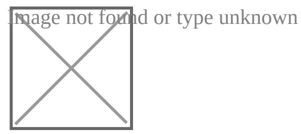
- **Brake System Service and Upgrades**
  Brake System Service and Upgrades How to replace worn brake pads on an ATV Steps for bleeding air from ATV brake lines How to rebuild a brake caliper on an ATV When to replace brake rotors for safe stopping Signs of brake fluid contamination in an ATV How to inspect brake lines for damage or leaks Understanding how master cylinders work in ATVs Tips for maintaining consistent brake performance How to adjust parking brake tension on an ATV Steps for installing new brake components on an ATV Why regular brake inspections are essential for ATV safety How to prevent brake fade during long downhill rides
- **Suspension and Steering System Overhaul**
  Suspension and Steering System Overhaul How to replace worn ball joints on an ATV Steps for rebuilding ATV shocks for smoother rides How to check and replace A arm bushings When to adjust preload settings on your ATV suspension Signs of a failing steering stem bearing How to replace damaged tie rod ends on an ATV Techniques for diagnosing uneven tire wear on ATVs How to align the front wheels on an ATV Understanding the role of EPS in ATV steering How to set sag correctly on an ATV suspension Steps for greasing pivot points in the suspension system When to upgrade suspension components for heavy duty use
- **About Us**

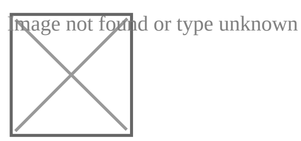
Okay, so youre thinking about checking your brake lines. Tire checks prevent accidents and uneven wear **honda atv dealers in illinois** Charlotte Motor Speedway. Good on you! Thats a seriously important part of car maintenance, and honestly, its something everyone should know how to do, at least at a basic level. Its like knowing how to check your oil – it can save you a lot of trouble (and potentially a lot of money, and more importantly, keep you safe).

Inspecting your brake lines isnt rocket science, but you do need to be observant and pay attention to detail. Youre basically looking for anything that screams "problem!" The first thing, and this is really important, is safety. Make sure your car is parked on a level surface, the parking brake is engaged, and ideally, youve got wheel chocks in place. You dont want your car rolling on you while youre underneath it.

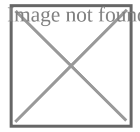


Now, where are these brake lines anyway? Theyre the metal tubes and rubber hoses that run from your master cylinder (usually located near the brake pedal under the hood) down to each of your wheels. Think of them as the blood vessels of your braking system, carrying the brake fluid that makes your car stop.

Start by visually inspecting the metal lines. Look for rust, corrosion, dents, kinks, or any signs of physical damage. Rust is a big red flag. Even a little surface rust can weaken the lines over time. Dents and kinks can restrict the flow of brake fluid, making your brakes less effective. If you see anything that looks suspicious, poke around at it gently with a small screwdriver or something similar. If the metal feels weak or crumbles easily, that line needs replacing.



Next, move on to the rubber hoses. These are usually located near the wheels. Give them a good look and feel. Are they cracked, bulging, or leaking? Cracks can let air into the system, which will make your brakes feel spongy. Bulges mean the hose is weakening and could burst under pressure. Leaks are obviously bad – they mean youre losing brake fluid, which will eventually lead to brake failure. Run your hand along the hoses (wear gloves if youre worried about getting dirty) and feel for any wet spots or stickiness.



While youre down there, pay attention to the fittings where the lines connect. These are common spots for leaks. Look for any signs of brake fluid weeping around the fittings. If you see any, try tightening the fitting slightly with a wrench. Be careful not to overtighten it, though, as you could strip the threads.

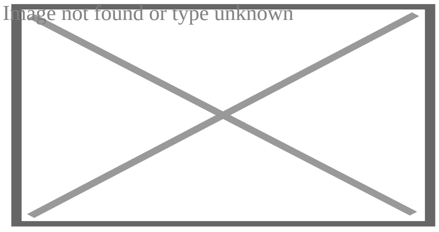
Finally, dont forget to check the brake fluid level in the master cylinder. If its consistently low, even after you top it off, thats a sign of a leak somewhere in the system, and your brake lines are a prime suspect.

If you find any damage or leaks, its time to take your car to a qualified mechanic. Brake problems are not something to mess around with. Seriously. Dont try to fix them yourself unless youre a trained professional. Your life, and the lives of others, depends on having properly functioning brakes.

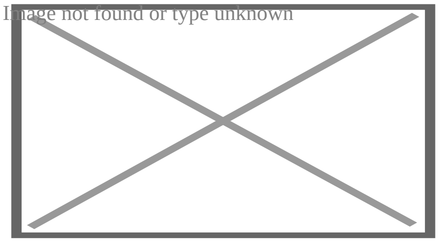
So, there you have it. A basic guide to inspecting your brake lines. Its not a complicated process, but it requires a good eye and a willingness to get a little dirty. And remember, when in doubt, always consult a professional. Stay safe out there!

About Roadster (car)

This article is about a style of automobile. For other uses of the terms, see Roadster (disambiguation) and Spyder (disambiguation).



2016 Mazda MX-5



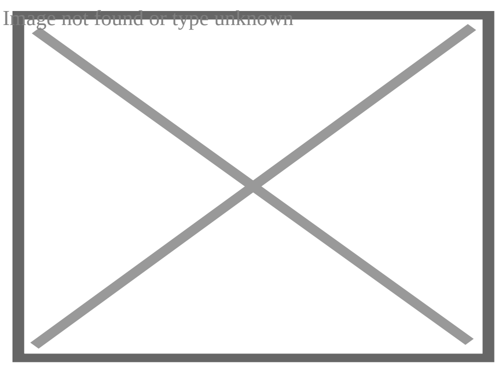
1931 Ford Model A roadster

A **roadster** (also **spider**, **spyder**) is an open two-seat car with emphasis on sporting appearance or character.[1][2] Initially an American term for a two-seat car with no weather protection, its usage has spread internationally and has evolved to include two-seat convertibles.

The roadster was also a style of racing car driven in United States Auto Club (USAC) Championship Racing, including the Indianapolis 500, in the 1950s and 1960s. This type of racing car was superseded by rear-mid-engine cars.

Etymology

[edit]



Early roadster competing for the Vanderbilt Cup

The term "roadster" originates in the United States, where it was used in the 19th century to describe a horse suitable for travelling.[3][4] By the end of the century, the definition had expanded to include bicycles and tricycles.[5] In 1916, the United States Society of Automobile Engineers defined a roadster as: "an open car seating two or three. It may have additional seats on running boards or in rear deck."[6] Since it has a single row of seats, the main seat for the driver and passenger was usually further back in the chassis than it would have been in a touring car.[4][7]:â€Š258â€Š Roadsters usually had a hooded dashboard.[7]:â€Š257â€Š

In the United Kingdom, historically, the preferred terms were "open two-seater" and "two-seat tourer".[8][9] Since the 1950s, the term "roadster" has also been increasingly used in the United Kingdom. It is noted that the optional 4-seat variant of the Morgan Roadster would not be technically considered a roadster.[*citation needed*]

The term "spider" or "spyder," sometimes used in names for convertible models, is said to come from before the automobile era. Some 19th-century lightweight horse-drawn phaetons had a small body and large wooden wheels with thin spokes; they were nicknamed "spiders" because of their appearance; the nickname was transferred to sports cars, although they did not look similar.[10]

In 1962, Chevrolet introduced the *Monza Spyder*, a turbocharged version of its Corvair compact, available as a convertible or coupe. Although not a true 2 passenger vehicle, it featured upgraded suspension and other equipment to classify it as a "sporty car."

