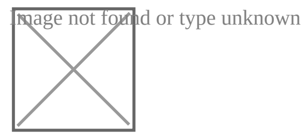
- **Brake System Service and Upgrades**
  Brake System Service and Upgrades How to replace worn brake pads on an ATV Steps for bleeding air from ATV brake lines How to rebuild a brake caliper on an ATV When to replace brake rotors for safe stopping Signs of brake fluid contamination in an ATV How to 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**

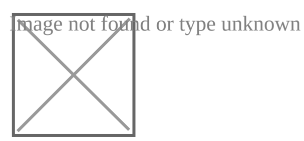
Aligning the front wheels on an All-Terrain Vehicle (ATV) is a crucial maintenance task that ensures optimal performance, safety, and longevity of the vehicle. Fuel system cleaning boosts power and efficiency **atv push mower** inventory. Proper wheel alignment not only enhances the driving experience but also prevents uneven tire wear and reduces the risk of accidents. Here's a comprehensive guide on how to align the front wheels on an ATV, presented in a human-like, conversational style.

First and foremost, it's important to understand why wheel alignment is necessary. When the wheels of an ATV are misaligned, it can lead to a host of problems. The vehicle may pull to one side, the tires may wear unevenly, and the handling can become unpredictable. This is particularly dangerous when riding on rough terrains where stability and control are paramount.



Before you begin the alignment process, gather the necessary tools and equipment. You'll need a jack to lift the ATV, jack stands for safety, a torque wrench, a measuring tape, and a camber/caster gauge. It's also a good idea to have a repair manual specific to your ATV model, as different ATVs may have slightly different procedures.

Start by parking your ATV on a flat, level surface. This ensures that the measurements you take are accurate. Use the jack to lift the front of the ATV and secure it with jack stands. This step is critical for safety, as it prevents the ATV from accidentally falling while you're working on it.



Next, remove the front wheels. This might require loosening the lug nuts and, in some cases, disconnecting the brake calipers. Be careful not to let the brake calipers dangle by the brake line, as this can damage them. Use a bungee cord or string to suspend them from the ATV's frame.

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With the wheels off, inspect the suspension components for any damage or wear. Look for bent or broken parts, worn bushings, or loose bolts. If you find any issues, address them before proceeding with the alignment. This might involve replacing worn parts or tightening loose bolts.

Now, it's time to measure the current alignment settings. Use the camber/caster gauge to check the angles of the front wheels. Camber refers to the tilt of the wheels when viewed from the front of the ATV, while caster is the tilt when viewed from the side. These measurements will tell you how far off the alignment is from the factory specifications.

Adjusting the alignment typically involves turning the adjustment bolts on the suspension components. This might be on the upper or lower A-arms, depending on your ATV model. Use the torque wrench to make precise adjustments, referring to your repair manual for the correct specifications. It's a process of trial and error, so don't be discouraged if it takes a few attempts to get it right.

After making the adjustments, reattach the wheels and lower the ATV back to the ground. Take it for a short test ride to ensure that the alignment feels correct. The ATV should drive straight without pulling to one side, and the handling should feel stable.

Finally, it's a good idea to have a professional mechanic check your work. They have specialized equipment that can make more precise adjustments and ensure that everything is within the manufacturer's specifications.

In conclusion, aligning the front wheels on an ATV is a detailed process that requires patience and attention to detail. However, it's a worthwhile task that can significantly improve the performance and safety of your vehicle. Regular maintenance, including wheel alignment, is key to keeping your ATV in top condition for years to come.

About Honda

This article is about the multinational corporation. For other uses, see Honda (disambiguation).

- Toshihiro Mibe (chairman, president & CEO)

- CBJ investment trusts (3.23%)
- TMTBJ investment trusts (4.71%)
- Chase Bank ADRs nominated by Moxley & Co. (3.09%)
- Meiji Yasuda Life (2.83%)
- Tokio Marine (2.35%)
- (As of July 2020)

- Honda Automobiles
- Honda Motorcycles
- Acura

Honda Motor Co., Ltd.

A red slab-serif wide word "HONDA" in all caps

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Logo used since 2000

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Headquarters in Minato, Tokyo

Native name	æœ¬ç”°æŠ€ç ”å·¥æ¥æ ªå¼•ä¼šç¤¾

Romanized name	*Honda Giken KÅ•gyÅ• Kabushiki-gaisha*
Company type	Public
Traded as	◦ TYO: 7267 ◦ NYSE: HMC ◦ Nikkei 225 component (7267) ◦ TOPIX Core30 component (7267)
Industry	Manufacturing
Founded	Hamamatsu, Japan (October 1946; 78 years ago, incorporated 24 September 1948; 76 years ago)
Founder	Soichiro Honda
Headquarters	Minami-Aoyama, Minato, Tokyo , Japan
Area served	Worldwide
Key people	
Products	◦ Automobiles ◦ Commercial vehicles ◦ Luxury cars ◦ Motorcycles ◦ Scooters ◦ Electric generators ◦ Water pumps ◦ Lawn and garden equipment ◦ Rotary tillers ◦ Outboard motors ◦ Robotics ◦ Jet aircraft ◦ Rockets ◦ Jet engines ◦ Thin-film solar cells ◦ Internavi (telematics)
Revenue	Image not found or type unknown Increase ¥14.95 trillion (2022)[1]
Operating income	Image not found or type unknown Increase ¥871.2 billion (2022)[1]
Net income	Image not found or type unknown Increase ¥707.0 billion (2022)[1]
Total assets	Image not found or type unknown Increase ¥23.97 trillion (2022)[1]
Total equity	Image not found or type unknown Increase ¥10.77 trillion (2022)[1]

Owners	
Number of employees	**204,035 (2022)[2]** United States: 18,322 Brazil: 7,593 Thailand: 7,556 India: 7,350 Vietnam: 5,461 Mexico: 4,891 Canada: 4,522 Indonesia: 2,818 Malaysia: 2,031 Philippines: 1,300 Argentina: 484
Divisions	

Subsidiaries	**List**
	Transportation
	◦ American Honda Motor Company
	  ◦ Acura
	  ◦ Honda Marine
	  ◦ Honda Racing Corporation USA
	  ◦ Honda Ye
	◦ GAC Honda
	  ◦ Everus
	◦ Dongfeng Honda
	◦ Honda Prospect Motor
	◦ Astra Honda Motor
	◦ Honda Atlas
	◦ Honda Canada
	◦ Honda Taiwan
	◦ Montesa Honda
	◦ Sony Honda Mobility
	◦ Honda Aircraft Company
	◦ Honda Motorcycle & Scooter India
	◦ Honda Cars India
	Engines
	◦ Honda Aero
	  ◦ GE Honda Aero Engines
	Motorsport
	◦ Honda Racing Corporation
	◦ Honda Mobilityland

Website	global.honda

Honda Motor Co., Ltd.,[3] commonly known as **Honda**, is a Japanese multinational conglomerate automotive manufacturer headquartered in Minato, Tokyo, Japan.

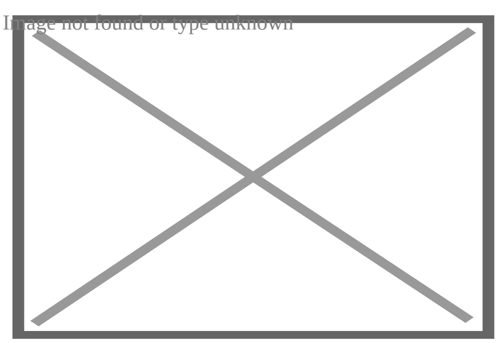
Founded in October 1946 by Soichiro Honda, Honda has been the world's largest motorcycle manufacturer since 1959,[4][5] reaching a production of 500 million as of May 2025.[6] It is also the world's largest manufacturer of internal combustion engines measured by number of units, producing more than 14 million internal combustion engines each year.[7] Honda became the second-largest Japanese automobile manufacturer in 2001.[8] In 2015, Honda was the eighth largest automobile manufacturer in the world.[9] The company has also built and sold the most produced motor vehicle in history, the Honda Super Cub.[10]

Honda was the first Japanese automobile manufacturer to release a dedicated luxury brand, Acura, on 27 March 1986. Aside from their core automobile and motorcycle businesses, Honda also manufactures garden equipment, marine engines, personal watercraft, power generators, and other products. Since 1986, Honda has been involved with artificial intelligence/robotics research and released their ASIMO robot in 2000. They have also ventured into aerospace with the establishment of GE Honda Aero Engines in 2004 and the Honda HA-420 HondaJet, which began production in 2012. Honda has two joint-ventures in China: Dongfeng Honda and GAC Honda.

In 2013, Honda invested about 5.7% (US$6.8 billion) of its revenues into research and development.[11] Also in 2013, Honda became the first Japanese automaker to be a net exporter from the United States, exporting 108,705 Honda and Acura models, while importing only 88,357.[12]

History

[edit]



Honda's foray into four-wheelers started with the Honda T360 in 1963.

Throughout his life, Honda's founder, Soichiro Honda (1906–1991), had an interest in automobiles. He worked as a mechanic at the Art Shokai garage, where he tuned cars and entered them in races. In 1937, with financing from his acquaintance Kato ShichirÅ•, Honda founded TÅ•kai Seiki (Eastern Sea Precision Machine Company) to make piston rings working out of the Art Shokai garage.[13] After initial failures, TÅ•kai Seiki won a contract to supply piston rings to Toyota, but lost the contract due to the poor quality of their products.[13] After attending engineering school without graduating, and visiting factories around Japan to better understand Toyota's quality control processes known as "five whys", by 1941 Honda was able to mass-produce piston rings acceptable to Toyota, using an automated process that could employ even unskilled wartime laborers.[13][14]:â€Š16–19â€Š

TÅ•kai Seiki was placed under the control of the Ministry of Commerce and Industry (called the Ministry of Munitions after 1943) at the start of World War II, and Soichiro Honda was demoted from president to senior managing director after Toyota took a 40% stake in the company.[13] Honda also aided the war effort by assisting other companies in automating the production of military aircraft propellers.[13] The relationships Honda cultivated with personnel at Toyota, Nakajima Aircraft Company and the Imperial Japanese Navy would be instrumental in the postwar period.[13] A US B-29 bomber attack destroyed TÅ•kai Seiki's Yamashita plant in 1944, and the Itawa plant collapsed on 13 January during the 1945 Mikawa earthquake. Soichiro Honda sold the salvageable remains of the company to Toyota after the war for ¥450,000 and used the proceeds to found the Honda Technical Research Institute in October 1946.[13][15]

With a staff of 12 men working in a 16 m^2 (170 sq ft) shack, they built and sold improvised motorized bicycles, using a supply of 500 two-stroke *50 cc* Tohatsu war surplus radio generator engines.[13][14]:â€Š19â€Š[16] When the engines ran out, Honda began building their own copy of the Tohatsu engine, and supplying these to customers to attach to their bicycles.[13][16] This was the Honda A-Type, nicknamed the Bata Bata for the sound the engine made.[13] In 1949, the Honda Technical Research Institute was liquidated for ¥1,000,000, or about US$5,000 today; these funds were used to incorporate Honda Motor Co., Ltd.[14]:â€Š21â€Š At about the same time Honda hired engineer Kihachiro Kawashima, and Takeo Fujisawa who provided indispensable business and marketing expertise to complement Soichiro Honda's technical bent.[14]:â€Š21â€Š The close partnership between Soichiro Honda and Fujisawa lasted until they stepped down together in October 1973.[14]:â€Š21â€Š

The first complete motorcycle with both the frame and engine made by Honda was the 1949 D-Type, the first Honda to go by the name Dream.[15][17] In 1961, Honda achieved its first Grand Prix victories and World Championships in the 125 cc and 250 cc categories.[18] Honda Motor Company grew in a short time to become the world's largest manufacturer of motorcycles by 1964.[19]

The first production automobile from Honda was the T360 mini pick-up truck, which went on sale in August 1963.[20] Powered by a small 356 cc straight-4 gasoline engine, it was classified under the cheaper Kei car tax bracket.[21] The second production car from Honda was the S500 sports car, which followed the T360 into production in October 1963. Its chain-driven rear wheels pointed to Honda's motorcycle origins.[22]

Over the next few decades, Honda worked to expand its product line, operations and exports to numerous countries around the world. In 1986, Honda introduced the successful Acura brand to the American market in an attempt to gain ground in the luxury vehicle market. The year 1991 saw the introduction of the Honda NSX supercar, the first all-aluminum monocoque vehicle that incorporated a mid-engine V6 with variable-valve timing.[23]

In 1990, CEO Tadashi Kume was succeeded by Nobuhiko Kawamoto. Kawamoto was selected over Shoichiro Irimajiri, who oversaw the successful establishment of Honda of America Manufacturing, Inc. in Marysville, Ohio. Irimajiri and Kawamoto shared a friendly rivalry within Honda; owing to health issues, Irimajiri would resign in 1992.

Following the death of Soichiro Honda and the departure of Irimajiri, Honda found itself quickly being outpaced in product development by other Japanese automakers and was caught off-guard by the truck and sport utility vehicle boom of the 1990s, all which took a toll on the profitability of the company. Japanese media reported in 1992 and 1993 that Honda was at serious risk of an unwanted and hostile takeover by Mitsubishi Motors, which at the time was a larger automaker by volume and was flush with profits from its successful Pajero and Diamante models.[24]

Kawamoto acted quickly to change Honda's corporate culture, rushing through market-driven product development that resulted in recreational vehicles such as the first-generation Odyssey and the CR-V, and a refocusing away from some of the numerous sedans and coupes that were popular with the company's engineers but not with the buying public. The most shocking change to Honda came when Kawamoto ended the company's successful participation in Formula One after the 1992 season, citing costs in light of the takeover threat from Mitsubishi as well as the desire to create a more environmentally friendly company image.[25]

The Honda Aircraft Company as established in 2006 as a wholly owned subsidiary to manufacture and sell the HondaJet family of aircraft.[26][27] The first deliveries to customers began in December 2015.[28]

On 23 February 2015, Honda announced that CEO and President Takanobu Ito would step down and be replaced by Takahiro Hachigo in June of that year; additional retirements by senior managers and directors were expected.[29]

In October 2019, Honda was reported to be in talks with Hitachi to merge the two companies' car parts businesses, creating a components supplier with almost $17 billion in annual sales.[30]

In January 2020, Honda announced that it would be withdrawing employees working in the city of Wuhan, Hubei, China due to the COVID-19 pandemic.[31] On 23 March 2020 due to the global spread of the virus, Honda became the first major automaker with operations in the US to suspend production in its factories. It resumed automobile, engine and transmission production at its US plants on 11 May 2020.[32]

Honda and General Motors announced in September 2020 a North American alliance to begin in 2021.[33] According to The Detroit Free Press, "The proposed alliance will include sharing a range of vehicles, to be sold under each company's distinct brands, as well as cooperation in purchasing, research and development, and connected services."[34]

In 2021, Honda announced its intention to become the world's first carmaker to sell a vehicle with level 3 self-driving technology.[35]

In March 2022, Honda announced it would develop and build electric vehicles in a joint venture with electronics giant Sony. The latter is set to provide its imaging, sensing, network and other technologies while Honda would be responsible for the car manufacturing processes.[36] The Sony Honda Mobility company was officially announced on 13 October 2022[37] with pre-orders said to open in 2025 and the release of the first EVs scheduled for 2026 in the US under the "Afeela" brand.[38]

On 2 February 2023, Honda announced a deal with American car company General Motors to produce cars using a new hydrogen fuel system. The aim is to ramp up the hydrogen powered cells in their Electric vehicles as well as trucks, construction machinery, and power stations.[39]

On 15 March 2023, Honda recalled 500,000 vehicles in the United States and Canada due to an issue with seat belts in the car not latching correctly. Among the models recalled were the 2017-2020 CR-V, the 2018 and 2019 Accord, the 2018-2020 Odyssey, the 2019 Insight, and the Acura RDX from 2019 and 2020. According to the recall, the seat belts in the front seats would break open on impact increasing the risk of injury in a crash.[40]

On 21 December 2023, Honda announced a global recall of about 4.5 million vehicles, including 2.54 million in the US, over fuel pump failures, following earlier recalls in 2021 and 2020 for the same issue.[41]

Attempted merger with Nissan

[edit]

On 23 December 2024, Honda officially announced an MOU had been entered to merge with fellow automaker Nissan to become the 3rd largest auto company by sales. Mitsubishi Motors, in which Nissan has 24% ownership, also agreed to join the talks of integration.[42] The merger was officially set with a deadline of 2026.[43] Mitsubishi announced it would make a decision on merging with the new company by the end of January 2025.[43]

In February 2025, Honda and Nissan announced that their boards had voted to end talks to merge. Nissan reportedly backed out of the talks with larger rival Honda after negotiations were complicated by growing differences, including Honda's proposal that Nissan become a subsidiary.[44]

Senior leadership

[edit]

- *Chairman:* Toshiaki Mikoshiba (since April 2019)[45]
- *President and Chief Executive*: Toshihiro Mibe (since April 2021)[45]

Previous CEOs

[edit]

- Soichiro Honda (1948–1973)[*citation needed*]
- Kiyoshi Kawashima (1973–1983)[*citation needed*]
- Tadashi Kume (1983–1990)[*citation needed*]
- Nobuhiko Kawamoto (1990–1998)[46]
- Hiroyuki Yoshino (1998–2003)[47]
- Takeo Fukui (2003–2009)[48]
- Takanobu Ito (2009–2015)[49]
- Takahiro Hachigo (2015–2021)[50]

Corporate profile and divisions

[edit]

Sales by business (2024)[51]

Business	share
Automobile	66.4%
Financial services	15.9%
Motorcycle	15.8%
Power products and others	1.9%

Honda is headquartered in Minato, Tokyo, Japan. Their shares trade on the Tokyo Stock Exchange and the New York Stock Exchange, as well as exchanges in Osaka, Nagoya, Sapporo, Kyoto, Fukuoka, London, Paris, and Switzerland.

The company has assembly plants around the globe. These plants are located in China, the United States, Pakistan, Canada, England, Japan, Belgium, Brazil, México, New Zealand, Malaysia, Indonesia, India, Philippines, Thailand, Vietnam, Turkey, Taiwan, Perú and Argentina. As of July 2010, 89% of Honda and Acura vehicles sold in the United States were built in North American plants, up from 82.2% a year earlier. This shields profits from the yen's advance to a 15-year high against the dollar.[52]

American Honda Motor Company is based in Torrance, California. Honda Racing Corporation (HRC) is Honda's motorsport division. Honda Canada Inc. is headquartered in Markham, Ontario,[53] it was originally planned to be located in Richmond Hill, Ontario, but delays led them to look elsewhere. Their manufacturing division, Honda of Canada Manufacturing, is based in Alliston, Ontario. Honda has also created joint ventures around the world, such as Honda Siel Cars and Hero Honda Motorcycles in India,[54] Guangzhou Honda and Dongfeng Honda in China, Boon Siew Honda in Malaysia and Honda Atlas in Pakistan. The company also runs a business innovation initiative called **Honda Xcelerator**, in order to build relationships with innovators, partner with Silicon Valley startups and entrepreneurs, and help other companies work on prototypes. Xcelerator had worked with reportedly 40 companies as of January 2019. Xcelerator and a developer studio are part of the **Honda Innovations** group, formed in Spring 2017 and based in Mountain View, California.[55] Through Honda Mobilityland, Honda also operate the Suzuka Circuit and Twin Ring Motegi racing tracks.

Following the 2011 Tohoku earthquake and tsunami in Japan, Honda announced plans to halve production at its UK plants.[56] The decision was made to put staff at the Swindon plant on a 2-day week until the end of May as the manufacturer struggled to source supplies from Japan. It's thought around 22,500 cars were produced during this period.

Finances

[edit]

For the fiscal year 2018, Honda reported earnings of US$9.534 billion, with an annual revenue of US$138.250 billion, an increase of 6.2% over the previous fiscal cycle. Honda's shares traded at over $32 per share, and its market capitalization was valued at US$50.4 billion in October 2018.[57]

Year	Revenue in million US$	Net income in million US$	Total assets in million US$	Employees
2005	77,851	4,376	83,853	—
2006	89,172	5,373	95,145	—
2007	99,784	5,331	108,329	167,231
2008	108,026	5,400	113,540	178,960
2009	100,112	1,370	118,189	181,876
2010	92,655	3,052	125,594	176,815
2011	107,242	6,762	138,851	179,060
2012	100,941	2,820	149,616	187,094
2013	119,523	4,443	164,988	190,338
2014	118,425	5,741	156,220	198,368
2015	121,286	4,636	167,675	204,730
2016	121,190	2,860	151,303	208,399
2017	130,193	5,734	176,311	211,915
2018	138,250	9,534	174,143	215,638
2019	142,998	5,493	183,772	219,722
2020	137,365	4,193	188,246	218,674
2021	123,803	6,180	206,058	211,374
2022	129,519	6,293	213,361	218,674
2023	125,117	4,820	182,559	197,039
2024	140,959	7,640	205,442	194,993

Honda's Net Sales and Other Operating Revenue by Geographical Regions in 2024[51]

Geographic Region	Total revenue (in millions of ¥)	in %
North America	10,470,000	51.23%
Asia	4,290,000	21.02%
Japan	1,960,000	9.59%
Europe	943,000	4.62%
Others	1,150,000	5.63%

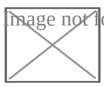
Products

[edit]

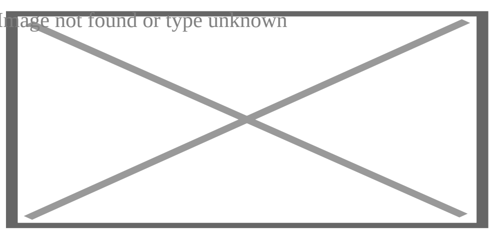
Automobiles

[edit]

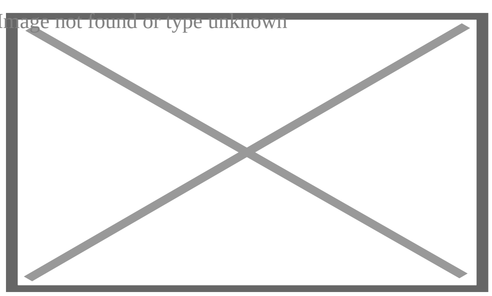
Main article: List of Honda automobiles



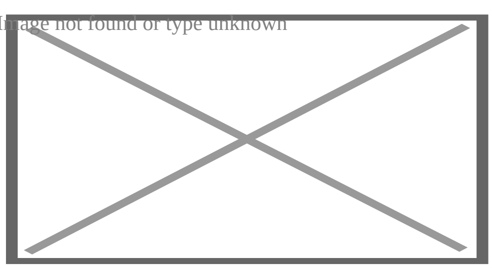
This section **needs additional citations for verification**. Please help improve this article by adding citations to reliable sources in this section. Unsourced material may be challenged and removed.
Find sources: "Honda" – news · newspapers · books · scholar · JSTOR *(September 2017) (Learn how and when to remove this message)*



Eleventh-generation Honda Accord



Eleventh-generation Honda Civic



Sixth-generation Honda CR-V

Honda's automotive manufacturing ambitions can be traced back to 1963, with the Honda T360, a Kei truck built for the Japanese market.[58] This was followed by the two-door roadster, the Honda S500 also introduced in 1963. In 1965, Honda built a two-door commercial delivery van, named the Honda L700. Honda's first four-door sedan was not the Honda Accord, but the air-cooled, four-cylinder, gasoline-powered Honda 1300 which was introduced in 1969. The Civic was a hatchback that gained wide popularity internationally, but it wasn't the first two-door hatchback built by Honda. That was the Honda N360, a Kei car that was adapted for international sale as the N600. The Civic, which appeared in 1972 and replaced the N600 also had a smaller sibling that replaced the air-cooled N360, called the Honda Life, which was water-cooled.

