



# Innovative technology for typical MINI driving pleasure. Contents.

<b>1. Innovative technology for typical MINI driving pleasure.</b>	
(Introduction) .....	2
<b>2. Innovative technology for typical MINI driving pleasure.</b>	
(Long version)	
2.1 The new generation of engines. ....	3
2.2 Chassis technology. ....	6
2.3 Passive safety, protection for passengers and pedestrians. ....	9

# 1. New MINI technology for future generations. (Introduction)



The latest innovations in drive-train, chassis and safety will see future MINI models build on their segment-leading position.

Since 1959, the unmistakable go-kart feeling has been at heart of the British marque's DNA. Today, every member of the MINI family has the combination of agile handling, exemplary efficiency, contemporary comfort and uncompromising safety. With the typical innovative strength expected from a premium manufacturer, MINI seeks to set standards for the future in developing vehicles and technologies that transform driving into a unique experience.

A new generation of engines is now about to optimise the balance between driving thrills and fuel consumption yet again. Future MINI models will be the first to use both three and four-cylinder engines, not only covering a broader performance spectrum, but also setting new standards in terms of output, performance, comfort and reliability. The quality of the new engines is a direct result of the unique development expertise of the BMW Group in the area of drive technology. Thanks to the brand and model-specific design, they have performance characteristics synonymous with the MINI driving experience.

The advances achieved by MINI in the area of drivetrain technology are characterised by the consistent further development of tried-and-tested design principles and the integration of innovative technology. Both in terms of design and in the coordination of all chassis variant, MINI developers will continue to emphasise sporty, agile handling.

In addition, MINI will introduce electrically adjustable dampers for the first time. The electric control of the damper valves will make it possible to vary the nature of responsiveness to uneven road surfaces. Two characteristic curves will be available for damper adjustment that can be activated at the flip of a switch. Depending on the driver's preferences, a decidedly sporty drivetrain setting or something more balanced and comfortable can be selected.



## **2. Innovative technology for typical MINI driving pleasure.**

### **2.1 The new generation of engines.**

Maximum driving fun and the most economical fuel consumption – a two-fold victory in terms of performance and efficiency has helped the latest MINI models to score top marks over their rivals in comparative tests regarding engine technology and driving performance. This is made possible by a new generation of engines and the consistent expansion of the MINIMALISM technology which will be available in all models as standard.

For the first time, the MINI models of the future will use both three and four-cylinder engines that not only cover an even broader range of performance, but also set new standards in terms of output, efficiency, comfort and reliability. The quality of the new engines is a direct result of the unique development expertise of the BMW Group in the area of drive technology. Both brand and model-specific design ensure that they have performance characteristics typical of MINI.

#### **More power and lower CO<sub>2</sub> emissions thanks to MINI TwinPower turbo technology.**

A common feature of the new drive units is the MINI TwinPower turbo technology, which optimises both performance and efficiency. In the case of the petrol engines, this technology package includes turbocharging, direct fuel injection, variable camshaft control on the intake and outlet sides (dual VANOS) and, in the more powerful versions, fully variable valve control according to the model of the BMW Group's patented VALVETRONIC system. The diesel engines also have a turbocharger and the latest generation common rail direct injection system.

All new engines were designed for the transverse configuration typical of the MINI and feature a compact and lightweight design. They also comply with exhaust standard EU6. Both the petrol and diesel versions of the engine are equipped with an aluminium crankshaft in a closed-deck configuration. A forged steel crankshaft with integrated balancing shaft drive, weight-optimised piston and forged conrod contributes to the high level of performance within the engine through reduced frictional coefficients. The three-cylinder engines each have a countershaft to enhance smooth operation, while the four-cylinder model has two such shafts that counter-rotate. The cylinder head in all engine variants is made of aluminium. There are further similarities in terms of the layout of the ancillary units and the design of the map-regulated oil pump and the mechanically activated coolant pump. As the coolant pump supports both the generator and the climate compressor, the drive units have a more compact design.

