Student

Introduction to small engines

What you will learn

When you have finished this introduction module, you should know:

- ❑ How small engines work
- ❑ The main differences between 2-stroke and 4-stroke engines
- ❑ The main parts of small engines
- ❑ Why engines need air, fuel and a spark to run
- ❑ Why engines need maintenance
- ❑ Technical information about your engine.

Things you need before you start

Materials

None

Tools or equipment

No tools for this module – but you will need to find out information about your engine

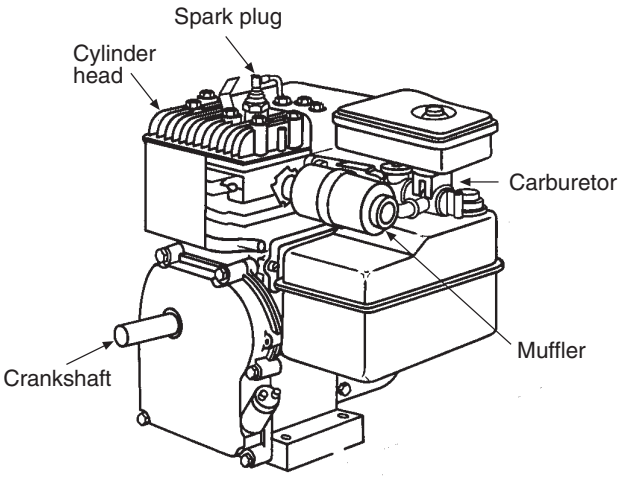
What is a small engine?

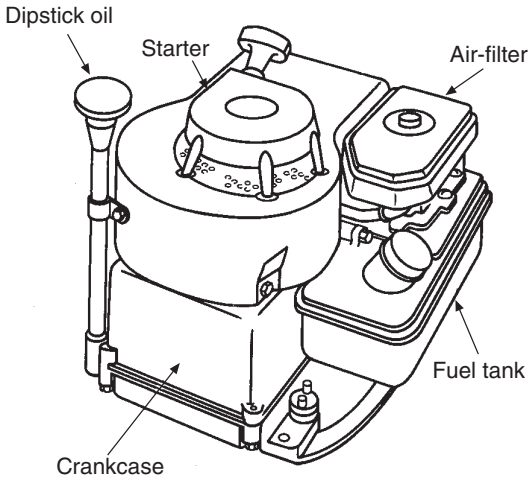
Engines can be in all sorts of shapes and sizes.

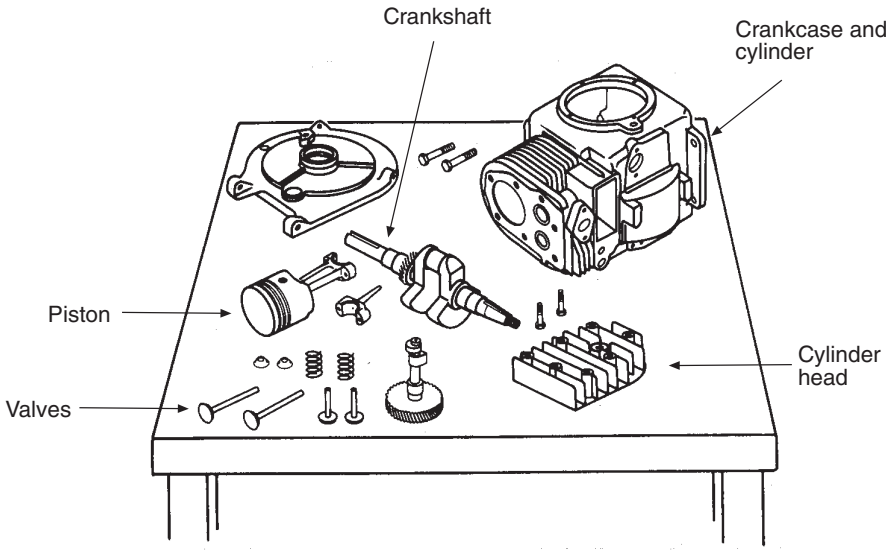
They are used to power:

- outboard motors
- brush cutters and mowers
- motor bikes
- small generators
- chainsaws
- concrete mixers

Here are the names for some important parts of an engine.