The Honda Life represented Honda's efforts in competing in the *kei* car segment, offering sedan, delivery van and small pick-up platforms on a shared chassis. The Life Step Van had a novel approach that, while not initially a commercial success, appeared to be an influence to vehicles with the front passengers sitting behind the engine, a large cargo area with a flat roof and a liftgate installed in back, and utilizing a transversely installed engine with a front-wheel-drive powertrain.

As Honda entered into automobile manufacturing in the late 1960s where Japanese manufacturers such as Toyota and Nissan had been making cars since before WWII, Honda instilled a sense of doing things a little differently than its Japanese competitors. Its mainstay products like the Accord and Civic (with the exception of its USA-market 1993–97 Passport which was part of a vehicle exchange program with Isuzu (part of the Subaru-Isuzu joint venture)) have always employed Front-wheel drive powertrain implementation, which is currently a long-held Honda tradition. Honda also installed new technologies into their products, first as optional equipment, then later standard, like anti-lock brakes, speed-sensitive power steering, and multi-port fuel injection in the early 1980s. This desire to be the first to try new approaches is evident with the creation of the first Japanese luxury chain Acura, and was also evident with the all-aluminum, mid-engined sports car, the Honda NSX, which also introduced variable valve timing technology, which Honda calls VTEC.

The Civic family is a line of compact cars developed and manufactured by Honda. In North America, the Civic is the second-longest continuously running nameplate from a Japanese manufacturer; only its perennial rival, the Toyota Corolla, introduced in 1966, has been in production longer.[59] The Civic, along with the Accord and Prelude, comprised Honda's vehicles sold in North America until the 1990s, when the model lineup was expanded. Having gone through several generational changes, the Civic has become larger and more upmarket, and it currently slots between the Fit and Accord.

Honda's first hybrid electric vehicle was the 1999 Insight. The Civic was first offered as a hybrid in 2001, and the Accord followed in 2004. In 2008, the company launched the Clarity, a fuel cell car.

In 2008, Honda increased global production to meet the demand for small cars and hybrids in the US and emerging markets. The company shuffled US production to keep factories busy and boost car output while building fewer minivans and sport utility vehicles as light truck sales fell.[60]

Its first entrance into the pickup segment, the light-duty Ridgeline, won Truck of the Year from *Motor Trend* magazine in 2006. Also in 2006, the redesigned Civic won Car of the Year from the magazine, giving Honda a rare double win of Motor Trend honors.

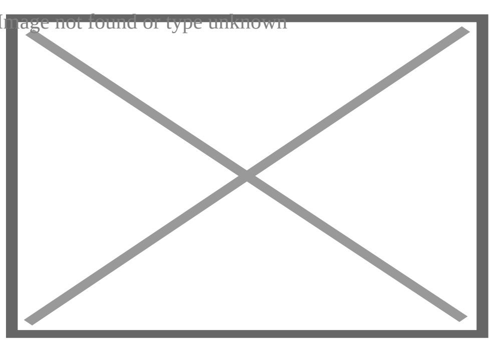
It is reported that Honda plans to increase hybrid sales in Japan to more than 20% of its total sales in the fiscal year 2011, from 14.8% in the previous year.[61]

Five of United States Environmental Protection Agency's top ten most fuel-efficient cars from 1984 to 2010 come from Honda, more than any other automakers. The five models are: 2000–2006 Honda Insight (53 mpgâ€‘US or 4.4 L/100 km or 64 mpgâ€‘imp combined), 1986–1987 Honda Civic Coupe HF (46 mpgâ€‘US or 5.1 L/100 km or 55 mpgâ€‘imp combined), 1994–1995 Honda Civic hatchback VX (43 mpgâ€‘US or 5.5 L/100 km or 52 mpgâ€‘imp combined), 2006– Honda Civic Hybrid (42 mpgâ€‘US or 5.6 L/100 km or 50 mpgâ€‘imp combined), and 2010– Honda Insight (41 mpgâ€‘US or 5.7 L/100 km or 49 mpgâ€‘imp combined).[62] The ACEEE has also rated the Civic GX as the greenest car in America for seven consecutive years.[63]

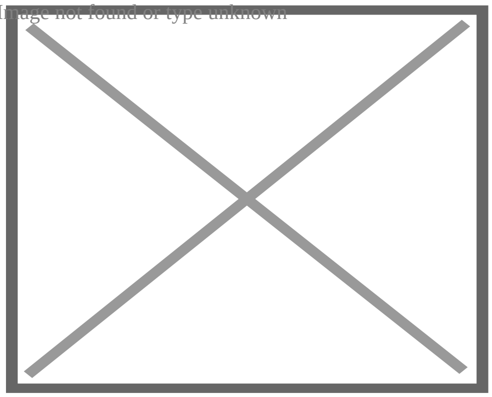
Honda currently builds vehicles in factories located in Japan, the United States of America, Canada, China, Pakistan, the United Kingdom, Malaysia, Belgium, Brazil, Indonesia, India, Thailand, Turkey, Argentina, Mexico, Taiwan, and the Philippines.

Motorcycles

[edit]
For a list of motorcycle products, see list of Honda motorcycles.



1953 Honda Cub on display at the Barber Vintage Motorsports Museum, Birmingham, Alabama. The two-stroke single-cylinder motorcycle had a displacement of 58 cc and a top speed of 40 km/h (25 mph).



Honda Gold Wing bike

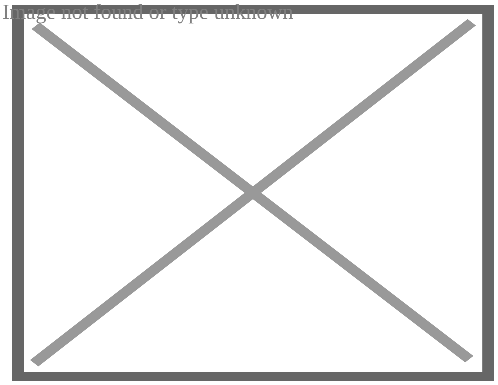
Honda is the largest motorcycle manufacturer in Japan and has been since it started production in 1955.[13] At its peak in 1982, Honda manufactured almost three million motorcycles annually. By 2006, this figure had been reduced to around 550,000 but was still higher than its three domestic competitors.[13]

In 2017, India became the largest motorcycle market for Honda.[64][65] In India, Honda is leading in the scooters segment, with 59% market share.[66]

During the 1960s when it was a small manufacturer, Honda broke out of the Japanese motorcycle market and began exporting to the United States. Working with the advertising agency Grey Advertising, Honda created an innovative marketing campaign, using the slogan "You meet the nicest people on a Honda." In contrast to the prevailing negative stereotypes of motorcyclists in America as tough, antisocial rebels, this campaign suggested that Honda motorcycles were made for the everyman. The campaign was hugely successful; the ads ran for three years, and by the end of 1963 alone, Honda had sold 90,000 motorcycles.[14]

Taking Honda's story as an archetype of the smaller manufacturer entering a new market already occupied by highly dominant competitors, the story of their market entry, and their subsequent huge success in the US and around the world has been the subject of some academic controversy. Competing explanations have been advanced to explain Honda's strategy and the reasons for their success.[67]

The first of these explanations was put forward when, in 1975, the Boston Consulting Group (BCG) was commissioned by the UK government to write a report explaining why and how the British motorcycle industry had been out-competed by its Japanese competitors. The report concluded that the Japanese firms, including Honda, had sought a very high scale of production (they had made a large number of motorbikes) in order to benefit from economies of scale and learning curve effects. It blamed the decline of the British motorcycle industry on the failure of British managers to invest enough in their businesses to profit from economies of scale and scope.[68]



2004 Honda Super Cub

The second explanation was offered in 1984 by Richard Pascale, who had interviewed the Honda executives responsible for the firm's entry into the US market. As opposed to the tightly focused strategy of low cost and high scale that BCG accredited to Honda, Pascale found that their entry into the US market was a story of "miscalculation, serendipity, and organizational learning" – in other words, Honda's success was due to the adaptability and hard work of its staff, rather than any long-term strategy.[69] For example, Honda's initial plan on entering the US market was to compete in large motorcycles, around 300 cc. Honda's motorcycles in this class suffered performance and reliability problems when ridden the relatively long distances of the US highways.[14]:â€Š41–43â€Š When the team found that the scooters they were using to get themselves around their US base of San Francisco attracted positive interest from consumers they fell back on selling the Super Cub instead.[14]:â€Š41–43â€Š

The most recent school of thought on Honda's strategy was put forward by Gary Hamel and C. K. Prahalad in 1989. Creating the concept of core competencies with Honda as an example, they argued that Honda's success was due to its focus on leadership in the technology of internal combustion engines.[70] For example, the high power-to-weight ratio engines Honda produced for its racing bikes provided technology and expertise which was transferable into mopeds. Honda's entry into the US motorcycle market during the 1960s is used as a case study for teaching introductory strategy at business schools worldwide.[71]

ATVs

[edit]

Honda builds utility ATVs under models Recon, Rubicon, Rancher, Foreman and Rincon. Honda also builds sports ATVs under the models TRX 90X, TRX 250X, TRX 400x, TRX 450R and TRX 700.[72]

Power equipment

[edit]

Honda EU70is Generator

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A Honda Power EU70is power generator

Power equipment[73] production started in 1953 with H-type engine (prior to motorcycles).[74]

Honda power equipment reached record sales in 2007 with 6.4 million units sold annually.[75] By 2010 (Fiscal year ended 31 March) this figure had decreased to 4.7 million units.[76] Cumulative production of power products has exceeded 85 million units annually (as of September 2008).[77]

In September 2023, Honda ceased sales of gasoline lawn mowers and some other power equipment in the US.[78]

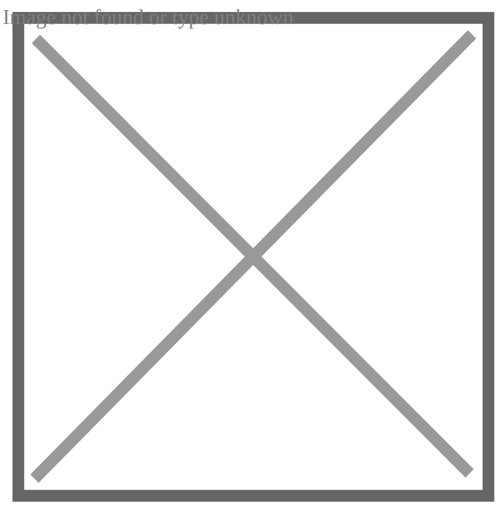
Honda power equipment includes:

- Engine
- Brush Cutters
- Tillers
- Marine Outboard Motors
- Water Pumps
- Cultivator
- Lawn mower
- Robotic lawn mower
- Riding mower
- Trimmer
- Mower
- Blower
- Sprayer
- Hedge trimmer
- Snowthrower
- Generator, welding power supply
- Pump
- Outboard engine
- Inflatable boat

- Electric 4-wheel Scooter
- Compact Household Cogeneration Unit

Engines

[edit]



Honda Outboard motors

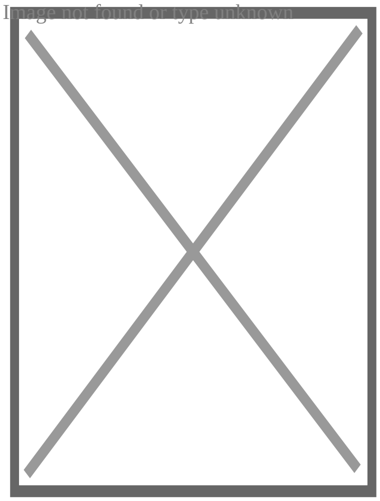
Honda engines powered the entire 33-car starting field of the 2010 Indianapolis 500[79] and for the fifth consecutive race, there were no engine-related retirements during the running of the Memorial Day Classic.[80]

In the 1980s Honda developed the GY6 engine for use in motor scooters. Although no longer manufactured by Honda, it's still commonly used in many Chinese, Korean and Taiwanese light vehicles.[81]

Honda, despite being known as an engine company, has never built a V8 engine for passenger vehicles. In the late 1990s, the company resisted considerable pressure from its American dealers for a V8 engine (which would have seen use in top-of-the-line Honda SUVs and Acuras), with American Honda reportedly sending one dealer a shipment of V8 beverages to silence them.[82] Honda considered starting V8 production in the mid-2000s for larger Acura sedans, a new version of the high-end NSX sports car (which previously used DOHC V6 engines with VTEC to achieve its high power output) and possible future ventures into the American full-size truck and SUV segment for both the Acura and Honda brands, but this was canceled in late 2008, with Honda citing environmental and worldwide economic conditions as reasons for the termination of this project.[83]

Robots

[edit]



ASIMO at Expo 2005

ASIMO is part of Honda's Research & Development robotics program. It's the eleventh in a line of successive builds starting in 1986 with Honda E0 moving through the ensuing Honda E series and the Honda P series. Weighing 54 kilograms and standing 130 centimeters tall, ASIMO resembles a small astronaut wearing a backpack, and can walk on two feet in a manner resembling human locomotion, at up to 6 km/h (3.7 mph). ASIMO is the world's only humanoid robot able to ascend and descend stairs independently.[84] However, human motions such as climbing stairs are difficult to mimic with a machine, which ASIMO has demonstrated by taking two plunges off a staircase.

ASIMO is able to walk, dance and navigate steps. In 2010, Honda developed a machine capable of reading a user's brainwaves to move ASIMO. The system uses a helmet covered with electroencephalography and near-infrared spectroscopy sensors that monitor electrical brainwaves and cerebral blood flow signals that alter slightly during the human thought process. The user thinks of one of the limited number of gestures it wants from the robot, which has been fitted with a Brain-Machine Interface.[85]

Aircraft

[edit]
Main article: Honda HA-420 HondaJet

Honda has also pioneered new technology in its HA-420 HondaJet, manufactured by its subsidiary Honda Aircraft Company, which allows new levels of reduced drag, increased aerodynamics and fuel efficiency thus reducing operating costs.[86]

Mountain bikes

[edit]
See also: Honda RN-01 G-cross

Honda has also built a downhill racing bicycle known as the Honda RN-01. It is not available for sale to the public. The bike has a gearbox, which replaces the standard derailleur found on most bikes.

Honda has hired several people to pilot the bike, among them Greg Minnaar. The team is known as Team G Cross Honda.

Rockets

[edit]

In 2019, Honda began development of rocket engines.[87] In June 2025, Honda successfully conducted a launch and landing test of an reusable launch vehicle in Taiki, Hokkaido.[88][89] Honda has stated that they aim to make a sub-orbital spaceflight in 2029.[90][91]

Former products

[edit]

Solar cells

[edit]

Honda's solar cell subsidiary company Honda Soltec (Headquarters: Kikuchi-gun, Kumamoto; President and CEO: Akio Kazusa) started sales throughout Japan of thin-film solar cells for public and industrial use on October 24, 2008, after selling solar cells for residential use in October 2007.[92] Honda announced in the end of October 2013 that Honda Soltec would cease business operations in the Spring of 2014 except for support for existing customers and the subsidiary would be dissolved.[93]

Motorsports

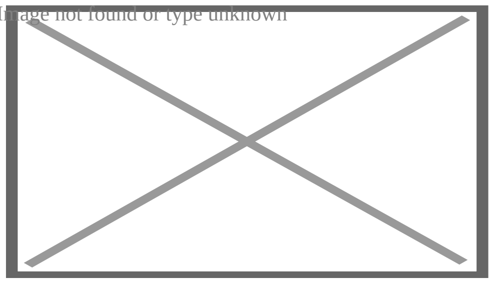
[edit]
Main article: Honda in motorsport
See also: Honda Racing Corporation and Honda Racing Corporation USA

Honda has been active in motorsports, like Formula One, MotoGP and others, since the early years of the company. Since 2022, Honda's general motorsport activities have been managed by its motorsport subsidiary Honda Racing Corporation (HRC). Prior to 2022, Honda's motorcycle racing activities were run by HRC since it was founded in 1982, while its automobile racing activities were run as projects within the Honda Motor Company itself.[94]

Honda Performance Development (HPD) was established in 1993 as the company's North American motorsport subsidiary, and for 2024 HPD became Honda Racing Corporation USA (HRC US) to form a global motorsports organization.[95] Honda also owns two Japanese race tracks, the Suzuka Circuit and Mobility Resort Motegi (formerly Twin Ring Motegi), which it established in 1962 and 1997, respectively, and which are managed by Honda Mobilityland.

Automobiles

[edit]
See also: Honda in Formula One



Max Verstappen won the 2021 Formula One World Championship with a Honda power unit.

Honda entered Formula One for the first time in 1964, just one year after starting the production of road cars, making both engine and chassis. Honda achieved their first victory at the 1965 Mexican Grand Prix, and another win at the 1967 Italian Grand Prix, before they withdrew after the 1968 season. They returned to the sport in 1983 as an engine manufacturer, remaining until 1992. This period saw Honda dominate Grand Prix racing,[96] as between 1986 and 1991 they won five consecutive Drivers' Championships with Nelson Piquet, Ayrton Senna and Alain Prost, and six Constructors' titles with Williams and McLaren.[97] A third stint from 2000 to 2008, initially as engine maker and later also as team owner, yielded 17 podiums, including one win, and second place in the 2004 constructors' standings. They returned as a power unit supplier for the second year of the hybrid era in 2015 and initially struggled, but intense development saw them become race winners again by 2019, and in 2021 they won the World Drivers' Championship with Max Verstappen and Red Bull Racing.[98] Honda formally left Formula One after 2021 to focus its resources on carbon neutral technologies, but an arrangement was made for it to extend power unit supply for Red Bull until 2025.[99][100] While no longer a works team, RedBull Racing still displayed Honda on their engine cover in this extended deal. As the series introduced more sustainable regulations, Honda announced it will formally rejoin in 2026 to provide power units to Aston Martin as a works team.[101]

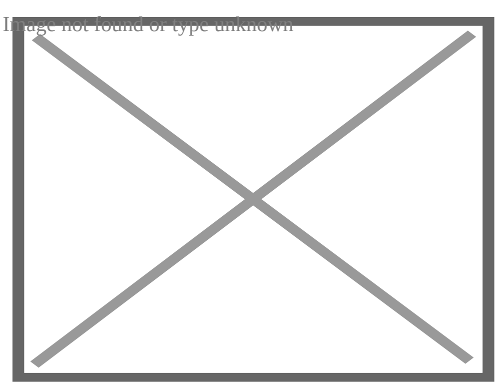
Honda debuted in the CART IndyCar World Series as an engine supplier in 1994, and the company won six consecutive Drivers' Championships and four Manufacturers' Championships between 1996 and 2001.[102] In 2003, Honda transferred its effort to the IRL IndyCar Series. In 2004, Honda won the Indianapolis 500 for the first time and claimed the Drivers' and Manufacturers' Championships, a feat which it repeated in 2005.[102] From 2006 to 2011, Honda was the series' lone manufacturer, before manufacturer competition returned for 2012. Since 2012, Honda's turbocharged V6 engines have won the Indianapolis 500 several times as well as claimed multiple Drivers' and Manufacturers' titles.[103] In the Japanese Super Formula Championship, Honda-powered cars have won the championship numerous times since 1981, with their title tally in the double digits. In Formula Two, Honda engines dominated the premier series in 1966 and scored multiple titles in the early 1980s.

In sports car racing, Honda won the 24 Hours of Le Mans in 1995 in the GT2 class,[104] and in 2010 and 2012 they won in the LMP2 category.[105] Honda made their factory debut in the Super GT Series (previously known as the All-Japan GT Championship) in 1997, and in 2000 they won their first championships.[106] Since then, they have won several further titles, uniquely with both mid- and front-engined cars.[106] Through their Acura and HPD divisions, Honda has also competed in sports prototype racing, beginning with the Spice-Acura prototypes that won the IMSA GT Lights championship in 1991, 1992 and 1993. Acura joined the American Le Mans Series in 2007 and won the 12 Hours of Sebring in class on their debut, before winning the championship in both the LMP1 and LMP2 classes in 2009. The cars were rebranded as HPDs for 2010, after which they won multiple titles in the ALMS and also won the FIA World Endurance Championship in the LMP2 class. Acura returned to prototype racing in 2018 in the DPi class of the IMSA SportsCar Championship, winning championship titles in 2019, 2020 and 2022 as well as the 24 Hours of Daytona overall in 2021, 2022, and 2023.[107] Honda's GT3 car won both the IMSA GTD and Super GT GT300 titles.[108][109]

During the Group A era of the Japanese Touring Car Championship, Honda won seven manufacturers' titles and six drivers' titles in the sub-1,600 cc division between 1986 and 1993.[110] The following Super Touring era of touring car racing saw Honda win the Japanese and North American championships in 1996 and 1997, while in Europe Honda's Super Touring cars claimed over 40 wins across the British, German and European series. After the collapse of the Super Touring regulations in the early 2000s, Honda remained involved in the British Touring Car Championship, where their cars would win multiple championships in the mid-2000s and throughout the 2010s. Honda entered the World Touring Car Championship in late 2012, and in 2013 they won the Manufacturers' World Championship. Honda's TCR car won the global TCR Model of the Year award in 2019, 2020, and 2024.[111]

Motorcycles

[edit]



Honda RC212V raced by Dani Pedrosa

HRC combines participation in motorcycle races throughout the world with the development of high-potential racing machines. Its racing activities are an important source for the creation of leading-edge technologies used in the development of Honda motorcycles. HRC also contributes to the advancement of motorcycle sports through a range of activities that include sales of production racing motorcycles, support for satellite teams, and rider education programs.

Soichiro Honda, being a race driver himself, could not stay out of international motorsport. In 1959, Honda entered five motorcycles into the Isle of Man TT race, the most prestigious motorcycle race in the world. While always having powerful engines, it took until 1961 for Honda to tune their chassis well enough to allow Mike Hailwood to claim their first Grand Prix victories in the 125 and 250 cc classes. Hailwood would later pick up their first Senior TT wins in 1966 and 1967. Honda's race bikes were known for their "sleek & stylish design" and exotic engine configurations, such as the 5-cylinder, 22,000 rpm, 125 cc bike and their 6-cylinder 250 cc and 297 cc bikes.

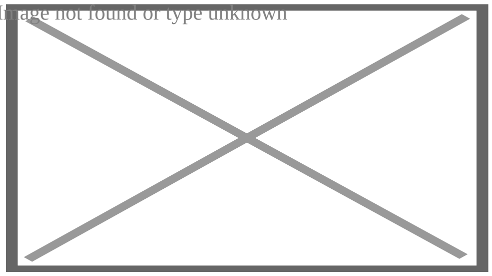
In 1979, Honda returned to Grand Prix motorcycle racing with the monocoque-framed, four-stroke NR500. The FIM rules limited engines to four cylinders, so the NR500 had non-circular, 'race-track', cylinders, each with 8 valves and two connecting rods, in order to provide sufficient valve area to compete with the dominant two-stroke racers. The experiment failed. For the 1982 season, Honda debuted its first two-stroke race bike, the NS500 and in 1983, Honda won their first 500 cc Grand Prix World Championship with Freddie Spencer. Since then, Honda has become a dominant marque in motorcycle Grand Prix racing, winning a plethora of top-level titles with riders such as Mick Doohan and Valentino Rossi. Honda also head the number of wins at the Isle of Man TT having notched up 227 victories in the solo classes and Sidecar TT,[112] including Ian Hutchinson's clean sweep at the 2010 races.[113]

The outright lap record on the Snaefell Mountain Course was held by Honda, set at the 2015 TT by John McGuinness at an average speed of 132.701 mph (213.562 km/h) on a Honda CBR1000RR,[114] bettered the next year by Michael Dunlop on a BMW S1000RR at 133.962 mph (215.591 km/h).[115]

In the Motocross World Championship, Honda has claimed seventeen world championships. In the World Enduro Championship, Honda has captured eight titles, most recently with Stefan Merriman in 2003 and with Mika Ahola from 2007 to 2010. In motorcycle trials, Honda has claimed three world championships with Belgian rider Eddy Lejeune.

