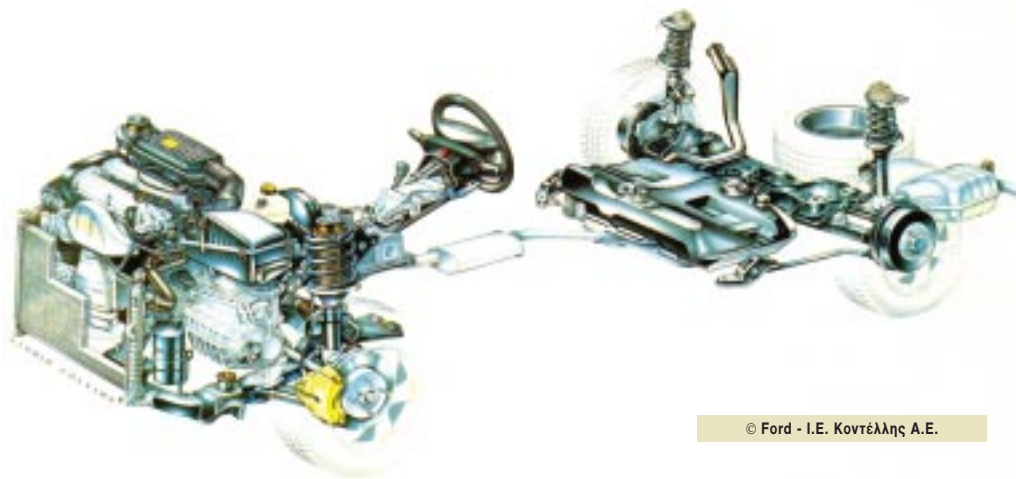


Complete the schematic diagram with the stages followed to transfer the power of the engine from the crankshaft to the road wheels.



TASK 3

Write a short, but complete definition of the power transmission system in the box below.



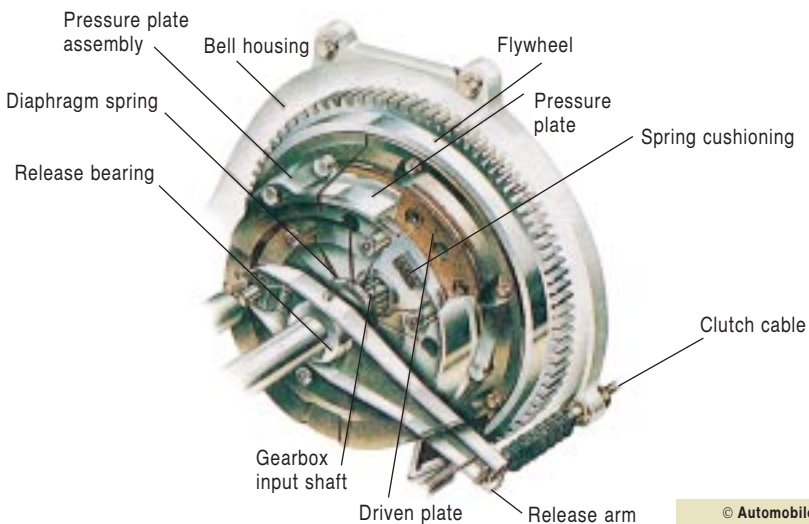
© Ford - I.E. Κοντέλλης Α.Ε.

A. The clutch

The clutch is the means of coupling the engine with the power-transmission units. Its job is to allow a smooth transfer of power from the engine to the gear box when the driver is moving the vehicle from a standstill and when he is engaging a gear. When the driver is changing gear or bringing the car to a stop, the clutch disconnects the engine from the driving wheels. It may be operated by means of a foot pedal, or it may be automatic or semi-automatic. The two basic varieties are the friction clutch and the fluid coupling, also referred to as fluid drive. In the fluid drive, the transfer of power from the engine to the gearbox is done by a hydraulic medium.

The friction or dry clutch

The friction or dry clutch which depends on solid contact between engine and transmission is the most common. It consists of: the rear face of the flywheel, the driving plate, the driven plate, the diaphragm spring, the release bearing and the clutch cover.



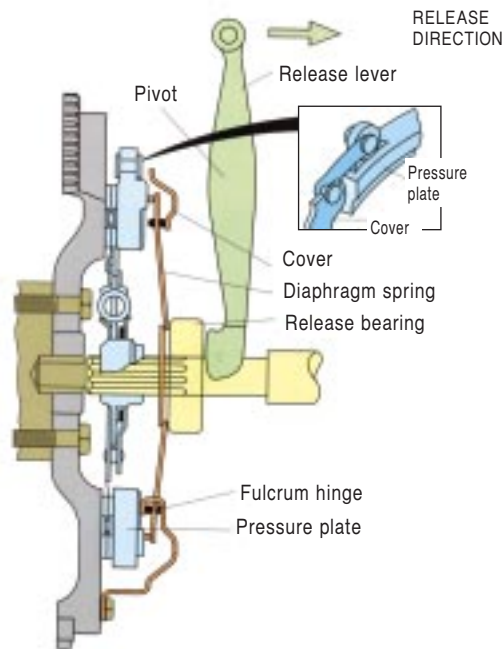
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The driving, or pressure plate, is mounted to rotate with the flywheel. The driven plate, which is also known as the friction or clutch disc or plate, is located between the flywheel and the pressure plate. It has a friction material (lining) on both sides and is free to slide along the splines of the input (or drive) shaft of the gear box driving it when the clutch is engaged. Between the friction material and the centre of the friction plate, there is a spring cushioning that absorbs the transmission shocks helping to give a smooth take-up of power when the clutch is engaged.

The diaphragm spring is mounted on the clutch cover. When the clutch is engaged, it pushes against the pressure plate, thus holding the friction plate in place.

The release bearing is fitted on a sleeve at the front of the gear box. It slides on the sleeve under the action of the release arm or lever, which pivots inside the end of the gearbox casing, operated either by a cable connected to the clutch pedal or by a hydraulic system.

When the clutch is engaged, the pressure plate, pushed by the diaphragm spring, presses the friction plate against the rear face of the flywheel. The power of the engine is then transmitted, through the contacting surfaces, to the gearbox by means of the splined gearbox drive shaft, which starts to rotate driven by the clutch disc, which turns with the flywheel.



Typical clutch components layout

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Complete the table

Alternative terms

1. dry / clutch
2. fluid coupling /
3. driving / plate
4. driven plate / / plate /
5. release arm / /
6. gearbox driving / / shaft

1. Reading Comprehension

1A Complete the sentences.

1. When the driver moves the car from a standstill or engages a gear,
.....
2. When the driver changes gear or stops the car,
.....
3. The dry clutch depends
.....
4. The clutch disc has
.....
.....
5. The release bearing is
.....
6. The release arm
.....

1B Are the following sentences true or false? Correct the false ones.

1. When the driver engages the gear he has selected, the clutch disconnects the engine from the gearbox.
2. In the friction clutch, the engine power is transferred to the gearbox by contact of solid parts.
3. The driving plate is also called friction plate.
4. The diaphragm spring is located between the flywheel and the pressure plate.
5. The release arm pivots inside the end of the gearbox casing.
6. The release arm is mounted to rotate with the gearbox splined shaft.
7. The diaphragm spring is mounted on the flywheel.
8. The release bearing is fitted on a guide sleeve at the front of the gearbox.
9. The release arm is operated by a cable connected to the gearbox cover.

1C Answer the questions.

1. Which are the main types of clutches?
2. What is the driven plate?

3. How is the smooth transfer of power from the engine to the gearbox achieved?
4. What is the function of the diaphragm spring?
5. What is the job of the pressure plate?
6. Which component transmits the rotation of the flywheel to the gearbox?

1D The two paragraphs below describe what happens when the clutch is engaged and what when it is disengaged. **Fill in the gaps with the appropriate phrases from the table with the missing information on p. 180.**

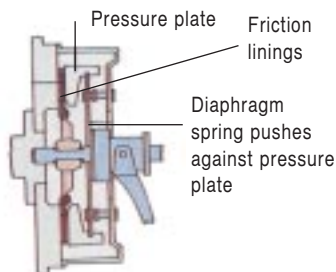
1. How the clutch connects the engine to the gearbox.

When the driver (1)
to engage the gear he has selected, the
release arm is drawn

..... (2) This reduces the pressure
against the centre

..... (3). The edge of the diaphragm spring
then pushes against the pressure plate, which
in turn (4)

against the rear face of the flywheel engaging the clutch. As the clutch disc
..... (5), it drives the gearbox input shaft, which
..... (6), thus transferring the power of the engine
..... (7).



Clutch engaged

2. How the clutch disconnects the engine from the gearbox.

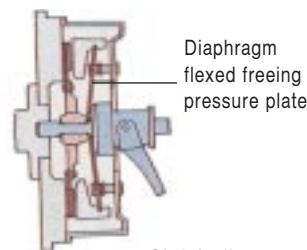
When the driver (1),
to change a gear or (2),

the release arm acts on the release bearing
..... (3) of the diaphragm

spring. This removes the pressure
..... (4) on

the pressure plate. As a result, the friction plate
..... (5) with the pressure

plate and the rear face of the flywheel and stops rotating. The gearbox drive
shaft (6) and so, the transmission of power from the
engine to (7).



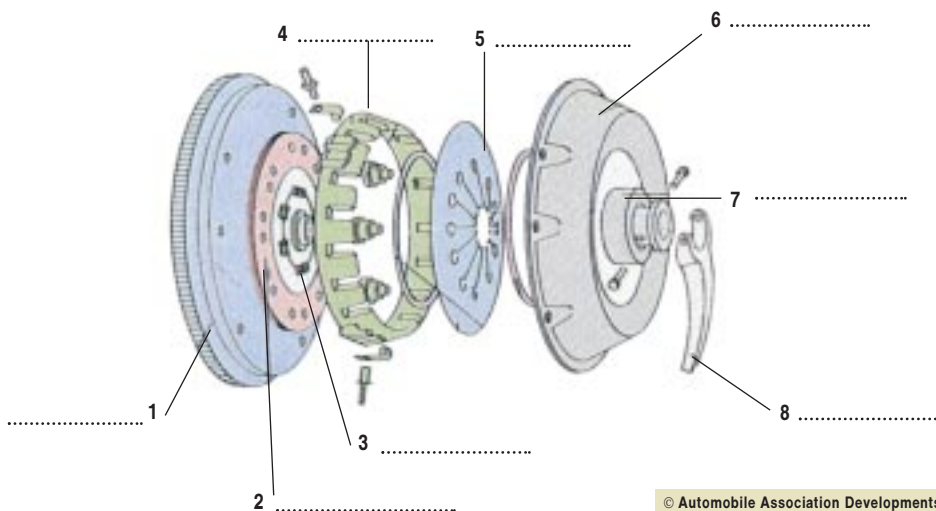
Clutch disengaged

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Table with missing information	
1. How the clutch is engaged.	2. How the clutch is disengaged.
a) pushes the friction plate b) starts rotating c) releases the clutch pedal d) to the gearbox e) and with it, the release bearing. f) of the diaphragm spring g) turns with it	a) which pushes the centre b) stops rotating, too c) to bring the car to a stop d) stops being in contact e) the gearbox is interrupted f) presses the clutch pedal g) exerted by the edge of the diaphragm spring

2. Vocabulary practice

2A Label the parts of the dry clutch in the picture below.



2B Write the equivalent English terms.

1. Ξηρός συμπλέκτης / Ξηρά σύμπλεξη (τριβής): /
2. υγρός / υδραυλικός συμπλέκτης/ σύμπλεξη τριβής: /
3. το πετάλι του συμπλέκτη:
4. δίσκος πίεσης, πλατό:
5. δίσκος τριβής, ο δίσκος του συμπλέκτη / του αμπραγιάζ:
6. το κτένι / ο ήλιος / το διάφραγμα του συμπλέκτη:

7. το ρουλεμάν του συμπλέκτη:
8. το δίσκαλο / η φουρκέτα του αμπραγιάζ:
9. η θήκη / βάση του ρουλεμάν:
10. το συρματοσχοινο / η ντίζα του συμπλέκτη:
11. η χελώνα / το καβούκι του αμπραγιάζ:
12. η θήκη / η χελώνα / το καβούκι του κιβωτίου ταχυτήτων
13. άξονας εισόδου, ο πρωτεύων / κινητήριος άξονας του αμπραγιάζ:

2C Match words with definitions.

Verbs

1. clutch
 2. mount
 3. slide
 4. absorb
 5. engage
- a) move smoothly over or against something
 - b) take something in; reduce the effects of vibrations, a shock or impact
 - c) put; attach; fasten something somewhere
 - d) move something into a position where it fits something else, e.g. the clutch disc, a gear, etc.
 - e) grab something and hold it tightly

Nouns

1. coupling
 2. standstill
 3. lining
 4. cushioning
 5. sleeve
 6. spline
- a) a deep, straight line, a groove cut into a metal shaft
 - b) a layer of a substance, e.g. friction material, metal, etc., attached to one side of a surface, usually the inner
 - c) a device used to join two pieces of equipment together
 - d) a cylinder of metal or other material put around a rod, a shaft, etc., as a cover
 - e) completely motionless; not moving at all
 - f) something (usually soft) that protects an object when it hits something by reducing the force of the impact

2D Odd-one out

1 technique means medium instrument	2 take-up transfer transport transmission	3 clutch engagement coupling contact
4 located existing placed fitted	5 mounted fixed fastened put	6 common usual often widespread

3. Listening activity

STEP 1



Listen to the text your teacher is going to read, say what it is about and give it a title.

STEP 2



While listening to the text again, read the text below to familiarize with it. Then, work with your partner and try to complete the missing words.

The coupling may be used either with or without the clutch. When it is not combined with a friction clutch, the engine power is to the transmission system exclusively through an oil medium without any contact of parts. This type of clutch is also known as a fluid drive. It consists of two The first disc is mounted to the rear face of the and, as result, it is driven by the engine. This disc is also called the fluid flywheel. The second disc is connected to the As the first disc, which is fan-bladed, rotates, it agitates the with sufficient force to the second disc. Because the rotation of the second disc depends directly on the amount of engine delivered, the prime result of fluid coupling is an automatic clutch, which greatly simplifies the requirements for gear shifting.

STEP 3



Listen to the text for a third time and fill in the rest of the gaps. Check in class.

Follow up

1. Replace words in the text with their synonyms below.

- | | |
|------------------------------------|---------------------------------|
| 1. transferred; transmitted: | 6. best; most important: |
| 2. only: | 7. makes easier, simpler: |
| 3. fixed firmly: | 8. need; necessity: |
| 4. stirs; shakes: | 9. changing: |
| 5. enough: | |

2. Answer the questions.

- Which are the two types of the fluid coupling?

2. How is the power of the engine transmitted to the gearbox in each of the two types of the fluid coupling?
3. Which are the main parts of the fully-automatic clutch type?
4. How is the fully-automatic clutch usually called?

4. Writing activity

4A Translate the following sentences into English.

1. Η ξηρή σύμπλεξη /Ο ξηρός συμπλέκτης, που στηρίζεται σε επαφή στερεών μερών μεταξύ κινητήρα και συστήματος μετάδοσης, είναι πιο διαδεδομένος από την υγρή σύμπλεξη.
2. Ο χειρισμός του ξηρού συμπλέκτη γίνεται είτε με καλώδιο / ντίζα συνδεδεμένο στο πετάλι του αμπραγιάζ, ή, στα περισσότερα σύγχρονα αυτοκίνητα, με ένα υδραυλικό σύστημα.
3. Το πλατό (ο δίσκος πίεσης) είναι βιδωμένο(ς) / στερεωμένο(ς) στο βολάν, ώστε να περιστρέφεται μαζί του.
4. Ο δίσκος του συμπλέκτη έχει επένδυση με υλικό τριβής και στις δύο πλευρές του και κινείται ελεύθερα μέσα στο πολυσφηνό (καρέ) / κατά μήκος των αυλακώσεων που φέρει ο άξονας εισόδου του κιβωτίου ταχυτήτων.
5. Το τσέρκι με τα ελατήρια που βρίσκεται ανάμεσα στο υλικό τριβής και το κέντρο του δίσκου του συμπλέκτη, απορροφά τους κραδασμούς της μετάδοσης της κίνησης και συντελεί στην ομαλή μετάδοση της (κίνησης) όταν το αμπραγιάζ συμπλέκεται.
6. Όταν το αμπραγιάζ συμπλέκεται, το χτένι / ο ήλιος σπρώχνει το πλατό, που πιέζει το δίσκο του αμπραγιάζ πάνω στην πίσω πλευρά του βολάν, κρατώντας τον στη θέση του.
7. Το ρουλεμάν του συμπλέκτη είναι προσαρμοσμένο σε μία θήκη / βάση που βρίσκεται στο μπροστινό μέρος του κιβωτίου ταχυτήτων.
8. Το δίχαλο / η φουρκέτα κινείται μπρος - πίσω στο άκρο του περιβλήματος του κιβωτίου ταχυτήτων και ενεργεί / δρα πάνω στο ρουλεμάν που γλιστρά / κινείται πάνω στη θήκη / βάση του.
9. Για να ξεκινήσει το αυτοκίνητο ή ναβάλει ταχύτητα, ο οδηγός ελευθερώνει / αφήνει το πετάλι του αμπραγιάζ για να εμπλέξει το συμπλέκτη ώστε να μεταφερθεί η κίνηση της μηχανής στο σύστημα μετάδοσης. Για να αλλάξει ταχύτητα ή να σταματήσει το αυτοκίνητο, πατάει το πετάλι του αμπραγιάζ ώστε να αποσυνδέσει τη μηχανή από τους τροχούς.

4B Write a short definition of the clutch.

Vocabulary – Terminology

(power-) transmission system σύστημα μετάδοσης κίνησης	release arm/ fork/ lever το δίχαλο, η φουρκέτα του συμπλέκτη
drive train σύστημα μετάδοσης κίνησης	clutch cover χελώνα, καβούκι (η θήκη / το περίβλημα του συμπλέκτη)
joint σύνδεσμος, αρμός, ένωση	mounted στερεωμένος, πακτωμένος, προσαρμοσμένος, βιδωμένος
axle άξονας	friction material υλικό τριβής
stage στάδιο (διαδικασίας, εξέλιξης)	lining ίνες υλικού τριβής, επικάλυψη, ντύσιμο, φόδρα
clutch συμπλέκτης, αμπραγιάζ, αρπάζω, κρατώ σφιχτά	slide γλιστρώ
gearbox κιβώτιο ταχυτήτων, σασμάν	spline αυλάκι, καρέ, πολύσφηνο
final drive τελική μετάδοση κίνησης, διαφορικό	gearbox driving/ input shaft πρωτεύων / κινητήριος άξονας, άξονας εισόδου κιβωτίου ταχυτήτων, πριζ ντιρέκτ
drive gear γρανάζια μετάδοσης κίνησης, διαφορικό	spring cushioning φωλιά ελατηρίου, τσέρκι
differential διαφορικό	take-up μετάδοση, μεταβίβαση
drive (half)shaft ημιαξόνιο	sleeve θήκη (του ρουλεμάν του συμπλέκτη)
driving/ driven (road) wheels κινητήριοι τροχοί	cable καλώδιο, ντίζα
coupling σύζευξη, σύμπλεξη	gearbox casing χελώνα, καβούκι (η θήκη το περίβλημα του κιβωτίου ταχυτήτων)
standstill ακινησία, στάση	engage εμ-/ συμ-πλέκω, δεσμεύω/-ομαι, (δια)κανονίζω
engage a gear βάζω ταχύτητα	act δρώ, ενεργώ
pedal ποδωστήριο, πετάλι	remove αφαιρώ, απομακρύνω, μετακινώ
friction / dry clutch ξηρός συμπλέκτης, σύμπλεξη τριβής	edge η άκρη
fluid coupling / drive = υγρός / υδραυλικός συμπλέκτης, υδραυλική σύμπλεξη	exert ασκώ (π.χ. πίεση)
solid contact επαφή στερεών (μη υδραυλικών) μερών	interrupt διακόπτω
driving / pressure plate το πλατό του συμπλέκτη, δίσκος πίεσης	exclusively αποκλειστικά
driven / friction plate δίσκος τριβής / ο δίσκος του αμπραγιάζ	fan ανεμιστήρας, εξαεριστήρας
clutch disc δίσκος τριβής / ο δίσκος του αμπραγιάζ	blade λεπίδα
diaphragm spring το χτένι, ο ήλιος (το διάφραγμα) του συμπλέκτη	fluid flywheel υδραυλικός μετατροπέας ροπής, σφόνδυλος
release απελευθερώνω, αποδεσμεύω, απελευθερώση, αποδέσμευση, αποσύμπλεξη	prime ο σημαντικότερος, σπουδαιότερος, καλλίτερος
release bearing το ρουλεμάν του συμπλέκτη	shift αλλάζω, μετατοπίζω, ρίχνω (το βάρος, την ευθύνη), αλλαγή, μετατόπιση, βάρδια
lever μοχλός	

B. The transmission

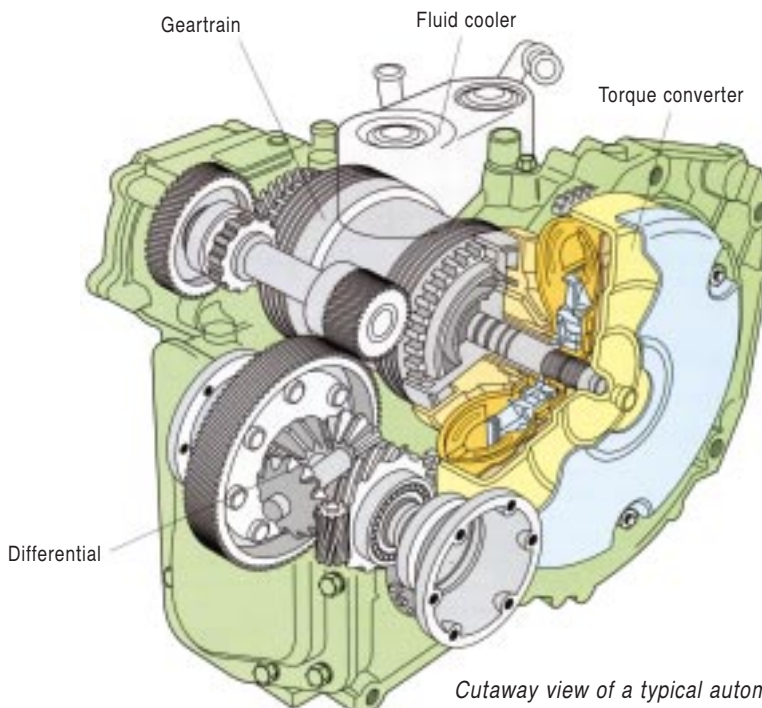
1 Manual and automatic transmissions

The transmission, usually referred to as the gearbox, is a mechanism that changes speed and power ratios between the engine and the road wheels. Four general types of transmission are in current use: the conventional or sliding-gear, the Hydra-Matic, the torque-converter systems and the continuously variable transmission (CVT). The last three types are either semi- or fully automatic hydraulically-operated mechanisms but, as they are complicated and their repair is quite costly, their use isn't widespread.

Another, fully-automatic transmission type is the serial transmission, which is used mostly in racing and some executive cars.

In automatic transmission, the transfer of the engine power is done by means of a special fluid, which also lubricates the transmission and keeps it cool.

The automatic transmission systems provide a great number of gear ratios with no shifting of gears. They are controlled by a selector lever which provides for the reverse and sometimes for emergency-low gears.



Cutaway view of a typical automatic transmission

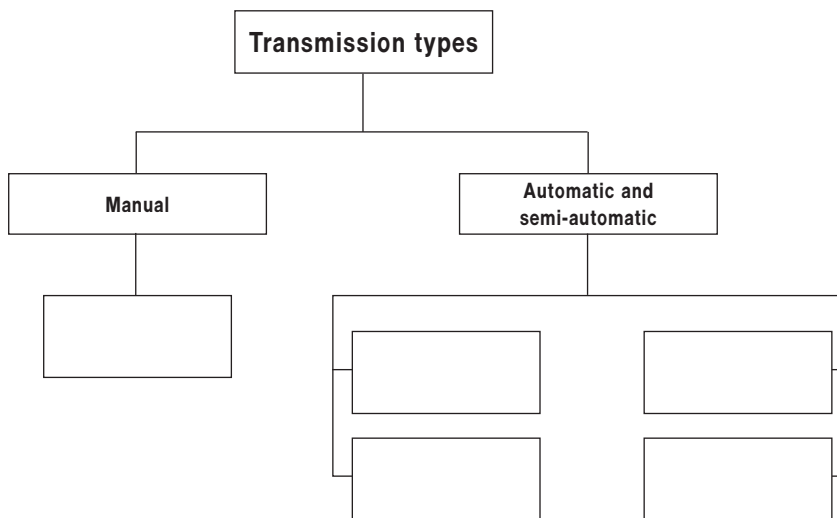
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The manual transmission, which is still the most common transmission type, provides for four or five forward speeds and one reverse. In the sliding gear, the engine power is transmitted to the final drive via different combinations of gearwheels fitted on shafts in the gearbox casing. The appropriate gear for each running condition* in the manual transmission type is engaged by means of a lever, the gear(shift) lever, which is operated by the driver.

$$\text{gear} = \begin{cases} \text{gearwheel} \\ \text{power ratio} + \text{the speed of the car} \end{cases}$$

TASK 1

Complete the diagram.

**TASK 2**

Answer the questions.

1. Which transmission type is the most common?
2. Which is the most rarely used transmission type? Which cars is it used on?
3. Why aren't fully and semi- automatic transmissions widely used?
4. How is the engine power transferred in automatic transmissions?

* By this term we mean the car's speed in relation to the road conditions.