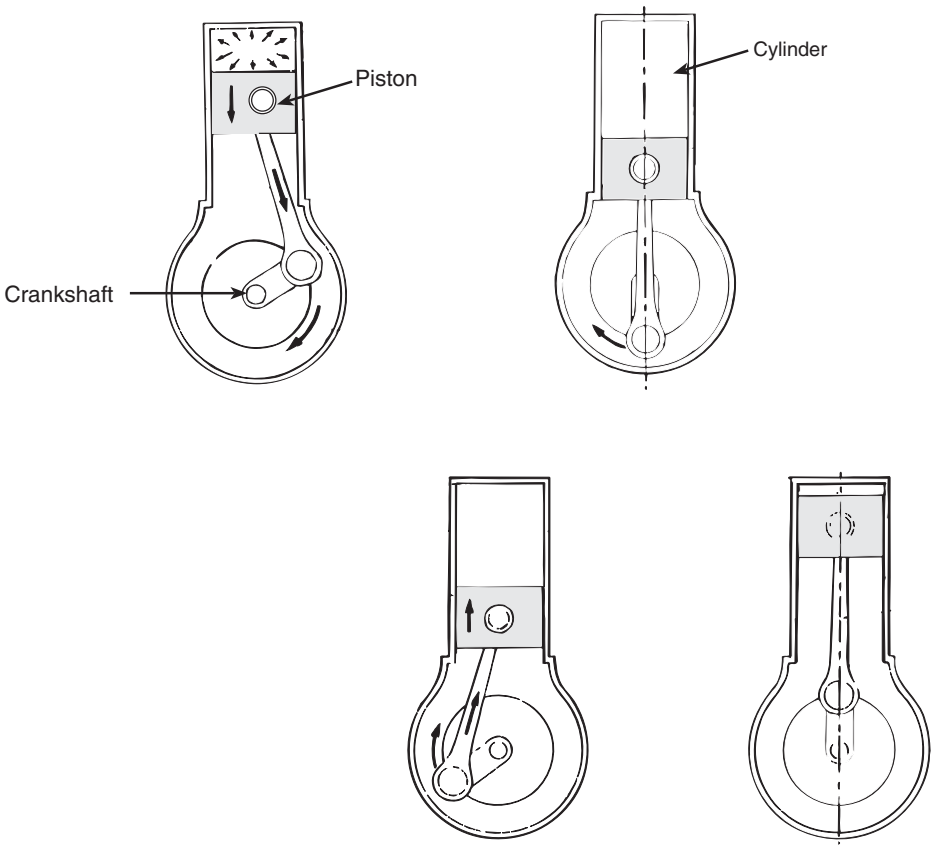
How do engines work?

The power and energy in an engine is made by burning a mix of fuel and air inside a **cylinder**.

As the fuel burns it explodes and pushes a **piston** down inside the cylinder

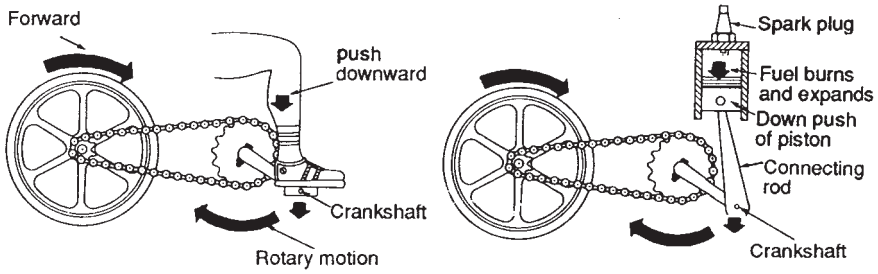
The piston is attached to a **crankshaft** that turns as the piston moves up and down

Here is the piston going up and down as the crankshaft turns



Think of a person riding a bicycle. Think of one of their legs pushing down on the pedal – round and round.

The leg is just like the piston and the pedal and chain-wheel are like a crankshaft



The engine crankshaft is then connected to what the engine is driving – a wheel, propeller, cutting blades.

The engine cycle

These are the steps that happen inside the engine:

intake. fuel and air is sucked or pushed into the cylinder

compression. the fuel-air mix is compressed – or squashed – as the piston moves up

ignition/power. a spark ignites the fuel-air. The exploding fuel pushes the piston down

exhaust. the burnt gasses are pushed out through the exhaust

and then the cycle goes around again.