For the market launch of the new drive generation, MINI is presenting a three-cylinder combustion engine that generates an output of 100 kW/136 bhp from a cubic capacity of 1.5 litres. At the same time, a 141 kW/192 bhp variant of the newly developed four-cylinder combustion engine is to be presented that has a cubic capacity of 2.0 litres.

### **A new generation of engines with typical MINI performance characteristics.**

All of the new petrol engines feature spontaneous responsiveness, high torque characteristics and supreme power delivery. Thus, for example, the 1.5 litre three-cylinder engine reaches its maximum torque of 220 newton metres at an engine speed of 1 250 rpm; this can be increased briefly to 230 newton metres by means of the overboost function. The 141 kW/192 bhp four-cylinder model actually achieves a torque of 280 newton metres with the same engine speed (300 Nm with overboost). The maximum speed of all new petrol engines is 6 500 rpm.

The engine's sporty character is favoured by the position of the turbocharger integrated in the exhaust manifold. The short path of the exhaust stream enables the charging system to be activated promptly and effectively. In addition, the emissions pattern of the engines is optimised by the positioning of the catalytic converter and an electronically regulated waste gate. An efficient and precisely dosed fuel supply system facilitates direct injection with centrally positioned injectors between the valves and directly next to the spark plugs. The electronic control for camshaft positioning and the stroke of the intake valves are further technological elements that optimise the responsiveness and the consumption and emissions readings of the new petrol engines for MINI.

The new diesel engines combine superior traction with convincing cost-efficiency and once again significantly enhance the high level of performance and efficiency already familiar in the MINI. Its new design ensures improved thermodynamic characteristics, while the common rail direct injection system operates with a maximum pressure of up to 2,000 bar and thereby ensures a particularly precise and thriftily dosed fuel supply.

At the head of the pack in the new generation of engines is a three-cylinder diesel model, which uses a capacity of 1.5 litres to generate a maximum output of 85 kW/116 bhp and a maximum torque of 270 newton metres. With its spontaneous power delivery and high level of efficiency, this engine produces a tangible advantage in terms of driving pleasure and measurable consumption benefits that add up to a more than 7 per cent reduction in comparison with the previous drive mechanism.

Newly developed manual and automatic gearboxes will make a further contribution to the intensive driving pleasure that MINI has to offer and will enhance the efficiency of the drive technology. The new manual gearboxes feature an innovative gear sensor which adapts the engine speed when gear-shifting. This permits especially fast and sporty shifting with always the right engine speed available during gear shifts.

The automatic start-stop function can also be used in future MINI models in conjunction with the automatic gearbox, avoiding unnecessary fuel consumption when stopped at junctions or when caught in heavy traffic. In addition for cars equipped with a navigation system, gear selection can be adapted to the current route. In this way for example the suitable gear is selected before reaching junctions or before cornering.

## 2.2 Chassis technology.



Thanks to the continued optimisation in the area of wheel suspension, spring system, damping, steering and braking, driving pleasure looks set to become an even more intense experience in future MINI models. In combination with the features characteristic of the MINI pedigree, such as the vehicle's low centre of gravity, wide track gauge, short overhangs, transverse engine, particularly rigid bodywork and intelligent lightweight design, innovative detailed solutions in the chassis area make for even more precise and sporty handling. The agility that characterises all MINIs is also combined with further advances in the area of driving comfort. This is the first time that MINI is to offer electrically adjustable dampers that can be used to optimise sportiness and driving comfort.