5. What is the main difference between manual and automatic transmissions?
6. How is the transmission protected from wear due to friction and kept in good condition? (*Read the information in the box below.*)

IMPORTANT

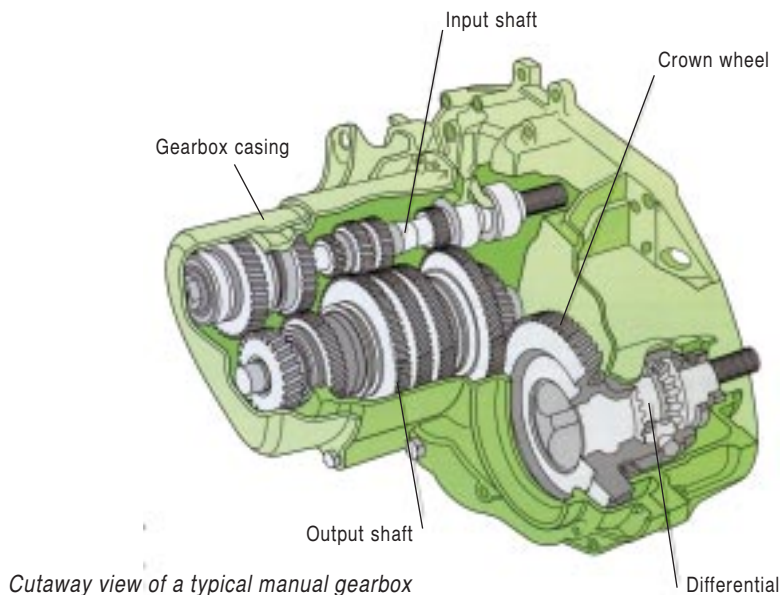
The shafts and gears of the manual transmission are enclosed in a casing that contains a special lubricating oil. The oil level should be checked regularly and renewed as recommended by the manufacturer (usually around every 20,000 km) because, if it gets low, the driver may have problems selecting gears, and the transmission may become noisy or damaged.

On cars equipped with an automatic transmission system, it is important to use the fluid type recommended by the manufacturer and check its level regularly because, if it gets too low, it will cause problems and damage expensive to repair. A too high fluid level can cause damage, as well.

TASK 3

Write a short definition of the transmission system.

2 Manual transmission - The sliding gear



Cutaway view of a typical manual gearbox

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Alternative terms

Transmission input / / /
 / shaft
 Transmission output / shaft

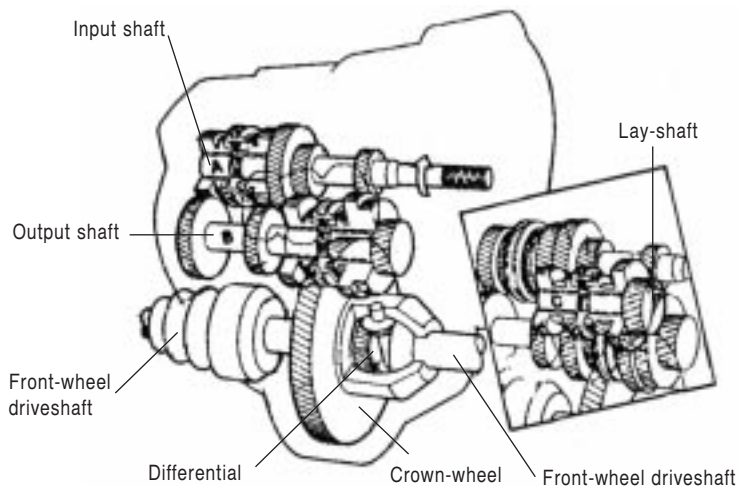
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The conventional transmission usually consists of two shafts, each with gear(wheel)s of varying diameters, that run in parallel next to each other. The first of these shafts (A), known as the drive, driving, primary, main, or transmission input-shaft, transmits the engine power from the clutch to the second shaft (B), known as driven or output shaft, at a pre-selected power ratio (= speed) by meshing the appropriate set of gear(wheel)s. The gears of the input shaft are permanently fixed to it. The gears of the output shaft, on the other hand, are free to turn. As a result, the driven shaft can rotate, even when the gears on it stay still. The engine power is transmitted to the final drive by the output shaft, either directly (on front-wheel drive cars) or by means of the propeller shaft (on the rear-wheel drive ones). The power transfer to the final drive is done by means of a pinion gear, known as the final drive pinion, which is fitted at the end of the output shaft and is in constant mesh with the differential.

.....

On front-wheel drive cars, the two shafts, via different combinations of gear(wheel)s, depending on the gear in use, provide power for all the forward gears. For the reverse speed, an extra gear, known as the idler gear, is required. The idler gear turns the driven shaft (B) in the opposite direction from its normal rotation. The power transfer to the final drive in all the gears is done by the output shaft.

Some front-wheel drive cars are equipped with a third shaft (C), commonly known as the lay-shaft. On these cars, the lay-shaft transmits power to the final drive either in both the 5th and the reverse gears or only in the reverse. In the other gears, the power is transmitted by the second shaft. On these cars, the lay-shaft is also fitted with a pinion gear, just like the output shaft. The two final drive pinions are in constant mesh with the differential.



Gearbox on a front-wheel drive car with three transmission shafts

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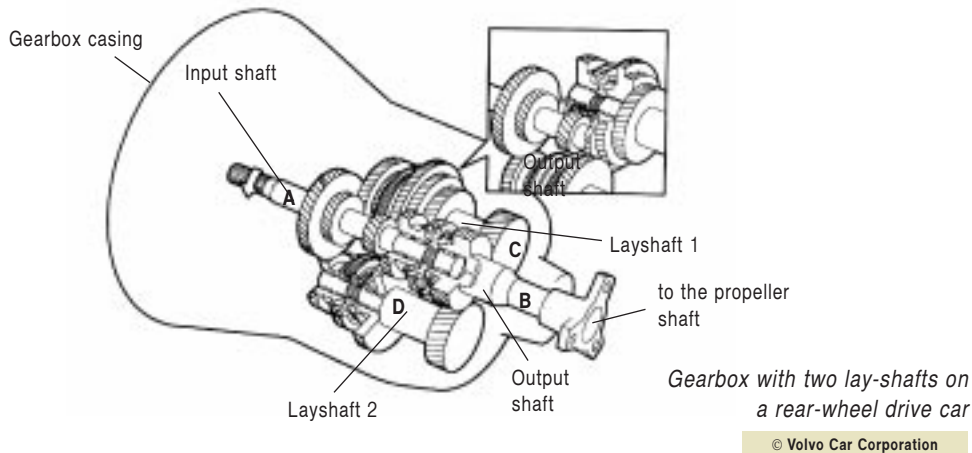
.....

Almost all rear-wheel drive cars and most four-wheel drive ones are equipped with a lay-shaft which provides power for the reverse. On these cars, the gearwheels of both the input and output shaft are permanently fixed and in constant mesh with the gearwheels of the third shaft. The gears of the lay-shafts are free to rotate, so that the lay-shaft can rotate even when the gears on it stay still. On these cars, the power of the engine is transferred to the final drive by the output shaft via the propeller shaft.



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Some other rear-wheel drive vehicles have a primary and two lay-shafts. On these cars, the primary shaft is split into two parts. The first part functions as the input (A), whereas the second as the output shaft (B). In the three or four forward speed gears, the engine power is transmitted from the input to the output shaft via the first lay-shaft (C), while in the 5th and the reverse, by the second lay-shaft (D). In the 4th gear, power is usually transmitted directly from the input to the output shaft.



.....

In high gear (4th), the input and output shafts usually turn at the same speed, regardless of the number of shafts in the gearbox. In the 1st, 2nd, 3rd, and the reverse gear, the driven shaft turns more slowly than the driving shaft. In the 5th gear, a pair of gearwheels permits the driven shaft (B) to turn more rapidly than the driving shaft (A). The transmission is then said to have overdrive. The overdrive is designed to increase the speed of a car without taxing the engine beyond what is considered its normal operating limit.

**Do you know
this?**



In modern cars, all gears are synchromesh, including the reverse. This means that a synchromesh assembly is fitted on the shaft(s) for each free-to-rotate gearwheel, to secure that the gearwheel is rotating at the same speed as the shaft when it is locked to it. When a driver selects a gear, a lever moves a sliding synchromesh hub along the shaft locking the appropriate gearwheel to it. In this way, the gears can be engaged without crashing the transmission gearwheels, even if they are not completely stationary at the time, thus allowing smooth and quiet gear engagement.

1. Reading Comprehension

1A Give titles to the thematic areas of the text about the sliding gear. Write them in the spaces provided.

1B Choose an appropriate phrase from the list below to complete the sentences.

- | | |
|---------------------------------|--------------------------|
| a) lay-shaft | g) are permanently fixed |
| b) one or two pinion gears | h) propeller shaft |
| c) a special oil | i) output shaft |
| d) the gearbox casing | j) idler gear |
| e) input shaft | k) primary shaft |
| f) a special transmission fluid | |

- The shaft that carries the engine power from the clutch to the gear box is called
- The shaft that carries the engine power from the gear box to the final drive on cars with two transmission shafts is called
- The shaft that transmits power to the final drive on some front-wheel drive cars equipped with three shafts in the 5th and reverse gears is commonly known as the
- The extra gear that provides power for the reverse gear on front-wheel drive cars equipped with two transmission shafts is usually referred to as the
- On cars with two transmission shafts, the gearwheels of the input shaft
- On cars with three transmission shafts, the gearwheels of both the input and output shaft
- On front-wheel drive cars, the transmission of power to the final drive is done directly by means of depending on the structure of the gearbox.
- On rear-wheel drive cars, the transmission of power to the final drive is done by the via the
- Some rear-wheel drive vehicles are equipped with a which is split into two parts that function as the and the These cars usually have two lay-shafts.
- The shafts of the sliding gear are enclosed in
- On cars with manual transmission, the shafts and gearwheels of the gearbox are lubricated by
- Automatic transmissions are lubricated by

1C Combine the appropriate information from the two columns to make meaningful sentences. (*In some cases, more than one combinations are possible.*)

- | | |
|--|---|
| <ol style="list-style-type: none"> 1. Most front-wheel drive cars have 2. Almost all rear- and 4-wheel drive cars have 3. Some front-wheel drive cars have 4. On front-wheel drive cars with two shafts, 5. On most front-wheel drive cars with three shafts 6. On rear- and 4-wheel drive cars with one lay-shaft, 7. In the 4th forward gear, 8. In the 1st, 2nd, 3rd forward gears and the reverse, 9. In the 5th gear, the output shaft 10. On some front-wheel drive cars with three shafts, 11. On some rear-wheel drive cars with two lay-shafts | <ol style="list-style-type: none"> a) various combinations of gears on the input and output shafts provide power for all the forward gears. b) the engine power is transferred to the final drive by the output shaft . c) turns more rapidly than the input shaft. d) two shafts: the input and the output. e) three shafts: the input, the output and the lay-shaft. f) the input and output shafts turn at the same speed. g) the lay-shaft transmits power to the final drive in the 5th and reverse gears. h) the output shaft turns more slowly than the input. i) the idler gear provides power for the reverse. j) the lay-shaft provides power for the reverse. k) in the 4th gear, the power is transmitted directly from the input to the output shaft, while in all the other gears, it is transmitted by means of the two lay-shafts. |
|--|---|

1D Answer the questions.

1. How is the appropriate gear engaged on cars with manual transmission?
2. Are all the gearwheels the same?
3. What is the function of the driving shaft?
4. How is the power of the engine transmitted from the driving to the other shafts and the idler gear?
5. What is the final drive pinion?

6. Which cars are equipped with a third shaft? What is its function?
7. On which shafts are the gearwheels permanently fixed?
8. Why are the gearwheels on one of the shafts free to rotate?
9. How is the power of the engine transmitted to the final drive on the various car types?

2. Vocabulary practice

2A Write the English equivalent term.

1. άξονας εισόδου:
2. άξονας εξόδου:
3. βοηθητικός άξονας:
4. κεντρικός άξονας από σασμάν σε διαφορικό:
5. ο τεμπέλης (το γρανάζι της όπισθεν):
6. κωνικό γρανάζι μετάδοσης κίνησης, πινιόν:
7. (μπροστινές) ταχύτητες:
8. η όπισθεν (ταχύτητα):
9. η 5η (ταχύτητα) / ταχύτητα ταξιδιού:

2B Identify which term from the list is defined below.

level	stationary	permanent	ratio	constant	manual
	emergency	automatic		conventional	

1. the relationship between two things expressed in numbers or amounts that shows how much greater the one is than the other:
2. a machine, mechanism or device that has controls which enable it to perform a task without needing to be operated by a person constantly:
3. a machine, mechanism or device operated by hand rather than by electricity or a motor:
4. something that lasts or is fixed somewhere for ever so that it cannot be moved:
5. an unexpected and difficult or dangerous situation:
6. the height of the surface of a liquid in a container:
7. a product that is usually used or has been in use for a long time:
8. something that stays the same / unchanged over a particular period of time:
9. something that is not moving:

2C Match the verbs in column A with their definition in column B.

- | | |
|------------|---|
| 1. crash | a) go together well; fit closely; engage; combine |
| 2. mesh | b) put a thing inside something, <i>e.g. a casing</i> , surround it completely |
| 3. lock | c) use all the power of something, <i>e.g. the engine</i> , so that it has great difficulty in carrying out what it is designed to do |
| 4. tax | d) hit violently on something and be damaged or destroyed |
| 5. enclose | e) fix something firmly in a position or place |

2D Complete the left and right columns with the synonyms and antonyms of the words in the middle column.

Synonyms		Antonyms
	varying	
	required	
	right; correct; suitable	
	main; important	
	common; ordinary; usual	
	reduce; lessen	
	permanent	
	stationary	
	complicated	
	expensive	

2E Word formation**The prefixes: semi-, self-, multi-, pre- and re-.****a. Study the following.**

- semi-:** indicates that something is partly, but not completely, in a particular state
e.g. *semi-professional, semi-tropical*
- self-:** indicates that you do something to yourself or by yourself
e.g. *self-diagnostic, self-employed*
- multi-:** indicates that something consists of many things of a particular kind
e.g. *multi-point injection, multi-lingual*
- pre-:** indicates that something takes place before a particular date, period, event
e.g. *preliminary, pre-historic*
- re-:** describes a change in the position or state of something
e.g. *replace, re-arrange*

b. Form new words by adding the above prefixes to the words below.

organized	adjustable	make	taught
educated	industrial	professional	national
circle	skilled	cooked	sphere
automatic	system	arranged	defence
heated	place	centred	cylinder
act	service	media	construct
set	existing	ignited	determined

2F Fill in the gaps in the sentences below with the appropriate preposition from the list.

to	of	for	on	in	at	with	from
----	----	-----	----	----	----	------	------

- Most cars are equipped two transmission shafts, which provide power all the forward gears.
- The gearwheels of the driven shaft are in constant mesh the gearwheels of the primary shaft.
- The driver engages the appropriate gear each running condition by means a lever.
- The job of the transmission system is to transmit power the clutch the final drive.
- Depending the gear in use, the gearwheels mesh differently.
- The driven shaft is usually referred as output shaft.
- The gears the input shaft are permanently fixed it.
- The shafts and gears of the sliding gear are completely enclosed the gearbox casing that contains a special lubricating oil.
- the 4th gear, the input and output shafts usually turn the same speed.
- The transmission system consists two or three shafts and a number of gearwheels fitted them.

3. Language functions

Expressing cause / reason → result / consequence

There are various ways to express the above relationships. **Study the table.**

Cause / Reason	Result / Consequence
because of due to thanks to <div style="display: inline-block; vertical-align: middle; margin-left: 10px;">] + noun </div>	so as a result consequently thus therefore (in) this way for that reason that is why <div style="display: inline-block; vertical-align: middle; margin-left: 10px;">] + sentence </div>
as since because <div style="display: inline-block; vertical-align: middle; margin-left: 10px;">] + sentence </div>	

Examples

- **Due to / because of** the large battery size, electric cars have limited space for passengers and their luggage.
- **Thanks to** the lightweight materials used in their construction, modern cars are more fuel efficient.
- **Because / as / since** modern cars are lighter, they are more fuel efficient.
- Modern cars are much lighter, **so / as a result / thus / consequently / therefore** their operation is more economical.
- Modern cars are smaller and lighter; **in this way / for that reason** they consume less fuel.

Practice

Use expressions from the table to join the sentences below. Make any necessary changes.

1. The ECU is connected to sensors that monitor the function of the engine and the various car systems. The ECU knows exactly how the engine is running and how the various systems operate.

Examples

- **Thanks to / because of** the sensors that monitor the function of the engine and the various car systems, the ECU knows exactly how the engine is running and the various systems operate.

- ***Because** / **as** the ECU is connected to sensors that monitor the function of the engine and the various car systems, it knows exactly how the engine is running and the various systems operate.*
 - *The ECU is connected to sensors that monitor the function of the engine and the various car systems, (and) **so** / **as a result** / **therefore** it knows exactly how the engine is running and the various systems operate.*
2. Car industry is the world's largest manufacturing industry. – It is of major economic and social importance.
 3. The increases in the price of oil in the 70s were accompanied by decreases in demand for motor cars. – Manufacturers started developing energy-saving vehicles.
 4. Butane, natural gas and bio-gas are highly explosive. – Their use is limited.
 5. The Wankel rotary engine proved less fuel-efficient than expected. – It remained a low-production.
 6. There were increasing concerns over the harmful gas emissions. – All cars after 80s use unleaded fuel and are equipped with emission controls.
 7. Electric cars have some drawbacks. – Manufacturers have started experimenting with fuel-cell hybrid cars.
 8. The battery of the fuel-cell hybrid cars is charged by the petrol engine. – It requires no external charging.
 9. The battery size of fuel-cell cars is quite small. – They have enough space for five passengers and their luggage.
 10. Each piston reciprocates inside the cylinder about 100 times a second. – They must be very strong and at the same time light. – They are made of a light aluminium alloy.
 11. The valve tappets are self-adjusting. – They need no maintenance.
 12. The fuel in diesel engines is self-ignited. – Diesel engines need no ignition system.
 13. The pressure plate is mounted to rotate with the flywheel. – When the clutch is engaged, the rotation of the flywheel is transferred to the gearbox by means of the gear box input shaft, which starts to rotate driven by the clutch disc.
 14. Automatic transmissions are complicated and their repair is quite costly. – Their use isn't widespread.
 16. The gears of the output transmission shaft are free to turn. – It can rotate, even when the gears on it stay still.

Vocabulary - Terminology

ratio λόγος

power ratio λόγος ισχύος

be in current use είναι σε ευρεία χρήση, χρησιμοποιείται ευρέως

conventional συνηθισμένος, κοινός, παλιός, παραδοσιακός (σε αντιδιαστολή με το σύγχρονο, εξελιγμένο)

slide ολισθαίνω, γλιστρώ, ολίσθηση

sliding gear σύμπλεξη ολίσθησης

torque ροπή

torque converter μετατροπέας ροπής

Hydra-Matic transmission υδραυλική μετάδοση κίνησης

continuously variable transmission συνεχώς μεταβαλλόμενη μετάδοση κίνησης

serial transmission σειριακή μετάδοση κίνησης

semi- ημι- (μισό-), όχι πλήρως

widespread διαδεδομένος, ευρέως χρησιμοποιούμενος

manual χειροκίνητος, όχι αυτόματος

gear(shift) lever μοχλός / λεβιές (επιλογής / αλλαγής) ταχυτήτων

costly ακριβός

selector lever μοχλός / λεβιές επιλογής

emergency low gear το αργό

forward (speed) έμπροσθεν / μπροστινή ταχύτητα

unlimited απεριόριστος

reverse speed η όπισθεν (ταχύτητα)

level επίπεδο, στάθμη

shifting αλλαγή, μετατόπιση, μεταφορά

driving/ drive/ main/ primary/ input shaft κινητήριος άξονας ισχύος / άξονας μετάδοσης κίνησης

driven / output shaft κινούμενος/ δευτερεύων άξονας, άξονας εξόδου / μεταφοράς κίνησης / ισχύος

mesh εμπλέκω, εμπλοκή

set σύνολο εξαρτημάτων, γραναζιών κλπ, σειρά

permanently μόνιμα

still ακίνητος, ακόμη

pinion (gear) οδοντωτός κωνικός τροχός, πινιόν

propeller shaft κεντρικός άξονας

idler gear ο τεμπέλης (το γρανάζι της όπισθεν)

lay-shaft παράπλευρος / βοηθητικός άξονας

constant συνεχής

enclosed (in) που περικλείεται

overdrive 5η ταχύτητα, ξεκούραστη ταχύτητα, ταχύτητα ταξιδιού

tax επιβαρύνω, φορολογώ, φόρος

beyond πέρα από

limit περιορίζω, μειώνω, όριο, περιορισμός

synchromesh συγχρονιζέ

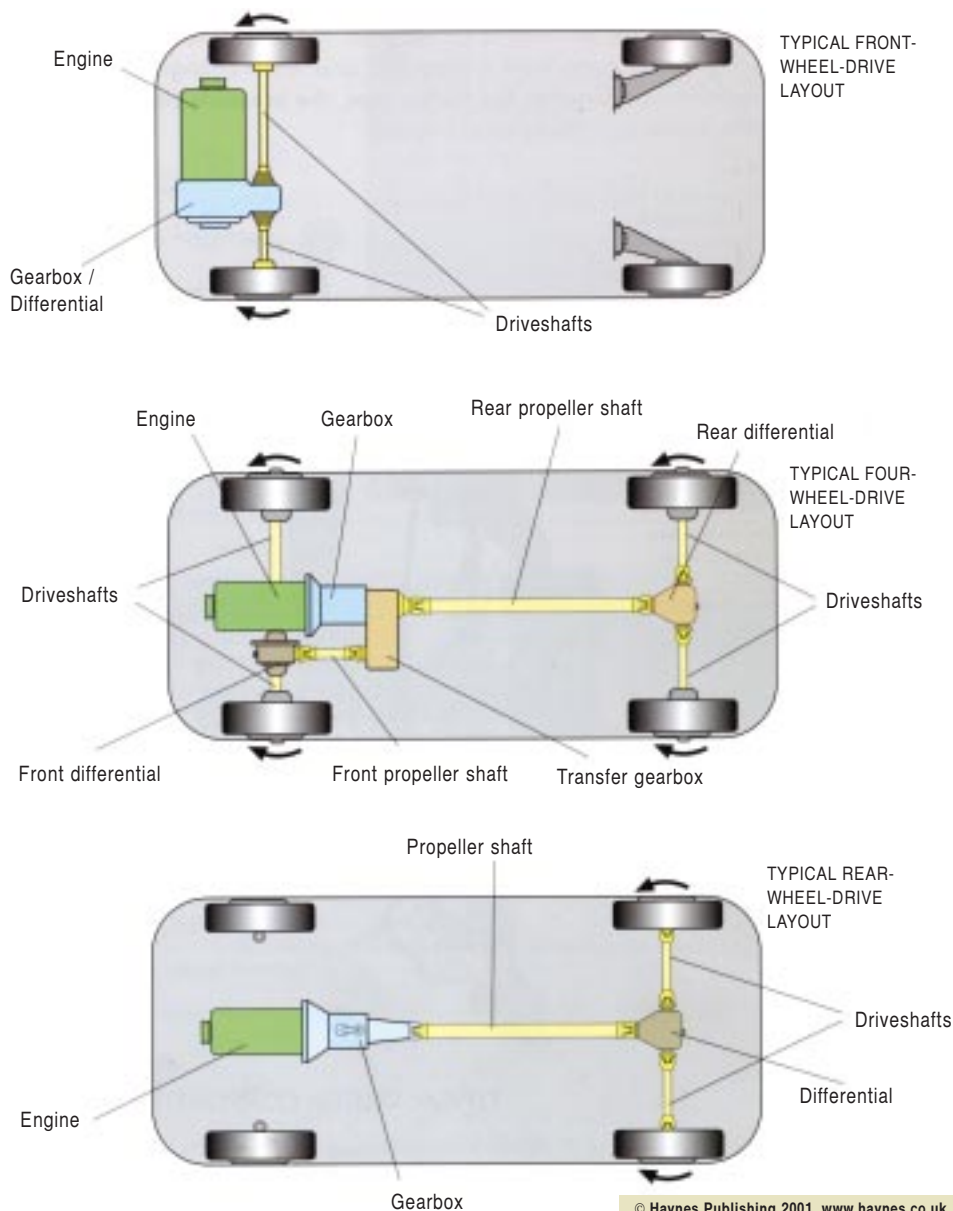
lock κλειδώνω, στερεώνω μόνιμα

hub = φουρκέτα

crash συντρίβω, καταστρέφω / -ομαι με πρόσκρουση, συγκρούω / -ομαι

stationary ακίνητος, σταθερός

C. The final drive

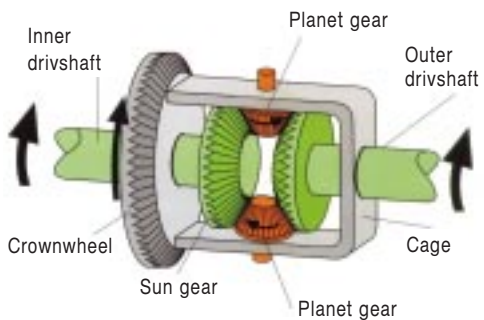


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1 The differential

The final drive, usually referred to as the differential, is the system that takes the engine power from the gearbox and transmits it to the drive (half-)shafts and the driving road wheels; either to two, the front or the rear, or to all four of them, depending on the type of the car.

The differential consists of the crownwheel, two differential or side pinion gears and two differential or side gears, all of the bevel type with straight teeth. The side pinions are commonly known as planet pinions or gears, while the side gears as sun gears. The set of gears is contained in the differential housing, or cage, which is bolted to the crownwheel and rotates with it. The crownwheel is driven by the final drive pinions.



Alternative terms

differential pinion gears / /
 / /

 differential side gears /

 differential housing /

The differential

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TASK 1



Write the parts of the differential, both in English and in Greek.

1.
2.
3.
4.

TASK 2



Complete the sentences.