Those are the proper names for the steps. Some people call them:

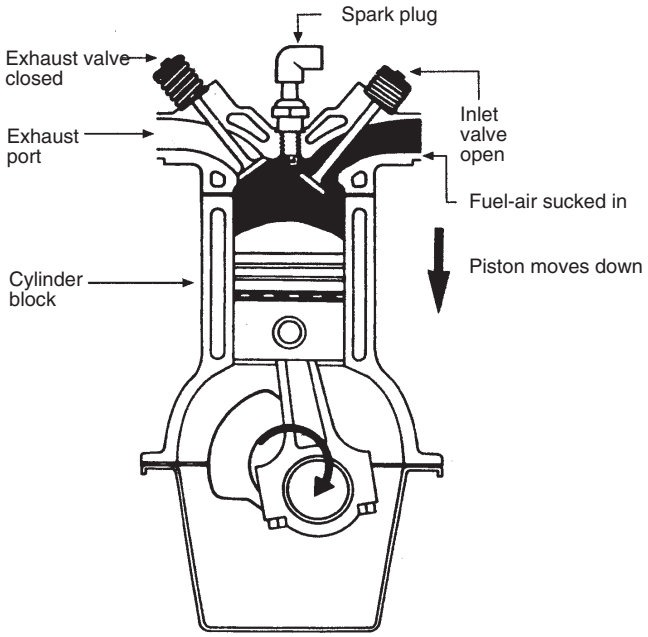
Suck - Squash - Bang - Blow

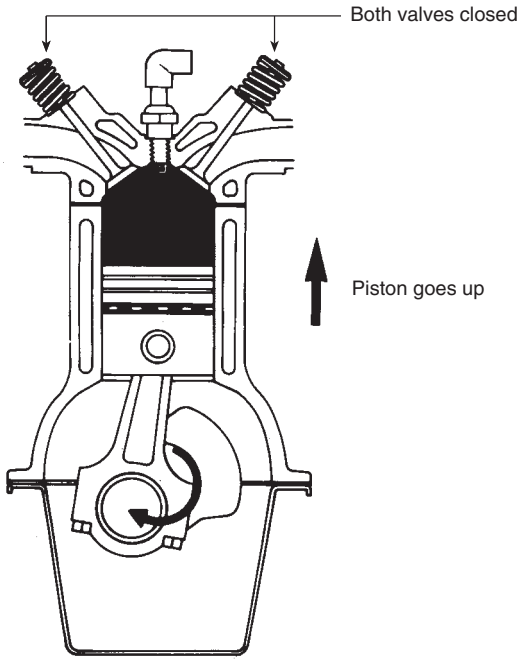
4 -Stroke engines

In these engines, each step in the engine cycle is done in one up or down movement (stroke) of the piston. So there are 4 strokes to each cycle.

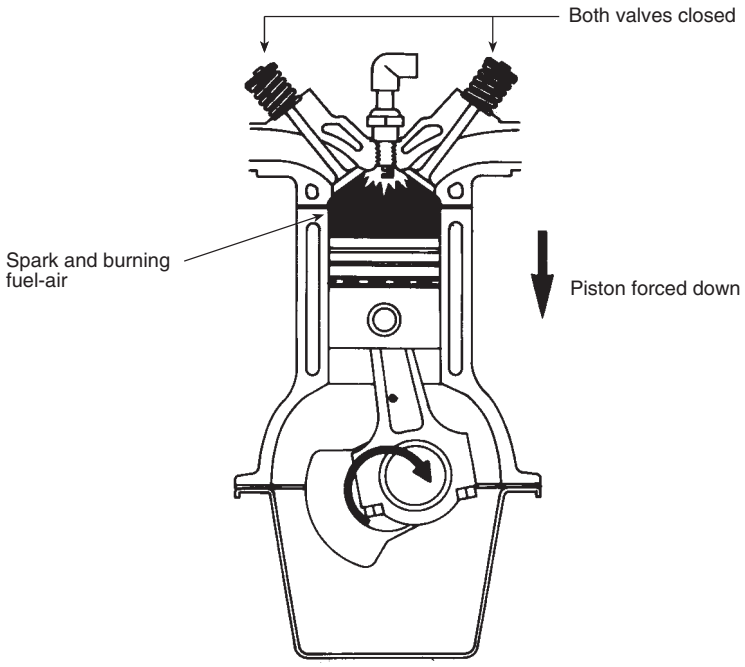
Like this:

Intake. Piston goes down. Fuel-air is sucked into the cylinder





Compression. Piston goes up. Fuel-air is squashed and gets hot.

