

30 years of BMW diesel engines. Table of Contents.



1. Efficient driving pleasure at high pressure.	
30 years of BMW diesel engines.	2
2. Milestones in technology development.	14
3. Overview of facts and figures.	
1983 – 2013: Technical data for selected BMW models powered by diesel engines.	17



1. Efficient driving pleasure at high pressure. 30 years of BMW diesel engines.

A diesel engine in a BMW? At the beginning of the 1980s, this combination was virtually inconceivable for many fans of the brand. The diesel engines known at the time were regarded as loud and not very sporty. However, the high level of efficiency and the associated fuel-efficiency commended this type of engine. In the wake of the oil crisis, BMW therefore developed initial plans already in 1975 to launch a diesel engine, which went into series production just three years later. Right from the start, it was clear that a diesel engine from BMW would have to feature some very special qualities. The challenge was to combine the fuel economy and long service life typical of diesel engines with high performance, spontaneous development of power and optimised drive quality. Already early on, the BMW engineers therefore opted for an inline six-cylinder power unit with swirl-chamber combustion system and an exhaust turbocharger. This power plant was to premiere in a BMW 5 Series saloon. In spring 1983, the outcome was presented to the press and on the world stage at the Frankfurt Motor Show (IAA). The BMW 524td was the first diesel model to be manufactured under the brand and it was the world's most powerful vehicle of its type. This car became the trailblazer for a new, particularly efficient form of driving pleasure.

Precisely 90 years previously, the German engineer Rudolf Diesel had started up the first prototype of his ideal "pressure-ignited heat engine". The principle underlying this engine involved heating air in the combustion chamber at high pressure to a temperature where the injected fuel ignited spontaneously, but it was initially only put forward convincingly in theory. The practical application of the theory required major resources which Rudolf Diesel was nevertheless willing to invest. His efforts were rewarded when his revolutionary power unit was made ready for production. The first diesel engine factory started up in 1898. The diesel engine went on to blaze a successful trail across the world in ships, locomotives and trucks.

Launch in Steyr: The new engine is manufactured in a new plant.

However, use of this type of engine to power a BMW was a long way off. After reaching the fundamental decision to develop a diesel engine, the German automotive manufacturer initially established a joint-venture company with Austrian company Steyr-Daimler-Puch-AG for the development, production and sale of diesel engines. In 1979, a joint engine plant was opened in Steyr, Austria. Although the cooperation came to an end three years later and BMW bought up the shares held by its partner, the production of petrol and diesel

engines for the BMW 5 Series was carried out on a joint production line located in Steyr from 1983.

The power unit for the BMW 524td was designed by the BMW engine development engineers in Munich on the basis of an inline six-cylinder petrol engine. The common features were restricted to the basic structure, the principle for supplying oil, and the overhead valve timing with a camshaft driven by a toothed belt. All other details were designed from scratch in order to meet the special requirements of the diesel principle and the development goals for the first BMW engine of this type. The thermal load and the high combustion pressure of the engine with 22.0 : 1 compression ratio were the main factors to be taken into account. The grey-cast crankcase was provided with a cooling system based on the longitudinal flow principle with water compartments configured between the cylinders and a special cover plate capable of withstanding the high forces applied to the cylinder-head bolts. The forged crankshaft generated a longer stroke and was also manufactured from particularly high-grade steel. The construction and material properties of the pistons, connecting rods and crankshaft bearings were also modified in order to be able to guarantee maximum reliability even under full load and in continuous operation. Oil supply was provided by a particularly powerful screw oil pump.

The cross-flow principle applied in the lightweight alloy cylinder head was adapted from petrol engines and modified to optimise power with large valve diameters and high flow cross-sections. An advanced development of the swirl-chamber combustion system specifically designed for BMW made a significant contribution to enhancing performance while at the same time reducing fuel consumption and noise emissions. The engine of the BMW 524td was also fitted with an Instant Start System which significantly shortened the preheating times typical of diesel engines.

Spontaneous development of power and high engine output per litre of displacement thanks to turbocharger.

The development engineers designing the engine decided to use an exhaust turbocharger at an early stage because sportiness and drive quality typical for the brand were also part of the development targets alongside favourable consumption and emission values. The existing conditions for a pulse-charging principle available in an inline six-cylinder engine were used to optimise the efficiency. The exhaust gases from each of three cylinders were brought together and conducted to the turbine wheel separately. This resulted in particularly dynamic behaviour for the charger system. The turbocharger deployed in BMW's first diesel engine already started its performance-enhancing work at 1 500 min⁻¹, the full charge pressure of

0.8 bar was available at $2\,200\text{ min}^{-1}$, while the maximum torque of 210 newton meters was delivered at $2\,400\text{ min}^{-1}$. This design allowed the high torque to be used for smooth driving without continually having to change gear. It also allowed high speeds to be attained in fuel-efficient operation while running at partial load.