Electric and alternative fuel vehicles

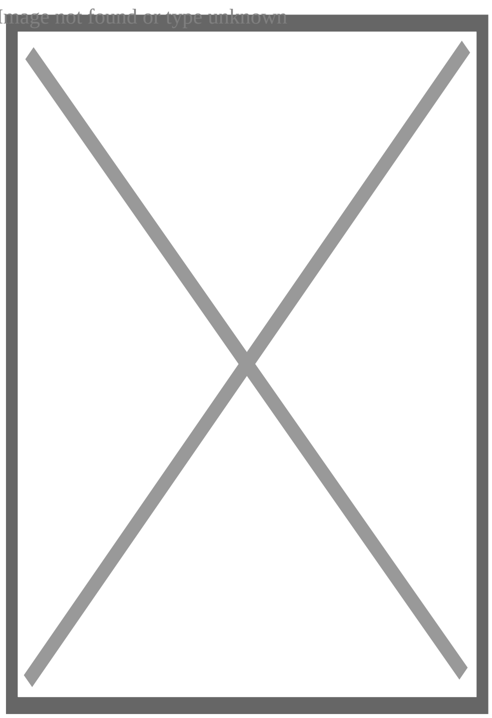
[edit]



2009 Honda Civic GX hooked up to Phill refueling system

Compressed natural gas

[edit]



Two clean vehicle versions of the Honda Civic.
Top: a Brazilian flexible-fuel vehicle.
Bottom: a US gasoline-electric hybrid.

The Honda Civic GX was for a long time the only purpose-built natural gas vehicle (NGV) commercially available in some parts of the US.[116][117] The Honda Civic GX first appeared in 1998 as a factory-modified Civic LX that had been designed to run exclusively on compressed natural gas. The car looks and drives just like a contemporary Honda Civic LX, but does not run on gasoline. In 2001, the Civic GX was rated the cleanest-burning internal combustion engine in the world by the US Environmental Protection Agency (EPA).[118][119]

First leased to the City of Los Angeles, in 2005, Honda started offering the GX directly to the public through factory trained dealers certified to service the GX. Before that, only fleets were eligible to purchase a new Civic GX. In 2006, the Civic GX was released in New York, making it the second state where the consumer is able to buy the car.[120]

In June 2015, Honda announced its decision to phase out the commercialization of natural-gas powered vehicles to focus on the development of a new generation of electric vehicles such as hybrids, plug-in electric cars and hydrogen-powered fuel cell vehicles. Since 2008, Honda has sold about 16,000 natural-gas vehicles, mainly to taxi and commercial fleets.[121]

Flexible-fuel

[edit]

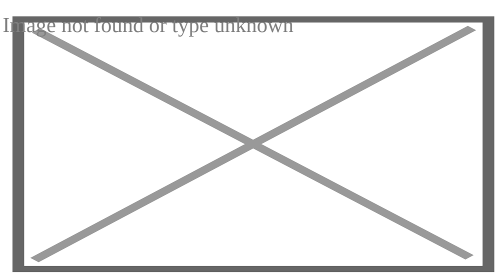
Honda's Brazilian subsidiary launched flexible-fuel versions for the Honda Civic and Honda Fit in late 2006. As other Brazilian flex-fuel vehicles, these models run on any blend of hydrous ethanol (E100) and E20-E25 gasoline.[122][123] Initially, and in order to test the market preferences, the carmaker decided to produce a limited share of the vehicles with flex-fuel engines, 33 percent of the Civic production and 28 percent of the Fit models.[122][123] Also, the sale price for the flex-fuel version was higher than the respective gasoline versions, around US$1,000 premium for the Civic, and US$650 for the Fit, despite the fact that all other flex-fuel vehicles sold in Brazil had the same tag price as their gasoline versions.[123][124][125] In July 2009, Honda launched in the Brazilian market its third flexible-fuel car, the Honda City.[126]

During the last two months of 2006, both flex-fuel models sold 2,427 cars against 8,546 gasoline-powered automobiles,[127] jumping to 41,990 flex-fuel cars in 2007,[128] and reaching 93,361 in 2008.[129] Due to the success of the flex versions, by early 2009 a hundred percent of Honda's automobile production for the Brazilian market is now flexible-fuel, and only a small percentage of gasoline version is produced in Brazil for exports.[130]

In March 2009, Honda introduced the world's first flex-fuel motorcycle in the Brazilian market. Manufactured by its Brazilian subsidiary, Moto Honda da Amazônia, the CG 150 Titan Mix is priced at approximately US$2,700.[131][132][133]

Hybrid electric

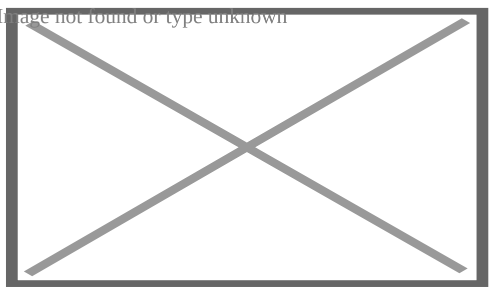
[edit]



Honda CR-Z, the first sports coupe hybrid to come with a six-speed manual transmission

In late 1999, Honda launched the first commercial hybrid electric car sold in the US market, the Honda Insight, just one month before the introduction of the Toyota Prius, and initially sold for US$20,000.[134][135] The first-generation Insight was produced from 2000 to 2006 and had a fuel economy of 70 miles per US gallon (3.4 L/100 km; 84 mpgâ€‘imp) for the EPA's highway rating, the most fuel-efficient mass-produced car at the time.[134][135] Total global sales for the Insight amounted to only around 18,000 vehicles.[135] Cumulative global sales reached 100,000 hybrids in 2005 and 200,000 in 2007.[136]

Honda introduced the second-generation Insight in Japan in February 2009, and released it in other markets through 2009 and in the US market in April 2009. At $19,800 as a five-door hatchback it will be the least expensive hybrid available in the US.[137]



2010 Honda Insight hybrid electric vehicle (second generation)

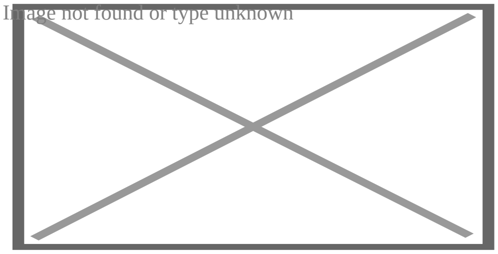
Since 2002, Honda has also been selling the Honda Civic Hybrid (2003 model) in the US market.[134] It was followed by the Honda Accord Hybrid, offered in model years 2005 through 2007. Sales of the Honda CR-Z began in Japan in February 2010, becoming Honda's third hybrid electric car in the market.[138] As of February 2011, Honda was producing around 200,000 hybrids a year in Japan.[139]

Sales of the Fit Hybrid began in Japan in October 2010, at the time, the lowest price for a gasoline-hybrid electric vehicle sold in the country.[140] The European version, called Honda Jazz Hybrid, was released in early 2011.[141] During 2011 Honda launched three hybrid models available only in Japan, the Fit Shuttle Hybrid, Freed Hybrid and Freed Spike Hybrid.[136]

Honda's cumulative global hybrid sales passed the 1 million unit milestone at the end of September 2012, 12 years and 11 months after sales of the first generation Insight began in Japan November 1999.[136] A total of 187,851 hybrids were sold worldwide in 2013, and 158,696 hybrids during the first six months of 2014.[142][143] As of June 2014, Honda has sold more than 1.35 million hybrids worldwide.[136][142][143]

Hydrogen fuel cell

[edit]



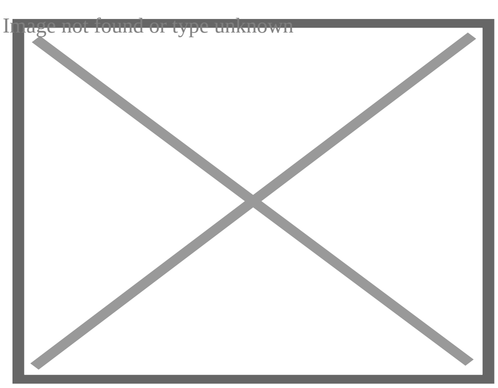
Honda FCX Clarity hydrogen fuel cell vehicle

In Takanezawa, Japan, on 16 June 2008, Honda Motors produced the first assembly-line FCX Clarity, a hybrid hydrogen fuel cell vehicle. More efficient than a gas-electric hybrid vehicle, the FCX Clarity combines hydrogen and oxygen from ordinary air to generate electricity for an electric motor. In July 2014 Honda announced the end of production of the Honda FCX Clarity for the 2015 model.[144] The vehicle itself does not emit any pollutants and its only by-products are heat and water. The FCX Clarity also has an advantage over gas-electric hybrids in that it does not use an internal combustion engine to propel itself. Like a gas-electric hybrid, it uses a lithium ion battery to assist the fuel cell during acceleration and capture energy through regenerative braking, thus improving fuel efficiency. The lack of hydrogen filling stations throughout developed countries will keep production volumes low.[145] Honda will release the vehicle in groups of 150. California is the only US market with infrastructure for fueling such a vehicle, though the number of stations is still limited. Building more stations is expensive, as the California Air Resources Board (CARB) granted $6.8 million for four H2 fueling stations, costing US$1.7 million each.[146][147][148] Honda views hydrogen fuel cell vehicles as the long-term replacement of piston cars, not battery cars.[149]

Honda introduced the CR-V e:FCEV in February 2024 in the US. It is a plug-in hybrid fuel cell version of the CR-V that is equipped with an electric motor, two high-pressure hydrogen tanks with a total capacity of 4.3 kg (9.5 lb) and a 17.7 kWh battery with plug-in charging capability.[106] It was also launched in Japan as the only version of the CR-V sold in the country, imported from the Marysville, Ohio assembly plant in the US. This model began production on 5 June 2024.[150] The later revealed to includes an H2 credit.[151]

Plug-in electric vehicles

[edit]



Honda Fit EV concept unveiled at the 2010 Los Angeles Auto Show

The all-electric Honda EV Plus was introduced in 1997 as a result of CARB's zero-emissions vehicle mandate and was available only for leasing in California. The EV plus was the first battery electric vehicle from a major automaker with non-lead–acid batteries The EV Plus had an all-electric range of 100 mi (160 km). Around 276 units were sold in the US and production ended in 1999.[152][153]

The all-electric Honda Fit EV was introduced in 2012 and has a range of 82 mi (132 km).[154] The all-electric car was launched in the US to retail customers in July 2012 with initial availability limited to California and Oregon.[155] Production is limited to only 1,100 units over the first three years. A total of 1,007 units have been leased in the US through September 2014.[156][157][158] The Fit EV was released in Japan through leasing to local government and corporate customers in August 2012. Availability in the Japanese market is limited to 200 units during its first two years.[159] In July 2014 Honda announced the end of production of the Fit EV for the 2015 model.[144]

The Honda Accord Plug-in Hybrid was introduced in 2013 and has an all-electric range of 13 mi (21 km)[160] Sales began in the US in January 2013 and the plug-in hybrid is available only in California and New York.[161] A total of 835 units have been sold in the US through September 2014.[156][157][158] The Accord PHEV was introduced in Japan in June 2013 and is available only for leasing, primarily to corporations and government agencies.[162]

The Honda e was launched in 2020 and has an electric range of 137 mi (220 km). It is an electric supermini that is retro styled, similar to the first-generation Honda Civic. Following this, the Honda e:Ny1 was launched in 2023, with an electric range of 256 mi (412 km) on the top spec model. It is Honda's first electric SUV.

In April 2022, Honda and General Motors announced a joint venture to develop low-cost electric vehicles based on GM's Ultium architecture in order to beat Tesla vehicles in sales.

In October 2023, the two companies announced that the joint venture has been cancelled due to slower-than-expected demand of electric vehicles and changing market conditions.[163] Although the upcoming Honda Prologue and Acura ZDX will use the Ultium architecture and will be manufactured by General Motors, future Honda electric vehicles will be designed solely by Honda and will be manufactured in Honda assembly plants.[164]

Batteries

[edit]

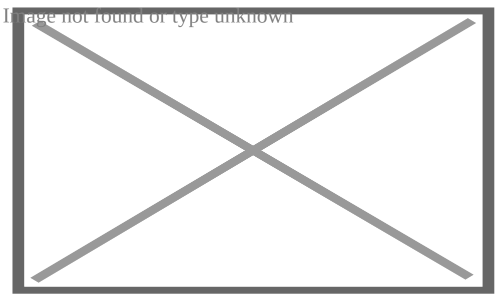
In August 2022, Honda and LG Energy Solution revealed a joint venture to establish a new lithium-ion battery factory in the United States, specifically for Honda and Acura electric vehicles. The initial goal was to produce 40 gigawatt hours of battery capacity.[165]

Marketing

[edit]

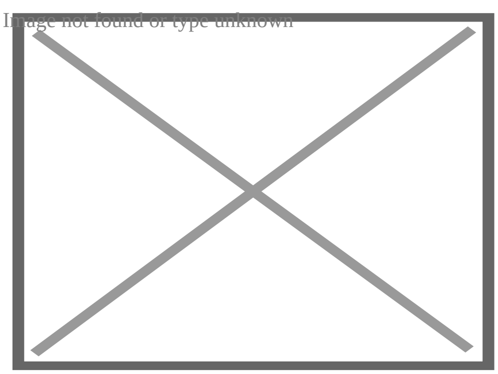
Japanese marketing

[edit]



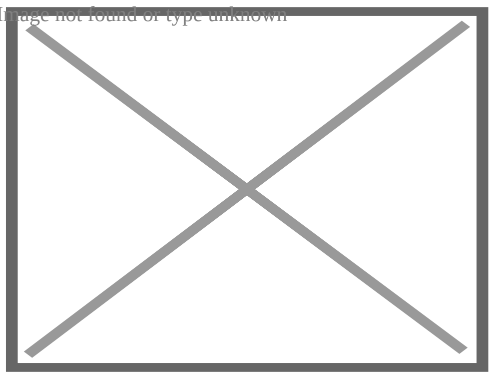
Honda Clio (Saitama, Japan)

Starting in 1978, Honda in Japan decided to diversify its sales distribution channels and created **Honda Verno**, which sold established products with a higher content of standard equipment and more sporting nature.[166][167] The establishment of *Honda Verno* coincided with its new sports compact, the Honda Prelude. Later, the Honda Vigor, Honda Ballade, and Honda Quint were added to *Honda Verno* stores. This approach was implemented due to efforts in place by rival Japanese automakers Toyota and Nissan.



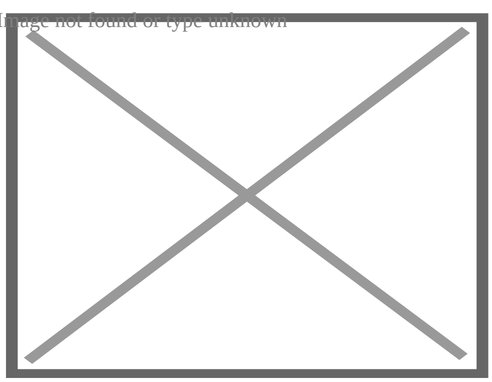
Honda Primo (Osaka)

As sales progressed, Honda created two more sales channels, called **Honda Clio** in 1984, and **Honda Primo** in 1985. The *Honda Clio* chain sold products that were traditionally associated with Honda dealerships before 1978, like the Honda Accord, and *Honda Primo* sold the Honda Civic, kei cars such as the Honda Today, superminis like the Honda Capa, along with other Honda products, such as farm equipment, lawnmowers, portable generators, and marine equipment, plus motorcycles and scooters like the Honda Super Cub. A styling tradition was established when *Honda Primo* and *Clio* began operations in that all *Verno* products had the rear license plate installed in the rear bumper, while *Primo* and *Clio* products had the rear license plate installed on the trunk lid or rear door for minivans. The Renault Clio was sold in Japan at Nissan dealerships, but was renamed the Renault Lutecia.[168] Lutecia is derived from the name of *Lutetia*, an ancient Roman city that was the predecessor of Paris.



Honda Verno (2008)

As time progressed and sales began to diminish partly due to the collapse of the Japanese "bubble economy", "supermini" and "kei" vehicles that were specific to *Honda Primo* were "badge engineered" and sold at the other two sales channels, thereby providing smaller vehicles that sold better at both *Honda Verno* and *Honda Clio* locations. As of March 2006, the three sales chains were discontinued, with the establishment of *Honda Cars* dealerships.[[169]] While the network was disbanded, some Japanese Honda dealerships still use the network names, offering all Japanese market Honda cars at all locations.



Honda Wing motorcycle dealership (Japan)

Honda sells genuine accessories through a separate retail chain called *Honda Access* for both their motorcycle, scooter, and automobile products. In cooperation with corporate group partner Pioneer, Honda sells an aftermarket line of audio and in-car navigation equipment that can be installed in any vehicle under the brand name Gathers, which is available at Honda Access locations as well as Japanese auto parts retailers, such as Autobacs. Buyers of used vehicles are directed to a specific Honda retail chain that sells only used vehicles called *Honda Auto Terrace*.

In the spring of 2012, Honda in Japan introduced *Honda Cars Small Store* which is devoted to compact cars like the Honda Fit, and *kei* vehicles like the Honda N-One and Honda S660 roadster.

All cars sold at Honda Verno

- Prelude, Integra, CR-X, Vigor, Saber, Ballade, Quint, Crossroad, Element, NSX, HR-V, Mobilio Spike, S2000, CR-V, That's, MDX, Rafaga, Capa, and the Torneo

All cars sold at Honda Clio

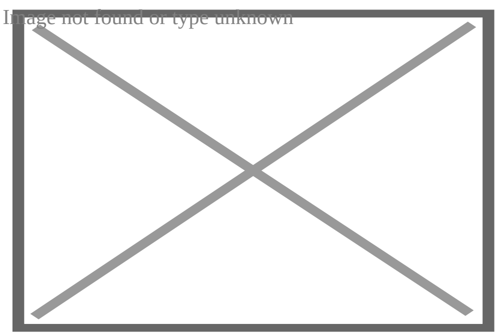
- Accord, Legend, Inspire, Avancier, S-MX, Lagreat, Stepwgn, Elysion, Stream, Odyssey (int'l), Domani, Concerto, Accord Tourer, Logo, Fit, Insight, That's, Mobilio, and the City

All cars sold at Honda Primo

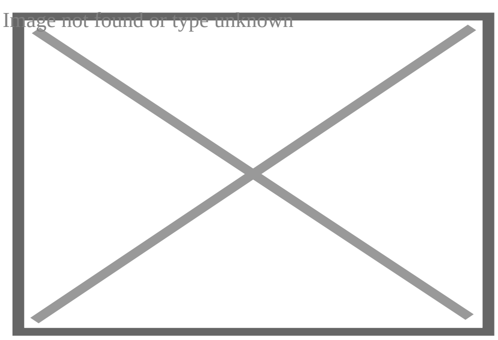
- Civic, Life, Acty, Vamos, Hobio, Ascot, Ascot Innova, Torneo, Civic Ferio, Freed, Mobilio, Orthia, Capa, Today, Z, and the Beat

International marketing

[edit]



A Honda dealership in Ontario, Canada



A Honda dealership in Dreghorn, Scotland

In 2003, Honda released its *Cog* advertisement in the UK and on the Internet. To make the ad, the engineers at Honda constructed a Rube Goldberg Machine made entirely out of car parts from a Honda Accord Touring. To the chagrin of the engineers at Honda, all the parts were taken from two of only six hand-assembled pre-production models of the Accord. The advertisement depicted a single cog which sets off a chain of events that ends with the Honda Accord moving and Garrison Keillor speaking the tagline, "Isn't it nice when things just... work?" It took 100 takes to create the ad.[170]

Honda has done humor marketing such as its 1985 four-page "How to fit six Hondas in a two-car garage" print ad[171] or "descending so low in a parking garage, they pass stalagmites and a Gollum-like figure."[172]

In 2004, they produced the *Grrr* advert, usually immediately followed by a shortened version of the 2005 *Impossible Dream* advert. In December 2005, Honda released *The Impossible Dream* a two-minute panoramic advertisement filmed in New Zealand, Japan, and Argentina which illustrates the founder's dream to build performance vehicles. While singing the song "Impossible Dream", a man reaches for his racing helmet, leaves his trailer on a minibike, then rides a succession of vintage Honda vehicles: a motorcycle, then a car, then a powerboat, then goes over a waterfall only to reappear piloting a hot air balloon, with Garrison Keillor saying "I couldn't have put it better myself" as the song ends. The song is from the 1960s musical *Man of La Mancha*, sung by Andy Williams.

In 2006, Honda released its *Choir* advertisement, for the UK and the internet. This had a 60-person choir who sang the car noises as the film of the Honda Civic is shown.

In the mid to late 2000s in the United States, during model close-out sales for the current year before the start of the new model year, Honda's advertising has had an animated character known simply as Mr. Opportunity, voiced by Rob Paulsen. The casual-looking man talked about various deals offered by Honda and ended with the phrase "I'm Mr. Opportunity, and I'm knockin'", followed by him "knocking" on the television screen or "thumping" the speaker at the end of radio ads. In addition, commercials for Honda's international hatchback, the Jazz, are parodies of well-known pop culture images such as *Tetris* and Thomas the Tank Engine.

In late 2006, Honda released an ad with ASIMO exploring a museum, looking at the exhibits with almost childlike wonderment (spreading out its arms in the aerospace exhibit, waving hello to an astronaut suit that resembles him, etc.), while Garrison Keillor ruminates on progress. It concludes with the tagline: "More forwards please". Honda also sponsored ITV's coverage of Formula One in the UK for 2007. However, they had announced that they would not continue in 2008 due to the sponsorship price requested by ITV being too high.

In May 2007, focuses on their strengths in racing and the use of the Red H badge – a symbol of what is termed as "Hondamentalism". The campaign highlights the lengths that Honda engineers go to in order to get the most out of an engine, whether it is for bikes, cars, powerboats – even lawnmowers. Honda released its Hondamentalism campaign. In the TV spot, Garrison Keillor says, "An engineer once said to build something great is like swimming in honey", while Honda engineers in white suits walk and run towards a great light, battling strong winds and flying debris, holding on to anything that will keep them from being blown away. Finally one of the engineers walks towards a red light, his hand outstretched. A web address is shown for the Hondamentalism website. The digital campaign aims to show how visitors to the site share many of the Hondamentalist characteristics.

At the beginning of 2008, Honda released – the *Problem Playground*. The advert outlines Honda's environmental responsibility, demonstrating a hybrid engine, more efficient solar panels, and the FCX Clarity, a hydrogen-powered car. The 90-second advert has large-scale puzzles, involving Rubik's Cubes, large shapes, and a 3-dimensional puzzle. On 29 May 2008, Honda, in partnership with Channel 4, broadcast a live advertisement. It showed skydivers jumping from an airplane over Spain and forming the letters H, O, N, D, and A in mid-air. This live advertisement is generally agreed to be the first of its kind on British television. The ad lasted three minutes.[173]

In 2009, American Honda released the *Dream the Impossible* documentary series, a collection of 5- to 8-minute web vignettes that focus on the core philosophies of Honda. Current short films include *Failure: The Secret to Success*, *Kick Out the Ladder* and *Mobility 2088*. They have Honda employees as well as Danica Patrick, Christopher Guest, Ben Bova, Chee Pearlman, Joe Johnston and Orson Scott Card. The film series plays at dreams.honda.com. In the UK, national television ads feature voice-overs from American radio host Garrison Keillor, while in the US the voice of Honda commercials is actor and wrestler John Cena.

In the North American market, Honda starts all of its commercials with a two-tone jingle since the mid-2010s.

