

# BMW 5 Series Saloon. Contents.



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# 1. Making a Dynamic Appearance in the Business Class: The New BMW 5 Series Saloon. (Short Story)

- **Innovative lightweight construction with an aluminium/steel body.**
- **All-aluminium chassis and suspension, Active Front Steering, Dynamic Drive and runflat tyres.**
- **Straight-six spark ignition engines from 2.2 – 3.0 litres;  
3.0-litre straight-six diesel engine with common rail;  
manual and automatic six-speed transmission.**
- **iDrive control concept, head-up display.**
- **Adaptive headlights, Brake Force Display,  
bi-xenon headlights, active cruise control.**
- **More space at the rear and much bigger luggage compartment.**

This really is an impressive newcomer at first sight: The very first time you behold and admire the sporting, elegant and powerful-looking body of the new 5 Series, you will immediately appreciate this dynamic representative of the BMW business class. And you will experience this dynamism on the road through the sophisticated overall concept of innovative technologies including a brand-new, weight-saving aluminium/steel bodywork structure. So in a nutshell, the new 5 Series Saloon offers more space and comfort on less weight, with enhanced fuel economy and even better performance, as well as ideal axle load distribution.

Only active driving systems are able to further enhance the safe and comfortable driving pleasure offered by the perfectly tuned all-aluminium suspension. And it is precisely here that the new 5 Series, featuring the world's first Active Front Steering as well as active Dynamic Drive stabilisation, gives the driver the option to enjoy an unprecedented synthesis of agility, handling, and driving comfort all in one. Providing a wide range of runflat tyres for the new 5 Series, BMW is also enhancing the leadership of the marque in the introduction of such safety tyres with failsafe running characteristics.

## **Entering the market with six-cylinder power units:**

### **The 520i, 530i, and 530d reaching customers in July 2003.**

To be launched in the European markets in July 2003, the new BMW 5 Series will be initially appearing in three variants featuring straight-six power units: The 520i developing maximum output of 125 kW/170 bhp and maximum torque of 210 Nm/155 lb-ft, the 530i with 170 kW/231 bhp and 300 Nm/ 221 lb-ft, both models featuring BMW's unique, silken-smooth bi-VANOS spark ignition engines, and the 530d developing maximum output of 160 kW/218 bhp and maximum torque of 500 Nm/369 lb-ft and powered by BMW's new diesel featuring second-generation common rail technology. All three variants come as standard with a new six-speed manual gearbox, with six-speed automatic being available as an option on all model variants.

The BMW 520i/530d/530i accelerate from 0–100 kilometres in 9.0/7.1/6.9 seconds and achieve a top speed of 230/245/250 kilometres/h (143/152/155 mph), with fuel consumption in the composite EU cycle of 9.0/6.9/9.5 litres/100 kilometres (31.3/40.9/29.7 mpg Imp).

The 520iA, the 525i displacing 2.5 litres and with maximum output of 141 kW/192 bhp plus maximum torque of 245 Nm/181 lb-ft, and, in particular, the 545i with a V8 power unit displacing 4.4 litres and developing 245 kW/333 bhp, with 450 Nm/332 lb-ft maximum torque, and with innovative VALVETRONIC, will be following in autumn 2003.

Whilst larger and more spacious than its predecessor, the new saloon is not heavier, but even – depending on the model – up to 75 kilograms (165 lb) lighter. This is attributable inter alia to the lightweight aluminium front section combined with the rest of the body-in-white made of steel to take a trendsetting step into the future of bodywork construction.

Despite its increase in size and the wider range of comfort features, the BMW 5 Series offers a standard of all-round performance setting new benchmarks in the Executives Express Segment on a relatively low level of fuel consumption.

### **Design: sporting, refined, unmistakable.**

In its looks and appearance, the new 5 Series combines the dynamism and sporting flair of the 3 Series with the supremacy and presence of the BMW 7 Series. Through its design alone, the new Saloon thus forms the powerful centrepiece within the BMW model range. The muscular front end with its unmistakable, curved headlight clusters featuring dual headlights and the coupé-like “greenhouse” clearly bear testimony to the car's sporting and dynamic character.

### **Networked: Active Front Steering, adaptive headlights, and ACC.**

Available as optional equipment, the world's first Active Front Steering offers a new level of driving comfort, motoring pleasure and safety on the road. Masterminded electronically, this sophisticated system varies the steering transmission ratio under normal driving conditions at low and medium road speeds, making the steering more direct, reducing the steering effort, and thus significantly enhancing the car's agile performance in city traffic, when parking and in bends. At high speeds, in turn, the steering becomes more indirect and thus provides superior directional stability and a very good, docile steering response. Networked to DSC Dynamic Stability Control, Active Front Steering is able to intervene as soon as the car starts to become unstable by monitoring the yaw rate and changing the steering angle accordingly. This reduces the number of DSC interventions at the lower end of the control range and thus offers optimum control comfort for the driver and his passengers.

Introducing adaptive headlights, BMW is offering yet another networked system in the new 5 Series as an option, thus providing a significant improvement of active safety on the road: With this system, the two bi-xenon headlights are controlled in real time as a function of the steering wheel angle, yaw rate and road speed, perfectly illuminating the road ahead in a bend.

Brake Force Display already homologated for the BMW 7 Series in the USA and now also available in the 5 Series reduces the risk of bumper-to-bumper collisions when the driver applies the brakes hard by enlarging the brake light area. Following completion of the homologation process, the system will also be introduced in other countries and then only requires activation of the software already available.

The new BMW 5 Series comes for the first time with ACC Automatic Cruise Control. This radar-based assistant is specially developed for driving on the motorway, making it much easier, in particular, to drive smoothly in convoys by automatically controlling the distance from the vehicle ahead chosen in advance.

### **Trendsetting ergonomics: Controller and head-up display.**

With its cockpit based on BMW's iDrive philosophy, the new 5 Series is taking on a pioneering role in its class in driver-oriented ergonomics: Most functions essential for motoring are within the driver's immediate reach on or around the steering wheel, whilst the basic comfort functions are in the centre console.

All other settings, functions and services are masterminded smoothly and efficiently by the driver or front passenger using the Controller and Control Display specially modified for the 5 Series – as an example, this control system is now featured for the first time together with a gearshift lever in the middle.



The head-up display also featured in a BMW for the first time makes a significant contribution to active safety by presenting information relevant to the driver in his direct line of vision. A further advantage is that the driver can determine himself at any time what information is to be presented on the windscreen, for example his road speed and/or navigation instructions.

**The interior: Rhythm and harmony, more space and high-quality, sophisticated features.**

Harmony as the result of clear lines and rhythm ensured by surfaces and contours full of tension act together with a sophisticated range of individualised colours and materials in creating the design language of the car's interior. Customers are able to choose their new 5 Series in five equipment variants and with four worlds of interior colours. The new Saloon offers more space above all at the rear and has a much larger luggage compartment than its predecessor. Standard features include the new automatic air conditioning with adaptive evaporation temperature control preventing the occupants' mucous membranes from growing too cold and drying out and providing individual stratification of temperatures inside the car.

## 2. Design: Elegant and Sporting.



Through its design alone, the new 5 Series reaches a new standard of aesthetic style, without in any way denying the tradition and roots of the BMW 5 Series. Within the BMW model family, the new model stands out even more clearly than its predecessor through even more unique and individual design. In its style and appearance the new 5 Series thus combines the dynamism and sportiness of the 3 Series with the supremacy and presence of the 7 Series.

### **Dual headlights with a new character: unmistakable from the front.**

The front end marks the starting point of the 5 Series' innovative design. The most striking highlight is provided by the two dual headlights which, through their special look, give the new 5 Series its unmistakable character. Flowing lines beginning around the headlights and extending back down the long engine compartment lid serve as character lines along the sides of the car and all the way to the rear. Styling features such as the additional lines in the engine compartment lid extending from the kidney grille to the A-pillars enhance the impression of light and nimble superiority. The characteristic double kidney grille is larger than on the former model and, through its sporting and dynamic look, clearly accentuates the front end of the car. The integrated front spoiler and the air intake scoop, in turn, enhance the car's powerful and dynamic flair.

### **Elegant and dynamic: the side view.**

The side view underlines the dynamic character of the saloon from every angle. Careful, discreet use of convex and concave surfaces gives the 5 Series an additional profile through the interplay of light and shadow. The flowing C-pillar provides a coupé-like touch, the dynamic and powerful stance of the car being further underlined by short overhangs and large wheels. The clear contour of the wheel arches, serving as yet another design feature typical of BMW, accentuates the wide track of the car. And last but not least, the rear lid opening joint moved to the side ensures even better access to the luggage compartment much larger than before.

### **Superior and generous: the rear view.**

Over and above the new design of the front and the side-line, the third design highlight of the new 5 Series focuses on the rear end. Through its design, the entire rear section gives the car a touch of power and strength eluding both supremacy and generosity in one. The absence of any visible joints combined with the clear design of the rear lid and the integrated spoiler makes the entire rear section look extra-wide, firm and taut. In their design language, the rear lights take up the look of the headlights, their brilliant effect making the individual function levels clear and distinctive. Smaller back-up lights, while providing the same illumination to the rear, add to the car's overall look of style and harmony.

### **Rhythm and harmony all in one: the interior.**

Harmony as the result of clear lines and rhythm provided by exciting contours and surfaces interacts closely with the exterior design language as well as the individual colour and materials scheme to further enhance the sporting and elegant interior of the new 5 Series. In its main features and components, the design of the cockpit follows the new interior design philosophy of the 7 Series but boasts additional classic cockpit features underlining the active driver orientation of the 5 Series.

The double binnacle for the instrument cluster and control monitor subdivides the cockpit into a driver and a comfort zone, their design alone representing two successive worlds extending over to the front passenger's side.

The comfort zone in the middle between the driver and the front passenger gives both occupants good and ergonomically convenient access to all comfort functions, and a new feature to be admired in the new 5 Series for the first time is the combination of a Controller with a gearshift lever – both with manual gearbox and automatic transmission – as well as the handbrake lever in the centre console. Through its formal design, this combination underlines that classic cockpit feeling and further accentuates the sporting, dynamic character of the new 5 Series.

Materials full of class and expression as well as four perfectly matched colour worlds contribute to the overall harmony of the 5 Series, the interior being available not only in black, but also in the two classic colours beige and grey. Carried over from the 7 Series, particularly the beige interior is warm and modern, whilst the grey is new and brighter, intentionally providing a more sporting touch than in the 7 Series. In this case the grey colour world is combined with modern dark basalt grey, as opposed to the black colour world coming with amethyst and chestnut as two additional, exclusive seat colours. The fourth colour world is truffle brown, again a new colour exclusive to the 5 Series and combined with natural black in a special



colour scheme emphasizing the modern, natural look of the interior and at the same time providing a discreet but distinguished sign of sporting performance.

The “basic” seat upholstery is a structured single-colour fabric accentuated by gloss yarn and providing a new, matter-of-fact but elegant look. As an option the customer can choose either a sporting and elegant combination of fabric and leather, Dakota leather with a distinctive surface grain, Nasca micro-perforated climate leather, and luxurious Exclusive soft Nappa leather.

### 3. Powertrain: The Power and Efficiency of Six Cylinders and Six Gears.



#### **Highlights.**

Straight-six spark ignition power units with bi-VANOS.

Second-generation straight-six diesel power unit.

Manual and automatic six-speed transmissions.

Powerful and refined, agile and economical – these are the four attributes which describe the new 5 Series' powertrain most appropriately.

Features defined not only through the high technical standard of the individual components, but also by the supreme harmony of the entire powertrain. This starts with the outstanding six-cylinder spark ignition bi-VANOS power units and extends all the way to the second-generation common rail diesel all acknowledged as leaders the world over through their superior refinement, performance, efficiency and emission management based on that outstanding BMW know-how.

Electronically masterminded, all of these engines interact perfectly with six-speed transmissions enabling the driver to transform the power of the engine into actual drive power on the road with maximum efficiency, whether with a manual gearbox or with automatic transmission.

This supreme harmony is also ensured by features such as the light-alloy propeller shaft, the differential matched individually to each engine, and the wheel drive shafts reduced for minimum weight.