Maximum power of 85 kW/115 hp is generated from a displacement of 2 443 cubic centimetres. The resulting specific output of 34.8 kW/47.3 hp generated values “which had previously been regarded as impossible in a diesel engine,” according to an announcement by BMW on the occasion of the world premiere at the Frankfurt Motor Show in 1983. BMW continued by saying that these statistics catapulted the BMW 524td to “the fastest series diesel in the world” at a stroke. 12.9 seconds sufficed for the sprint from zero to 100 km/h, and the top speed of 180 km/h was more than impressive for a diesel automobile at that time. The press lauded “the refreshing energy” and the “continuous development of power” demonstrated by the turbocharged six-cylinder engine. The automotive magazine “auto, motor und sport” also highlighted the favourable acoustic properties: “When the diesel engine has warmed up it can hardly be distinguished from a petrol engine, the turbo engine purrs smoothly along the road so quietly and free of vibration.” The consumption data were all the more impressive since 7.1 litres delivered 100 kilometres according to the ECE standard of the time.

BMW met the high-pitched expectations at home and abroad with its successful diesel premiere. Shortly after the launch of production in Steyr, the US Ford Group concluded an agreement with BMW for the supply of diesel engines. The era of more fuel-efficient engines with sporty performance characteristics also appeared to have arrived in the USA. Ford powered its Lincoln Continental flagship model with the sports diesel engine from “good old Germany” but the US market continued to favour gasoline engines. The development in Europe was quite different. Between 1973 and 1982, the proportion of diesel models travelling on roads in West Germany increased from four to 15 percent. In France, Belgium and Italy, the proportion of diesel engines was even higher. And BMW continued to rank among the manufacturers who were exerting a profound influence in empowering the diesel boom. Already in 1986, virtually every third new BMW 5 Series car registered in Germany was powered by the turbodiesel engine – within the space of just four years, the BMW 524td had developed into the most popular model in the series.

Even more fuel efficient: aspirated engine version – also for the BMW 3 Series.

The BMW 524td was a milestone for BMW and for the diesel engine. The positive reception provided clear evidence that the diesel engine would play an important role for BMW over the long term and that its importance would continue to grow. BMW therefore also established a development centre for diesel engines at the new Steyr location alongside its production facility. The first diesel version of the BMW 3 Series was presented in 1985 with the aim of expanding the model range. The engine designers had developed an aspirated version of the inline six-cylinder engine for the BMW 324d. This engine generated 63 kW/86 hp and delivered a maximum torque of 152 newton metres. The fully encapsulated engine impressed with its running smoothness and low level of noise emissions, in both respects meeting the standards typical of the brand. It powered the saloon to achieve acceleration from zero to 100 km/h in 16.1 seconds and yielded satisfactory consumption statistics of 6.9 litres per 100 kilometres with the ECE 'Euromix' formula.

The engine version consistently tailored to fuel efficiency was also supplied in the BMW 5 Series shortly afterwards. The debut of the BMW 524d took place at the Geneva Motor Show in 1986 and the model went on to be a sales success in France and Italy in particular. By the same token, the turbodiesel was also fitted in the BMW 3 Series from 1987. A diesel family was now available with the models BMW 524td and BMW 524d, as well as the BMW 324td and BMW 324d in order to win customers over to the particularly fuel-efficient form of driving pleasure.

BMW innovations for consistent emission reduction: Digital Diesel Electronics and catalytic converter.

BMW also took a pioneering lead at an early stage in the reduction of diesel-specific exhaust emissions. As early as 1989, the BMW 524td and BMW 324td models were fitted with a diesel catalytic converter. The prerequisites for effective after-treatment of exhaust gases with a catalytic converter were created in advance with Digital Diesel Electronics (DDE). The world's first electronic control for a diesel engine was responsible for controlling and monitoring the injection and the combustion sequence. This also guaranteed the temperature control necessary for catalytic emission control.

The DDE was presented in 1987 for the upcoming model change in the BMW 5 Series for the BMW 524td and in parallel also for the BMW 324td. This was the first time that diesel engines had been provided with a system that matched the computer-controlled engine management for petrol engines with fuel injection, and its operational principle continues to be applied today. The much more precise engine control compared with mechanical systems

exerted a positive impact on consumption and exhaust emissions as well as improving the development of power and the acoustic properties of the power unit.

The DDE control unit processed the data gathered from the sensors and switching contacts concerning the position of the accelerator pedal, the driving speed, engine speed, actions of the braking system, clutch and air-conditioning, the air temperature, cooling water and fuel, as well as the slider position of the injection pump and the charge pressure. Two powerful microprocessors compared the recorded data with defined nominal values and calculated the necessary adjustments of the controlled variables for ideal operating conditions within fractions of a second. This enabled the start of injection and the volume of fuel injected to each cylinder, the charge pressure and the exhaust-gas recirculation to be matched precisely with each other. Optimum power could be controlled reliably and precisely with minimum consumption and maximum quality of exhaust gases, and the same was true of the temperature-controlled injection volume when starting the engine. The DDE also acted to prevent the engine overheating and ensured uniform idling with low revs. Fault diagnosis and cold-start control with minimum emissions also numbered among the range of functions featured in this pioneering system. In 1989, the non-turbocharged engine powering the BMW 324d was also fitted with Digital Diesel Electronics.

1991: New diesel generation, new best values.