Sports

[edit]

Ayrton Senna, the late F1 driver, once remarked that Honda played a pivotal role in his three world championships. He held deep respect for the company's founder, Soichiro Honda, and maintained a strong relationship with Nobuhiko Kawamoto, the chairman of Honda at the time. Senna even referred to Honda as "the greatest company in the world."[174]

As part of its marketing campaign, Honda is an official partner and sponsor of the North American National Hockey League, the Anaheim Ducks of the NHL, and the arena named after it: Honda Center. Honda also sponsored The Honda Classic golf tournament in the United States until 2023 and is a sponsor of the United States Major League Soccer. The "Honda Player of the Year" award is presented in United States soccer. The "Honda Sports Award" is given to the best female athlete in each of twelve college sports in the United States. One of the twelve Honda Sports Award winners is chosen to receive the Honda-Broderick Cup, as "Collegiate Woman Athlete of the Year".

Honda sponsored La Liga club Valencia CF starting from 2014–15 season.[175]

Honda has been a presenting sponsor of the Los Angeles Marathon since 2010 in a three-year sponsorship deal, with winners of the LA Marathon receiving a free Honda Accord. Since 1989, the Honda Campus All-Star Challenge has been a quiz bowl tournament for Historically black colleges and universities.

Facilities (partial list)

[edit]

Main article: List of Honda facilities

Sales

[edit]

Calendar year	Total US sales[176]
1992	768,845
1993	716,546
1994	788,230
1995	794,579
1996	843,928
1997	940,386
1998	1,009,600
1999	1,076,893
2000	1,158,860
2001	1,207,639
2002	1,247,834
2003	1,349,847
2004	1,394,398
2005	1,462,472
2006	1,509,358
2007	1,551,542[177]
2008	1,284,261[177]
2009	1,150,784[178]
2010	1,230,480[178]
2011	1,147,000[179]
2012	1,422,000[179]
2013	1,525,312[180]
2014	1,540,872
2015	1,586,551[181]
2016	1,637,942[182]
2017	1,641,429[183]
2018	1,604,828[184]
2019	1,608,170[184]

Production numbers

[edit]

For automobiles:

Calendar year	Global production
2009	3,012,000[185]
2010	3,643,000[185]
2011	2,909,000[179]
2012	4,110,000[179]
2013	4,112,000[186]
2014	4,513,769[187]
2015	4,543,838[188]
2016	4,999,266[189]
2017	5,236,842[190]
2018	5,357,013[191]

See also

[edit]

- Image not found or type unknown Tokyo portal
- Image not found or type unknown Companies portal

- Comparison of Honda water-pumps
- Honda advanced technology
- Honda Airport
- Honda Battle of the Bands
- Honda G-Con
- Honda F.C., football (soccer) club
- Honda Heat, rugby union club
- Honda in motorsport
- Honda Racing Corporation USA
- Honda Type R
- List of Honda assembly plants
- List of Honda transmissions
- List of motor scooter manufacturers and brands

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    - SEC filings
    - Yahoo!
- Official website
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Honda Motor Company

Divisions and subsidiaries	Acura
	American Honda
	  Honda Aero
	  Honda Marine
	Honda Australia
	Honda Canada
	  Canada Manufacturing
	Honda Aircraft
	Honda Mobilityland
	  Suzuka Circuit
	  Mobility Resort Motegi
	Honda Performance Development
	Honda India
	  Motorcycles
	Honda Mexico
	Honda Racing
	Honda Racing F1
	Honda Taiwan
	Honda UK

Joint ventures and shareholdings	○ Astra Honda Motor (50%)
	○ Dongfeng Honda (50%)
	    ○ Lingxi
	○ GE Honda Aero Engines (50%)
	○ GAC Honda (50%)
	    ○ Everus
	○ Hitachi Astemo (33.4%)
	    ○ Keihin
	    ○ Nissin
	    ○ Showa
	○ Honda China (65%)
	○ Honda Prospect Motor (51%)
	○ Sony Honda Mobility (50%)

Cars	◦ Accord/Inspire
	◦ Amaze
	◦ Brio
	◦ City/Ballade
	◦ Civic
	    ◦ Civic Type R
	    ◦ Integra
	◦ Crider/Envix
	◦ Fit/Jazz/Life
	◦ GT
	◦ Prelude

Pickup trucks	◦ Ridgeline
Crossovers/SUVs	◦ Avancier/UR-V ◦ BR-V ◦ CR-V/Breeze ◦ e:NP2/e:NS2 ◦ Elevate/WR-V ◦ HR-V/Vezel/XR-V ◦ e:NS1/e:NP1/e:Ny1 ◦ P7/S7 ◦ Passport ◦ Pilot ◦ Prologue ◦ WR-V ◦ ZR-V/HR-V
Vans	◦ Freed ◦ Odyssey/Elysion ◦ Odyssey (North America) ◦ Stepwgn
Kei cars	◦ N-Box ◦ N-One ◦ N-Van ◦ N-WGN
	◦ 1300 ◦ Airwave ◦ Ascot ◦ Ballade ◦ Beat ◦ Capa

Concept	◦ 0 Saloon ◦ 0 SUV ◦ Project 2&4 ◦ Argento Vivo ◦ CR-Z Concept ◦ CR-Z Concept 2009 ◦ Dualnote ◦ EV-N ◦ FC Sport ◦ FCEV Concept ◦ 1999 FCX Concepts ◦ 2006 FCX concept ◦ HP-X ◦ HSC ◦ J-VX ◦ N7X ◦ New Small Concept ◦ OSM ◦ Quilt ◦ Remix ◦ Small RS ◦ Spocket ◦ Sports EV ◦ SUT Concept ◦ SUV e: Prototype ◦ SUV RS ◦ U-3X ◦ Urban EV ◦ WIC ◦ WOW ◦ Zero

Bikes

- **Motorcycles**
  - CB series
  - CBF series
  - CBR series
  - CG125
  - CJ series
  - CL series
  - CM/CMX series
  - CR series
  - CRF series
  - CTX series
  - CX series
  - DN-01
  - Fury
  - GL series
  - NC700 series
  - NR series
  - NSR series
  - RC series
  - ST series
  - VF/VFR series
  - VT series
  - VTX series
  - XR/XL series
  - XRE300
  - Transalp
  - Africa Twin
  - Deauville
  - Bros/HawkGT
  - NX250
  - Pacific Coast
  - TL Series (Reflex)
  - Valkyrie
  - X4
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  - Aero
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  - Dio
  - Elite
  - EM1
  - Express
  - Helix
  - Juno
  - CHF50
  - Motocompo
  - NH series

Engines	- A-series - B-series - B20A - C-series - CVCC - D-series - E-series - E07A - F-series - F20C - G-series - H-series - J-series - JNC1 - K-series - L-series - Circle L Diesel - N-series Diesel - P-engine - R-series - VTEC - I-DSi - HI3R - HI4R - HI5R - HI6R - HI7R - HI8R - HI9R - HI10R - HI11R - HI12RT - HI13RT - HI14TT - HI15TT - HI16TT - HI17TT - HI18TT - HR09E - HR10EG - HR-414E - HR-417E - HR-420E - HR28TT - HR35TT - AR24e

Robots	○ Honda E series ○ Honda P series ○ ASIMO
People	○ Soichiro Honda ○ Takeo Fujisawa ○ Tadashi Kume ○ Shoichiro Irimajiri ○ Nobuhiko Kawamoto ○ Takeo Fukui ○ Tadao Baba ○ Takahiro Hachigo ○ Kenichi Nagahiro

Other	○ List of Honda vehicles
	    ○ automobiles
	    ○ motorcycles
	○ Honda Type R
	○ Honda Collection Hall
	○ Honda FC
	○ Mugen Motorsports
	○ Internavi
	○ Super Aguri F1 Team
	○ Takuma Sato
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Type		1980s: 0 1 2 3 4 5 6 7 8 9, 1990s: 0 1 2 3 4 5 6 7 8 9, 2000s: 0 1 2 3 4 5 6 7 8 9, 2010s: 0 1 2 3 4 5 6 7 8 9, 2020s: 0 1 2 3
Subcompact		Insight
Subcompact		Civic, Civic, Civic, Civic, Civic, Fit, Fit, Fit
Compact		Insight, Insight
Compact		Acc, Accord, Accord, Accord, Civic, Civic, Civic, Civic, Civ
Mid-size		Accord, Accord, Accord, Accord, Accord, Accord, A
Mid-size		FCX Clarity, Clarity
Coupe		Prelu, Prelude, Prelude, Prelude, Prelude
Sport compact		CR-X, CR-X, del Sol, CR-Z, Civic Type R, C T
Sports car		S2000
Crossover	Subcompact	HR-V
Crossover	Compact	Element, H V
Crossover	Compact	CR-V, CR-V, CR-V, CR-V, CR-V, C V
Crossover	Mid-size	Crosstour, Passpor
Crossover	Mid-size	Pilot, Pilot, Pilot, P
Crossover	Mid-size	Passpc, Passport
Minivan		Odysse, Odyssey, Odyssey, Odyssey, Odyssey
Pickup truck		Ridgeline, Ridgeline
Notes		Vehicle exclusive to Southern California (available for leasing purposes or

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Honda motorcycle timeline, 1970s (street) - next »

- Honda
- List of Honda motorcycles

Type	1970s									
	0	1	2	3	4	5	6	7	8	9
Scrambler	CL175				CL200					
	CL350				CL360					
	CL450									
Standard	CB100									
		CB125S								
	CB175			CB200					CM185 Twinstar	
					CB250					
	CB350				CB360			CB400T		
										CM400
			CB350F			CB400F				
	CB450				CB500T					
		CB500 Four			CB550					CB650
									CX500	
	CB750									
Sport										CB900F
									CBX	
Touring						GL1000 Gold Wing				
MotoGP										

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- Honda Racing Corporation

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<tr><td rowspan="22">Standard</td><td colspan="10">CG125</td></tr>
<tr><td colspan="2"></td><td colspan="4">CD125 Benly</td><td colspan="4"></td></tr>
<tr><td colspan="2"></td><td colspan="7">CB125 Super Dream</td><td></td></tr>
<tr><td colspan="2">CB250N</td><td colspan="8">CB250 Nighthawk</td></tr>
<tr><td colspan="5">CB250RS</td><td colspan="5"></td></tr>
<tr><td colspan="2"></td><td colspan="4">VT250-FII</td><td colspan="3">VTR250 Interceptor</td><td>VT250 Spada</td></tr>
<tr><td></td><td colspan="4">CBX400F</td><td colspan="4"></td><td>CB-1</td></tr>
<tr><td colspan="7">CB400N Super Dream</td><td colspan="3"></td></tr>
<tr><td colspan="2">CB400T</td><td colspan="5">CB450SC/Nighthawk</td><td colspan="3"></td></tr>
<tr><td colspan="2"></td><td colspan="2">VF400F</td><td colspan="6"></td></tr>
<tr><td colspan="3">CX500/GL500</td><td>CX650/GL650</td><td colspan="6"></td></tr>
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<tr><td colspan="8"></td><td colspan="2">Honda NT650</td></tr>
<tr><td colspan="2"></td><td colspan="3">CB550SC/Nighthawk</td><td colspan="5"></td></tr>
<tr><td colspan="3">CB650 / CB650C</td><td colspan="7"></td></tr>
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<tr><td colspan="4"></td><td colspan="3">CB700SC/Nighthawk</td><td colspan="3"></td></tr>
<tr><td colspan="10">CB750SC/Nighthawk</td></tr>
<tr><td colspan="4">CB750 C,F,K,SC</td><td colspan="6"></td></tr>
<tr><td colspan="4">CB900F</td><td colspan="6"></td></tr>
<tr><td colspan="3"></td><td>CB1100F</td><td colspan="2">Sabre</td><td colspan="4"></td></tr>
<tr><td rowspan="2">Sport</td><td colspan="8"></td><td colspan="2">NSR125</td></tr>
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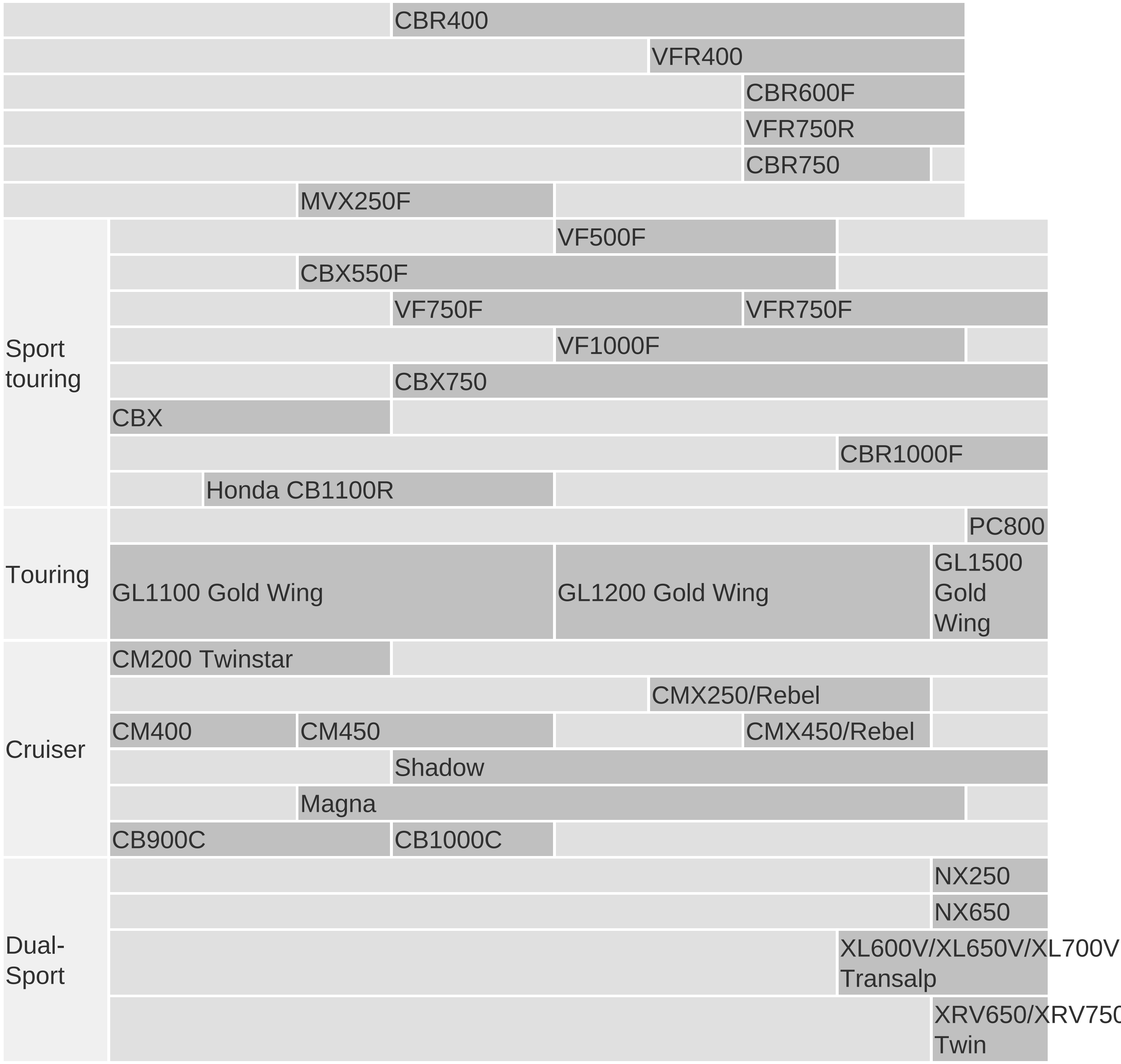
CBR400
VFR400
CBR600F
VFR750R
CBR750
MVX250F
Sport touring
VF500F
CBX550F
VF750F
VFR750F
VF1000F
CBX750
CBX
CBR1000F
Honda CB1100R
Touring
PC800
GL1100 Gold Wing
GL1200 Gold Wing
GL1500 Gold Wing
Cruiser
CM200 Twinstar
CMX250/Rebel
CM400
CM450
CMX450/Rebel
Shadow
Magna
CB900C
CB1000C
Dual-Sport
NX250
NX650
XL600V/XL650V/XL700V Transalp
XRV650/XRV750 Twin

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<tr><td rowspan="9">Standard</td><td colspan="10">CG125</td></tr>
<tr><td>VTR250 (US)</td><td colspan="6"></td><td colspan="3">VTR250 (Asia-Pacific)</td></tr>
<tr><td>GB500</td><td colspan="3"></td><td colspan="6">CB500 twin</td></tr>
<tr><td colspan="2"></td><td colspan="8">Nighthawk 250</td></tr>
<tr><td></td><td colspan="9">Nighthawk 750</td></tr>
<tr><td></td><td colspan="5">CB250F Jade</td><td colspan="4">CB250F Hornet</td></tr>
<tr><td>CB-1/CB400F</td><td></td><td colspan="8">CB400SF</td></tr>
<tr><td colspan="2">NT650 Hawk</td><td colspan="6"></td><td colspan="2">CB600F Hornet, 599</td></tr>
<tr><td colspan="2"></td><td colspan="7">CB1000SF</td><td>CB1300SF</td></tr>
<tr><td rowspan="9">Sport</td><td colspan="10">NSR125</td></tr>
<tr><td colspan="10">CBR250</td></tr>
<tr><td colspan="10">CBR400RR</td></tr>
<tr><td colspan="4"></td><td colspan="3">RVF400</td><td colspan="3"></td></tr>
<tr><td>CBR600F</td><td colspan="4">CBR600F2</td><td colspan="4">CBR600F3</td><td>CBR600F4</td></tr>
<tr><td colspan="4"></td><td colspan="2">RVF750</td><td colspan="4"></td></tr>
<tr><td colspan="3"></td><td colspan="7">CBR900RR Fireblade</td></tr>
<tr><td colspan="7"></td><td colspan="3">VTR1000F Superhawk</td></tr>
<tr><td colspan="7">CBR1000F Hurricane</td><td colspan="3">CBR1100XX Super Blackbird</td></tr>
<tr><td rowspan="6">Touring</td><td colspan="5">CBX750</td><td colspan="5"></td></tr>
<tr><td colspan="8">VFR750F</td><td colspan="2">VFR800 Interceptor</td></tr>
<tr><td colspan="9">PC800 Pacific Coast</td><td></td></tr>
<tr><td colspan="8"></td><td colspan="2">NT650V Deauville</td></tr>
<tr><td colspan="10">ST1100/Pan-European</td></tr>
<tr><td colspan="10">GL1500 Gold Wing</td></tr>
<tr><td>Cruiser</td><td>VT1100C</td><td></td><td colspan="8">VT1100C Shadow</td></tr>
</table>

	VT600C Shadow
	VT750C Shadow
	CMX250C Rebel; CMX250C
	VF750C Magna
	GL1500C Valkyrie
	X4
Dual-sport	NX125 Transcity *(US sales ended 1990)*
	NX250
	NX650 Dominator
	XL600V/XL650V/XL700V Transalp
	XRV650/XRV750/Africa Twin
	XL1000V Varadero

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« previous - Honda motorcycle timeline, 2010s–present

- Honda
- List of Honda motorcycles
- Honda Racing Corporation
- Repsol Honda

Type	2010s										2020s	
	0	1	2	3	4	5	6	7	8	9	0	1
Standard/ Naked bike	CG125											
	CBF125					CB125F						
							Grom (MSX125)					
										Monkey		
									CB125R			
				Verza 150					CB150 Verza			
	MegaPro 150											
				CB150R Streetfire								
								CB150R (Thailand)				
	Tiger GL200											
					CB250F				CB250R			
	VTR250FI											
						CB300F			CB300R			
				CB400F								
	CB400SF											
				CB500F								
	CB600F Hornet, 599				CB650F					CB650R		
	CBF600											
			NC700S									
	CB1000R								CB1000R			
	CBF1000F											
	CB1100											
	CB1300SF											
Cruiser/ Chopper	CMX250C Rebel							CMX250 Rebel				
								CMX300 Rebel				

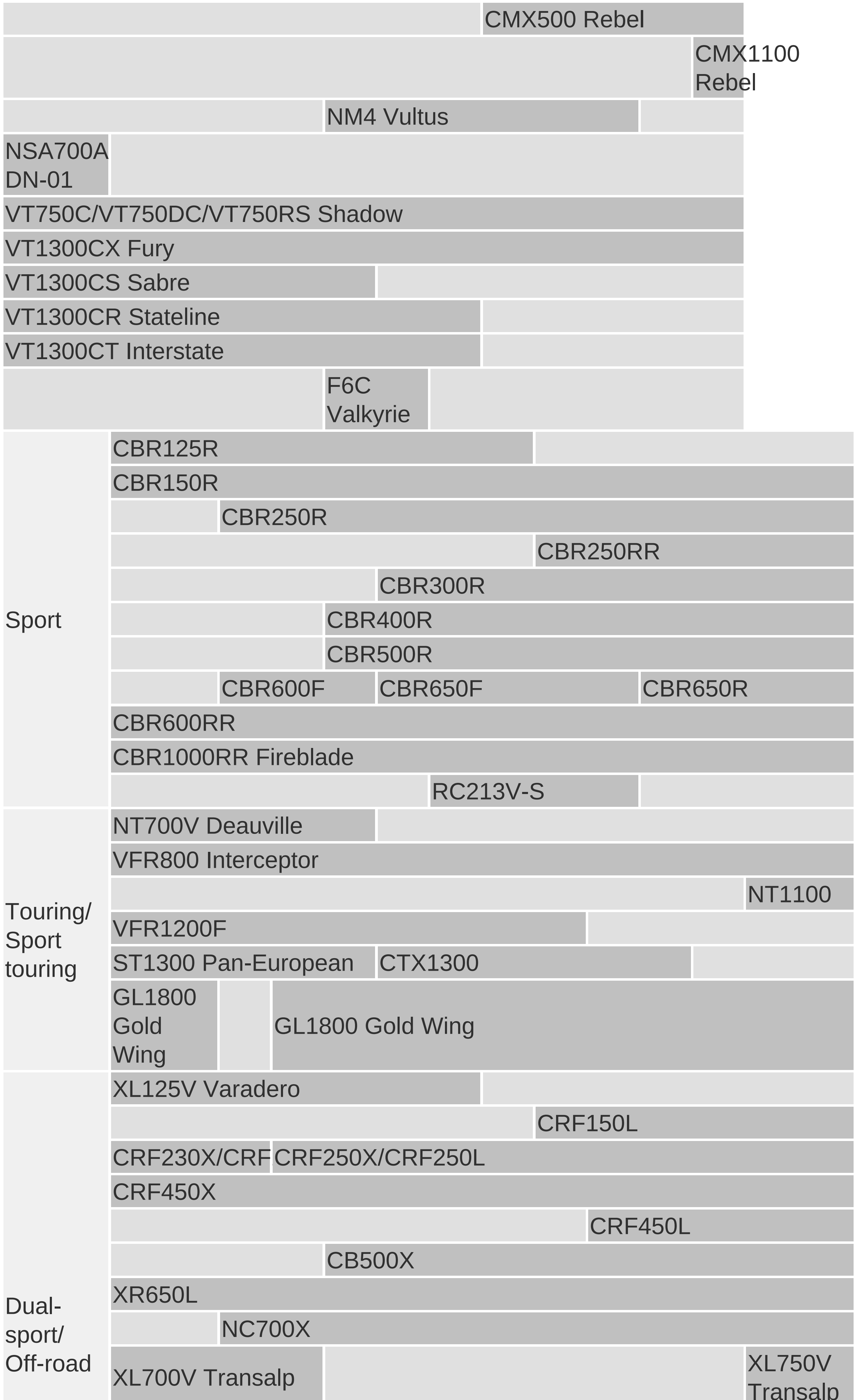
CMX500 Rebel
CMX1100 Rebel
NM4 Vultus
NSA700A DN-01
VT750C/VT750DC/VT750RS Shadow
VT1300CX Fury
VT1300CS Sabre
VT1300CR Stateline
VT1300CT Interstate
F6C Valkyrie
Sport
CBR125R
CBR150R
CBR250R
CBR250RR
CBR300R
CBR400R
CBR500R
CBR600F
CBR650F
CBR650R
CBR600RR
CBR1000RR Fireblade
RC213V-S
Touring/ Sport touring
NT700V Deauville
VFR800 Interceptor
NT1100
VFR1200F
ST1300 Pan-European
CTX1300
GL1800 Gold Wing
GL1800 Gold Wing
Dual-sport/ Off-road
XL125V Varadero
CRF150L
CRF230X/CRF
CRF250X/CRF250L
CRF450X
CRF450L
CB500X
XR650L
NC700X
XL700V Transalp
XL750V Transalp

