Formula One engines

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Since its inception in 1947, **Formula One** has used a variety of engine regulations. "Formulas" limiting engine capacity had been used in Grand Prix racing on a regular basis since after World War I. The engine formulae are divided according to era.

Contents

Operation

Formula One currently uses 1.6 litre four-stroke turbocharged 90 degree V6 reciprocating engines.[1]

The power a Formula One engine produces is generated by operating at a very high rotational speed, up to 15,000 revolutions per minute (RPM).[2] This contrasts with road car engines of a similar size which typically operate at less than 6,000 rpm. The basic configuration of a naturally aspirated Formula One engine had not been greatly modified since the 1967 Cosworth DFV and the mean effective pressure had stayed at around 14 bar MEP.[3] Until the mid-1980s Formula One engines were limited to around 12,000 rpm due to the traditional metal valve springs used to close the valves. The speed required to operate the engine valves at a higher RPM called for ever stiffer springs, which increased the power loss to drive the camshaft and the valves to the point where the loss nearly offset the power gain through the increase in rpm. They were replaced by pneumatic valve springs introduced by Renault,[4][5] which inherently have a rising rate (progressive rate) that allowed them to

have extremely high spring rate at larger valve strokes without much increasing the driving power requirements at smaller strokes, thus lowering the overall power loss. Since the 1990s, all Formula One engine manufacturers used pneumatic valve springs with the pressurised air allowing engines to reach speeds of over 20,000 rpm.[5][6][7]

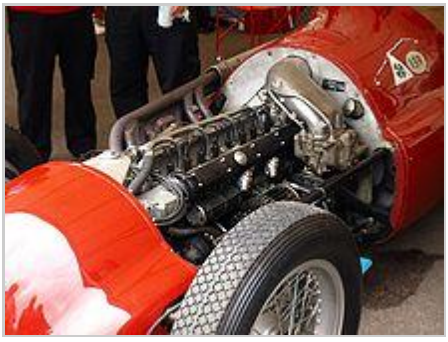
Short stroke engine

Formula one engines use short stroke engines. These engines are common in racing motorcycles and streetbikes.[8] The bore is the diameter of the cylinder in the engine block, and the stroke is the distance the piston travels from top dead-centre (TDC) to bottom dead-centre (BDC) inside the cylinder. To operate at high engine speeds the stroke must be relatively short to prevent catastrophic failure; this is usually connecting rod failure as the rod is under very large stresses at these speeds. Having a short stroke means that a relatively large bore is required to make the 2.4 litre engine displacement. This results in a less efficient combustion stroke, especially at lower RPM. The stroke of a Formula One engine is approximately 39.7 mm (1.56 in), less than half the bore diameter (98.0 mm), what is known as an *over-square* configuration.

In addition to the use of pneumatic valve springs a Formula One engine's high RPM output has been made possible due to advances in metallurgy and design allowing lighter pistons and connecting rods to withstand the accelerations necessary to attain such high speeds, also by narrowing the connecting rod ends allowing for narrower main bearings. This allows for higher RPM with less bearing-damaging heat build-up. For each stroke, the piston goes from a null speed, to almost two times the mean speed, (approximately 40 m/s) then back to zero. This will occur four times for each of the four strokes in the cycle. Maximum piston acceleration occurs at top dead center and is in the region of 95,000 m/s^2, about 10,000 times standard gravity or 10,000 g.

History

Formula One engines have come through a variety of regulations, manufacturers and configurations through the years.[9]



This Alfa Romeo 159 supercharged straight-8 engine of 1950s could produce up to 425 bhp.

1947–1953

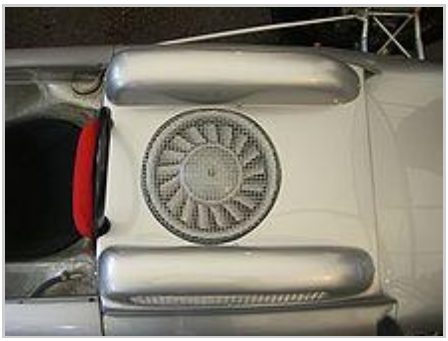
This era used pre-war voiturette engine regulations, with 4.5 L atmospheric and 1.5 L supercharged engines. The Indianapolis 500 (which was a round of the World Drivers' Championship from 1950 onwards) used pre-war Grand Prix regulations, with 4.5 L atmospheric and 3.0 L supercharged engines. The power range was up to 425 hp (317 kW).

In 1952 and 1953, the World Drivers' Championship was run to Formula 2 regulations, but the existing Formula One regulations remained in force and a number of Formula One races were still held in those years.

