CLASSIFICATION OF INTERNAL COMBUSTION ENGINE

There is a wide range of internal combustion engines corresponding to their many varied applications. Likewise there is a wide range of ways to classify internal-combustion engines, some of which are listed below.

Although the terms sometimes cause confusion, there is no real difference between an "engine" and a "motor." At one time, the word "engine" (from Latin[[15]] , via Old French[[16]] , ingenium, "ability") meant any piece of machinery. A "motor" (from Latin motor, "mover") is any machine that produces mechanical power. Traditionally, electric motors are not referred to as "engines," but combusion engines are often referred to as "motors."

Principles of operation

Reciprocating:

- Two-stroke engine
- Four-stroke engine
- Sleeve valve four-stroke
- Bourke Engine

Rotary:

- **Demonstrated:**
  - Wankel engine
- **Proposed:**
  - orbital engine
  - quasiturbine

Continuous combustion:

- gas turbine
- jet engine
- rocket engine

Engine cycle

Engines based on the two-stroke cycle use two strokes (one up, one down) for every power stroke. Since there are no dedicated intake or exhaust strokes, alternative methods must be used to scavenge the cylinders. The most common method in spark-ignition two-strokes is to use the downward motion of the piston to pressurize fresh charge in the crankcase, which is then blown through the cylinder through ports in

the cylinder walls. Spark-ignition two-strokes are small and light (for their power output), and mechanically very simple. Common applications include snowmobiles, lawnmowers, chain saws, jet skis, mopeds, outboard motors and some motorcycles. Unfortunately, they are also generally louder, less efficient, and far more polluting than their four-stroke counterparts, and they do not scale well to larger sizes. Interestingly, the largest compression-ignition engines are two-strokes, and are used in some locomotives and large ships. These engines use forced induction to scavenge the cylinders.

Engines based on the four-stroke cycle or Otto cycle have one power stroke for every four strokes (up-down-up-down) and are used in cars, larger boats and many light aircraft. They are generally quieter, more efficient and larger than their two-stroke counterparts. There are a number of variations of these cycles, most notably the Atkinson and Miller cycles. Most truck and automotive Diesel engines use a four-stroke cycle, but with a compression heating ignition system it is possible to talk separately about a diesel cycle. The Wankel engineoperates with the same separation of phases as the four-stroke engine (but with no piston strokes, would more properly be called a four-phase engine), since the phases occur in separate locations in the engine; however like a two-stroke piston engine, it provides one power 'stroke' per revolution per rotor, giving it similar space and weight efficiency. The Bourke cycle's combustion phase more closely approximates constant volume combustion than either four stroke or two stroke cycles do. It also uses less moving parts, hence needs to overcome less friction than the other two reciprocating types have to. In addition, its greater expansion ratioalso means more of the heat from its combustion phase is utilized than is used by either four stroke or two stroke cycles.

Fuel and oxidizer types

Fuels used include gasoline (British term: petrol), Liquified Petroleum Gas, Vapourized Petroleum Gas,Compressed Natural Gas, hydrogen, diesel fuel, JP18 (jet fuel), landfill gas, biodiesel, peanut oil, ethanol,methanol (methyl or wood alcohol). Even fluidised metal powders and explosives have seen some use. Engines that use gases for fuel are called gas engines and those that use liquid hydrocarbons are called oil engines. However, gasoline engines are unfortunately also often colloquially refered to as 'gas engines'.

The main limitations on fuels are that the fuel must be easily transportable through the fuel system to thecombustion chamber, and that the fuel release sufficient energy in the form of heat upon combustion to make use of the engine practical.

The oxidiser is typically air, and has the advantage of not being stored within the vehicle, increasing the power-to-weight ratio. Air can, however, be compressed and carried aboard a vehicle. Some submarines are designed to carry pure oxygen or hydrogen peroxide to make them air-independent. Some race cars carrynitrous oxide as oxidizer. Other chemicals such as chlorine or fluorine have seen experimental use; but mostly are impractical.

Diesel engines are generally heavier, noisier and more powerful at lower speeds than gasoline engines. They are also more fuel-efficient in most circumstances and are used in heavy road-vehicles, some automobiles (increasingly more so for their increased fuel-efficiency over gasoline engines), ships and some locomotivesand light aircraft. Gasoline engines are used in most other road-vehicles including most

cars, motorcycles andmopeds. Note that in Europe, sophisticated diesel-engined cars have become quite prevalent since the 1990s, representing around 40% of the market. Both gasoline and diesel engines produce significant emissions. There are also engines that run on hydrogen, methanol, ethanol, liquefied petroleum gas (LPG) and biodiesel.Paraffin and Tractor vaporising oil (TVO) engines are no longer seen.