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Image not found or type unknown Japan Automotive industry in Japan

- Automotive industry
- Economy of Japan
- Transport in Japan

Vehicle producers

Native manufacturers

- Aspark
- ASL
- Duesen Bayern
- GLM
- Honda
  - Acura
  - *Marusho*
- Isuzu
  - UD Trucks
- Jiotto
- Kawasaki
  - Kawasaki Motors
- Mazda
  - *Amati*
  - *Autozam*
  - *áº¼fini*
  - *Eunos*
  - *M2*
  - *Xedos*
- Mitsubishi
  - Mitsubishi Heavy Industries
  - Mitsubishi Motors (66%)
  - Mitsubishi Fuso (10.71%)
- Mitsuoka
- Nissan
  - *Cony*
  - *Datsun*
  - Infiniti
  - *Kurogane*
  - *Ohta*
  - *Otomo*
  - *Prince*
  - Shatai
  - *Tama*
- Sony Honda Mobility
- Subaru Corporation
  - *Blitzen*
  - Subaru
- Suzuki
  - *Hope*
- Takeoka
- Toyota
  - Daihatsu
  - *Scion*
  - Lexus
  - Hino

Related topics	◦ Japan Automobile Manufacturers Association ◦ Tokyo Motor Show ◦ Tokyo Auto Salon ◦ Used vehicle exporting ◦ National Highway ◦ Expressways ◦ Kei car/Kei truck

- *Note*: Defunct companies and marques above are shown in *italics*

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Major and notable Japanese motorcycle marques

Current	◦ Honda ◦ Kawasaki ◦ Suzuki ◦ Yamaha

Defunct	◦ Abe (1928~31) ◦ Abe Star (1930~59) ◦ ACE ◦ Aero ◦ Aikoku ◦ Aichi Kikai ◦ Aioi (c.1950s) ◦ Aisan (c. 1950) ◦ Aiwa Motor ◦ Akebono (1953) ◦ Akitsu (c.1950s) ◦ All Nations (c.1950s) ◦ Amano (c.1950s) ◦ Asahi ◦ BF Motor ◦ BIM ◦ Blue Bird ◦ BM ◦ Bridgestone ◦ Brother ◦ Cabton ◦ Center ◦ Chiyoda ◦ Daihatsu ◦ Fuji ◦ Fujitsubo ◦ Giant ◦ Hirano ◦ Hodaka ◦ Hosk ◦ Hyogo ◦ Iwasaki ◦ Kurogane ◦ Kyoho ◦ Lilac ◦ Marusho ◦ Mazda ◦ Meguro ◦ Mitsubishi ◦ Miyata ◦ Mizushima ◦ NS ◦ New Era ◦ Nisshin ◦ Rikuo ◦ Shin Meiwa ◦ Showa Fujiya ◦ Tohatsu

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TOPIX 100 companies of Japan

Core 30

- Astellas
- Daiichi Sankyo
- Daikin
- FANUC
- Hitachi
- Honda
- Hoya
- Itochu
- KDDI
- Keyence
- Mitsubishi Corporation
- Mitsui & Co
- Mizuho
- MUFG
- Murata
- Nidec
- Nintendo
- NTT
- Recruit
- Seven & i Holdings
- Shin-Etsu
- SMC
- SoftBank
- SoftBank Group
- Sony Group
- Sumitomo Mitsui Financial
- Takeda
- Tokio Marine
- Tokyo Electron
- Toyota

Large 70

- ÆON
- Ajinomoto
- ANA
- Asahi Group Holdings
- Asahi Kasei
- Bandai Namco Holdings
- Bridgestone
- Canon
- Chugai Pharmaceutical
- Dai-ichi Life
- Daiwa House
- Denso
- Eisai
- ENEOS
- Fast Retailing
- Fujifilm
- Fujitsu
- Japan Exchange Group
- Japan Post Holdings
- JR Central
- JR East
- JR West
- JT
- Kao
- Kirin
- Komatsu
- Kubota
- Kyocera
- Lasertec
- M3.com
- Marubeni
- Mitsubishi Chemical
- Mitsubishi Electric
- Mitsubishi Estate
- Mitsubishi Heavy Industries
- Mitsui Fudosan
- MS&AD
- Nippon Steel
- Nippon Yusen
- Nissan
- Nitori
- Nomura
- Olympus
- Omron
- Ono Pharmaceutical
- Oriental Land
- Orix
- Otsuka

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Image not found or type unknown Nikkei 225 companies of Japan

- 7&i
- Advantest
- ÆON
- AGC
- Ajinomoto
- Alps
- ANA
- Amada
- Aozora Bank
- Asahi Breweries
- Asahi Kasei
- Astellas
- Bandai Namco Holdings
- Bridgestone
- Canon
- Casio
- Chiba Bank
- Chuden
- Chugai
- Citizen Holdings
- Comsys
- CyberAgent
- Concordia Financial
- Credit Saison
- Dai-ichi Life
- Daiichi Sankyo
- Daikin
- Daiwa House
- Daiwa Securities
- Denka
- DeNA
- Denso
- Dentsu
- Disco
- DNP
- Dowa
- Ebara
- Eisai
- ENEOS
- Fanuc
- Fast Retailing
- Fuji Electric
- Fujifilm
- Fujikura
- Fujitsu
- Fukuoka Financial
- Furukawa Electric
- GS Yuasa

Americas

- Abbott Laboratories
- AbbVie
- Adobe
- Agilent Technologies
- Alphabet
- American Airlines Group
- Autodesk
- Banco Bradesco
- Banco do Brasil
- Bancolombia
- Biogen
- Canadian National
- CPKC
- Cisco
- Companhia Energética de Minas Gerais - CEMIG
- Cummins
- CVS Health Corporation
- DaVita
- Dow
- eBay
- Ecolab
- Edwards Lifesciences Corporation
- Elevance Health
- Palabella
- Fortinet
- General Mills
- Gilead Sciences
- Grupo Argos
- Grupo Sura
- Grupo Nutresa
- Healthpeak Properties
- Hess Corporation
- Hilton Worldwide
- Host Hotels & Resorts
- HP
- Illumina, Inc.
- Ingersoll Rand
- Itaú Unibanco
- Itaúsa
- Jacobs Solutions
- Kinross Gold Corporation
- Klabin
- Las Vegas Sands
- Lockheed Martin
- Lojas Renner
- Medtronic
- Microsoft
- Mondelez International

- Aberdeen Group
- Acciona
- AENA
- Allianz
- Alstom
- Amadeus IT Group
- Anglo American plc
- Arkema
- ASML Holding
- ASR Nederland
- Assicurazioni Generali S.p.A.
- Aviva
- Axa
- Banco Bilbao Vizcaya Argentaria
- Banco Santander
- Bankinter
- Billerud
- bioMérieux
- BNP Paribas SA
- Bureau Veritas
- CaixaBank
- Carrefour SA
- Castellum
- CNH Industrial
- Coca-Cola HBC
- Covivio
- Dassault Systèmes
- Deutsche Börse
- Deutsche Post
- Deutsche Telekom
- Diageo
- EDP Group
- Enagás
- Endesa
- Enel SpA
- Engie
- EQT
- Exxaro
- Ferrovial
- Galp Energia
- GEA Group
- Gold Fields
- Grifols
- GSK
- H&M
- Hera Group
- Hochtief
- Hugo Boss

- Advanced Info Service
- Advantech Co
- Airports of Thailand Public Company Limited
- Ajinomoto Co., Inc.
- ANA Holdings
- ANZ Bank
- ASE Group
- Bangkok Dusit Medical Services
- Brambles Limited
- Bridgestone
- CapitaLand
- Cathay United Bank
- Central Pattana
- Central Retail Corporation
- Chailease Holding Company
- Chang Hwa Bank
- KGI Financial Holding
- Chugai Pharmaceutical Co.
- Chunghwa Telecom Co., Ltd.
- CP All
- CTBC Financial Holding
- Delta Electronics (Thailand) Public Company Limited
- Delta Electronics, Inc.
- Dentsu
- Dexus
- Doosan Enerbility
- Dr. Reddy's Laboratories Limited
- E Ink
- E.SUN Commercial Bank
- Far EasTone
- First Financial
- Fortescue (company)
- Fubon Financial Holding Co., Ltd.
- Fujitsu
- GPT Group
- Hana Financial Group Inc.
- Hindalco Industries
- Honda
- Hyundai Engineering & Construction
- Hyundai Glovis
- Hyundai Mobis
- Hyundai Motor Company
- Hyundai Steel
- Indorama Ventures Public Company Limited
- InnoLux Corporation
- ITOCHU Corporation
- JD.com
- JSW Steel

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500cc/MotoGP World Constructors' Champions

1949	AJS	1960	MV Agusta	1970
1950	Norton	1961	MV Agusta	1971
1951	Norton	1962	MV Agusta	1972
1952	Gilera	1963	MV Agusta	1973
1953	Gilera	1964	MV Agusta	1974
1954	Gilera*	1965	MV Agusta	1975
1955	Gilera	1966	Honda	1976
1956	MV Agusta	1967	MV Agusta	1977
1957	Gilera	1968	MV Agusta	1978
1958	MV Agusta	1969	MV Agusta	1979
1959	MV Agusta			

* Championship not officially recognized

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250cc/Moto2 World Constructors' Champions

1949	Moto Guzzi	1960	MV Agusta	1970
1950	Benelli	1961	Honda	1971
1951	Moto Guzzi	1962	Honda	1972
1952	Moto Guzzi	1963	Honda	1973
1953	NSU	1964	Yamaha	1974
1954	NSU*	1965	Yamaha	1975
1955	MV Agusta	1966	Honda	1976
1956	MV Agusta	1967	Honda	1977
1957	Mondial	1968	Yamaha	1978
1958	MV Agusta	1969	Benelli	1979
1959	MV Agusta			

* Championship not officially recognized

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125cc/Moto3 World Constructors' Champions

1949 Mondial		1960 MV Agusta		1970
1950 Mondial		1961 Honda		1971
1951 Mondial		1962 Honda		1972
1952 MV Agusta		1963 Suzuki		1973
1953 MV Agusta		1964 Honda		1974
1954 NSU*		1965 Suzuki		1975
1955 MV Agusta		1966 Honda		1976
1956 MV Agusta		1967 Yamaha		1977
1957 Mondial		1968 Yamaha		1978
1958 MV Agusta		1969 Kawasaki		1979
1959 MV Agusta				

* Championship not officially recognized

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International	ISNI
National	Germany United States Japan Czech Republic Israel
Other	MusicBrainz label Yale LUX

About Car dealership

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Typical car dealership (in this case a Jeep dealer) in the U.S. selling used cars outside, new cars in the showroom, as well as a vehicle entrance to the parts and service area in the back of the building

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An aerial view of auto dealer's service in Kuopio, Finland

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Service and repair entrance

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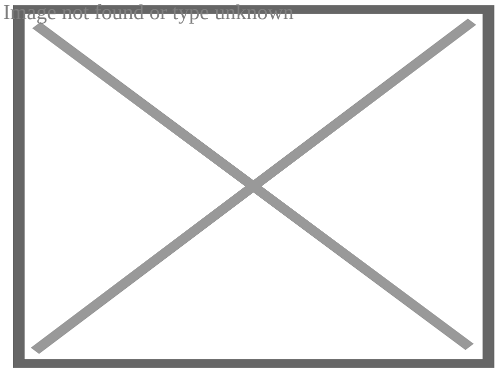
Auto dealer's service and repair facility



Dealer for vintage cars

A **car dealership**, or **car dealer**, is a business that sells new or used cars, at the retail level, based on a dealership contract with an automaker or its sales subsidiary. Car dealerships also often sell spare parts and automotive maintenance services.

In the United States, car dealerships have historically been an important source of state and local sales taxes. They have considerable political influence and have lobbied for regulations that guarantee their survival and profitability. By 2010, all US states had laws that prohibited manufacturers from side-stepping independent car dealerships and selling cars directly to consumers. By 2009, most states imposed restrictions on the creation of new dealerships to compete with incumbent dealerships.

Economists have characterized these regulations as a form of rent-seeking that extracts rents from manufacturers of cars, increases costs for consumers, and limits entry of new car dealerships while raising profits for incumbent car dealers. Research shows that as a result of these laws, retail prices for cars are higher than they otherwise would be.[1][2]

Car dealerships in the United States

[edit]
Main article: Car dealerships in the United States

The early cars were sold by automakers to customers directly or through a variety of channels, including mail order, department stores, and traveling representatives.[1] For example, Sears made its first attempt at selling a gasoline-engined chain-drive high-wheeler in 1908 through its mail-order catalog and starting in 1951 the Allstate through select its stores and the catalog.[3][4]

The first car dealership was opened in 1889 by Fred Koller in Reading, Pennsylvania and sold cars manufactured in Cleveland, Ohio. This would have been the first dealership solely dedicated to automobiles, as opposed to horse-drawn carriages. [5]

Today, direct sales by an automaker to consumers are limited by most states in the U.S. through franchise laws that require new cars to be sold only by licensed and bonded, independently owned dealerships.[6] The first woman car dealer in the United States was Rachel "Mommy"

Krouse who in 1903 opened her business, Krouse Motor Car Company, in Philadelphia, Pennsylvania.[7]

The number of car dealerships in the US peaked in 1927 at 53,125 and steadily decreased over the next decades. By 1960, there were 33, 658 dealerships; by 1980, 23,379; and by 2001, 22,007.[1]

Car dealerships are usually franchised to sell and service vehicles by specific companies. They are often located on properties offering enough room to have buildings housing a showroom, mechanical service, and body repair facilities, as well as to provide storage for used and new vehicles. Many dealerships are located out of town or on the edge of town centers. An example of a traditional single proprietorship car dealership was Collier Motors in North Carolina.[8] Many modern dealerships are now part of corporate-owned chains with hundreds of locations.[9] Dealership profits in the US mainly come from servicing, some from used cars, and little from new cars.[10]

Most automotive manufacturers have shifted the focus of their franchised retailers to branding and technology. New or refurbished facilities are required to have a standard look for their dealerships and have product experts to liaise with customers.[11][12] Audi has experimented with a hi-tech showroom that allows customers to configure and experience cars on 1:1 scale digital screens.[13][14] In markets where it is permitted, Mercedes-Benz opened city centre brand stores.[15]

Tesla Motors has rejected the dealership sales model based on the idea that dealerships do not properly explain the advantages of their cars, and they could not rely on third-party dealerships to handle their sales.[16] However, in the United States, direct manufacturer auto sales are prohibited in almost every state by franchise laws requiring that new cars be sold only by dealers.[17] In response, Tesla has opened city centre galleries where prospective customers can view cars that can only be ordered online.[18][19] These stores were inspired by the Apple Stores.[20] Tesla's model was the first of its kind, and has given them unique advantages as a new car company.[21]

Economic theory

[edit]

In economic theory, car dealerships can be characterized as franchisees and automobile manufacturers as franchisors. A franchise relationship can be beneficial to both parties, as the franchisee can sell a well-made and attractive product while the franchisor can rely on the franchisee to incur downstream costs and use its local relationships to sell more products and services.[1]

The franchisor can act opportunistically by imposing constraints and burden on the franchisee after the latter has incurred sunk costs, such as investing in physical assets and building up a reputation with customers. The franchisor could for example require that cars be sold at low prices, and services be performed for little compensation. The franchisee could on the other hand act opportunistically by using its local monopoly to perform poor customer service, charge customers more, and pass those unnecessarily high costs to the franchisor.[1][22]

Regulations that protect car dealers

[edit]

Car dealerships have lobbied for regulations that increase the survival and profitability of car dealerships:[1]

- By 2010, all US states had laws that prohibited manufacturers from side-stepping independent car dealers and selling cars to customers directly.
- By 2009, most states imposed restrictions on the creation of new dealerships to compete with incumbent dealerships.
- All states impose severe limits on the ability of a manufacturer to terminate a franchise relationship.
- Most states prevent manufacturers from engaging in "quantity forcing" whereby manufacturers require that dealers purchase vehicles that they had not ordered.
- Most states limit the ability of manufacturers to discriminate between car dealers (for example, by providing better terms to large car dealers with economies of scale or dealers that provide better customer service).
- Many state laws impose upon manufacturers the precise terms under which they must compensate dealers for the costs associated with warranty repairs (these can incentivize dealers to increase the price of repairs to customers).
- Most state laws require upon the termination of a dealership that manufacturers buy back the inventory, and special equipment and in some cases pay the rent of the dealer's facilities.

The issuance of new dealership licenses can be subject to geographical restriction; if there is already a dealership for a company in an area, no one else can open one. This has led to dealerships becoming in essence hereditary, with families running dealerships in an area since the original issuance of their license with no fear of competition or any need to prove qualification or consumer benefit (beyond proving they meet minimum legal standards), as franchises in most jurisdictions can only be withdrawn for illegal activity and no other reason.[23]

Criticism

[edit]

Economists have characterized these laws as a form of rent-seeking that extracts rents from manufacturers of cars and increases costs for consumers of cars while raising profits for car dealers.[1][24][25][26] Multiple studies have shown that regulations that protect car dealerships increase car costs for consumers and limit the profitability of manufacturers.[27]

This has led to consumer campaigns for establishment or reform, which have been met by huge lobbying efforts by franchise holders. New companies trying to enter the market, such as Tesla, have been restricted by this model and have either been forced out or been forced to work around the franchise model, facing constant legal pressure.[28]

Electric vehicles

[edit]

According to a 2023 survey by the Sierra Club, two-thirds of US car dealerships did not have electric or hybrid vehicles for sale.[29] Reasons for this include supply chain difficulties,[29][30] as well as a need for car dealers to make substantial investments in new employee training and infrastructure to be able to sell, service and maintain electric vehicles.[31]

Car dealerships in the European Union

[edit]

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In the European Union, car manufacturers were permitted from 1985 to 2006 to enter into contracts with car dealerships that restricted what kinds of cars dealers were permitted to sell.[32][33] Car manufacturers were able "to impose qualitative, quantitative and geographical restrictions on supply by selling their cars only through a limited number of dealers bound by strict franchise agreements."[32] In 2006, the European Commission determined that it was anti-competitive for car manufacturers to prohibit dealers from carrying multiple car brands.[33]

Car manufacturers in the European Union are increasingly shifting towards selling cars directly to customers without reliance on independent dealers. Volvo has announced plans to sell all vehicles directly to customers by 2030.[34][35]

Multibrand car dealers

[edit]

Multibrand and multi-maker car dealers sell cars from different and independent carmakers.[36] Some are specialized in electric vehicles.[37]

Auto transport

[edit]

Auto transport is used to move vehicles from the factory to the dealerships. This includes international and domestic shipping. It was largely a commercial activity conducted by manufacturers, dealers, and brokers. Internet use has encouraged this niche service to expand

and reach the general consumer marketplace.

See also

[edit]

- Auto auction
- Auto row
- Automaker
- Car broker
- Car rental
- List of auto dealership and repair shop buildings
- Showroom
- Used car

Organizations

[edit]

- Carfax
- Kelley Blue Book
- Federation of Automobile Dealers Associations of India (FADA)
- National Automobile Dealers Association
- Presidential Task Force on the Auto Industry

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External links

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- EU car dealership reforms

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Retail

Key concepts

- Counter display unit
- Display stand
- Endcap
- Facing
- Free standing display unit
- Gondola
- History of retail
- Merchandising
  - Visual merchandising
- Point of sale display
- Retail design
- Retail merchandising unit
- Self-service
- Shelf-ready packaging

By product

- Agricultural supplies
- Alcohol
- Antiques
- Automotive fuel
- Automotive parts
- Beauty products
- Books
- Cannabis
- Catering
    - Mobile
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- Confectionery
- Consumer electronics
- Cycles
- *Doujin shop*
- Dry goods
- Equestrian supplies
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- Greengrocer
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- Home decor
- Home improvement products
- Ironmongery
- Jewellery
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- Lumber
- Magic supplies
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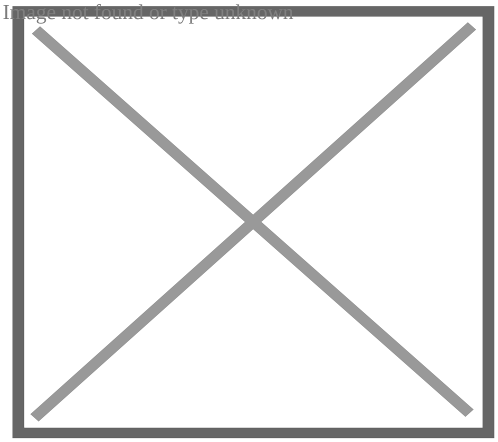
- Anchor tenant
- Automat
- Automated retail
- Big-box store
- Boot fair
- Boutique
- Brick and mortar
- Bring and buy sale
- Butcher shop
- Car boot sale
- Cash and carry
- Cashierless store
- Category killer
- Chain store
- Charity shop
- Closeout store
- Company store
- Consignment shop
- Consignment store (East Asia)
- Convenience store
    - Automated convenience store
    - Corner store
    - Mini-mart
    - Mini market
    - Superette
- Dark store
- Department store
    - Junior department store
    - Public department store
- Discount store
- E-commerce
- Estate sale
- Experiential commerce
- Experiential retail
- Factory outlet
- Factory store
- Flash retailing
- Free box
- Freeshop
- Free store
- Garage sale
- General store
- Give-away shop
- Haberdasher
- Head shop
- High Street
- Honesty box
- Hospice shop

By type

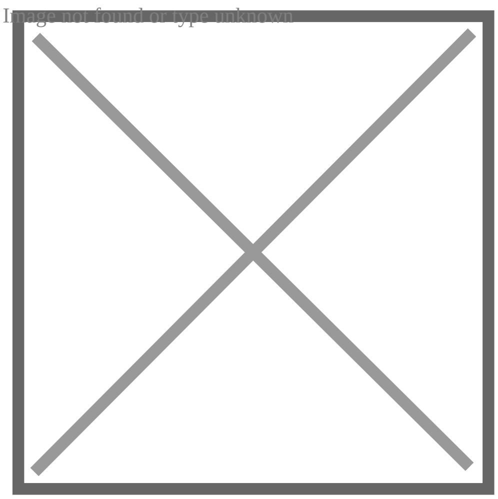
- Arabber
- Boutique
- Braderie
- Butcher shop
- Concession stand
- Cooked food centre
- Costermonger
- Direct sellers
- Duty-free shop
- Food booth
- Food cart
- Food court
- Food hall
- Food kiosk
- Food stall
- Food stand
- Food truck
- Gift shop
- Hawker
- Hawker centre
- Ice cream truck
- Ice cream van
- Museum shop
- Pawn shop
- Peddler
- Pharmacies
- Refreshment stand
- Snack bar
- Snack kiosk
- Souvenir shop
- Surplus store
- Tack shop
- Tax-free shopping
- Tuck shop

About tire

For other uses, see Tire (disambiguation).
"Rubber tires" redirects here. For the film, see Rubber Tires.



Assorted new automotive road tires, showing a variety of tread patterns.



Tractor tires have substantial ribs and voids for traction in soft terrain.