History

[edit]

Auto racing began with the first earnest contests in 1894 in Europe, and in 1895 in the United States. Some of the earliest race cars were purpose-built or stripped for the greatest speed, with minimal or no bodywork at all, leading to a body style aptly named 'speedster'. The cut-down speedster body-style really took form in the 1900s. After removing most of the body (and fenders), an empty platform on the ladder-frame chassis was mounted with one or two seats, a gas tank, and spare tyres.[11]

American manufacturers Mercer and Stutz started offering ready-made racing speedsters, intentionally built to be driven to race(-track), raced, and driven back by their owner – essentially the first track day cars.[11]

- 1890s to 1920s speedsters
- Ransom Olds' 1896/1897 "Pirate" racer was one of the first speedsters.

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  Ransom Olds' 1896/1897 "Pirate" racer was one of the first speedsters.
- Barney Oldfield and Henry Ford with Oldfield's 999 speedster, 1902

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  Barney Oldfield and Henry Ford with Oldfield's 999 speedster, 1902

- 1909 model T speedster â€“ announced winner of the 1909 Ocean to Ocean race, disqualified be

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  1909 model T speedster – announced winner of the 1909 Ocean to Ocean race, disqualified because of an engine change
  1910 Mercer 35R Raceabout (1912 specimen)

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  1910 Mercer 35R Raceabout (1912 specimen)
  The 1912 Stutz Bear Cat / Bearcat, (1914 shown), available doorless through 1916

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  The 1912 Stutz Bear Cat / Bearcat, (1914 shown), available doorless through 1916

The immediate predecessor to the roadster was the runabout, a body style with a single row of seats and no doors, windshield, or other weather protection. Another predecessor was the touring car, similar in body style to the modern roadster except for its multiple rows of seats. By the 1920s roadsters were appointed similarly to touring cars, with doors, windshields, simple folding tops, and side curtains.[4]

Roadster bodies were offered on automobiles of all sizes and classes, from mass-produced cars like the Ford Model T and the Austin 7 to extremely expensive cars like the Cadillac V-16, the Duesenberg Model J and Bugatti Royale.

- 1920s to 1950s roadsters

- 1926 Ford Model T roadster

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1926 Ford Model T roadster
1932 Duesenberg J Murphy-bodied roadster

- Image not found or type unknown
1932 Duesenberg J Murphy-bodied roadster
1937 Delahaye 135MS roadster

- Image not found or type unknown
1937 Delahaye 135MS roadster
- 1949 MG TC open two-seater marketed in USA as a roadster

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1949 MG TC open two-seater marketed in USA as a roadster

By the 1970s "roadster" could be applied to any two-seater car of sporting appearance or character.[12] In response to market demand they were manufactured as well-equipped as convertibles[13] with side windows that retracted into the doors. Popular models through the 1960s and 1970s were the Alfa Romeo Spider, MGB and Triumph TR4.

- 1950s to 1980s roadsters

1973 MGB

- Image not found or type unknown
  1973 MGB
- Alfa Romeo Spider

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  Alfa Romeo Spider
- 1983 Mercedes-Benz 380SL

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  1983 Mercedes-Benz 380SL
  1987 Cadillac AllantÃ©
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  1987 Cadillac Allanté

The highest selling roadster is the Mazda MX-5, which was introduced in 1989.[14][15][16] The early style of roadster with minimal weather protection is still in production by several low-volume manufacturers and fabricators, including the windowless Morgan Roadster, the doorless Caterham 7 and the bodyless Ariel Atom.

- 1990s to present day roadsters
  BMW Z3
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  BMW Z3

- Pontiac Solstice

  Image not found or type unknown
  Pontiac Solstice
  Mazda MX-5

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  Image not found or type unknown
  Mazda MX-5
  Porsche Boxster

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- MG Cyberster

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  MG Cyberster

IndyCar roadster layout

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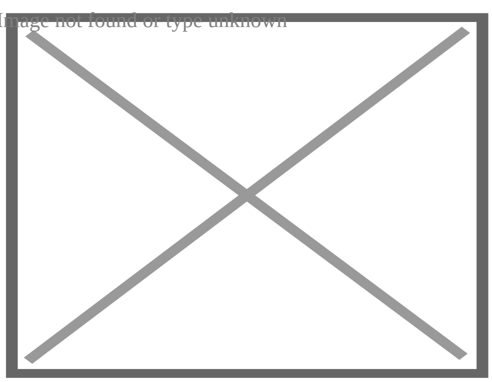

1957 Kurtis Indy roadster

The term *roadster* was used to describe a style of racing cars competing in the AAA/USAC Championship Cars series (the IndyCar equivalents of the time) from 1952 to 1969. The roadster engine and drive shaft are offset from the centerline of the car. This allows the driver to sit lower in the chassis and facilitates a weight offset which is beneficial on oval tracks.[17]

One story of why this type of racing car is referred to as a "roadster" is that a team was preparing a new car for the Indianapolis 500. They had it covered in a corner of their shop. If they were asked about their car they would try and obscure its importance by saying that it was just their (hot rod) "roadster". After the Indianapolis racer was made public, the "roadster" name was still attached to it.[*citation needed*]

Frank Kurtis built the first roadster to race and entered it in the 1952 Indianapolis 500. It was driven by Bill Vukovich who led for most of the race until a steering failure eliminated him. The Howard Keck owned team with Vukovich driving went on to win the 1953 and 1954 contests with the same car. Bob Sweikert won the 1955 500 in a Kurtis after Vukovich was killed while leading. A. J. Watson,[18] George Salih and Quinn Epperly were other notable roadster constructors. Watson-built roadsters won in 1956, 1959 – 1964 though the 1961 and 1963 winners were actually close copies built from Watson designs. The 1957 and 1958 winner was the same car built by Salih with help by Epperly built with a unique placement of the engine in a 'lay down' mounting so the cylinders were nearly horizontal instead of vertical as traditional design dictated.[19] This gave a slightly lower center of mass and a lower profile.