Eight years after the launch of the diesel age at BMW, the second generation of this engine family was presented at the Frankfurt Motor Show in 1991. The new inline six-cylinder engine was an advanced design with lots of refined details. The new engine also operated on the principle of the swirl chamber, while valve timing was carried out with a chain-driven camshaft and cup tappets with hydraulic valve-clearance compensation. The combustion chambers had V-shaped piston bowls. The motor for the injection and coolant pump, and the oil sump were also designed afresh. A modified DDE system and an oxidation catalytic converter were standard in the power unit supplied with two power levels, each fitted with a turbocharger. The displacement was 2 498 cubic centimetres. The model designations changed accordingly. The basic version generating 85 kW/115 hp was introduced in the BMW 325td, while the world's most powerful diesel engine in this displacement class generated 105 kW/143 hp and made its debut in the BMW 525tds.

The torque curve and the acoustic properties benefitted particularly from the innovations, as did the consumption and emissions behaviour. Charge air cooling for the more powerful of the two engine versions also created a lower thermal load, a further reduction in consumption and lower levels of nitrogen

oxides in the exhaust gases. The average fuel consumption over 100 kilometres was 7.0 litres for the new BMW 3 Series and 7.2 litres for the new BMW 5 Series. Pollution levels were significantly below all European limits, while the diesel models from BMW once again defined benchmarks for driving pleasure. The athletic talents of the diesel engine were highlighted with maximum torque of 222 Nm for the BMW 325td and 260 Nm for the BMW 525tds, alongside values of 12.0 (BMW 325td) and 11.0 seconds (BMW 525tds) for acceleration in the sprint to 100 km/h. "The more powerful diesel generated a surprising amount of power even at low revs," was the assessment of "auto, motor und sport" in their test report on the BMW 525tds. The engine also had full encapsulation with temperature-dependent, adjustable air baffles – a pioneering detail for improving the acoustic and aerodynamic properties and the warm-up performance.

BMW succeeded in exploiting and enhancing the sustained diesel boom with the new engines. Every sixth newly registered automobile across Europe was now powered by a diesel engine under the bonnet. Petrol and diesel models were even running neck and neck in France. Design engineers developing engines at BMW used their know-how to consistently expand the portfolio of power units. In 1994, an inline four-cylinder engine derived from the inline six-cylinder engine was presented. The 1.7 litre power unit generating 66 kW/90 hp was installed in the BMW 318tds. A new oil-water heat exchanger gave the four-cylinder engine particularly favourable acoustic characteristics and emission values. The average consumption of the BMW 318tds was 5.9 litres for every 100 kilometres.

1998: New diesel engines with four, six and eight cylinders, launch of common-rail direct injection.

The year 1998 marked several milestones in the development story of BMW diesel engines. A new inline six-cylinder diesel and a new four-cylinder diesel engine were introduced. At the same time, a V8 diesel power unit was being prepared for series production and it was launched on the marketplace in 1999.

A uniform design principle gave the 2.0 litre four-cylinder engine and 3.0 litre six-cylinder engine outstanding qualities in the competitive environment relating to power development, acoustics and efficiency. Hollow sections cast in the outside walls increased the stiffness of the crankcase. Particularly efficient charge change was provided by new cylinder heads with four-valve technology alongside innovative intake duct routing and roller cam followers. Turbochargers with electrically controlled variable inlet geometry offered completely new possibilities for combining spontaneous response with high power in the upper rev range. Dual mass flywheel and vibration dampers

optimised the drive quality. The inline six-cylinder engine was also mounted on electronically controlled hydraulic bearings to reduce the vibrations.

Pre-injection also helped to minimise the noise emissions typical of diesel emissions particularly in a cold start. Both engine versions were now equipped with direct injection. A high-pressure distributor pump was responsible for fuel supply in the four-cylinder engine. The new generation of inline six-cylinder engines featured a common-rail direct injection for the first time. The common rail for all cylinders enabled fuel flow to be controlled extremely precisely even for the larger engine.

The four-cylinder engine of the new BMW 320d mobilised maximum power of 100 kW/136 hp and maximum torque of 280 Nm, which was available at 1 750 min⁻¹. Before series production was rolled out, the engine already displayed its extraordinary capabilities with a historic success in motor sport. In June 1998, Hans-Joachim Stuck, Christian Menzel, Marc Duez and Andreas Bovensiepen won the 24 Hour Race held at the Nürburgring driving a BMW 320d. This was the first victory achieved by a diesel-engined touring car in an endurance race. The series BMW 320d also proved to be powerful, efficient and reliable. It combined an acceleration value of 9.9 seconds in the sprint from zero to 100 km/h with average consumption of 5.7 litres per 100 kilometres.

The new inline six-cylinder engine was the world's most powerful diesel engine to be supplied in a car, with output of 135 kW/184 hp and maximum torque of 390 Nm. This engine accelerated the new BMW 530d from zero to 100 km/h in just 8.0 seconds and the average consumption of this model was 7.2 litres per 100 kilometres.

The BMW 530d was presented in spring 1998 as a saloon and touring model. The BMW 730d had its premiere at the same time. Two years previously, BMW had already paved the way for introducing the diesel engine into the luxury class. The BMW 725tds was the first diesel model in the BMW 7 Series. Its successor was even more successful in also achieving the exceptionally attractive combination of high torque and efficiency in this vehicle class. The new inline six-cylinder engine generated a maximum torque increased to 410 Nm in the BMW 730d, and recorded a time of 9.2 seconds for the sprint to 100 km/h with average consumption of 8.7 litres for each 100 kilometres. However, this was by no means the apogee for the potential of diesel technology. In spring 1999, the first V8 diesel engine was presented by BMW. The engine developed for the BMW 740d had a displacement of 3.9 litres and mobilised maximum power of 175 kW/238 hp and maximum torque of 500 Nm, which was already available at 1 800 min⁻¹.