1. On the cars, the power of the engine is transferred to the front road wheels. On the it is transmitted to the rear wheels and on, the engine power is transferred to
2. All the gears of the differential are of the type with

3. The differential housing is to the crownwheel, and as a result it

1. Listening activity

STEP 1



The information in the table below is taken from a text that describes the differential on the various types of vehicles. **Familiarize yourself with the information in the table and, while listening to the text, number the items in the table, in the order you hear them in each paragraph of the text your teacher is going to read.**

Table with missing information

1st paragraph	2nd paragraph	3rd paragraph
a) in constant engagement b) under high pressure c) the differential housing d) free to rotate e) is transmitted to the driveshafts	a) depending on the manufacturer b) is the most common in family cars now-a-days c) casing as the gearbox d) of the final drive pinions	a) propeller shaft b) drives the crownwheel c) universal joint d) the two driveshafts e) crownwheel and the differential cage f) to the final drive

STEP 2



Listen to the text again and make sure you have numbered the phrases correctly.

STEP 3

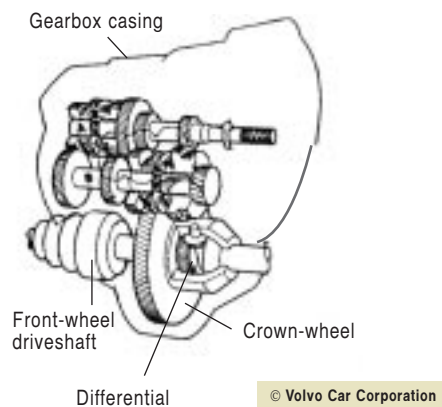


Listen to the text again and make sure that you have numbered the phrases correctly.

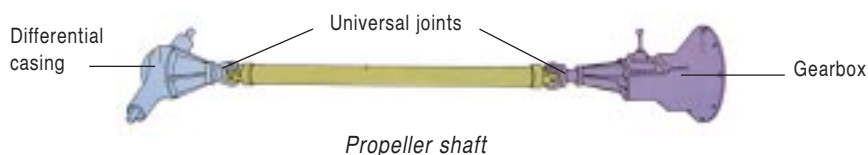
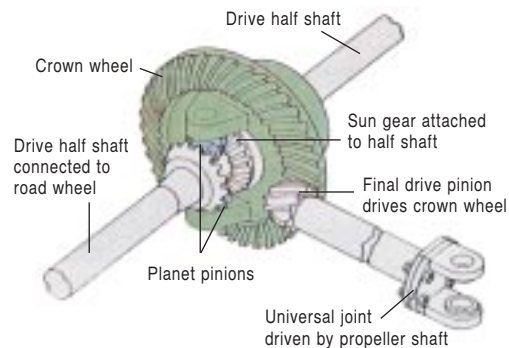
Write each phrases from the table in its appropriate place in the text below.

-
1. Each of the two planet gears is ⁽¹⁾ on a single shaft, which is fixed across the middle of ⁽²⁾. The two sun gears are attached to a driveshaft each, driving it. The planet pinions and the sun gears are ⁽³⁾. The power of the engine ⁽⁴⁾ by a rolling and sliding action between the teeth of the planet pinions and the sun gears ⁽⁵⁾.

2. On the front-wheel drive technology, which (1), the crownwheel and the differential housing are located in the front of the car. They are enclosed in the same (2). The engine power is transmitted from the gear box directly to the crownwheel by means (3), either of only the driven shaft or of both the driven and the lay-shaft, (4).



3. On the rear-wheel drive cars, the (1) are enclosed in a casing which is supported in the rear axle casing, between (2). The power of the engine is transferred from the transmission (3) by the gear box output shaft via the propeller shaft. The propeller shaft is a steel tube with two universal joints* at each end. One of the universal joints connects the (4) to the gearbox output shaft. The other (5) connects the propeller shaft to another short shaft, which ends to the final drive pinion that (6).



The universal joints, which are attached on the propeller shaft, allow for the suspension movements and the movements of the transmission.

Follow up

Give the text a title. Write it in the space provided over it.

2. Writing activity

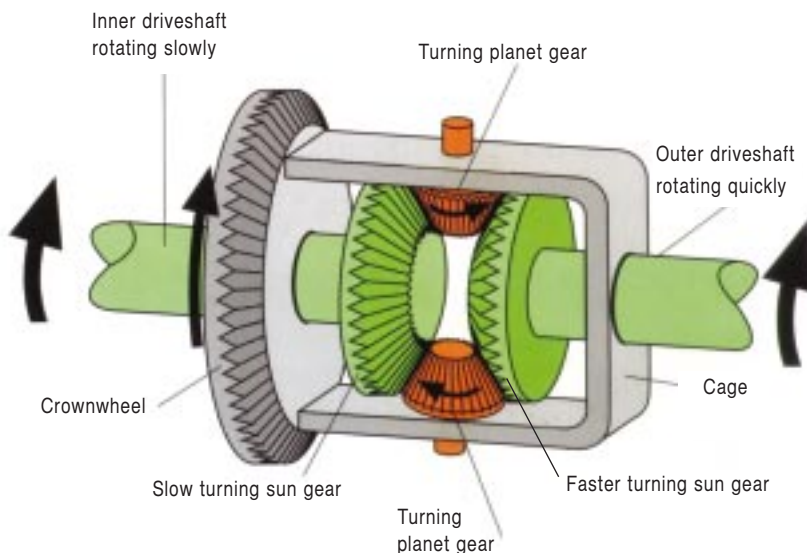
- Write:**
1. a short definition of the propeller shaft, and
 2. a description of the way the engine power is transferred from the gearbox to the differential on the front- and rear-wheel drive vehicles.

How the differential operates

Regardless of the type of vehicle, all differentials operate in the same way.

The final drive pinion _____ turns the crownwheel. The crownwheel transfers the drive to the planet pinions, via the differential cage _____. As the differential cage rotates, the planet pinions push the sun gears to turn _____. The driveshafts start rotating and, as a result, they drive the wheels.

When the vehicle drives in a straight line, the whole unit rotates as one. When the car turns, the inner wheel slows down. This makes the planet pinions to turn on their axis, thus speeding up the outer wheel. Though the speed of the two driving wheels differs, when the car is turning, the amount of power they receive is the same.



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TASK

The phrases below include some additional information about the components of the differential mentioned in the short text above. They all belong to the 2nd paragraph of the text. **Say: a) which component each phrase is related to and b) which gap in the text each phrase fits in.**

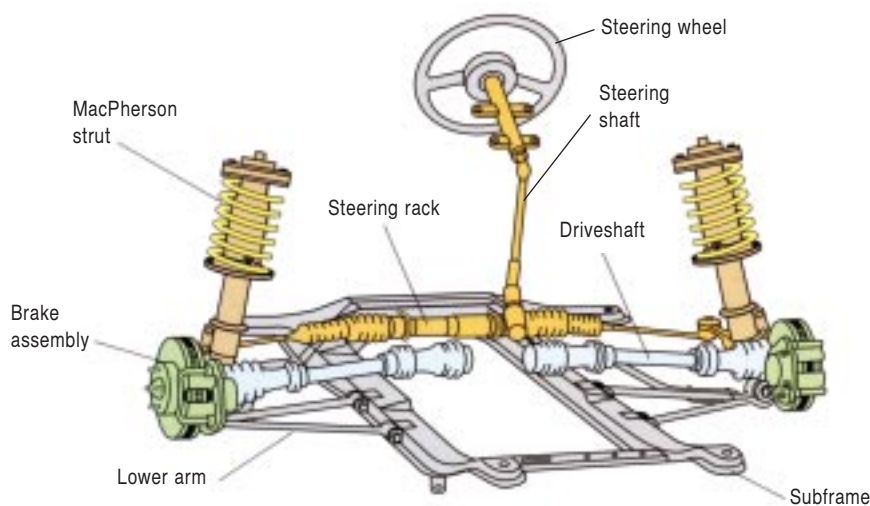
- a. which are free to rotate on their shafts that are fixed across the middle of the differential housing,
- b. since the sun gears are attached to the end of the drive-shafts,
- c. which is attached at the end of the transmission shaft that transfers the engine power from the gearbox to the final drive,
- d. which is bolted to the crownwheel and rotates with it

IMPORTANT

The differential casing of the rear-wheel drive cars contains oil that lubricates the gears and the axle. The oil level in the casing needs regular checking (around every 100,000km) because, if it gets low, the differential may be damaged. The oil should be renewed at the manufacturer's recommended intervals. The universal joints of the propeller shaft are grease lubricated.

2 The driveshafts

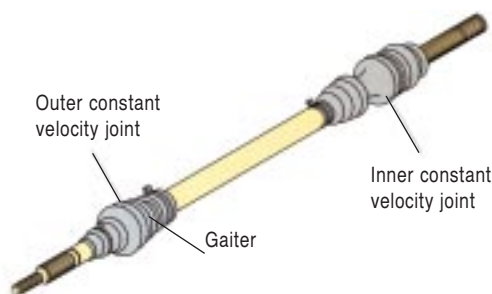
The last link in the chain of mechanisms that transmit the power from the engine to the driving wheels are the driveshafts. One end of each driveshaft is attached to a sun gear and, as a result, it is fixed to the differential cage; the other end is fixed to the wheel hub. The design of the driveshafts depends on the type of vehicle.



The driveshafts on a front-wheel drive car

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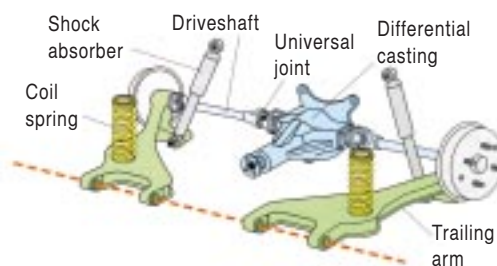
On front-wheel drive vehicles, the angle of both the wheels and the driveshafts changes as the steering wheel is turned and the suspension of the vehicle moves. To allow for these movements, the ends of the front wheel driveshafts are equipped with constant velocity joints. The inner joints, which are located before the sun gears, are usually of the ball type; the outer joints, which are located before the wheel hub, are of the universal type. The joints are lubricated with a special grease and they are covered with flexible rubber gaiters. The gaiters should be checked at regular intervals for damage.



Typical front-wheel driveshaft assembly

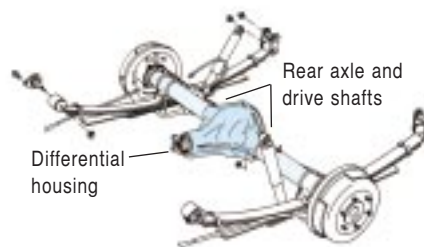
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Both ends of the driveshafts of the rear-wheel drive cars with independent suspension are equipped with universal joints to allow for the suspension movement. These joints also need regular greasing.



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The driveshafts of the rear-wheel drive cars with a rigid rear axle assembly are straight and, as they are enclosed in the rear axle, they don't have any joints but run straight from the differential to the wheel hubs.



© Volvo Car Corporation

1. Reading comprehension

1A The following sentences are incorrect. Correct the wrong information in them.

1. The two planet gears are attached to the end of the shafts that transmit the power from the gearbox to the final drive, while the two sun gears are attached on two short shafts which are fixed in the middle of the crownwheel.
2. The crownwheel is bolted on the differential cage and is driven by it.
3. The final drive pinion drives the differential cage.
4. The planet gears are in constant mesh with the final drive pinions.
5. On-rear wheel drive vehicles, the differential is enclosed in the same casing as the gearbox, so the engine power is transmitted directly from the gearbox to the final drive.
6. The propeller shaft is an extension of the gearbox output shaft. It has a ball-joint at each end and is used in front-wheel drive cars to transfer the engine power to the wheel hubs.
7. The driveshafts of the rear-wheel drive vehicles with rigid rear-axle assembly are equipped with ball joints to allow for the suspension movement.

1B Answer the questions.

1. How are the shafts, gears and wheels that transmit the engine power to another system, mechanism or component driving it usually called?
2. How are the shafts, gears and wheels that take the engine power from another component and are driven by it usually called?
3. What is the type of the gears that are contained in the differential cage?
4. Which gears in the final drive are in constant engagement?
5. What kind of joints are used in the various shafts in the last stage of the power transmission system?
6. What is the use of the various types of joints used on the driveshafts?
7. How are the gears and joints in the final drive protected from wear due to friction?
8. What is the function of the driveshafts?
9. How does the differential operate when the car moves in a straight line and how when it turns?

2. Vocabulary practice**2A Write the Greek equivalent term**

1. bevel type gear:
2. propeller shaft:
3. rolling and sliding action:
4. constant velocity joint:
5. wheel hub:
6. universal joint:
7. ball joint:

2B Write the English equivalent term or expression.

1. σύστημα ανάρτησης:
2. σύστημα διεύθυνσης:
3. σύστημα άκαμπτου πίσω άξονα:
4. ημιαξόνιο:
5. εύκαμπτες ελαστικές επικαλύψεις / φούσκες:
6. υπό υψηλή πίεση:
7. επιβραδύνω:
8. ανάλογα με τον κατασκευαστή:
9. επιταχύνω:

2C Choose the appropriate preposition from the list to fill in the gaps in the sentences below it.

up between with for in down to

1. The transmission shafts are contained the gearbox.
2. The final-drive pinion is attached the shaft that transfers the engine power the crownwheel.
3. The propeller shaft is a steel tube a universal joint at each end.
4. On rear-wheel drive vehicles, the differential is located the rear of the car the two driveshafts.
5. To allow the movements of steering and transmission systems, the front driveshafts have two velocity joints each.
6. The outer end of the driveshafts is connected the wheel hub by means of a universal joint.
7. The constant velocity joints are lubricated a special grease and covered rubber gaiters.
8. Don't forget to check the gaiters damage and the level of the oil contained the gearbox and the differential casing.
9. Be careful. Slow and keep the car a straight line. Don't speed before you cross the central road.

2D Word formation

a. The suffixes -ful and -less

The above suffixes are added to nouns to form adjectives.

The adjectives formed by adding the suffix **-ful** mean: **full of....**

e.g. beauty → *beautiful*, peace → *peaceful*

The adjectives formed by adding the suffix **-less** mean: **not having, without...**

e.g. wire → *wireless*, regard → *regardless*

Use the above suffixes to form adjectives out of the nouns below.

Noun	Adjective		Noun	Adjective	
	+ -ful	+ -less		+ -ful	+ -less
success			use		
wonder			speech		
home			skill		
hope			harm		
help			worth		
price			respect		
care			rest		

b. The suffix -ly

By adding the suffix **-ly** to adjectives we form **adverbs of manner**.

e.g. different → *differently* warm → *warmly*

Don't forget that when the adjective ends in **l**, the **l** is doubled.

e.g. universal → *universally* manual → *manually*

■ Practice ■

Choose nouns from the list and form them appropriately to fill in the gaps in the sentences below it.

regular	primary	normal	manual	common	direct	automatic
free	rapid	continuous	permanent	special	constant	

1. This book aims at teaching the students technical terms related to their specialty.
2. The mechanism operates
3. The final drive is referred to as the differential.
4. The shaft rotates driven by the engine.
5. The gears of the transmission input shaft are fixed on it, and they are engaged with the gears on the input shaft.
6. The crankshaft and the two camshafts rotate thanks to the bearings they are installed in.
7. On front-wheel drive cars, the power of the engine is transferred to the final drive.
8. To prevent damages, it is important to check the level of the transmission fluid
9. the oil in the differential casing should be renewed every 120,000 km.
10. In the 5th gear the output shaft turns more
11. This transmission type is designed for racing cars.
12. In the sliding gear, the gears are engaged by means of a lever operated by the driver.

3. Use fo English

S. Future, S. Present Perfect and the modals in passive voice

Study the examples.

- The phone call **has been made** from a city in Germany.
- The burglars **have been arrested** by the police.
- He **will be given** the motorcycle he dreamt of as a birthday present by his parents.
- The car **must be taken** to the garage at around 10 o'clock tomorrow morning.
- My supervisor **may be promoted** soon and I hope that I'll **be offered** his post.
- The damage **cannot / could not be repaired**.
- The shop **should have been painted** by now.

Practice

The sentences below are in various simple tenses in the active voice.

Choose ten sentences and rewrite them in the passive voice. Check in class.

1. They will not take the decision until next morning.
2. They have already replaced the spark plugs.
3. The Japanese have dominated the car market since 1975.
4. In the next decade, they will construct more fuel-cell cars.
5. They sold the car I liked for 5,000 ECU yesterday afternoon.
6. His company might send George to England in August.
7. They have offered him the post of the Production Manager in Poland.
8. Everybody recognizes his professional skills.
9. They should have postponed the meeting earlier.
10. The company will fire 400 workers until the end of the year.
11. They built the factory only two years ago.
12. Someone must replace the cable immediately.
13. The owner of the car hasn't checked the transmission fluid level since last summer.
14. The driver disengages the clutch by pressing the clutch pedal.
15. They have just brought the spare part you ordered last Tuesday.
16. Someone should have cleaned the grease from the floor by now.
17. A selector lever controls automatic transmissions.
18. They have sent the answer to his application letter by fax.
19. Don't worry. The assistant will fit the new glow plugs in a few minutes.
20. The boy cannot remove the rusty bolt.

4. Writing activity

4A Translate the following sentences into English.

1. Η φωλιά του διαφορικού είναι στερεωμένη με πείρους /μπουλόνια στον κύριο οδοντωτό τροχό του διαφορικού.
2. Οι πλανήτες είναι προσαρτημένοι σε δύο κοντούς άξονες / πείρους που είναι στερεωμένοι εγκάρσια στο μέσο της φωλιάς του διαφορικού.
3. Οι πλανήτες και οι ήλοι είναι σε συνεχή σύμπλεξη.
4. Στα οχήματα με κίνηση στους εμπρός τροχούς, το διαφορικό βρίσκεται στο ίδιο κέλυφος με το κιβώτιο ταχυτήτων.
5. Στα αυτοκίνητα με κίνηση στους πίσω τροχούς, το διαφορικό βρίσκεται στο κέλυφος του πίσω άξονα / στην κουκουβάγια ανάμεσα στα δύο ημιαξόνια.
6. Η στάθμη του λιπαντικού στην κουκουβάγια του πίσω άξονα πρέπει να ελέγχεται σε τακτά διαστήματα γιατί, αν κατέβει χαμηλά, το διαφορικό μπορεί να πάθει ζημιά.
7. Όταν το αυτοκίνητο κινείται σε ευθεία γραμμή, οι δύο κινητήριοι τροχοί περιστρέφονται με την ίδια ταχύτητα. Όταν το αυτοκίνητο στρίβει, χάρη στο διαφορικό, ο εσωτερικός τροχός (μπορεί να) επιβραδύνει ενώ ο εξωτερικός αυξάνει ταχύτητα.
8. Για να είναι δυνατές οι κινήσεις του συστήματος διεύθυνσης και του συστήματος ανάρτησης, τα άκρα των ημιαξόνιων των μπροστινών τροχών είναι εφοδιασμένα με μπιλιοφόρους και αρθρωτούς συνδέσμους / σταυρούς που καλύπτονται από εύκαμπτες ελαστικές φούσκες.

4B Write a definition of the final drive.

Useful tools



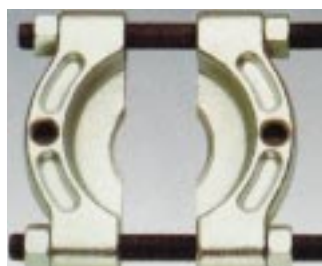
Extractor for ball joints (USAG)



Ball-joint separator (USAG)
Εξολκείς συνδέσμων με μπίλια



Clutch aligner (Facom)
Ρυθμιστής συμπλέκτη



Shaft and bearing separator (Facom)
Εξολκέας για άξονες και ρουλεμάν



Gear separator (Facom)
Εξολκέας για γρανάζια



Bearing separator (Facom)
Εξολκέας για ρουλεμάν



Press (Facom)
Πρέσα



Ram (Facom)
Θηλυκή βάση πρέσας



(USAG)



Jacks
Γρύλοι



(Facom)



Hydro-pneumatic pump fitted with pressure gauge (Facom)
Αντλία με μετρητή πίεσης / μανόμετρο

Vocabulary - Terminology

crownheel κύριος οδοντωτός τροχός διαφορικού, κορώνα, κωνικός οδοντωτός τροχός

side/ planet pinion gear (γρανάζι) πλανήτης

side/ sun gear ήλιος, δορυφόρος (γρανάζι) διαφορικού

bevel type gear οδοντωτός κωνικός τροχός, γρανάζι με ελλειψοειδείς αύλακες

bolt μπουλόνι, στερεώνω με μπουλόνια

attach προσαρμόζω, προσκολλώ

differential housing/ cage φωλιά διαφορικού

differential casing κουκουβάγια, περίβλημα / θήκη διαφορικού

rolling and sliding action δράση / κίνηση κύλισης και ολίσθησης

universal joint αρθρωτός σύνδεσμος, σταυρός

lubricating oil λιπαντικό, βαλβολίνη

grease γράσο

axle άξονας

interval (μεσο-)διάστημα, ο ενδιάμεσος χρόνος

regardless ανεξάρτητα

link συνδέω, δεσμός, κρίκος

suspension ανάρτηση

hub ακραξόνιο

design σχεδιάζω, σχεδιασμός, σχέδιο

steering διεύθυνση (οχήματος), χειρισμός

angle γωνία

velocity ταχύτητα

constant velocity joint σύνδεσμος

ball joint μπιλιοφόρος σύνδεσμος

grease λιπαίνω, λίπος, λιπαντικό

flexible εύκαμπτος

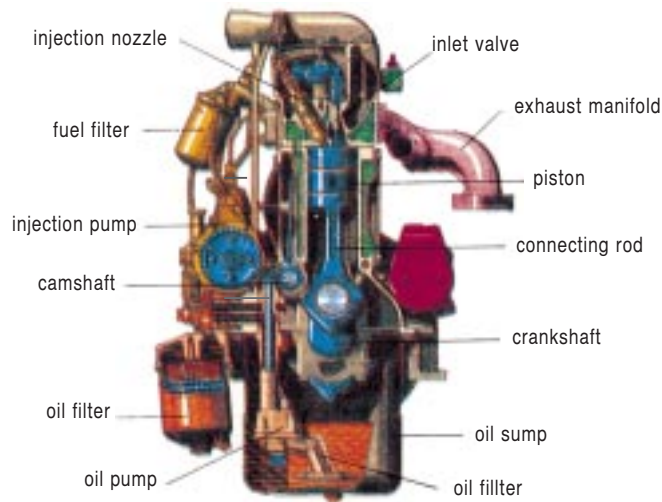
gaiter φούσκα, κάλυμμα

independent suspension ανεξάρτητη ανάρτηση

rigid άκαμπτος, δύσκαμπτος

Diesel engines are widely used in the various means of transport, particularly in trains, ships and lorries. They are also used in power plants to produce electricity.

Diesel, like petrol engines, belong to the Internal Combustion Engines and have a lot in common. Their mechanical parts, for instance, are almost the same.



Cross section of a diesel engine

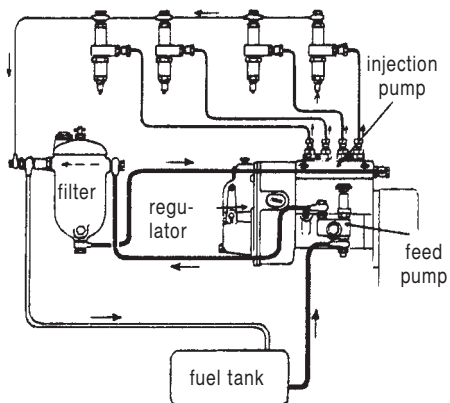
The essential difference between these two types of engines is that they use a different type of fuel. The petrol engine uses gasoline whereas the diesel engine uses diesel oil, instead. As a result, they operate differently.

The main differences in operation are: a) the order the fuel and air enter the combustion chamber and b) the way the fuel/air (f/a) mixture is ignited.

The petrol engine admits fuel and air simultaneously on the induction stroke. In modern cars, the air enters the cylinder flowing past the intake valves while the petrol is injected directly in the combustion chamber, by an injector. There, the fuel intermixes with the air and is vaporised. In conventional petrol cars, the fuel and air enter the cylinder already intermixed*. On the compression stroke, the f/a mixture is compressed by the piston, and just before the piston reaches the TDC**, it is ignited by a spark produced by the spark plug that is fitted at the top of the cylinder of the petrol engine.

* On conventional petrol cars, the petrol is intermixed with the air in the carburettor.

** Top Dead Centre is the top of the piston stroke, that is, the highest point the piston reaches as it moves upwards.

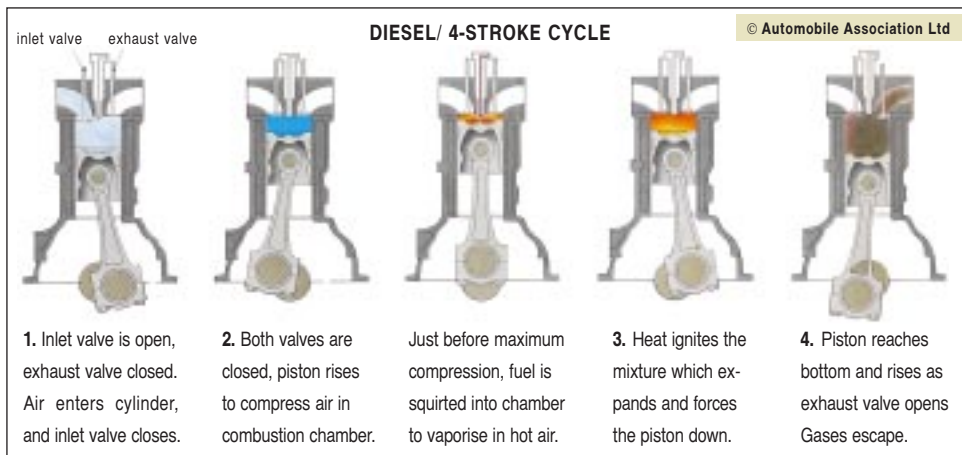


*Schematic diagram of the fuel system
in a diesel engine*

The diesel engine, on the other hand, admits only air on the induction stroke. The air enters the cylinder flowing past the inlet valves, exactly as in the petrol engines. On the compression stroke, the air is compressed by the piston and its temperature becomes very high, above the self-ignition point of the fuel. At about the end of the compression stroke, a fine spray of fuel is injected through an injector, located at the top of each cylinder, directly into the combustion chamber. As the fuel intermixes with the high temperature air,

it is automatically ignited, and so combustion occurs. The diesel engine, therefore, has no ignition system and, as a result, its electrical system is much simpler.