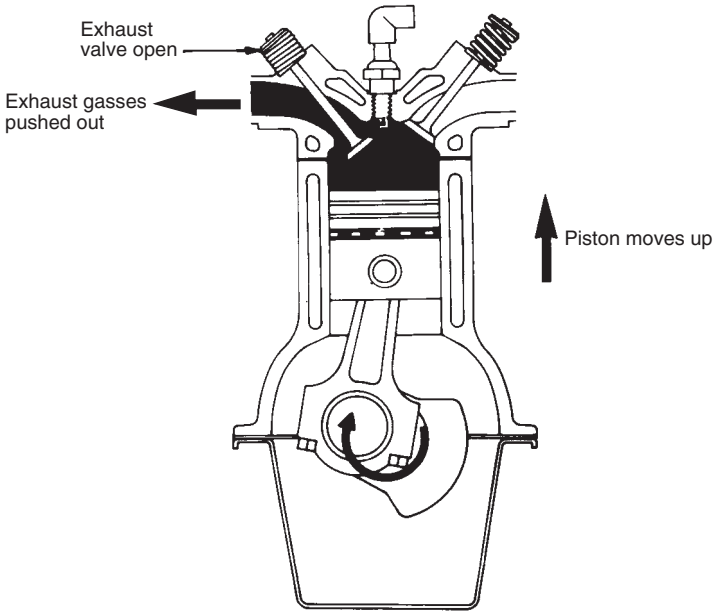


Power. A spark ignites the fuel-air as the piston is at the top. The exploding fuel pushes the piston down again.

Exhaust. The piston moves up and blows the waste gasses out through the exhaust.

The cycle then goes round again.

See how the valves at the top open and close at just the right time to let fuel-air mix in and the burnt gasses to exhaust.



A flywheel fixed on the end of the crankshaft keeps the engine turning during the exhaust and intake strokes.

Things about 4 stroke engines

The spark ignites the fuel on every **two turns** of the crankshaft.

They have oil in the bottom of the engine to lubricate the moving parts

They need more engine parts to open and close the valves at the right time.