The most important attributes of the new flagship diesel engine included a grey-cast alloy manufactured with vermicular graphite (GGV). This gave it a particularly strong engine block with cylinder banks configured at an angle of 90 degrees, the bi-turbocharging with charge-air cooling and electrically adjustable turbine guide vanes, four-valve technology with innovative airflow for the intake ducts and common-rail injection with centrally positioned injection nozzle. Another special feature was the cracked bearing blocks for the crankshaft. This involved the bearing cover of the crankcase cast as a single unit being blasted off hydraulically. When the two parts were subsequently brought together the interface in the area of the fracture formed a particularly tight positive fit and high strength when subject to lateral forces. The large number of innovations ensured that the most ambitious aspirations for drive quality in a luxury automobile were fulfilled. Even in this segment the power unleashed by the engine defined completely new benchmarks. The BMW 740d accelerated from zero to 100 km/h in 8.4 seconds and the top speed was 242 km/h. Only the consumption values of 9.8 litres per 100 kilometres according to the EU standard were modest. The factors producing exemplary emission values included a preconverter and main catalytic converter for each cylinder bank.

Subsequent years saw continuous further development of the diesel engines, which were now installed in three model series, and from 2001 also in the new BMW X5 Sports Activity Vehicle. A second 2.5 litre version of the inline six-cylinder engine generating 120 kW/163 hp and 350 Nm was included in the range and the 3.0 litre version was upgraded to 142 kW/193 hp and 410 Nm. In the summer of 2001, the portfolio of the four-cylinder diesel engines was renewed. An 85 kW/115 hp version of the 2.0 litre power unit provided an entry-level engine and this was installed in the BMW 318d. The BMW 320d was given a comprehensively revised four-cylinder engine with output of 110 kW/150 hp and a maximum torque of 330 Nm. The engine had a displacement of 1 995 cubic centimetres, a further strengthened and yet lighter crankcase, two balance shafts, the now fifth generation of DDE engine control, a new Instant Start System and new intake ducts. It was also the world's first engine to be fitted in a production series automobile with second-generation common-rail direct injection. Power and acoustics were both optimised with injection pressure increased to 1 600 bar and new flow-rate control. The fuel could now be injected into the combustion chambers in up to five injection stages for each power stroke. The precise fuel control rendered cooling the fuel superfluous and ensured a significant increase in efficiency. The new BMW 320d sprinted from zero to 100 km/h in 8.9 seconds, and its average fuel consumption according to the EU standard was 5.5 litres per 100 kilometres.

Just one year later, the second generation of common-rail direct injection also became the standard in the six-cylinder and eight-cylinder diesel engines. Moreover, the displacement of the inline six-cylinder engine was expanded to 2 998 cubic centimetres alongside further optimisation of details. The engine's output increased to 160 kW/218 hp, and its maximum torque went up to 500 Nm. The V8 engine of the BMW 740d now delivered 190 kW/258 hp and a maximum torque of 600 Nm.

2004: Growing engine diversity, premiere for multi-stage charging.

In the new millennium, the appeal and popularity of diesel engines were mutually enhanced in parallel. However, the boom that had been emerging for some time was still almost exclusively restricted to Europe. In 2002, the proportion of diesel models accounted for by new registrations in Germany was 38 percent and the statistic for Europe as a whole was even slightly above this figure. Statistics at BMW undoubtedly reflected the trend because more than 40 percent of all the automobiles supplied to Europe by the brand were powered by a diesel engine for the first time in 2002. There was no doubt about it, diesel engines had undergone a spectacular change in image over the two decades since the launch of the BMW 524td. This was also reflected in the model range of BMW. In the summer of 2003, a coupé powered by a diesel engine was launched for the first time in the history of the company. In the BMW 330cd, a six-speed manual transmission transferred the power of the inline six-cylinder diesel engine generating 150 kW/204 hp to the rear wheels. The engine developed maximum torque of 410 Nm and accelerated the coupé from zero to 100 km/h in 7.2 seconds. Sporty, elegant design, torque and efficiency combined to redefine signature driving pleasure for the brand.

One year later, BMW went one step further. The diesel engine was now ready to power a convertible. The four-cylinder diesel engine took on this pioneering role in the BMW 320d convertible, and the inline six-cylinder engine followed one year later. The brand had successfully entered the compact segment with new BMW 1 Series and right at the beginning of 2004 two four-cylinder diesel models were launched in this series: powered by the 90 kW/122 hp BMW 118d and the 120 kW/163 hp BMW 120d.