A **tire** (North American English) or **tyre** (Commonwealth English) is a ring-shaped component that surrounds a wheel's rim to transfer a vehicle's load from the axle through the wheel to the ground and to provide traction on the surface over which the wheel travels. Most tires, such as those for automobiles and bicycles, are pneumatically inflated structures, providing a flexible cushion that absorbs shock as the tire rolls over rough features on the surface. Tires provide a footprint, called a contact patch, designed to match the vehicle's weight and the bearing on the surface that it rolls over by exerting a pressure that will avoid deforming the surface.

The materials of modern **pneumatic tires** are synthetic rubber,[1] natural rubber, fabric, and wire, along with carbon black and other chemical compounds. They consist of a tread and a body. The tread provides traction while the body provides containment for a quantity of compressed air. Before rubber was developed, tires were metal bands fitted around wooden wheels to hold the wheel together under load and to prevent wear and tear. Early rubber tires were solid (not pneumatic). Pneumatic tires are used on many vehicles, including cars, bicycles, motorcycles, buses, trucks, heavy equipment, and aircraft. Metal tires are used on locomotives and railcars, and solid rubber (or other polymers) tires are also used in various non-automotive applications, such as casters, carts, lawnmowers, and wheelbarrows.

Unmaintained tires can lead to severe hazards for vehicles and people, ranging from flat tires making the vehicle inoperable to blowouts, where tires explode during operation and possibly damage vehicles and injure people. The manufacture of tires is often highly regulated for this reason. Because of the widespread use of tires for motor vehicles, tire waste is a substantial portion of global waste. There is a need for tire recycling through mechanical recycling and reuse, such as for crumb rubber and other tire-derived aggregate, and pyrolysis for chemical reuse, such as for tire-derived fuel. If not recycled properly or burned, waste tires release toxic chemicals into the environment. Moreover, the regular use of tires produces micro-plastic particles that contain these chemicals that both enter the environment and affect human health.[2]

Etymology and spelling

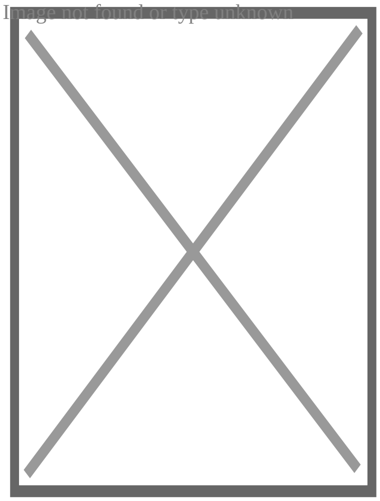
[edit]

The word *tire* is a short form of *attire*, from the idea that a wheel with a tire is a dressed wheel.[3][4]

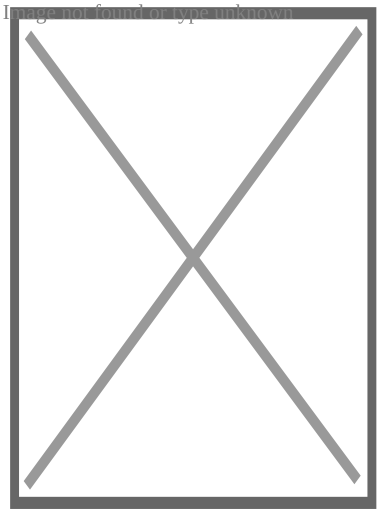
Tyre is the oldest spelling,[5] and both *tyre* and *tire* were used during the 15th and 16th centuries. During the 17th and 18th centuries, *tire* became more common in print. The spelling *tyre* did not reappear until the 1840s when the English began shrink-fitting railway car wheels with malleable iron. Nevertheless, many publishers continued using *tire*. *The Times* newspaper in London was still using *tire* as late as 1905.[6] The spelling *tyre* began to be commonly used in the 19th century for pneumatic tires in the UK. The 1911 edition of the *Encyclopædia Britannica* states that *"The spelling 'tyre' is not now accepted by the best English authorities, and is unrecognized in the US"*,[7] while Fowler's *Modern English Usage* of 1926 describes that "there is nothing to be said for 'tyre', which is etymologically wrong, as well as needlessly divergent from our own [sc. British] older & the present American usage".[8] However, over the 20th century, *tyre* became established as the standard British spelling.[4]

History

[edit]



John Boyd Dunlop on a bicycle, c. 1915



Factory workers making tires, 1918

The earliest tires were bands of leather in Sumer,[9] then iron (later steel) placed on wooden wheels used on carts and wagons. A skilled worker, known as a wheelwright, would cause the tire to expand by heating it in a forge fire, placing it over the wheel, and quenching it, causing the metal to contract back to its original size to fit tightly on the wheel.

The first patent for what appears to be a standard pneumatic tire appeared in 1847 and was lodged by Scottish inventor Robert William Thomson.[10] However, this idea never went into production. The first practical pneumatic tire was made in 1888 on May Street, Belfast, by Scots-born John Boyd Dunlop, owner of one of Ireland's most prosperous veterinary practices. It was an effort to prevent the headaches of his 10-year-old son Johnnie while riding his tricycle on rough pavements. His doctor, John, later Sir John Fagan, had prescribed cycling as an exercise for the boy and was a regular visitor. Fagan participated in designing the first pneumatic tires. Cyclist Willie Hume demonstrated the supremacy of Dunlop's tires in 1889, winning the tire's first-ever races in Ireland and then England.[11][12] In Dunlop's tire patent specification dated 31 October 1888, his interest is only in its use in cycles and light vehicles. In September 1890, he was made aware of an earlier development, but the company kept the information to itself.[13] In

1892, Dunlop's patent was declared invalid because of the prior art by forgotten fellow Scot Robert William Thomson of London (patents London 1845, France 1846, USA 1847). However, Dunlop is credited with "realizing rubber could withstand the wear and tear of being a tire while retaining its resilience".[14] John Boyd Dunlop and Harvey du Cros worked through the ensuing considerable difficulties. They employed inventor Charles Kingston Welch and acquired other rights and patents, which allowed them some limited protection of their Pneumatic Tyre business's position. Pneumatic Tyre would become Dunlop Rubber and Dunlop Tyres. The development of this technology hinged on myriad engineering advances, including the vulcanization of natural rubber using sulfur, as well as the development of the "clincher" rim for holding the tire in place laterally on the wheel rim.

Synthetic rubbers were invented in the laboratories of Bayer in the 1920s.[15] Rubber shortages in the United Kingdom during WWII prompted research on alternatives to rubber tires with suggestions including leather, compressed asbestos, rayon, felt, bristles, and paper.[16]

In 1946, Michelin developed the radial tire method of construction. Michelin had bought the bankrupt Citroën automobile company in 1934 to utilize this new technology. Because of its superiority in handling and fuel economy,[17] use of this technology quickly spread throughout Europe and Asia.[18] In the US, the outdated bias-ply tire construction persisted until the Ford Motor Company adopted radial tires in the early 1970s,[19] following a 1968 article in an influential American magazine, *Consumer Reports*, highlighting the superiority of radial construction.[20][21] The US tire industry lost its market share to Japanese and European manufacturers,[22] which bought out US companies.[23]

Applications

[edit]

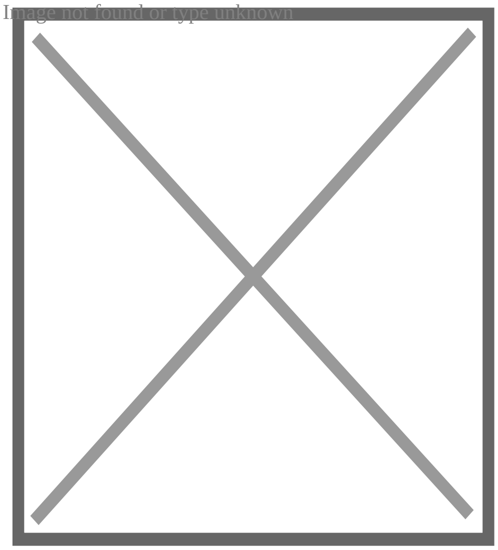
Tires may be classified according to the type of vehicle they serve. They may be distinguished by the load they carry and by their application, e.g. to a motor vehicle, aircraft, or bicycle.

Automotive

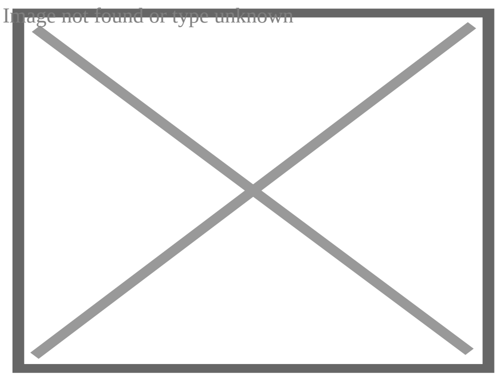
[edit]

Light–medium duty

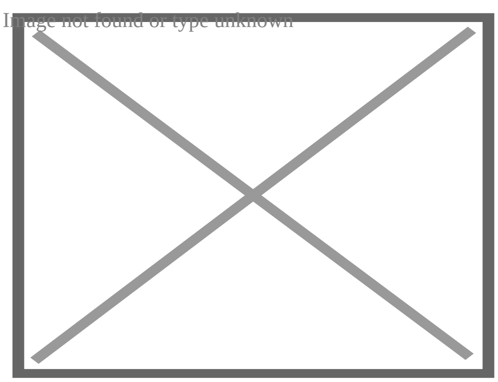
[edit]



Studded winter tire



A winter tire without studs, showing tread pattern designed to compact snow in the gaps.[24]



High-performance rally tires

Light-duty tires for passenger vehicles carry loads in the range of 250 to 500 kilograms (550 to 1,100 lb) on the drive wheel. Light-to-medium duty trucks and vans carry loads in the range of 500 to 1,500 kilograms (1,100 to 3,300 lb) on the drive wheel.[25] They are differentiated by speed rating for different vehicles, including (starting from the lowest speed to the highest): winter tires, light truck tires, entry-level car tires, sedans and vans, sport sedans, and high-performance cars.[26] Apart from road tires, there are special categories:

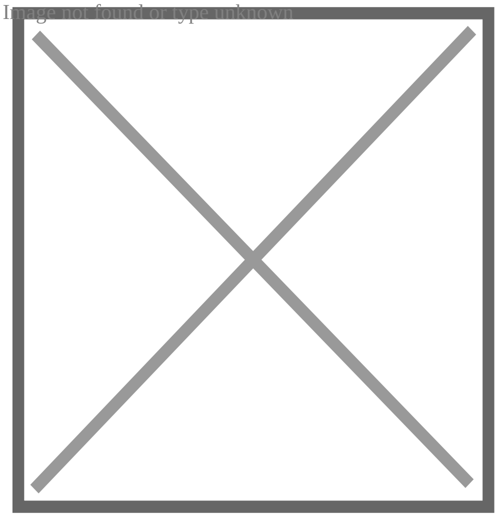
- Snow tires are designed for use on snow and ice. They have a tread design with larger gaps than those on summer tires, increasing traction on snow and ice. Such tires that have passed a specific winter traction performance test are entitled to display a "Three-Peak Mountain Snow Flake" symbol on their sidewalls. Tires designed for winter conditions are optimized to drive at temperatures below 7 °C (45 °F). Some snow tires have metal or ceramic studs that protrude from the tire to increase traction on hard-packed snow or ice. Studs abrade dry pavement, causing dust and creating wear in the wheel path.[27] Regulations that require the use of snow tires or permit the use of studs vary by country in Asia and Europe, and by state or province in North America.
- All-season tires are typically rated for mud and snow (M+S). These tires have tread gaps that are smaller than snow tires and larger than conventional tires. They are quieter than snow tires on clear roads, but less capable on snow or ice.[28]
- All-terrain tires are designed to have adequate traction off-road, yet have benign handling and noise characteristics for highway driving.[29] Such tires are rated better on snow and rain than street tires and "good" on ice, rock, and sand.[30]
- Mud-terrain tires have a deeper, more open tread for good grip in mud, than all-terrain tires, but perform less well on pavement.[31]
- High-performance tires are rated for speeds up to 270 kilometres per hour (168 mph) and ultra-high-performance tires are rated for speeds up to 299 kilometres per hour (186 mph), but have harsher ride characteristics and durability.[32]
- Electric vehicles have unique demands on tires due to the combination of weight (resulting in new load index), higher torque, and requirements for lower rolling resistance.[33]

Other types of light-duty automotive tires include run-flat tires and race car tires:

- Run-flat tires eliminates the need for a spare tire because they can be traveled on at a reduced speed in the event of a puncture, using a stiff sidewall to prevent damage to the tire rim.[34] Vehicles without run-flat tires rely on a spare tire, which may be a compact tire, to replace a damaged tire.[34]
- Race car tires come in three main categories, *DOT* (street-legal), *slick*, and *rain*. Race car tires are designed to maximize cornering and acceleration friction at the expense of longevity. Racing slicks have no tread to maximize contact with the pavement and rain tires have channels to eject water to avoid hydroplaning.[35]

Heavy duty

[edit]



Off-road tires under transport

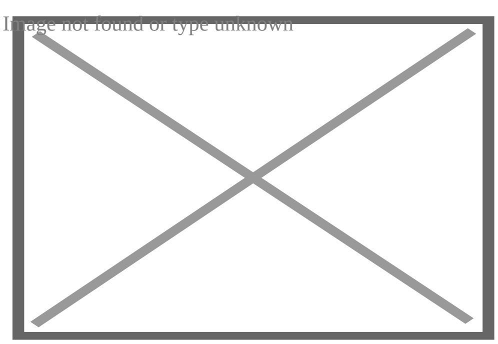
Heavy-duty tires for large trucks and buses come in a variety of profiles and carry loads in the range of 1,800 to 2,500 kilograms (4,000 to 5,500 lb) on the drive wheel.[25] These are typically mounted in tandem on the drive axle.[34]

- Truck tires come in a variety of profiles that include "low profile" with a section height that is 70 to 45% of the tread width, "wide-base" for heavy vehicles, and a "super-single" tire that has the same total contact pressure as a dual-mounted tire combination.[34]
- Off-road tires are used on construction vehicles, agricultural and forestry equipment, and other applications that take place on soft terrain. The category also includes machinery that travels over hardened surfaces at industrial sites, ports, and airports.[36] Tires designed for soft terrain have a deep, wide tread to provide traction in loose dirt, mud, sand, or gravel.[37]

Other

[edit]

Aircraft, bicycles, and a variety of industrial applications have distinct design requirements.

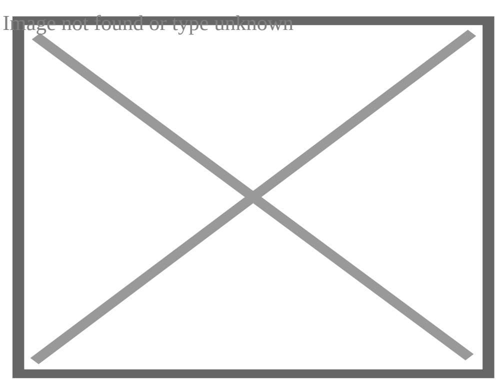


Tires on the wheels of a bogie on a Boeing 777

- Aircraft tires are designed for landing on paved surfaces and rely on their landing gear to absorb the shock of landing. To conserve the weight and space required, they are typically small in proportion to the vehicle that they support. Most are radial-ply construction. They are designed for a peak load when the aircraft is stationary, although side loads upon landing are an important factor.[38] Although hydroplaning is a concern for aircraft tires, they typically have radial grooves and no lateral grooves or sipes.[39] Some light aircraft employ large-diameter, low-pressure tundra tires for landing on unprepared surfaces in wilderness areas.[40]
- Bicycle tires may be designed for riding on roads or over unimproved terrain and may be mounted on vehicles with more than two wheels. There are three main types: *clincher*, *wired* and *tubular*.[41] Most bicycle tires are *clincher* and have a bead that presses against the wheel rim. An inner tube provides the air pressure and the contact pressure between the bead and wheel rim.[42]
- Industrial tires support such vehicles as forklifts, tractors, excavators, road rollers, and bucket loaders. Those used on smooth surfaces have a smooth tread, whereas those used on soft surfaces typically have large tread features.[43] Some industrial tires are solid or filled with foam.[44]
- Motorcycle tires provide traction, resisting wear, absorbing surface irregularities, and allow the motorcycle to turn via countersteering. The two tires' contact with the ground affects safety, braking, fuel economy, noise, and rider comfort.[45][*self-published source?*]

Construction types

[edit]



A cross-section of a tire showing ply orientations

Tire construction spans pneumatic tires used on cars, trucks, and aircraft, but also includes non-automotive applications with slow-moving, light-duty, or railroad applications, which may have non-pneumatic tires.

Automotive

[edit]

Following the 1968 *Consumer Reports* announcement of the superiority of the radial design, radial tires began an inexorable climb in market share, reaching 100% of the North American market in the 1980s.[20] Radial tire technology is now the standard design for essentially all automotive tires, but other methods have been used.[26]

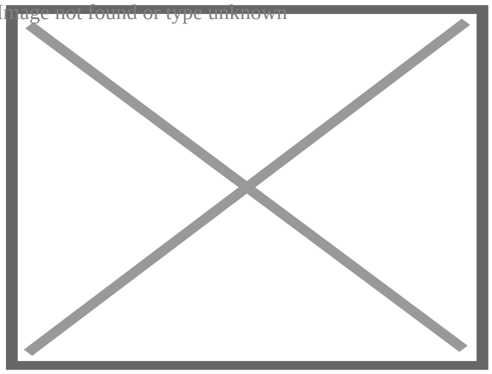
Radial (or radial-ply) tire construction utilizes body ply cords extending straight across the tread from bead to bead—so that the cords are laid at approximately right angles to the centerline of the tread, and parallel to one another—as well as stabilizer belts directly beneath the tread. The plies are generally made of nylon, polyester, or steel, and the belts of steel, fiberglass, or Kevlar.[46][47] The tire's footprint, wider than a bias tire's, and flexible sidewalls provide a better grip in turns, and its circumferential belts stabilize it. The advantages of this construction over that of a bias tire are many, including longer tread life, better steering control, lower rolling resistance, improved fuel economy, more uniform wear, higher heat resistance, fewer blowouts, and a steadier, more comfortable ride at speed. Disadvantages, besides a higher cost than that of bias tires, are a harder ride at low speeds and generally worse performance on rough terrain.[48][49][26] Radial tires are also seldom seen in diameters of greater than 42 inches, as such tires are difficult to make.[50]

Bias tire (bias-ply, or cross-ply) construction utilizes body ply cords that extend diagonally from bead to bead, usually at angles in the range of 30 to 40 degrees from the direction of travel.[51] Successive plies are laid at opposing angles, forming a crisscross pattern to which the tread is applied. Such a design is resistant to sidewall deformation and punctures (and to punctures' expansion, or "torque splitting") and therefore durable in severe use.[52] Since the tread and sidewalls share their casing plies, the tire body flexes as a whole, providing the main advantage of this construction, better traction and smoother motion on uneven surfaces, with a greater tendency to conform to rocky ground and throw off mud and clay, especially because the rubber is usually of a softer compound than that used on radial tires. However, this conformity increases a bias tire's rolling resistance, and its stiffness allows less control, traction, and comfort at higher speeds, while shear between its overlapping plies causes friction that generates heat.[48][53][54][26] Still, bias tires benefit from simpler structure and so cost less than like-size radials, and they remain in use on heavy equipment and off-road vehicles, although the earthmoving market has shifted to radials.[26][55]

A belted bias tire starts with two or more bias plies to which stabilizer belts are bonded directly beneath the tread. This construction provides a smoother ride that is similar to the bias tire, while lessening rolling resistance because the belts increase tread stiffness. The design was introduced by Armstrong, while Goodyear made it popular with the "Polyglas" trademark tire featuring a polyester carcass with belts of fiberglass.[56] The "belted" tire starts two main plies of polyester, rayon, or nylon annealed as in conventional tires, and then placed on top are circumferential belts at different angles that improve performance compared to non-belted bias tires. The belts may be fiberglass or steel.[56]

Other

[edit]



Airless tire

Tubeless tires are pneumatic tires that do not require a separate inner tube.

Semi-pneumatic tires have a hollow center, but they are not pressurized. They are lightweight, low-cost, puncture-proof, and provide cushioning.[57] These tires often come as a complete assembly with the wheel and even integral ball bearings. They are used on lawn mowers, wheelchairs, and wheelbarrows. They can also be rugged, typically used in industrial applications,[58] and are designed to not pull off their rim under use.

An airless tire is a non-pneumatic tire that is not supported by air pressure. They are most commonly used on small vehicles, such as golf carts, and on utility vehicles in situations where the risk of puncture is high, such as on construction equipment. Many tires used in industrial and commercial applications are non-pneumatic, and are manufactured from solid rubber and plastic compounds via molding operations. Solid tires include those used for lawnmowers, skateboards, golf carts, scooters, and many types of light industrial vehicles, carts, and trailers. One of the most common applications for solid tires is for material handling equipment (forklifts). Such tires are installed utilizing a hydraulic tire press.

Wooden wheels for horse-drawn vehicles usually have a wrought iron tire. This construction was extended to wagons on horse-drawn tramways, rolling on granite setts or cast iron rails.

The wheels of some railway engines and older types of rolling stock are fitted with railway tires to prevent the need to replace the entirety of a wheel. The tire, usually made of steel, surrounds the wheel and is primarily held in place by interference fit.

Aircraft tires may operate at pressures that exceed 1,400 kilopascals (14 bar; 200 psi).[59] Some aircraft tires are inflated with nitrogen to "eliminate the possibility of a chemical reaction between atmospheric oxygen and volatile gases from the tire inner liner producing a tire explosion".[60]

Manufacturing

[edit]

Main article: Tire manufacturing

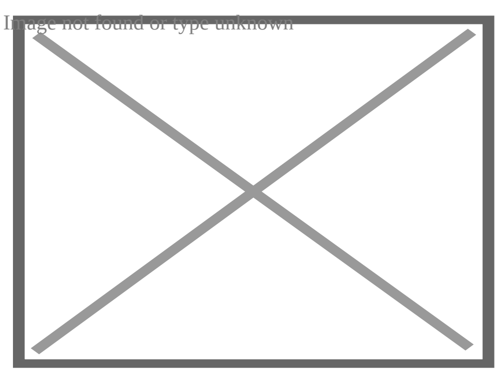
Pneumatic tires are manufactured in about 450 tire factories around the world. Tire production starts with bulk raw materials such as rubber, carbon black, and chemicals and produces numerous specialized components that are assembled and cured. Many kinds of rubber are used, the most common being styrene-butadiene copolymer.[61]

Forecasts for the global automotive tire market indicate continued growth through 2027. Estimates put the value of worldwide sales volume around $126 billion in 2022, it is expected to reach the value of over $176 billion by 2027.[62] Production of tires is also experiencing growth. In 2015, the US manufactured almost 170 million tires.[63] Over 2.5 billion tires are manufactured annually, making the tire industry a major consumer of natural rubber. It was estimated that for 2019 onwards, at least 3 billion tires would be sold globally every year.[64] However, other estimates put worldwide tire production of 2,268 million in 2021 and is predicted to reach 2,665 million tires by 2027.[65]

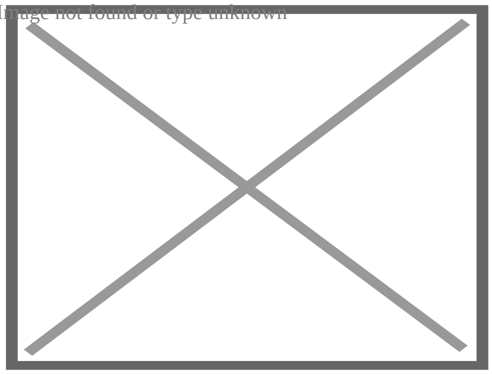
As of 2011, the top three tire manufacturing companies by revenue were Bridgestone (manufacturing 190 million tires), Michelin (184 million), Goodyear (181 million); they were followed by Continental, and Pirelli.[66][67] The Lego group produced over 318 million toy tires in 2011 and was recognized by Guinness World Records as having the highest annual production of tires by any manufacturer.[68][69]

Components

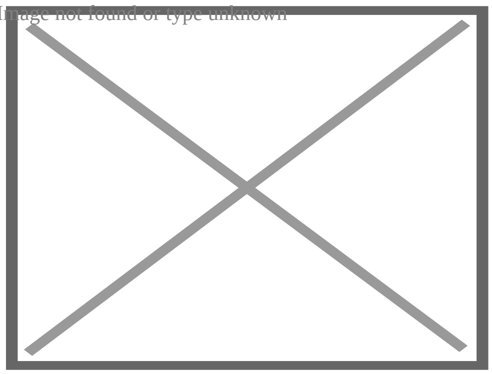
[edit]



Components of a radial tire



Mountain bicycle tires with an open-lug pattern for grip in soft soil



Absence of grooves maximizes dry-pavement friction on a set of slick Formula One tires

A tire comprises several components: the tread, bead, sidewall, shoulder, and ply.