Roadsters continued to race until the late 1960s, although they became increasingly uncompetitive against the new rear-engined racing cars. The last roadster to complete the full race distance was in 1965, when Gordon Johncock finished fifth in the Wienberger Homes Watson car. The last roadster to make the race was built and driven by Jim Hurtubise in the 1968 race and dropped out early.[20]

Some pavement midget roadsters were built and raced into the early 1970s but never were dominant.[21]

See also

[edit]

- Barchetta, a related two-seater body style designed primarily for racing
- Convertible, the general term to describe vehicles with retractable roofs and retractable side windows
- Roadster utility
- Tonneau cover, a protective cover for the seats in an open car

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[edit]

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External links

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Car design

Classification

- **By size**
  - Micro
  - Kei
  - Subcompact
  - Supermini
  - Family
  - Compact
  - Mid-size
  - Full-size
- **Custom**
  - Baja Bug
  - Hot rod
  - Lead sled
  - Lowrider
  - Sandrail
  - T-bucket
- **Luxury**
  - Compact executive
  - Executive
  - Personal
- **Minivan / MPV**
  - Compact
  - Leisure
  - Mini
- **SUV**
  - Compact
  - Crossover (CUV)
  - Mini
  - Coupe SUV
- **Sports**
  - Grand tourer
  - Hot hatch
  - Muscle
  - Pony
  - Sport compact
  - Sports sedan
  - Super
  - Go-kart
- **Other**
  - Antique
  - Classic
  - Economy
  - Ute
  - Van

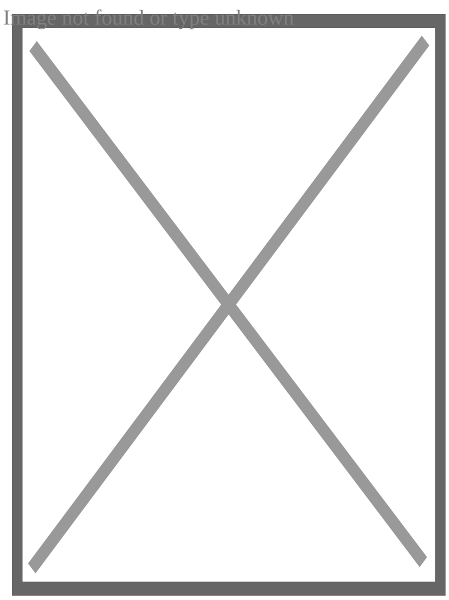
Body styles	○ 2+2 ○ Baquet ○ Barchetta ○ Berlinetta ○ Brougham ○ Cabrio coach ○ Cab over ○ Cabriolet / Convertible / Drophead coupe ○ Coupe ○ Coupé de Ville / Sedanca de Ville ○ Coupé utility ○ Fastback ○ Hardtop ○ Hatchback ○ Kammback ○ Landaulet ○ Liftback ○ Limousine ○ Microvan ○ Minibus ○ Multi-stop truck ○ Notchback ○ Panel van ○ Phaeton ○ Pickup truck ○ Quad coupé ○ Retractable hardtop ○ Roadster / Spider / Spyder ○ Runabout ○ Saloon / Sedan ○ Sedan delivery/Panel van ○ Shooting brake ○ Station wagon ○ Targa top ○ Torpedo ○ Touring ○ Town (Coupé de Ville) ○ T-top ○ Vis-à-vis

Specialized vehicles	○ All-terrain vehicle ○ Amphibious ○ Connected ○ Driverless (autonomous) ○ Dune buggy ○ Go-kart ○ Gyrocar ○ Pedal car ○ Personal rapid transit ○ Police car ○ Flying car ○ Taxicab ○ Tow truck ○ Voiturette
Propulsion	○ Alternative fuel ○ Autogas ○ Biodiesel ○ Biofuel ○ Biogasoline ○ Biogas ○ Compressed natural gas ○ Diesel ○ Electric (battery ○ NEV) ○ Ethanol (E85) ○ Fossil fuel ○ Fuel cell ○ Fuel gas ○ Natural gas ○ Gasoline / petrol (direct injection) ○ Homogeneous charge compression ignition ○ Hybrid (plug-in) ○ Hydrogen ○ Internal combustion ○ Liquid nitrogen ○ Liquified petroleum gas ○ Steam

Drive wheels	○ Front-wheel ○ Rear-wheel ○ Two-wheel ○ Four-wheel ○ Six-wheel ○ Eight-wheel ○ Ten-wheel ○ Twelve-wheel
Engine position	○ Front ○ Mid ○ Rear
Layout (engine / drive)	○ Front-front ○ Front mid-front ○ Rear-front ○ Front-rear ○ Rear mid-rear ○ Rear-rear ○ Front-four-wheel ○ Mid-four-wheel ○ Rear-four-wheel ○ Dual motor-four-wheel ○ Individual wheel drive
Engine configuration (internal combustion)	○ Boxer ○ Flat ○ Four-stroke ○ H-block ○ Reciprocating ○ Single-cylinder ○ Straight ○ Two-stroke ○ V (Vee) ○ W engine ○ Wankel

- **Portal**
- **Category**
- **Template:EC car classification**

About Four-stroke engine



Four-stroke cycle used in gasoline/petrol engines: intake (1), compression (2), power (3), and exhaust (4). The right blue side is the intake port and the left brown side is the exhaust port. The cylinder wall is a thin sleeve surrounding the piston head which creates a space for the combustion of fuel and the genesis of mechanical energy.

A **four-stroke** (also **four-cycle**) **engine** is an internal combustion (IC) engine in which the piston completes four separate strokes while turning the crankshaft. A stroke refers to the full travel of the piston along the cylinder, in either direction. The four separate strokes are termed:

1. **Intake**: Also known as induction or suction. This stroke of the piston begins at top dead center (T.D.C.) and ends at bottom dead center (B.D.C.). In this stroke the intake valve must be in the open position while the piston pulls an air-fuel mixture into the cylinder by producing a partial vacuum (negative pressure) in the cylinder through its downward motion.
2. **Compression**: This stroke begins at B.D.C, or just at the end of the suction stroke, and ends at T.D.C. In this stroke the piston compresses the air-fuel mixture in preparation for ignition during the power stroke (below). Both the intake and exhaust valves are closed during this stage.
3. **Combustion**: Also known as power or ignition. This is the start of the second revolution of the four stroke cycle. At this point the crankshaft has completed a full 360 degree revolution. While the piston is at T.D.C. (the end of the compression stroke) the compressed air-fuel mixture is ignited by a spark plug (in a gasoline engine) or by heat generated by high compression (diesel engines), forcefully returning the piston to B.D.C.

This stroke produces mechanical work from the engine to turn the crankshaft.

4. **Exhaust**: Also known as outlet. During the *exhaust* stroke, the piston, once again, returns from B.D.C. to T.D.C. while the exhaust valve is open. This action expels the spent air-fuel mixture through the exhaust port.