#### **Six-cylinder spark ignition power units.**

Sharing a common foundation, the spark ignition power units in the 520i and 530i are acknowledged worldwide as benchmarks in six-cylinder engine technology: The BMW straight-six is the epitome for dynamic performance, superior refinement, high specific output on very low emissions, and outstanding all-round economy. Benefitting from the exceptional smoothness and refinement of these straight-six engines combined with bi-VANOS technology, the driver of the 5 Series enjoys turbine-like power and performance throughout a broad range of engine speed. And at the same time the customer benefits from superior fuel economy combined with low emissions.

Engine specifications at a glance:

Model	□	520i	530i
Capacity	cc	2,171	2,979
Output	kW (bhp)/rpm	125 (170)/6,100	170 (231)/5,900
Torque	Nm (lb-ft)/rpm	210 (155)/3,500	300 (221)/3,500

This leadership is attributable to a whole range of convincing achievements in technology: Four-valve technology for superior cylinder management, a resonance intake manifold, adaptive knock control, and individual coils have been standard features on BMW six-cylinder power units for a long time. Added to this there is bi-VANOS, the world's first infinite camshaft adjustment serving to move the opening and closing points of the intake and outlet camshafts smoothly from "retard" to "advance" and vice versa. This fully automatic control function takes effect between the timing chain and the camshafts, the change in the relative position of the crankshaft versus the respective camshaft and, accordingly, the change in valve opening times serving in particular to control the flow of residual gas (internal exhaust gas recirculation) as a function of the operating point with the following objectives:

- To ensure an optimum cylinder charge and supreme power under full load as well as optimum smoothness and refinement when idling by keeping residual gas to a minimum.
- To improve fuel efficiency and reduce emissions by increasing the share of residual gas under part load.

Special swirl ducts for each cylinder significantly improve the combustion process to an even higher standard, intake air flowing in through these ducts to the optimum point right in front of the intake valves. The purpose of these ducts is to increase the velocity of the fuel/air mixture flowing into the cylinders at low engine speeds and loads. This provides better fuel/air mixture preparation, allowing a retarded ignition angle and, in turn, reducing emissions and fuel consumption to an even lower level. Combined with the benefits of infinite, fully automatic bi-VANOS, this offers far more possibilities of optimising the fuel/air mixture according to current demands than with conventional fuel supply systems.

Benefitting from these superior technologies, these straight-six power units are the first BMW engines to fulfil the world's strictest ULEV II (Ultra Low Emission Vehicle) emission standard in the USA. And it therefore almost goes without saying that they already comply today with the EU4 standard in Europe not coming into force until 2005, offering customers in Germany a tax relief of up to Euro 300. Sweden, incidentally, also pays a tax benefit for

the premature fulfilment of future emission standards, meaning that owners of the 5 Series in Sweden also enjoy such a financial advantage.

The combination of bi-VANOS, the resonance intake system and the two-chamber exhaust system serves furthermore to boost maximum torque to a very high level of 100 Nm/ltr between 3,500 and 4,500 rpm, with maximum output per litre of 57 kW or 78 bhp. And a minimum of 90 per cent of the engine's maximum torque is consistently available throughout the wide speed range between 1,500 and 6,000 rpm.

Engine management developed to the highest standard of excellence is obviously essential to provide such qualities and, indeed, leadership in so many crucial disciplines. Precisely this is why the six cylinders come with MS45 engine control masterminding not only the main functions of the engine as such, but also other functions such as on-board power management with an intelligent battery sensor, the comfort start mode on automatic transmission models, and automatic cruise control.

The six-cylinder power units in the BMW 5 Series feature an all-electronic throttle butterfly dosing the driver's commands (= use of the gas pedal) even more sensitively in stop-and-go traffic and ensuring an immediate response of the car whenever the driver requires maximum power: The system "sees" which gear is currently in mesh and is therefore able to activate an individually programmed throttle butterfly control line for each gear increment.

The same convenience is also offered when driving with cruise control, which is again integrated in its functions in the electronic throttle butterfly.

Through their fundamental design and construction, the six-cylinder power units also prove how much attention BMW gives to the question of all-round economy in the configuration of engines:

- Like the ancillary units driven by a ribbed V-belt, the camshaft chain drive is maintenance-free for the entire life of the engine.
- The air filters and long-life spark plugs only have to be replaced after approximately 100,000 kilometres when driving under normal conditions.
- The average oil change interval is approximately 24,000 kilometres or 15,000 miles, and may, under appropriate conditions, be extended up to 30,000 kilometres or 19,000 miles.
- Whilst the engine is built for 98 octane fuel, it is able to recognise all fuel grades between 91 and 98 octane and will not suffer even when driven consistently with 91 octane fuel. Like on all BMW petrol

engines, anti-knock control automatically adjusts the engine's running parameters to the fuel grade currently used.

- The exhaust system is made of stainless steel fully welded all round to virtually eliminate any risk of corrosion.

The Service Interval Indicator, a BMW invention now enhanced to an even higher standard, offers the driver additional information on

- his residual mileage up to the next oil change (in kilometres or miles, depending on national specifications)
- the month and year in which service is required next
- possible expiry of the period allowed for service.

### **Six-cylinder diesel engine.**

Introducing the 530d, BMW now offers a genuine power diesel in the executive class: The straight-six diesel within the engine compartment so far only available in the 7 Series with this kind of power and performance is one of the most powerful high-performance six-cylinder diesel engines in the world.

Just consider the following specifications:

Model	□	530di
Capacity	cc	2,993
Output	kW (bhp)/rpm	160 (218)/4,000
Torque	Nm (lb-ft)/rpm	500(369)/2,000

This represents an increase in output by well over 12 per cent and a boost in torque by 22 per cent over the previous model.

Together with the introduction of six-speed transmission and the wide range of weight-reducing improvements, this extra power serves to shorten the time required for accelerating from 0–100 kilometres/h by 0.7 seconds to 7.1 (7.3) seconds and to increase top speed by 15 (13) kilometres/h to 245 (243) kilometres/h or 152 (151) mph. At the same time fuel consumption is down by 0.2 (0.5) litres to 6.9 (7.8) litres/100 kilometres or 40.9 (36.2) mpg Imp in the EU combined cycle (figures in brackets for automatic transmission model).

This exemplary combination of superior output and torque with equally superior fuel efficiency and unparalleled refinement is based on the straight-six design principle featuring second-generation common rail fuel injection. The common rail, as the name indicated, is a common pressure vessel for

all cylinders supplying the injection jets with compressed fuel. The currently most advanced system operates at a system pressure of 1,600 bar and features volume control to speed up the injection process and atomise the fuel injected even more efficiently in the interest of enhanced performance and greater fuel efficiency.

Instead of constantly compressing the entire volume of fuel supplied to maximum pressure, the new system with volume control compresses only as much fuel as is currently required. The reduction of energy in the high-pressure pump achieved in this way makes a significant contribution to reducing fuel consumption, micro-hole injection jets with optimised jet openings serving at the same time to atomise the fuel with maximum efficiency.

With the system being able to inject fuel several times per operating cycle, the conflict of interests between power, performance and noise control is solved even more efficiently than before, fuel now being injected up to four times per operating stroke in a double-pilot, main and post-injection process. Whilst double-pilot injection makes the entire combustion process even softer and more harmonious, post-injection reduces particle oxidation and cuts back emissions of harmful pollutants at the same time, giving the driver of the 530d two important benefits in one: The engine is even quieter and more comfortable and burns fuel with optimum emission management. So it is no surprise that the new diesel saloon easily outperforms the EU3 emission standard.

#### **Digital Diesel Electronics with engine smoothness management and 6,000 control maps.**

To capitalise on the potentials offered in particular by the latest generation of common rail technology, BMW's specialists have further enhanced Digital Diesel Electronics in the DDE5 generation with 32-bit architecture, 1.5-megabyte memory, and operating cycle frequency of 40 megahertz. DDE5 is also able to process the commands sent to the automatic cruise control.

#### **Quick and convenient:**

##### **Automatic, spontaneous engine start without preheating.**

DDE5 also masterminds the rapid-heating system using electronically controlled 6-volt low voltage spark plugs with only the tip raised to maximum temperature and therefore offering spontaneous engine starting characteristics, higher terminal temperatures, greater efficiency by reducing power uptake to a minimum, and more compact dimensions. The engine can start immediately at temperatures down to 5 °C, and takes just two seconds to fire in very cold temperatures down to -20 °C.

##### **Six-speed transmission.**

Engine power in all new 5 Series Saloons is transmitted to the wheels by six-speed transmission – either by a manual gearbox featured as standard or by automatic transmission available as an option.

The newly developed manual gearbox gives the driver five benefits in one: even more dynamic power, superior economy and comfort combined with a smooth and simple gearshift, as well as optimum precision when shifting

gears. Sixth gear increases the overall range of gear increments and allows the driver to capitalise on engine power both when accelerating and at top speed. The gear increments vary according to the engine, the 520i and 530i each reaching their top speed in fifth gear. Then, shifting to the highest gear, engine speeds are reduced and the engine becomes quieter, with road speed slightly decreasing.

Sixth gear therefore serves as an overdrive or economy gear in the spark ignition models, whilst in the 530d it is the “fastest” gear giving the car its top speed, since here the focus in the development process was on superior performance.

As precise and smooth as it already was, the previous gearshift has been thoroughly upgraded and enhanced to provide an even more comfortable and precise experience of shifting gears.

All 5 Series are available as an option with automatic transmission again with six gears in all cases: The new 6HP19 transmission on the 520i and 530i extends the range of the six-speed automatic transmission introduced in the 7 Series as the first transmission units of this type in the world. The 530d, in turn, comes with the 6HP26 transmission, which already made its debut in the 730d, where it is fitted as standard.

Using a Lepelletier gearset and benefitting from consistent lightweight construction, the new 6HP19 is 8, the 6HP26 even 14 kilograms lighter than the respective previous models with five gears. And at the same time the total range of gear increments covered is up by 22 and, respectively, 35 per cent. Again interacting with the improved standard of engine efficiency, this benefits both fuel economy and dynamic performance, the modular construction system allowing use of many shared parts, with only the components conveying engine torque being modified accordingly.

In conjunction with automatic transmission the 5 Series now also features BMW's comfort start function requiring only a short start signal from the ignition key to trigger the largely automatic starting process.



**Built for dynamic performance:**

**Final drive, propeller shaft, wheel drive shafts.**

BMW is the only car maker in the world to use an aluminium propeller shaft for the ongoing transmission of power. The main reason for this superior technology is the reduction of weight, the lightweight shaft saving more than three kilograms versus a steel shaft. And since the bolted connections are still made of steel for reasons of strength and stability, BMW has developed a special friction welding technology to ensure low-cost and efficient production.

Efficient use of energy was also the crucial factor in designing the final drive and choosing the right configuration, with a different transmission ratio for each combination of engine and transmission. Indeed, this harmony of transmission provides the final touch in balancing the entire powertrain, offering yet again an even higher standard of dynamic performance together with superior fuel economy.

Reduction of weight was also the name of the game when focusing on the wheel drive shafts: The shafts connecting the individual joints used to be solid inside. Now a newly developed technology allows the wall thickness of the hollow shafts to be adjusted exactly to the exterior diameter. Such hollow shafts not only save up to one kilograms, but also reduce unsprung masses and improve roll comfort accordingly.

## 4. Chassis and Suspension: Agile and Dynamic – and with Further Options.



### **Highlights:**

- Active Front Steering.
- Aluminium chassis and suspension.
- Dynamic Drive.
- DSC with DTC.
- Runflat tyres.
- Tyre defect indicator.

Dynamic performance, superior agility, outstanding safety and enhanced comfort have been crucial to the driving behaviour of the BMW 5 Series ever since its introduction in 1972. And now these features are being lifted to a new level in the latest 5 Series Saloon. To reach this objective, BMW's engineers have adapted the all-aluminium chassis and suspension of the new 7 Series including BMW's innovative Dynamic Drive anti-roll system to the new car, introduction of the world's first and truly unique Active Front Steering serving additionally to pave the way into the future of steering systems.

This unique package is rounded off by further enhanced DSC and DTC driving stability control, a tyre defect indicator, and a wide range of wheel and tyre combinations in runflat technology.

### **Rack-and-pinion steering for precise handling.**

To capitalise in full on the low weight of the aluminium chassis, the 5 Series comes as standard with extra-light hydraulic rack-and-pinion steering with a variable transmission ratio depending on the steering angle. Benefitting from power assistance, the steering combines superior comfort with precise directional control and feedback.