1954–1960

Engine size was reduced to 2.5 L. 750 cc supercharged cars were allowed but no constructor built one for the World Championship. The Indianapolis 500 continued to use old pre-war regulations. The power range was up to 290 hp (216 kW).

1961–1965

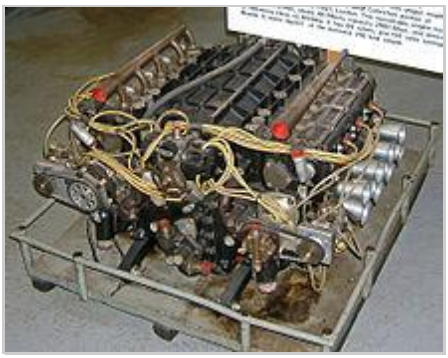


Porsche 804 had a cooling fan to cool the air-cooled flat-8 engine.

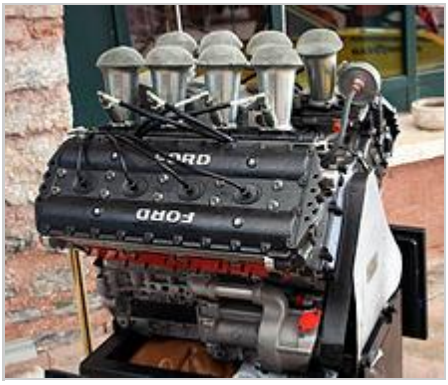
A 2.5 L V8 in the Lancia-Ferrari D50

Introduced in 1961 amidst some criticism, the new reduced engine 1.5 L formula took control of F1 just as every team and manufacturer switched from front to mid-engined cars. Although these were initially underpowered, five years later average power had increased by nearly 50% and lap times were better than in 1960. The old 2.5 L formula had been retained for International Formula racing, but this didn't achieve much success until the introduction of the Tasman Series in Australia and New Zealand during the winter season, leaving the 1.5 L cars as the fastest single seaters in Europe during this time. The power range was between 150 hp (112 kW) and 225 hp (168 kW).

1966–1986



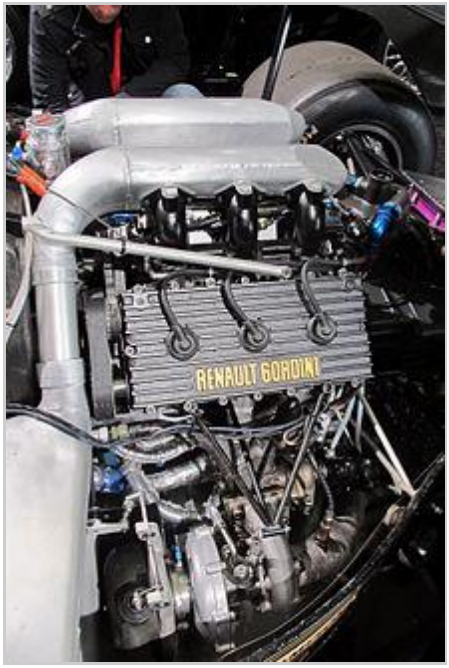
A 1968 British Racing Motors H16, 64-valve, Formula One engine.



A Cosworth DFV 3 litre V8 Formula One engine.

In 1966, with sports cars capable of outrunning Formula 1 cars thanks to much larger and more powerful engines, the FIA increased engine capacity to 3.0 L atmospheric and 1.5 L compressed engines. Although a few manufacturers had been clamouring for bigger engines, the transition wasn't smooth and 1966 was a transitional year, with 2.0 L versions of the BRM and Coventry-Climax V8 engines being used by several entrants. The appearance of the standard-produced Cosworth DFV in 1967 made it possible for small manufacturers to join the series with a chassis designed in-house. Compression devices were allowed for the first time since 1960, but it wasn't until 1977 that a company actually had the finance and interest of building one, when Renault debuted their new Gordini V6 Turbo at the British Grand Prix at Silverstone that year. It was in 1980 that Renault proved that turbocharging was the way to go in order to stay competitive in Formula One (particularly at high-altitude circuits like Kyalami in South Africa and Interlagos in Brazil) ; this engine had a considerable power advantage against the Ford-Cosworth DFV, Ferrari and Alfa Romeo naturally aspirated engines. Following this, Ferrari introduced their all-new turbocharged engine in 1981. Following these developments, Brabham owner Bernie Ecclestone managed to get BMW to make the team turbocharged inline-4 engines from 1982 onwards. And in 1983, Alfa Romeo made a turbocharged V8 engine, and in the same year and following years, Honda, Porsche (badged as TAG), Ford-Cosworth and other smaller companies made turbo-charged engines, mostly twin-turbocharged V6's. By the midpoint of 1985, every competing team had a turbocharged engine in their car. And by 1986, the power figures were becoming quite crazy- all of the engines had unrestricted turbo boost in qualifying, where they were developing 1,350+ hp at 5.5 bar boost (80 psi). These engines and gearboxes would only last about 2–3 laps, and for the race, the turbocharger's boost was restricted to ensure engine reliability; but the engines still produced 950–1000 hp during the race. The power range from 1966 to 1986 was between 285 hp (210 kW) to 500 hp (370 kW), turbos 500 hp (370 kW) to 900 hp (670 kW) in race, in qualifying up to