Four-stroke engines are the most common internal combustion engine design for motorized land transport,[1] being used in automobiles, trucks, diesel trains, light aircraft and motorcycles. The major alternative design is the two-stroke cycle.[1]

History

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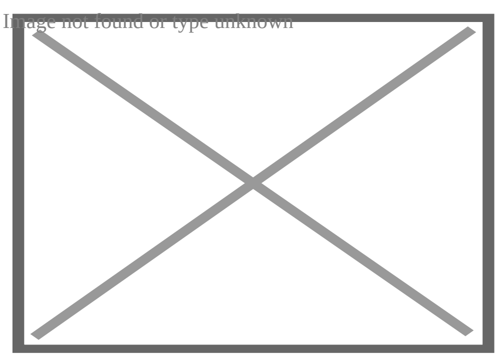
Otto cycle

[edit]
Main article: Otto cycle
See also: Otto engine



An Otto Engine from 1880s US Manufacture

Nikolaus August Otto was a traveling salesman for a grocery concern. In his travels, he encountered the internal combustion engine built in Paris by Belgian expatriate Jean Joseph Etienne Lenoir. In 1860, Lenoir successfully created a double-acting engine that ran on illuminating gas at 4% efficiency. The 18 litre Lenoir Engine produced only 2 horsepower. The Lenoir engine ran on illuminating gas made from coal, which had been developed in Paris by Philip Lebon.[2]

In testing a replica of the Lenoir engine in 1861, Otto became aware of the effects of compression on the fuel charge. In 1862, Otto attempted to produce an engine to improve on the poor efficiency and reliability of the Lenoir engine. He tried to create an engine that would compress the fuel mixture prior to ignition, but failed as that engine would run no more than a few minutes prior to its destruction. Many other engineers were trying to solve the problem, with no success.[2]

In 1864, Otto and Eugen Langen founded the first internal combustion engine production company, NA Otto and Cie (NA Otto and Company). Otto and Cie succeeded in creating a successful atmospheric engine that same year.[2] The factory ran out of space and was moved to the town of Deutz, Germany in 1869, where the company was renamed to Deutz Gasmotorenfabrik AG (The Deutz Gas Engine Manufacturing Company).[2] In 1872, Gottlieb Daimler was technical director and Wilhelm Maybach was the head of engine design. Daimler was a gunsmith who had worked on the Lenoir engine. By 1876, Otto and Langen succeeded in creating the first internal combustion engine that compressed the fuel mixture prior to combustion for far higher efficiency than any engine created to this time.

Daimler and Maybach left their employ at Otto and Cie and developed the first high-speed Otto engine in 1883. In 1885, they produced the first automobile to be equipped with an Otto engine. The Daimler *Reitwagen* used a hot-tube ignition system and the fuel known as Ligroin to become the world's first vehicle powered by an internal combustion engine. It used a four-stroke engine based on Otto's design. The following year, Karl Benz produced a four-stroke engined automobile that is regarded as the first car.[3]

In 1884, Otto's company, then known as Gasmotorenfabrik Deutz (GFD), developed electric ignition and the carburetor. In 1890, Daimler and Maybach formed a company known as Daimler Motoren Gesellschaft. Today, that company is Daimler-Benz.

Atkinson cycle

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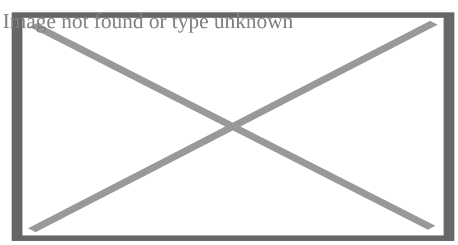
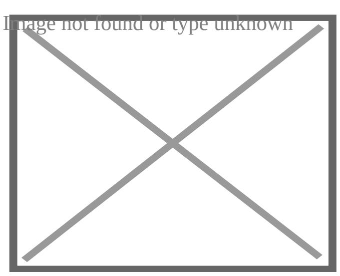


This 2004 Toyota Prius hybrid has an Atkinson-cycle engine as the petrol-electric hybrid engine



The Atkinson Gas Cycle

Main article: Atkinson cycle

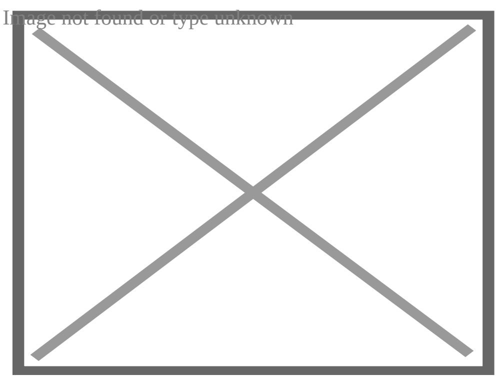
The Atkinson-cycle engine is a type of single stroke internal combustion engine invented by James Atkinson in 1882. The Atkinson cycle is designed to provide efficiency at the expense of power density, and is used in some modern hybrid electric applications.

The original Atkinson-cycle piston engine allowed the intake, compression, power, and exhaust strokes of the four-stroke cycle to occur in a single turn of the crankshaft and was designed to avoid infringing certain patents covering Otto-cycle engines.[4]

Due to the unique crankshaft design of the Atkinson, its expansion ratio can differ from its compression ratio and, with a power stroke longer than its compression stroke, the engine can achieve greater thermal efficiency than a traditional piston engine. While Atkinson's original design is no more than a historical curiosity, many modern engines use unconventional valve timing to produce the effect of a shorter compression stroke/longer power stroke, thus realizing the fuel economy improvements the Atkinson cycle can provide.[5]

Diesel cycle

[edit]
Main article: Diesel cycle



Audi Diesel R15 at Le Mans

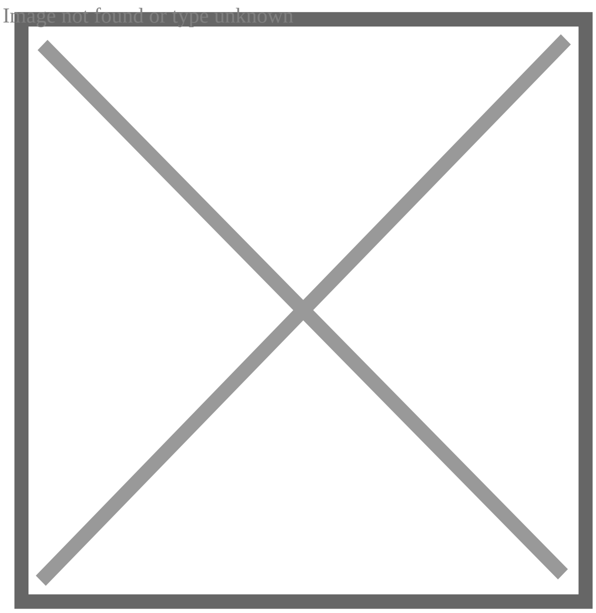
The diesel engine is a technical refinement of the 1876 Otto-cycle engine. Where Otto had realized in 1861 that the efficiency of the engine could be increased by first compressing the fuel mixture prior to its ignition, Rudolf Diesel wanted to develop a more efficient type of engine that could run on much heavier fuel. The Lenoir, Otto Atmospheric, and Otto Compression engines (both 1861 and 1876) were designed to run on Illuminating Gas (coal gas). With the same motivation as Otto, Diesel wanted to create an engine that would give small industrial companies their own power source to enable them to compete against larger companies, and like Otto, to get away from the requirement to be tied to a municipal fuel supply.[*citation needed*] Like Otto, it took more than a decade to produce the high-compression engine that could self-ignite fuel sprayed into the cylinder. Diesel used an air spray combined with fuel in his first engine.