The steering transmission is designed to provide a pleasant and smooth steering response. And to make sure that the driver only has to turn the steering wheel slightly even in a tight bend, the steering becomes more direct with increasing lock. Hydraulic steering assistance serves in the process to provide a smooth steering response and behaviour even in very fast manoeuvres, without the steering becoming harder or unduly tough.

As an option the steering is also available with Servotronic, steering assistance being controlled in this case as a function of road speed and thus solving the conflict of interest between more assistance for parking the car smoothly with maximum comfort and a reduction in power assistance at high

speeds in the interest of dynamic motoring. At the same time this reduces the risk of the driver suddenly “tearing” at the steering in an abrupt manoeuvre on the road.

Fitted as standard, the multifunction steering wheel can be adjusted mechanically for reach and height via the steering column. Electrical adjustment is available as an option, memorising the respective driver’s setting as a function of Key Memory. And to offer the driver maximum comfort when getting into and out of the car, the steering wheel moves up to its highest position when the driver turns off the key in the ignition.

### **Active Front Steering.**

BMW is now becoming the world’s first car maker to offer Active Front Steering as an option in the new 5 Series. This is an electronically controlled steering system with variable transmission ratios and power assistance.

Active Front Steering solves the fundamental conflict of interests inevitable with every kind of conventional steering – that is the fundamental compromise between agility, stability, and motoring comfort. Whenever the driver opts

for a more sporting style of motoring at medium speeds up to approximately 120 kilometres/h or 75 mph, the car, benefitting from its more direct steering transmission ratio, is far more agile and precise in its steering response, making it unnecessary for the driver to cross over his hands on the steering wheel. In city traffic and when parking, the steering effort is reduced to a highly comfortable minimum. At higher speeds, in turn, the steering angle and

power assistance are reduced successively in the interest of enhanced driving stability, the more indirect steering transmission ratio guaranteeing a superior and relaxed style of steering even at very high speeds.

Featuring yaw rate control and networked with the DSC system, Active Front Steering is able to stabilise the car by intervening in the steering angle of the front wheels, thus providing a slight correction of the yaw angle. And by dampening yaw movements at an early point, Active Front Steering reduces intervention by DSC in the lower range, the two systems thus forming a perfect team.

BMW’s Active Front Steering still features a mechanical connection permanently linking the steering wheel and the front wheels of the car. This not only guarantees fully functional steering at all times even in the highly unlikely case of the new system failing altogether, but is also the prerequisite for maintaining that typical BMW steering feel with optimum feedback from the steering.

### **Solving the conflict of interests with conventional steering.**

With a conventional steering system the driver's steering commands are conveyed from the steering wheel to the front wheels with the same transmission ratio at all times, regardless of the respective driving situation (even though the transmission ratio becomes more progressive with increasing wheel lock). Direct steering ideal up to medium engine speeds therefore remains direct even when a much more indirect transmission ratio would be appropriate at high speeds in order to compensate for the physically-induced increase in steering sensitivity as road speeds increase.

Naturally, the situation is exactly the same – only the other way round – with indirect steering: The steering transmission ratio ideal for very high speeds makes the process of steering the car very strenuous at lower speeds, requiring the driver to “work” very hard on the steering wheel relative to the wheel lock. Conventional steering systems are therefore always a compromise between these two extremes.

Active Front Steering revolutionises the steering process by eliminating this conflict of interests. It combines the potentials of all-electronic steer-by-wire with an authentic steering feedback currently only offered by mechanical steering. As a result, Active Front Steering sets a new standard in agility, comfort, and safety on the road all in one.

### **The function principle – superimposed steering angles.**

In technical terms, the many functions of Active Front Steering are based on the principle of superimposed steering angles: An electromechanical adjuster between the steering wheel and the steering transmission adds an additional positive or negative steering angle to the angle of the steering wheel chosen by the driver. The “core” element of this revolutionary Active Front Steering is therefore the superimposed steering function, a planetary gearing with two input shafts and one output shaft integrated in the split steering column. One of the input shafts is connected to the steering wheel, the second is driven by an electric motor via a self-inhibiting helical gear wheel serving to provide a reduced gearing ratio. The overall steering angle thus applied on the output shaft is made up of the steering wheel angle as such plus the angle of the electromechanical adjuster.

The forces serving to lock the wheels are however applied not by the electric motor, but rather by Servotronic power steering combined with Active Front Steering. Additional Active Front Steering components are the separate control unit and various sensors determining both driving conditions and the driver's commands. And last but not least, Active Front Steering communicates consistently with the DSC control unit via the car's on-board network.

### **A genuine kart feeling at low and medium speeds.**

Depending on the driving situation, Active Front Steering builds up an additional – or, alternatively, reduced – steering angle on the front wheels: When driving slowly the adjuster motor works in the same direction as the driver turning the steering, moving the front wheels further in the desired direction and reducing the steering effort required. This makes the steering transmission far more direct up to medium speeds than with a conventional car: Whilst the conventional steering on the new 5 Series still requires about three full revolutions of the steering wheel to move from lock to lock, Active Front Steering cuts back this steering travel to just two turns, thus significantly reducing the driver's steering effort when manoeuvring in confined parking spaces or when taking a sharp corner particularly in the inner city. Accordingly, the driver is hardly required to cross over his arms on the steering wheel, for example on winding mountain passes, his hands staying where they belong thanks to Active Front Steering: on the steering wheel. Steering forces, that is the forces exerted by the driver on the steering wheel, are kept to a comfortably low level thanks to the superimposed Servotronic function.

### **More relaxed motoring also at high speeds.**

At high speeds the adjuster motor acts against the steering wheel angle, reducing steering lock on the front wheels and making the steering transmission more indirect. On a fast stretch of the motorway, for example, this allows uncompromising, dynamic steering, Servotronic serving at the same time to increase steering forces in order to prevent any nervous or exaggerated reaction of the steering. The result is a relaxed, superior style of motoring also at high speeds.

### **Aluminium chassis and suspension, much wider track, longer wheelbase: minimum weight, perfect axle load distribution, optimum driving behaviour**

The chassis of the new 5 Series has been carried over largely from the all-aluminium chassis of the BMW 7 Series, the outstanding dynamic driving qualities of the new 5 Series benefitting additionally from the significantly wider track up by 46 millimetres (1.81") to 1,558 millimetres (61.34") at the front and 56 millimetres (2.20") to 1,582 millimetres (62.28") at the rear, as well as the wheelbase extended by 62 millimetres (2.44") to 2,890 millimetres (113.78") and ideal axle load distribution of approximately 50:50.

The spring strut, tie-bar front axle is made almost entirely of aluminium, with the exception of a few highly exposed components such as the thrust rods, wheel bearings or pivot pins. The front axle subframe accommodates the steering transmission, anti-roll bar, track control arms and tie-bars. Shaped like a letter U, the front axle subframe is reinforced by a thrust plate ensuring a further improvement of crosswise stiffness and, as a result, an even more precise response of the front wheels.

The rear axle features the integral IV design principle carried over as a new feature from the BMW 7 Series. This gives the 5 Series exactly the right axle configuration able to meet all the fundamental requirements of the suspension such as excellent track control and motoring comfort. The four control bars guiding the wheels on the integral rear axle are not fastened directly to the body of the car, but are rather mounted elastically on a rear axle subframe also bearing the differential likewise running on rubber mounts. The subframe, in turn, is connected elastically to the body of the car by four extra-large rubber elements. Bumps and vibrations conveyed by the road to the tyres must therefore first go through these elastic bearing points before reaching the interior of the new 5 Series – assuming they get that far in the first place.

The excellent roll comfort of the chassis and suspension is also attributable to another factor: the front swing bearing on the rear axle subframe providing the important longitudinal spring effect serving to guide the wheels. The bearings on the rear axle subframe, in turn, allow additional longitudinal suspension of the entire rear axle unit, thus making a significant contribution to the car's superior roll and noise comfort.

#### **High-performance brakes with aluminium swing callipers.**

Extra-large 16-inch swing-calliper brakes with inner-vented brake discs on all four wheels ensure superior deceleration and fading-free brake qualities at all times. Made of aluminium, the swing callipers significantly reduce unsprung masses and serve to maximise the car's agility, driving comfort and safety on the road.

Following the BMW 7 Series, the 5 Series now also comes with BMW's unique brake lining wear diagnostic system: Incorporating measuring points on the brake lining wear sensor, the DSC control unit calculates the current state of brake lining wear as a function of the car's driving behaviour. Applying this information, the system forecasts the remaining mileage until the brake linings have to be replaced. This information is used for Condition Based Service (CBS) in order to calculate service and maintenance requirements, thus minimising the time spent at the workshop. With the new BMW 5 Series, therefore, the driver no longer has to observe fixed, rigid service dates and intervals.

#### **Aluminium wheels ranging from 16–18 inches and a wide range of optional runflat tyres.**

The 520i, 530i and 530d come as standard with light-alloy wheels measuring 7J x 16-225/55 R 16. In this case an emergency spare wheel in the luggage compartment helps to keep the driver on the move even after a puncture.

As an option, the driver can choose 7.5J x 17-inch, 8J x 18 and 8J/9J x 18-inch aluminium wheels with 225/50, 245/45 R17, 245/40 R18 as well as

different-sized 245/40 R 18 (front) and 275/35 R18 (rear) tyres. With these wheels coming exclusively in runflat technology, the new 5 Series no longer requires an emergency spare wheel.

Reinforced side walls on the tyres with additional support strips and a particularly temperature-resistant rubber compound give the tyres self-bearing qualities even when completely empty, thus allowing the driver to go on driving at a maximum speed of 80 kilometres/h and for a distance of at least 150 kilometres under full load, even with an absolutely flat tyre. And with the car carrying a lighter load or with the tyre not entirely flat, the driver can even cover a much longer distance. A further advantage, finally, is that ABS, ASC and DSC remain fully functional even on a tyre without the slightest air pressure inside.

Benefitting from specially contoured double rim humps (Extended Hump 2/EH2), runflat tyres are not able to “jump” off the rims even under a sudden loss of pressure. Clearly, this means a significant increase in safety particularly at high speeds and on winding roads. And a further benefit with these rims is that the driver can even fit conventional tyres if necessary.

Fitted as standard, the tyre defect indicator (TDI) measures air pressure indirectly and informs the driver of any loss of pressure. This system is indeed a prerequisite for using runflat tyres, which remain so smooth and easy to control (and even retain their usual looks) under a loss of pressure that the driver would not necessarily even notice what has happened. So TDI ensures superior safety also in the case of pressure loss and warns the driver in good time.

BMW is once again confirming its trendsetting qualities and unique position in the market through the consistent introduction of runflat tyres: Following the introduction of this safety technology on the BMW 7 Series, the Z8, the MINI and the Z4, the new BMW 5 Series marks another significant milestone featuring this superior concept.

#### **Sports suspension available as an option.**

Sports suspension giving the 5 Series Saloon even more progressive handling is available as an option. Versus the normal suspension, the modifications featured in this case are harder springs and firmer dampers serving also to lower the entire vehicle by approximately 15 millimetres or 0.59”, providing a change in ride height visible at first sight.

#### **Active suspension control: Dynamic Drive.**

The new BMW 5 Series introduces BMW’s innovative active body control system into the upper midrange segment. Already well known as BMW Dynamic Drive, this system, which made its world debut in the BMW 7

Series, combines superior driving comfort with sporting driving dynamics: Whilst the driver and passengers will hardly feel any bumps or uneven surfaces when driving straight ahead, Dynamic Drive suppresses body roll in bends and thus ensures superior agility and stability under all driving conditions. Indeed, the noticeable increase in driving safety, the nimble response of the car, and the accuracy of the steering in virtually all manoeuvres set new standards in sophisticated chassis and suspension technology. The passengers at the rear also experience this unparalleled smoothness on the road referred to by the engineer as dynamic, vertical stabilisation of the car as a significant improvement in motoring comfort.



### **Active anti-roll bars: optimum handling and comfort all in one.**

Dynamic Drive largely overrides the conflict of interest between handling and vibration comfort, since the system is able to set the springs and dampers to a superior level of vibration control and superior driving comfort on the road all in one. Dynamic Drive is made up of two active anti-roll bars, a valve block with integrated sensors, a dual oil pump, an accelerometer, a control unit and additional supply components. The key elements are the two active anti-roll bars taking the place of conventional, mechanical roll bars on the front and rear axle. An active roll bar or actuator is made up of a hydraulically operated swivel motor incorporating a swivel motor shaft and housing each connected to one half of the anti-roll bar.