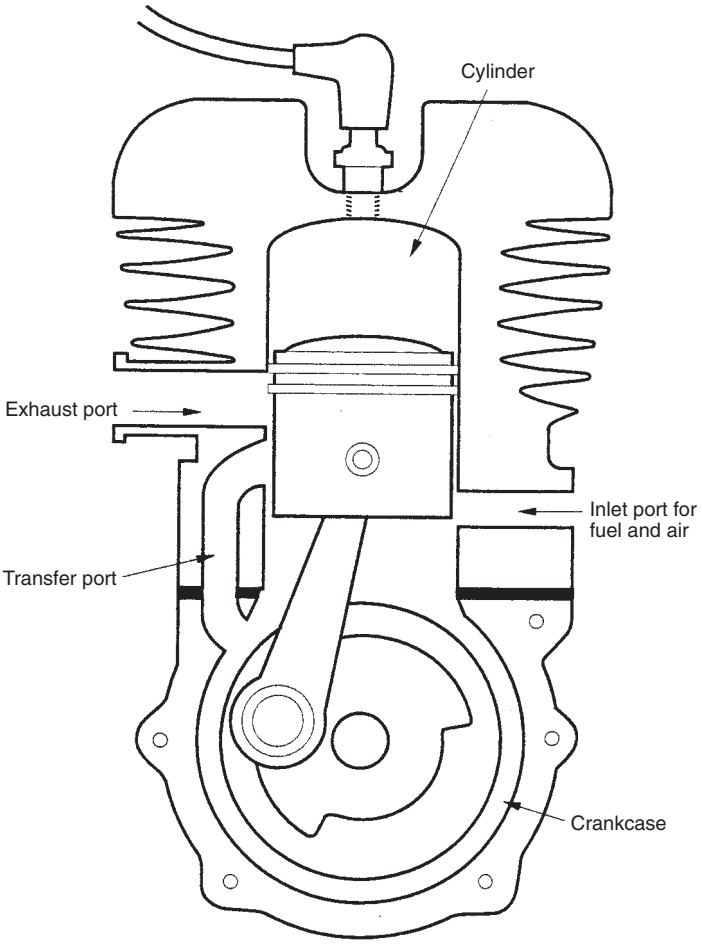
They use ordinary petrol

2-stroke engines

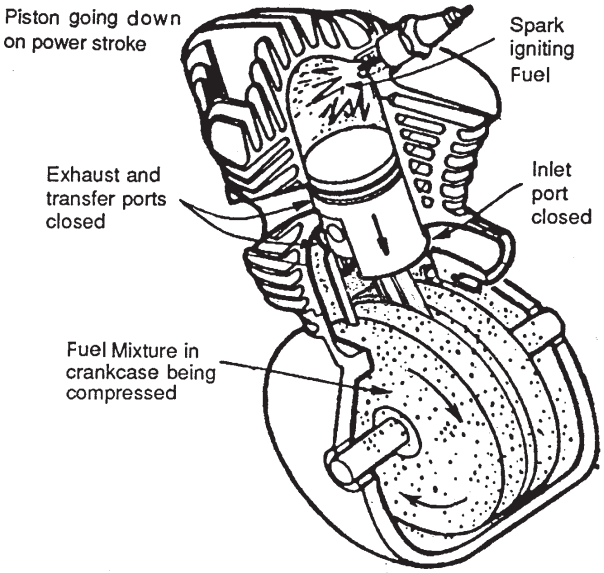
These engines use the same engine cycle of intake, compression, power and exhaust.

They complete each cycle in just two up and down movements of the piston – or 2 stokes per cycle.

These engines do not have valves. They have ports (holes) in the cylinder wall and the fuel-air mix is sucked in through crankcase at the bottom of the engine.



The cycle works like this:



Power

Spark ignites fuel-air. Exploding fuel pushes piston down (**power**).

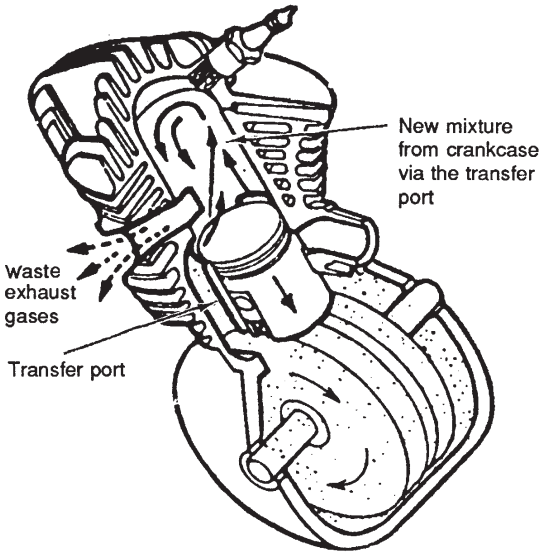
The piston compresses fuel-air in the crankcase as it goes down.

The compressed fuel-air rushes into the cylinder through the transfer port.

Intake and exhaust

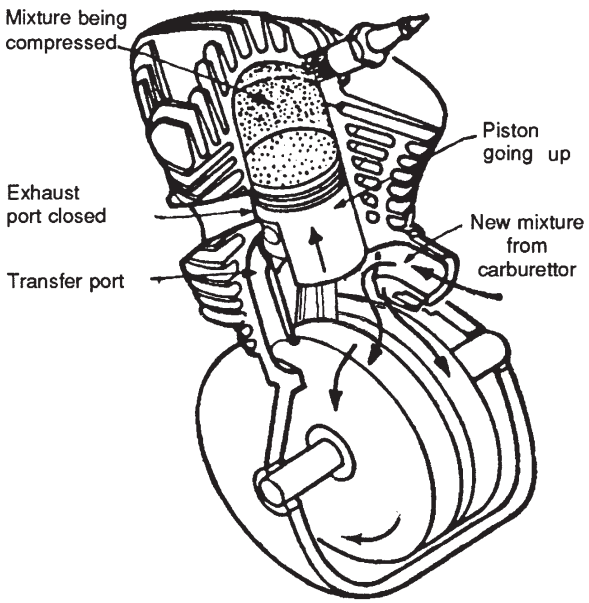
The fuel-air rushing in from the crankcase pushes the waste gases out through the exhaust port

As the piston moves up, it closes off the inlet and exhaust ports.



Compression

The piston compresses the fuel-air as it moves up. It also sucks more fuel-air into the crankcase for the next cycle.



Things about 2 stroke engines:

2 stroke engines spark on **every turn** of the crankshaft

They can be made lighter then 4-strokes because they:

- have less parts – no valves or their operating parts.
- use oil mixed with the fuel (petroil) to lubricate the engine parts, so they have no oil, filter or oil pumps.