2004 saw the diversity of the product range rising to a new level in the BMW 5 Series and the power achievable with a diesel engine also increased. The BMW 535d joined the BMW 520d four-cylinder version and the two models BMW 525d und BMW 530d. The inline six-cylinder engine of the BMW 535d had been given an innovative turbocharger system. BMW was the world's first automobile manufacturer to install a multi-stage charging process designated as a Variable Twin Turbo in a series automobile. Power values were achieved

with two turbochargers of different size which could previously only be achieved with significantly bigger displacement and therefore heavier engines. At low engine speeds, only the smaller of the two turbochargers started operating and the bigger charger initially supported it as a pre-compressor when the load was increasing in order then to operate as the primary supplier of the charge pressure. The cooperation between the two chargers was coordinated by an electronically controlled system comprising turbine control, compressor bypass and waste gate. The effect of the multi-stage charging process was impressive. The new 3.0 litre power unit generating 200 kW/272 hp and a maximum torque of 560 Nm was the most world's most powerful six-cylinder engine supplied for series automobiles. This engine accelerated the BMW 535d from zero to 100 kilometres in just 6.5 seconds and its average consumption was 8.0 litres per 100 kilometres. Since 2007, the Twin Turbo Diesel also enriched the range of engines supplied for the luxury models in the BMW 6 Series.

The V8 diesel engine for the BMW 7 Series nevertheless remained the front runner for performance evaluation among the various models within the brand. In spring 2005, the eight-cylinder model now designated BMW 745d was given a power unit with a completely new design, an all-aluminium crankcase and an output of 220 kW/300 hp and maximum torque of 700 newton metres in order to maintain this position. The V8 displacement was now 4.4 litres and the weight was reduced by 30 kg compared with its predecessor.

The catalytic converters fitted to the engine were supported by a diesel particle filter for purification of the exhaust gases. Starting in March 2004, BMW had fitted all diesel models in the BMW 5 Series with the supplementary after-treatment system. The BMW 7 Series and BMW 3 Series followed shortly afterwards. Once again, this saw BMW playing a pioneering role in this area. By the end of 2005, the particle filter was part of the series equipment for all BMW diesel models.

2007: BMW EfficientDynamics technology for even more driving pleasure and less CO₂.

From 2007, another generation change for diesel engines with four and six cylinders accompanied by the introduction of BMW EfficientDynamics technology facilitated an even more favourable relationship between driving pleasure and consumption. The diesel engines made a significant contribution to empowering BMW models to take over the leading role on efficiency in all relevant segments. A continuous process introduced technologies for reducing consumption and emissions to four-cylinder diesel engines followed by six-cylinder diesel models. These technologies included

brake energy regeneration, shift-point display and Auto Start Stop function, alongside demand-controlled auxiliary units and electromechanical servo steering. In parallel, the efficiency of the engines was optimised once more. The new four-cylinder and six-cylinder power units shared the key attributes with a weight-optimised aluminium crankcase, turbocharger and the third generation of common-rail direct injection. Each of the two engine families were also supplied in three power levels because the most powerful version of the four-cylinder engine was now fitted with a multi-stage charging process.

The BMW 118d was a particularly striking example of the progress made on efficiency in the new generation of engines with an output of 105 kW/143 hp and an EU average consumption of 4.5 litres. This car received the prestigious international award “World Green Car of the Year” in 2008.

In the same year, BMW believed that the time had come also to establish advanced diesel technology in the automobile markets of North America. The models BMW X5 xDrive35d and the BMW 335d saloon were launched in the USA and Canada with the double turbocharged 3.0 litre engine. The engine's purification of exhaust gases was supplemented by BMW BluePerformance technology. Meanwhile, BluePerformance technology was transferred to Europe in order to reduce the proportion of nitrogen oxides in exhaust gases. This technology depends on the model and consists either of a nitrogen-oxide storage catalytic converter or an SCR catalytic converter with urea injection.

In 2009, BMW was also the world's first automobile manufacturer to introduce a misfuelling inhibitor for diesel models. A safety catch for the tank inlet prevents the erroneous fuelling of a car with petrol.

2011: More efficient and cleaner than ever thanks to BMW TwinPower Turbo and BMW BluePerformance.

Diesel engines are now being supplied by BMW in all model series with the exception of the BMW Z4 roadster. The launch of the new BMW 1 Series in 2011 expanded the selection of four-cylinder diesel engines by a 1.6 litre version. Today, the combination of turbocharging and common-rail direct injection is a hallmark for outstanding efficiency as BMW TwinPower turbo technology. Combined with BMW BluePerformance technology it is now already equipped for compliance with the EU6 emissions standard applicable from autumn 2014. The current performance spectrum ranges from 70 kW/95 hp in the BMW 114d fitted with a 1.6 litre four-cylinder engine to 280 kW/381 hp for the BMW M Performance Automobiles BMW M550d xDrive saloon, BMW M550d xDrive touring, BMW X5 M50d and BMW

X6 M50d, which are powered by a 3.0 litre inline six-cylinder engine. This engine continues a 30-year-old tradition. Once more the world's most powerful diesel engine of its kind comes from BMW. The BMW M550d xDrive saloon sprints from a standing start to 100 km/h in 4.7 seconds and its average consumption in conformity with the EU standard is 6.2 litres per 100 kilometres. The consumption of this model is therefore almost one litre less than that of the BMW 524td from the year 1983 – with more than three times the output.

Today, the performance of the one-time diesel pioneer is reflected in the BMW 116d EfficientDynamics Edition with a 1.6 litre four-cylinder engine generating 85 kW/116 hp. This engine can justifiably be described in terms of superlatives. The BMW 116d EfficientDynamics Edition has an average consumption of 3.8 litres per 100 kilometres in the EU test cycle and a CO₂ value of 99 grams per kilometre and is currently the flagship car for consumption and emission values in the BMW model range.