The active roll bars convert hydraulic pressure into torsional and, via the firm connection to the body, stabilisation forces. When driving straight ahead the two halves of the anti-roll bar are allowed to move freely in order to avoid any unwanted and unpleasant sway motion caused by asymmetric bumps or unevenness on the road.

### **Roll movements almost completely eliminated.**

On the road, Dynamic Drive absorbs virtually all roll movements, say, in urban traffic, maintaining full balance of the vehicle up to a lateral acceleration of 0.3 g. When driving straight ahead, in turn, the car's occupants enjoy optimum suspension comfort even on bumpy roads thanks to disconnection of the two halves of the anti-roll bars avoiding any unpleasant "copying effect", and the 5 Series Saloon drives smoothly through long, stretched-out bends without any unpleasant side sway or rocking motion. Even when driving fast on winding country roads, where the ambitious driver can achieve lateral acceleration of up to 0.6 g, the system reduces body sway by 80 per cent and more. In such dynamic driving situations typically including lane change or rapid steering manoeuvres, Dynamic Drive masterminds the car's steering behaviour according to specific requirements by means of a control map. The result is even greater tracking accuracy and enhanced load change behaviour, which in practice means greater active safety.

The fact nevertheless remains that even Dynamic Drive cannot override the laws of physics: With lateral acceleration reaching the extreme limit in a fast bend, the side angle of a car increases consistently and noticeably. At the same time the car changes in its behaviour from a more neutral stance to a slight understeer, this deliberate change in suspension serving to warn the driver without making him feel unsafe or insecure.

### **Superior safety even with a flat tyre: TDI tyre defect indicator.**

The new BMW 5 Series is the first large-volume production car in the world to be fitted with a tyre pressure control system straight from the factory. A gradual loss of tyre pressure always presents a very significant accident risk, since the tyre will overheat when running on significantly lower tyre

pressure, with the risk of the tyre suddenly bursting. The TDI tyre defect indicator therefore monitors tyre pressure by consistently comparing wheel speed and revolutions with the help of the signals from the ABS anti-lock brake system: A significant loss of tyre pressure changes the circumference of the tyre and, accordingly, the running speed of the tyre on the road, the driver being informed by both a warning light and an acoustic signal, regardless of the type or make of tyre or whether the car is travelling round a bend, running at high speed or on varying road conditions such as wet or snowbound surfaces. Designed to warn the driver of any excessive loss of pressure, the system provides a warning as of a road speed of 15 kilometres/h and with a loss in pressure of more than 30 per cent.

This means that the driver must continue to check tyre pressure regularly even on a car fitted with a tyre defect indicator, re-activating the system after every change in tyre pressure and when fitting new tyres in order to record the current pressure required.

The TDI control system compares actual and target tyre pressure. As soon as tyre pressure remains at least 0.2 bar below the target level for more than eight minutes, the system requests the driver to check the air pressure in the tyres. If the drop in pressure is 0.4 bar or more, the driver is warned by an acoustic signal and the message "Tyre Defect" appears in the display. And regardless of the deviation from the desired pressure level, the data measured is re-transmitted and presented to the driver every eight seconds as soon as the control unit detects inadequate pressure.

Target tyre pressure is set in basically the same way as on the 7 Series: Once the pressure set has been confirmed as the appropriate target via the Controller, the electronic wheel control units memorise this pressure level as soon as the car starts to move, regardless of whether this is after changing the wheel or just filling in air.

#### **DSC with DTC:**

##### **even more dynamic performance when driving to the limit.**

Featured as standard, DSC Dynamic Stability Control is now supplemented also on the 5 Series – like on the 7 Series – by DTC Dynamic Traction Control serving in particular to enhance traction under difficult conditions and allowing even more individual adjustment for the sporting, dynamic driver.

DSC enhances driving safety in abrupt manoeuvres or in the early phase of instability in bends and especially on slippery roads by applying the brakes on specific wheels of the car, as required. A further function of DSC is integrated ASC Automatic Stability Control monitoring wheel spin and, by applying the brakes selectively on the respective wheels, preventing a drive

wheel from spinning through an effect similar to that of a limited-slip differential avoiding loss of traction.

In the new 5 Series this function of ASC is enhanced by the DTC program allowing extra slip on the rear wheels tailored to specific driving conditions and activated by the driver pressing down the DSC switch on the centre console for a somewhat longer period. This function serves to significantly improve vehicle traction on roads requiring extra slip such as deep snow, mud and snow, sand or gravel, especially when driving on a gradient, and when driving with snow chains or “rocking” the car out of snow, slush or mud. Yet a further point is that the stabilising brake effect of DSC cuts in at a slightly higher point in this mode in the interest of extra traction and drive power, without however impairing the stability of the car. In practice, this means that the DTC mode ensures an even more sporting and dynamic style of motoring.

Such greater priority is given to enhanced traction only in the lower to medium speed ranges with this effect being consistently taken back up to a medium level of lateral dynamics, that is at about 70 kilometres/h and/or approximately 0.4 g lateral acceleration. The higher slip thresholds are adjusted to driving conditions by means of additional DSC criteria such as the car’s yaw rate, the anticipated frictional coefficient of the road surface and the assessment of wheel spin.

All this does not in any way impair the fundamental safety function of DSC: As soon as the car leaves the DTC range, the control unit will automatically switch to the normal DSC/ASC mode, then however switching back to DTC as soon as the car re-enters the DTC range when running at a lower speed and/or under lower lateral acceleration. The DTC mode then remains in force until deactivated by the driver, with the normal DSC mode always switching on automatically when the car is started anew.

## 5. Body: Trendsetting Lightweight Construction with Hybrid Technology.



### **Highlights.**

First-ever combination of steel and aluminium construction.

Superior safety on low weight.

More space inside, smaller increase in size outside.

Climate comfort glazing.

Protective glazing.

Introducing the new 5 Series, BMW is becoming the first car maker in the world to use a new, trendsetting combination of steel and aluminium structures on the body-in-white: the combination of an aluminium front section with the remaining bodyshell around the A-pillars made of steel. A further

point is that the front side panels and the front lid are also made of aluminium. This new technology is the main reason why the entire car, depending on the model, is up to 75 kilograms (165 lb) lighter than its respective predecessor. And there can be no doubt that BMW, introducing this hybrid construction technology, is opening up a new trend in lightweight body design.

A particular challenge with this new concept was to join the lightweight aluminium front section with the steel body structure. Indeed, the use of aluminium goes far beyond the usual standard, the spring supports resting on the front axle springs and dampers being made of pressure-cast aluminium. The material used for the spring supports is an alloy made mainly of aluminium, with small amounts of magnesium, silicon and manganese, a combination of materials offering supreme strength and dimensional flexibility all in one.

### **Innovative production methods allowing a new blend of metals.**

This hybrid construction technology requires special measures taking the fact into account that steel and aluminium have different thermal expansion coefficients. With the punch rivets joining the panels being 50 millimetres apart, however, even peak tension and deformation remains within the prescribed limits. A further point is that steel and aluminium have different electrochemical potentials, the combination of materials seeking to avoid corrosion therefore requiring consistent use of a newly developed, insulating glue completely filling the flanges resting against one another. Even the flange surfaces are specially designed and contoured, and the process of applying the glue is automated and monitored by cameras in production.

Since this is the only joining method applied, the joints can be repaired by all workshops if necessary.

**Hybrid structure providing superior passive safety on lower weight.**

The body structure of the new 5 Series offers the car's occupants maximum safety with a significant reduction of weight provided by hybrid construction. Use of high-strength panels in extra-large support structures with specific reinforcements, interacting with the front section made largely of aluminium, ensures a high standard of structural protection in all types of collisions. And last but not least, the superior torsional stiffness of the body is an important prerequisite for precise driving dynamics.

**Tailor-made: more space inside, less growth outside.**

Right from the start one of the main criteria in developing the new 5 Series was to significantly extend the car's wheelbase in order to provide a lot more space at the rear reflecting customer demand. As a result, wheelbase is up by 62 millimetres (2.44"), benefitting particularly the rear-seat passengers with 46 millimetres/1.81" more legroom than on the former model. Overall, the new 5 Series is 66 millimetres (2.60") longer than its predecessor, that is hardly more than the increase in wheelbase (reflecting the intention of the concept engineers to keep the as compact as possible). Measuring 1,847 millimetres (72.72") in width, in turn, the new 5 Series is 48 millimetres (1.89") wider than its predecessor, offering above all the passengers at the rear extra shoulder width.

The configuration of the interior considers both the five per cent woman and the 95 per cent man, related in each case to the population figures and measurements established for 2003. Accordingly, vehicle height is up by 40 millimetres (1.57") to 1,468 millimetres (57.80") in the interest of generous headroom up by 10 millimetres (0.39") for the driver and front passenger and 7 millimetres (0.28") for the rear passengers.

**Luggage compartment with extra useful space.**

In designing the luggage compartment, the responsible engineers focused above all on the useful space available as well as simple loading and unloading of large objects.

The new 5 Series offers ample space for four 46-inch golf bags or two extra-large suitcases on top of one another as well as three medium-sized/small cases. Filled with standard cubes, the luggage compartment offers a useful capacity of 520 litres, 60 litres more than on the previous model. And if the driver opts for runflat tyres instead of the normal tyres fitted as standard, the car no longer requires an emergency spare tyre and useful luggage space increases by another 35 litres to 555 litres.

**A special comfort option: climate comfort glass.**

Particularly with the car at a standstill, bright sunshine will heat up the interior to a possibly unpleasant level. Indeed, not only the hot air, but also heat irradiated by the seats and dashboard may be very unpleasant for the car's occupants. And while automatic air conditioning serves to quickly cool down the air, the surfaces within the interior will remain very hot for a relatively long time.

Precisely this is why BMW offers infrared-reflecting glass all round on the new 5 Series. Compared with a car featuring standard glass, this reduces the interior temperature when the car is parked in the sun by approximately 5 °C, surface temperatures dropping by an even more significant 10 °C. And the radiated heat the driver and his passengers will feel on their skin is also reduced accordingly.

This means that the automatic air conditioning is able to run on less power right from the start and later on while driving. The blower can be set to a lower level and the flow of air blowing against the occupants is reduced accordingly (together with the noise level of the air blower and the energy consumed). On the road, finally, the reduction in thermal radiation not only enhances driving comfort, but also helps to keep the driver and his passengers fitter and more alert.

**A further option for extra security: theft-inhibiting glass.**

Theft-inhibiting glass available as an option offers unique security against theft and raises the excellent level of security on the 5 Series to an even higher level. This specially developed composite glass is made up of two layers of glass with an intermediate layer of polycarbonate embedded in a film of TPU. Polycarbonate is an extra-strong and tough material originally used in aircraft construction, where for years it has served to reinforce the windows in jet planes. Thanks to this film, the transparent sandwich structure is able to take up substantial impact forces, thus resisting even a heavy hammer or an axe. An additional splinter protection film serves to keep glass splinters out of the interior.

On cars fitted with this special feature, all side windows are made of this special glass, with the windscreen and rear window made of laminated glass featuring several layers of film again ensuring superior strength and resistance.

## 6. Assistance Systems: Innovations for Extra Safety and Comfort.



### Highlights.

Masterminded by Controller and Control Display.

Multifunction steering wheel.

Head-up display.

Adaptive headlights and Brake Force Display.

ACC Active Cruise Control.

Bluetooth technology integrating the telephone.

LOGIC7 HiFi system.

DVD navigation.

Satellite radio for the USA.

Integrating BMW's iDrive philosophy, the new 5 Series is becoming the pioneer in ergonomics in its class, standing out from competitors with similar solutions by providing intuitive control of numerous secondary functions and thus allowing the driver to keep his eyes on road traffic virtually at all times. Most functions essential for driving the car are operated directly from the multifunction steering wheel, the basic comfort functions are in the centre console. All other settings and services are masterminded by the driver or front passenger operating the Controller and Control Display now modified for the 5 Series and with a simpler menu structure not requiring the user to take his eyes off the road. A further new feature is the combination of the Controller with the gearshift lever and handbrake in the centre console.

The Control Display positioned high up in the middle of the dashboard for good visibility serves as the central user interface for nearly all assistance and communication systems. The "basic" version is a monochromatic 5.8-inch monitor with 16 greyness levels. In combination with the navigation system or the high-end automatic air conditioning, the new 5 Series is fitted with a 6.5-inch colour display offering 8-bit colour resolution.