They use more fuel than 4 strokes

They usually run faster than 4-strokes and make more noise

They can work in many positions

The seal around the crank-case/crank shaft is very important – if it leaks, there may not be enough pressure to push the fuel/air into the cylinder.

Engines with more cylinders

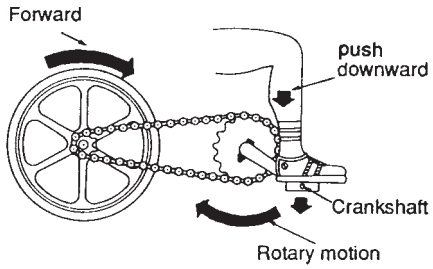
All our pictures so far have shown engines with just one cylinder.

Most mower, chainsaw, brush-cutter and many other small engines are made just like that.

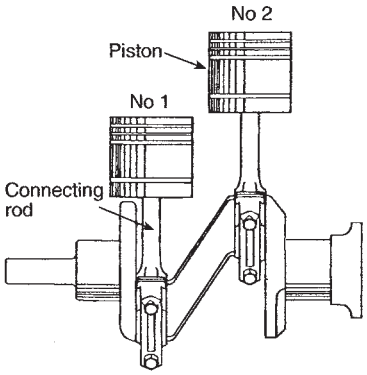
To get more power and make engines run smoother, bigger engines have more than one cylinder.

Think back to the man on the bicycle.

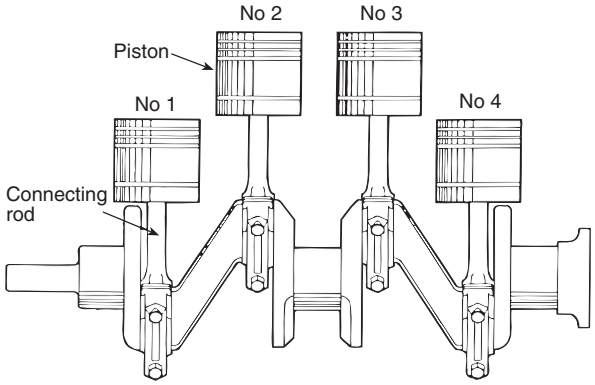
You saw one leg acting like a piston in a cylinder. If you think about two legs working on the pedals – you have a two cylinder engine working on the same crankshaft.

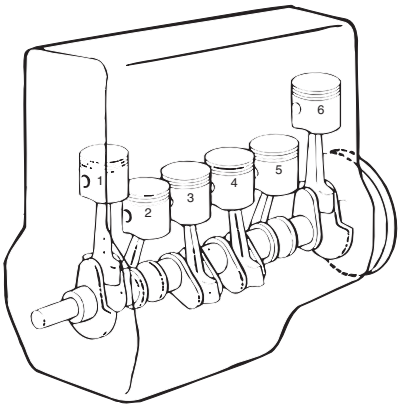


Two-cylinder engines are common for outboards and motor bikes



Cars and trucks usually have four or six cylinders





Engines can have 8 or even 10 cylinders – but they get very complicated

How do you measure the size and power of an engine?

Size

The ‘size’ of an engine is the size of the space inside the cylinder(s) above the piston(s) – called the volume, or its ‘capacity’.

The volume depends upon how wide the cylinder is – and how far the piston goes up and down inside the cylinder.

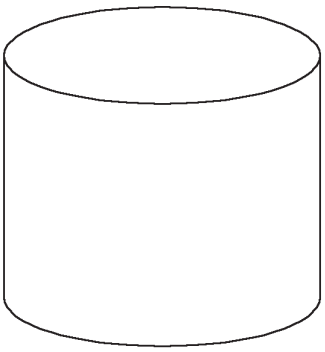
The engine size is usually given in cubic centimetres (cc) or litres (L). Some USA made engines may still give the size in cubic inches (cui).