### **Tried-and-tested construction principle, completely redeveloped components.**

The complete redesign of the chassis for future MINI models continues to focus on the tried-and-tested structure of the single-link spring strut axle at the front and the multi-link rear axle, which is unique among MINI's competitors; it also to includes component optimisations in terms of the choice of material and geometry. The dampers on the front and rear axles are uncoupled from the bodywork by means of complex struts. In combination with the reduction of the unsprung inertial masses, this makes it possible to increase both agility and driving comfort. Newly developed and aerodynamically optimised light alloy wheels are manufactured in a forging process requiring the use of less material. The use of roll-friction reduced tyres and friction-optimised wheel bearings help minimise the unsprung and rotating masses. They contribute considerably to reducing fuel consumption and CO<sub>2</sub> emissions. Underfloor airflow is improved through the respective design of components and additional trim also serves to enhance the car's sporty and agile handling by reducing lift forces.

In its latest incarnation, the front single-link spring strut axle features increased component rigidity. In combination with a modified axial kinematic movement, this creates ideal conditions for particularly agile manoeuvrability and steering control that is largely freed from the influence of the drive mechanism. The wider track gauge also makes a further contribution to optimising sporty characteristics.

Consistency in lightweight design has also had an influence over driving performance. The use of aluminium in the pivot bearing and high tensile steels in the front axle bearing and in the transverse rocker arms reduces the unsprung inertial masses. The innovative torque roll axial bearing enables both agility and comfort to be tangibly increased. This component consists of an engine and a transmission bearing that together absorb the weight of the engine and also

support the torque in conjunction with the engine swivel support. The engine block is hydraulically attenuated, further enhancing the increase in comfort because this design prevents the engine from surging under the influence of uneven road surfaces.

By further developing the multi-link rear axle, MINI is building on its unique position in the competitive field. Key changes – wider track gauge, the use of high-strength steels and greater rigidity in the wheel suspension – take place in tandem with the modifications to the front axle. The spatial design of the rear axle also leads to improved entry comfort and to more space in the rear as well as a larger luggage compartment volume which is also easier to load.

### **More precise, more comfortable: electromechanical power steering.**

The next generation of the EPS (Electronic Power Steering) used for MINI models offers speed-dependent support for the steering force. In future it will take less steering force to operate this, while the system will also meet the requirements for the use of a parking assist function.

The further development of the steering system will promote agility, driving safety and comfort in equal measure. Thanks to the complex wheel suspension system, the steering ratio can be implemented very directly. Likewise, the optimisation of the front axle has a direct impact on the steering, as it facilitates a sensitive steering style when negotiating bends in a sporty style. This effect is further enhanced by the use of so-called torque steer compensation. This torque steering compensation counteracts a tendency towards self-steering in powerful front-wheel drive vehicles due to differences in torque between the right and left front wheels. In future, active rotational damping will provide for gentler and therefore more precisely controllable vehicle reactions in rapid evasion manoeuvres and when negotiating particularly sporty bends.

### **Advanced brake system for more comfort and security.**

Another important contribution to driving pleasure derives from the improvements in the function and weight of the brake system, which is more closely tailored to the specific models. The new system impresses with its excellent durability with low unsprung inertial masses. This results in greater comfort, more precise dosability and a longer service life. The efficiency of the MINI can also be increased through targeted innovations in the brake system. Thus, optimised coatings help to reduce the residual braking momentum, thereby enhancing the vehicle's rolling friction.

Excellent long-lasting properties are achieved through improved surface protection on the disc brake chamber and brake callipers. Another plus point is

the optimisation of the brake cooling system through refined brake protection plates and a redesigned brake cooling shaft.

**A first for MINI: adjustable dampers.**

In a move designed to emphasise the sprightly character of the MINI even more, the spring and damper adjustment will be optimised. On the front axle, spring struts made of aluminium and steel and two-pipe compression dampers with coated pistons and a degressive damper characteristic curve are used. The support bearings on the front and rear axles will have three paths in future. The characteristic curves of the support bearing and additional springs have also been optimised on a functional basis, as have the helical springs installed on both axes. The stabilisers on the front and rear axles have holdings bearings and will have a tubular design in future, helping to reduce weight in the chassis area.