### Control Display:

#### **Transflective technology providing a brilliant picture at all times.**

This new generation of display presentation features transflective technology, daylight making the surface of other displays unclear and even impossible to read being reflected by the back of the display. This so-called passive reflection ("passive" because it absorbs daylight irradiation) makes the entire picture even clearer and more brilliant in poor light conditions or in the dark, the display remaining easy to read thanks to transmissive background illumination with brightness controlled by a sensor adjusting to

light conditions. A further feature is that both the driver and front passenger are now able to control brightness themselves for the first time. And last but not least, the display comes complete with a heater providing the most appropriate operating temperature as quickly as possible even in extremely cold weather.

The main menu presented on the display is subdivided into four sections: Communication, Navigation, Entertainment, and Climate. Depending on the features fitted in the car, the driver may operate various functions in these menus on a number of different levels, moving the Controller in the four directions of the compass to shift from one function level to another. By pressing the Controller in the main menu, the user can then proceed into a fifth menu for information and setting functions.

Pushing the Controller within a given menu provides navigation control, pressing the Controller adjusts the menu point of the cursor and performs the actual operative function. A button behind the Controller, finally, allows the user to select the main menu directly.

#### **Multifunction steering wheel featured as standard.**

The new 5 Series comes as standard with a multifunction steering wheel incorporating four buttons near each of the two cross-spokes and thus allowing the driver to operate various functions without being distracted from traffic conditions around him. These include operation of the audio system and, if fitted, the telephone or voice entry function, as well as acoustic repetition of the last instructions provided by the navigation system. Two programmable multifunction keys are furthermore at the free disposal of the driver for setting functions such as permanent activation of air recirculation, Control Display on/off, mute on/off, radio/telephone switchover, etc.

#### **Another first achievement by BMW: programmable head-up display.**

BMW offers a head-up display for the first time in the new 5 Series, thus making a significant contribution to active safety and motoring comfort by presenting information relevant to the driver right in front of his eyes. This allows the driver to take up and process important information without taking his eyes off the road, the information presented being selected from a list via the Control Display and offered on the screen according to specific requirements. Personal settings such as brightness are saved and recorded by Key Memory.



The head-up display is able to present the following information also shown in part on the instrument cluster:

- Navigation instructions
- Instructions and information for the Active Cruise Control
- Current road speed (when chosen, this is the only permanent display)
- Check/Control warnings.

The virtual image is provided by a projector unit integrated in the instrument panel and transmitting the picture on to the windscreen. This requires special windscreen technology, the virtual picture appearing roughly at the end of the engine compartment lid, as perceived by the driver. Benefitting from this very good ergonomic position of the image, the driver is able to concentrate more consistently on road traffic, without having to lower his eyes to the cockpit that often and not encountering any focusing problems, say, when changing his line of vision from the road to the car's instruments. The head-up display is switched on in the Lights Centre. To provide a clearly legible picture at all times even with changing light conditions, the rain/light sensor controls the brightness of the display, with the driver himself being able to set the basic brightness via the Controller and Control Display. Even a wet road or darkness therefore do not impair the quality of presentation, the automatic control function adjusting the presentation to ambient conditions even in this case.

#### **New: Adaptive headlights and Brake Force Display.**

Introducing new adaptive headlights, BMW offers yet another networked active safety system in the new 5 Series. The big advantage of adaptive headlights is the enhancement of active safety at night, the lights turning with the steering to improve driver visibility and thus adjusting infinitely to the steering angle. The two bi-xenon headlight units are masterminded in their position as a function of the steering wheel angle, the yaw rate and road speed, thus illuminating the road ahead clearly and brightly in a bend.

The driver activates the adaptive headlights by switching the headlights in the "Automatic" position, the headlights thus moving in the desired direction as soon as the car itself starts to move. When the car is at a standstill with the wheels locked to the left, the headlights have to be pointing straight ahead in accordance with road traffic regulations (with the opposite setting in left-hand traffic) in order to avoid any dazzling of oncoming traffic. When backing up, in turn, the adaptive headlights remain inactive.

The basic component of adaptive headlights is the swivelling headlight module with bi-xenon high and low beams. Further features of this system are dynamic headlight range control and the headlight cleaning system.

The Brake Force Display already homologated in the USA reduces the risk of collisions from behind when the driver applies the brakes hard by enlarging the illuminated surface of the brake lights. Already prepared for use on the car, this system may be activated after homologation by the road traffic authorities in each country simply by setting the software to the appropriate standard.

#### **PDC also with optical feedback.**

Like in the 7 Series, the central Control Display allows further improvement of PDC Park Distance Control facilitating the process of entering and leaving a parking space by means of ultrasonic distance measurement: Providing an acoustic – and, as an option, a graphic – signal, the system informs the driver of his distance from obstacles front and rear. The graphic display presents the vehicle from above, obstacles detected being presented by coloured sections within the area monitored. This allows the driver to pinpoint an obstacle conveniently and with absolute precision, obtaining a clear overview of all obstacles around the car at first sight. A further advantage is that the optical warning is activated earlier than the acoustic warning, monitoring an area of 1.5 metres at the front and 2.0 metres at the rear.

#### **ACC Active Cruise Control.**

ACC Active Cruise Control is an enhancement of conventional cruise control helping the driver keep an appropriate distance from vehicles ahead and maintain the right road speed as a function of traffic conditions. The system is able to control not only the desired speed pre-set by the driver, but also – traffic conditions allowing – the distance from the vehicle ahead on the motorway or a country road.

As long as the road ahead is free and unobstructed, the system works largely in the same way as conventional cruise control. But as soon as there is a car ahead driving at a lower speed, ACC will detect the situation by means of a radar distance sensor, adjusting the distance between the two vehicles by setting the speed of the car to that of the vehicle ahead.

Once activated, ACC automatically accelerates the car and applies the brakes with maximum comfort and convenience in order to keep an appropriate distance. The driver may however intervene at any time by giving gas or applying the brakes himself – and indeed, this is essential whenever the system reaches its limits, since the driver must always retain his responsibility at the wheel.

To activate ACC, all the driver has to do is choose his desired speed by means of a control stalk on the steering column, moving up or down in convenient

10 kilometres/h increments. ACC is able to operate between 30 and 180 kilometres/h. the driver's desired speed being presented by a mark in

the speedometer and consistently maintained as long as a vehicle ahead does not require a reduction in speed.

Acting as the core component in the system, a 77GHz radar sensor is able to detect vehicles ahead up to a distance of 120 metres, more or less regardless of weather conditions. As soon as the driver's own car is following another vehicle, Active Cruise Control sensitively adjusts the speed of the car to that of the vehicle ahead, at the same time keeping a consistent distance the driver may again choose from four settings on the control lever.

In the same way as when driving freely without any kind of obstruction or vehicle ahead, this function is performed by intervening in the engine, in the brakes and the transmission management. Application of the brakes is limited to a comfortable 2 metres/sec\_ quite sufficient for fine adjustment of the car's speed and distance in line with the system's functions. Whenever more powerful deceleration is required, the driver is informed by an optical and acoustic signal requiring him to apply the brakes.

ACC relieves the driver of the permanent task of adjusting the distance from a vehicle ahead and his road speed in a rather monotonous process. This is a particularly pleasant advantage in dense traffic on the motorway and on expressways, with a constant change in road speeds making conventional cruise control useless in many cases. Now, using ACC, the driver is able to follow the flow of traffic smoothly and comfortably in such a situation, without having to intervene himself.

### **Bluetooth technology integrating the telephone.**

As an alternative to the dual-band telephone built into the 5 Series, BMW offers a highly convenient, future-proof solution for integrating the mobile phone into the car: This is the universal mobile phone preparation kit with a Bluetooth interface able, at least in principle, to connect every Bluetooth-compatible mobile phone with the electronic system in the 5 Series, without requiring any cables or wiring. Currently, the driver has the choice of the Nokia 6310, Ericsson T39 or Siemens S55 mobile phones.

The connection is provided by the standardised Bluetooth transmission link, the mobile phone automatically registering with the system as soon as it enters the car's reception area (with a range of about 10 metres), as if the connection were provided by a cable. The only additional requirement facing the driver is to enter a four-digit code when registering the first time.

Once the mobile phone has been connected to the car via Bluetooth, the driver can operate his phone safely and conveniently from the multifunction steering wheel and via displays in the car – even including a 100 per cent hands-free control function. All important data such as the telephone

directory, the Top

eight list, as well as the numbers dialled last is synchronised with the on-board system.

The system is able to operate up to four different telephones. To provide perfect reception, the mobile phone is connected with the exterior aerial by a very convenient and easy-to-use snap-in adapter in the centre console serving at the same time to recharge the battery. For reasons of electromagnetic compatibility, BMW recommends only mobile phones with a separate connection to the aerial.

Apart from the much higher standard of compatibility (nearly all current and future Bluetooth mobile phones made by all manufacturers may be used in future with the help of an appropriate snap-in adapter), the universal mobile phone preparation kit with its Bluetooth interface offers the customer particular benefits when buying a new mobile phone: All he has to do is replace the inexpensive and easy-to-exchange snap-in adapter available from his BMW dealer. Clearly, this makes the system absolutely future-proof with all the advantages of such a trendsetting concept.

BMW's universal mobile phone preparation kit with its Bluetooth interface is available in all countries where Bluetooth technology has been duly approved and homologated by the local licensing authorities. Wherever this is not yet the case, BMW will provide an appropriate alternative solution.

The alternative dual-band telephone fitted into the car comes with a cordless handpiece also communicating with the base station through Bluetooth technology. Its radius of use is up to ten metres around the car.

#### **Navigation system with DVD.**

As an option, the new BMW 5 Series Saloon is available with a DVD-based navigation system combined with the radio system Professional.

Operating in conjunction with an audio CD-compatible DVD-ROM drive, this navigation system provides voice messages and arrow symbols guiding the driver to his destination. If necessary, the guidance arrows are also presented in the head-up display. The system also takes RDS-TMC, that is road traffic information received by the radio through a digital flow of data, into account. In particular, it presents messages relating to the driver's planned route and traffic conditions, also considering the driver's wishes regarding the route chosen. The driver may however also choose dynamic route guidance, with the system automatically calculating the best route in each case. Traffic congestion on any of the routes considered is duly taken into account. Should the system determine that such a route is still the fastest option despite such traffic congestion, the system will advise the driver accordingly.

Featuring an integrated memory navigation function, the system is able to plan the appropriate route by means of the navigation DVD and memorise the information required. Now the driver can take out the DVD and replace it, for example, by an audio CD. Then, when leaving the navigation corridor already entered, the system will once again call for the navigation DVD in order to download the map data required.

A variant with additional map presentation will be available as of autumn 2003.

**A unique sound experience on four wheels:**

**The audio systems in the new 5 Series.**

The new 5 Series Saloon comes as standard with a high-quality, sophisticated stereo system featuring the BMW Business radio and a CD player. Other HiFi systems ensuring the highest standard of audio quality are also available as an option. The Professional radio also comes with a player able to provide not only the standard CD functions, but also CD-ROM functions, thus playing back data files such as MP3 CDs. This radio system is once again part of the navigation unit.

A special satellite radio is available in the USA for the satellite broadcasting system with virtually nationwide coverage.

**Optional: CD and DVD changer.**

As an option, the audio systems may be supplemented by a CD changer within easy reach of the driver and front passenger: The main unit is integrated in the interior of the car and is hidden in the glove compartment. The changer is operated via the Controller and Control Display, operates particularly smoothly and quietly, and can accommodate up to six music CDs. A multimedia changer is also available either as an additional or as an alternative feature. Likewise operated via the Controller, this multimedia changer is able to accommodate six CDs, audio or video DVDs and is fitted in the luggage compartment behind a flap in the left-hand wheel arch section.

**HiFi system with two central bass loudspeakers.**

Two central bass loudspeakers beneath the front seats providing perfect reproduction of low sounds throughout the car form the very "heart" of the HiFi system. As in the 7 Series, the volume required is provided by linking the central bass loudspeakers to the side-sills. A tweeter is housed in each of the mirror triangles, and a sub-woofer is integrated in each of the front door panels. Two further sub-woofers are integrated in the parcel shelf, with two tweeters in between.