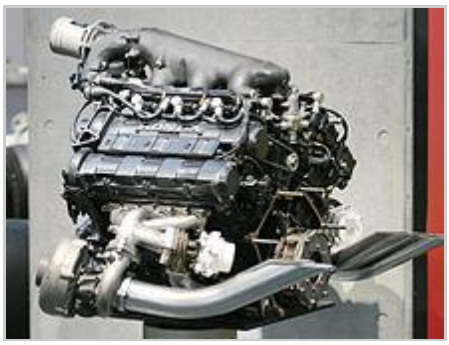
1,300 hp (970 kW). Following their experiences at Indianapolis, in 1971 Lotus made a few unsuccessful experiments with a Pratt & Whitney turbine fitted to chassis which had also 4WD.



Renault 1.5 litre turbo engine

1987–1988

Following the turbo domination, forced induction was allowed for two seasons before its eventual ban. The FIA regulations limited boost pressure, to 4 bar in qualifying in 1987 for 1.5 L turbo; and allowed a bigger 3.5 L formula. These seasons were still dominated by turbocharged engines, the Honda RA167E V6 supplying Nelson Piquet winning the 1987 Formula One season on a Williams also winning the constructors championship, followed by TAG-Porsche P01 V6 in McLaren then Honda again with the previous RA166E for Lotus then Ferrari's own 033D V6.

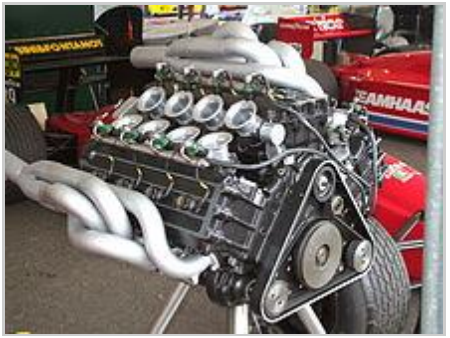

A 1988 Honda RA168E turbocharged V6 engine.

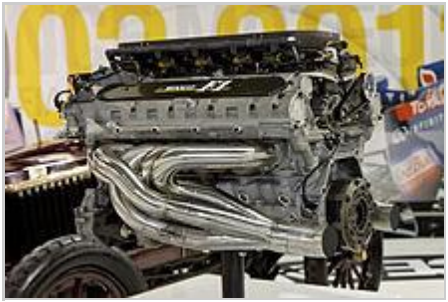
The rest of the grid was powered by the Ford GBA V6 turbo with Benetton, then the only naturally aspirated engine, the DFV-derived Ford Cosworth DFZ 3.5 L V8 outputting 575 hp (429 kW) in Tyrrell, Lola, AGS, March and Coloni.[10] The BMW M12/13 inline four was found in Brabhams BT55 tilted almost horizontally, and in upright position under the Megatron brand in Arrows and Ligier, producing 900 bhp (670 kW) at 3.8 bar in race.[11] Zakspeed was building its own turbo inline four, Alfa Romeo was to power the Ligiers with an inline four but the deal fell through after initial testing had been carried out. Alfa was still represented by its old 890T V8 used by Osella, and Minardi was powered by a Motori Moderni V6.

The 1988 Formula One season was again dominated by turbocharged engines limited to 2.5 bar and Honda with its RA168E turbo V6 producing 675 hp (503 kW) at 12500 rpm in qualifying, this time with McLaren drivers Ayrton Senna and Alain Prost winning all the grands prix except one won by Ferrari with its 033E V6 with about 690 hp (515 kW) at 12800 rpm in qualifying. Just behind, Ford introduced its DFR 3.5 L V8 producing 620 hp (462 kW) at 11000 rpm for Benetton, and the Megatron BMW M12/13 was still powering Arrows ahead of the Lotus-Honda. Judd introduced its CV 3.5 L V8 for March, Williams and Ligier, and the rest of the grid was mainly using previous year's Ford Cosworth DFZ except Zakspeed and the Alfa-Romeo for Osella.