2. Milestones of technology development.



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| 1983 | Premiere for the first diesel engine from BMW; the 85 kW/115 hp inline six-cylinder engine with swirl-chamber combustion system and turbocharger was launched in the BMW 524td. |
| 1985 | First version of the BMW diesel power unit with an aspirated engine installed in the BMW 324d generating 63 kW/86 hp. |
| 1987 | Digital Diesel Electronics – the world's first electronic control for diesel engines debuted in the BMW 524td and in the BMW 324td; computer-controlled engine management for controlling the start of injection and the amount of petrol injected, charging pressure and exhaust gas recirculation optimises power, consumption, emissions and cold-start behaviour. |
| 1989 | First diesel catalytic converter for turbodiesel models from BMW. |
| 1991 | Second generation of the inline six-cylinder diesel engine, now with chain-operated camshaft, V-shaped piston bowls, new DDE and additionally with charge-air cooling, full encapsulation and temperature-dependent adjustable air baffles in the new 105 kW/143 hp BMW 525tds flagship model. |
| 1994 | First four-cylinder diesel engine from BMW: derived from the inline six-cylinder engine the 1.7 litre power unit installed in the BMW 318tds with an oil-water heat exchanger generates power of 66 kW/90 hp. |
| 1996 | The diesel engine is launched in the luxury class: BMW 725tds as the first diesel model in the BMW 7 Series. |
| 1998 | New generation of four-cylinder and six-cylinder diesel engines: extremely stiff crankcase with hollow sections, four-valve technology, turbocharger with electrically controlled variable inlet geometry, dual mass flywheel and hydraulic bearings to reduce vibrations in the inline six-cylinder engine; four-cylinder engine now generated 100 kW/136 hp and for the first time provided with direct injection using a high-pressure distributor pump; the new six-cylinder engine was fitted with common-rail direct injection for the first time and was the world's most powerful diesel engine to be supplied in a car with output of 135 kW/184 hp. |
| 1999 | Introduction of the BMW 740d with the first V8 diesel engine from BMW; 3.9 litre displacement, grey-cast alloy with vermicular graphite (GGV), cracked bearing blocks for the |

crankshaft, bi-turbocharging, four-valve technology, common-rail direct injection, 175 kW/238 hp.

- 2001 Second generation of common-rail direct injection with new flow-rate control and up to five injection stages for each power stroke, installed for the first time in the four-cylinder diesel engine of the BMW 320d with 110 kW/150 hp.
- 2002 Launch of the second generation of common-rail direct injection in the six-cylinder and eight-cylinder engines.
- 2003 First BMW coupé with diesel engine: BMW 330cd with inline six-cylinder engine generating 150 kW/204 hp.
- 2004 Diesel power unit also installed for the first time in a BMW convertible: BMW 320d convertible with four-cylinder engine.
- Premiere for Variable Twin Turbo technology: multi-stage charging process for the 3.0 litre inline six-cylinder diesel engine defines new benchmarks for spontaneous power development and torque; BMW 535d with the world's most powerful six-cylinder diesel engine generating 200 kW/272 hp.
- Start of the introduction of the diesel particle filter as a supplement to the oxidation catalytic converter; from 2005 it was part of the series equipment of all BMW diesel models.
- 2005 New eight-cylinder diesel engine in the BMW 745d, now with all-aluminium crankcase and displacement of 4.4 litres; maximum power: 220 kW/300 hp, maximum torque: 700 Nm.
- 2007 BMW EfficientDynamics enhances the fuel efficient characteristics of BMW diesel engines; brake energy regeneration, shift-point display, Auto Start Stop function and other measures are gradually integrated as standard in an increasing number of models.
- Further generation change in four-cylinder and six-cylinder engines: introduction of the third generation of common-rail direct injection, aluminium crankcase, variable twin turbo technology now also supplied for the four-cylinder power unit.
- 2008 BMW Advanced Diesel established as a new package in the automobile markets of North America; particularly consistent purification of exhaust gases by BMW BluePerformance technology with SCR catalytic converter (Selective Catalytic Reaction) and use of AdBlue to avoid emissions of nitrogen oxides
- BMW 118d (105 kW/143 PS, EU test consumption: 4.5 l/100 km) was given award "World Green Car of the Year".
- 2009 World's first misfuelling inhibitor for diesel models using a safety catch at the tank inlet

- 2011
- BMW TwinPower Turbo technology as a new hallmark for reduction of consumption in all four-cylinder and six-cylinder diesel engines; launch of a new 1.6 litre four-cylinder diesel engine generating 70 kW/95 hp in the BMW 114d; new “CO₂ Champion” in the model range: BMW 116d EfficientDynamics Edition generating 85 kW/116 hp, EU test consumption of 3.8 l/100 km and CO₂ value of 99 g/km.
- Launch of BMW M Performance Automobiles and the world's most powerful six-cylinder diesel engine: triple turbocharging, common-rail direct injection with piezo injectors and maximum injection pressure of 2 200 bar; high output: 280 kW/381 hp, maximum torque: 740 Nm; supplied in the BMW M550d xDrive saloon, the BMW M550d xDrive Touring, the BMW X5 M50d and the BMW X6 M50d.
- 2013
- BMW Blue Performance technology introduced into all new BMW diesel models as standard; each model version was fitted with SCR catalytic converter or a nitrogen-oxide storage catalytic converter; reduced emissions permit compliance with the EU6 emissions standard.