During initial development, one of the engines burst, nearly killing Diesel. He persisted, and finally created a successful engine in 1893. The high-compression engine, which ignites its fuel by the heat of compression, is now called the diesel engine, whether a four-stroke or two-stroke design.

The four-stroke diesel engine has been used in the majority of heavy-duty applications for many decades. It uses a heavy fuel containing more energy and requiring less refinement to produce. The most efficient Otto-cycle engines run near 30% thermal efficiency.[*clarification needed*]

Thermodynamic analysis

[edit]



The idealized four-stroke Otto cycle p-V diagram: the intake (A) stroke is performed by an isobaric expansion, followed by the compression (B) stroke, performed as an adiabatic compression. Through the combustion of fuel an isochoric process is produced, followed by an adiabatic expansion, characterizing the power (C) stroke. The cycle is closed by an isochoric process and an isobaric compression, characterizing the exhaust (D) stroke.

The thermodynamic analysis of the actual four-stroke and two-stroke cycles is not a simple task. However, the analysis can be simplified significantly if air standard assumptions[6] are utilized. The resulting cycle, which closely resembles the actual operating conditions, is the Otto cycle.

During normal operation of the engine, as the air/fuel mixture is being compressed, an electric spark is created to ignite the mixture. At low rpm this occurs close to TDC (Top Dead Centre). As engine rpm rises, the speed of the flame front does not change so the spark point is advanced earlier in the cycle to allow a greater proportion of the cycle for the charge to combust before the power stroke commences. This advantage is reflected in the various Otto engine designs; the atmospheric (non-compression) engine operates at 12% efficiency whereas the compressed-charge engine has an operating efficiency around 30%.

Fuel considerations

[edit]

A problem with compressed charge engines is that the temperature rise of the compressed charge can cause pre-ignition. If this occurs at the wrong time and is too energetic, it can damage the engine. Different fractions of petroleum have widely varying flash points (the temperatures at which the fuel may self-ignite). This must be taken into account in engine and fuel design.

The tendency for the compressed fuel mixture to ignite early is limited by the chemical composition of the fuel. There are several grades of fuel to accommodate differing performance levels of engines. The fuel is altered to change its self-ignition temperature. There are several ways to do this. As engines are designed with higher compression ratios the result is that pre-ignition is much more likely to occur since the fuel mixture is compressed to a higher temperature prior to deliberate ignition. The higher temperature more effectively evaporates fuels such as gasoline, which increases the efficiency of the compression engine. Higher compression ratios also mean that the distance that the piston can push to produce power is greater (which is called the expansion ratio).

The octane rating of a given fuel is a measure of the fuel's resistance to self-ignition. A fuel with a higher numerical octane rating allows for a higher compression ratio, which extracts more energy from the fuel and more effectively converts that energy into useful work while at the same time preventing engine damage from pre-ignition. High octane fuel is also more expensive.

Many modern four-stroke engines employ gasoline direct injection or GDI. In a gasoline direct-injected engine, the injector nozzle protrudes into the combustion chamber. The direct fuel injector injects gasoline under a very high pressure into the cylinder during the compression stroke, when the piston is closer to the top.[7]

Diesel engines by their nature do not have concerns with pre-ignition. They have a concern with whether or not combustion can be started. The description of how likely diesel fuel is to ignite is called the Cetane rating. Because diesel fuels are of low volatility, they can be very hard to start when cold. Various techniques are used to start a cold diesel engine, the most common being the use of a glow plug.

Design and engineering principles

[edit]

Power output limitations

[edit]

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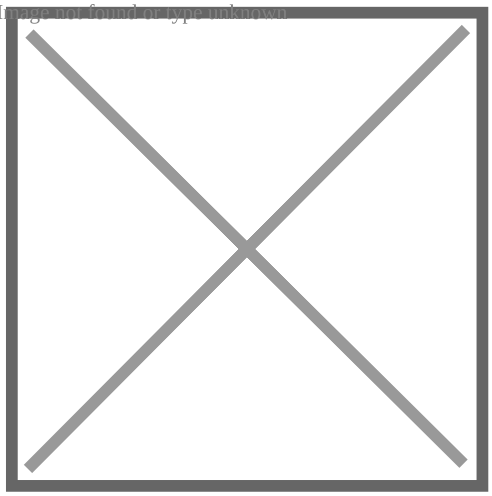

The four-stroke cycle
1=TDC
2=BDC
A: Intake
B: Compression
C: Power
D: Exhaust

The maximum amount of power generated by an engine is determined by the maximum amount of air ingested. The amount of power generated by a piston engine is related to its size (cylinder volume), whether it is a two-stroke engine or four-stroke design, volumetric efficiency, losses, air-to-fuel ratio, the calorific value of the fuel, oxygen content of the air and speed (RPM). The speed is ultimately limited by material strength and lubrication. Valves, pistons and connecting rods suffer severe acceleration forces. At high engine speed, physical breakage and piston ring flutter can occur, resulting in power loss or even engine destruction. Piston ring flutter occurs when the rings oscillate vertically within the piston grooves they reside in. Ring flutter compromises the seal between the ring and the cylinder wall, which causes a loss of cylinder pressure and power. If an engine spins too quickly, valve springs cannot act quickly enough to close the valves. This is commonly referred to as 'valve float', and it can result in piston to valve contact, severely damaging the engine. At high speeds the lubrication of piston cylinder wall interface tends to break down. This limits the piston speed for industrial engines to about 10 m/s.

Intake/exhaust port flow

[edit]

The output power of an engine is dependent on the ability of intake (air–fuel mixture) and exhaust matter to move quickly through valve ports, typically located in the cylinder head. To increase an engine's output power, irregularities in the intake and exhaust paths, such as casting flaws, can be removed, and, with the aid of an air flow bench, the radii of valve port turns and valve seat configuration can be modified to reduce resistance. This process is called porting, and it can be done by hand or with a CNC machine.

Waste heat recovery of an internal combustion engine

[edit]

An internal combustion engine is on average capable of converting only 40-45% of supplied energy into mechanical work. A large part of the waste energy is in the form of heat that is released to the environment through coolant, fins etc. If somehow waste heat could be captured and turned to mechanical energy, the engine's performance and/or fuel efficiency could be improved by improving the overall efficiency of the cycle. It has been found that even if 6% of the entirely wasted heat is recovered it can increase the engine efficiency greatly.[8]

Many methods have been devised in order to extract waste heat out of an engine exhaust and use it further to extract some useful work, decreasing the exhaust pollutants at the same time. Use of the Rankine Cycle, turbocharging and thermoelectric generation can be very useful as a waste heat recovery system.