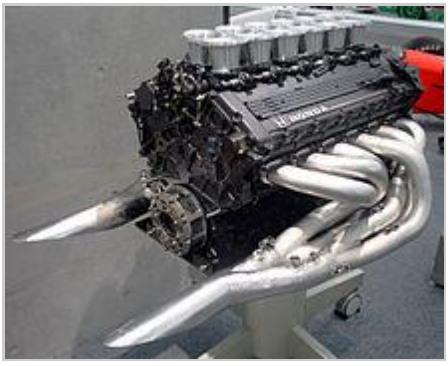
1989–1994

Turbochargers were banned from the 1989 Formula One season, leaving only a naturally aspirated 3.5 L formula. Honda was still dominant with their RA109E 72° V10 giving 675 hp (503 kW) at 13000 rpm on McLaren cars, enabling Prost to win the championship in front of his team-mate Senna. Behind were the Renault RS01 powered Williams, a 67° V10 giving 650 hp (485 kW) at 14300 rpm. Ferrari with its 035/5 65° V12 giving 660 hp (492 kW) at 13,000 rpm. Behind, the grid was powered mainly by Ford Cosworth DFR V8 giving 620 hp (462 kW) at 10,750 rpm except for a few Judd CV V8 in Lotus, Brabham and EuroBrun cars, and two oddballs: the 620 hp (460 kW) Lamborghini 3512 80° V12 powering Lola, and the 560 hp (420 kW) Yamaha OX88 75° V8 in Zakspeed cars. Ford started to try its new design, the 75° V8 HBA 1 with Benetton.


A 1990 W12 3.5 Formula One engine from the Life F1 car


A 1990 Renault RS2 V10 engine.

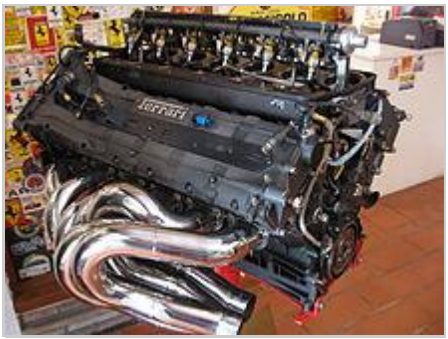
The 1990 Formula One season was again dominated by Honda in McLarens with the 690 hp (515 kW) at 13000 rpm RA100E powering Ayrton Senna and Gerhard Berger ahead of the 680 hp (507 kW) at 12750 rpm Ferrari Tipo 036 of Alain Prost and Nigel Mansell. Behind them the Ford HBA4 for Benetton and Renault RS2 for Williams with 660 hp (492 kW) at 12,800 rpm were leading the pack powered by Ford DFR and Judd CV engines. The exceptions were the better Lamborghini 3512 in Lola and Lotus, and the new Judd EV 76° V8 giving 640 hp (477 kW) at 12,500 rpm in Leyton House and Brabham cars. The two new contenders were the Life which built for themselves an F35 W12 with three four cylinders banks at 60°, and Subaru giving Coloni a 1235 flat 12 from Motori Moderni


A 1991 Honda RA121E V12 engine.

Honda was still leading the 1991 Formula One season in Senna's McLaren with a 710 hp (529 kW) at 13,000 rpm 60° V12 RA121E, just ahead of the Renault RS3 powered Williams benefiting from 700 hp (520 kW) at 12,500 rpm. Ferrari was behind with its Tipo 037, a new 65° V12 giving 710 hp (529 kW) at 13,800 rpm also powering Minardi, just ahead the Ford HBA4/5/6 in Benetton and Jordan cars. Behind, Tyrrell was using the previous Honda RA109E, Judd introduced its new GV with Dallara leaving the previous EV to Lotus, Yamaha were giving its 660 hp (492 kW) OX99 70° V12 to Brabham, Lamborghini engines were used by Modena and Ligier. Ilmor introduced its LH10, a 680 hp (507 kW) at 13000 rpm V10 which eventually became the Mercedes with Leyton House and Porsche sourced a little successful 3512 V12 to Footwork Arrows; the rest of the field was Ford DFR powered.