### **The top HiFi concept: BMW's Professional LOGIC7 system.**

The Professional LOGIC7 HiFi system offers the driver and passengers in the new BMW 5 Series high-end audio quality with supreme technology carried over from the BMW 7 Series: As the world's first system of its kind in a car, this HiFi technology applies the LOGIC7 concept so far only to be found in stationary professional and semi-professional sound systems. LOGIC7 is a special digital audio signal processing mode for two-channel stereo signals and multi-channel multimedia signals.

The objective of LOGIC7 is to create an experience in sound as true to the original as possible for all listeners within the car. To do this, a matrix circuit splits up every signal of an analogue or digital stereo recording into seven individual signals then processed specifically in accordance with the car's interior configuration. To provide a multi-dimensional sound experience as close to the original as possible, LOGIC7 uses the spatial information contained in each stereo signal and breaks down this information into the two crucial sound dimensions: The place where the sound was originally generated and the acoustic environment or the location where the sound is now disseminated.

This gives the listener an even greater experience in spatial sound and more precise resolution, allowing him to locate individual sound sources with even greater precision. Particularly moving sound sources such as a car passing by are presented far more plastically and impressively.

The Professional LOGIC7 HiFi loudspeaker system comprises the following units:

- Four tweeters in the mirror triangles and in the parcel shelf
- A 100-millimetres conical sub-woofer serving as the central loudspeaker in the middle of the instrument cluster
- Four 100-millimetres conical sub-woofers in the doors and three in the parcel shelf
- Two 210-millimetres central base loudspeakers beneath the front seats.

### **Individual entertainment for the passengers at the rear.**

The rear seat passengers benefit from two supplementary systems allowing them to put together their own entertainment programme: First, the "basic" rear-seat entertainment system offers the passengers at the rear the opportunity to listen to music, etc over headphones, with two headphone sockets fitted in the centre console. The entertainment menu itself is operated by wireless remote control: Once you press the menu button, a pop-up window appears in the Control Display in the cockpit, which may also be read from the rear. The usual menu finder in the basic menu is

replaced in this case by a headset symbol, the user then being able to move around within the menu by remote control operating the same way as the Controller – by pushing, pressing and turning the button. Both a directional control block and a push/press button are provided on the remote control for this purpose. Commands entered on the front Controller nevertheless have priority over this system in all cases.

The basic principle is that internal sound sources such as the radio or CD player can be specified and pre-set only once: If the driver is listening to the radio the passengers at the rear can only listen to the station the driver has selected, but they are able at the rear to listen to, say, a CD over the headsets.



## 7. Equipment: Personalised Business Comfort.



### Highlights.

Six types of different seats.

Fully variable multifunction seat.

Through-loading also retrofittable.

Automatic air conditioning with humidity control.

Down to the very last detail, the features and equipment offered by the new BMW 5 Series reflect the dynamic but comfortable concept underlying this outstanding saloon. Through its unique design alone, the cockpit gives the interior of the new 5 Series an exceptional, truly characteristic look.

The customer can choose his or her new 5 Series in five equipment variants and four worlds of interior colours. The "basic" version comes with high-quality flat-weave fabric, with a leather/fabric combination as well as three different types of leather upholstery available as an option: Standard Dakota leather, Climate Nasca leather with micro-perforation, and luxurious and elaborately finished Exclusive Nappa leather.

This sophisticated style and flair is further enhanced by a special lighting concept: the front interior illumination provides anti-dazzle conditions and ensures a pleasant feeling of space. To be specific, the interior illumination comprises two reading lights in the middle of the roof lining with illumination from above providing an ambient lighting effect on the centre console. Further highlights are provided by the two vanity mirror lights beneath the sun visors, illumination of the glove compartment, and door cut-out lights at the front on the bottom of the doors themselves.

Apart from an interior light, the rear-seat illumination comprises two additional reading lights as well as ambient illumination of the rear footwells.

Footwell lights at the front, ambient illumination of the door openers and pockets, door exit lights at the rear on each door as well as illumination of the area around the car are all available as optional extras. The outside illumination is made up of six LEDs on each side down the bottom of the exterior mirrors, operated by the car's remote control. This illuminates the area around the car before the driver has even walked up to the car itself in order to unlock the door. The door exit lights, in turn, provide the same function as soon as the door has been opened.

### **Wide range of seats: six variants for every purpose.**

Never before has the BMW 5 Series offered the customer so many options in choosing his very own seats and comfort features – the new 5 Series offers no less than four seat variants at the front, two at the rear, and six additional special features.

Even the “basic” seat for the driver and front passenger comes with electrical adjustment of seat height and backrest angle. Fore-and-aft adjustment as well as the adjustment of the headrests is manual, and the driver’s seat is also adjustable for seat squab angle. The options available include seat heating, a lumbar support and an active seat, the latter again including a lumbar support. The special feature of the active seat is the hydraulic motion system helping to relax your back muscles and avoid any tension.

A centre armrest sliding to-and-fro available only from BMW in this configuration may be fitted between the front seats. The upper of the two compartments in the armrest serves as a folding storage box with a separate cover, the lower compartment is climate-controlled through the air duct for the rear seat air vents.

In addition to the adjustment options on the standard seat, the all-electric “basic” seat comes with electrical fore-and-aft adjustment as well as electrical adjustment for angle and the level of the headrest. The driver’s seat even features a memory function as an additional amenity. The options available in this case also include seat climate control comprising an electrical seat heating function. Multi-stage blowers are embedded in the upholstery on the seat squab and backrest to climatise the seat by pumping air from the interior of the car through the seat upholstery. A further alternative is the all-electric sports seat again boasting the same features plus more strongly contoured side supports holding the driver’s body securely in position in a fast bend.

### **Multifunction seat with variable side support for the driver’s head and upper body.**

The top version is the multifunction seat offering such a wide range of adjustments and features that it is virtually able to combine contrasting requirements. At the touch of a button, for example, the upper section of the backrest moves forward to provide individual shoulder support tailored to the user. Seat depth adjustment and a lumbar support are also standard features on this comfort seat, which moreover comes with variable headrest side support of the type to be found in modern aircraft seats as well as a pyrotechnically activated headrest to avoid spinal injury and the whiplash effect in bumper-to-bumper collisions. Yet a further forte is optimum side support for a sporting style of driving, the contoured side elements adjusting individually to the respective driver.

The standard version of the rear seats consists of a single-piece all-foam seat element combined with a single-piece backrest. The folding centre armrest, in turn, comprises a firmly integrated headrest as well as cupholders. The outer headrests at the rear are manually adjustable and seat heating is available as an option.

The rear seats also come as an option with through-loading and the rear-seat backrest is split 60:40. With a modular ski-bag integrated in the wider section of the backrest, the ski-bag can be easily exchanged against other features such as a cooling box, an additional storage compartment, a sports bag, etc.

#### **First-ever retrofittable through-loading.**

For the first time the new construction principle provides the option to retrofit a through-loading system on the rear seats: So far cars with the standard rear seat structure came with a metal panel serving to reinforce the vehicle and hold back the cargo in the luggage compartment. Now the new 5 Series no longer requires this rear bulkhead, the rear-seat backrest being made of a tubular steel frame hybrid structure embedded in a plastic coating. This frame is connected to the bodyshell at four points and serves to hold back the cargo in the luggage compartment whenever necessary. And – as its big advantage – it provides the option to retrofit the through-loading function at any time.

#### **New: automatic air conditioning featured as standard.**

BMW has developed new automatic air conditioning for the new 5 Series setting a new benchmark in performance and featured as standard in its “basic” configuration. An even more versatile high-end version offering an even greater number of settings is available as an option, BMW’s iDrive concept enabling the driver to operate the basic ventilation, heating and cooling functions directly from buttons and switches on the instrument panel.

The basic version of the automatic air conditioning controls the temperature, air volume and distribution fully automatically, temperature stratification as well as the temperature and amount of air coming out of the central vent in the instrument panel being varied by the Controller and Control Display.

#### **High-end automatic air conditioning with even more individual control.**

Optional high-end automatic air conditioning allows an even broader and more individual range of settings: Over and above the “basic” features, this system provides separate temperature control right and left, automatic air volume control and ventilation through the central vent with infinite temperature adjustment and individual control of upper body temperature. To provide these sophisticated functions, a bi-directional solar sensor measures solar irradiation on each side of the car and varies the inflow of cooling air accordingly. At the rear, in turn, the passengers are able to stratify the air flowing out of the centre grille for optimum air dosage.

To avoid any obstruction of visibility, an anti-misting sensor monitors window and air temperature. If necessary, the sensor can prevent the windows from misting over by operating in several steps, without the interior climate deteriorating as long as the system is in its initial stages: In this case it will switch over from air recirculation to exterior air supply and increase the volume of air before cooling down the air to a lower level in order to remove air moisture.

Yet a further feature of high-end automatic air conditioning is the residual heat function with coolant being pumped through the heat exchanger even when the engine is not running in order to supply the interior with warm air without requiring any additional energy. Then there is also auxiliary ventilation again supplying the car with outside air through the automatic air conditioning without the engine running in the process. In this case the air is cleaned by an activated carbon filter binding and holding back nearly all dust and pollutants. And should the gas sensors detect a high level of harmful pollutants in the outside air, Automatic Air Recirculation will switch over immediately to the recirculation mode.

**New: fully controlled air humidity for a better climate.**

A particularly pleasant feature for the car's occupants is evaporator temperature control on both versions of automatic air conditioning helping to avoid an excessive cooling effect and preventing the passengers' mucous membranes from growing dry: So far the air to be cooled was always reduced to a temperature of approximately 1–3 °C, with a lot of moisture being extracted in the process before this very dry air was warmed up again to the desired temperature. Now an external sensor monitors the air temperature and cools the air only as far as absolutely necessary. With the air cooling range thus being extended to about 10 °C, air humidity remains at a higher level and keeps the air more pleasant for the mucous membranes.

## 8. Passive Safety: A Demanding Overall Concept.



### Highlights.

Trendsetting body structure.

Advanced Safety Electronics (ASE) with light conductor technology.

Advanced ITS head airbags front and rear.

Active headrests for driver and front passenger.

Throughout the last three generations of cars, BMW has made huge progress in the area of passive safety. And whilst this extra safety is often communicated to the public only in very superficial terms focusing on issues regarded as relevant to the customer such as more airbags, additional belt latch tensioners or new crash tests conducted at even higher speeds, genuine progress actually lies in all the details, not so much in terms of quantity, but rather in terms of quality.

Only a perfect balance of individual improvements tailored to one another is able to provide optimum results living up to the high standard BMW is able to fulfil with the new 5 Series not only in terms of increasingly strict regulations and legislation the world over, but also with consumer tests in Europe, the USA and other markets becoming more demanding all the time. And in particular there are the demands resulting from real-life accident requirements even more diverse and challenging, and therefore requiring very precise configuration of the car focusing on each and every detail. Precisely this is why major developments featured for the first time in the 7 Series have been carried over and further enhanced in the new 5 Series, making the new model the benchmark in passive safety even in the premium class – innovative, progressive and highly efficient in every respect.

All the features for minimising the loads acting on the occupants and maximising the survival area in the event of a collision are to be found within the attractive body of the car:

- Highly resistant bearing structures for frontal, side and rear-end collisions as well as a rollover.
- Deformation travel put to optimum use.
- An extremely stiff passenger cell.

- Compatible, interacting features in the front-end structure.

Apart from the airbags, the highly efficient restraint system comprises the steering column, steering wheel, seats, headrests, seat belts, belt latch tensioners, belt force limiters, and an all-round safety package enabling the occupants to move as far as possible with the car in the event of an impact, thus cushioning the impact forces.

### **Advanced Safety Electronics.**

Full integration and adaptation of the Safety and Information System carried over from the new 7 Series optimises the intelligent management of the car's active safety components, creating the concept of Advanced Safety Electronics (ASE) featured by the new 5 Series.

The main components of ASE are the decentralised, intelligent sensors (satellites) and an ultra-fast data bus system for optimum activation of the airbags, belt latch tensioners and active headrests. The purpose of the system is to activate the right component with the right intensity at the right time in the event of a collision, thus ensuring optimum passenger safety and protection. Functions not required, in turn, remain inactive.

The advantages of this innovative safety technology with its decentralised satellites come out clearly in a number of areas:

- Faster acquisition and exchange of data.
- More precise recognition of a crash and the underlying circumstances.
- Networked airbag control system.
- Selective activation of the airbags, belt latch tensioners and active headrests geared to the severity of an accident.
- Greater accuracy and reliability in activating the safety components required.
- Diagnosis of the battery connection for damage, with separation of the battery by means of the safety battery terminal whenever required.