Cylinders

Internal combustion engines can contain any number of cylinders with numbers between one and twelve being common, though as many as 28 have been used. Having more cylinders in a engine yields two potential benefits: First. the engine can have a larger displacement with smaller individual reciprocating masses (that is, the mass of each piston can be less) thus making a smoother running engine (since the engine tends to vibrate as a result of the pistons moving up and down). Second, with a greater displacement and more pistons, more fuel can be combusted and there can be more combustion events (that is, more power strokes) in a given period of time, meaning that such an engine can generate more torque than a similar engine with fewer cylinders. The down side to having more pistons is that, over all, the engine will tend to weigh more and tend to generate more internal friction as the greater number of pistons rub against the inside of their cylinders. This tends to decrease fuel efficiency and rob the engine of some of its power. For high performance gasoline engines using current materials and technology (such as the engines found in modern automobiles), there seems to be a break point around 10 or 12 cylinders, after which addition of cylinders becomes an overall detriment to performance and efficiency, although exceptions such as the W-16 engine from Volkswagen exist.

Most car engines have four to eight cylinders, with some high performance cars having ten, twelve, or even sixteen, and some very small cars and trucks having two or three. In previous years some quite large cars, such as the DKW and Saab 92, had two cylinder, two stroke engines.

Radial aircraft engines, now obsolete, had from five to 28 cylinders. A row contains an odd number of cylinders, so an even number indicates a two- or four-row engine.

Motor cycles commonly have from one to four cylinders, with a few high performance models having six.

Snowmobiles usually have two cylinders. Some larger (not necessarily high-performance, but also touring machines) have four.

Small portable appliances such as chainsaws, generators and domestic lawn mowers most commonly have one cylinder, although two-cylinder chainsaws exist.

Ignition system

Internal combustion engines can be classified by their ignition system. Today most engines use an electrical orcompression heating system for ignition. However outside flame and hot-tube systems have been used historically. Nikola Tesla gained one of the first patents on the mechanical ignition system with Template:US patent, "Electrical Igniter for Gas Engines", on 16 August 1898.

Fuel systems

Often for simpler reciprocating engines a carburetor is used to supply fuel into the cylinder. However, exact control of the correct amount of fuel supplied to the engine is impossible.

Larger gasoline engines such as used in cars have mostly moved to Fuel injection systems. LPG engines use a mix of Fuel injection systems and closed loop carburetors. Diesel engines always use fuel injection.

Other internal combustion engines like Jet engines use burners, and rocket engines use various different ideas including impinging jets, gas/liquid shear, preburners and many other ideas.

Engine configuration

Internal combustion engines can be classified by their configuration which affects their physical size and smoothness (with smoother engines producing less vibration). Common configurations include the straight or inline configuration, the more compact V configuration and the wider but smoother flat or boxer configuration. Aircraft engines can also adopt a radial configuration which allows more effective cooling. More unusual configurations, such as "H", "U", "X", or "W" have also been used.

Multiple-crankshaft configurations do not necessarily need a cylinder head at all, but can instead have a piston at each end of the cylinder, called an opposed piston design. This design was used in the Junkers Jumo 205diesel aircraft engine, using two crankshafts, one at either end of a single bank of cylinders, and most remarkably in the Napier Deltic diesel engines, which used three crankshafts to serve three banks of double-ended cylinders arranged in an equilateral triangle with the crankshafts at the corners. It was also used in single-bank locomotive engines, and continues to be used for marine engines, both for propulsion and for auxiliary generators. The Gnome Rotary engine, used in several early aircraft, had a stationary crankshaft and a bank of radially arranged cylinders rotating around it.

Engine capacity

An engine's capacity is the displacement or swept volume by the pistons of the engine. It is generally measured in litres or cubic inches for larger engines and cubic centimetres (abbreviated to cc's) for smaller engines. Engines with greater capacities are usually more powerful and provide greater torque at lower rpms but also consume more fuel.

Apart from designing an engine with more cylinders, there are two ways to increase an engine's capacity. The first is to lengthen the stroke and the second is to increase the piston's diameter. In either case, it may be necessary to make further adjustments to the fuel intake of the engine to ensure optimal performance.

An engine's quoted capacity can be more a matter of marketing than of engineering. The Morris Minor 1000, the Morris 1100, and the Austin-Healey Sprite Mark II all had engines of the same stroke and bore according

to their specifications, and were from the same maker. However the engine capacities were quoted as 1000cc, 1100cc and 1098cc respectively in the sales literature and on the vehicle badges.

Engine pollution

Generally internal combustion engines, particularly reciprocating internal combustion engines, produce moderately high pollution levels, due to incomplete combustion of carbonaceous fuel, leading to carbon monoxide and some soot along with oxides of nitrogen & sulphur and some unburnt hydrocarbons depending on the operating conditions and the fuel/air ratio.

Diesel engines produce a wide range of pollutants including aerosols of many small particles that are believed to penetrate deeply into human lungs.

Many fuels contain sulfur leading to sulfur oxides (SOx) in the exhaust, promoting acid rain.

The high temperature of combustion creates greater proportions of nitrogen oxides (NOx), demonstrated to be hazardous to both plant and animal health.

Net carbon dioxide production is not a necessary feature of engines, but since most engines are run from fossil fuels this usually occurs. If engines are run from biomass, then no net carbon dioxide is produced as the growing plants absorb as much, or more carbon dioxide while growing.

Hydrogen engines need only produce water, but when air is used as the oxidizer nitrogen oxides are also produced.

Source : http://engineering.wikia.com/wiki/Internal_combustion_engine