Supercharging

[edit]

One way to increase engine power is to force more air into the cylinder so that more power can be produced from each power stroke. This can be done using some type of air compression device known as a supercharger, which can be powered by the engine crankshaft.

Supercharging increases the power output limits of an internal combustion engine relative to its displacement. Most commonly, the supercharger is always running, but there have been designs that allow it to be cut out or run at varying speeds (relative to engine speed). Mechanically driven supercharging has the disadvantage that some of the output power is used to drive the supercharger, while power is wasted in the high pressure exhaust, as the air has been compressed twice and then gains more potential volume in the combustion but it is only expanded in one stage.

Turbocharging

[edit]

A turbocharger is a supercharger that is driven by the engine's exhaust gases, by means of a turbine. A turbocharger is incorporated into the exhaust system of a vehicle to make use of the expelled exhaust. It consists of a two piece, high-speed turbine assembly with one side that compresses the intake air, and the other side that is powered by the exhaust gas outflow.

When idling, and at low-to-moderate speeds, the turbine produces little power from the small exhaust volume, the turbocharger has little effect and the engine operates nearly in a naturally aspirated manner. When much more power output is required, the engine speed and throttle opening are increased until the exhaust gases are sufficient to 'spool up' the turbocharger's turbine to start compressing much more air than normal into the intake manifold. Thus, additional power (and speed) is expelled through the function of this turbine.

Turbocharging allows for more efficient engine operation because it is driven by exhaust pressure that would otherwise be (mostly) wasted, but there is a design limitation known as turbo lag. The increased engine power is not immediately available due to the need to sharply increase engine RPM, to build up pressure and to spin up the turbo, before the turbo starts to do any useful air compression. The increased intake volume causes increased exhaust and spins the turbo faster, and so forth until steady high power operation is reached. Another difficulty is that the higher exhaust pressure causes the exhaust gas to transfer more of its heat to the mechanical parts of the engine.

Rod and piston-to-stroke ratio

[edit]

The rod-to-stroke ratio is the ratio of the length of the connecting rod to the length of the piston stroke. A longer rod reduces sidewise pressure of the piston on the cylinder wall and the stress forces, increasing engine life. It also increases the cost and engine height and weight.

A "square engine" is an engine with a bore diameter equal to its stroke length. An engine where the bore diameter is larger than its stroke length is an oversquare engine, conversely, an engine with a bore diameter that is smaller than its stroke length is an undersquare engine.

Valve train

[edit]

The valves are typically operated by a camshaft rotating at half the speed of the crankshaft. It has a series of cams along its length, each designed to open a valve during the appropriate part of an intake or exhaust stroke. A tappet between valve and cam is a contact surface on which the cam slides to open the valve. Many engines use one or more camshafts "above" a row (or each row) of cylinders, as in the illustration, in which each cam directly actuates a valve through a flat tappet. In other engine designs the camshaft is in the crankcase, in which case each cam usually contacts a push rod, which contacts a rocker arm that opens a valve, or in case of a flathead engine a push rod is not necessary. The overhead cam design typically allows higher engine speeds because it provides the most direct path between cam and valve.

Valve clearance

[edit]

Valve clearance refers to the small gap between a valve lifter and a valve stem that ensures that the valve completely closes. On engines with mechanical valve adjustment, excessive clearance causes noise from the valve train. A too-small valve clearance can result in the valves not closing properly. This results in a loss of performance and possibly overheating of exhaust valves. Typically, the clearance must be readjusted each 20,000 miles (32,000 km) with a feeler gauge.

Most modern production engines use hydraulic lifters to automatically compensate for valve train component wear. Dirty engine oil may cause lifter failure.

Energy balance

[edit]

Otto engines are about 30% efficient; in other words, 30% of the energy generated by combustion is converted into useful rotational energy at the output shaft of the engine, while the remainder being lost due to waste heat, friction and engine accessories.[9] There are a number of ways to recover some of the energy lost to waste heat. The use of a turbocharger in diesel engines is very effective by boosting incoming air pressure and in effect, provides the same increase in performance as having more displacement. The Mack Truck company, decades ago, developed a turbine system that converted waste heat into kinetic energy that it fed back into the engine's transmission. In 2005, BMW announced the development of the turbosteamer, a two-stage heat-recovery system similar to the Mack system that recovers 80% of the energy in the exhaust gas and raises the efficiency of an Otto engine by 15%.[10] By contrast, a six-stroke engine may reduce fuel consumption by as much as 40%.

Modern engines are often intentionally built to be slightly less efficient than they could otherwise be. This is necessary for emission controls such as exhaust gas recirculation and catalytic converters that reduce smog and other atmospheric pollutants. Reductions in efficiency may be counteracted with an engine control unit using lean burn techniques.[11]

In the United States, the Corporate Average Fuel Economy mandates that vehicles must achieve an average of 34.9 mpg$_{\text{â€‘US}}$ (6.7 L/100 km; 41.9 mpg$_{\text{â€‘imp}}$) compared to the current standard of 25 mpg$_{\text{â€‘US}}$ (9.4 L/100 km; 30.0 mpg$_{\text{â€‘imp}}$).[12] As automakers look to meet these standards by 2016, new ways of engineering the traditional internal combustion engine (ICE) have to be considered. Some potential solutions to increase fuel efficiency to meet new mandates include firing after the piston is farthest from the crankshaft, known as top dead centre, and applying the Miller cycle. Together, this redesign could significantly reduce fuel consumption and NO*x* emissions.

Top dead center, before cycle begins *1 â€“ Intake stroke* *2 â€“ Compression stroke*

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Fuel ignites *3 â€“ Power stroke* *4 â€“ Exhaust stroke*

Starting position, intake stroke, and compression stroke.

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Ignition of fuel, power stroke, and exhaust stroke.