The ASE safety electronics incorporate an optical bus system (byteflight) exchanging and processing sensor information. This bus serves to transfer and exchange data at maximum speed and with optimum system reliability, communicating with and among the satellites arranged at different points all over the car. These decentralised satellites are made up in each case of a control unit with integrated sensor technology able to take intelligent decisions triggering an actuator (for the airbag, belt latch tensioner, etc). The individual sensors allow optimum management of the pyrotechnical

components within the restraint system (airbags, belt latch tensioners, active headrests, etc), only the safety components really required being activated in each case.

The byteflight bus system is a joint development by BMW in cooperation with system suppliers serving to meet critical safety requirements. Signals are transmitted by means of plastic byteflight light wave conductors operating at a very fast data rate and with optimum reliability. The byteflight data bus is an integrated component of the on-board network and is networked with the existing CAN buses and the diagnostic system by means of a central gateway module.

### **Body structure.**

The comprehensive know-how of BMW's development and safety experts came to bear specifically in the development of the bodyshell and its various components. Using a lightweight aluminium front end for the first time, BMW's engineers have succeeded in combining optimum safety with a considerable reduction in weight, ultra-strong body panels within large bearing structures incorporating specifically designed reinforcements providing a supreme standard of stiffness and body strength. Use of high-strength glue over a length of approximately 65 metres (equal to about 50 per cent of the car's flange connections) serves to reduce weight to an even lower level, helping again to create one of the most advanced bodyshell structures also comprising the doors and bumpers.

### **Head-on collisions.**

The behaviour of a car in collisions with full or partial overlap and in collisions varying in intensity depends to a large extent on the optimum balance and harmonisation of the front-end structure. Experts therefore make a clear distinction between the following types of head-on impacts:

- **Low crash forces:**  
Crash forces are defined as "low" in minor bumps at speeds of up to 4 kilometres/h and in accidents up to 15 kilometres/h. The focus in this case is particularly on easy repair allowed primarily by "cold" joining technologies such as bolting, gluing and riveting of aluminium components.
- **Medium and high crash forces:**  
In this case the front end of the car, together with the front axle, must absorb the crash energy and divert the forces involved whenever necessary through various load paths into the passenger cell.

### **Low crash forces.**

An aluminium front end module made up of an aluminium crossbar, two bolted-on deformation boxes and a bridge structure accommodating the radiator and headlights is bolted on to the engine and support arms.

Energy-absorbing foam elements are integrated into the body panels in front of the bumper crossbar. In impacts at a speed of up to 4 kilometres/h foam elements absorb the impact energy, avoiding any damage to body components and structures further back. After a collision, the plastic covers return to their original shape. In a collision at speeds of up to 15 kilometres/h, in turn, the front-end module absorbs all the impact energy, avoiding any damage to the engine support arms.

### **Medium and high crash forces.**

In providing for medium and severe head-on collisions, the focus is on optimum interaction of front-end deformation and passenger cell stiffness. Maximum energy-absorbing deformation travel serves to minimise the forces acting on the passenger cell and, accordingly, on the occupants themselves. The objective in an offset collision, in turn, is to preserve the survival area in front of the instrument panel and in the footwells, thus restricting intrusion to a minimum.

- Exactly calculated force and load paths in head-on and offset collisions proven in practical tests ensure optimum distribution of impact forces throughout the structure of the car. In the event of a severe collision, above all with forces exerted from one side, such load distribution is able to guide impact forces to the other side of the vehicle away from the impact point, protecting the bulkhead area in the footwells by means of dynamic deformation zones at the front.

### **Side-on collisions.**

To keep the forces acting on the occupants below the acceptable biomechanical limits, deformation effects and forces in a side-on collision must be minimised. Related in all cases to real-life accident conditions, the measures taken for this purpose act on three levels:

- Within the floor assembly reinforced side-sills convey impact forces to two crossbars beneath the front seats. The seat support frames are appropriately dimensioned for side crash loads and feature, in addition with other components, an extra-stable transverse-tube subframe. The additionally reinforced centre tunnel, in turn, with bridge elements bolted on from beneath serves to convey forces to the opposite side of the car away from the point of impact.
- The pillars in the door area are built in a three-shell structure, the B-pillar featuring additional reinforcement around the sill area. The doors have several reinforcement profiles and are integrated into the body of the car by means of extra-stable joints and locks. The seats themselves protect the occupants by means of particularly stable seat and backrest frames, the instrument panel crossbar between the A-pillars providing additional crosswise support.



- The roof frame comes as a three-shell structure at all connection and junction points.

These design and construction features keep both intrusion depth and the rate of intrusion in a side-on collision to a minimum.

#### **Rear-end collision.**

The safety package on the rear body structure is made up of two longitudinal support arms, two crossbars around the axle, the luggage compartment floor panel, the rear-end support arm and the rear side walls. A highly stable rear bumper incorporating energy-absorbing support elements serves to reduce damage at low impact speeds to components easy to exchange.

#### **Rollovers.**

The extra-strong pillars and crossbars in the passenger cell preserve the occupants' survival area in a rollover. In addition, the windscreen and rear window bonded on to the body help to further improve deformation resistance in such a case.

#### **Occupant protection systems.**

Efficient energy absorption reducing the forces acting on the occupants (and naturally harmonised with the deformation behaviour of the car's body) is crucial to the efficiency of the occupant protection systems, in particular the seat belts and airbags, as well as the surfaces and panels within the interior.

#### **Belt system.**

The belt system for the driver and front passenger comprises a number of units.

#### **Pyrotechnical belt latch tensioner with belt use detector.**

The pyrotechnical belt latch tensioner eliminates or reduces belt slackness in the event of a collision in both the lap and shoulder belt. Serving to detect proper use of the seat belt, the belt latch switches set off an optical and acoustic warning whenever the occupant has not buckled up, reminding the driver and passenger to wear their seat belts.

#### **Inertia reel belt system with belt force limitation.**

The inertia reel belt system comprises belt force limiters reducing chest forces in the event of a severe impact and shifting a greater share in the restraint function to the airbag. Optimum interaction with the airbag serves to smoothly reduce the kinetic energy acting on the occupants throughout the entire period of a collision, thus cutting back occupant loads and forces accordingly.

### **Seat occupancy detector.**

The sensor mat serving as a seat occupancy detector on the driver's and front passenger's seat responds as of a weight of approximately 12 kilograms, "recognising" that the seat is occupied.

This seat occupancy signal serves to trigger a number of actuators:

- Airbag activation thresholds (US models only).
- Activation of the ignition pellets for the belt latch tensioner
- Activation of the active headrest.

#### **Rear seat safety package.**

Over and above the standard fitment of three-point inertia reel seat belts on all three seats, the optional rear seat safety package comes with the following additional features:

- thorax side airbags
- inertia reel belt systems with force limiters
- belt latch tensioners

on the two outer seats.

#### **Frontal airbag system.**

The belt system on the front seats is rounded off by frontal airbags actuated at two different levels, depending on the severity of an accident. The volume of the driver airbag is approximately 53, the volume of the front passenger airbag approximately 125 litres. In accidents with medium severity, the gas generators for the driver and front passenger build up only about 70 per cent of the maximum pressure, making the entire system far less aggressive. Airbag pressure is controlled by an ignition delay function between the two generator charges, with both stages being triggered in all cases to allow immediate rescue of the occupants without any danger or exposure as well as disposal of the airbag.

#### **Safety steering column.**

The key feature of the steering column is the deformation element reducing forces acting on the driver's head and chest, taken over from the 7 Series and carefully modified for the 5 Series. Made of a corrugated tube and slide pieces, the connection elements on the lower and upper steering column set off any backward movement of the steering transmission and intrusion through the bulkhead in a collision.

Providing highly efficient energy absorption, the deformation element directly behind the steering wheel ideally supplements the belt force limiter with the driver moving forwards in his seat. This ensures additional safety and protection even for the driver not wearing his seat belt.

### **Active headrest.**

The active headrest for the driver and front passenger comes on the multi-function seat available as an option. Depending on the standard of comfort desired by the driver and front passenger, the active headrest serves to increase the distance between the headrest surface and the occupant's head by up to about 9°, simply by electrical adjustment of the upper backrest. In the event of a collision the active headrest reduces this distance immediately

by activating an autonomous (pyrotechnically actuated) head support function, thus preventing the risk of cervical spine injury. A further advantage of the system, especially after rear-end collisions in a less severe accident, is the low cost of repair requiring only the gas generator to be replaced.

### **Side-on collision restraint system.**

Thorax side airbags and energy-absorbing design of the door lining and armrest as well as the Advanced ITS headbag serve to protect the occupants in a side-on collision.

The head airbag plays a significant role in supplementing the effect of the side airbags, the addition of a "sail" element like in the 7 Series creating the Advanced ITS (Inflatable Tubular Structure) concept housed in the roof area. The Advanced ITS system is therefore made up of the well-known tubular airbag with an additional sail for enhanced protection. Extending back from the A- to the C-pillar, Advanced ITS covers the entire side area and thus protects the occupants' heads front and rear. The sail fastened in the roof frame is pulled down upon activation of Advanced ITS by the tube inflating to its volume of approximately 24 litres.

This sophisticated system offers a number of important benefits:

- Extended coverage of the side windows front and rear.
- Efficient restraint of the occupants in a side-on collision or rollover, preventing the occupant's head from swaying to the outside. This, in turn, reduces forces acting on the occupant's neck and helps to avoid head injury.
- Enhanced protection from glass splinters and intruding objects.
- Larger protection area for occupants of all sizes.

This all-inclusive system retains the car's safety structure and stability for several seconds, which is a particular advantage above all in a rollover and in a second, follow-up collision or impact.

## 9. Production: Sustainable, Efficient and Trendsetting.



Introducing the new generation of the 5 Series, BMW is not only presenting a whole range of innovations in the product itself, but also trendsetting processes and concepts in production. To a certain extent this progress with the product and in production goes hand-in-hand, the combined steel/aluminium structures, for example, requiring special procedures in the bodyshop and paintshop. Even conventional production technologies have also been developed to a higher standard than before, serving the cause of Clean Production and even better ergonomics in the assembly process.

### **Lightweight aluminium front end – a special challenge in body construction.**

In search of the best and most intelligent combination of materials, the new BMW 5 Series is the first car in the world to feature a Lightweight Aluminium Front End (LAFE) as standard. This combination of various aluminium and steel materials is only possible with the help of the most sophisticated and elaborate joining processes and technologies developed by BMW's engineers to ensure optimum connections with supreme precision: Depending on load conditions and the material used, the various LAFE components are bonded, riveted, welded or joined by special laser technology.

LAFE production is based on the following facts, figures and features:

15.2 metres of bonded flanges	48 aluminium bolts
2.94 metres of aluminium MIG welding seams	599 punch rivets
1.74 metres of aluminium laser welding seams	Material mix (AlMgSi, Magsimal 59, AlMg3,5Mg, TRIP 700, composite panels) Total weight approx. 45 kilograms

Optimised use of different joining technologies is however not limited to the Lightweight Aluminium Front End alone, but rather applies to the entire body-in-white: approximately 60 metres of connection seams are bonded, some 4,000 welding spots are applied all round the car, and almost 70 connection points are bolted together. Further methods applied in this process are MAG welding, MIG soldering, laser welding and beading, riveting, sub-coating, sealing, clinching and clipping with more than 98 per cent of all processes being fully automated.

In all, some 1,350 industrial robots are used in the Bodyshop at the Dingolfing Plant, some 1,000 thereof in production of the new BMW 5 Series and again approximately 300 therefore for LAFE production. The entire bodysell produced in four different variants and made up of almost 500 steel plate and aluminium components weighs less than 350 kilograms (772 lb), including all attachments.

### **LAFE requires a new approach also in the Paintshop.**

The intelligent mix of materials on the Lightweight Aluminium Front End can only be painted in a rotation dipping paint application process (RoDip), the aluminium/steel body being dipped in a paint bath for the first time. The innovative RoDip facility has been used since 2002 for pretreatment of the body-in-white, for cleaning, degreasing and, in particular, applying a layer of phosphate. Through its specific structure in combination with the latest and most advanced membrane filter technology, the RoDip bath provides an optimum concentration of cryolith and phosphate sludge, the membrane filter presses serving to separate sludge with an aluminium content of up to 30 per cent. The entire pre-treatment process is monitored online, precise management supervising the chemical composition of the individual baths and the process of reconditioning waste water in this recycling system. The new phosphating bath flooding system serves in addition to provide an optimum flow of liquid around the body with minimum consumption of chemicals and with both effluent and sludge reduced to a minimum.