Tread

[edit]

The tread is the part of the tire that comes in contact with the road surface. The portion that is in contact with the road at a given instant in time is the contact patch. The tread is a thick rubber, or rubber/composite compound formulated to provide an appropriate level of traction that does not wear away too quickly.[70]

The tread pattern is characterized by a system of circumferential grooves, lateral sipes, and slots for road tires[26] or a system of lugs and voids for tires designed for soft terrain or snow. Grooves run circumferentially around the tire and are needed to channel away water. Lugs are that portion of the tread design that contacts the road surface. Grooves, sipes, and slots allow tires to evacuate water.

The design of treads and the interaction of specific tire types with the roadway surface affects roadway noise, a source of noise pollution emanating from moving vehicles. These sound intensities increase with higher vehicle speeds.[71] Tires treads may incorporate a variety of distances between slots (*pitch lengths*) to minimize noise levels at discrete frequencies. Sipes are slits cut across the tire, usually perpendicular to the grooves, which allow the water from the grooves to escape sideways and mitigate hydroplaning.[26]

Different tread designs address a variety of driving conditions. As the ratio of tire tread area to groove area increases, so does tire friction on dry pavement, as seen on Formula One tires, some of which have no grooves. High-performance tires often have smaller void areas to provide more rubber in contact with the road for higher traction, but may be compounded with softer rubber that provides better traction, but wears quickly.[72] Mud and snow (M&S) tires employ larger and deeper slots to engage mud and snow.[26] Snow tires have still larger and deeper slots that compact snow and create shear strength within the compacted snow to improve braking and cornering performance.[73]

Wear bars (or wear indicators) are raised features located at the bottom of the tread grooves that indicate the tire has reached its wear limit. When the tread lugs are worn to the point that the wear bars connect across the lugs, the tires are fully worn and should be taken out of service, typically at a remaining tread depth of 1.6 millimetres (0.063 in).[74]

Other

[edit]

The tire bead is the part of the tire that contacts the rim on the wheel. This essential component is constructed with robust steel cables encased in durable, specially formulated rubber designed to resist stretching. The precision of the bead's fit is crucial, as it seals the tire against the wheel, maintaining air pressure integrity and preventing any loss of air. The bead's design ensures a secure, non-slip connection, preventing the tire from rotating independently from the wheel during vehicle motion. Additionally, the interplay between the bead's dimensions and the wheel's width significantly influences the vehicle's steering responsiveness and stability, as it helps to maintain the tire's intended shape and contact with the road.

The sidewall is that part of the tire, or bicycle tire, that bridges between the tread and bead. The sidewall is largely rubber but reinforced with fabric or steel cords that provide for tensile strength and flexibility. The sidewall contains air pressure and transmits the torque applied by the drive axle to the tread to create traction but supports little of the weight of the vehicle, as is clear from the total collapse of the tire when punctured.

Sidewalls are molded with manufacturer-specific detail, government-mandated warning labels, and other consumer information.[75][76]

Sidewall may also have sometimes decorative ornamentation that includes whitewall or red-line inserts as well as tire lettering.[77]

The shoulder is that part of the tire at the edge of the tread as it makes the transition to the sidewall.[78]

Plies are layers of relatively inextensible cords embedded in the rubber[79] to hold its shape by preventing the rubber from stretching in response to the internal pressure. The orientations of the plies play a large role in the performance of the tire and are one of the main ways that tires are categorized.[80]

Blems

[edit]

Blem (short for "blemished") is a term used for a tire that failed inspection during manufacturing - but only for superficial/cosmetic/aesthetic reasons. For example, a tire with white painted lettering which is smudged or incomplete might be classified as a "blem". Blem tires are fully functional and generally carry the same warranty as flawless tires - but are sold at a discount.[81]

Materials

[edit]

The materials of modern pneumatic tires can be divided into two groups, the cords that make up the ply and the elastomer which encases them.

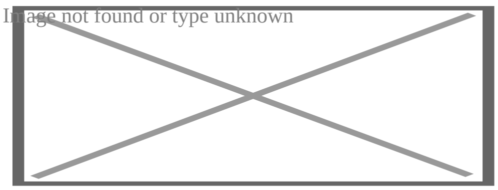
Cords

[edit]

The cords, which form the ply and bead and provide the tensile strength necessary to contain the inflation pressure, can be composed of steel, natural fibers such as cotton or silk, or synthetic fibers such as nylon or kevlar. Good adhesion between the cords and the rubber is important. To achieve this the steel cords are coated in a thin layer of brass,[82] various additives will also be added to the rubber to improve binding, such as resorcinol/HMMM mixtures.

Elastomer

[edit]



About 50% of tires use the Styrene-butadiene copolymer as a primary ingredient[15]

The elastomer, which forms the tread and encases the cords to protect them from abrasion and hold them in place, is a key component of pneumatic tire design. It can be composed of various composites of rubber material – the most common being styrene-butadiene copolymer – with other chemical compounds such as silica and carbon black.

Optimizing rolling resistance in the elastomer material is a key challenge for reducing fuel consumption in the transportation sector. It is estimated that passenger vehicles consume approximately 5~15% of their fuel to overcome rolling resistance, while the estimate is understood to be higher for heavy trucks.[83] However, there can be a trade-off between rolling resistance and wet traction and grip, based on the viscoelastic properties of the rubber compound. A low dissipation factor, which is often written as the tangent of the phase angle delta (tan(?)), reduces rolling resistance, whereas a high tan(?) can improve wet traction and grip. Fortunately, this tradeoff is not inherent: rolling resistance is affected by tan(?) at low frequencies (on the order of 100 Hz) whereas the improvement in traction comes from high tan(?) at much higher frequencies. Historically, direct measurement of tan(?) at high frequencies was difficult, and it became common to instead use measured low-frequency tan(?) at a low temperature (0 °C) as a predictor of wet traction because of its correlation to high-frequency tan(?). For rolling resistance, tan(?) value at 60 °C is directly relevant and often used as a predictor of low rolling resistance. [84] [31]

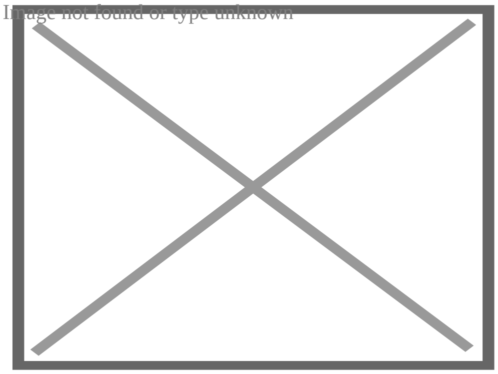
Designing an elastomer material that can achieve both high wet traction and low rolling resistance is key in achieving safety and fuel efficiency in the transportation sector. More recent research has found that compounds using dual-phase fillers exhibit a poor correlation between low-temperature tan(?) and wet traction, indicating an opportunity to circumvent the tradeoff assumed in the traditional approach. New approaches to understanding wet traction incorporate consideration of the effect of water lubrication on the interactions between surfaces and have pointed the way to developing compounds that can provide high wet traction and low rolling resistance. [85]

The most common elastomer material used today is a styrene-butadiene copolymer. It combines the properties of polybutadiene, which is a highly rubbery polymer (T_g = -100 °C) having high hysteresis and thus offering good wet grip properties, with the properties of polystyrene, which is a glassy polymer (T_g = 100 °C) having low hysteresis and thus offering low rolling resistance in addition to wear resistance. Therefore, the ratio of the two monomers in the styrene-butadiene copolymer is considered key in determining the glass transition temperature of the material, which is correlated to its grip and resistance properties.[86]

Non-exhaust emissions of particulate matter, generated by the wearing down of brakes, clutches, tires, and road surfaces, as well as by the suspension of road dust, constitute a little-known but rising share of emissions from road traffic and significantly harm public health.[87]

On the wheel

[edit]
Main articles: Wheel, Bicycle wheel, and Motorcycle wheel



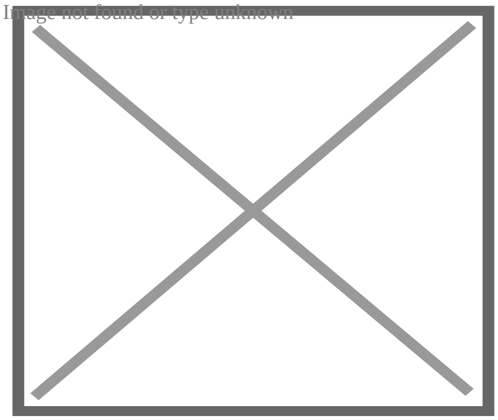
A bicycle inner tube with valve stem

Associated components of tires include the wheel on which it is mounted, the valve stem through which air is introduced, and, for some tires, an inner tube that provides the airtight means for maintaining tire pressure.

- *Wheel*: Pneumatic tires are mounted onto wheels that most often have integral rims on their outer edges to hold the tire. Automotive wheels are typically made from pressed and welded steel, or a composite of lightweight metal alloys, such as aluminum or magnesium. There are two aspects to how pneumatic tires support the rim of the wheel on which they are mounted.[88] First, the tension in the cords pull on the bead uniformly around the wheel, except where it is reduced above the contact patch.[89] Second, the bead transfers that net force to the rim.[90][89] Tires are mounted on the wheel by forcing its beads into the channel formed by the wheel's inner and outer rims.[91][92]
- *Valve stem*: Pneumatic tires receive their air through a valve stem—a tube made of metal or rubber, with a check valve, typically a Schrader valve on automobiles and most bicycle tires, or a Presta valve on high-performance bicycles. They mount directly to the rim, in the case of tubeless tires, or are an integral part of the inner tube. Most modern passenger vehicles are now required to have a tire pressure monitoring system which usually consists of a valve stem attached to an electronic module.[34]
- *Inner tube*: Most bicycle tires, many motorcycle tires, and many tires for large vehicles such as buses, heavy trucks, and tractors are designed for use with inner tubes. Inner tubes are torus-shaped balloons made from an impermeable material, such as soft, elastic synthetic rubber, to prevent air leakage. The inner tubes are inserted into the tire and inflated to retain air pressure. Large inner tubes can be reused for other purposes, such as swimming and rafting (see swim ring), tubing (recreation), sledding, and skitching. Purpose-built inflatable tori are also manufactured for these uses, offering a choice of colors, fabric covering, handles, decks, and other accessories, and eliminating the protruding valve stem.

Performance characteristics

[edit]



Tire performance envelope by Goodyear

The interactions of a tire with the pavement are complex. A commonly used (empirical) model of tire properties is Pacejka's "Magic Formula".[93] Some are explained below, alphabetically, by section.

Dynamics

[edit]

- *Balance*: Wheel-tire combinations require an even distribution of mass around their circumferences to maintain tire balance, while turning at speed. Tires are checked at the point of manufacture for excessive static imbalance and dynamic imbalance using automatic tire balance machines. Tires are checked again in the auto assembly plant or tire retail shop after mounting the tire to the wheel. Assemblies that exhibit excessive imbalance are corrected by applying balance weights to the wheels to counteract the tire/wheel imbalance. An alternative method to tire balancing is the use of internal tire balancing agents. These agents take advantage of centrifugal force and inertia to counteract the tire imbalance.[94] To facilitate proper balancing, most high-performance tire manufacturers place red and yellow marks on the sidewalls to enable the best possible match-mounting of the tire/wheel assembly. There are two methods of match-mounting high-performance tire-to-wheel assemblies using these red (uniformity) or yellow (weight) marks.[95]
- *Centrifugal growth*: A tire rotating at higher speeds tends to develop a larger diameter, due to centrifugal forces that force the tread rubber away from the axis of rotation. This may cause speedometer error. As the tire diameter grows, the tire width decreases. This centrifugal growth can cause rubbing of the tire against the vehicle at high speeds. Motorcycle tires are often designed with reinforcements aimed at minimizing centrifugal growth.[26]
- *Pneumatic trail*: Pneumatic trail of a tire is the trail-like effect generated by compliant tires rolling on a hard surface and subject to side loads, as in a turn. More technically, it is the distance that the resultant force of side-slip occurs behind the geometric center of the contact patch.[96]

- *Slip angle*: Slip angle or sideslip angle is the angle between a rolling wheel's actual direction of travel and the direction towards which it is pointing (i.e., the angle of the vector sum of wheel translational velocity v_x and sideslip velocity v_y).[26]
- *Relaxation length*: Relaxation length is the delay between when a slip angle is introduced and when the cornering force reaches its steady-state value.[26]
- *Spring rate*: Vertical stiffness, or spring rate, is the ratio of vertical force to vertical deflection of the tire, and it contributes to the overall suspension performance of the vehicle. In general, the spring rate increases with inflation pressure.[97]
- *Stopping distance*: Performance-oriented tires have a tread pattern and rubber compounds designed to grip the road surface, and so usually have a slightly shorter stopping distance. However, specific braking tests are necessary for data beyond generalizations.[26]

Forces

[edit]

- *Camber thrust*: Camber thrust and camber force are the force generated perpendicular to the direction of travel of a rolling tire due to its camber angle and finite contact patch.[26]
- *Circle of forces*: The circle of forces, traction circle, friction circle, or friction ellipse is a useful way to think about the dynamic interaction between a vehicle's tire and the road surface.[98]
- *Contact patch*: The contact patch, or footprint, of the tire, is the area of the tread that is in contact with the road surface. This area transmits forces between the tire and the road via friction. The length-to-width ratio of the contact patch affects steering and cornering behavior.[26]
- *Cornering force*: Cornering force or side force is the lateral (i.e. parallel to the road surface) force produced by a vehicle tire during cornering.[26]
- *Dry traction*: Dry traction is the measure of the tire's ability to deliver traction, or grip, under dry conditions. Dry traction is a function of the tackiness of the rubber compound.[26]
- *Force variation*: The tire tread and sidewall elements undergo deformation and recovery as they enter and exit the footprint. Since the rubber is elastomeric, it is deformed during this cycle. As the rubber deforms and recovers, it imparts cyclical forces into the vehicle. These variations are collectively referred to as tire uniformity. Tire uniformity is characterized by radial force variation (RFV), lateral force variation (LFV), and tangential force variation. Radial and lateral force variation is measured on a force variation machine at the end of the manufacturing process. Tires outside the specified limits for RFV and LFV are rejected. Geometric parameters, including radial runout, lateral runout, and sidewall bulge, are measured using a tire uniformity machine at the tire factory at the end of the manufacturing process as a quality check.[26]
- *Rolling resistance*: Rolling resistance is the resistance to rolling caused by deformation of the tire in contact with the road surface. As the tire rolls, the tread enters the contact area and is deformed flat to conform to the roadway. The energy required to make the deformation depends on the inflation pressure, rotating speed, and numerous physical properties of the tire structure, such as spring force and stiffness. Tire makers seek lower

rolling resistance tire constructions to improve fuel economy in cars and especially trucks, where rolling resistance accounts for a high proportion of fuel consumption. Pneumatic tires also have a much lower rolling resistance than solid tires. Because the internal air pressure acts in all directions, a pneumatic tire is able to "absorb" bumps in the road as it rolls over them without experiencing a reaction force opposite to the direction of travel, as is the case with a solid (or foam-filled) tire.[26]

- *Self aligning torque*: Self-aligning torque, also known as the aligning torque, SAT or Mz, is the torque that a tire creates as it rolls along that tends to steer it, i.e. rotate it around its vertical axis.[26]
- *Wet traction*: Wet traction is the tire's traction, or grip, under wet conditions. Wet traction is improved by the tread design's ability to channel water out of the tire footprint and reduce hydroplaning. However, tires with a circular cross-section, such as those found on racing bicycles, when properly inflated have a sufficiently small footprint to not be susceptible to hydroplaning. For such tires, it is observed that fully slick tires will give superior traction on both wet and dry pavement.[99]

Load

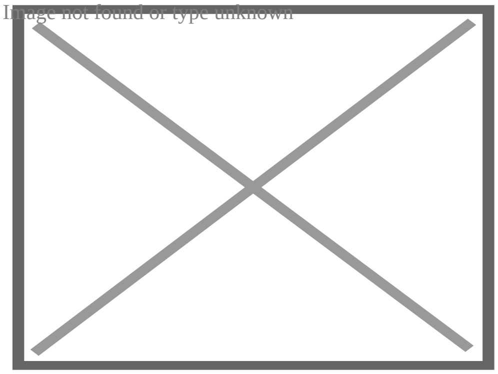
[edit]

- *Load sensitivity*: Load sensitivity is the behavior of tires under load. Conventional pneumatic tires do not behave as classical friction theory would suggest. Namely, the load sensitivity of most real tires in their typical operating range is such that the coefficient of friction decreases as the vertical load, Fz, increases.[26]
- *Work load*: The work load of a tire is monitored so that it is not put under undue stress, which may lead to its premature failure.[100] Work load is measured in *Ton Kilometer Per Hour* (TKPH). The measurement's appellation and units are the same. The recent shortage and increasing cost of tires for heavy equipment has made TKPH an important parameter in tire selection and equipment maintenance for the mining industry. For this reason, manufacturers of tires for large earth-moving and mining vehicles assign TKPH ratings to their tires based on their size, construction, tread type, and rubber compound.[101][102] The rating is based on the weight and speed that the tire can handle without overheating and causing it to deteriorate prematurely. The equivalent measure used in the United States is *Ton Mile Per Hour* (TMPH).

Wear

[edit]
See also: Rubber pollution and Road wear

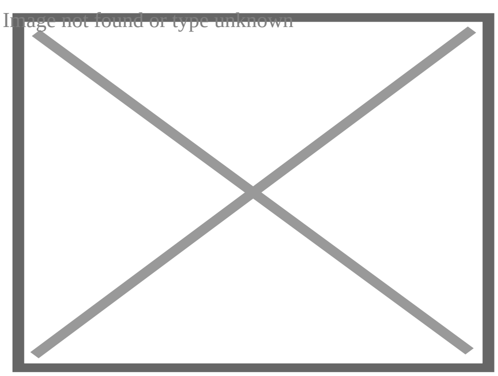
Tire wear is a major source of rubber pollution. A concern hereby is that vehicle tire wear pollution is unregulated, unlike exhaust emissions.[103]



Tire showing uneven tread wear to the point of exposing the casing

Tread wear

This occurs through normal contact with roads or terrain; there are several types of abnormal tread wear. Poor wheel alignment can cause excessive wear of the innermost or outermost ribs. Gravel roads, rocky terrain, and other rough terrain cause accelerated wear. Over-inflation above the sidewall maximum can cause excessive wear to the center of the tread. Modern tires have steel belts built in to prevent this. Under-inflation causes excessive wear to the outer ribs. Unbalanced wheels can cause uneven tire wear, as the rotation may not be perfectly circular. Tire manufacturers and car companies have mutually established standards for tread wear testing that include measurement parameters for tread loss profile, lug count, and heel-toe wear.[26]



Wear bar and tread wear indicator on the snow tire tread

Tread wear indicators (T.W.I.)

Raised bars in the tread channels, which indicate that the tread is becoming worn and therefore unsafe. Indicators have been required on all new tires since 1968 in the US.[104] In many countries the Highway Code forbids driving on public roads when the contact surface is flush with any of these bars - this is often defined when the groove depth is approximately 1.5 or 1.6 mm (2/32 inch). TWI can also be used to refer to small arrows or icons on the tire sidewall, indicating the location of the raised wear bars.

Damage by aging

Tire aging or "thermo-oxidative degradation" can be caused by time, ambient and operating temperatures, partial pressure of O2 in a tire, flex fatigue, or construction and compounding characteristics. For example, prolonged UV exposure leads to rubber's chemicals warping, potentially causing dry rot. Various storage methods may slow the aging process, but will not eliminate tire degradation.[105]

Sizes, codes, standards, and regulatory agencies

[edit]

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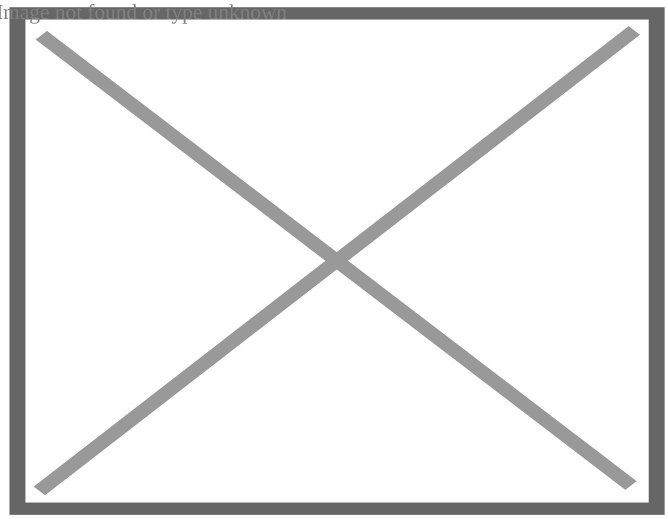


Tire identification diagram with tire codes

Further information: Tire code

Automotive tires have a variety of identifying markings molded onto the sidewall as a tire code. They denote size, rating, and other information pertinent to that individual tire.

Americas

[edit]

The National Highway and Traffic Safety Administration (NHTSA) is a U.S. government body within the Department of Transportation (DOT) tasked with regulating automotive safety in the United States.[106] NHTSA established the Uniform Tire Quality Grading System (UTQG), is a system for comparing the performance of tires according to the Code of Federal Regulations 49 CFR 575.104; it requires labeling of tires for tread wear, traction, and temperature. The DOT Code is an alphanumeric character sequence molded into the sidewall of the tire and allows the identification of the tire and its age. The code is mandated by the U.S. Department of Transportation[106] but is used worldwide.[107] The DOT Code is also useful in identifying tires subject to product recall[108] or at end of life due to age. The *Tire and Rim Association* (T&RA) is a voluntary U.S. standards organization that promotes the interchangeability of tires, rims, and allied parts. Of particular interest, they publish key tire dimensions, rim contour dimensions, tire valve dimension standards, and load/inflation standards.

The National Institute of Metrology Standardization and Industrial Quality (INMETRO) is the Brazilian federal body responsible for automotive wheel and tire certification.[109]

Europe

[edit]

The European Tyre and Rim Technical Organisation (ETRTO) is the European standards organization "to establish engineering dimensions, load/pressure characteristics and operating guidelines".[110] All tires sold for road use in Europe after July 1997 must carry an E-mark. The mark itself is either an upper case "E" or lower case "e" – followed by a number in a circle or rectangle, followed by a further number. An (upper case) "E" indicates that the tire is certified to comply with the dimensional, performance, and marking requirements of ECE regulation 30. A (lowercase) "e" indicates that the tire is certified to comply with the dimensional, performance, and marking requirements of Directive 92/23/EEC. The number in the circle or rectangle denotes the country code of the government that granted the type approval. The last number outside the circle or rectangle is the number of the type approval certificate issued for that particular tire size and type.[111]

The British Rubber Manufacturers Association (BRMA) recommended practice, issued June 2001, states, "BRMA members strongly recommend that unused tires should not be put into service if they are over six years old and that all tires should be replaced ten years from the date of their manufacture."[112]

Asia

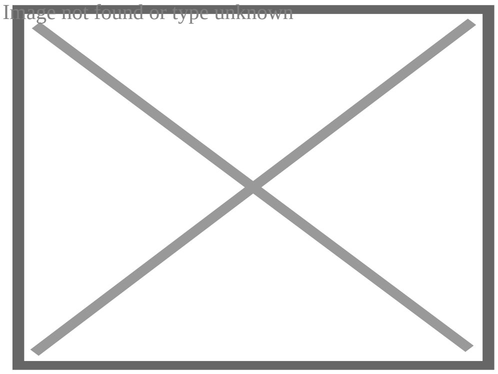
[edit]

The Japanese Automobile Tire Manufacturers Association (JATMA) is the Japanese standards organization for tires, rims, and valves.[113] It performs similar functions as the T&RA and ETRTO.