By the end of the 1994 season, Ferrari's 043 was putting out 820 hp (611 kW) at 15,800 rpm.[12]

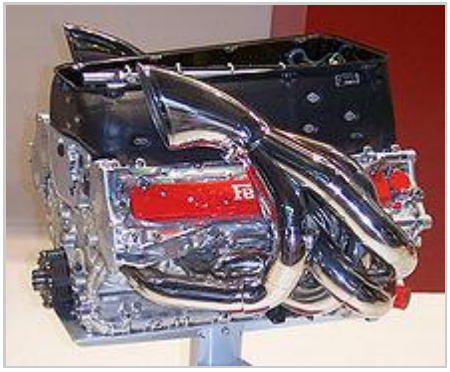
1995–2005


This Ferrari 3.0 litre V12 F1 engine (1995) produced 700 hp (522 kW) at 17,000 rpm

This era used a 3.0 L formula, with a power range between 650 hp (485 kW) and 950 hp (708 kW). Renault was the dominant engine supplier between 1990 and 1997, winning five world championships with Williams and Benetton. From 1998 to 2000 it was Mercedes power that ruled giving Mika Häkkinen two world championships. Ferrari gradually got better with their engine. For 1996, they changed from their traditional V12 engine to a smaller and lighter V10 engine. They preferred reliability to power, losing out to Mercedes in terms of outright power initially. At the 1998 Japanese GP, Ferrari's 047D engine spec was said to produce over 800 bhp (600 kW). From 2000 they were never short of power nor reliability.

BMW started supplying their engines to Williams from 2000. In the first season, the engine was very reliable though slightly short of power compared to Ferrari and Mercedes units. BMW went straight forward with its engine development. The P81,

used during the 2001 season, was able to hit 17,810 rpm. Unfortunately reliability was a big issue with several blowups during the season.



A 2004 Ferrari model 054 V10 engine of the Ferrari F2004

The BMW P82, the engine used by the BMW WilliamsF1 Team in 2002, had hit a peak speed of 19,050 revolutions a minute in its final evolutionary stage. It was also the first engine in the 3.0 litre V10-era to break through the 19,000 rpm-wall, during the 2002 Italian Grand Prix's qualifying.[13] BMW's P83 engine used in 2003 season managed an impressive 19,200 rpm and cleared the 900 bhp (670 kW) mark and weighs less than 200 lb (91 kg).[14]

In 2005, the 3.0 L V10 engine was permitted no more than 5 valves per cylinder.[15] Also, the FIA introduced new regulations limiting each car to one engine per two Grand Prix weekends, putting the emphasis on increased reliability and decreased power output. BMW and Mercedes engines had about 930 bhp (690 kW) in this season. Renault, Honda, Toyota and Ferrari had about 900 bhp (670 kW).

2006–2013

For 2006, the engines had to be 90° V8 of 2.4 litres maximum capacity with a 98 mm (3.9 in) maximum circular bore, which implies a 39.8 mm (1.57 in) stroke at maximum bore. They had to have two circular inlet and exhaust valves per cylinder, be normally aspirated and have a 95 kg (209 lb) minimum weight. The previous year's engines with a rev-limiter were permitted for 2006 and 2007 for teams who were unable to acquire a V8 engine, with Scuderia Toro Rosso using a Cosworth V10, after Red Bull's takeover of the former Minardi team did not include the new engines.[16]

Pre-cooling air before it enters the cylinders, injection of any substance other than air and fuel into the cylinders, variable-geometry intake and exhaust systems, and variable valve timing were forbidden. Each cylinder could have only one fuel injector and a single plug spark ignition. Separate starting devices were used to start engines in the pits and on the grid. The crankcase and cylinder block had to be made of cast or wrought aluminium alloys. The crankshaft and camshafts had to be made from an iron alloy, pistons from an aluminium alloy and valves from alloys based on iron, nickel, cobalt or titanium. These restrictions were in place to reduce development costs on the engines.[17]

The reduction in capacity was designed to give a power reduction of around 20% from the three litre engines, to reduce the increasing speeds of Formula One cars. Despite this, in many cases, performance of the car improved. In 2006 Toyota F1 announced an approximate 740 hp (552 kW) output at 19000 rpm for its new RVX-06 engine,[18] but real figures are of course difficult to obtain.

The engine specification was frozen in 2007 to keep development costs down. The engines which were used in the 2006 Japanese Grand Prix were used for the 2007 and 2008 seasons and they were limited to 19,000 rpm. In 2009 the limit was reduced to 18,000 rpm with each driver allowed to use a maximum of 8 engines over the season. Any driver needing an additional engine is penalised 10 places on the starting grid for the first race the engine is used. This increases the importance of reliability, although the effect is only seen towards the end of the season. Certain design changes intended to improve engine reliability may be carried out with permission from the FIA. This has led to some engine manufacturers, notably Ferrari and Mercedes, exploiting this ability by making design changes which not only improve reliability, but also boost engine power output as a side effect. As the Mercedes engine was proven to be the strongest, re-equalisations of engines were allowed by the FIA to allow other manufacturers to match the power.[19]

2009 saw the exit of Honda from Formula 1. The team was acquired by Ross Brawn, creating Brawn GP and the BGP 001. With the absence of the Honda engine, Brawn GP retrofitted the Mercedes engine to the BGP 001 chassis. The newly branded team won both the Constructors' Championship and the Drivers' Championship from better-known and better-established contenders Ferrari, McLaren-Mercedes, and Renault.