3. Overview of facts and figures.

3.1 Technical data for selected BMW models powered by diesel engines.

BMW 524td (1983).

Engine

Cylinder layout/no. of cylinders	I-6
Bore x stroke	80.0 mm x 81.0 mm
Displacement	2 443 cm ³
Output	85 kW/115 hp at 4 800 min ⁻¹
Torque	210 Nm at 2 400 min ⁻¹
Compression ratio	22.0 : 1
Output/litre displacement	34.8 kW

Power transmission/Chassis

Gearbox	5-speed manual shift (4-speed automatic)
Brakes	front disc brakes, rear drum brakes

Dimensions and weight

Length	4 325 mm
Width	1 645 mm
Height	1 380 mm
Wheelbase	2 570 mm
Tyres	175/70 TR 14
Kerb weight (DIN)	1 175 kg

Performance characteristics / Fuel consumption

Top speed	165 km/h
Acceleration 0–100 km/h	16.1 s
Fuel consumption (DIN 'Euromix')	6.9 l

BMW 324d (1985).

Engine

Cylinder layout/no. of cylinders	I-6
Bore x stroke	80.0 mm x 81.0 mm
Displacement	2 443 cm ³
Output	63 kW/86 hp at 4 600 min ⁻¹
Torque	152 Nm at 2 500 min ⁻¹
Compression ratio	22.0 : 1
Output/litre displacement	25.8 kW

Power transmission/Chassis

Gearbox	5-speed manual shift (4-speed automatic)
Brakes	front disc brakes, rear drum brakes

Dimensions and weight

Length	4 620 mm
Width	1 700 mm
Height	1 415 mm
Wheelbase	2 625 mm
Tyres	175 HR 14
Kerb weight (DIN)	1 300 kg

Performance characteristics / Fuel consumption

Top speed	180 km/h
Acceleration 0–100 km/h	12.9 s
Fuel consumption (DIN 'Euromix')	7.1 l

BMW 525tds (1991).

Engine

Cylinder layout/no. of cylinders	I-6
Bore x stroke	80.0 mm x 83.0 mm
Displacement	2 498 cm ³
Output	105 kW/143 hp at 4 800 min ⁻¹
Torque	260 Nm at 2 200 min ⁻¹
Compression ratio	22.0 : 1
Output/litre displacement	42.0 kW

Power transmission/Chassis

Gearbox	5-speed manual shift (5-speed automatic)
Brakes	front disc brakes, rear disc brakes

Dimensions and weight

Length	4 720 mm
Width	1 751 mm
Height	1 412 mm
Wheelbase	2 761 mm
Tyres	195/65 R 15
Kerb weight (DIN)	1 480 kg

Performance characteristics / Fuel consumption

Top speed	207 km/h
Acceleration 0–100 km/h	11.0 s
Fuel consumption (DIN 'Euromix')	7.0 l

BMW 318tds (1994).

Engine

Cylinder layout/no. of cylinders	I-4
Bore x stroke	80.0 mm x 82.8 mm
Displacement	1 665 cm ³
Output	66 kW/90 hp at 4 400 min ⁻¹
Torque	190 Nm at 2 000 min ⁻¹
Compression ratio	22.0 : 1
Output/litre displacement	39.6 kW

Power transmission/Chassis

Gearbox	5-speed manual shift
Brakes	front disc brakes, rear drum brakes

Dimensions and weight

Length	4 433 mm
Width	1 698 mm
Height	1 393 mm
Wheelbase	2 700 mm
Tyres	185/65 R 15
Kerb weight (DIN)	1 265 kg

Performance characteristics / Fuel consumption

Top speed	182 km/h
Acceleration 0–100 km/h	14.4 s
Fuel consumption (DIN 'Euromix')	5.9 l

BMW 530d (1998).

Engine

Cylinder layout/no. of cylinders	I-6
Bore x stroke	84.0 mm x 88.0 mm
Displacement	2 926 cm ³
Output	135 kW/184 hp at 4 000 min ⁻¹
Torque	390 Nm at 1 750 – 3 200 min ⁻¹
Compression ratio	18.0 : 1
Output/litre displacement	44.4 kW

Power transmission/Chassis

Gearbox	5-speed manual shift (5-speed automatic)
Brakes	front disc brakes, rear disc brakes

Dimensions and weight

Length	4 775 mm
Width	1 800 mm
Height	1 435 mm
Wheelbase	2 830 mm
Tyres	225/65 R 15
Kerb weight (DIN)	1 575 kg

Performance characteristics / Fuel consumption

Top speed	225 km/h
Acceleration 0–100 km/h	8.0 s
Fuel consumption (NEDC)	7.2 l

BMW 740d (1999).