Modern diesel-engined cars are equipped with an electronic control unit exactly as the petrol-engined ones.



Compared to gasoline ones, diesel engines are more heavily built, because of the higher compression ratios (14 or more to one) they use, they have a noisier operation, due to the increased engine's vibrations, and are more expensive to repair. Moreover, diesel-engined cars have slower acceleration and lower maximum speed, with crankshaft speeds of 100 to 750 revolutions per minute (rpm) compared to 2,500 to 5,000 rpm for the typical petrol-engined cars. Despite their disadvantages, however, because of their very high compression ratio, which results in greater efficiency, and because they operate on less expensive fuel oils, diesel engines have become popular and are being fitted in an increasing number of private cars.

1. Reading comprehension

1A Answer the questions.

1. Where are the diesel engines used?
2. Do the mechanical parts of petrol and diesel-oil engines differ greatly?
3. Which are the two main differences between diesel-oil and gasoline engines?
4. Do fuel and air enter the engine at the same time in a diesel engine?
5. What is the TDC?
6. Why do diesel-oil engines have neither a carburettor nor a fuel ignition system?
7. Which are the advantages of petrol-engined cars over the diesel-oil ones?
8. Which are the crankshaft speeds of a diesel-oil, and which of a petrol engine?
9. Why does an increasing number of people prefer diesel to petrol engines?

1B Which type of engine (petrol or diesel) does each of the two cylinders illustrated below belong to? Give reasons.



Picture A



Picture B

© Automobile Association Developments Ltd

1C Which type of I.C.E. do the following items belong to? Tick appropriately as in the example.

I T E M S		E N G I N E T Y P E		
		Petrol		Diesel-oil
		Conventional	With fuel injection	
PARTS	cylinders			
	pistons			
	connecting rods			
	crankshaft			
	camshaft(s)			
	flywheel			
	oil sump			
	valves			
	spark plugs			
	injectors			
	carburettor			
	distributor*			
	ignition coil**			
	electronic ignition module			
	fuel tank			
	fuel pump			
	fuel filter			
	electronic control unit			
FUEL	leaded gasoline / petrol			
	unleaded gasoline / petrol			
	diesel(-oil)			

* The first cars equipped with fuel injection had a primary electronic ignition system that included a distributor which, instead of a contact breaker, had a transistor that operated as a solid state switch turned on and off by a magnetic sensor or a photoelectric device fitted in the distributor. This primary ignition system was referred to as "transistorised ignition". On modern cars equipped with an electronic control unit, the distributor has been replaced by an electronic module.

** On modern cars fitted with an engine-management system, the ignition coil has been replaced by the electronic discharge module(s).

I T E M S		E N G I N E T Y P E		
		Petrol		Diesel-oil
		Conventional	With fuel injection	
O P E R A T I O N	Fuel and air enter the cylinder simultaneously.			
	Air and fuel enter the cylinder on different strokes.			
	Fuel and air are mixed in the carburettor.			
	The fuel is injected directly into the cylinder.			
	The fuel is self-ignited.			
	The fuel is ignited by a spark.			
P R O P E R T I E S	lower compression ratio			
	greater efficiency			
	noisier operation			
	slower acceleration			
	higher maximum speed			
	more expensive fuel			
	more heavily built			
	less expensive repair			

1D Complete the following table with the similarities and differences of the three engine types (*parts, fuel and operation, not properties*).

S I M I L A R I T I E S	D I F F E R E N C E S		
	Petrol engine		Diesel engine
	Conventional	With fuel injection	
cylinders	spark plugs	spark plugs	_____

2. Vocabulary practice

2A Match the following with words or phrases in the text.

1st and 2nd paragraph

- | | |
|----------------------|-----------------------|
| 1. commonly: | 4. generate: |
| 2. especially: | 5. for example: |
| 3. trucks: | 6. similar: |

3rd paragraph

- | | |
|-----------------------|-----------------------|
| 1. main, basic: | 3. operates on: |
| 2. kind: | |

5th paragraph

- | | |
|------------------------------------|----------------------------|
| 1. allows to enter, lets in: | 5. mixes together: |
| 2. at the same time: | 6. becomes a vapour: |
| 3. inlet: | 7. fixed: |
| 4. straight : | |

6th paragraph

- | | |
|------------------|---|
| 1. over: | 3. takes place: |
| 2. placed: | 4. for this reason; consequently: |

7th paragraph

- | | |
|--|---------------------|
| 1. because of: | 5. drawbacks: |
| 2. furthermore; in addition to that: | 6. costly: |
| 3. complete turns: | 7. installed: |
| 4. in spite of; regardless: | |

2B Search the text to find the terms defined below.

- the place where electricity is generated:
- the process of burning:
- each upward or downward movement of a piston:
- rapid and continuous movements of an engine; trembling; shaking:
- the relationship between two things expressed in numbers or amounts, to show how much greater the one is than the other, *e.g. under steady load conditions the engine needs a mixture of 15 parts air to one part petrol (15:1)*:
.....
- the rate at which a vehicle can increase its speed, seen in terms of the time that it takes to reach a particular speed (*e.g. 0-100 km in 9.9 sec*):
.....

7. the rate at which / how fast something, e.g. a car, moves or travels:
.....
8. the temperature at which a fuel ignites automatically, by itself:
.....
9. the amount that the fuel and air mixture is compressed in the cylinder:
.....

2C Match words with definitions.

- | | |
|-----------------|---|
| | a) the way things are placed in relation to one another |
| | b) method or product that has been in use for a long time; |
| 1. compress | ordinary; traditional; old |
| 2. private | c) squeeze or press something so as to get into a smaller space |
| 3. ignite | d) set on fire; take fire |
| 4. order | e) force a liquid, e.g. a medicine or fuel, into something with a |
| 5. popular | syringe, or a device that functions as a syringe |
| 6. conventional | f) someone or something that is liked and admired by a large |
| 7. inject | number of people |
| | g) something that belongs to and is used by one person or a |
| | group of persons, not by the public, in general |

2D Identify the defined item. Write the English term and its Greek equivalent in the space provided over each definition.

1.

The upper part of an engine cylinder where combustion takes place.

2.

The downward movement of a piston during which air (and fuel in petrol engines) enter(s) the cylinder.

3.

The upward movement of a piston during which the air (and fuel in petrol engines) is (are) compressed.

4.

The valves that open and close the port through which air (and fuel in the conventional petrol engines) enter(s) the cylinder.

5.

The system that produces the spark by which the explosive gases take fire in the combustion chamber of a gasoline engine.

6.

The system by which the fuel is forced in the combustion chamber in the form of tiny droplets and intermixes with air.

7.

A microprocessor which, connected to various sensors, monitors the operation of the car engine and the systems related to it.

3. Listening activity

The glow plugs

STEP 1

Your teacher is going to read a text about the glow plugs. Listen to it carefully and say what exactly it is about. Tick the correct alternatives below.

- The text
- a. is a description of the glow plug and its parts.
 - b. is a comparison of spark and glow plugs.
 - c. describes how the glow plugs work.



Glow plug

STEP 2

Read the sentences below to familiarise with them. Listen to the text about the glow plugs again. Then, tick the correct alternatives and fill in the gaps in the sentences.

- a. both petrol and diesel engines
 - b. diesel engines
 - c. petrol engines
1. The glow plugs are fitted to to help them start from in weather.
- a. an on/off switch.
 - b. a special ignition switch.
 - c. a heating element.
2. A glow plug is

3. Glow plugs produce
 a. heat to help the fuel/air mixture ignite.
 b. sparks
4. In modern cars, the glow plugs are controlled
 a. by the driver.
 b. by the ECU.
5. Modern cars have
 a. one glow plug for all the cylinders.
 b. one glow plug for every two cylinders.
 c. one glow plug per cylinder.
6. Glow plugs are switched
 a. immediately after the engine has started working.
 b. as soon as the ignition switch is turned.
 c. a little before the ignition switch is turned.
7. We know that the glow plugs are working when a warning on the instrument comes on.
8. When the glow plugs are enough to start the engine, the light goes
9. If the driver doesn't wait for the to out, the engine may not and if it does, it will a lot of smoke.
10. Glow plugs have a
 a. short a. frequent
 b. medium lifespan, so they need
 c. long b. rare checking
 c. no
 and renewal.
11. When the engine has problems or it is time to it with

STEP 3

While listening to the text for a third time, check your answers and complete the rest. Check in class.

Follow up

Look through the sentences above to find the English equivalent term or phrase to the following:

1. πυράκτωση, λάμψη -
2. ανανέωση, αντικατάσταση -
3. πίνακας οργάνων -
4. διάρκεια ζωής -
5. το προειδοποιητικό φως ανάβει / σβήνει -
6. το αυτοκίνητο βγάζει καπνό -

4. Language functions

4A Comparing

Use the table you completed in Exercise 1D, to compare the three ICE types as in the examples below.

- **All** three engines / types of engines have cylinders.
- **Both** conventional and modern petrol engines have spark plugs.
- **Only** conventional gasoline engines have carburettors.
- **Neither** conventional, **nor** modern petrol engines operate on diesel oil.
- **In** diesel engines, the fuel is self-ignited

but / while /whereas
on the contrary,
on the other hand,

..... in gasoline engines, it is ignited by means of a spark.

4B Presenting similarities and differences

Examples

- The cylinder of a gasoline engine is **the same as** / **similar to** (that of) a diesel engine.
- **Like** gasoline, diesel engines belong to the I.C.E.
- **Unlike** the four-stroke engines, the two-stroke ones don't have valves in their cylinders.
- Conventional petrol engines have carburettors; modern petrol-engined cars, have injectors, **instead**.

- The distributor of an engine with a primary electronic ignition **is different / differs from** that of a conventional engine. It has a transistor **instead of** a contact breaker.
- Diesel oil is not **so / as** expensive **as** unleaded fuel is.

Apart from the expressions you used in Exercise 4A, the words or phrases included in the table below are widely used when comparing two items.

In case of	
Similarity	Difference
Like ..., ... is/are/has/have ...	Unlike ..., ... is/are/has/have ...
... is/are similar to ...	... is/are different (from) ...
... is/are the same as ...	... differ from ... (in that) ...
... have/has/use(s) ... as ... do/does	... have/has ... instead (of) ...
... is/are as + adjective + as ...	... is/are not so/as + adjective + as ...

■ Practice ■

Use expressions from the above table to make meaningful sentences out of the prompts below.

1. Turbine steam engines ↔ gasoline engines (*ECEs ↔ ICEs*)
2. Engine without turbocharger ↔ engine with turbocharger (*efficient*)
3. ECEs ↔ ICEs (*used in automobiles*)
4. Gasoline engine ↔ diesel-oil engine (*mechanical parts*)
5. Gasoline engine ↔ diesel-oil engine (*the type of fuel they operate on / use*)
6. Operation of conventional cars ↔ operation of modern cars (*complex*)
7. Gasoline engines ↔ diesel engines (*lubrication system*)
8. Conventional cars ↔ modern cars (*equipped with a computer that controls the functions of the engine*)
9. Wankel engines ↔ Otto engines (*ICEs*)
10. The f/a mixture the engine needs: under steady load conditions ↔ for a cold starting
11. Conventional gasoline engines ↔ engines equipped with fuel injection (*save fuel and reduce air pollution*)

5. Writing activity

Taking your information from the texts, tables and exercises in this unit, write a text comparing modern diesel-oil and gasoline engines.

Ideas to include

- Classification
 - Uses
 - Main similarities
 - Main differences
 - Comparison of properties
- of the two types of engines

Don't forget to split your text into paragraphs.
to use linking words to connect your sentences and paragraphs.

Useful tools

Socket wrenches for glow plugs (USAG)

Εργαλεία /καρυδάκια αφαίρεσης
των αντιστάσεων προθέρμανσης
της πετρελαιομηχανής



Glow-plug tester (Facom)

Εργαλείο ελέγχου της αντίστασης
προθέρμανσης του πετρελαιοκινητήρα



Compression tester (Facom)

Εργαλείο ελέγχου πίεσης κυλίνδρων

Vocabulary – Terminology

means of transport μέσα μεταφοράς	solid state switch ξηρός διακόπτης
power plant σταθμός παραγωγής ηλεκτρικής ενέργειας	device συσκευή, επινόηση
essential βασικός, ουσιαστικός	costly ακριβός
order σειρά, διάταξη, εντολή, παραγγελία, διαταγή, διατάσσω, διατάζω, παραγγέλλω	drawback μειονέκτημα
admit αφήνω να περάσει, δέχομαι	process μέθοδος, διαδικασία
conventional συμβατικός, συνηθισμένος, παραδοσιακός, παλιός, παλαιάς τεχνολογίας	rate τιμή, αξία, βαθμός, τάξη, αναλογία, εκτιμώ, διατιμώ, βαθμολογώ
simultaneously ταυτόχρονα, συγχρόνως	amount ποσό
intermix αναμιγνύω, -ομαι	set on fire βάζω φωτιά, αναφλέγω, -ομαι
vaporise μετατρέπω σε αέριο, εξατμίζω, -ομαι	port θύρα, θυρίδα, λιμάνι
self-ignition point σημείο αυτοανάφλεξης	droplet σταγονίδιο
therefore γι' αυτό, κατόπιν τούτου	whereas ενώ
ratio λόγος, αναλογία	regardless of ανεξάρτητα από
compression ratio λόγος συμπίεσης	start up εκκίνηση
acceleration επιτάχυνση	glow πυρακτώνω, λάμπω, λαμπιρίζω, πυράκτωση, λάμψη
revolution περιστροφή	glow plug αντίσταση / ηλεκτρόδιο προθέρμανσης
despite παρά το/τη...(αντίθεση)	heating element θερμαντικό στοιχείο
popular δημοφιλής, λαϊκός	heater θερμαντήρας
carburettor αναμκτήρας, εξαερωτήρας, καρμπυρατέρ	instrument όργανο
distributor διανομέας, ντιστριμπυτέρ	panel πίνακας
primary πρωταρχικός, πρώιμος	warn προειδοποιώ
contact breaker αυτόματος διακόπτης, διακόπτης (επαφής) πλατινών, πλατίνες	lifespan διάρκεια ζωής
	renewal ανανέωση, αντικατάσταση

UNIT 16

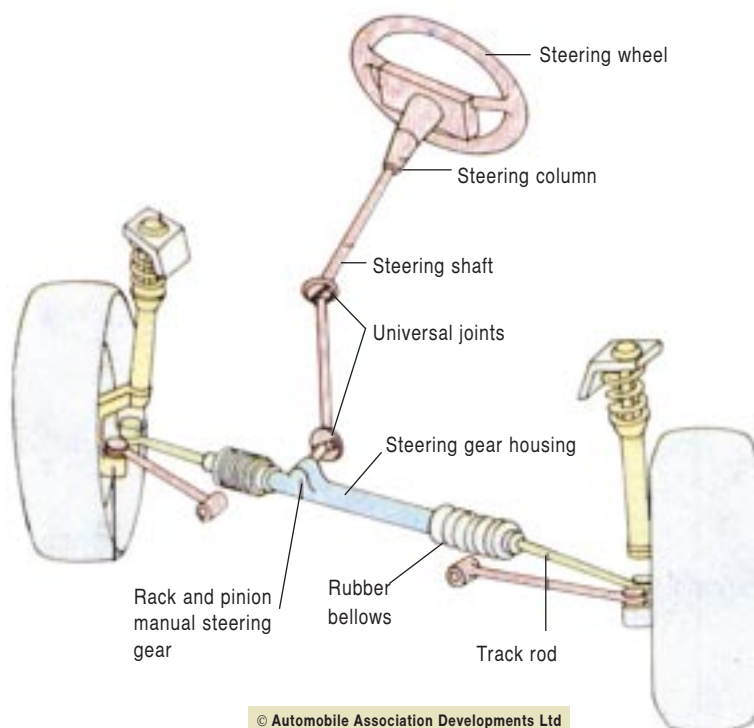
The steering system

Learning goals

Reading: Presenting the function and parts of the manual and power steering systems and their operation.

Vocabulary: Related to the above. Definitions, synonyms, antonyms.

Writing: How the power steering system operates (Description).



The function of the steering system

The steering system permits the driver to turn the vehicle and change direction. It has to work in conjunction with the suspension system to ensure that the passengers have a comfortable ride but at the same time, it has to enable the driver to keep the car pointing straight ahead, even if it hits on a pavement or other object on the road at high speed, or if he drives on a road with bumps and irregularities. It should also permit the driver to steer the car without applying too much effort but, at the same time, it must enable him to feel what is happening to the front wheels.

The system consists of the steering wheel, the steering column, the steering shaft, the manual steering gear, the tie or track rods and the steering arms, that transmit the movement of the steering gear to the wheels.

Warm up

How much do you know about the steering system? Check your knowledge.

Choose the correct alternatives and complete the sentences below. More than one answers may be correct.

1. The steering wheel is attached to the steering shaft by a
 - a) ball joint.
 - b) universal joint.
 - c) splined joint.
2. The airbag system is contained in the
 - a) steering wheel.
 - b) steering column.
 - c) steering shaft.
3. The steering wheel adjustment comprises the steering wheel
 - a) raising and lowering mechanism.
 - b) lock mechanism.
 - c) rake mechanism.
4. The steering shaft is made of
 - a) steel.
 - b) aluminium.
 - c) cast iron.

5. On modern cars, the steering column consists of
 - a) one
 - b) two
 - c) three
 parts.
6. The steering shaft ends in a
 - a) ball joint.
 - b) universal joint.
 - c) pinion.
7. The manual steering gear consists of a
 - a) pump.
 - b) pinion.
 - c) piston.
 - d) rack.
 - e) casing.
 - f) control valve.
8. The steering gear is lubricated by
 - a) grease.
 - b) oil.
 - c) a special kind of fluid.
9. When the steering wheel is turned,
 - a) the pinion moves to the left or to the right on the rack.
 - b) the pinion pushes the rack to the left or to the right.
 - c) both the pinion and the rack move.
10. The tie rods are connected to the steering gear and the steering arms by
 - a) splined joints.
 - b) universal joints.
 - c) ball joints.

Read the texts that follow and check your answers. Correct the wrong ones.

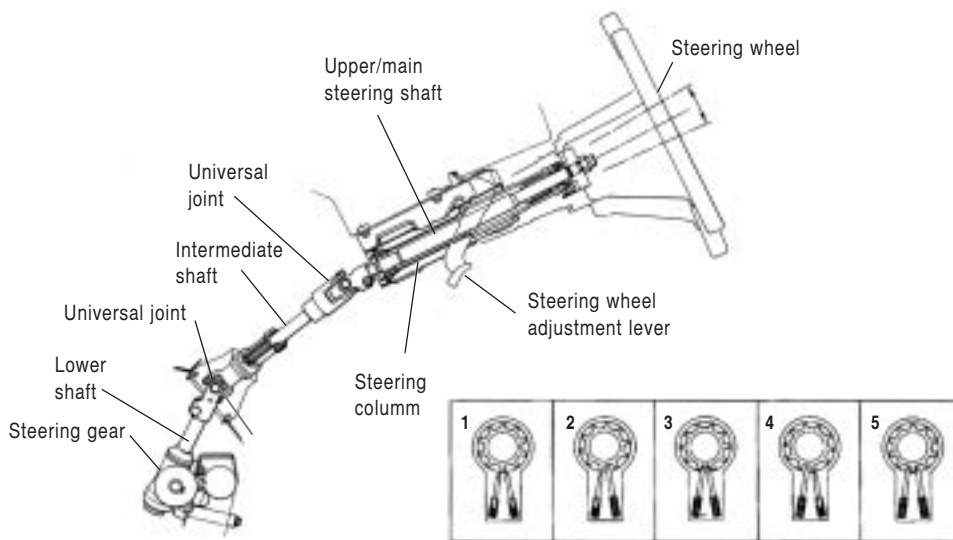
The main parts of the steering system

The steering wheel is a hand wheel that permits the driver to steer the vehicle. It is mounted on the steering column and attached to the steering shaft by means of a splined joint. On modern cars, the steering wheel carries the airbag system and the horn. The movement of the steering wheel is transmitted to the steering gear by means of the steering shaft.

The steering shaft is a rod or tube, made of either aluminium or steel, that connects the steering wheel to the steering gear. On modern cars, the steering shaft is divided

into two (upper and lower) or, most often, into three (upper, intermediate and lower) parts by universal joints which make the steering wheel adjustments possible.

The upper part of the steering shaft, usually referred to as the main steering shaft, is enclosed in the steering column. The steering column is an inclined pipe that comprises the steering wheel lock and the mechanism for the steering wheel adjustment, that is, the steering wheel raising / lowering and rake mechanisms. The steering wheel rake can be set in different positions. The rake and the raising or lowering of the steering wheel is set by a lever which is located on the left side, under the steering wheel. On most cars, the indicator lights and the headlights are controlled by levers or switches located on the steering column.



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The steering wheel lock in different positions
(Position 1 displays the driving position and positions 2-5 the lock activated)

Safety devices

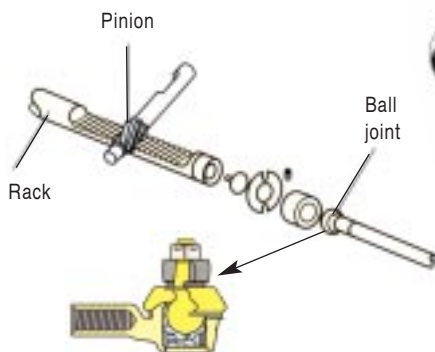


The steering wheel spokes are made of sheet steel that deforms in case of a collision, if the load is too great.

The main shaft is further divided to prevent intrusion into the passenger compartment in a collision. There is a rubber isolator in the division. In case of a collision, the lower part of the main shaft is pushed together.

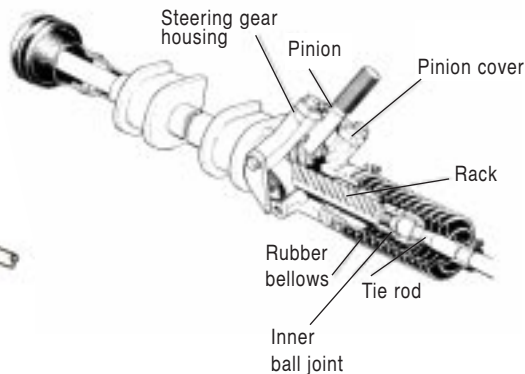
There is also a collapsible coupling integrated in the steering column.

The manual steering gear



The pinion is on the upper side of the rack

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The pinion is placed under the rack

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On the lower end of the steering shaft, there is a pinion that connects the steering shaft to the steering gear, which is enclosed in a casing, usually referred to as the steering gear housing. The steering gear is of the rack and pinion type and grease lubricated.

The pinion mates with the rack, which is like a gearwheel opened up and laid flat. The pinion is placed either on the upper side or at the underside of the rack, depending on the manufacturer. When the steering wheel is turned, the pinion turns moving the rack either to the left or to the right, depending on the direction to which the steering wheel is turned.

When the driver turns the steering wheel to the right, the rack is pushed by the pinion to the left, if the pinion is placed on its upper side, or to the right, if the pinion meshes with it on its underside.

When the steering wheel is turned to the left, the rack is pushed to the right, if the pinion is placed on its upper side, or to the left, if the pinion meshes with it on its underside.

The steering gear is connected to the tie rods by ball joints which are fastened directly onto the steering rack and protected by rubber bellows. Another pair of ball joints, fixed on the outer side of the tie rods, connects the rods to the steering arms. The outer end of the steering arms is attached to the road wheels by ball joints, too.

TASK

Fill in the gaps in the sentences below with the main components of the steering system and their parts.

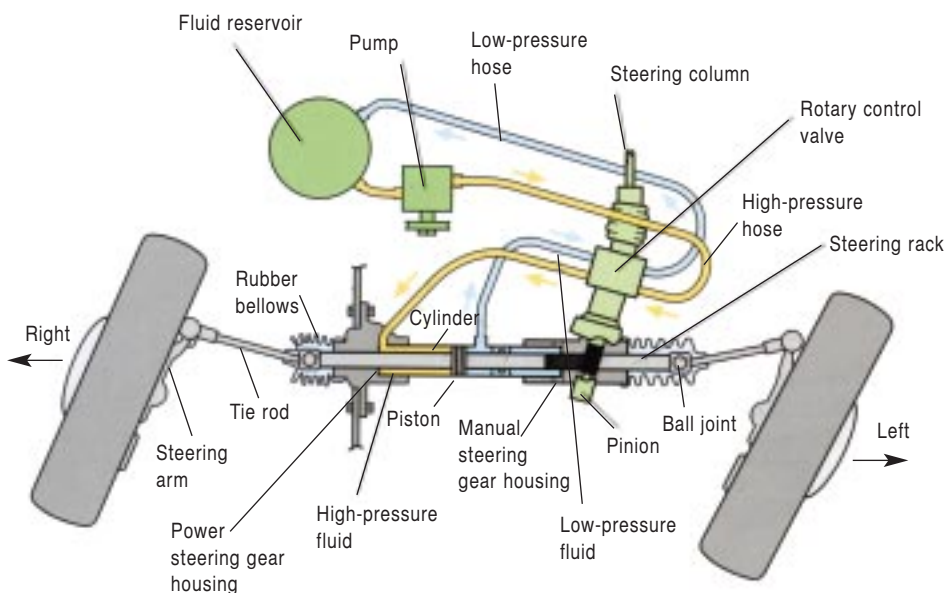
The steering system comprises:

1. The wheel that carries:
 - a) the which are made of sheet steel,
 - b) the system, and
 - c) the horn.
2. The that comprises:
 - a) the steering mechanisms (= the steering wheel / lowering and mechanisms)
 - b) the steering wheel, and
 - c) various levers and for controlling the lights and the
3. The shaft, which is divided either into two parts: the upper or and the, or into three parts: the or, the, and the by joints.
4. The manual which consists of:
 - a) a, known as the steering gear,
 - b) a attached to the lower shaft, and
 - c) the that ends in joints covered by rubber or gaiters.
5. The or rods.
6. The steering which are connected to the road wheels by joints.