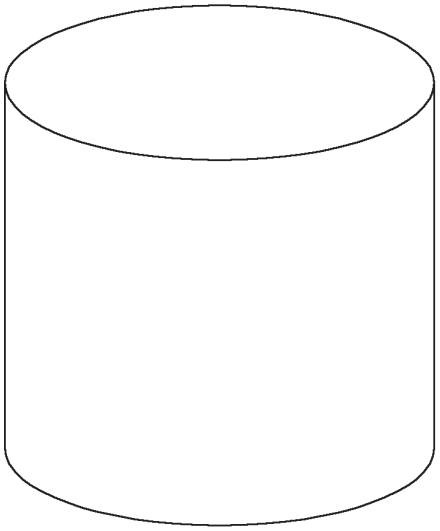
Some examples: engine sizes

- a small brush-cutter or chainsaw may have an engine of about 30cc, (about the size of your finger).
- small outboards and motor bikes are from about 60cc upwards
- mowers are about 70 or 80cc,
- middle size outboards 250cc to 500cc. (A coke can is 330cc.)
- car engines from 1000cc (1 litre). Big USA V8’s can be 7 litres or more!

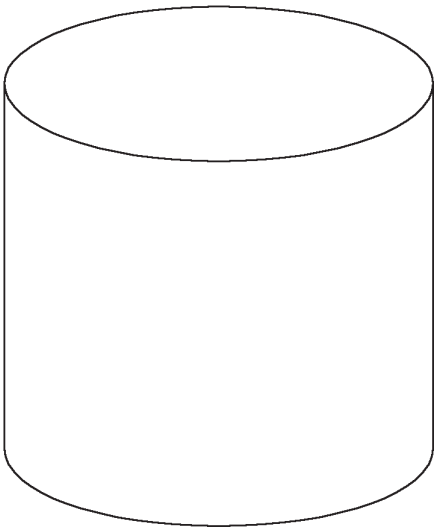
These two examples show the actual size of the space inside the cylinders.

60cc single cylinder engine. 2 HP





335cc two cylinder engine. 15 HP



Power

Generally, the bigger the engine capacity, the more powerful it is – but lots of other things can effect the engine power.

Most engine makers give the power rating of their engines in ‘HP’.

They may use ‘HP’ for the model name of the engine as well.

HP is a very old name meaning ‘Horse- Power’. It is not accurate, but it gives a good idea of the amount of power from different engines.

Small boat outboards are 2 HP to 8 HP.

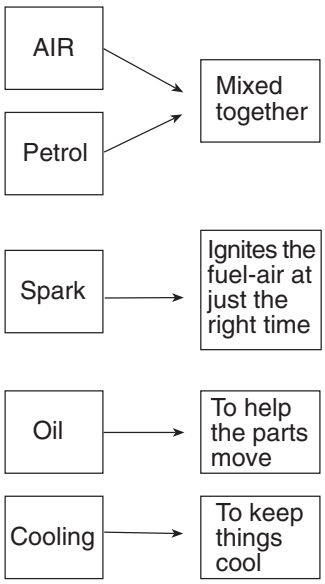
Large fishing craft outboards are 25 HP and over.

Mowers and generators are usually 3 or 4 HP

(Most real horses can only produce about 0.6 of a HP!)

The things an engine needs to make it work

For an engine to start and run it needs all these things:



If any of these things are not doing their job, the engine will run poorly, breakdown – or may not start at all.

If you look after all of them and keep them 'just right' in your engine, it will:

start and run better

give more power

use least fuel

keep going!

last longer

Each one needs you to do some important things to look after the engine and to check, change or adjust parts at regular times.

We call this **'Operator Maintenance'.**

It is what this course is for. You will work through modules and worksheets on Air, Fuel, Electrics (sparks), Lubrication and Cooling.

Service and repair workshops

This course helps you do simple maintenance on your engine.

More difficult work – and work that needs special tools or equipment – must be done by experienced mechanics in a workshop.

Your tutor will talk to you about where you can get your engine repaired and where you can buy parts from - things like oil or filters.

Information and manuals

All new engines and equipment are sold with a technical manual.

It will tell you

about the engine,

how to start and use it

what you need to do to look after it, and

what parts you will need to change.

If you do not have a manual for your engine, you may be able to:

get a copy from the people who sell your make of engine

borrow one - and write down the information you need

or – ask your local mechanic if they can tell you about your engine.

Your course tutor may be able to give you information – or help you find it.

Activity

Find out this information about **your** engine:

What type of engine do *you* have?

Make

Model

Is it an: Outboard motor, a mower, a generator or……..?

Size/rating:

2-stroke or 4-stroke?

How many cylinders?

How old is it?

When was it last maintained?

When did it last go wrong?

What was wrong?

Who fixed it?

Do you have the makers manual?

Do you have a list of service parts?