

COMBUSTION ENGINES

Combustion engines are machines which transfer thermal **fuel** energy into energy by motion. It takes energy from a crankshaft in the form of the **torque moment**. **Combustion engines** are used in cars, and in **rail**, air and water transport.

1. Engines are categorized into three groups according to their principles of activity:

- a) **piston engines** - with a **reciprocating piston** motion.
 - with a **circular piston** motion (Wankel motor)
- b) **turbine engines** = **blade machines**
- c) **rocket engines**

2. It is possible to transfer thermal energy into a combustion engine in three ways:

- a) by **burning** the fuel mixture with air in an **engine** working compartment
- b) by **burning** in a **turbine chamber**
- c) by transferring heat from the **combustion chamber** into the **heater** (Stirling **engine**)

3. Engines are further categorized according to their fuel phases:

- a) gas - the **fuel** is a gas (methane, propane-butane, natural gas)
- b) **liquid** - petrol, diesel
- c) various **fuels** (petrol-gas)

4. Engines are categorized according to the method of fuel ignition:

- a) **spark-ignition** - The mixture is **ignited** by an electric **spark** at the time when the **compression stroke** is in front of the **upper dead centre**
- b) **compression-ignition** - The mixture is burnt by heat which **arises** when the mixture is compressed in front of the **upper dead centre**

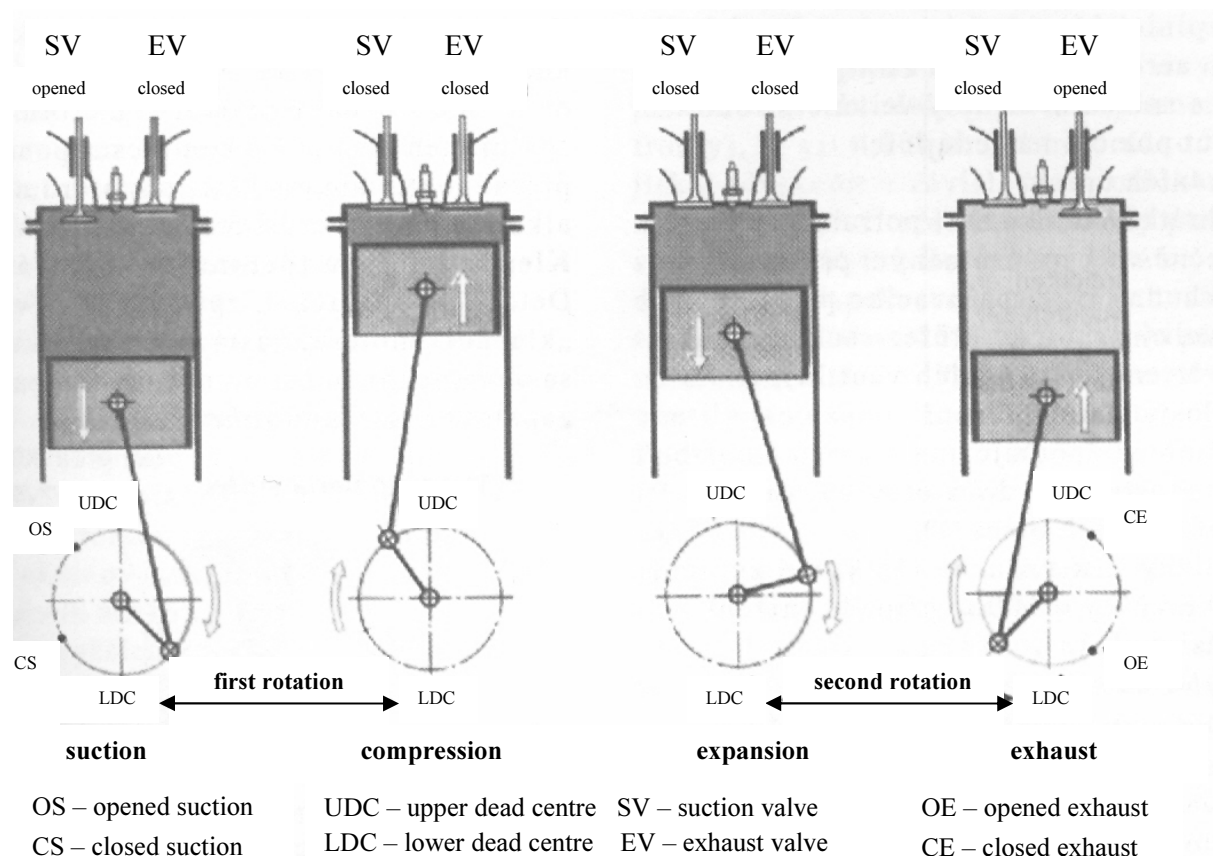
5. Engines are categorized according to the number of strokes in the working circuit:

- a) **two-stroke** - The working **cycle** is carried out during one crankshaft **rotation**
- b) **four-stroke** - The working **cycle** is carried out during two crankshaft **rotations**

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5.1 You can see the Working Circuit (Cycle) of a Four-stroke *Spark-Ignition Engine* in Picture 1.

Picture 1



6. Engines are categorized according to how *fuel* is transported into a cylinder:

- through a *carburetor* – It is equipment which prepares the *combustion* mixture, which is *fuel* with air.
- by *injection*
 - It is for *spark-ignition engines* with direct or indirect *fuel injection*.
 - For *compression-ignition engines* - It is only for *engines* with direct *fuel ignition* into a *combustion chamber*.