The power-assisted steering

In the early 1950s, manufacturers equipped passenger cars with a hydraulically-operated servo-mechanism, commonly known as power (assisted) steering, which functions as a booster that increases the force applied by the driver when he is turning the steering wheel. This is done by hydraulic pressure, which is supplied by a pump*. Most cars now-a-days are equipped with power steering.

On these cars, the mechanical and servo-assisted elements are usually combined in one module by an outer pipe. This pipe also acts as the working cylinder for the piston of the power-steering gear. In this way, even if the servo-assistance is lost, the mechanical steering will remain steering. The mechanical element of the steering gear is separated from the servo element with seals.



Typical power-steering layout

(The pinion moves on the upper side of the rack)

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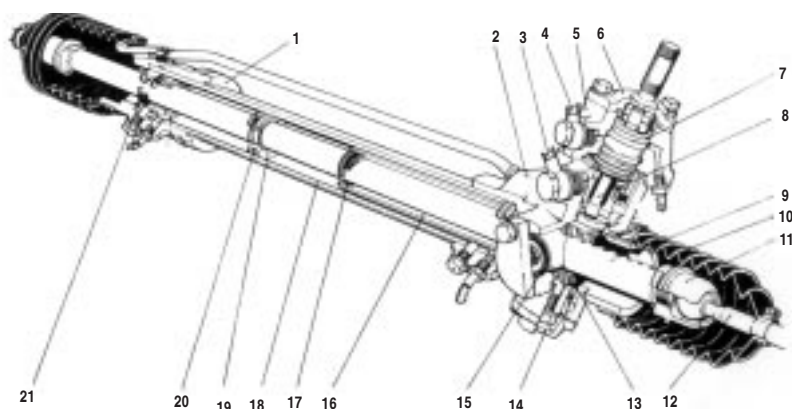
The power steering system consists of:

- a reservoir where the power-steering fluid is stored,
- a pump that increases the pressure of the fluid,
- two hoses: a) the steering pump high-pressure hose that connects the pump to the

* The power steering fluid pump is driven by the auxiliary (or accessories) drive belt, which is driven by the crankshaft.

valve housing, and b) the low-pressure hose, that returns the low-pressure fluid from the valve housing to the reservoir,

- a cylinder, secured to the manual-steering gear housing, that is full of the power-steering fluid and acts as the power-assisted steering gear housing,
- a double action piston which is attached to the steering rack and moves in the power-steering fluid that fills the cylinder,
- the valve housing, which consist of a rotary control valve that controls the flow of the power steering fluid, and
- two external flexible pipes that connect the control valve to each side of the piston.



Power steering gear on a left-hand drive car (The pinion is placed under car rack)

1 Power-steering gear housing	8 Torsion rod	15 O-ring
2 Manual steering gear housing	9 Rack	16 Inner tube
3 Fluid return connection	10 Protective bellows	17 Seal
4 Fluid pressure connection	11 Inner ball joint	18 Outer tube
5 Valve housing	12 Tie rod	19 Piston
6 Valve housing cover	13 Pinion	20 Piston seal
7 Valve assembly on input shaft	14 Lower pinion cover	21 Seal

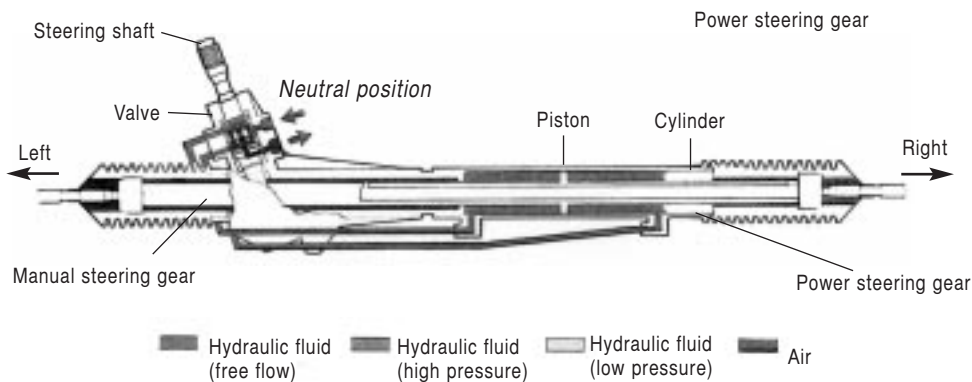
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How the power steering system operates

The valve is activated by the steering wheel turning. Depending on the direction to which the steering wheel is turned, as well as on the side of the rack on which the pinion is placed, either the left or the right side of the valve opens for fluid pressure. In other words, when the driver turns the steering wheel, fluid under pressure is let to flow into the cylinder of the power-steering gear either to the left or to the right side of the piston (always the opposite to the direction of the piston's movement). The fluid pushes the piston towards the direction of its flow. As the piston moves, it either

pushes or it draws the rack towards the appropriate direction, thus amplifying the effort that the driver applies on the steering wheel.

On a left-hand drive car, to push the rack to the left, the right side of the valve opens to send high-pressure fluid to the right side of the cylinder; to draw the rack to the right, the left side of the valve opens to send fluid under high pressure to the left side of the cylinder.



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TASK



Name the parts of the power-steering system and give their Greek equivalent.

1. Reading comprehension

1A Answer the questions.

- Which are the factors that should be taken into consideration when designing the steering system of a vehicle so as to ensure the safety and comfort of the driver and the passengers?
- What is the function of the universal joints on the steering shaft?
- How is the steering-wheel adjustment mechanism controlled?
- What is the rack?
- What happens to the manual-steering gear when the driver turns the steering wheel?
- What is the power-assisted steering?
- How is the flow of the high-pressure fluid in the power-steering gear controlled?
- What is the function of the double action piston?
- How does the power-steering system operate?

- 1B** The two paragraphs below describe how the power-assisted steering system operates on a left-hand-drive car with the pinion placed on the upper side of the rack.

Fill in the gaps in the paragraphs with either left or right. (*The coloured picture of the power steering system on p. 221 will help you. In this picture, the steering wheel is turned to the right. To see what is happening, it is more convenient to turn your book upside-down.*)

1st paragraph

The driver turns the steering wheel to the right. This movement is transferred by the steering shaft to the pinion. As the pinion turns to the, it pushes the steering rack to the In the meanwhile, as the steering wheel is turned, the side of the control valve opens allowing fluid under pressure to flow through the hose and enter the side of the cylinder. The high-pressure fluid pushes the piston to the Since the piston is attached to the rack, it pushes the rack to the, thus amplifying the force applied by the driver to the steering wheel. In this way, the effort required by the driver to turn the steering wheel is decreased.

2nd paragraph

The driver turns the steering wheel to the left. This movement is transferred by the steering shaft to the pinion. As the pinion turns to the, it pushes the steering rack to the Meanwhile, the pump sends steering fluid under pressure through the high-pressure hose to the control valve. The control valve, activated by the turning of the steering wheel, opens its side and lets fluid under pressure to flow through the hose to the side of the cylinder which includes the piston. The high-pressure fluid pushes the piston to the The piston, draws the rack to the, thus amplifying the force applied by the driver to the steering wheel. In this way, the turning of the road wheels becomes easier and thus the effort required by the driver to turn the steering wheel is decreased.

1. Vocabulary practice

2A Which words in the introductory paragraph could be replaced with the following?

1. allows:
2. function:
3. combination; connection; cooperation:
4. secure:
5. journey; trip:
6. sidewalk:
7. using:
8. comprises:

2B Match words with definitions.

Verbs

- | | |
|-------------|---|
| 1. assist | a) be connected to, suit, fit another thing |
| 2. apply | b) control a vehicle, so that it goes to the direction that you want |
| 3. amplify | c) cause a device to start working, actuate it |
| 2. activate | d) increase the strength, effort, intensity of something |
| 5. deform | e) help someone or something to do a job or task by doing part of the work for them |
| 6. steer | f) use something, e.g. force or method, in a situation or activity |
| 7. mate | g) cause something to take another shape |

Nouns

- | | |
|--------------|--|
| 1. collision | a) a long, thin metal bar |
| 2. module | b) a device used for blowing air into the fire or a balloon; also a device having the same shape |
| 3. rod | c) a device that increases, improves or makes something more successful |
| 4. reservoir | d) a part of a machine, system, etc; a unit |
| 5. booster | e) a long flexible pipe made of plastic or rubber |
| 6. hose | f) what occurs when an object, e.g. a car, crashes into something |
| 7. bellows | g) a quantity of something available when needed |

2C Give the English or Greek equivalent to the following phrases or sentences.

1. Το αυτοκίνητο

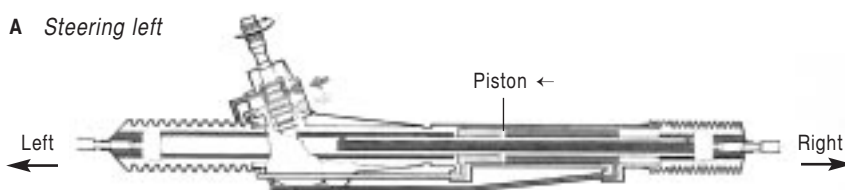
- a) άλλαξε κατεύθυνση.
 - b) στρίβει.
 - c) πηγαίνει ευθεία / κρατά ευθύγραμμη πορεία.
2. The road is full of bumps and irregularities.
3. A collapsible coupling is integrated in the steering column.
4. Ο κύριος άξονας του τιμονιού χωρίζεται παραπέρα / σε ακόμη περισσότερα μέρη για να αποφευχθεί η διεύθυνσή του στο χώρο των επιβατών σε περίπτωση σύγκρουσης.
5. In case of a collision, the lower part of the main steering shaft is pushed together and the wheelspokes deform.
6. Η κλίση και το ύψος του τιμονιού ρυθμίζονται από ένα μοχλό στην κολώνα του τιμονιού.
7. Στα παλιότερα αυτοκίνητα έπρεπε να καταβάλεις σχετικά μεγάλη προσπάθεια για να στρίψεις το τιμόνι.

3. Writing activity

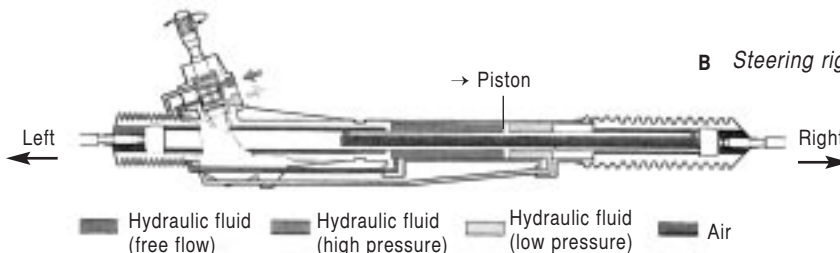
The two schematic representations below illustrate how the power-transmission system operates on left-hand drive cars with the pinion placed on the underside of the rack. The steering gear is placed as if you were sitting on the driver's seat, that is, the left or right side of the car is the same as your left- / right-hand side.

Study the pictures and then write a paragraph describing what happens when the driver turns the wheel a) to the left and b) to the right.

A Steering left



B Steering right



Hydraulic fluid (free flow)
 Hydraulic fluid (high pressure)
 Hydraulic fluid (low pressure)
 Air

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Useful tools



Extractors for steering wheels (USAG)
Εξολκείς τιμονιών



Extractors for ball and socket joints (USAG)
Εξολκείς για συνδέσμους μπίλιας, κ.λ.π.)

Vocabulary - Terminology

direction κατεύθυνση

conjunction συνδυασμός, σύνδεσμος

ahead εμπρός

pavement πεζοδρόμιο

bump σαμάρι (στο δρόμο)

irregularities ανωμαλίες (στο οδόστρωμα)

steering wheel τιμόνι, τροχός διεύθυνσης

steering column κολώνα διεύθυνσης / τιμονιού

steering shaft άξονας διεύθυνσης

steering gear κιβώτιο διεύθυνσης

tie / track rod μπαροτίμονο, μπάρα

steering arm ακρόμπαρο, άκρο

rod ράβδος

main steering shaft ο κύριος (το επάνω τμήμα του) άξονα διεύθυνσης

intermediate steering shaft ενδιάμεσος / μεταίτιος άξονας διεύθυνσης

inclined λοξός, επικλινής, κεκλιμένος

steering wheel lock ο μηχανισμός κλειδώματος του τιμονιού, το κλείδωμα τιμονιού

steering wheel adjustment mechanism ο μηχανισμός ρύθμισης του τιμονιού

steering wheel rake mechanism ο μηχανισμός που ρυθμίζει την απόσταση και κλίση του τιμονιού ως προς τον οδηγό

steering wheel raising/lowering mechanism ο μηχανισμός ρύθμισης του τιμονιού ως προς το ύψος

set ρυθμίζω, ρύθμιση

rack and pinion steering system σύστημα ατέρμονα και κοχλία

rack ατέρμονας κοχλίας

mate ταιριάζω, συμπλέκομαι, ζευγαρώνω, ταιριάζω, φιλαράκι

steering gear housing κουτί ατέρμονα / τιμονιού

ball joint σύνδεσμος με μπίλια

bellow φουσερό, φουσητήρας, κάλυμμα μορφής φουσερού

steering wheelspokes οι ακτίνες του τιμονιού

sheet steel φύλλα χάλυβα

deform παραμορφώνω

collision σύγκρουση

load φορτίο

integrated ενταγμένος, συγχωνευμένος

intrusion διείσδυση

passenger compartment χώρος, διαμέρισμα επιβατών

isolate απομονώνω

the shaft is pushed together μπαίνει το ένα κομμάτι του άξονα διεύθυνσης μέσα στο άλλο

collapsible coupling σπαστός σύνδεσμος
fasten στερεώνω
servo-mechanism μηχανισμός υποβοήθησης
power-assisted steering σύστημα διεύθυνσης με υδραυλική υποβοήθηση
assist βοηθώ
assistance βοήθεια, υποβοήθηση
booster ενισχυτής
module μονάδα, στοιχείο
seal φραγή, στεγανοποίηση, εξάρτημα (π.χ. δακτύλιος) στεγανοποίησης

hydraulic pressure υδραυλική πίεση
reservoir απόθεμα, ταμειυτήρας, δεξαμενή, ρεζερβουάρ
hose εύκαμπτος σωλήνας
steering valve housing = περίβλημα / κάλυμμα / θήκη βαλβίδας
rotary control valve περιστροφική βαλβίδα ελέγχου
activate ενεργοποιώ
amplify ενισχύω

UNIT 17

The suspension system; its components and their operation

Learning objectives

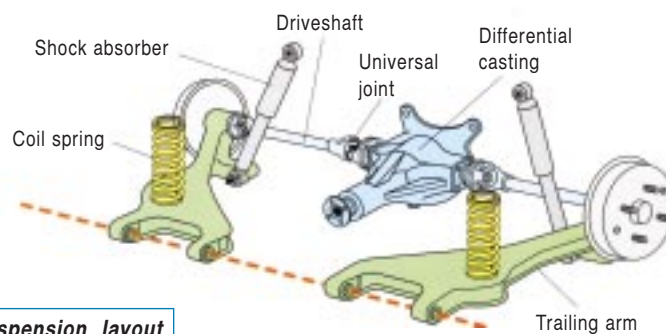
Reading comprehension: Understanding the positioning of components.

Vocabulary: Words related to front and rear suspension.

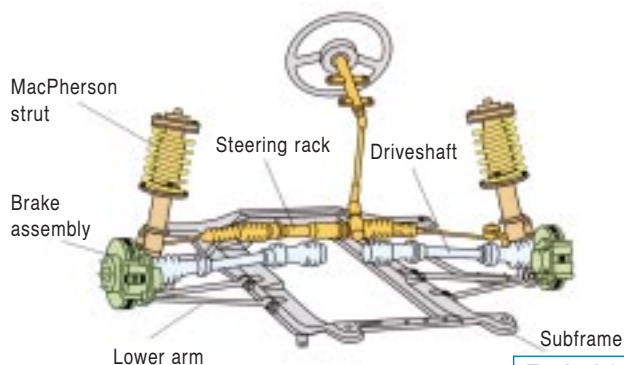
Listening: Understanding and consolidating location (of components).

Language functions: Giving instructions (imperative form).

Use of English: Using the appropriate prepositions after specific verbs and after or before nouns / phrases.



Typical rear suspension layout

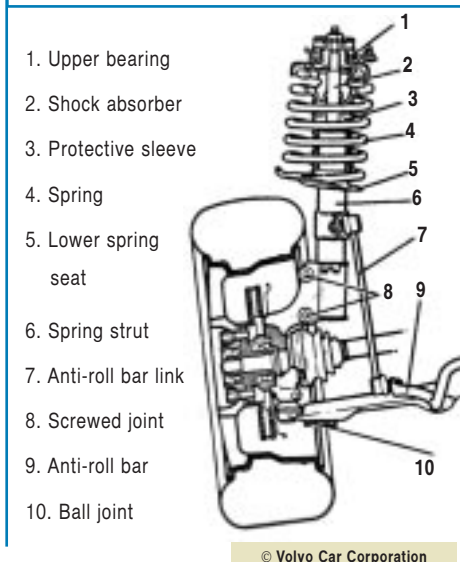
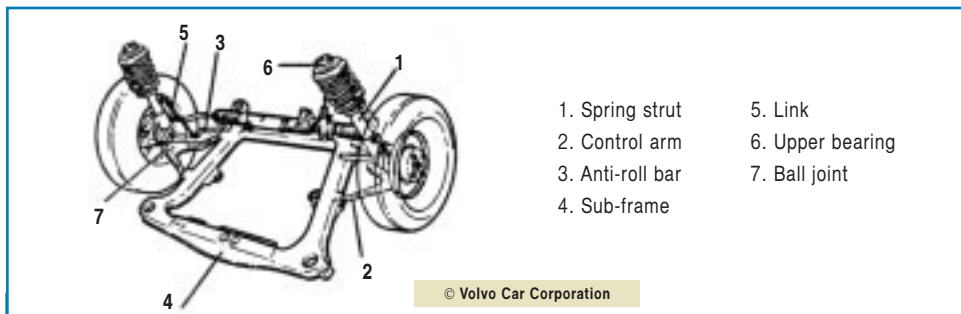


Typical front suspension layout

The suspension system is the arrangement of springs, spring struts, links, anti-roll bars, shock absorbers etc in a vehicle, connecting the wheel-suspension units or axles to the chassis frame.

Each car is equipped with a suspension system for the front and rear wheels (front and rear suspension). Today, most family cars have a front wheel drive. Heavy and executive cars have a rear or four wheel drive.

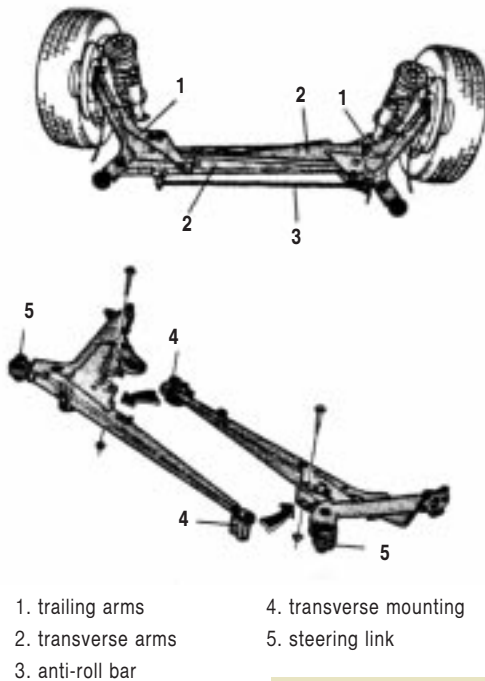
The main front suspension components for front wheel drive cars are the following: There is a spring strut and control arm on each side. The anti-roll bar (stabilizer) is between the spring struts. The anti-roll bar is fixed to the sub-frame with two clamps and to the spring strut with short link rods. The upper end of the spring strut is attached to the wheel arch via an upper bearing. The lower end of the spring strut is attached to the stub axle with a screwed joint. The control arm is connected to the stub axle with a ball joint. The toe in is adjustable. In certain cases the front wheel camber angle can be adjusted.



Spring strut

The spring strut consists of a tube, the lower end of which is fixed with a screwed joint. The ball joint is secured in the lower part of the stub axle. The lower spring strut seat is welded to the upper part of the tube. The shock absorber is located in the tube and is held in place by a screw in the upper end and a seat in the bottom of the tube. The shock absorber piston rod is guided by the upper bearing. The upper bearing is secured in the wheel arch and supports the spring.

The main rear suspension components for modern front wheel drive cars are the following:



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The rear suspension consists of two front-rear trailing arms with integrated transverse arms. The rear wheels are suspended on the trailing arms.

The rear suspension also includes an anti-roll bar. The transverse arms are supported in a transverse mounting in the opposite trailing arm. In principle, both trailing arms with the transverse arms operate as a unit, however rubber bushings allow a degree of movement in relationship to each other. Each trailing arm is mounted to the body via a steering link (rear axle link). The steering link allows the wheel limited pre-determined changes in direction. The steering link system compensates for the rear axle elasticity by resisting lateral forces.

When the bodywork is subjected to lateral force during cornering, the rear wheels move sideways without affecting the steering. This design allows the car to retain neutral steering, making it stable and easy to control.

1. Reading comprehension

Choose the correct item to complete the sentences.

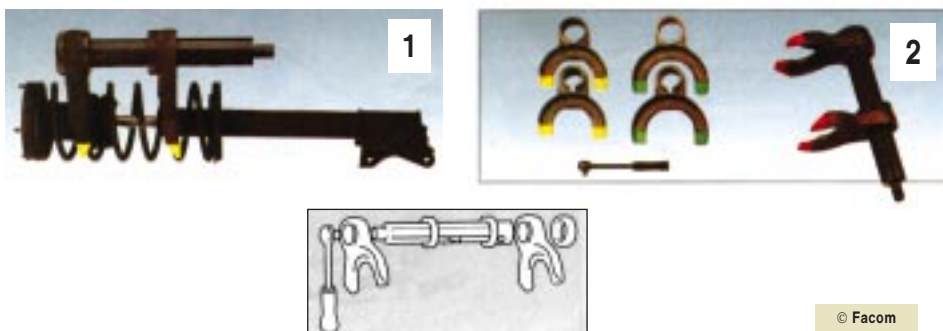
1. The suspension system connects the wheel-suspension units or axle to the
 - a. chassis frame.
 - b. combustion engine.
 - c. cylinders.
2. The anti-roll bar (stabilizer) is between
 - a. the control arms.
 - b. the spring struts.
 - c. the ball joints

3. The control arm is connected to the stub axle
 - a. with a ball joint.
 - b. through a welding process.
 - c. with a bolt.
4. The spring strut consists of a tube the lower end of which is fixed with a
 - a. bracket.
 - b. rivet.
 - c. screwed joint.
5. The shock absorber is located in the tube and is held in place by a screw in the
 - a. upper end and a seat in the bottom of the tube.
 - b. lower end and a seat in the bottom of the tube.
 - c. upper end and a seat in the top of the tube.
6. The rear suspension consists of
 - a. two front-rear trailing arms.
 - b. transverse arms.
 - c. two front-rear trailing arms with integrated transverse arms.
7. The steering link allows
 - a. the wheel unlimited pre-determined changes in direction.
 - b. the wheel limited pre-determined changes in direction.
 - c. the driver to control the car when driving on rough soil.
8. The rear suspension design allows the car
 - a. to retain neutral steering making it stable and easy to control.
 - b. to retain neutral steering making it stable but difficult to control.
 - c. to retain neutral steering making it unstable and difficult to control.

Useful tools for the suspension system



Driveshaft extractor



© Facom

(1) The interchangeable-fork spring compressor and removal tool with its standard set (2) including spring compressor body, red forks, yellow forks and green forks

2. Vocabulary practice

2A Complete the gaps in the following table.

	verb	noun
1	suspend	.....
2	.....	operation
3	.....	attachment
4	screw	.....
5	.....	welding
6	.....	location
7	support	.....
8	.....	integration
9	.....	mounting
10	compensate	.....
11	.....	resistance
12	.....	steering

2B Complete the gaps at the end of each of the following definitions using the words: *clamp*, *wheel*, *spring*, *frame*, *link*, *component*, *lateral*, *bushing*, *bearing*, *sleeve*, *stable*, *seat*.

1. Part of a large or more complex object (e.g. a machine).
2. A length of twisted, coiled metal which returns to its shape or position after being pulled or pressed.

3. Movable piece or rod, connected with other parts by means of pivots or the like (for the purpose of transmitting motion).
4. A circular frame or disk arranged to revolve on an axis, as on or in a vehicle or machinery.
5. The main structure used in the process of building a vehicle, plane, ship etc.
6. A device for strengthening or supporting objects or fastening them together.
7. A supporting part of a structure.
8. A tubular piece, as of metal, fitting over a rod or the like.
9. Something on which the base of an object rests; the base itself.
10. A lining intended to insulate and protect from abrasion etc.
11. Pertaining or directed to a side.
12. Firm; steady.

3. Listening activity

Your teacher is going to read a text about the rear spring and the shock absorber. While listening, complete the gaps with the missing words.

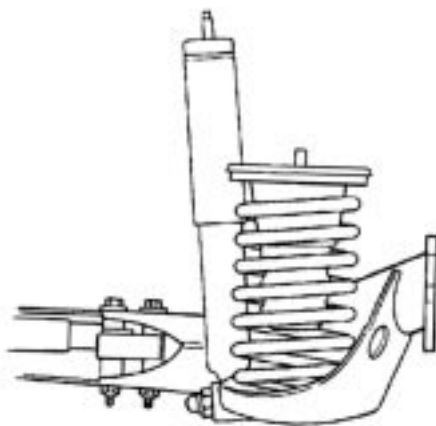
Rear spring

The rear springs are of the (1) and (2) at the top to the side member with a rubber spacer, a (3) and a screw and nut. The bottoms of the springs (4) in a seat in the (5) arms.

There are rubber bump stops mounted in the upper part of the springs to prevent the springs (6)

Shock absorber

The rear (7) are of the gas spring type and mounted to the trailing arms at the bottom and by a bracket to the (8) at the top. The bracket is



1. shock absorber
2. spring
3. rubber bump stop

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located with two⁽⁹⁾. Many cars can also⁽¹⁰⁾ with self-leveling shock absorbers in combination with other springs and anti-roll bar. There is an⁽¹¹⁾ mounted⁽¹²⁾ the trailing arms.