### **Hydrofiller – an important milestone in Clean Production.**

The entire Paintshop is designed and built for Clean Production, the BMW Group's philosophy using all technical, economical and ecological options for an effective and environmentally-friendly production process. Reducing solvents by 75 per cent versus conventional filler materials, the introduction of hydrofiller – that is water-based filler material – makes an important contribution to this objective: The hydrofiller system alone is able to save approximately 40 tons of solvent a year in this process of applying five layers of paint in the production of the new BMW 5 Series – and at the same time this advanced material offers an enhanced standard of visual and functional quality. Fully automatic production under clean room conditions carried over from the aerospace industry ensures optimum quality in the Paintshop at all times.

### **Powder clear paint providing protection and supreme surface gloss.**

Perfectly prepared for application of the actual paintwork, the body is now treated in colour lines spraying the appropriate colour on a water basis and using powder clear paint technology unique the world over to provide superior protection and surface gloss. Absolutely no water, effluent, cleaners and solvents are used in the entire process – the new BMW 5 Series is painted with a standard of clean and sustainable environmental-friendliness never seen before.

### **Colours – the challenge of finding the right match.**

BMW takes a new approach in painting the new 5 Series also in terms of quality, smooth transitions from the body to painted attachments and add-on components representing a big challenge in terms of colour-matching in the production process. To meet this challenge, cooperation of the paint supplier, the suppliers of the ready-painted add-on components and the Paintshop itself has been optimised in an elaborate, painstaking process. An important element in this context is automatic online colour measurement of the ready-painted car body conducted in the Paintshop for the first time in this way

on the new BMW 5 Series. A further point is that the new 5 Series is available with no less than twelve regular colours, two of which are exclusive to this particular model.

A further new feature in the Paintshop is the reflow-type small-volume paint supply system allowing a change in colour without the slightest loss of paint. This allows the application of some 250 different paint colours in production quality, enabling the Paintshop to respond very flexibly to customer wishes.

### **Upgraded assembly process for maximum efficiency and ergonomics.**

The entire assembly process has been revised in preparing production of the BMW 5 Series. Apart from a flexible configuration for ramping-up production, a clear focus on the worker in developing, planning and implementing the production process helps to ensure particularly ergonomic working conditions. Thorough use of swivelling assembly hooks, greater deployment of assembly systems moving along with the car such as insert plates as well as modern illumination technology provide a working environment conceived not only for maximum efficiency but also for pleasant conditions at work.

A further core element of this new concept is the highly flexible installation of components and modules. This process no longer takes place on the main assembly lines, but rather right next door in the pre-assembly (engine/chassis assembly) area, thus separating production operations from all other areas upstream and downstream of the production process as such. The advantage of this concept is that the complete drivetrains of various model series can be fitted into the body of the car and bolted fully automatically within a matter of minutes, all quality-relevant parameters being permanently monitored to ensure the high standard of quality so typical of BMW.

### **Change management up to one week prior to the start of production.**

The new BMW 5 Series is built exclusively at the BMW Group's largest production plant some 100 kilometres east of Munich in Dingolfing. Here some 23,000 associates build more than 1,250 BMW 3, 5 and 7 Series every day, each car tailored to the customer's order. And this means flexibility to the utmost limit: The Customer-Oriented Sales and Production

Process implemented by BMW as a new benchmark for the first time with the 7 Series in 2002 is also maintained consistently with the BMW 5 Series.

This guarantees not only maximum efficiency in production, but also a very high level of change management for the customer as well as punctual delivery of the vehicle: Changes involving the engine, colour and equipment can still be made up to one week prior to the start of assembly without affecting the delivery date agreed.



## Specifications BMW 5 Series Saloon. 520i, 530i.

<b>Body</b>		<b>520i</b>	<b>530i</b>
No. of doors/seats		4/5	4/5
Length/width/height (unladen)	mm	4,841/1,846/1,468	4,841/1,846/1,468
Wheelbase	mm	2,888	2,888
Track, front/rear	mm	1,558/1,582	1,558/1,582
Turning circle	metres	11.44	11.44
Tank capacity	approx ltr	70	70
Cooling system incl heater	ltr	9.8	9.8 (10.2)
Engine oil	ltr	6.5	6.5
Transmission fluid	ltr	Lifetime	Lifetime
Final drive fluid	ltr	Lifetime	Lifetime
Weight, unladen, to EU <sup>1</sup>	kg	1,560	1,570 (1,580)
Max. load to DIN	kg	540	560
Max. permissible weight to DIN	kg	2,025	2,055 (2,065)
Max. axle loads, front/rear	kg	980/1,130	980/1,150
Max. trailer load <sup>2</sup> , braked (12%); unbraked	kg	1,600/750	2,000/750
Max. roofload/max towbar download	kg	100/90	100/90
Luggage compartment DIN70020	ltr	520	520
Air drag	C <sub>x</sub> x A	0.26 x 2.26	0.28 x 2.26
<b>Engine</b>			
Configuration/cyls/valves		Inline/6/4	Inline /6/4
Fuel supply		Siemens MS45	Siemens MS45
Capacity, effective	cc	2,171	2,979
Stroke/bore	mm	72.0/80.0	89.6/84.0
Compression ratio	:1	10.8	10.2
Fuel grade		RON 91–98 <sup>3</sup>	RON 91–98 <sup>3</sup>
Max. output	kW/bhp	125/170	170/231
at	rpm	6,100	5,900
Max. torque	Nm(lb-ft)	210(155)	300(221)
at	rpm	3,500	3,500
<b>Electrical system</b>			
Battery/installation	Ah/–	80/luggage comp	80/luggage comp
Alternator	A/W	150/2,100	150/2,100
<b>Chassis and suspension</b>			
Suspension, front		Double-joint thrust-rod spring strut axle in aluminium; compensation of transverse forces; anti-dive	
Suspension, rear		Integral IV multi-arm axle in aluminium; wheel suspension with special effect Anti-squat/anti-dive	
Brakes, front		Single-piston swing-calliper disc brakes	
Diameter	mm	310, vented	324, vented
Brakes, rear		Single-piston swing-calliper disc brakes	
Diameter	mm	320, vented	320, vented
Driving stability systems		ABS, CBC, ASC, DSC, DTC, DBC; optional: Dynamic Drive	
Steering		Rack-and-pinion power steering; optional: Active Front Steering	
Steering ratio, overall	:1	13.7	13.7
Transmission, type		Six-speed manual gearbox (six-speed automatic transmission with Steptronic)	
Gear ratio	1 <sup>st</sup>	:1	4.35
	2 <sup>nd</sup>	:1	2.496 (2.34)
	3 <sup>rd</sup>	:1	1.665 (1.52)
	4 <sup>th</sup>	:1	1.23 (1.14)
	5 <sup>th</sup>	:1	1.0 (0.87)
	6 <sup>th</sup>	:1	0.851 (0.69)
	R	:1	3.93 (3.40)
Final drive	:1	3.38	2.93 (3.46)
Tyres		225/55R16 95 W	225/55R16 95 W
Rims		7 J x 16 LM (LBS-R)	7 J x 16 LM (LBS-R)
<b>Performance</b>			
Power-to-weight ratio, DIN	kg/kW	11.9	8.8 (8.9)
Output per litre	kW/ltr	57.6	57.1
Acceleration	0–100 km/h	sec	9.0
	standing-start km	sec	30.2
	80–120 km/h in 4 <sup>th</sup> /5 <sup>th</sup> gear	sec	9.4/12.5
Top speed	Km/h	230	250 (245)
<b>Fuel consump in the EU cycle</b>			
Urban	ltr/100 km	13.0	14.1 (14.2)
Extra-urban	ltr/100 km	6.8	7.0 (7.5)
Composite	ltr/100 km	9.0	9.5 (9.9)
CO <sub>2</sub>	g/km	219	231 (240)
<b>Miscellaneous</b>			
Emission category		EU4	EU4

Figures in brackets apply to cars with automatic transmission.

<sup>1</sup>Weight of the car in road trim (DIN) plus 75 kg for driver and luggage.

<sup>2</sup>May be increased under certain conditions.

<sup>3</sup>Performance and fuel consumption data on RON 98 fuel.

<sup>4</sup>Electronically limited.

## Specifications BMW 5 Series Saloon. 530d.

<b>Body</b>		<b>530d</b>
No. of doors/seats		4/5
Length/width/height (unladen)	mm	4,841/1,846/1,468
Wheelbase	mm	2,888
Track, front/rear	mm	1,558/1,582
Turning circle	metres	11.44
Tank capacity	approx ltr	70
Cooling system incl heater	ltr	9.6(9.8)
Engine oil	ltr	7.75
Transmission fluid	ltr	Lifetime
Final drive fluid	ltr	Lifetime
Weight, unladen, to EU <sup>1</sup>	kg	1,670 (1,685)
Max. load to DIN	kg	560
Max. permissible weight to DIN	kg	2,155(2,170)
Max. axle loads, front/rear	kg	1,050/1,180
Max. trailer load <sup>2</sup> , braked (12%); unbraked	kg	2,000/750
Max. roofload/max towbar download	kg	100/90
Luggage compartment DIN70020	ltr	520
Air drag	C <sub>d</sub> x A	0.28 x 2.26
<b>Engine</b>		
Configuration/cyls/valves		Inline/6/4
Fuel supply		Bosch DDE 5 (CR)
Capacity, effective	cc	2,993
Stroke/bore	mm	90.0/84.0
Compression ratio	:1	17.0
Fuel grade		Diesel
Max. output	kW/bhp	160/218
at	rpm	4,000
Max. torque	Nm(lb-ft)	500 (369)
at	rpm	2,000
<b>Electrical system</b>		
Battery/installation	Ah/–	90/luggage comp
Alternator	A/W	170/2,380
<b>Chassis and suspension</b>		
Suspension, front		Double-joint thrust-rod spring strut axle in aluminium; compensation of transverse forces; anti-dive
Suspension, rear		Integral IV multi-arm axle in aluminium; wheel suspension with special effect Anti-squat/anti-dive
Brakes, front		Single-piston swing-calliper disc brakes
Diameter	mm	324, vented
Brakes, rear		Single-piston swing-calliper disc brakes
Diameter	mm	320, vented
Driving stability systems		ABS, CBC, ASC, DSC, DTC, DBC; optional: Dynamic Drive
Steering		Rack-and-pinion power steering; optional: Active Front Steering
Steering ratio, overall	:1	13.7
Transmission, type		Six-speed manual gearbox (six-speed automatic transmission with Steptronic)
Gear ratio	1 <sup>st</sup>	:1 5.08 (4.17)
	2 <sup>nd</sup>	:1 2.804 (2.34)
	3 <sup>rd</sup>	:1 1.783 (1.52)
	4 <sup>th</sup>	:1 1.26 (1.14)
	5 <sup>th</sup>	:1 1.0 (0.87)
	6 <sup>th</sup>	:1 0.835 (0.69)
	R	:1 4.64(3.40)
Final drive	:1	2.47
Tyres		225/55R16 95 W
Rims		7 J x 16 LM (LBS-R)
<b>Performance</b>		
Power-to-weight ratio, DIN	kg/kW	10.0 (10.1)
Output per litre	kW/ltr	53.5
Acceleration	0–100 km/h	sec 7.1(7.3)
	standing-start km	sec 27.2(27.6)
	80–120 km/h in 4th/5th gear	sec 5.4/6.7(–)
Top speed	km/h	245 (243)
<b>Fuel consump in the EU cycle</b>		
Urban	ltr/100 km	9.5(10.6)
Extra-urban	ltr/100 km	5.5 (6.3)
Composite	ltr/100 km	6.9 (7.8)
CO <sub>2</sub>	g/km	184 (208)
<b>Miscellaneous</b>		
Emission category		EU3

Figures in brackets apply to cars with automatic transmission.

<sup>1</sup>Weight of the car in road trim (DIN) plus 75 kg for driver and luggage.

<sup>2</sup>May be increased under certain conditions.

# 11. Output and Torque Diagram. BMW 520i.

# BMW 530i.



## 12. Exterior and Interior Dimensions.