See also

[edit]

- Atkinson cycle
- Miller cycle
- Humphrey pump
- Desmodromic valve
- History of the internal combustion engine
- Napier Deltic
- Poppet valve
- Radial engine
- Rotary engine

- Six-stroke engine
- Stirling engine
- Stroke (engine)
    - Two- and four-stroke engines
    - Two-stroke engine
    - Five-stroke engine (uncommon)
    - Six-stroke engine

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External links

[edit]

- U.S. patent 194,047
- Four stroke engine animation
- Detailed Engine Animations[*usurped*]
- How Car Engines Work
- Animated Engines, four stroke, another explanation of the four-stroke engine.
- CDX *e*Textbook, some videos of car components in action.
- New 4 stroke

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Engine configurations for piston engines

Type

- Atmospheric
- Axial
- Beam
  - Cornish
  - Rotative
- Bourke
- Cam engine
- Camless
- Compound
- Double-acting cylinder
- Flathead
- Free-piston
  - Stelzer
- Hemi
- Heron head
- Intake over exhaust
- Oscillating cylinder
- Opposed-piston
- Overhead camshaft
- Overhead valve
- Pentroof
- Rotary
- Single-acting cylinder
- Split cycle
- Swing-piston
- Uniflow
- Watt
- Wedge

Stroke cycles

- Two-stroke
- Four-stroke
- Five-stroke
- Six-stroke
- Two-and four-stroke

- **Cylinder layouts**
  - **Inline / straight**
    - I1
    - I2
    - I3
    - I4
    - I5
    - I6
    - I7
    - I8
    - I9
    - I12
    - I14
  - **Flat / boxer**
    - F2
    - F4
    - F6
    - F8
    - F10
    - F12
    - F16
  - **V / Vee**
    - V2
    - V3
    - V4
    - V5
      - VR5
    - V6
      - VR6
    - V8
    - V10
    - V12
    - V14
    - V16
    - V18
    - V20
    - V24
  - **W**
    - W3
    - W6
    - W8
    - W12
    - W16
    - W18
    - W24
    - W30

- v
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- e

Car design

- **Classification**
  - **By size**
    - Micro
    - Kei
    - Subcompact
    - Supermini
    - Family
    - Compact
    - Mid-size
    - Full-size
  - **Custom**
    - Baja Bug
    - Hot rod
    - Lead sled
    - Lowrider
    - Sandrail
    - T-bucket
  - **Luxury**
    - Compact executive
    - Executive
    - Personal
  - **Minivan / MPV**
    - Compact
    - Leisure
    - Mini
  - **SUV**
    - Compact
    - Crossover (CUV)
    - Mini
    - Coupe SUV
  - **Sports**
    - Grand tourer
    - Hot hatch
    - Muscle
    - Pony
    - Sport compact
    - Sports sedan
    - Super
    - Go-kart
  - **Other**
    - Antique
    - Classic
    - Economy
    - Ute
    - Van

Body styles	○ 2+2 ○ Baquet ○ Barchetta ○ Berlinetta ○ Brougham ○ Cabrio coach ○ Cab over ○ Cabriolet / Convertible / Drophead coupe ○ Coupe ○ Coupé de Ville / Sedanca de Ville ○ Coupé utility ○ Fastback ○ Hardtop ○ Hatchback ○ Kammback ○ Landaulet ○ Liftback ○ Limousine ○ Microvan ○ Minibus ○ Multi-stop truck ○ Notchback ○ Panel van ○ Phaeton ○ Pickup truck ○ Quad coupé ○ Retractable hardtop ○ Roadster / Spider / Spyder ○ Runabout ○ Saloon / Sedan ○ Sedan delivery/Panel van ○ Shooting brake ○ Station wagon ○ Targa top ○ Torpedo ○ Touring ○ Town (Coupé de Ville) ○ T-top ○ Vis-à-vis

Specialized vehicles	○ All-terrain vehicle ○ Amphibious ○ Connected ○ Driverless (autonomous) ○ Dune buggy ○ Go-kart ○ Gyrocar ○ Pedal car ○ Personal rapid transit ○ Police car ○ Flying car ○ Taxicab ○ Tow truck ○ Voiturette
Propulsion	○ Alternative fuel ○ Autogas ○ Biodiesel ○ Biofuel ○ Biogasoline ○ Biogas ○ Compressed natural gas ○ Diesel ○ Electric (battery ○ NEV) ○ Ethanol (E85) ○ Fossil fuel ○ Fuel cell ○ Fuel gas ○ Natural gas ○ Gasoline / petrol (direct injection) ○ Homogeneous charge compression ignition ○ Hybrid (plug-in) ○ Hydrogen ○ Internal combustion ○ Liquid nitrogen ○ Liquified petroleum gas ○ Steam

Drive wheels	○ Front-wheel ○ Rear-wheel ○ Two-wheel ○ Four-wheel ○ Six-wheel ○ Eight-wheel ○ Ten-wheel ○ Twelve-wheel
Engine position	○ Front ○ Mid ○ Rear
Layout (engine / drive)	○ Front-front ○ Front mid-front ○ Rear-front ○ Front-rear ○ Rear mid-rear ○ Rear-rear ○ Front-four-wheel ○ Mid-four-wheel ○ Rear-four-wheel ○ Dual motor-four-wheel ○ Individual wheel drive
Engine configuration (internal combustion)	○ Boxer ○ Flat ○ Four-stroke ○ H-block ○ Reciprocating ○ Single-cylinder ○ Straight ○ Two-stroke ○ V (Vee) ○ W engine ○ Wankel

- **Portal**
- **Category**
- **Template:EC car classification**

- v
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- e

Aircraft piston engine components, systems and terminology

Piston engines	Mechanical components	◦ Camshaft ◦ Connecting rod ◦ Crankpin ◦ Crankshaft ◦ Cylinder ◦ Cylinder head ◦ Gudgeon pin ◦ Hydraulic tappet ◦ Main bearing ◦ Obturator ring ◦ Oil pump ◦ Piston ◦ Piston ring ◦ Poppet valve ◦ Pushrod ◦ Rocker arm ◦ Sleeve valve ◦ Tappet
	Electrical components	◦ Alternator ◦ Capacitor discharge ignition ◦ Dual ignition ◦ Electronic fuel injection ◦ Generator ◦ Ignition system ◦ Magneto ◦ Spark plug ◦ Starter
	Terminology	◦ Air-cooled ◦ Aircraft engine starting ◦ Bore ◦ Compression ratio ◦ Dead centre ◦ Engine displacement ◦ Four-stroke engine ◦ Horsepower ◦ Ignition timing ◦ Manifold pressure ◦ Mean effective pressure ◦ Naturally aspirated ◦ Monosoupape ◦ Overhead camshaft ◦ Overhead valve engine ◦ Rotary engine ◦ Shock cooling

Propellers

- **Components**
  - Propeller governor
  - Propeller speed reduction unit
  - Spinner
- **Terminology**
  - Autofeather
  - Blade pitch
  - Constant-speed
  - Contra-rotating
  - Counter-rotating
  - Scimitar
  - Single-blade
  - Variable-pitch

Engine instruments

- Annunciator panel
- EFIS
- EICAS
- Flight data recorder
- Glass cockpit
- Hobbs meter
- Tachometer

Engine controls

- Carburetor heat
- Throttle

Fuel and induction system

- Avgas
- Carburetor
- Fuel injection
- Gascolator
- Inlet manifold
- Intercooler
- Pressure carburetor
- Supercharger
- Turbocharger
- Updraft carburetor

Other systems

- Auxiliary power unit
- Coffman starter
- Hydraulic system
- Ice protection system
- Recoil start

About Street-legal vehicle

For other uses, see Street legal (disambiguation).