4. Language functions

Giving instructions

You are in the workshop and you are going to remove one of the rear shock-absorbers. Using the **imperative form**, instruct your partner **to do (or not to do)** the following:

1. not to jack up the rear of the car unless he chocks the front wheels
2. to support the rear of the car on axle stands
3. not to remove the roadwheel if it is not properly supported on the axle stands
4. to use a trolley jack for lifting the trailing arm
5. to unscrew and remove the bracket
6. to withdraw the shock absorber from under the vehicle

5. Use of English

Complete the gaps with the suitable preposition.

1. Each vehicle is equipped a suspension system.
2. There is a spring strut and a control arm each side.
3. The anti-roll bar is fixed the subframe.
4. The upper end the spring strut is attached the wheel arch.
5. The control arm is connected the stub axle a ball joint.
6. certain cases, the front wheel camber angle can be adjusted.
7. The spring strut consists a tube, the lower end which is fixed a screwed joint.
8. The shock absorber is located the tube.
9. The shock absorber piston rod is guided the upper bearing.
10. The steering link system compensates the rear axle elasticity resisting lateral forces.
11. When the bodywork is subjected lateral force during cornering the rear wheels move sideways affecting the steering.

Vocabulary – Terminology

suspension ανάρτηση	protective προστατευτικός
component εξάρτημα	sleeve δακτύλιος
operation λειτουργία	trailing arm υστερούντας βραχίονας
arrangement διάταξη	integrate ενοποιώ
spring ελατήριο, στοιχείο ανάρτησης μπουκάλας ελατηρίου	transverse arm εγκάρσιος βραχίονας
strut στύλος	suspend αναρτώ
spring strut σπειροειδές ελατήριο, μπουκάλα με ελατήριο	mounting μοντάρισμα, εφαρμογή, στήριξη
link βραχίονας, μπράτσο, αρμός	opposite απέναντι
anti-roll ζαφόν, αντιστρεπτή ράβδος, σταμπιλίζερ	in principle κατ'αρχήν, γενικά, κατά κανόνα
shock absorber αποσβεστήρας κραδασμών, αμορτισέρ	rubber πλαστικός / από καουτσούκ
connect συνδέω	bushing επίστρωση, επένδυση
wheel τροχός	mount μοντάρω, στερεώνω
unit μονάδα	steering link / rear axle link οδηγούντας βραχίονας
axle άξονας	compensate (for) αντισταθμίζω
frame σκελετός, πλαίσιο, σώμα, φέρων οργανισμός	elasticity ελαστικότητα
chassis frame φέροντας οργανισμός, «σασί»	resist ανθίσταμαι
front μπροστινός	lateral , πλευρικός
rear πίσω, όπισθεν	bodywork κινούμενο / εργαζόμενο σώμα
front wheel drive μπροστινή κίνηση	subjected (to) υποκείμενος σε
heavy car αυτοκίνητα βαρέως τύπου, βαρύ όχημα	corner παίρνω / στρίβω γωνία
executive cars αυτοκίνητα σπορ «γκαντ τουρίσμ» (μεγάλου τουρισμού), σπορ υπεραυτοκίνητο	sideways πλαγίως
control-arm ψαλίδι	affect επηρεάζω
fix «φιξάρω», ενσωματώνω, προσαρμόζω	steering έλεγχος / διεύθυνση τιμονιού, οδική συμπεριφορά
sub-frame κάτω μέρος σκελετού / σώματος	coil σωληνοειδής
clamp σφιγκτήρας, στήριγμα	side member πλευρικό σκέλος
rod ράβδος	spacer αποστάτης, θήκη
attach (to) συνδέω, δένω, προσαρμόζω	nut παξιμάδι
wheel arch θόλος ποδιάς / τροχού, εσωτερική ποδιά	bump stop τερματισμός / στοπ κραδασμών (τρανταγμάτων)
bearing πιάτο, έδρανο, ρουλεμάν	rubber bump stop ελαστικός αποστάτης
stub axle προεξέχοντας άξονας	bottoming τερματισμός
screwed joint ένωση με καρέ	bracket ενισχυτικό στήριγμα, στήριγμα με γωνίες
ball joint μπαλάκι (αρμού)	self-leveling shock absorbers αυτορυθμιζόμενα αμορτισέρ
toe in σύγκλιση	pivot άξονας περιστροφής, κύριος μοχλός
adjustable ρυθμιζόμενος	revolve περιστρέφομαι
camber angle γωνία κάμπερ	axis άξονας
adjust ρυθμίζω	tubular σωληνοειδής
tube σωλήνας	lining επίστρωση
secure στερεώνω, ασφαλίζω	abrasion τριβή, γδάρισμα
spring strut seat θήκη / βάση μπουκάλας ελατηρίου	jack γρύλλος, σηκώνω τμήμα αυτοκινήτου με γρύλλο
weld ηλεκτροσυγκολλώ	chock τάκος, στύλωμα, τακώνω, (απο)σύρω, αποσυνδέω
locate τοποθετώ	extractor εξολκέας
hold in place κρατώ σε θέση	driveshaft extractor εξολκέας ημιαξονίου, μαλάκας
screw βίδα	interchangeable-fork compressor and removal fork εξολκέας συμπιεστής ελατηρίων ανάρτησης

UNIT 18

The wheel angles and their alignment

Learning objectives

Reading comprehension: Understanding texts related to wheels, their angles and their alignment.

Vocabulary: Words related to the wheel angles, alignment, inclination and components related to the wheel systems.

Language functions: Checking and confirming information.

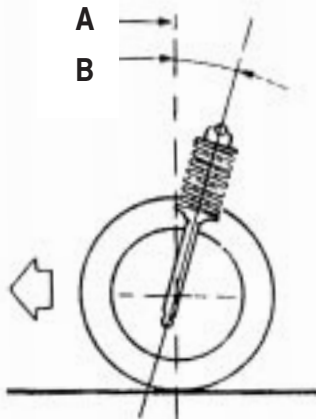
Use of English: Using negative prefixes to form opposites.

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For the car to have good steering properties and a minimum of tire wear, the wheels must be correctly aligned. The wheel angles include; caster (axle inclination), camber (wheel inclination), Ackerman angles, king pin inclination and toe-in/out.

Note! All measurements should be made with the car empty.



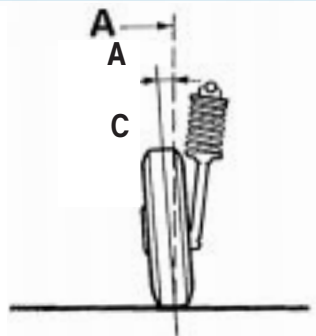
A. Vertical line

B. Caster

Caster

The caster angle (B) is the angle between vertical line (A) and a line which goes through the center of the lower ball joint and upper bearing (in other words a line through the spring strut). Caster encourages the wheel to travel straight forward and so makes steering easier. In addition, the greater the caster angle the greater the self-centering effect.

Note! Caster angle cannot be adjusted.



A. Vertical line

C. Camber

Camber

Camber (C) refers to the wheel leaning in or outwards. The angle is considered positive if the wheel leans outwards and negative if the wheel leans inwards.

Note! Camber can be adjusted within certain limits.



Negative camber



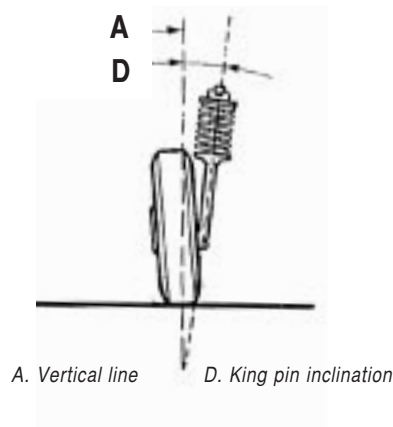
Positive camber

King pin inclination

Originally king pin inclination (D) referred to king pin lean. If the car does not have a king pin, the inclination corresponds to the angle between the vertical line (A) and a line through the spring strut.

A real king pin inclination ensures that the wheel turns easily and retains a self centering effect.

Note! King pin inclination cannot be adjusted.

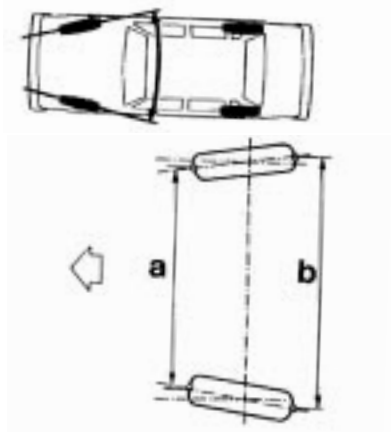


Toe in

With toe-in the front part of the wheel points inwards. Toe-in can either be measured as an angle or as a difference between measurement **a** and **b** (see the illustration).

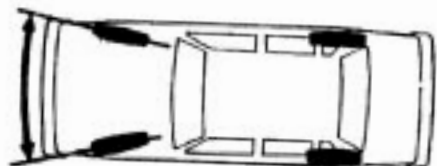
Correct toe-in gives the correct feeling from the road through the steering wheel and assists directional stability.

The toe-in angles are adjusted by the tie-rod length.



Toe-out

Toe-out or incorrect toe-in causes vibrations that increase tire wear. Tires slide sideways. Too much toe-in causes wear to the outer shoulders of the tires.



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Corrections before wheel alignment

The following may also affect the wheel angles. Before measuring and adjusting, the following faults should be rectified.

- | | |
|---|---|
| 1. Differing tire pressures | 6. Damaged steering gear |
| 2. Differing tire wear | 7. Play in the tie rods |
| 3. Play in the front wheel bearings | 8. Damaged upper shock absorber bearing. |
| 4. Play in the ball joint or control arm mounting | 9. Abnormal (temporary) equipment or load |
| 5. Broken springs | |

1. Reading comprehension

1A Answer the following questions.

1. Why must the wheels be correctly aligned?
2. Can the car carry a load when alignment measurements are made?
3. In what way does caster angle make steering easier?
4. Can caster angle be adjusted?
5. Does camber angle refer only to the wheel leaning inwards?
6. When is the camber angle considered positive and when is it considered negative?
7. What does a real king pin inclination ensure?
8. With toe in, what direction does the front part of wheels point to?
9. Why must the toe-in angles be always adjusted?
10. What does toe-out cause?

1B Say whether the following statements are True or False.

1. The axle inclination is known as *caster* and the wheel inclination is known as *camber*.
2. The smaller the caster angle, the greater the self-centering effect.
3. Camber cannot be adjusted.
4. King pin inclination can be adjusted.
5. The toe-in angles are adjusted by the tie-rod length.
6. Incorrect toe-out makes tires slide sideways.
7. Before measuring wheel alignment, among other things, you should check tire pressures, the steering gear, the tie rods and the upper shock absorbers' bearings.
8. Abnormal load on the car doesn't affect measuring and adjusting of the wheel angles.

2. Vocabulary practice

2A Match the words in column A with their definitions in column B.

A	B
a. property	1. loss of quality by continued use
b. wear	2. not bending or curving
c. vertical	3. a special quality that belongs to sth
d. straight	4. (of a line) at a right angle to the earth's surface or to another line
e. adjust	5. cause sth to happen as a result
f. effect	6. put right; change sth to make it suitable
g. limit	7. slope or slant
h. inclination	8. within or up to a certain amount, size, extent etc
i. stability	9. continuous and shaky movement
j. vibration	10. quality of being firm/stable

2B Match the words to form pairs of antonyms.

A	B
a. minimum	1. upper
b. correctly	2. back
c. lower	3. with difficulty
d. forward	4. similarity
e. positive	5. maximum
f. easily	6. negative
g. front	7. wrong
h. difference	8. wrongly
i. correct	9. backward
j. increase	10. decrease

3. Language functions

Checking and confirming information

In the flow of communication, the person who is listening to another one may need some techniques for handling information. Some of them are shown in the following examples.

a. asking for clarification

speaker: For the car to have good steering properties, the wheels must be correctly aligned.

listener: *What exactly do you mean by "good steering properties"?*

or *Could you tell us a bit more about the good steering properties?*

b. Asking for verification

speaker: Caster angle can't be adjusted

listener: *Did you say can or can't?*

or *Let me just check. You said can't. Right?*

or *You said can't, didn't you?*

c. Making a request

speaker: The toe-in angles are adjusted by the toe-rod length.

listener: *Could you repeat what you said, please?*

or *Could you say that again, please?*

or *Would you mind repeating that, please?*

d. Correcting information

speaker: Camber can't be adjusted.

listener: *Excuse me. It can be adjusted within certain limits.*

or *Sorry, I think you made a mistake. Camber can be adjusted within certain limits.*

NOTE



Sometimes the speaker may want to reinforce what he/she has said, or to summarise the main points. In such cases he/she:

a. paraphrases

- *In other words, king pin inclination cannot be adjusted.*
- *What I mean is that king pin inclination cannot be adjusted.*

b. summarises

- *Let me just repeat that a real king pin inclination retains a self-centering effect.*
- *Let me go over the main point again. A real king pin inclination ensures that the wheel turns easily and retains a self-centering effect.*

Practice

Based on the above techniques, check and / or confirm the following information.

1. Caster encourages the wheel to travel straight forward.
2. The camber angle is considered positive if the wheel leans outwards.
3. Caster angle can be adjusted.
4. Incorrect toe-in causes vibrations that increase tire wear.

4. Use of english

Negative prefixes

We can use a negative prefix to form an opposite. Common negative prefixes are:

un, dis, in, il(+l), im (+m or p), ir (+r), non-

examples

changed – **unchanged**

organized – **disorganized**

direct – **indirect**

legal – **illegal**

proper – **improper**

regular – **irregular**

stop – **non-stop**

Practice

Form the opposites of the following words, using the suitable prefix.

- | | |
|--------------------|-----------------------|
| 1. correct | 7. checked |
| 2. effective | 8. connect (v.) |
| 3. certain | 9. load (v.) |
| 4. stability | 10. patient |
| 5. stable | 11. logical |
| 6. return | 12. replaceable |

5. Useful phrases

How do you say the following in English?

1. Καλά χαρακτηριστικά οδήγησης:
2. η κάστερ (υπο)βοηθάει τον τροχό να «πατάει» / κινείται στρωτά / κινείται σε ευθεία πορεία:
3. Όσο μεγαλύτερη (είναι) η γωνία κάστερ, τόσο καλύτερο είναι το αποτέλεσμα του κεντραρίσματος:
4. η γωνία θεωρείται θετική αν οι τροχοί έχουν κλίση προς τα έξω:
.....
5. η κλίση είναι ανάλογη με τη γωνία:
.....
6. το μπροστινό τμήμα του τροχού στρέφεται προς τα μέσα:
.....
7. κακή / λανθασμένη (συγ)κλίση προκαλεί δονήσεις / τρεμούλιασμα:
.....
8. αυξάνω τη φθορά του ελαστικού:

Vocabulary – Terminology

steering οδήγηση, διεύθυνση (για κίνηση)

property ιδιότητα, κυριότητα

steering properties χαρακτηριστικά οδήγησης

tire/ tyre λάστιχο, ελαστικό, επίστρωτα

wear φθορά

wheel τροχός

align ευθυγραμμίζω

angle γωνία

caster κάστερ, κλίση άξονα

axle άξονας

inclination κλίση

camber κάμπερ, κλίση τροχών, κλίση ως προς την κατακάρυφο

king-pin inclination κλίση κίνγκ πιν, κλίση / γωνία βασιλικού πείρου

toe-in σύγκλιση

toe-out απόκλιση

measurement μέτρηση

empty άδειος

vertical κάθετος

ball joint μπαλλάκι / ελαστικός σύνδεσμος

bearing έδραση, κουζινέτο, ρουλεμάν, έδρανο

spring strut ελατήριο μπουκάλας

encourage υποβοηθώ, ενθαρρύνω

travel κινούμαι, ταξιδεύω

straight ίσια, κατευθείαν

forward προς τα μπρος

travel straight forward κινούμαι σε ευθεία πορεία

self-centering αυτοκεντράρισμα

adjust ρυθμίζω

lean in κλίνω / έχω κλίση / πατώ προς τα μέσα

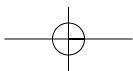
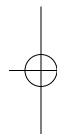
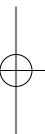
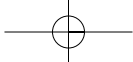
lean outwards κλίνω / έχω κλίση / πατώ προς τα έξω

consider θεωρώ

positive θετικός

negative αρνητικός
correspond (to) αντιστοιχώ, είμαι ανάλογος
ensure εξασφαλίζω, σιγουρεύω
retain διατηρώ, εξασφαλίζω
effect αποτέλεσμα
front μπροστινός
point δείχνω
point inwards στρέφω προς τα μέσα
difference διαφορά
feeling αίσθηση, αντίληψη
feeling from the road κράτημα του δρόμου
assist βοηθώ
stability σταθερότητα
directional stability σταθερότητα στην κατεύθυνση
tie-rod άκρα
alignment ευθυγράμμιση
affect επηρεάζω
rectify διορθώνω, επανορθώνω
fault ελάττωμα, σφάλμα
pressure πίεση
play «παίξιμο», «τζόγος», μπόσικα, ανοχή
control arm άξονας διεύθυνσης
control arm mounting σύνδεσμος του άξονα διεύθυνσης

break (broke – broken) σπάζω
shoulder (of a tire) το καμπυλωτό τμήμα του ελαστικού στις άκρες του πέλματος και προς τα πλαϊνά
spring ελατήριο
steering gear κουτί τιμονιού, σύστημα / μηχανισμός πηδαλιούχησης
shock absorber αμορτισέρ, αποσβεστήρας (ταλαντώσεων)
abnormal αντικανονικός
temporary προσωρινός
equipment εξοπλισμός
load φορτίο, ωφέλιμο φορτίο
bend κάμπτω, γέρνω
curve κάμπτω, κάνω στροφή / καμπύλη, κυρτώνω
surface επιφάνεια
slope κλίση (εδάφους)
slant γέρνω, κλίνω, κλίση
extent έκταση, σημείο, βαθμός
shaky τρεμάμενος
clarification διευκρίνιση
verification επαλήθευση, επιβεβαίωση
reinforce ενισχύω



UNIT 19

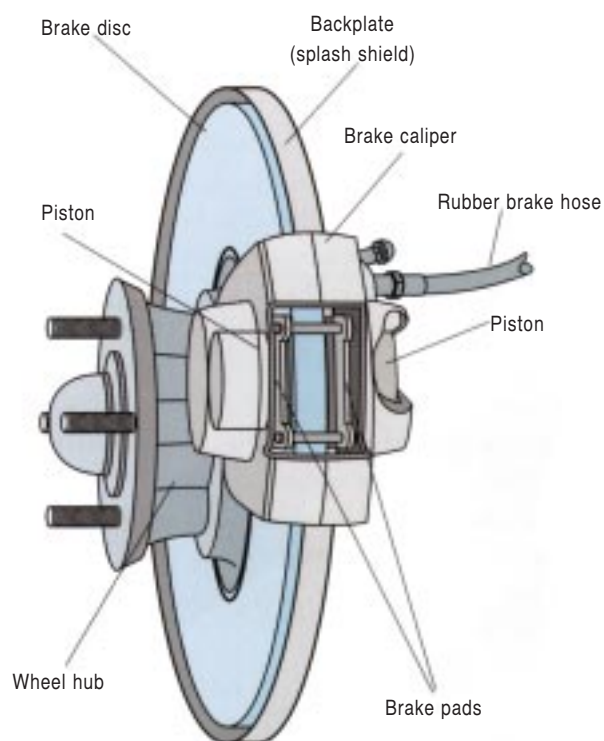
Brakes

Learning objectives

Reading comprehension: Understanding and reproducing texts related to the Brake systems. Understanding uses, operations, utilities.

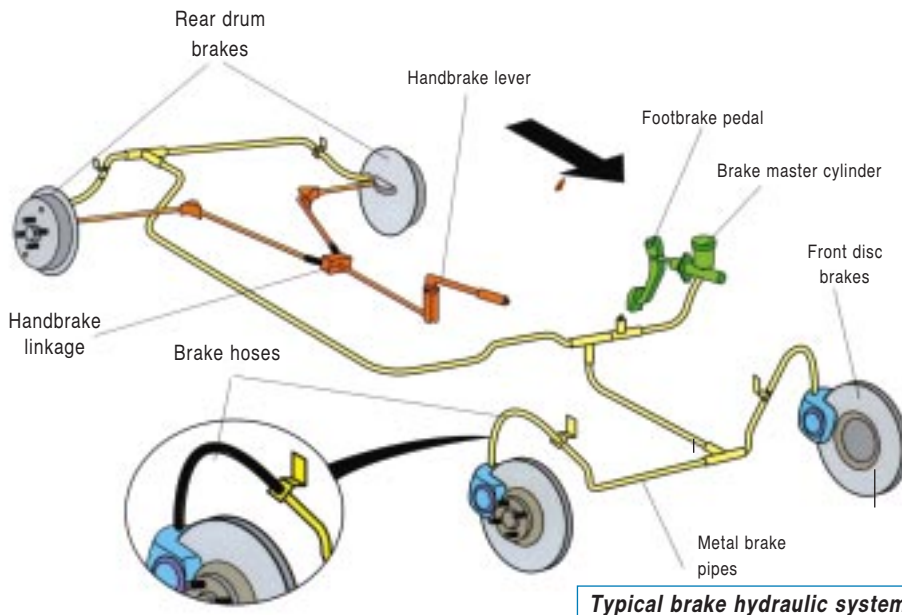
Vocabulary: Words related to the brake systems, their components and their operation.

Use of English: Using the correct prepositions.



Typical disc brake components

The brake system can be divided into the following main braking systems: The wheel braking system, the hydraulic system, the parking brake system, the ABS system, the EBD and the anti-spin system.



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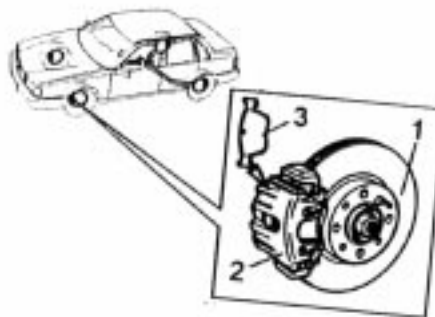
A. The wheel braking system and the hydraulic system

Certain components are located differently in the engine compartment depending on whether the car is left or right-hand drive. The main systems consist of the following main components:

Wheel braking system

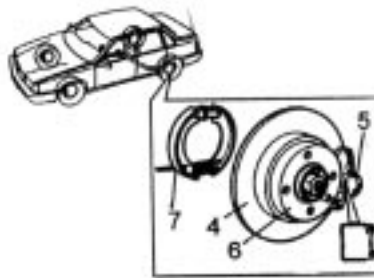
In many cars, **front wheel brakes** have **ventilated brake discs** (1) and a **sliding brake caliper** (2) with special **brake blocks** (3) making for effective brakes and a long life expectancy.

The brake caliper has two main components: the *caliper* and the *caliper mounting*. The



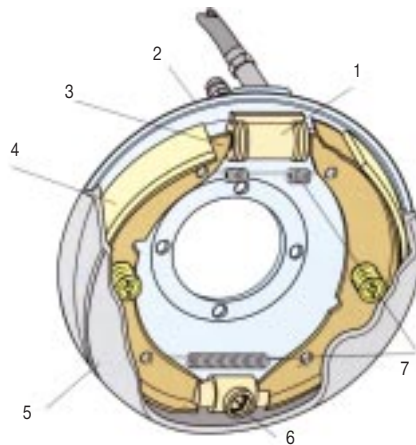
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caliper has a piston with an O-ring and a dirt guard. The O-ring is designed to prevent brake fluid escaping and to return the piston to its resting position after braking. The dirt guard prevents dirt getting in between the cylinder and piston. In some cars, the **rear wheel brakes** have **solid brake discs** (4) and **(fixed brake calipers** (5). The **brake disc hub** (6) also acts as the parking **brake drum** (7).



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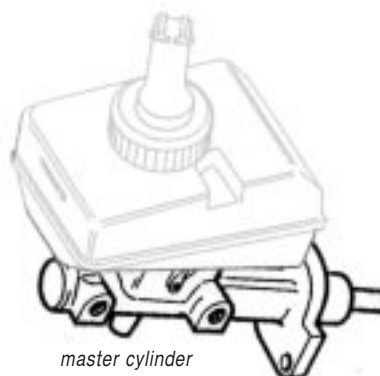
Rear drum brakes are used in many modern cars. A drum brake assembly consists of a **wheel cylinder** (1), the **backplate** (2), the **brake shoes** (3), the **friction lining** (4), the **brake drums** (5) the manual **brake adjuster** (6), and the **return springs** (7).



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The hydraulic system

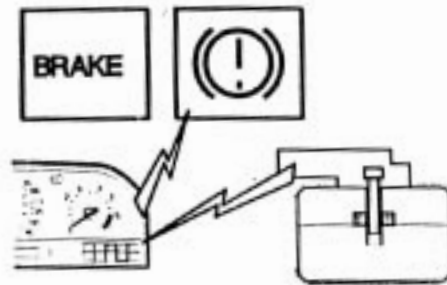
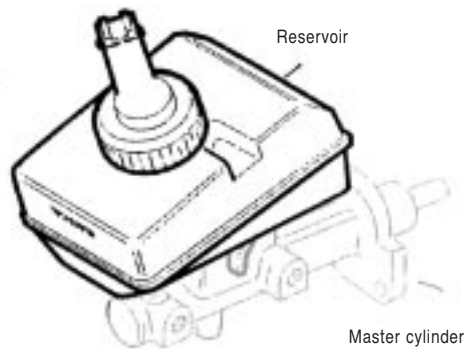
The main component of the hydraulic system is the **master cylinder**, which has two pistons: A primary piston (for the primary circuit) and connections to the brake fluid reservoir, brake cables and Electronic Brakeforce Distribution (EBD) pressure sensor. The system also comprises the **brake fluid reservoir** and the **level sensor** as well as the **brake circuit warning indicator** and the **brake pedal** and **stop (brake) light control** (switch).