Engine

Cylinder layout/no. of cylinders	V-8
Bore x stroke	84.0 mm x 88.0 mm
Displacement	3 901 cm ³
Output	175 kW/238 hp at 4 000 min ⁻¹
Torque	500 Nm at 1 800 min ⁻¹
Compression ratio	18.0 : 1
Output/litre displacement	46.1 kW

Power transmission/Chassis

Gearbox	5-speed automatic transmission
Brakes	front disc brakes, rear disc brakes

Dimensions and weight

Length	4 984 mm
Width	1 862 mm
Height	1 435 mm
Wheelbase	2 930 mm
Tyres	235/60 R 16
Kerb weight (DIN)	1 960 kg

Performance characteristics / Fuel consumption

Top speed	242 km/h
Acceleration 0–100 km/h	8.4 s
Fuel consumption (NEDC)	9.8 l

BMW 320d (2001).

Engine

Cylinder layout/no. of cylinders	I-4
Bore x stroke	84.0 mm x 90.0 mm
Displacement	1 995 cm ³
Output	110 kW/150 hp at 4 000 min ⁻¹
Torque	330 Nm at 2 000 min ⁻¹
Compression ratio	17.0 : 1
Output/litre Displacement	55.1 kW

Power transmission/Chassis

Gearbox	5-speed manual shift (5-speed automatic)
Brakes	front disc brakes, rear disc brakes

Dimensions and weight

Length	4 471 mm
Width	1 739 mm
Height	1 415 mm
Wheelbase	2 725 mm
Tyres	205/55 R 16
Kerb weight (DIN)	1 415 kg

Performance characteristics / Fuel consumption

Top speed	216 km/h
Acceleration 0–100 km/h	8.9 s
Fuel consumption (NEDC)	5.5 l

BMW 330cd (2003).

Engine

Cylinder layout/no. of cylinders	I-6
Bore x stroke	84.0 mm x 90.0 mm
Displacement	2 993 cm ³
Output	150 kW/204 hp at 4 000 min ⁻¹
Torque	410 Nm at 1 500 – 3 250 min ⁻¹
Compression ratio	17.0 : 1
Output/litre displacement	50.1 kW

Power transmission/Chassis

Gearbox	6-speed manual shift (5-speed automatic)
Brakes	front disc brakes, rear disc brakes

Dimensions and weight

Length	4 488 mm
Width	1 757 mm
Height	1 369 mm
Wheelbase	2 725 mm
Tyres	225/45 R 17
Kerb weight (DIN)	1 540 kg

Performance characteristics / Fuel consumption

Top speed	242 km/h
Acceleration 0–100 km/h	7.2 s
Fuel consumption (NEDC)	6.6 l

BMW 535d (2004).

Engine

Cylinder layout/no. of cylinders	I-6
Bore x stroke	84.0 mm x 90.0 mm
Displacement	2 993 cm ³
Output	200 kW/272 hp at 4 400 min ⁻¹
Torque	560 Nm at 2 000 min ⁻¹
Compression ratio	16.5 : 1
Output/litre displacement	66.8 kW

Power transmission/Chassis

Gearbox	6-speed automatic transmission
Brakes	front disc brakes, rear disc brakes

Dimensions and weight

Length	4 841 mm
Width	1 846 mm
Height	1 468 mm
Wheelbase	2 888 mm
Tyres	225/50 R 17
Kerb weight (DIN)	1 665 kg

Performance characteristics / Fuel consumption

Top speed	250 km/h
Acceleration 0–100 km/h	6.5 s
Fuel consumption (NEDC)	8.0 l

BMW 118d (2008).

Engine

Cylinder layout/no. of cylinders	I-4
Bore x stroke	84.0 mm x 90.0 mm
Displacement	1 995 cm ³
Output	105 kW/143 hp at 4 000 min ⁻¹
Torque	300 Nm at 1 750 – 2 500 min ⁻¹
Compression ratio	16.5 : 1
Output/litre displacement	52.6 kW

Power transmission/Chassis

Gearbox	6-speed manual shift (6-speed automatic)
Brakes	front disc brakes, rear disc brakes

Dimensions and weight

Length	4 239 mm
Width	1 748 mm
Height	1 421 mm
Wheelbase	2 660 mm
Tyres	195/55 R 16
Kerb weight (DIN)	1 320 kg

Performance characteristics / Fuel consumption

Top speed	210 km/h
Acceleration 0–100 km/h	9.0 s
Fuel consumption (NEDC)	4.5 l

BMW M550d xDrive Limousine (2013).

Engine

Cylinder layout/no. of cylinders	I-6
Bore x stroke	84.0 mm x 90.0 mm
Displacement	2 993 cm ³
Output	280 kW/381 hp at 4 000 – 4 400 min ⁻¹
Torque	740 Nm at 2 000 – 3 000 min ⁻¹
Compression ratio	16.0 : 1
Output/litre displacement	93.6 kW

Power transmission/Chassis

Gearbox	6-speed automatic transmission
Brakes	front disc brakes, rear disc brakes

Dimensions and weight

Length	4 910 mm
Width	1 860 mm
Height	1 454 mm
Wheelbase	2 968 mm
Tyres	245/40 R 19 front / 275/35 R 19 rear
Kerb weight (DIN)	1 880 kg

Performance characteristics / Fuel consumption

Top speed	250 km/h
Acceleration 0–100 km/h	4.7 s
Fuel consumption (NEDC)	6.2 l