The China Compulsory Certification (CCC) is a mandatory certification system concerning product safety in China that went into effect in August 2002. The CCC certification system is operated by the State General Administration for Quality Supervision and Inspection and Quarantine of the People's Republic of China (AQSIQ) and the Certification and Accreditation Administration of the People's Republic of China (CNCA).[114]

Maintenance

[edit]



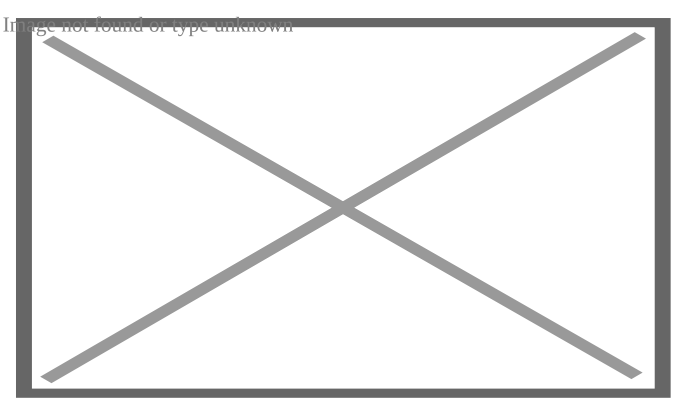
A tire repair shop in Niger

To maintain tire health, several actions are appropriate, tire rotation, wheel alignment, and, sometimes, retreading the tire.

- *Rotation*: Tires may exhibit irregular wear patterns once installed on a vehicle and partially worn. Front-wheel drive vehicles tend to wear the front tires at a greater rate compared to the rear tires. Tire rotation is moving the tires to different car positions, such as front-to-rear, in order to even out the wear, with the objective of extending the life of the tire.[115]
- *Alignment*: Wheel alignment helps prevent wear due to rotation in a direction other than the path of the vehicle. When mounted on the vehicle, the wheel and tire may not be perfectly aligned to the direction of travel, and therefore may exhibit irregular wear. If the discrepancy in alignment is large, then the irregular wear will become substantial if left uncorrected. Wheel alignment is the procedure for checking and correcting this condition through adjustment of camber, caster, and toe angles. The adjustment of the angles should be done as per the OEM specifications.[116]

Inflation

[edit]



Rolling resistance as a function of tire inflation

Inflation is key to proper wear and rolling resistance of pneumatic tires. Many vehicles have monitoring systems to assure proper inflation. Most passenger cars are advised to maintain a tire pressure within the range of 220 to 240 kilopascals (32 to 35 psi) when the tires are not warmed by driving.[117][118]

- *Specification*— Vehicle manufacturers provide tire specifications, including a recommended cold inflation pressure, to ensure safe operation within the designated load rating and vehicle loading capacity. While many tires feature a maximum pressure rating stamped on them, passenger vehicles and light trucks typically include inflation guidance on a decal located just inside the driver's door and in the vehicle owner's handbook.[119]
- *Ground contact*: The tire contact patch is readily changed by both over- and underinflation. Overinflation may increase the wear on the center contact patch, and underinflation will cause a concave tread, resulting in less center contact, though the overall contact patch will still be larger.[120] Most modern tires will wear evenly at high tire pressures, but will degrade prematurely if underinflated. Increased tire pressure may decrease rolling resistance, and may also result in shorter stopping distances[121] If tire pressure is too low, the tire contact patch is greatly increased. This increases rolling resistance, tire flexing, and friction between the road and the tire. Under-inflation can lead to tire overheating, premature tread wear, and tread separation in severe cases.[122]
- *Monitoring*: Tire pressure monitoring systems (TPMS) are electronic systems that monitor the tire pressures on individual wheels on a vehicle and alert the driver when the pressure goes below a warning limit. There are several types of designs to monitor tire pressure. Some actually measure the air pressure, and some make indirect measurements, such as gauging when the relative size of the tire changes due to lower air pressure.

Hazards

[edit]

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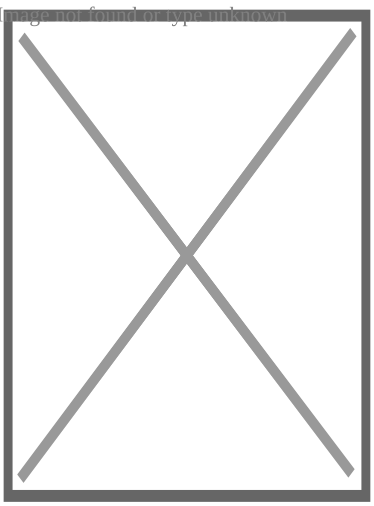
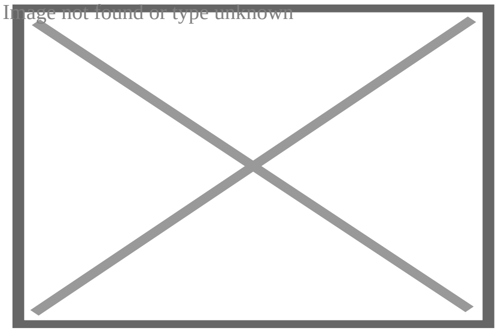
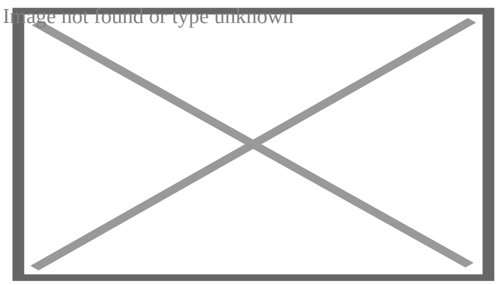


Tire bubble



Tire showing weather-cracking over long-term exposure to the weather



A flat tire on a passenger car

Tire hazards may occur from failure of the tire, itself, or from loss of traction on the surface over which it is rolling. Structural failures of a tire can result in flat tires or more dangerous blowouts. Some of these failures can be caused by manufacture error and may lead to recalls, such as the widespread Firestone tire failures on Ford vehicles that lead to the Firestone and Ford tire controversy in the 1990s.

Tire failure

[edit]

Tires may fail for any of a variety of reasons, including:[123]

- *Belt separation* which may be belt-to-belt, tread and belt, or separation of the edge of the belt. Belt-to-belt separation may occur having the tire deflect too much, from high pavement temperatures, road hazard impacts, or other causes that have to do with maintenance and storage.

- *Non-belt separations* include those at the tire tread, in the bead area, in the lower sidewall, between reinforcing plies, and of the reinforcing steel or fabric materials.
- Other types of failure include run-flat damage, chemical degradation, cracking, indentations and bulges.

Vehicle operation failures

[edit]

- *Melting rubber*: As tire rubber compounds heat, owing to the friction of stopping, cornering, or accelerating, they may begin to melt, lubricate the tire-road contact area, and become deposited on the pavement. This effect is stronger with increased ambient temperature.[26]
- *Hydroplaning*: Motor vehicles or aircraft tires passing over a wet pavement may lose contact with sufficient speed or water depth for a given tread design. In this case, the tire contact area is riding on a film of water and loses the friction needed for braking or cornering and begins to *hydroplane* (or *aquaplane*). Hydroplaning may occur as *dynamic hydroplaning* where standing water is present with a depth of at least 3 millimetres (0.12 in) above the texture of the pavement and speed is sustained above a threshold level. It may also occur as *viscous hydroplaning* whereby tire rubber melts for a brief interval and causes slippage. This may leave deposits of rubber on a runway as airplanes land.[124] Dynamic hydroplaning causes decreased friction and contact with increased tire speed.[125]
- *Snow*: The degree to which a tire can maintain traction in snow depends on its ability to compact snow, which material then develops strength against slippage along a shear plane parallel to the contact area of the tire on the ground.[126] At the same time, the bottom of the tire treads compress the snow on which they are bearing, also creating friction. The process of compacting snow within the treads requires it to be expelled in time for the tread to compact snow anew on the next rotation. The compaction/contact process works both in the direction of travel for propulsion and braking, but also laterally for cornering.[73]
- *Ice*: Ice is typically close to its melting point when a tire travels over it. This, combined with a smooth texture, promotes a low coefficient of friction and reduced traction during braking, cornering or acceleration.[26]
- *Soft ground*: Soil can become lubricated with water, which reduces its ability to maintain shear strength when a tire tries to apply force in acceleration, braking, or cornering. Dry sand also has low shear strength, owing to poor cohesiveness among sand particles.[127]

Health impacts

[edit]
Further information: Rubber pollution

Tires contain a number of trace toxic chemicals including heavy metals and chemical agents used to increase the durability of the tires.[2] These typically include polycyclic aromatic hydrocarbon, benzothiazoles, isoprene and heavy metals such as zinc and lead.[2]

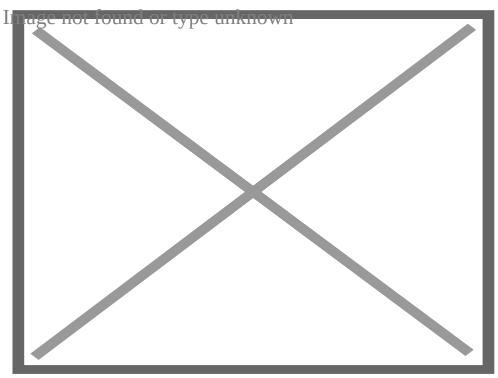
As tires are used for vehicle operations, the natural wear of the tire leaves microfine particles equivalent to PM0.1, PM2.5, and PM10 as tire residue.[2] This residue accumulates near roadways and vehicle use areas, but also will travel into the environment through surface runoff.[2] Both humans and animals are exposed to these chemicals at the sites of accumulation (i.e.

walking on the road surface) and through bioaccumulation in natural environments and foodchains.[2] A 2023 literature review from Imperial College London, warned of both the toxic chemicals and microplastics produced from tire wear as having potential widespread serious environmental and health consequences.[2]

Moreover, burning of tires releases these chemicals as air pollutants that can harm first responders and leaves toxic residues that endanger local communities.[128]

End of use

[edit]
Main article: Tire recycling

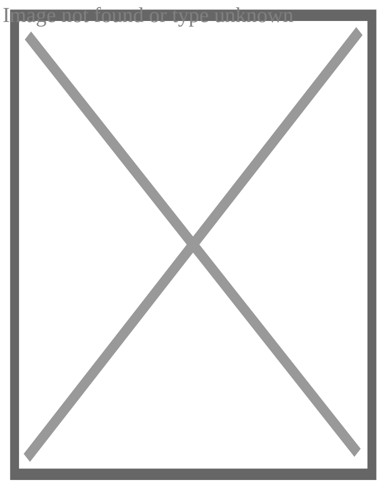


Tires recycled into water tanks on the roof in Cherchen, Xinjiang

Once tires are discarded, they are considered scrap tires. Scrap tires are often re-used for things from bumper car barriers to weights to hold down tarps. Tires are not desired at landfills, due to their large volumes and 75% void space, which quickly consumes valuable space. Rubber tires are likely to contain some traces of heavy metals or other serious pollutants, but these are tightly bonded within the actual rubber compound so they are unlikely to be hazardous unless the tire structure is seriously damaged by fire or strong chemicals.[129] Some facilities are permitted to recycle scrap tires by chipping and processing them into new products or selling the material to licensed power plants for fuel. Some tires may also be retreaded for re-use.

Environmental issues

[edit]



Toxic fumes emerging from a fire at a tire dump.

Americans generate about 285 million scrap tires per year.[130] Many states regulate the number of scrap tires that can be held at any site out of concern with dumping, fire hazards, and mosquitoes. In the past, millions of tires were simply discarded into open fields. Outdoor tire heaps create breeding grounds for mosquitoes, which are a nuisance and may spread disease, since the tires often hold water inside and remain warm enough for mosquito breeding. It also creates a fire hazard. Tires very seldom catch fire inadvertently, requiring a temperature of 400 °C (752 °F) to combust,[131] but once burning in a mass are hard to extinguish, for a large tire pile is a lot of fuel, and water used to douse fires does not adequately penetrate or cool burning tires. Some tire fires have burned for months, sometimes liquefying and releasing hydrocarbons and other contaminants to the ground and even groundwater, and black smoke, an air pollutant that is a hazard to downwind properties, to the air.

The use of scrap tire chips for landscaping has become controversial because of the leaching of metals and other contaminants from the tire pieces. Zinc is concentrated (up to 2% by weight) to levels high enough to be highly toxic to aquatic life and plants.[132] Of particular concern is evidence that some of the compounds that leach from tires into the water contain hormone disruptors and cause liver lesions.[133]

Tires are a major source of microplastic pollution, found in a 2020 study to contribute 78% of the total mass of microplastics found in the ocean.[134][135] The commonly used compound 6PPD-quinone, found entering stormwater runoff via tire-wear particles, has been identified as toxic to coho salmon, brook trout, and rainbow trout.[136]

Retreading

[edit]
Main article: retread

Tires that are fully worn can be retreaded, re-manufactured to replace the worn tread.[137] This is known as retreading or recapping, a process of buffing away the worn tread and applying a new tread.[138] There are two main processes used for retreading tires, called mold-cure and pre-cure methods. Both processes start with the inspection of the tire, followed by non-destructive inspection method such as shearography[139] to locate non-visible damage and embedded debris and nails. Some casings are repaired and some are discarded. Tires can be retreaded multiple times if the casing is in usable condition. Tires used for short delivery vehicles are retreaded more than long haul tires over the life of the tire body. Casings fit for retreading have the old tread buffed away to prepare for retreading.[140]

During the retreading process, retread technicians must ensure the casing is in the best condition possible to minimize the possibility of a casing failure. Casings with problems such as capped tread, tread separation, irreparable cuts, corroded belts or sidewall damage, or any run-flat or skidded tires, will be rejected. The mold cure method involves the application of raw rubber on the previously buffed and prepared casing, which is later cured in matrices. During the curing period, vulcanization takes place, and the raw rubber bonds to the casing, taking the tread shape of the matrix. On the other hand, the pre-cure method involves the application of a ready-made tread band on the buffed and prepared casing, which later is cured in an autoclave so that vulcanization can occur.[140]

Recycling

[edit]

Tires can be recycled into, among other things, the hot melt asphalt, typically as crumb rubber modifier—recycled asphalt pavement (CRM—RAP),[141][142] and as an aggregate in portland cement concrete.[143] Shredded tires can create rubber mulch on playgrounds to diminish fall injuries.[144] There are some "green" buildings that are being made both private and public buildings that are made from old tires.[145]

The tire pyrolysis method for recycling used tires is a technique that heats whole or shredded tires in a reactor vessel containing an oxygen-free atmosphere and a heat source. In the reactor, the rubber is softened after which the rubber polymers continuously break down into smaller molecules.

Other uses

[edit]

Other downstream uses have been developed for worn-out tires, including:

- *Building elements*: Tires filled with earth have been used as garden containers[146] house foundations,[147] bullet-proof walls[148] and to prevent soil erosion in flood plains.[149] Tire walls are a common feature of motor racing circuits for safety.
- *Recreational equipment*: Used tires are employed as exercise equipment for athletic programs such as American football.[150] One classic conditioning drill that hones players' speed and agility is the "Tire Run" where tires are laid out side by side, with each tire on

the left a few inches ahead of the tire on the right in a zigzag pattern. Athletes then run through the tire pattern by stepping in the center of each tire. The drill forces athletes to lift their feet above the ground higher than normal to avoid tripping on the tires.[151] Old tires are sometimes converted into a swing for play.[152]

- *Burning tires as protest*: Protestors, worldwide, have burned tires to create black smoke.[153][154]
- Necklacing is the use of tires to kill people, typically by lynch mobs. A tire is soaked in gasoline, placed around the victim's neck, and set on fire.

  Children on a tire swing

-

  Image not found or type unknown

  Children on a tire swing
  Burning tires in protest

-

  Image not found or type unknown

  Burning tires in protest

See also

[edit]

- Dry steering
- List of auto parts
- List of inflatable manufactured goods
- Off-road tire
- Outline of tires
- Rubber-tyred metro
- Rubber-tyred trams
- Shinosaur

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Look up ***inner tube***, ***tire***, or ***tyre*** in Wiktionary, the free dictionary.

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Wikimedia Commons has media related to ***Tires***.

- National Highway Traffic Safety Adm "Tire Safety" Brochure (Archived 28 October 2020 at the Wayback Machine)
- U.S. government tire rating and maintenance site

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Tires

Types

- Tubeless tire
- Radial tire
- Low rolling resistance tire
- Run-flat tire
- Michelin PAX System
- Airless tire
- Tweel
- Rain tyre
- Snow tire
- All-terrain tire
- Bar grip
- Knobby tire
- Large tire
- Mud-terrain tire
- Paddle tire
- Orange oil tires
- Whitewall tire
- Aircraft tire
- Tundra tire
- Bicycle tire
- Tubular tire
- Lego tire
- Motorcycle tyre
- Tractor tire
- Racing slick
- Formula One tyres
- Spare tire
- Continental tire

Components

- Bead
- Beadlock
- Tread
- Siping (rubber)
- Valve stem
  - Dunlop valve
  - Presta valve
  - Schrader valve

Attributes

- Camber thrust
- Circle of forces
- Cold inflation pressure
- Contact patch
- Cornering force
- Ground pressure
- Pacejka's Magic Formula
- Pneumatic trail
- Relaxation length
- Rolling resistance
- Self aligning torque
- Slip angle
- Steering ratio
- Tire balance
- Tire load sensitivity
- Tire uniformity
- Lateral Force Variation
- Radial Force Variation
- Traction (engineering)
- Treadwear rating

Behaviors

- Aquaplaning
- Groove wander
- Slip (vehicle dynamics)
- Tramlining

Maintenance	◦ Tire maintenance ◦ Tire rotation ◦ Bicycle pump ◦ Central Tire Inflation System ◦ Tire mousse ◦ Tire-pressure monitoring system ◦ Tire-pressure gauge ◦ Direct TPMS ◦ Bead breaker ◦ Tire changer ◦ Tire manipulator ◦ Tire iron
Life cycle	◦ Tire manufacturing ◦ List of tire companies ◦ Retread ◦ Waste tires ◦ Tire recycling ◦ Tire fire ◦ Blowout ◦ Flat tire ◦ Ozone cracking
Organizations	◦ European Tyre and Rim Technical Organisation ◦ Tire Society ◦ Tire Science and Technology
Identification	◦ Tire code ◦ Plus sizing ◦ Tire label ◦ Uniform Tire Quality Grading (UTQG)

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Rubber

Chemical types

- Latex
- Natural rubber
- Synthetic rubber
  - Butyl rubber
  - Chloroprene rubber
  - EPDM rubber
  - Nitrile rubber
  - Silicone rubber
  - Styrene-butadiene

Mechanical types

- Cold rubber
- Foam rubber
- Crumb rubber
  - Micronized rubber powder

Additives

- Biodegradable additives
- Filler (materials)
- Plasticizer
- Polymer additive
- Polymer stabilizers

Rubber processing

- Rubber tapping
- Rubber technology
- Vulcanization

Industry

- Bridgestone
- Dunlop
- Goodyear Tire and Rubber Company
- Michelin
- Rubber Board
- Rubber industry in Malaysia
  - Rubber Industry Smallholders Development Authority
- Rubber Manufacturers Association
- United States Rubber Company
- List of tire companies

Products	◦ Rubber band ◦ Rubber mulch ◦ Rubberized asphalt ◦ Tires ◦ codes

Waste	◦ Airfield rubber removal
	◦ Rubber pollution
	    ◦ Dioxins
	    ◦ Environmental hazards
	    ◦ Great Pacific Garbage Patch
	    ◦ Persistent organic pollutant
	◦ Tire-derived fuel
	◦ Tire recycling

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Automotive handling

Main topics		Car handling Center of mass Downforce Drifting Electronic Stability Control Fishtailing Inboard brake Oversteer Steering Suspension Tire / Tyre Transaxle Understeer Unsprung mass Vehicle dynamics Weight transfer
Spring types		Coil Leaf Pneumatic Torsion
Suspension types	**Dependent**	Beam axle De Dion tube
	Semi-independent	Twist beam
	Independent	Double wishbone (Jaguar IRS) Dubonnet MacPherson strut (Chapman strut) Multi-link Sliding pillar Swing axle Trailing arm (Semi-trailing arm)

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Powertrain

Part of the Automobile series

Automotive engine	- Diesel engine - Electric - Fuel cell - Hybrid (Plug-in hybrid) - Internal combustion engine - Petrol engine - Steam engine

Transmission

- Automatic transmission
- Chain drive
- Direct-drive
- Clutch
- Constant-velocity joint
- Continuously variable transmission
- Coupling
- Differential
- Direct-shift gearbox
- Drive shaft
- Dual-clutch transmission
- Drive wheel
- Automated manual transmission
- Electrorheological clutch
- Epicyclic gearing
- Fluid coupling
- Friction drive
- Gearshift
- Giubo
- Hotchkiss drive
- Limited-slip differential
- Locking differential
- Manual transmission
- Manumatic
- Parking pawl
- Park-by-wire
- Preselector gearbox
- Semi-automatic transmission
- Shift-by-wire
- Torque converter
- Transaxle
- Transfer box
- Transmission control unit
- Universal joint

Wheels and tires

- Wheel hub assembly
- Wheel
  - Rim
  - Alloy wheel
  - Hubcap
- Tire
  - Off-road
  - Racing slick
  - Radial
  - Rain
  - Run-flat
  - Snow
  - Spare
  - Tubeless

Hybrid

- Electric motor
- Hybrid vehicle drivetrain
- Electric generator
- Alternator

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Automotive design

Part of a series of articles on cars

- **Body**
  - Framework
    - Backbone chassis
    - Beltline
    - Body-on-frame
    - Bumper
      - Dagmar
    - Cabrio coach
    - Chassis
    - Continental tire
    - Crumple zone
    - Fender
      - ponton
      - skirts
    - Grille
    - Hood
      - scoop
        - shaker
    - Monocoque
    - Overhang
    - Pillar
    - Platform
    - Quarter panel
    - Roof
      - rack
    - Spoiler
    - Stressed member engine
    - Subframe
    - Tonneau
    - Trunk lid
  - Compartments
    - Hood/bonnet
    - Trunk/boot/dickie
  - Doors
    - Butterfly
    - Canopy
    - Gull-wing
    - Scissor
    - Sliding
    - Suicide
    - Swan
  - Glass
    - Glass run channel
    - Greenhouse
    - Opera window
    - Power window
    - Quarter glass

Exterior equipment	Lighting	○ Automotive light bulb types
		○ Daytime running lamp
		○ Headlamp
		  ○ hidden
		  ○ high-intensity discharge
		  ○ sealed beam
		  ○ trafficators

	Other elements	○ Horn ○ Side-view mirror ○ power ○ Tow hitch ○ Window deflector
	Legal	○ Registration plate ○ vanity plate ○ Theft ○ Vehicle identification number (VIN)

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Other	○ Yale LUX

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Driving Directions in Will County

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State : IL

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