7. Engines are categorized according to how the mixture is transformed:

- atmospheric – The *engine* cylinder is being filled with the mixture when there is atmospheric pressure.
- over-filled* – The mixture is transported into the cylinder by *over-pressure* which creates a *turbo-blower* or *compressor*.

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8. Engine output

Work per time unit represents the output which is given for a *combustion engine* in kilowatts. The *efficiency* is not very high. It is up to about 35% for *spark-ignition engines* and up to 45% for *compression- ignition engines*. *Losses* create the *rest up* to 100%.

9. Engine Composition

Combustion engines consist of three main groups:

- There are fixed parts that are *unmovable*, including the *engine* block and *engine* head.
- There are *movable* parts, including the crank mechanism and distribution mechanism.
- There are *auxiliary* devices, including *ignition*, *cooling*, *lubricating*, burning and starting devices.

10. Conclusion

Designers and economists *are aware of* the fact that *combustion engines* have already reached their limit and the *supply* of petroleum is becoming less. Trends in the development of cars and their driving units are being slowly directed to hybrid and electrical driving systems.

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VOCABULARY

arise	vznikat	loss	ztráta
auxiliary	pomocný	lower dead centre	dolní úvrat'
be aware of	být si vědom	lubricating	mazací
blade machine	lopatkový stroj	movable	pohyblivý
burning	spalování	over-filled	přeplňovaný
carburettor	karburátor	over-pressure	přetlak
chamber	komora	phase	skupenství
circuit	oběh	piston engine	pístový motor
circular	krouživý	principle	princip
combustion engine	spalovací motor	rail	železniční
compression	komprese	reciprocating	vratný
compression stroke	kompresní zdvih	rest up	zbytek do
compression-ignition	vznětový	rocket engine	raketový motor
conclusion	závěr	rotation	otáčka
cooling	chlazení	spark	jiskra
cycle	cyklus	spark-ignition	zážehový
efficiency	účinnost	suction	sání
engine	motor	supply	dodávka
exhaust	výfuk	torque moment	točivý moment
expansion	expanze	turbine engine	turbína
fuel	palivo	turbo-blower	turbodmychadlo
heater	ohřívač	two-stroke	dvoutaktní
ignite	zapálit	unmovable	nepohyblivý
ignition	zapálení	upper dead centre	horní úvrat'
injection	vstřikování	valve	ventil
liquid	kapalný		

COMPREHENSION QUESTIONS

1. What are combustion engines?
2. Where do we use them?
3. What kinds of engines do you know? Can you name at least 6?
4. What parts do combustion engines consist of?

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EXERCISES

1. Translate the following verbs into Czech:

- 1 burn _____
- 2 transfer _____
- 3 consist of _____
- 4 be aware of _____
- 5 ignite _____
- 6 prepare _____
- 7 carry out _____

2. Translate the following sentences using 5 of the verbs from Exercise 1:

- 1 Spalovací motor přeměňuje tepelnou energii paliva.

- 2 Spalovací motory se skládají ze tří hlavních skupin.

- 3 Konstrukteři si uvědomují nové trendy v automobilové dopravě.

- 4 Palivo hoří v motoru.

- 5 Směs se zapaluje elektrickou jiskrou.

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3. Make phrases from the words in the box according to the Czech translations.

combustion	head	exhaust	engine	cycle	rail	fuel	rotation	lower
lubricating	centre	transport	engine	valve	compression	four-stroke		
engine	over-pressure	dead	suction	cooling	mixture	second	working	

1 železniční doprava

2 spalovací motor

3 směs paliva

4 pracovní cyklus

5 dolní úvrat'

6 hlava motoru

7 sání a komprese

8 přetlak

9 chlazení a mazání

10 druhá otáčka

11 výfukový ventil

12 čtyřtaktní motor

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Exercises – Key for teachers only

- | | | |
|---|-------------|-------------------|
| 1 | burn | hořet |
| 2 | transfer | přenést, přeměnit |
| 3 | consist of | skládat se |
| 4 | be aware of | být si vědom |
| 5 | ignite | zapálit |
| 6 | prepare | připravit |
| 7 | carry out | provádět |

2.

- 1 Spalovací motor přeměňuje tepelnou energii paliva.
The combustion engine transfers thermal fuel energy.

- 2 Spalovací motory se skládají ze tří hlavních skupin.
Combustion engines consist of three main groups.

- 3 Konstrukteři si uvědomují nové trendy v automobilové dopravě.
Designers are aware of new trend in the car transport.

- 4 Palivo hoří v motoru.
Fuel is burning in the engine.

- 5 Směs se zapaluje elektrickou jiskrou.
Mixture is ignited by an electric spark.

3.

- | | | |
|----|--------------------|-------------------------|
| 1 | železniční doprava | rail transport |
| 2 | spalovací motor | combustion engine |
| 3 | směs paliva | fuel mixture |
| 4 | pracovní cyklus | working cycle |
| 5 | dolní úvrať | lower dead centre |
| 6 | hlava motoru | engine head |
| 7 | sání a komprese | suction and compression |
| 8 | přetlak | over-pressure |
| 9 | chlazení a mazání | cooling and lubricating |
| 10 | druhá otáčka | second rotation |
| 11 | výfukový ventil | exhaust valve |
| 12 | čtyřtákní motor | four-stroke engine |