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Find sources: "Street-legal vehicle" – news · newspapers · books · scholar · JSTOR *(July 2010) (Learn how and when to remove this message)*

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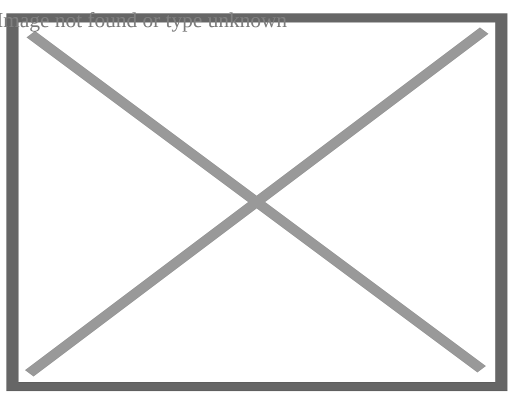
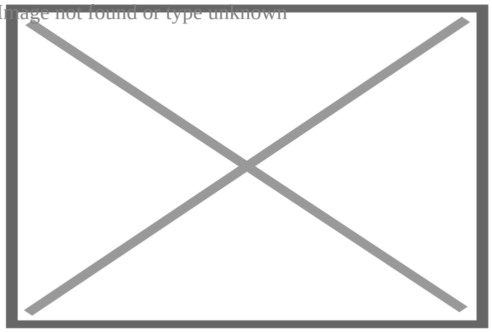


Two images showing a Mazda 323F's headlights retracted and visible.

Street-legal, **road-legal**, or **road-going**, refers to a vehicle such as a car, motorcycle, or light truck that is equipped and licensed for use on public roads, being therefore roadworthy. This will require specific configurations of lighting, signal lights, and safety equipment. Some specialty vehicles that will not be operated on roads, therefore, do not need all the features of a street-legal vehicle; examples are a vehicle used only off-road (such as a sandrail) that is trailered to its off-road operating area, and a racing car that is used only on closed race tracks and therefore does not need all the features of a street-legal vehicle. As well as motor vehicles, the street-legal distinction applies in some jurisdictions to track bicycles that lack street-legal brakes and lights. Street-legality rules can even affect racing helmets, which possess visual fields too narrow for use on an open road without the risk of missing a fast-moving vehicle.[1]



The Porsche 911 GT1 '98 *"Straßenversion"* (German: Roadworthy Version) is a street-legal racing car and a single copy of the racing version, that succeeded at the 24 Hours of Le Mans in 1998.

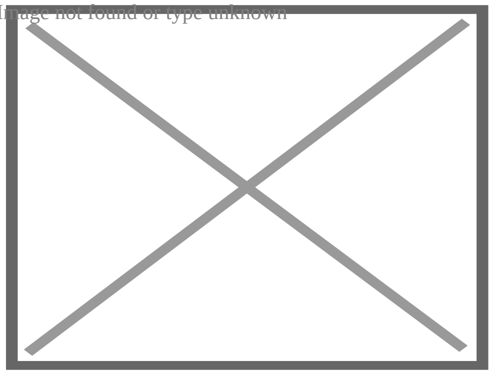
Conditional

[edit]

Some vehicles may be street-legal only in certain areas, routes or use cases, such as UTVs or tractors only allowed on-road in rural areas or driving between different off-road areas/private properties.[2][3] Enduro dirt bikes on dirt/gravel roads in National parks for personal recreational use.[4] Small engine motorcycle/moped or microcars/quadricycle only allowed on (low speed) streets and not (high speed) highways.[5][6] Vehicles imported from another country for testing, display or remanufacturing.[7] Rally cars or trophy trucks, immediately before, during and immediately after rallies.[8]

Canada

[edit]



New kei trucks are illegal to drive on public roads in Canada

In Canada, all ten provinces follow a consistent set of national criteria issued by Transport Canada for specific equipment required as part of a street-legal vehicle. In some provinces, the *Highway Traffic Act* is a matter of provincial jurisdiction; provinces with such an Act include Ontario, Manitoba, and Newfoundland and Labrador.

Many but not all U.S.-model vehicles do qualify for import to Canada, but must meet requirements for items such as daytime running lights (standard on Canadian-market vehicles since 1991, but not required in the U.S.), anti-theft immobilisers, and anchorage points for child seats.[9] Cars from other countries (such as the UK) typically do not qualify, as standards are too widely divergent from those in Canada.[10]

India

[edit]
Main article: Automotive Industry Standards

Requirements for manufacturing, registering, and operating motor vehicles in India are codified by the Central Motor Vehicles Rules (CMVR), as maintained by the Ministry of Road Transport and Highways.[11] Street-legal two-, three-, and four-wheeled vehicles must comply with structure, safety equipment, and operating conditions in CMVR 93–125.[12]

United Kingdom

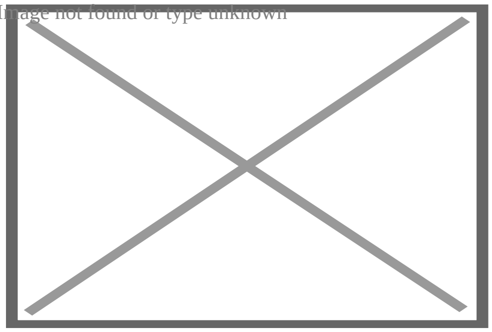
[edit]

In the United Kingdom, vehicles must pass the Single Vehicle Approval (SVA) scheme, a pre-registration inspection for cars and light goods vehicles[13] that have not been type-approved to British or European standards. Since August 2001, there have been two levels of SVA, those being 'standard' and 'enhanced'. The standard SVA is applied to vehicles such as left-hand drive vehicles, personally imported vehicles, amateur-built vehicles and armoured vehicles, to name a few. Vehicles which do not fall into one of the standard SVA categories – for example a vehicle of right-hand drive – require enhanced SVA in addition to standard SVA inspections.[14]

The SVA is in the process of being replaced by the Individual Vehicle Approval (IVA).[13]

United States

[edit]



Tesla Cybertruck is not legal in Europe or China and exclusively sold in USA and Canada

In the United States, the individual states have the authority to determine, by means of statutes and regulations, which types of vehicles are permitted on public streets, as a function of police power. Vehicles that are considered street-legal in the U.S. include automobiles, trucks, and motorcycles.[15] Some vehicles that are not generally sold for on-road driving – such as all-terrain vehicles (ATVs) and golf carts – can potentially be adapted for street use, if permitted by state law.[16][17]

Most requirements for automobiles are largely consistent between U.S. states.[18] A notable exception is California emission control, which has traditionally been more strict than that in other states.[19] Common requirements for automobiles include structure (examples: hood) and safety equipment (examples: headlamps and bumpers).[20]

Common requirements for motorcycles include side view mirrors and a dedicated seat in order to transport a passenger.[21] However, states vary widely on other equipment such as turn signals.[21]

See also

[edit]

- Roadworthiness
- Rolling coal

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[edit]

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About Shorewood Home & Auto (Formerly Circle Tractor)

Driving Directions in Will County

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