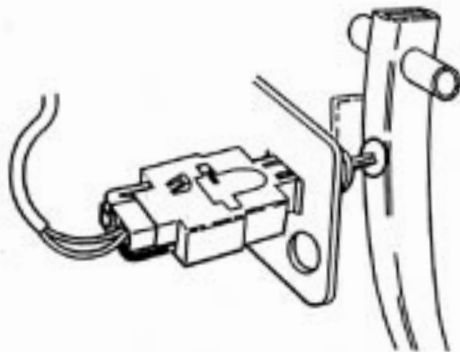
master cylinder

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The brake fluid reservoir is divided into **three chambers**, two of which are for the **brake circuits**. One is for the primary and one for the secondary circuit. This is for safety reasons. If there is a leak in one circuit (e.g. the secondary circuit), there will still be brake fluid in the primary circuit. This means that the intact circuit will continue to provide full braking power. In manual-transmission vehicles, the *third chamber* is used for connecting the *master cylinder* to the *clutch*. The reservoir has MIN and MAX markings within which the brake fluid level must be kept. The **reservoir cap** has a **brake fluid level sensor**, which switches on a warning indicator on the instrument panel (dashboard), if the brake fluid level is too low. The brake fluid level sensor consists of a **magnetic floater** which makes a contact if the brake fluid falls below the MIN level. When the contact closes, it grounds an output on the dashboard and the warning light comes on. The reservoir is connected direct to the master cylinder primary and secondary circuit.



The stop (brake)light switch is located behind the brake pedal. It is controlled by the brake pedal lever arm and switches the car's brake light on, when the driver brakes. It also sends a signal to the control module telling it that braking has started.



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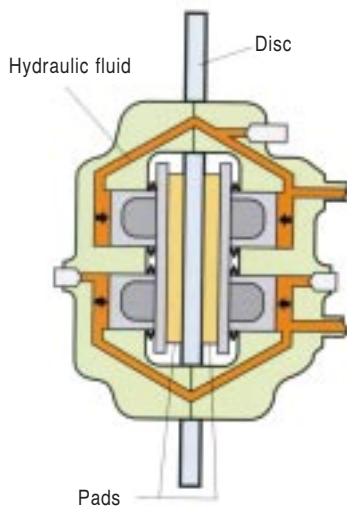
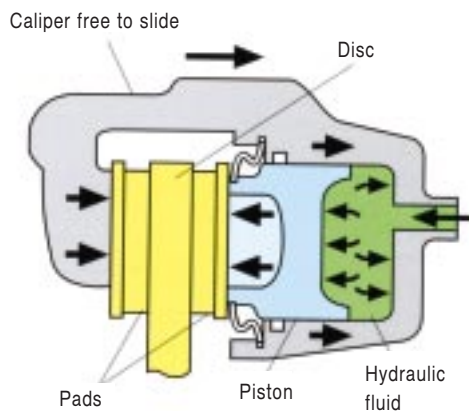
1. Reading comprehension

1A Answer the following questions.

1. What are the main components of the front wheel braking system?
2. What is the O-ring of the caliper's piston designed to do?
3. Name the main components of the rear wheel braking system some cars have.
4. What does a drum brake assembly of many modern cars consist of?
5. How many pistons does the master cylinder of the hydraulic system have?
6. Why does the brake fluid reservoir have two chambers for the two brake circuits?
7. In manual-transmission cars, what is the third chamber of the brake fluid reservoir used for?
8. Within which level must the brake fluid be kept in the reservoir?
9. What's the utility of the brake fluid level sensor of the reservoir cap?
10. When does the floater of the brake liquid level sensor make contact?
11. What happens when the contact closes?
12. Where is the stop light located?

1B Match the system with their components.

Systems	Components
<ul style="list-style-type: none"> • Front wheel brakes 	solid brake discs sliding brake caliper brake shoes friction lining
<ul style="list-style-type: none"> • Rear wheel brakes 	master cylinder stop light control ventilated brake discs
<ul style="list-style-type: none"> • Drum brakes 	brake adjuster brake blocks fixed brake calipers return springs
<ul style="list-style-type: none"> • Hydraulic system 	brake fluid reservoir brake circuit warning indicator

**Fixed caliper operation****Sliding caliper operation**

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2. Vocabulary practice

2A Complete each gap with one of the following words: *assembly, comprise, ventilated, guard, indicator, intact, effective, escaping, dashboard, switches on, safety, compartment*.

1. One of the several separate divisions of a structure:
2. Causing air to move in and out freely:
3. Able to bring the results intended:
4. Finding a way out:
5. An apparatus designed to protect:
6. An arrangement of parts consisting a whole:
7. Composed of / consist of:
8. An apparatus pointing out or giving information:
9. The state of being free from danger:
10. Untouched or undamaged:
11. An instrument panel below the windscreen inside a vehicle:
12. Turns on:

2B Write the nouns / apparatuses deriving from the following verbs:

1. guard:
2. adjust:
3. reserve
4. sense
5. indicate
6. clutch
7. float
8. switch

*Brake discs**Brake blocks*

© Τεχνικές Εκδόσεις Α.Ε.

2C Choose the correct halves from each column to form a correct compound word.

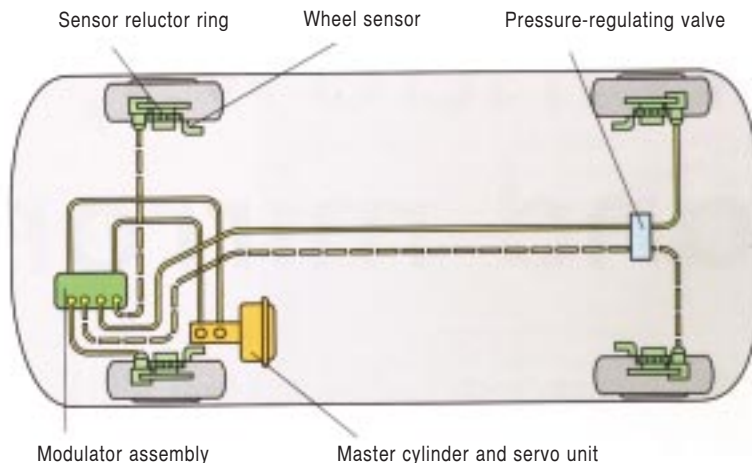
A	B
anti-	force
back	spin
brake	plate
trans	board
dash	hand
left	mission

A useful tool for the drum brakes*Hydraulic drum extractor*

© Facom

B. The ABS, EBD, parking brake systems and the brake servo

The Anti-lock Braking System (ABS) is designed to stop wheels from locking under heavy braking. The earlier type of this system worked on the front wheels. However, most cars of today have an ABS system working on all four wheels. The system is activated by the likelihood of the wheels locking during braking and ensures that a maximum braking effect is retained without the wheels locking, ensuring the cars driveability and steering capacity.



Typical ABS layout

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The hydraulic components of the ABS systems are similar to the ones of the conventional braking systems with the addition of some items, among which are:

1. **The speed sensor** on each of the four wheels, 2. **The electronic computer** which includes a *self-monitoring system*, a *hydraulic unit* with a *pressure-regulating valve* and a *high-pressure pump*, 3. **The sensor gears** fixed on the front drive shaft and rear discs or hubs, 4. **The warning light** which is located on the instrument panel.

The EBD (Electronic Brakeforce Distribution) is activated during normal braking (without ABS control) and divides the braking force on the wheels.

As for the **parking brake system**, it consists of the **parking brake lever**, commonly known as the **handbrake**, which usually works on the rear wheels, the **brake wires**, the **brake shoes** and the **parking brake lever warning lamp**.

The air hydraulic brake power assist unit

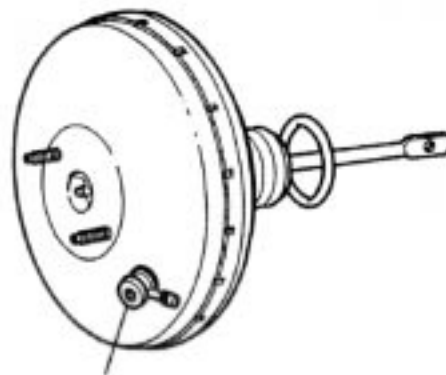
(brake servo) is of the vacuum-assisted type, and enhances the force the driver exerts on the pedal when braking.

In family cars, the enhancement ratio is 4-5:1. The vacuum is derived from the partial vacuum in the engine inlet manifold.

The connection between the engine inlet manifold and the air hydraulic brake power assist unit (brake servo) has a **non-return valve**.

This prevents air flowing back into the air hydraulic brake power assist unit (brake servo) if there is no partial vacuum in the inlet manifold.

There are two designs of air hydraulic brake power assist unit (brake servo), depending on whether the car is LH or RH drive. The air hydraulic brake power unit (brake servo) in RH drive models has a somewhat longer **pressure hose**.



non-return valve

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1. Reading comprehension

1A Choose the correct item to form complete sentences.

1. The ABS is designed to stop wheels locking
 - a. under normal braking.
 - b. under heavy braking.
 - c. under high speed.
2. Most cars of today have an ABS system working
 - a. on all four wheels.
 - b. on the front wheels.
 - c. on the rear wheels.
3. In the ABS system a speed sensor is included
 - a. on each of the front wheels.
 - b. on each of the rear wheels.
 - c. on each of the four wheels.
4. The electronic computer includes a *self-monitoring system*, a *hydraulic unit* with and a high pressure pump.
 - a. a pressure-regulating valve

- b. a needle
 - c. a brake-regulating valve
- 5. The shortened form EBD stands for
 - a. Electric Brakeforce Distribution.
 - b. Electronic Brake Distribution.
 - c. Electronic Brakeforce Distribution.
- 6. EBD is activated during
 - a. normal braking (without ABS control).
 - b. heavy braking (with ABS control).
 - c. whenever ABS control is activated.
- 7. The parking brake lever is commonly known as
 - a. the brake pedal.
 - b. the handbrake.
 - c. the brake shoes.
- 8. The brake servo
 - a. enhances the force the driver exerts on the pedal when braking.
 - b. minimizes the force the driver exerts on the pedal when braking.
 - c. works on the front wheels.
- 9. The connection between the engine inlet manifold and the brake servo has
 - a. a long pressure hose.
 - b. two pistons.
 - c. a non-return valve.

1B Match the systems with their components

Systems	Components
<ul style="list-style-type: none"> • Anti-block braking system • Parking brake system • Brake servo 	ABS warning light non-return valve brake shoes parking brake lever (hand brake) speed sensor brake wires sensor gears pressure hose brake lever warning lamp

1C Find what the following descriptions refer to.

1. It is designed to stop wheels from locking under heavy braking:
2. There is one on each of the four wheels:
3. It includes a self monitoring system, a hydraulic unit with a pressure-regulating valve and a high-pressure pump:
4. They are fixed on the front driveshaft and rear discs or hub:
5. It is activated during normal braking dividing the brake force on the wheels:
6. It is also known as the *handbrake*:
7. The air hydraulic brake power assist unit is also known as the
8. It is located between the engine inlet manifold and the brake servo:

2. Vocabulary practice**2A Complete the gaps in the following table with nouns deriving from the given verbs.**

Verb	Noun
add
press
locate
distribute
control
park
enhance
connect
assist
design

2B Match a word from A column with one from B column to form antonyms.**A**

front
earlier
similar
include
high
consist of
enhance
connect
inlet
left

B

later
exclude
rear
low
different
reduce
disconnect
divide into
right
outlet

2C Match the words (column A) with their definitions (column B).**A**

a. activate
b. hydraulic
c. instrument
d. component

e. normal
f. panel
g. vacuum
h. pedal

B

1. a part of a larger or more complex object
2. cause to operate
3. worked by water or liquid moving through pipes
4. mechanical tool or implement esp one used for delicate or precision work
5. a board or other surface for controls and instruments
6. average or regular
7. a lever on a vehicle worked by foot
8. space completely empty of substance or gas

3. Use of English**Complete the gaps with the suitable preposition.**

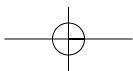
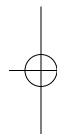
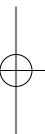
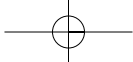
1. The brake system is divided a number of main braking systems.
2. The main systems consist certain components.
3. The dirt guard prevents dirt getting between the cylinder and piston.
4. The brake disc hub acts the parking brake drum.
5. Two of the brake fluid reservoir chambers are the brake circuits.
6. The third chamber is used connecting the master cylinder the clutch.

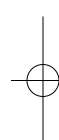
Vocabulary – Terminology

brake φρένο, πέδηση, φρενάρω	secondary δευτερεύων /-ουσα
brake system σύστημα φρένων / πέδησης	circuit κύκλωμα
hydraulic υδραυλικός (επιθ)	connection σύνδεση, συνδεσμολογία
ABS (Anti-lock Braking System) σύστημα αντικλει- δώματος / αντιμπλοκαρίσματος φρένων	reservoir δεξαμενή, δοχείο
EBD (Electronic Brakeforce Distribution) ηλεκτρονι- κή κατανομή πίεσης / δύναμης φρένων	cables καλώδια, καλωδίωση, ντίζα
anti-spin αντιολίσθηση	electronic ηλεκτρονικός
wheel-braking system σύστημα φρένων τροχών	Electronic Brakeforce Distribution (EBD) κατανεμη- τής διανομής / κατανομής πίεσης πέδησης / φρενα- ρίσματος
locate τοποθετώ	pressure πίεση
compartment διαμέρισμα	sensor αισθητήρας
left-hand drive (LH drive) αριστεροτίμονο	comprise περιλαμβάνω
right-hand drive (RH drive) δεξιότιμονο	level επίπεδο, στάθμη
ventilated αεριζόμενος	warn προειδοποιώ
brake discs δισκόφρενα	indicator δείκτης
sliding ολισθαίνων /-ουσα	pedal πετάλι, ποδωστήριο
brake caliper σιαγόνα	stop light control / switch διακόπτης για τα φώτα στάθμευσης
sliding brake caliper σιαγόνα φρεναρίσματος ολί- σθησης	divide (into) διαιρώ (σε)
brake block τακάκι, στοιχείο τριβής	chamber θάλαμος, διαμέρισμα, τμήμα
life expectancy πιθανή διάρκεια ζωής	safety ασφάλεια
mounting υποδοχή	reason λόγος, αιτία
O-ring δακτύλιος στεγανοποίησης, Ο-ριγκ	leak διαρροή, διαφυγή
brake fluid υγρό φρένων	intact ανέπαφος, ακέραιος, απρόσβλητος
escape διαφεύγω, εκρέω (για υγρά)	provide παρέχω, δίδω
resting position αρχική θέση, θέση ακινησίας	transmission μετάδοση
braking φρενάρισμα, πέδηση	manual-transmission μηχανική μετάδοση, σασμάν
dirt βρωμιά, ακαθαρσία (σκόνη, λάσπη κλπ)	clutch συμπλέκτης
guard προστασία, προφυλακτήρας, προστατευτικό	cap τάπα, πώμα, κάλυμμα
rear wheel brakes φρένα πίσω τροχών	instrument panel πίνακας οργάνων, καντράν
solid συμπαγής	dashboard πίνακας οργάνων, καντράν
fixed προσαρμοσμένος, «φιξαρισμένος»	magnetic μαγνητικός
disc hub άκρο δισκόφρενου	floater πλωτήρας, δείκτης επιπέδου (υγρών), φλοτέρ
brake drum ταμπόουρο	ground γειώνω, γείωση, «κάνω σώμα»
assembly συναρμολόγηση, σύνολο στοιχείων	lever μοχλός
wheel cylinder κύλινδρος / έμβολο φρένων	lever arm βραχίονας πενταλίου φρένων
backplate πίσω πιάτο	signal σήμα
brake shoe σιαγόνα ταμπόουρου	control module στοιχείο ελέγχου
friction lining φερμουίτ, υλικό τριβής	heavy braking έντονο / δυνατό φρενάρισμα / πέδηση
return spring ελατήριο επαναφοράς	activate ενεργοποιώ, δραστηριοποιώ
manual χειροκίνητος	likelihood πιθανότητα
brake adjuster ρυθμιστής φρένων, ρεγουλατόρος	ensure εξασφαλίζω, σιγουρεύω
master cylinder αντλία φρένων	retain διατηρώ, εξασφαλίζω
primary πρωτεύων /-ουσα, κύριος	driveability ικανότητα οδήγησης

steering capacity ικανότητα διεύθυνσης
conventional συμβατικός
self-monitoring σύστημα αυτοπροσδιορισμού
unit μονάδα
high-pressure υψηλή πίεση
pump αντλία
gear οδοντωτός τροχός, γρανάζι
driveshaft ημιαξόνιο
handbrake / parking brake lever χειρόφρενο, φρένο
συσφίξεως
brake wire σύρμα φρένων, ντίζα χειρόφρενου
lamp λάμπα
brake power assist unit / brake servo σερβόφρενα,
βοηθητική μονάδα φρεναρίσματος, υποβοήθηση
φρένων





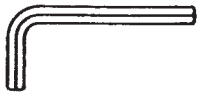

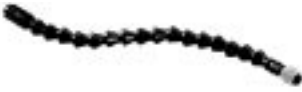
air-hydraulic πνευματικο-υδραυλικός
vacuum κενό
enhance επαυξάνω
exert (on) επενεργώ (σε)
ratio αναλογία
derive προέρχομαι
partial μερικός
inlet manifold σωλήνας εισαγωγής
non-return valve βαλβίδα ανεπιστροφής
air-flowing back επιστροφή αέρα
longer pressure μεγαλύτερη πίεση
hose εύκαμπτος σωλήνας.
drum extractor εξολκέας ταμπόρων

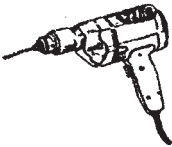



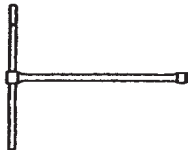

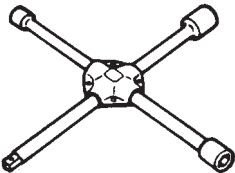
















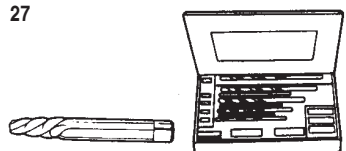
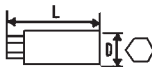
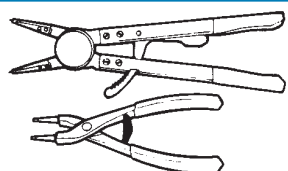


TOOLS



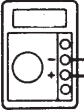
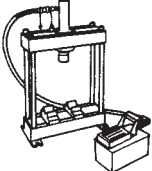

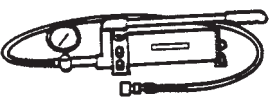

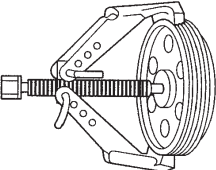
A selection of good tools is a fundamental requirement for a car repair workshop. Provided that they meet the relevant safety standards and are of good quality, they will last for many years and prove a worthwhile investment. The tools in the list are a minimum requirement for routine maintenance, servicing and minor repair operations.


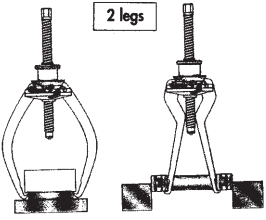
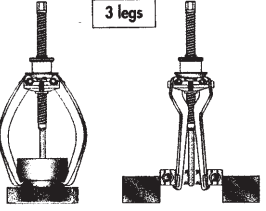
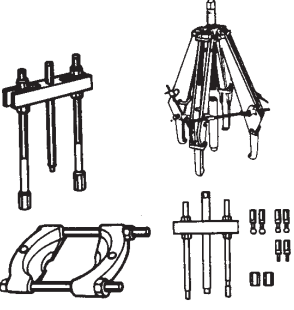

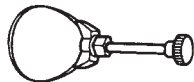
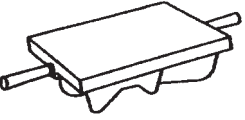
1		Flat-tip screwdrivers Κατσαβίδια εγκοπής / κοινά
2		Cross-point / Phillips screwdrivers Σταυροκατσάβιδα
3		Offset screwdrivers Στραβοκατσάβιδα, τεθλασμένα / αγκωνωτά κατσαβίδια (με κυρτά άκρα)
4		Automatic / retaining screwdrivers Κατσαβίδια αυτόματα / επαναφοράς / παλινδρόμησης / με κασάνια
5		Allen-hex(agonal) sockets Κλειδιά (τύπου) Άλλεν / εξάγωνα
6		Socket spanners / spinners Σωληνωτά / ακροδεκτικά κλειδιά
7		Screw holders Πολύσπαστες προεκτάσεις

8		Electric drills Ηλεκτρικά δρέπανα / τρυπάνια
9		Sockets* Καρυδάκια
10		Ratchets Καστάνιες, μανέλλες, τροχοί αναστολής
11		Swivel handles / hinged socket wrenches Σπαστές λαβές
12		Tee-handles Λαβές σχήματος Ταφ
13		Extensions Επεκτάσεις
14		Wheel-nut tools Εργαλεία εξαγωγής παξιμαδιών από τους τροχούς
15		Open-ended wrenches Κλειδιά με ανοιχτά άκρα / σταθερού ανοίγματος / Γερμανικά

16		Ring wrenches Κλειδιά με κλειστά άκρα / πολυγωνικά / Αμερικάνικα
17		Combination wrenches Κλειδιά με ανοιχτά και κλειστά άκρα / συνδυασμού Γερμανικού και Αμερικάνικου τύπου
18		Impact wrenches Επαναφορτιζόμενα εργαλεία βιδώματος / Αερόκλειδα
19		Combination / universal pliers* Πένσες / τανάλιες γενικής χρήσης
20		Flat-nose pliers* Πένσες / τσιμπίδες με επίπεδα άκρα / πλατυτσιμπίδα
21		Round-nose pliers* Πένσες / τσιμπίδες με στρογγυλά άκρα / στρογγυλοτσιμπίδα
22		Lock-grip pliers / Self-locking grips Αρπάγες, σκύλες, γρύποι, πένσες συγκράτησης
23		Files Λίμες

<p>24</p> 	<p>Ball-peen hammers Σφυριά μπάλας / με ημισφαιρική κεφαλή</p>
<p>25</p> 	<p>Mallets Σφυριά με πλαστικά ή ξύλινα / μαλακά άκρα</p>
<p>26</p> 	<p>Nut splitters Κόφτες παξιμαδιών</p>
<p>27</p> 	<p>Stud extractors Αρπάγες / εξαγωγείς για φυτευτές/ κλωτσημένες βίδες</p>
<p>28</p> 	<p>Stud drivers Οδηγοί / εξολκείς για κλωτσημένες γωνίες στο κεφάλι της βίδας</p>
<p>29</p> 	<p>Circlips Εξολκείς δαχτυλιδωτών ασφαλειών και ελατηρίων εμβόλων</p>
<p>30</p> 	<p>Screw pitch gauges Σπειρό(ματό)μετρα</p>
<p>31</p> 	<p>Feeler gauges Ελάσματα τυποποιημένου πάχους</p>

<p>32</p> 	<p>Micrometers Μικρόμετρα</p>
<p>33</p> 	<p>Vernier calipers* Παχύμετρα / διαβήτες κο(υ)μπάσα Βερνιέρου / Βερνιέροι</p>
<p>34</p> 	<p>Electrical multimeters Ηλεκτρικά πολύμετρα</p>
<p>35</p> 	<p>Presses Υδραυλικές πρέσες</p>
<p>36</p> 	<p>Rams Θηλυκές βάσεις πρεσαρίσματος</p>
<p>37</p> 	<p>Pumps with pressure gauge Υδραυλικές τρόμπες πρέσας με μετρητή πίεσης</p>
<p>38</p> 	<p>Jacks Γρύλλοι</p>
<p>39</p> 	<p>Pulley removers Εξολκείς για τροχαλίες</p>

<p>40</p> 	<p>Pulley stays Εργαλεία συγκράτησης τροχαλιών</p>
<p>41</p> <p>2 legs</p>  <p>3 legs</p>  	<p>2-, 3- and 4-legs / jaws inside and outside pullers Bearing extractors Shaft separators and beam pullers</p> <p>Εξολκείς εσωτερικοί και εξωτερικοί, με 2, 3 ή τέσσερες σιαγώνες για διάφορες χρήσεις (π.χ. για άξονες, ρουλεμάν, κλπ)</p>
<p>42</p>  	<p>Oil-change tools Εργαλεία αλλαγής φίλτρων λαδιού και πετρελαίου</p>
<p>43</p> 	<p>Surface plates Πλάκες εφαρμογής (για καπάκια κινητήρα)</p>

<p>44</p> 	<p>Surface gauges Παχύμετρα ύψους, υψομετρικοί χαράκτες</p>
<p>45</p> 	<p>Clamps Σφιγκτήρες, τσεμπέρια</p>
<p>46</p> 	<p>Oilers Λαδικά, λαδωτήρια</p>
<p>47</p> 	<p>Steel brushes Ατσαλόβουρτσες</p>

* The tools marked with an asterisk are always in plural.