Cosworth, absent since the 2006 season, returned in 2010. New teams Lotus Racing, HRT, and Virgin Racing, along with the established Williams, used this engine. The season also saw the withdrawal of the BMW and Toyota engines, as the car companies withdrew from Formula One due to the recession.[20]

In 2009, constructurs were allowed to use kinetic energy recovery systems (KERS), also called regenerative brakes. Energy can either be stored as mechanical energy (as in a flywheel) or as electrical energy (as in a battery or supercapacitor), with a maximum power of 81 hp (60 kW; 82 PS). Four teams used it at some point in the season: Ferrari, Renault, BMW, and McLaren.

Although KERS was still legal in F1 in the 2010 season, all the teams agreed not to use it. KERS returned for the 2011 season, when only three teams elected not to use it. For the 2012 season, only Marussia and HRT raced without KERS, and in 2013 all teams on the grid had KERS.

2014–present

The FIA announced the intention to change the 2.4-litre V8 engines to 1.6 litre V6 turbo engines for the 2014 season. The new regulations include multiple energy recovery systems [21] and fuel flow restrictions, in order to make Formula One more environmentally aware and to attract more commercial partners.

The new formula reintroduced turbocharged engines, which last appeared in 1988. These have their efficiency improved by turbo-compounding and introduce more energy recovery systems – with power to be harvested from the brakes and exhaust gases.[22] The original proposal for four-cylinder turbocharged engines was not welcomed by the racing teams, in particular Ferrari. Adrian Newey stated during the 2011 European Grand Prix that the change to a V6 enables teams to carry the engine as a stressed member, whereas an inline 4 would have required a space frame. A compromise was reached to adopt V6 turbocharged engines instead.[22] The internal combustion engines are limited to 15,000 rpm, but rarely exceed 12,000 rpm during Grand Prix due to the new reliability and fuel flow restrictions.[23]

Energy recovery systems were allowed to have a maximum power of 120 kW (160 bhp) and 2 megajoules per lap. KERS was renamed Motor Generator Unit-Kinetic (MGU-K). Halso, heat energy recovery systems were allowed under the name Motor Generator Unit-Heat (MGU-H)

Of the previous suppliers, only Mercedes, Ferrari and Renault produced engines to the new formula in 2014, whereas Cosworth stopped supplying engines. Honda returned in 2015 with their own engine, partnering McLaren who used Mercedes power for the 2014 season.[24]

Engine specification progression

<table>
<tr><th rowspan="2">Years</th><th rowspan="2">Other than 4 Stroke piston engines[note 1]</th><th colspan="2">Engine displacement (max.)</th><th rowspan="2">Revolution limit</th><th rowspan="2">Cylinders</th><th colspan="2">Fuel</th></tr>
<tr><th>Naturally aspirated</th><th>Super- or Turbo-charged</th><th>Alcohol</th><th>Gasoline</th></tr>
<tr><td>2014[note 2]</td><td rowspan="15">Prohibited</td><td colspan="2">1.6 L[note 3][25][26]</td><td>15,000 rpm</td><td>90° V6</td><td rowspan="3">5.75%[note 4]</td><td rowspan="6">Unleaded Pump[note 5]</td></tr>
<tr><td>2009–2013[note 6]</td><td rowspan="3">2.4 L</td><td rowspan="8">Prohibited</td><td>18,000 rpm</td><td rowspan="3">90° V8</td></tr>
<tr><td>2008</td><td>19,000 rpm</td></tr>
<tr><td>2007</td><td rowspan="13">Unrestricted</td><td rowspan="14">Prohibited</td></tr>
<tr><td>2006[note 7][27]</td><td rowspan="3">3.0 L</td><td>V10</td></tr>
<tr><td>2000–2005</td><td rowspan="3">Up to 12</td></tr>
<tr><td>1999</td><td rowspan="3">3.5 L</td><td rowspan="3">Unleaded</td></tr>
<tr><td>1995–1998</td></tr>
<tr><td>1992–1994</td></tr>
<tr><td>1989–1991</td><td rowspan="3">Unrestricted</td></tr>
<tr><td>1987–1988</td><td>1.5 L, 4 bar</td><td rowspan="3">Unrestricted</td></tr>
<tr><td>1986</td><td>Prohibited</td><td rowspan="3">1.5 L</td></tr>
<tr><td>1981–1985</td><td rowspan="2">3.0 L</td><td rowspan="6">Unrestricted</td></tr>
<tr><td>1966–1980</td><td rowspan="7">Unspecified</td><td rowspan="2">Pump[28]</td></tr>
<tr><td>1963–1965</td><td>1.5 L (1.3 L min.)</td><td>Prohibited</td></tr>
<tr><td>1961–1962</td><td rowspan="3">Unrestricted</td></tr>
<tr><td>1958–1960</td><td rowspan="2">2.5 L</td><td rowspan="2">0.75 L</td></tr>
<tr><td>1954–1957</td><td>Unrestricted</td></tr>
<tr><td>1947–1953[note 8]</td><td>4.5 L</td><td>1.5 L</td></tr>
</table>