In addition, MINI will introducing adjustable dampers for the first time. The electric control of the damper valves allows the characteristic response to uneven road surface to be varied. Two characteristic curves are available for adjusting the damper and these can be activated at the flip of a switch. The traction and compression level in the shock absorber can be adjusted by selecting the appropriate setting. Depending on the driver's preferences, it is possible to choose either an emphatically sporty or a balanced, comfortable chassis. This means that it is possible to enjoy greater driving comfort in poor road conditions or an emphatically sporty driving style on an even road surface.



## 2.3 Passive safety, protection for passengers and pedestrians.



Premium vehicles by MINI hold an excellent position within their vehicle class not just in terms of driving pleasure, but also in the area of passenger protection. In the event of a collision, precisely defined support structures and generously proportioned crumple zones help to protect the passenger cell from the forces that are unleashed, while highly efficient restraint systems offer MINI passengers optimum protection in all types of crashes.

Top scores in international crash tests confirm the effectiveness of the overall concept for maximum passive safety, which is under continuous development for new models to ensure that the latest standards are always met. In addition, innovative solutions in the area of pedestrian protection are also being developed for future MINI models, helping to reduce the risk of injury for other road users.

### **Reduced weight and increased safety thanks to intelligent lightweight construction.**

The focus of developments in the body area is on structural improvements that have a positive influence on both driving features and crash performance. Intelligent lightweight construction enables MINI to combine the reduction of weight with an increase in rigidity and this promotes both agility and passenger protection. The use of second generation high-strength multi-phase steels plays a key role. Their excellent forming properties allow for much more complex structures than would be possible with conventional materials, while still permitting no compromise on strength. Parts that are of particular relevance to structural rigidity are made from micro-alloyed steels. In addition, hot-formed steels are used in the safety-related zones.

So-called tailored welded blanks and tailored rolled blanks also contribute to the optimisation of weight. Welded and rolled sheet metal joints are widely used for the first time in cars from the small vehicle segment. The reinforcement of the B pillars with a coating of galvanised, hot-formed steel, which acts as a cathodic anti-corrosion finish, means that additional, weight-increasing measures could be dropped.

Despite the reduced weight, the intelligent mix of materials for the highly resilient support structures in the front and rear and in the roof and side frame. In the event of the vehicle rolling over, the reinforced pillars and roof supports secure the survival space of the passengers even more intensively than ever. Reinforced

structures in the B pillar and sill area, high-strength side impact bars in the doors and stable seat braces will further minimise the degree of deformation and the speed of intrusion in the event of a side impact. In the event of frontal collisions, precisely defined load paths and optimally exploited deformation zones ensure precise deflection and absorption of the impact energy.

This concept establishes the right conditions for maintaining the passenger cell as a survival space in a wide variety of accident scenarios and forms the basis for the high level of effectiveness of the restraint systems. The integrated safety electronics ensure that the triggering of the airbag and belt systems is adapted to the type and severity of the accident. The coordinated interaction of all components ensures the best possible protection, irrespective of the position of the passengers at the time of impact.

**Active engine cover and crumple elements on the front for extensive pedestrian protection.**

By introducing an active motor hood, MINI is extending the safety equipment in the area of pedestrian safety. The system, which has already proven its worth in higher vehicle classes, ensures that the engine cover is automatically raised in the event of a collision with pedestrians. The pyrotechnical trigger mechanism for this is deployed at a speed of between 20 and 55 km/h as soon as the data recorded by a photosensor in the bumper indicates that a collision is immanent. The rise of the bonnet creates a yielding crumple zone that absorbs impact energy and largely protects the pedestrian from impacting with harder parts of the vehicle.

In addition, the front section of future MINI models will have extra crumple elements. As well as the yielding sections of the engine cover, a shock absorber between the bumper bracket and the cladding is intended to reduce the risk of injury. The pedestrian protection system will also be part of the standard equipment supplied with new MINI models.