Tool cases / tool chests (Facom)
Εργαλειοθήκες

Stud extractors inserters, drivers and removers

Εργαλεία εξαγωγής, εμφύτευσης, θιδώματος και απομάκρυνσης για βίδες με κομμένο κεφάλι



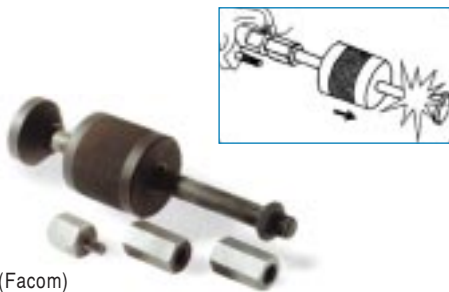
(USAG)

Stud extractor and inserter, conical type
(Εργαλείο εξαγωγής και εμφύτευσης με σπείρωμα κωνικού τύπου)



(Facom)

Roller-type stud drivers/pullers
(Οδηγοί / εξολκείς κυλινδρικού τύπου)



(Facom)

Screw extractor
(Εξολκέας για βίδες με κρούση)



(USAG)

Stud extractor and inserter, cam type
(Εργαλείο με έκκεντρο για εμφύτευση και εξαγωγή βιδών)

Oil-filter wrenches and extractors

Εργαλεία εξαγωγής φίλτρων λαδιού και πετρελαίου



Oil-filter wrench (Facom)



Filter extractors (Facom)



Self-adjusting wrench (Facom)



Chain wrench (Facom)



Circlip pliers (Facom)

Εξαγωγείς ελατηρίων εμβόλων και
δαχτυλιδωτών ασφαλειών



Multi-meter (Facom)
Πολύμετρο

CHANCES IN SPELLING

Vowels

a, e, i, o, u, y, w

Consonants

b, c, d, f, g, h, j, k, l, m, n, p, q, r, s, t, v, w, x, y, z

I. When adding the ending -s

1. Instead of adding -s, we add -es to:

a) Nouns > ending in $\begin{cases} -s \\ -sh \\ -ch \\ -x \\ -z \end{cases} \rightarrow \text{e.g.} \left\{ \begin{array}{l} \text{a bus} \rightarrow \text{buses} \\ \text{I wash} \rightarrow \text{s/he washes} \\ \text{I watch} \rightarrow \text{s/he watches} \\ \text{a box} \rightarrow \text{boxes} \\ \text{a buzz} \rightarrow \text{buzzes} \end{array} \right.$

b) Nouns > ending in -o before which there is a consonant.
Verbs

e.g. a hero → heroes a cargo → cargoes
I do → s/he does I go → s/he goes

but a piano → pianos radio → radios
a photo → photos a kilo → kilos
a studio → studios $\left. \begin{array}{l} \text{radio} \rightarrow \text{radios} \\ \text{a kilo} \rightarrow \text{kilos} \end{array} \right\} \text{ words of foreign origin or abbreviations}$

2. In words ending in -y before which there is a consonant, the -y changes to -ie- before the ending -s.

e.g. a body → bodies a city → cities
I study → s/he studies I worry → s/he worries

but a boy → boys a day → days
I enjoy → s/he enjoys I buy → s/he buys

3. When the ending **-s** is added to some nouns ending in **-f** or **-fe**, the **-f/fe+s** changes to **-ves**. These nouns are: half, thief, leaf, loaf, self, shelf, wolf, knife, wife, life:

e.g. a half → halves a life → lives a knife → knives
 but roof → roofs proof → proofs handkerchief → handkerchiefs
 safe → safes cliff → cliffs

II. When adding the endings **-ed**, **-er**, **-est**, **-ing**

1. If a word ends in one **-e**, it drops this **-e** before the above endings.

e.g. live → lived, living prepare → prepared, preparing
 simple → simpler, simplest large → larger, largest
 but agree → agreeing see → seeing (*they end in 2e*)
 be → being (*exception*)

2. In words ending in **-y** before which there is a consonant, the **-y** changes to **-i** before the ending **-ed**, **-er**, **-est**, but not before **-ing** (studying, worrying)

e.g. I study → s/he studies I worry → s/he worries
 easy → easier, easiest heavy → heavier, heaviest
 but I play → s/he plays } *there is a vowel before -e*
 grey → greyer

3. When the ending **-ing** is added to a verb that ends in **-ie**, the **-ie-** changes to **-y**.

e.g. lie → lying die → dying

4. If a one-syllable word ends in a consonant before which there is a vowel, the final consonant is doubled when **-ed**, **-er**, **-est** or **-ing** is added.

e.g. stop → stopped, stopping drop → dropped, dropping
 big → bigger, biggest hot → hotter, hottest
 but form → formed, forming } *there is another consonant*
 dark → darker, darkest } *before the final one*

5. If a word of more than one syllables whose final syllable is stressed ends in a consonant before which there is a vowel, the final consonant is doubled when -ed, -er, -est or -ing is added.

e.g. refer → referred, referring begin → beginning
 permit → permitted, permitting

but listen → listened, listening } *the final syllable*
 clever → cleverer, cleverest } *is not stressed*

**Don't
forget**



- We do not double -y, -w or -x at the end of words.
e.g. fix → fixed, fixing
 stay → stayed, staying
 slow → slower, slowest
- In British English, the final -l is always doubled.
e.g. travel → travelled, travelling
 expel → expelled, expelling

LIST OF IRREGULAR VERBS

INFINITIVE	PAST TENSE	PAST PARTICIPLE
be	was	been
become	became	become
begin	began	begun
bend	bent	bent
bite	bit	bitten
blow	blew	blown
break	broke	broken
bring	brought	brought
build	built	built
burn*	burnt	burnt
buy	bought	bought
catch	caught	caught
choose	chose	chosen
come	came	come
cost*	cost	cost
cut	cut	cut
deal	dealt	dealt
do	did	done
draw	drew	drawn
drink	drank	drunk
drive	drove	driven
eat	ate	eaten
fall	fell	fallen
feel	felt	felt
find	found	found
fly	flew	flown
forget	forgot	forgotten
forgive	forgave	forgiven
freeze	froze	frozen
get	got	got
give	gave	given
go	went	gone
grow	grew	grown

hang*	hung	hung
have	had	had
hear	heard	heard
hide	hid	hidden
hit	hit	hit
hold	held	held
hurt	hurt	hurt
keep	kept	kept
know	knew	known
lead	led	led
learn*	learnt	learnt
leave	left	left
lend	lent	lent
let	let	let
light*	lit	lit
lose	lost	lost
make	made	made
mean	meant	meant
meet	met	met
melt	melted	melted/molten
pay	paid	paid
put	put	put
read	read	read
ride	rode	ridden
ring	rang	rung
rise	rose	risen
run	ran	run
say	said	said
see	saw	seen
sell	sold	sold
send	sent	sent
shake	shook	shaken
shine*	shone	shone
shoot	shot	shot
show	showed	shown/showed
shut	shut	shut
sing	sang	sung

sink	sank	sunk/sunken
sit	sat	sat
sleep	slept	slept
smell	smelt	smelt
speak	spoke	spoken
spend	spent	spent
spread	spread	spread
spring	sprang	sprung
stand	stood	stood
steal	stole	stolen
strike	struck	struck
sweep	swept	swept
swim	swam	swum
take	took	taken
teach	taught	taught
tear	tore	torn
tell	told	told
think	thought	thought
throw	threw	thrown
understand	understood	understood
wake	woke	woke/awoken
wear	worn	worn
win	won	won
wind	wound	wound
write	wrote	written

* The past tense and the past participle of the verbs marked with an asterisk are also formed as if the verb were regular (= + -ed) e.g. burned, costed, lighted, etc.

ΑΝΑΛΥΤΙΚΟΣ ΚΑΤΑΛΟΓΟΣ

- Πηγών τεχνικών κειμένων-πληροφοριών
- Προέλευσης φωτογραφικού υλικού

Όσον αφορά στις ενότητες 3 - 4 - 5- 6 - 9 - 11 - 14 - 15 - και 16 τις οποίες διαμόρφωσε και επιμελήθηκε η κ. Σουβλάκη Αλεξάνδρα, η προέλευση του έντυπου και φωτογραφικού υλικού έχει ως εξής:

ΠΗΓΕΣ ΦΩΤΟΓΡΑΦΙΩΝ

Unit 3 The development of the car engine

ΣΕΛ.	ΠΕΡΙΕΧΟΜΕΝΟ ΦΩΤΟΓΡΑΦΙΑΣ	ΠΗΓΗ
29	Ford-T model	Περιοδικό 4 τροχοί, Τεχνικές Εκδόσεις ΑΕ
31	Internal combustion reciprocating engine	Automobile Association Developments Ltd
31	Internal combustion rotary engine	Automobile Association Developments Ltd
32	Petrol/gasoline engine	Περιοδικό Οδηγώντας, Τεχνικές Εκδόσεις ΑΕ
32	Diesel-oil engine	Coursebook for mechanical engineering technicians- Π.Ι. / ΟΕΔΒ, 2001
32	Karl Benz's first petrol-engined vehicle, 1885	CD Automania, Rom/Internet Multimedia, 10/11 1998
33	Rover, England 1909	Περιοδικό 4 τροχοί, Τεχνικές Εκδόσεις ΑΕ
40	The horseless carriage built by the Duryea brothers, USA 1893	CD Automania, Περιοδικό Rom/Internet Multimedia, 10/11 1998

Unit 4 New developments in the car industry

ΣΕΛ.	ΠΕΡΙΕΧΟΜΕΝΟ ΦΩΤΟΓΡΑΦΙΑΣ	ΠΗΓΗ
43	A fuel-cell hybrid car, Honda Insight, Japan 2000	Περιοδικό Οδηγώντας, Τεχνικές Εκδόσεις ΑΕ
44	Typical front-wheel-drive layout	The car book, Haynes Publishing
45	The cylinder block of a V-8 engine	Biamax AEBE
46	Catalytic converter	Volvo Car Corporation, Αφοι Σαρακάκη AEBE
46	An electric car	Περιοδικό Οδηγώντας, Τεχνικές Εκδόσεις ΑΕ
46	Schematic diagram of the power sources on a fuel-cell hybrid car	CD Toyota Prius, Toyota Hellas AEBEE
47	The engine of a fuel-cell hybrid car (Toyota, Prius)	CD Toyota Prius, Toyota Hellas AEBEE
47	The first fuel-cell hybrid car (Prius) launched by Toyota	CD Toyota Prius, Toyota Hellas AEBEE

Unit 5 The petrol reciprocating engine

ΣΕΛ.	ΠΕΡΙΕΧΟΜΕΝΟ ΦΩΤΟΓΡΑΦΙΑΣ	ΠΗΓΗ
A. The structure of the petrol reciprocating engine		
57	A Fuel-cell hybrid car, Honda, Insight, Japan 2000	Περιοδικό Οδηγώντας, Τεχνικές Εκδόσεις ΑΕ
59	A V-6 petrol reciprocating engine (Renault, sport Clio)	Περιοδικό Οδηγώντας, Τεχνικές Εκδόσεις ΑΕ
60	The structure of the upper and lower engine	Volvo Car Corporation, Αφοι Σαρακάκη AEBE (Σύνθεση, Α. Σουβλάκη)
62	Petrol engine	Biamax AEBE
70	Various ICE cylinder arrangements	Coursebook for mechanical engineering technicians, ΟΕΔΒ, 1989

B. Extra information about the engine components

72	The valves	Volvo Car Corporation, Αφοι Σαρακάκη ΑΕΒΕ
72	The piston	Automobile Association Developments Ltd
73	The oil sump	Toyota Hellas ABEE
73	The flywheel and the clutch	Automobile Association Developments Ltd
73	The starter motor	Toyota Hellas ABEE
74	The timing belt and the timing-belt tensioner	Volvo Car Corporation, Αφοι Σαρακάκη ΑΕΒΕ
74	The camshaft	Automobile Association Developments Ltd
74	The crankshaft	Volvo Car Corporation, Αφοι Σαρακάκη ΑΕΒΕ
83	Piston- ring pliers, piston-groove cleaner, piston-ring compressor	USAG, Κ. Μητρόπουλος ΕΠΕΕ
83-84	All the other pictures of tools	Facom S.A., Μπαρμπέρη ΕΠΕ

Unit 6 The valves and their tappets

ΣΕΛ.	ΠΕΡΙΕΧΟΜΕΝΟ ΦΩΤΟΓΡΑΦΙΑΣ	ΠΗΓΗ
87-89	The valves and the valve tappets (their structure and operation)	Volvo Car Corporation, Αφοι Σαρακάκη ΑΕΒΕ
95	Tappet plates removing pliers, hold-down for changing valve plates tool	USAG, Κ. Μητρόπουλος ΕΠΕΕ
95	All the other pictures of tools	Facom S.A., Μπαρμπέρη ΕΠΕ

Unit 9 The engine-management system

ΣΕΛ.	ΠΕΡΙΕΧΟΜΕΝΟ ΦΩΤΟΓΡΑΦΙΑΣ	ΠΗΓΗ
113	Typical layout of the engine- management system	<i>The car book</i> , Haynes Publishing
114	Schematic diagram of the engine-management system	Volvo Car Corporation, Αφοι Σαρακάκη ΑΕΒΕ

Unit 11 The ignition system

ΣΕΛ.	ΠΕΡΙΕΧΟΜΕΝΟ ΦΩΤΟΓΡΑΦΙΑΣ	ΠΗΓΗ
131	Schematic diagram of the modern ignition system	Volvo Car Corporation, Αφοι Σαρακάκη ΑΕΒΕ (Σύνθεση, Α. Σουβλάκη)
132	The parts of the old ignition system	Automobile Association Developments Ltd
133	Diagram of a typical ignition system	Volvo Car Corporation, Αφοι Σαρακάκη ΑΕΒΕ
135	Schematic diagram of the conventional ignition system	Automobile Association Developments Ltd
137	The spark plug	Automobile Association Developments Ltd
141	Spark-plug wrench	USAG, Κ. Μητρόπουλος ΕΠΕΕ
141	All the other pictures of tools	Facom S.A., Μπαρμπέρη ΕΠΕ

Unit 14 The diesel-oil engine

ΣΕΛ.	ΠΕΡΙΕΧΟΜΕΝΟ ΦΩΤΟΓΡΑΦΙΑΣ	ΠΗΓΗ
159	Volvo 2.4-litre, 5-cylinder, Common Rail Diesel	Volvo Car Corporation, Αφοι Σαρακάκη ΑΕΒΕ
160	Cross section of a diesel engine	Coursebook for mechanical engineering technicians – Π.Ι. / ΟΕΔΒ, 1989
161	Schematic diagram of the fuel system in a diesel engine	Coursebook for mechanical engineering technicians – Π.Ι. / ΟΕΔΒ, 1989
161	The cycle of operation of a diesel engine	Automobile Association Developments Ltd
162	The cylinder of a petrol and a diesel engine	Automobile Association Developments Ltd
167	The glow plug	Coursebook for mechanical engineering technicians, ΟΕΔΒ, 1989
171	Socket wrenches for glow plugs	USAG, Κ. Μητρόπουλος ΕΠΕΕ
171	All the other pictures of tools	Facom S.A., Μπαρμπέρη ΕΠΕ

Unit 15 The transmission system

ΣΕΛ.	ΠΕΡΙΕΧΟΜΕΝΟ ΦΩΤΟΓΡΑΦΙΑΣ	ΠΗΓΗ
173	The transmission system (DAFF)	Coursebook for mechanical engineering technicians, – Π.Ι. / ΟΕΔΒ, 1989
	A. The clutch	
176	The friction or dry clutch	Automobile Association Developments Ltd
177	Typical clutch component layout	<i>The car book</i> , Haynes Publishing
179	The clutch engaged and disengaged	Automobile Association Developments Ltd
180	The parts of the dry clutch	Automobile Association Developments Ltd
	B. The transmission	
185	Cutaway view of a typical conventional automatic transmission	<i>The car book</i> , Haynes Publishing
188	Cutaway view of a typical manual gearbox on a front-wheel drive car with two shafts	<i>The car book</i> , Haynes Publishing
189	The manual gearbox on a front-wheel drive car with three transmission shafts	Volvo Car Corporation, Αφοι Σαρακάκη ΑΕΒΕ
190	Manual gearbox with two lay-shafts on a rear-wheel drive car	Volvo Car Corporation, Αφοι Σαρακάκη ΑΕΒΕ
189	The propeller shaft	Automobile Association Developments Ltd
	C. The final drive	
199	Typical front-, rear- and four-wheel drive layouts	<i>The car book</i> , Haynes Publishing
	1. The differential	
200, 203	The differential and how it operates	<i>The car book</i> , Haynes Publishing
202	The differential on a front-wheel drive car	Volvo Car Corporation, Αφοι Σαρακάκη ΑΕΒΕ
202	The differential on a rear-wheel drive car	Automobile Association Developments Ltd
202	The propeller shaft	Automobile Association Developments Ltd
	2. The driveshafts	
205	The driveshafts on a front-wheel drive car	<i>The car book</i> , Haynes Publishing
205	Typical front-wheel driveshaft assembly	<i>The car book</i> , Haynes Publishing
205	The axle hub	Toyota Hellas ΑΕΒΕΕ

206	The driveshafts on a rear-wheel drive car with independent suspension	<i>The car book</i> , Haynes Publishing
206	The driveshafts on a rear-wheel drive car with rigid-axle assembly	Volvo Car Corporation, Αφοι Σαρακάκη ΑΕΒΕ
206	Extractor for ball joints and ball-joint separator	USAG, Κ. Μητρόπουλος ΕΠΕΕ
206	All the other pictures of tools	Facom S.A., Μπαρμπέρη ΕΠΕ

Unit 16 The steering system

ΣΕΛ.	ΠΕΡΙΕΧΟΜΕΝΟ ΦΩΤΟΓΡΑΦΙΑΣ	ΠΗΓΗ
215	The steering system	Automobile Association Developments Ltd
218	The steering wheel, the steering column and the steering shaft	Volvo Car Corporation, Αφοι Σαρακάκη ΑΕΒΕ
218	The steering-wheel lock in various positions	Volvo Car Corporation, Αφοι Σαρακάκη ΑΕΒΕ
218	The steering wheel	Toyota Hellas ΑΕΒΕΕ
219	The steering gear(with the pinion on the upper side of the rack) and a ball joint	<i>The car book</i> , Haynes Publishing
	The steering gear(with the pinion placed under the rack)	Volvo Car Corporation, Αφοι Σαρακάκη ΑΕΒΕ
221	Typical power steering system layout with the pinion on the upper side of the rack	<i>The car book</i> , Haynes Publishing
222	Power-steering gear layout with the pinion under the rack	Volvo Car Corporation, Αφοι Σαρακάκη ΑΕΒΕ
223, 226	How the power assisted steering operates	Volvo Car Corporation, Αφοι Σαρακάκη ΑΕΒΕ
227	Extractors for steering wheels and for ball and socket joints	USAG, Κ. Μητρόπουλος ΕΠΕΕ

ΠΗΓΕΣ ΚΕΙΜΕΝΩΝ

Unit 3 The development of the car engine

Εγκυκλοπαίδειες (Encarta 97 Encyclopedia World English Edition, Britanica)
Περιοδικά (Οδηγώντας, 4 Τροχοί)

Unit 4 New developments in the car industry

Εγκυκλοπαίδειες (Encarta 97 Encyclopedia World English Edition, Britanica)
Περιοδικά (Οδηγώντας, 4 Τροχοί)
CD με ενημερωτικό υλικό που παραχωρήθηκε από την Toyota Hellas ΑΕΒΕΕ

Unit 5 The petrol reciprocating engine

Βιβλία των εκδοτικών οίκων: Haynes Publishing και Automobile Association Developments Ltd
Εγχειρίδια της Volvo Car Corporation που δόθηκαν από την Εταιρεία, Αφοι Σαρακάκη ΑΕΒΕ.
Τα διδακτικά βιβλία των ΤΕΛ και ΤΕΕ, Π.Ι. / ΟΕΔΒ

Unit 6 The valves and their tappets

Εγχειρίδια της Volvo Car Corporation που δόθηκαν από την Εταιρεία, Αφοι Σαρακάκη ΑΕΒΕ.
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Unit 9 The engine-management system και**Unit 11 The ignition system**

Τεχνικά βιβλία των εκδοτικών οίκων: Haynes Publishing και Automobile Association Developments

Εγχειρίδια της Volvo Car Corporation που δόθηκαν από την Εταιρεία, Αφοι Σαρακάκη ΑΕΒΕ

Τα διδακτικά βιβλία των ΤΕΛ και ΤΕΕ, Π.Ι. / ΟΕΔΒ

Unit 14 The diesel-oil engine

Βιβλία των εκδοτικών οίκων: Haynes Publishing και Automobile Association Developments.

Τα διδακτικά βιβλία των ΤΕΛ και ΤΕΕ, Π.Ι. / ΟΕΔΒ

Unit 15 The transmission system και**Unit 16 The steering system**

Βιβλία των εκδοτικών οίκων: Haynes Publishing και Automobile Association Developments

Εγχειρίδια της Volvo Car Corporation που δόθηκαν από την Εταιρεία, Αφοι Σαρακάκη ΑΕΒΕ

Εγκυκλοπαίδειες (Encarta 97 Encyclopedia World English Edition, Britannica)

Περιοδικά (Οδηγώντας, 4 Τροχοί)

Τα διδακτικά βιβλία των ΤΕΛ και ΤΕΕ, Π.Ι. / ΟΕΔΒ

Όσον αφορά στις ενότητες 1 - 2 - 7- 8- 10 - 12 - 13 - 17 - 18 και 19 τις οποίες επιμελήθηκε και διαμόρφωσε η κ. Μωραϊτάκη Μαρία, η προέλευση του έντυπου και φωτογραφικού υλικού έχει ως εξής:

ΠΗΓΕΣ ΦΩΤΟΓΡΑΦΙΩΝ ΚΑΙ ΚΕΙΜΕΝΩΝ

ΕΝΟΤΗΤΑ	ΚΕΙΜΕΝΑ	ΦΩΤΟΓΡΑΦΙΚΟ ΥΛΙΚΟ
1η	Απόψεις της ίδιας της συγγραφέα	• Τεχνικές εκδόσεις Α.Ε. (όλες οι φωτογραφίες της ενότητας)
2η	Απόψεις της ίδιας της συγγραφέα (κείμενα και βιογραφικό σημείωμα)	• Coursebook for mechanical engineering technicians – Π.Ι. / ΟΕΔΒ (Οι φωτογραφίες που απεικονίζουν: van, lorry, tanker, coaches) • Ιδιωτικές φωτογραφίες της ομάδας συγγραφής (double-decker buses, tractor, pick-up truck) • Τεχνικές εκδόσεις Α.Ε. (οι υπόλοιπες φωτογραφίες της ενότητας)
7η	Coursebook for mechanical engineering technicians – Π.Ι. / ΟΕΔΒ και πρόσθετες τεχνικές πληροφορίες από τον καθηγητή ειδικότητας της συγγραφικής ομάδας	• Τεχνικές εκδόσεις Α.Ε. (εισαγωγική σελίδα) • Coursebook for mechanical engineering technicians – Π.Ι. / ΟΕΔΒ (οι υπόλοιπες φωτογραφίες της ενότητας)
8η	Αυθεντικά κείμενα (Volvo Car Corporation-Αφοι Σαρακάκη ΑΕΒΕ)	• Volvo Car Corporation-Αφοι Σαρακάκη ΑΕΒΕ (όλα τα σκίτσα της ενότητας)

10η	Ελληνικό κείμενο διαμορφωμένο από τον καθηγητή ειδικότητας και μεταφρασμένο στα Αγγλικά από τη συγγραφέα	<ul style="list-style-type: none"> • Facom SA Μπαρμπέρη Ε.Π.Ε. (εισαγωγική σελίδα) • Σκίτσο του καθηγητή ειδικότητας (ένθετο στο κείμενο)
12η	Αποσπάσματα αυθεντικών κειμένων (Volvo Car Corporation-Αφοι Σαρακάκη ΑΕΒΕ)	<ul style="list-style-type: none"> • Volvo Car Corporation-Αφοι Σαρακάκη ΑΕΒΕ (σκίτσα) • Facom SA Μπαρμπέρη Ε.Π.Ε. (φωτογραφία εξοπλισμού μέτρησης καυσαερίων)
13η	Αυθεντικά κείμενα (Volvo Car Corporation-Αφοι Σαρακάκη ΑΕΒΕ)	<ul style="list-style-type: none"> • Facom SA Μπαρμπέρη Ε.Π.Ε. (φωτογραφία εισαγωγικής σελίδας) • Volvo Car Corporation-Αφοι Σαρακάκη ΑΕΒΕ (σκίτσα)
17η	Αυθεντικά κείμενα (Volvo Car Corporation-Αφοι Σαρακάκη ΑΕΒΕ)	<ul style="list-style-type: none"> • Haynes Publishing (J.H. Publishing and Co. Ltd.) (εισαγωγική σελίδα) • Volvo Car Corporation-Αφοι Σαρακάκη ΑΕΒΕ (σκίτσα) • Facom SA Μπαρμπέρη Ε.Π.Ε. (εργαλεία)
18η	Αυθεντικά κείμενα (Volvo Car Corporation-Αφοι Σαρακάκη ΑΕΒΕ)	<ul style="list-style-type: none"> • Τεχνικές εκδόσεις Α.Ε. (εισαγωγική σελίδα) • Volvo Car Corporation-Αφοι Σαρακάκη ΑΕΒΕ (σκίτσα)
19η	Αποσπάσματα αυθεντικών κειμένων (Volvo Car Corporation-Αφοι Σαρακάκη ΑΕΒΕ)	<ul style="list-style-type: none"> • Haynes Publishing (J.H. Publishing and Co. Ltd.) (εισαγωγική σελίδα και έγχρωμα σκίτσα που απεικονίζονται στην ενότητα) • Volvo Car Corporation-Αφοι Σαρακάκη ΑΕΒΕ (ασπρόμαυρα σκίτσα) • Τεχνικές εκδόσεις Α.Ε. (φωτογραφίες που παρεμβάλλονται ανάμεσα στις ασκήσεις 2b και 2c – Α' κεφ.) • Facom SA Μπαρμπέρη Ε.Π.Ε. (φωτογραφίες εργαλείων για το σύστημα πέδησης)

ΣΗΜΕΙΩΣΗ: Παρόλο που στην παράγραφο «Ευχαριστίες» (5η σελ.) αναφέρουμε ότι στο τέλος του βιβλίου παρατίθεται αναλυτικός κατάλογος προέλευσης του φωτογραφικού υλικού που χρησιμοποιήθηκε, θεωρήσαμε σκόπιμο να αναφέρουμε και κάτω από κάθε φωτογραφία ή σκίτσο την προέλευσή τους.

Για τεχνικούς όμως λόγους (επειδή η εκτύπωση των ενότητων 1-6 έγινε ξεχωριστά και ευσχεσμένα για την έκδοση του πρώτου τεύχους για το σχολικό έτος 2001-2002) αυτό κατέστη δυνατό μόνο για τις ενότητες 7-19 που απαρτίζουν το δεύτερο τεύχος.