Note:

1. 2 Stroke, Gas Turbine, Rotary, etc.
2. Kinetic (brake) and heat (exhaust) energy recovery systems allowed.
3. Normally aspirated engines are not prohibited. Boost pressure is not limited, but fuel flow rate (which was not regulated up to 2013) is limited to 100 kg per hour. (This translates to about 3.5 bar with the specified fuel at the maximum rpm.)
4. 5.75% bio-sourced alcohol content is required in pump-gas.
5. 'Pump-Gas' means gasoline and additive composition available at ordinary gas-stations.
6. Kinetic (braking) energy recovery system (KERS) was allowed from 2010, and used from 2011.
7. For 2006 and 2007, FIA reserved the right to give special dispensations to teams (without access to new 2.4 L engine) to use 2005 spec 3 L engines with a rev-limiter. This dispensation was given to Scuderia Toro Rosso in 2006.
8. For 1952 and 1953, World Championship races were run to Formula Two rules (0.75 L with compressor, 2 L without), but Formula One regulations remained intact.

Records

Figures correct as of the 2016 Monaco Grand Prix

Bold indicates engine manufacturers competing in Formula One in the 2016 season.

World Championship Grand Prix wins by engine manufacturer

Rank	Engine	Wins	First win	Latest win
1	**Ferrari**	225	1951 British Grand Prix	2015 Singapore Grand Prix
2	Ford	176	1967 Dutch Grand Prix	2003 Brazilian Grand Prix
3	**Renault**	168	1979 French Grand Prix	2014 Belgian Grand Prix
4	**Mercedes**	136	1954 French Grand Prix	2016 Monaco Grand Prix
5	**Honda**	72	1965 Mexican Grand Prix	2006 Hungarian Grand Prix
6	Coventry Climax	40	1958 Argentine Grand Prix	1965 German Grand Prix
7	TAG	25	1984 Brazilian Grand Prix	1987 Portuguese Grand Prix
8	BMW	20	1982 Canadian Grand Prix	2008 Canadian Grand Prix
9	BRM	18	1959 Dutch Grand Prix	1972 Monaco Grand Prix
10	Alfa Romeo	12	1950 British Grand Prix	1978 Italian Grand Prix
11	Maserati	11	1953 Italian Grand Prix	1967 South African Grand Prix
11	Offenhauser	11	1950 Indianapolis 500*	1960 Indianapolis 500*
13	Vanwall	9	1957 British Grand Prix	1958 Morocco Grand Prix
14	Repco	8	1966 French Grand Prix	1967 Canadian Grand Prix
15	Mugen Honda	4	1996 Monaco Grand Prix	1999 Italian Grand Prix
16	Matra	3	1977 Swedish Grand Prix	1981 Canadian Grand Prix
17	Porsche	1	1962 French Grand Prix	
17	Weslake	1	1967 Belgian Grand Prix	
17	**TAG Heuer**	1	2016 Spanish Grand Prix	

* The Indianapolis 500 was part of the World Drivers' Championship from 1950 to 1960.

Most wins in a season

By number

Rank	Manufacturer	Season	Races	*Wins*	Percentage	Engine(s)	Supplying to
1	**Renault**	1995	17	16	94.1%	RS7	Benetton, Williams
	Mercedes	2014	19		84.2%	PU106A Hybrid	Mercedes, McLaren, Williams, Force India
		2015				PU106B Hybrid	Mercedes, Williams, Force India, Lotus
4	Ford	1973	15	15	100.0%	DFV	Lotus, Tyrrell, McLaren, Brabham, March, Shadow, Surtees, Iso-Marlboro, Ensign
	Honda	1988	16		93.8%	RA168E	McLaren, Lotus
	Ferrari	2002	17		88.2%	Tipo 050, Tipo 051	Ferrari
		2004	18		83.3%	Tipo 053	
8	**Renault**	2013	19	14	73.7%	RS27-2013	Red Bull, Lotus, Williams, Caterham
9	Ford	1974	15	12	80.0%	DFV	McLaren, Tyrrell, Lotus, Brabham, Hesketh, Shadow, March, Frank Williams Racing Cars, Surtees, Lola, Token, Trojan, Penske, Parnelli, Lyncar, Ensign, Amon, Maki
		1977	17		70.6%		Lotus, McLaren, Wolf, Tyrrell, Shadow, Fittipaldi, Ensign, Surtees, Penske, Williams, Boro, LEC, McGuire, Kojima, Hesketh, March
	TAG	1984	16		75.0%	TTE PO1	McLaren
	Renault	1996	16		75.0%	RS8	Benetton, Williams
		2011	19		63.2%	RS27-2011	Red Bull, Renault, Lotus

By percentage

Rank	Manufacturer	Season	Races	Wins	*Percentage*	Engine(s)	Supplying to
1	Ford	1969	11	11	100.0%	DFV	Matra, Brabham, Lotus, McLaren
		1973	15	15			Lotus, Tyrrell, McLaren, Brabham, March, Shadow, Surtees, Iso-Marlboro, Ensign
3	**Renault**	1995	17	16	94.1%	RS7	Benetton, Williams
4	**Honda**	1988	16	15	93.8%	RA168E	McLaren, Lotus
5	Ford	1968	12	11	91.7%	DFV, FVA	Lotus, McLaren, Matra
6	**Ferrari**	2002	17	15	88.2%	Tipo 050, Tipo 051	Ferrari
7	**Ferrari***	1952	8	7	87.5%	Tipo 500, Tipo 375	Ferrari
8	Alfa Romeo**	1950	7	6	85.2%	Tipo 158, Tipo 159	Alfa Romeo
9	**Mercedes**	2014	19	16	84.2%	PU106A Hybrid	Mercedes, McLaren, Williams, Force India
		2015				PU106B Hybrid	Mercedes, Williams, Force India, Lotus

* Only Alberto Ascari raced in the 1952 Indianapolis 500 with Ferrari.
** Alfa Romeo did not race in the 1950 Indianapolis 500.

Most consecutive wins

Rank	Manufacturer	Wins	Season(s)	Races	Engine(s)	Winning team(s)
1	Ford	22	1972, 1973, 1974	1972 Austrian Grand Prix–1974 South African Grand Prix	DFV	Lotus, Tyrrell, McLaren, Brabham
2	Ford	20	1968, 1969, 1970	1968 British Grand Prix–1970 Monaco Grand Prix	DFV	Lotus, Matra, McLaren, Brabham, March
3	**Renault**	16	1995, 1996	1995 French Grand Prix–1996 San Marino Grand Prix	RS7, RS8	Benetton, Williams
4	**Honda**	11	1988	1988 Brazilian Grand Prix–1988 Belgian Grand Prix	RA168E	McLaren
5	**Ferrari**	10	2002	2002 French Grand Prix–2002 Japanese Grand Prix	Tipo 051	Ferrari
	Mercedes		2015, 2016	2015 Japanese Grand Prix–2016 Russian Grand Prix	PU106B Hybrid, PU106C Hybrid	Mercedes
7	Ford	9	1980, 1981	1980 Dutch Grand Prix–1981 Belgian Grand Prix	DFV	Brabham, Williams
	Renault		2013	2013 Belgian Grand Prix–2013 Brazilian Grand Prix	RS27-2013	Red Bull
9	Ford	8	1974, 1975	1974 Austrian Grand Prix–1975 Spanish Grand Prix	DFV	Brabham, Lotus, McLaren, Tyrrell
			1976, 1977	1976 German Grand Prix–1977 Argentine Grand Prix		McLaren, Penske, March, Lotus, Wolf
	TAG		1984, 1985	1984 British Grand Prix–1985 Brazilian Grand Prix	TTE PO1	McLaren
	Honda		1987	1987 Monaco Grand Prix–1987 Italian Grand Prix	RA166E, RA167E	Lotus, Williams
	Ferrari		2003, 2004	2003 Italian Grand Prix–2004 Spanish Grand Prix	Tipo 052, Tipo 053	Ferrari
	Mercedes		2014, 2015	2014 Italian Grand Prix–2015 Australian	PU106A Hybrid, PU106B Hybrid	Mercedes

				Grand Prix		

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- Formula One Engines (http://www.f1technical.net/articles/4) In-depth article covering facts, evolution and tech specs of F1 engines
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